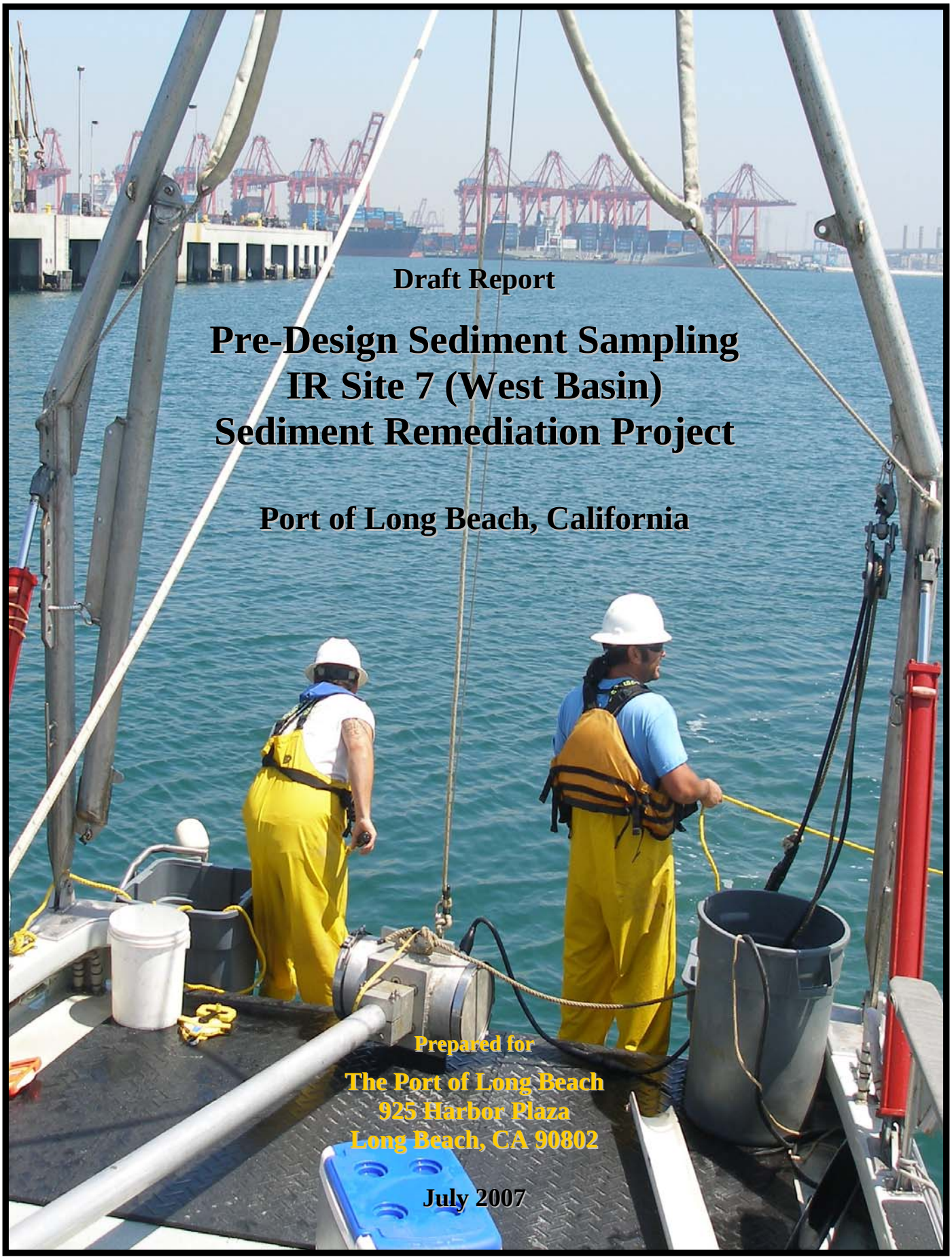

Draft Report

Pre-Design Sediment Sampling IR Site 7 (West Basin) Sediment Remediation Project

Port of Long Beach, California

Prepared for

The Port of Long Beach
925 Harbor Plaza
Long Beach, CA 90802

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Prepared by
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2433 Impala Drive
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July 2007

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ABBREVIATIONS AND ACRONYMS

AOEC	area of ecological concern
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
Bechtel	Bechtel National, Inc.
Cal/EPA	California Environmental Protection Agency
Calscience	Calscience Environmental Laboratories
COC	chain-of-custody
CVAFS	cold vapor atomic fluorescence spectrophotometry
DDT	dichlorodiphenyltrichloroethane
DGPS	Differential Global Positioning System
DTSC	Department of Toxic Substances Control
ER-L	effects range – low
ER-M	effects range – median
GC-MS	gas chromatography - mass spectrometry
GC-ECD	gas chromatography - electron capture detection
ICP-MS	inductively coupled plasma – mass spectrometry
ID	identification
IR	Installation Restoration
LBNS	Long Beach Naval Station
MEC	MEC Analytical Systems, Inc.
MLLW	mean lower low water
MDL	method detection limit
MRL	method reporting limit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
POLB	Port of Long Beach
QA/QC	quality assurance/quality control
RIA	Regional Implementation Agreement
SAP	sampling and analysis plan
SET	standard elutriate test
SIM	selective ion monitoring
SM	Standard Methods
SMOs	sediment management objectives
SOP	standard operating procedure
SWRCB	State Water Resources Control Board
TTLC	total threshold limit concentration
USACE	United States Army Corps of Engineers
USACE-LA	United States Army Corps of Engineers, Los Angeles District
USEPA	United States Environmental Protection Agency
Weston	Weston Solutions, Inc.

UNITS OF MEASURE

cm	centimeter
cy	cubic yards
^{o}C	centigrade
ft	feet or foot
L	liter
m	meter
mg/kg	milligram per kilogram
mL	milliliter
µg/L	microgram per liter
µg/kg	microgram per kilogram
ng/L	nanogram per liter

1.0 INTRODUCTION

1.1 Background

As a consequence of over 50 years of shipping and industrial uses by the U.S. Navy's Long Beach operations, elevated concentrations of contaminants (i.e., heavy metals, polychlorinated biphenyls [PCBs], and polycyclic aromatic hydrocarbons [PAHs]) have been measured in sediments from the Installation Restoration (IR) Site 7 (West Basin) area in the Port of Long Beach (POLB). Because sediments from IR Site 7 may pose ecological risks to benthic organisms, an environmental remediation project is necessary to remove contaminated sediments from the area.

Current plans include the removal of material from two Areas of Ecological Concern (AOECs) requiring remediation, as identified by the Navy and previously established as part of a Remedial Investigation/Feasibility Study conducted by Bechtel National, Inc. (Bechtel 2003). Potential dredged material will then be used as slip fill at Pier G, in accordance with the Navy's Proposed Plan and the Consent Agreement between the POLB and the California Environmental Protection Agency (Cal/EPA) Department of Toxic and Substances Control (DTSC). However, prior to removal, it is necessary to evaluate the potential dredged material for its suitability for use as slip fill material. As a result, additional sampling and analysis was conducted to further delineate the extent of vertical and horizontal sediment contamination in AOEC A and AOEC C. Sediment chemical concentrations from these samples were evaluated against applicable criteria: the Regional Implementation Agreement (RIA) (USEPA Region IX/USACE-LA 1993), Title 22 of the California Code of Regulations for the classification for hazardous material, sediment management objectives (SMOs) established for the Long Beach Naval Station (LBNS), and sediment quality objectives (i.e., effects-range low and median (ER-L and ER-M) values (Long et al. 1995). In addition, sediment elutriate and site water (collected as a means of comparison) chemical concentrations were compared to California Ocean Plan's water quality objectives, or daily maximum limiting concentrations (State Water Resources Control Board [SWRCB], Cal/EPA 2006).

The study location, IR Site 7, incorporates the area bounded by Pier T to the north and by the southern extent of Terminal Island and the Navy Mole (Figure 1). This area comprises approximately 700 acres of the POLB. Within IR Site 7, AOEC C comprises 62 acres between Piers 10 and 15, with water depths ranging from -40 to -45 ft mean lower low water (MLLW). AOEC A comprises 15 acres between Pier T, Pier Echo, and the former Pier 1, with water depths at approximately -40 to -50 ft MLLW.

1.2 Site History

Previous studies have characterized sediments in the project area (Bechtel 1995; Bechtel 2003) and in nearby portions of the West Basin (MEC Analytical, Inc. [MEC] 1996a-d; Toxscan 1996; MEC 1999; Bechtel 2003). These studies demonstrated that surface sediments (less than 5 ft in depth) along the docks and piers were contaminated with PAHs, dichlorodiphenyltrichloroethanes [DDTs], PCBs, and heavy metals. However, central areas of the basin were less contaminated; in these areas, the principle contaminants of concern are PAHs. Bioassay testing with amphipods (*Rhepoxynius abronius*) and a polychaete worm (*Neanthes arenaceodentata*) demonstrated poor survival in many of the areas where elevated concentrations of surface contaminants were measured (Bechtel 1995), but high survival in more central areas of the West Basin (MEC 1999). Toxicity to *R. abronius* was elevated in the area surrounding Pier 12 (fuel Pier), found within the current project area (AOEC C East and West).

Sediment sampling and analyses performed in IR Site 7 as part of the feasibility study in 1998 demonstrated similar results to previous investigations in the project areas (Bechtel 2003). Within AOEC A, one of the present study's project areas, mercury was significantly elevated (4.7 mg/kg) above the sediment quality objective or ER-M value (0.71 mg/kg) to a depth of approximately 5 ft; however, no

significant biological effects were detected in toxicity tests with echinoderms, amphipods or polychaetes. In AOEC C, also one of the present study's project areas, mercury, lead, PAHs (i.e., benzo(a)pyrene and high molecular weight PAHs), and total PCBs were elevated in surface sediments to approximately 3 ft. In additional to elevated chemicals, toxicity to echinoderms, as well as benthic community effects were observed in sediments from AOEC C.

Existing contamination likely remains in the surface sediments within the project areas. Specifically, although industrial activities in the West Basin have ceased, there is little flushing in the project area and sedimentation rates may be too low to bury existing contamination. Thus, in areas adjacent to docks and piers, additional testing was necessary to more accurately delineate the contamination in surface and subsurface sediments within the areas to be dredged.

1.3 Sampling and Testing Objectives

The purpose of this investigation was to delineate the vertical and horizontal sediment contamination (i.e., metals, PAHs, PCBs, and DDTs) within three areas of IR Site 7 (AOEC A, AOEC C-East, AOEC C-West) of the POLB, and to evaluate the suitability of this material for use as slip fill material at Pier G.

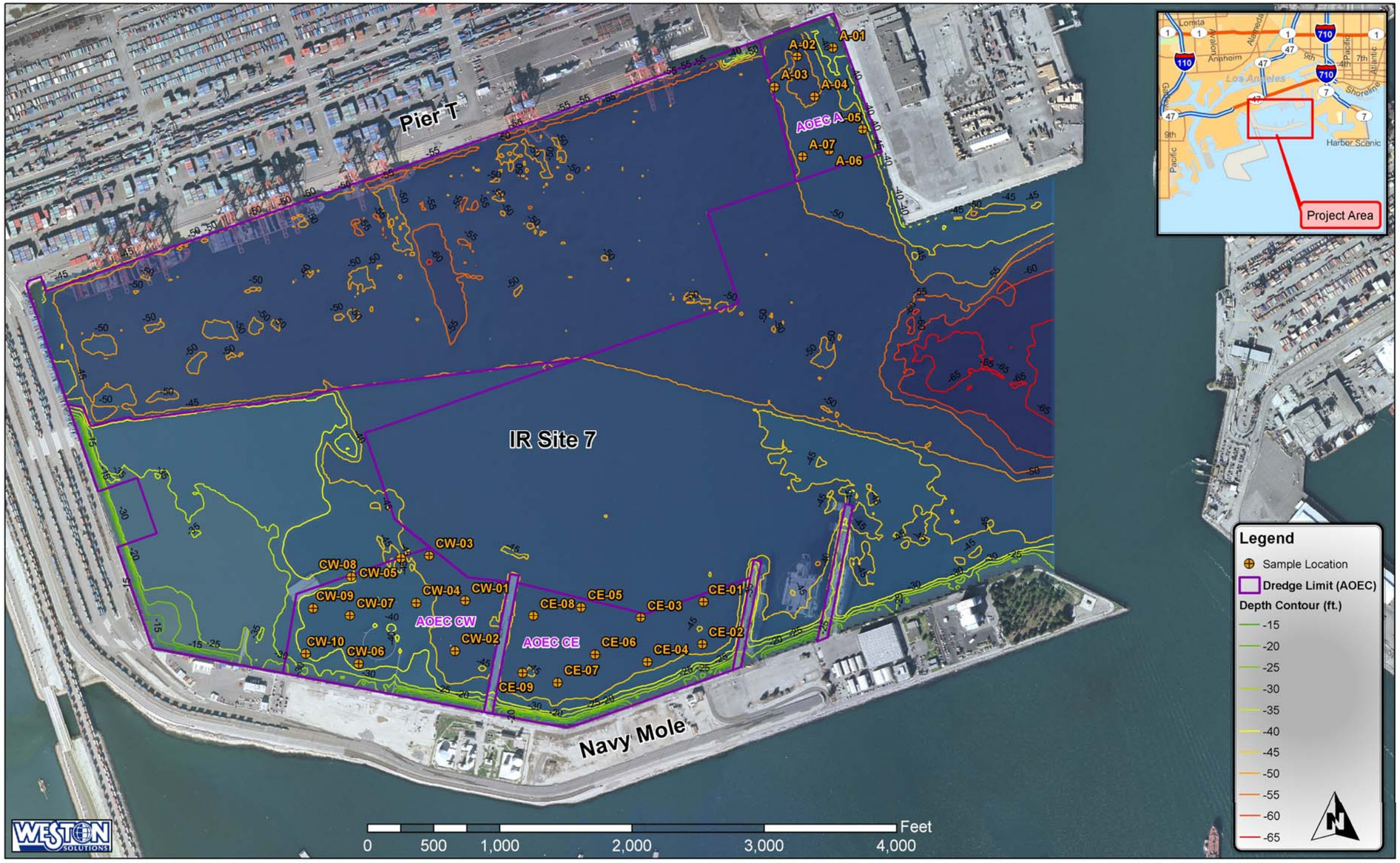

Figure 1. Overview of Project Area within IR Site 7, the Port of Long Beach[1]

[1] Bathymetry is depicted in color

2.0 MATERIALS AND METHODS

2.1 Field Collection Program for Sediment Core Samples

2.1.1 Sampling Locations and Depths

The areas proposed for dredging, AOEC A, AOEC C-East, and AOEC C-West, are located in the IR Site 7 (West Basin) of the POLB (Figure 1). Sampling was conducted at 26 coring locations within the three areas: 7 locations in AOEC A (Figure 2), 9 locations in AOEC C-East (Figure 3), and 10 locations in AOEC C-West (Figure 4). All cores from each of the 26 locations were sampled using an electric vibracore sampler. Samples in AOEC A were collected to a depth of 11 ft below mudline or until refusal; samples in AOEC C were collected to a depth of 8 ft below the mudline or refusal. The retrieved cores were sectioned into discrete 1 ft intervals and a subsample from each 1 ft interval was analyzed for metals. A composite of all depth intervals from each sampling location was prepared and analyzed for particle size (i.e., grain size) distribution. Three area-wide composite samples were created and analyzed for metals, total DDTs, total PAHs, and total PCBs. In addition, the three area-wide composites were evaluated in standard chemical elutriate tests to evaluate potential water quality impacts associated with dredging. The number of cores, core identification (ID) numbers, locations, and target lengths are provided in Table 1.

The sampling depths selected encompass the maximum depths at which the Navy detected contamination exceeding sediment management objectives plus an approximate two-foot overdredge depth to account for any over-dredged material collected during the sediment removal activities.

2.1.2 Navigation

Pre-plotted station positions were located using the research vessel (R/V) *Early Bird II*'s Differential Global Positioning System (DGPS), accurate to less than 10 ft (3 m). All final station locations were recorded in the field using positions from the DGPS.

2.1.3 Core Collection and Handling

Cores were collected using an electric vibracore (Figure 5), which was deployed from R/V *Early Bird II.* The vibracore will be equipped with a 4-inch (~10 cm) outer diameter aluminum barrel and stainless steel catcher to retain sediment. The standard system is capable of collecting cores up to ~20 ft (~6 m) long which was more than sufficient to cover the target sampling depths identified in this project (Table 1). A new polyethylene liner was inserted into the tube prior to sampling at each station to eliminate the possibility of cross contamination between stations. Following sampling, the vibracore was retrieved to the deck of the boat and the liner with sediment core removed from the aluminum tube and placed in a core tray for processing. The liner was then cut vertically along the length of the sediment core and each core examined by a qualified scientist and photographed. The geologic description of each core included the texture, odor, color, length, and any evident stratification of the sediment, which was documented in a core log (Appendix A).

All sediment cores were collected to the appropriate depth unless refusal is encountered[2]. If refusal was encountered, the vessel was moved and a second core attempted. If refusal was encountered again, additional cores were not attempted unless operational problems were suspected.

[2] Refusal is defined as less than 2 inches (~5 cm) of penetration per minute.

Figure 2. Sampling Locations within Area A, IR Site 7, the Port of Long Beach[3]

[3] Bathymetry depicted in color

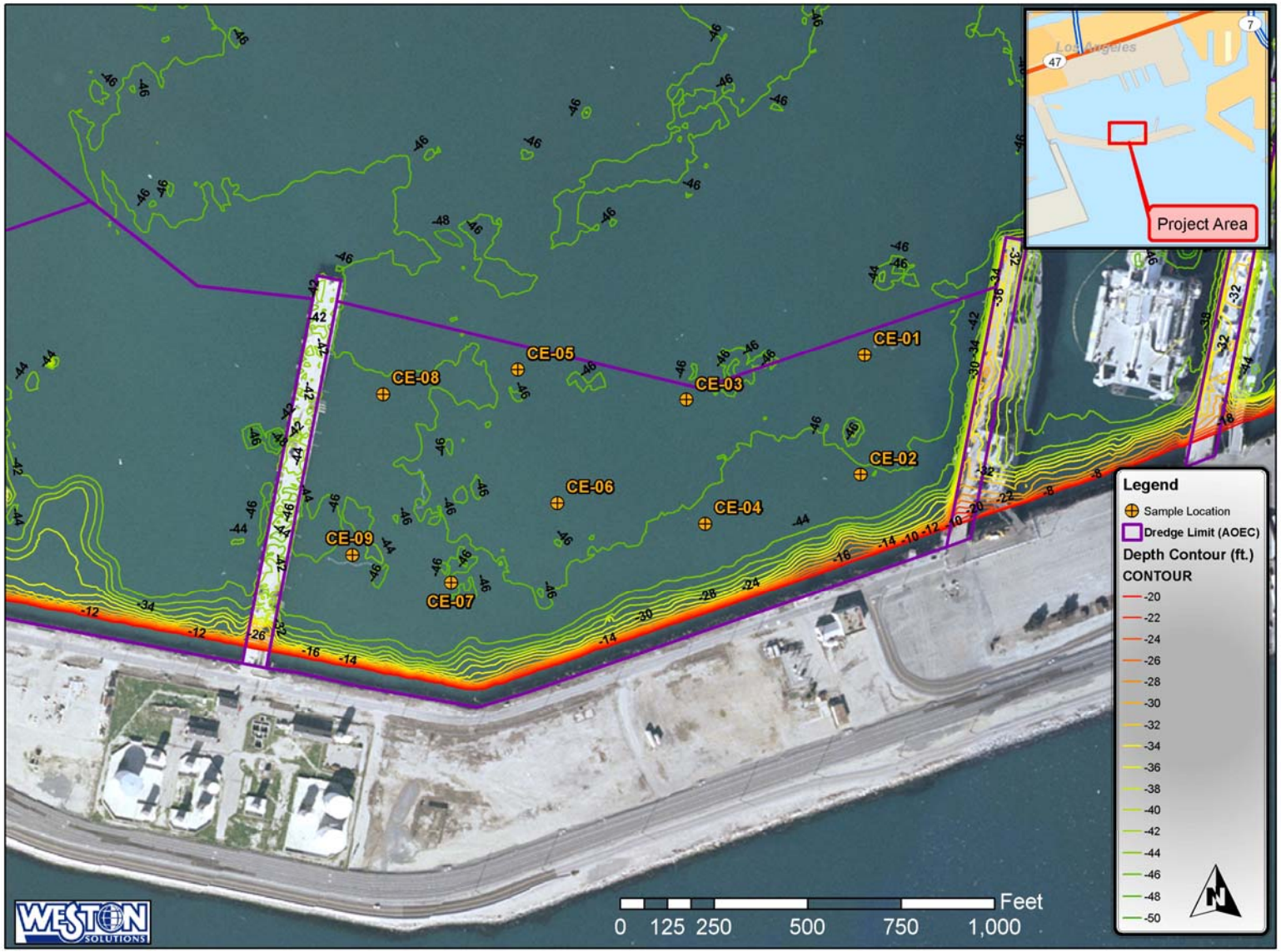

Figure 3. Sampling Locations within Area C East, IR Site 7, the Port of Long Beach

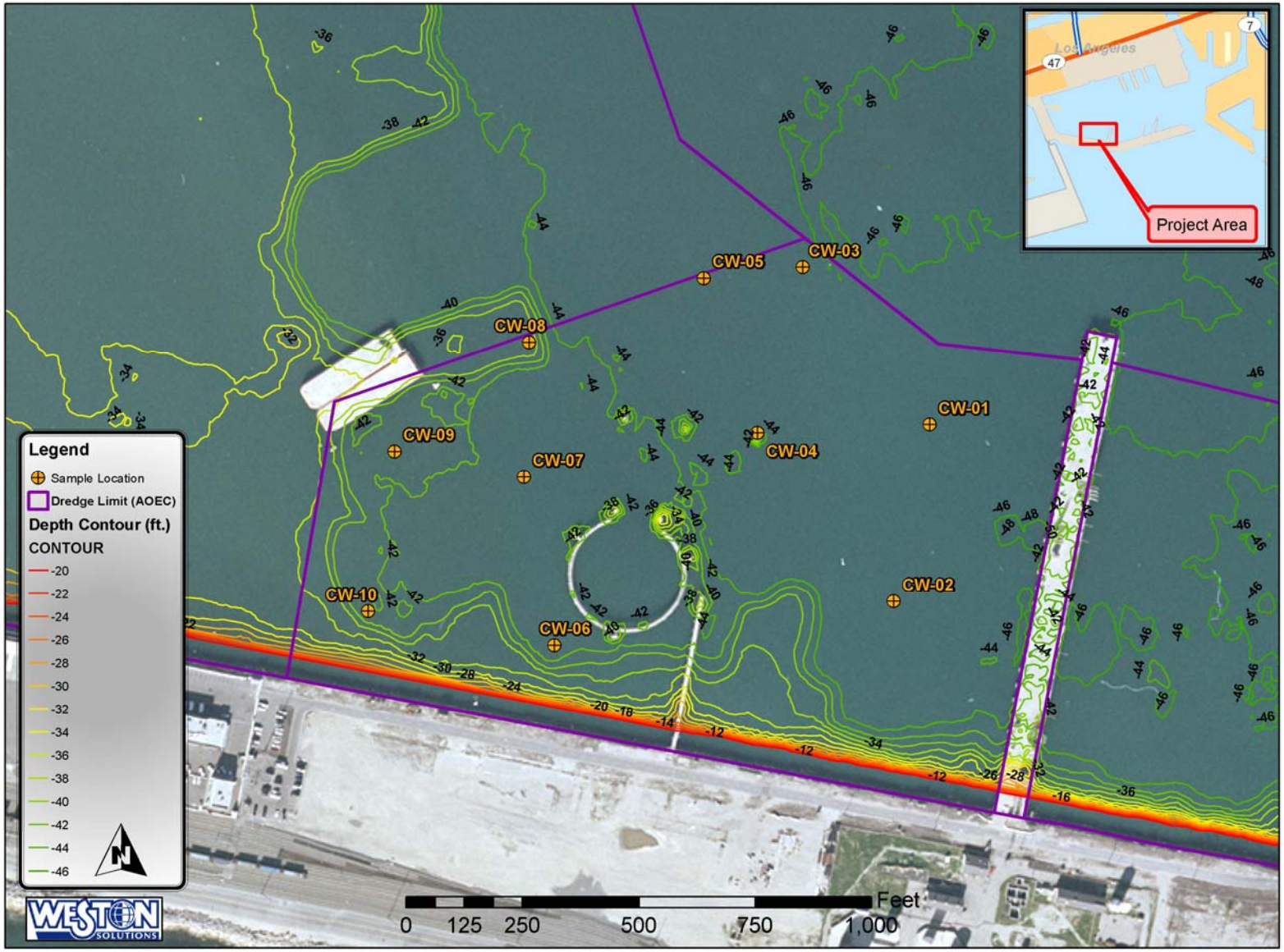

Figure 4. Sampling Locations within Area C West, IR Site 7, the Port of Long Beach

Table 1. Core Locations, Target Lengths, Number of Cores, Composite ID, and Analyses for Samples Collected by Vibracore

Station ID	Latitude (WGS 84)	Longitude (WGS 84)	Water Depth (ft MLLW)	Target Core Length (ft below mudline)	Project Depth (ft MLLW)	Metals Analysis	Grain Size Analysis	Analysis for Metals, PAHs, PCBs, DDTs
A-01	33° 45.366	-118° 13.488	-42.5	-11	-53.5	1 per ft, 11/core	1 per core	1 per Area AOEC A
A-02	33° 45.355	-118° 13.541	-54.0	-11	-65.0	1 per ft, 11/core	1 per core	
A-03	33° 45.32	-118° 13.582	-54.9	-11	-65.9	1 per ft, 11/core	1 per core	
A-04	33° 45.305	-118° 13.515	-54.5	-11	-65.5	1 per ft, 11/core	1 per core	
A-05	33° 45.264	-118° 13.443	-48.9	-11	-59.9	1 per ft, 11/core	1 per core	
A-06	33° 45.238	-118° 13.493	-52.5	-11	-63.5	1 per ft, 11/core	1 per core	
A-07	33° 45.23	-118° 13.533	-52.5	-11	-63.5	1 per ft, 11/core	1 per core	
CW-01	33° 44.675	-118° 14.035	-49.2	-8	-57.2	1 per ft, 8 /core	1 per core	1 per Area AOEC CW
CW-02	33° 44.612	-118° 14.05	-49.0	-8	-57.0	1 per ft, 8 /core	1 per core	
CW-03	33° 44.731	-118° 14.089	-48.8	-8	-56.8	1 per ft, 8 /core	1 per core	
CW-04	33° 44.672	-118° 14.108	-48.6	-8	-56.6	1 per ft, 8 /core	1 per core	
CW-05	33° 44.727	-118° 14.131	-48.0	-8	-56.0	1 per ft, 8 /core	1 per core	
CW-06	33° 44.596	-118° 14.194	-46.2	-8	-54.2	1 per ft, 8 /core	1 per core	
CW-07	33° 44.656	-118° 14.207	-46.5	-8	-54.5	1 per ft, 8 /core	1 per core	
CW-08	33° 44.704	-118° 14.205	-42.0	-8	-50.0	1 per ft, 8 /core	1 per core	
CW-09	33° 44.665	-118° 14.262	-45.5	-8	-53.5	1 per ft, 8 /core	1 per core	
CW-10	33° 44.608	-118° 14.273	-45.0	-8	-53.0	1 per ft, 8 /core	1 per core	
CE-01	33° 44.672	-118° 14.685	-52.8	-8	-60.8	1 per ft, 8 /core	1 per core	1 per Area AOEC CE
CE-02	33° 44.621	-118° 13.681	-51.0	-8	-59.0	1 per ft, 8 /core	1 per core	
CE-03	33° 44.654	-118° 13.773	-50.5	-8	-58.5	1 per ft, 8 /core	1 per core	
CE-04	33° 44.599	-118° 13.763	-49.7	-8	-57.7	1 per ft, 8 /core	1 per core	
CE-05	33° 44.667	-118° 13.862	-49.8	-8	-57.8	1 per ft, 8 /core	1 per core	
CE-06	33° 44.608	-118° 13.841	-49.5	-8	-57.5	1 per ft, 8 /core	1 per core	
CE-07	33° 44.573	-118° 13.897	-49.7	-8	-57.7	1 per ft, 8 /core	1 per core	
CE-08	33° 44.656	-118° 13.933	-49.0	-8	-57.0	1 per ft, 8 /core	1 per core	
CE-09	33° 44.585	-118° 13.949	-49.5	-8	-57.5	1 per ft, 8 /core	1 per core	

2.1.4 Site Water

In addition to the core samples, site water was collected from IR Site 7 for chemical analysis and for use in the preparation of sediment elutriates as described below.

2.1.5 Decontamination of Equipment

All vibracore equipment was cleaned prior to sampling. Between stations, core barrels and the deck of the vessel were rinsed with site water and new polyethylene core tube liners were used at each sample location. Before creating each core and area composite, all stainless steel utensils (stainless steel bowls, spoons, spatulas, mixers, and other utensils) were cleaned with soapy water, rinsed with tap water, and then rinsed three times with deionized water.

2.1.6 Sample Processing and Storage

Sediment cores from each station (up to 8 or 11 ft) were sectioned into 1 ft intervals. One subsample representing each 1 ft interval was placed in a 100 mL glass jar with Teflon-lined lid, and submitted to Calscience Environmental Laboratories (Calscience) for metals analysis. Another 100 mL sample representing each 1 ft interval was collected for archival in case additional analysis is required.

A 500 mL subsample of sediment from each 1 ft interval was placed into a stainless steel bowl and homogenized with stainless steel utensils to prepare a core composite. A subsample of each core composite (200 mL) was placed into double Ziploc bags and analyzed by Weston Solutions, Inc. (Weston) Benthic Laboratory in Carlsbad for grain size. Another 500 mL of each core composite sample was placed into a glass jar with Teflon-lined lid and archived.

One subsample (500 mL) from each core composite sample from each of area separately (AOEC A, AOEC C-East, AOEC C-West), was placed into a separate stainless steel bowl. Area wide composite samples were created by homogenizing the core composite samples from each area. A subsample (500 mL) of each area composite was then placed in glass jars with Teflon lined-lids and submitted to Calscience for analysis of chemical constituents (metals, PAHs, PCBs, DDTs). Another 500 mL of each area composite was archived. An additional 2 L of each area composite, and 60 L of site water from each area was sent to Calscience for the preparation of sediment elutriate samples and chemical analyses, as described in section 2.3.3.

Samples were labeled, placed on ice, and shielded from light until delivered to Calscience or Weston laboratory personnel for analysis. Any sediment not immediately analyzed was stored at 4°C at Weston's laboratory in Carlsbad until chemical and grain size characterization was complete.

2.1.7 Shipping/Transport

Prior to shipping or transport, sample containers were securely packed inside the cooler with ice. Chain-of-custody (COC) forms were filled out as described in section 2.2, and the original signed COC forms were placed in a sealable plastic bag and placed inside the cooler. The cooler lids will be securely taped shut. Samples were delivered to the analytical laboratory for analysis. The particular analyses to be performed the laboratory, and the point of contact and relevant shipping information are listed in Table 2.

Table 2. Point of Contact Information for Analytical Laboratories

Laboratory	Analyses Performed	Point of Contact	Shipping Information
Weston Solutions, Inc.	Grain size	Dr. David Moore Ms. Sheila Holt (760) 795-6900	Weston Solutions, Inc. 2433 Impala Dr. Carlsbad, CA 92010
Calscience Environmental Laboratories, Inc.	Sediment and Elutriate Chemistry	Mr. Bob Stearns (714) 895-5494	Calscience 7440 Lincoln Way Garden Grove, CA 92841-1427

2.2 Documentation and Chain-of-Custody

This section describes the program requirements for sample handling and COC procedures. Samples are considered to be in custody if they are: (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a secured container. The principal documents used to identify samples and to document possession are COC records, field log books, and field tracking forms. COC procedures will be used for all samples throughout the collection, transport, and analytical process, and for all data and data documentation, whether in hard copy or electronic format.

COC procedures were initiated during sample collection. A COC record was provided with each sample or sample group. COC forms are provided in Appendix B. Each person who had custody of the samples signed the form to ensure that the samples were not left unattended unless properly secured. Minimum documentation of sample handling and custody included the following:

- Sample identification
- Sample collection date and time
- Any special notations on sample characteristics
- Initials of the person collecting the sample
- Date the sample was sent to the laboratory
- Shipping company and waybill information

The completed COC form was placed in a sealable plastic envelope that traveled inside the ice chest containing the listed samples. The COC form was signed by the person transferring custody of the samples. The condition of the samples was recorded by the receiver. COC records are included in the final analytical report prepared by the laboratory, and are considered an integral part of that report.

Figure 5. Electric Vibracore Sampler

2.3 Physical and Chemical Analyses

Physical and chemical analytes to be measured in this testing program were selected to provide data on potential chemicals of concern in POLB sediments, as specified in the sampling and analysis plan (SAP; Weston 2007). All analytical methods used to obtain contaminant concentrations follow USEPA or Standard Methods (SM). In addition, chemical and physical measures selected for this evaluation are consistent with those recommended for assessing dredged material in Los Angeles (USEPA/USACE 1991; USEPA Region IX/USACE-LA 1993).

2.3.1 Physical Analyses

Physical analyses of the sediment included grain size on each core composite, to determine the general size classes that make up the sediment (e.g., gravel, sand, silt, and clay) at each station location. Grain size was assessed using the gravimetric procedure described in Plumb (1981). The frequency distribution of the size ranges (reported in millimeters [mm]) of the sediment was also reported. Total solids were also measured to convert concentrations of the chemical analytes from a wet-weight to a dry-weight basis according to SM 2540G (American Public Health Association [APHA] et al. 1992).

2.3.2 Sediment Chemistry

The analysis for priority pollutant metals (except mercury) was conducted using an inductively coupled plasma emissions spectrometer equipped with a mass detector (ICP-MS), in accordance with USEPA 6020M. Mercury analysis was conducted using cold vapor atomic fluorescence spectrophotometry (CVAFS) in accordance with USEPA 7471A. PAHs were analyzed using gas chromatography-mass spectrometry with selective ion monitoring (GC-MS SIM) according to USEPA Method 8270M. This method followed a serial extraction with methylene chloride and alumina and gel permeation column cleanup procedures. PCBs were identified as Aroclors and DDTs were measured using gas chromatography-electron capture detection (GC-ECD) according to USEPA Methods 8081A and 8081A/8082, respectively.

2.3.3 Sediment Elutriate and Site Water Chemistry

Elutriate samples were prepared by using a standard elutriate test (SET) method. The analysis of the metals, PAHs, PCBs, and DDTs was similar to those methods described above.

2.3.4 Comparison to Sediment Quality Guidelines and Water Quality Objectives

Sediment chemical concentrations in this study were compared to ER-L and ER-M values (Long et al., 1995), sediment management objectives established for the LBNS, and regulatory levels, or total threshold limit concentrations (TTLCs). The effects range values are helpful in assessing the potential significance of elevated sediment-associated contaminants of concern, in conjunction with biological analyses. Briefly, these values were developed from a large data set where results of both benthic organism effects (e.g., toxicity tests, benthic assessments) and chemical concentrations were available for individual samples. To derive these guidelines, the chemical values for paired data demonstrating benthic impairment were sorted in according to ascending chemical concentration. The 10th percentile of this rank order distribution was identified as the ER-L and the 50th percentile as the ER-M. While these values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. The ER-L and ER-M sediment quality values are included for comparative purposes only. TTLCs indicate the level above which material must be managed as hazardous waste upon removal, in accordance with the Title 40 CFR part 261 and Title 22 of the California Code of Regulations.

Elutriate and site water analyte results were compared to the California Ocean Plan's water quality objectives (SWRCB, Cal/EPA 2006).

2.4 Quality Assurance/Quality Control

Weston's quality assurance/quality control (QA/QC) staff performs periodic audits to ensure that test conditions, data collection, and test procedures are conducted in accordance with Weston's standard operating procedures (SOPs). Weston's SOPs have been audited and approved by an independent USEPA-approved laboratory and placed in the QA file as well as laboratory files.

2.4.1 Field Collection and Sample Handling

All relevant project and sample information and field measurements was recorded on customized water-proof core log data forms. A daily field log was maintained, and formal chain-of-custody procedures followed and documented. The DGPS system was verified daily by comparing accuracy with known landmarks. All sampling equipment was cleaned between sample stations. Samples were double-bagged, and both inner and outer bags labeled. Samples were held on ice until transport to Weston in Carlsbad, California or to the analytical laboratory. COC forms were prepared in the field during sediment collection by Weston personnel.

2.4.2 Chemical and Physical Analyses

Chemical analyses were performed using QC criteria specified in Methods for Chemical Analysis of Water and Wastes (USEPA 1983) and Test Methods for Evaluating Solid Waste (SW-846) (USEPA 2004), in a California state-certified and nationally-accredited laboratory (California ELAP Certification #1230 and NELAP Certification #03220CA). Grain size analyses performed by Weston were consistent with internal QC criteria. Performance objectives were evaluated via the use of standard reference materials or laboratory control samples, method blanks, surrogates, spiked samples, duplicate samples, and internal QC samples. Precision and accuracy objectives were established for method reporting limits (MRLs), spike recoveries, and duplicate analyses.

3.0 RESULTS

3.1 Sediment Sample Collection and Handling

Vibracore sampling was conducted June 26 to June 28. The weather was warm and sampling was conducted primarily under clear skies and calm seas.

Field coordinates, depth of penetration relative to the mudline (i.e., the sediment surface), depth of recovery relative to the mudline, and core length retained for each station location are summarized in Table 3. The actual length of the cores differs from the target lengths because of differences in the actual bathymetry and the historical bathymetry used to calculate target core lengths. Field core logs, core photos, and other associated documentation for the sampling effort are provided in Appendix A.

Table 3. Field Coordinates and Sampling Depths of Sediment Core Samples

Station ID	Attempt	Latitude	Longitude	Date	Time	Water Depth (ft MLLW)	Target Sampling Depth (ft MLLW)	Actual Sampling Depth (ft MLLW)	Penetration (ft)	Final Core Length (ft)	Core Length Retained for Analysis (ft)	Comments
A-01	1	33° 45.366	-118° 13.488	6/26/07	9:59	-42.5	-53.5	-48.5	13.0	6.0	0.0	bent tube-
A-01	2	33° 45.366	-118° 13.488	6/26/07	11:00	-42.5	-53.5	-53.8	12.0	11.3	11.0	
A-02	1	33° 45.355	-118° 13.541	6/26/07	14:01	-54.0	-65.0	-64.0	12.0	10.0	10.0	
A-03	1	33° 45.320	-118° 13.582	6/26/07	15:01	-54.9	-65.9	-59.9	12.0	5.0	0.0	rock caught in catcher head-no sample
A-03	2	33° 45.32	-118° 13.585	6/26/07	15:22	-55.0	-66.0	-56.5	12.0	1.5	0.0	hit rock pile-no sample
A-03	3	33° 45.317	-118° 13.575	6/26/07	15:39	-53.0	-64.0	-63.0	12.0	10.0	10.0	
A-04	1	33° 45.305	-118° 13.515	6/26/07	16:43	-54.5	-65.5	-62.5	12.5	8.0	8.0	
A-05	1	33° 45.264	-118° 13.443	6/26/07	12:01	-48.9	-59.9	-59.9	12.0	11.0	11.0	
A-06	1	33° 45.238	-118° 13.493	6/27/07	9:14	-52.5	-63.5	-63.5	12.0	11.0	11.0	
A-07	1	33° 45.23	-118° 13.533	6/27/07	10:08	-52.5	-63.5	-61.0	11.5	8.5	8.5	
CE-01	1	33° 44.672	-118° 14.685	6/27/07	17:48	-52.8	-60.8	-61.3	10.0	8.5	8.0	
CE-02	1	33° 44.621	-118° 13.681	6/27/07	17:13	-51.0	-59.0	-59.0	11.0	8.0	8.0	
CE-03	1	33° 44.654	-118° 13.773	6/27/07	16:41	-50.5	-58.5	-58.5	11.0	8.0	8.0	
CE-04	1	33° 44.599	-118° 13.763	6/27/07	15:54	-49.7	-57.7	-57.7	10.5	8.0	8.0	
CE-05	1	33° 44.667	-118° 13.862	6/27/07	15:02	-49.8	-57.8	-57.3	10.5	7.5	7.5	
CE-06	1	33° 44.608	-118° 13.841	6/27/07	14:26	-49.5	-57.5	-57.5	10.5	8.0	8.0	
CE-07	1	33° 44.573	-118° 13.897	6/27/07	13:26	-49.7	-57.7	-58.2	10.5	8.5	8.0	
CE-08	1	33° 44.656	-118° 13.933	6/27/07	12:02	-49.0	-57.0	-57.0	10.5	8.0	8.0	
CE-09	1	33° 44.585	-118° 13.949	6/27/07	11:09	-49.5	-57.5	-57.5	10.5	8.0	8.0	
CW-01	1	33° 44.675	-118° 14.035	6/28/07	15:43	-49.2	-57.2	-57.2	11.0	8.0	8.0	
CW-02	1	33° 44.612	-118° 14.050	6/28/07	14:59	-49.0	-57.0	-57.0	11.0	8.0	8.0	
CW-03	1	33° 44.731	-118° 14.089	6/28/07	14:15	-48.8	-56.8	-57.3	11.0	8.5	8.0	
CW-04	1	33° 44.672	-118° 14.108	6/28/07	13:33	-48.6	-56.6	-56.6	11.0	8.0	8.0	
CW-05	1	33° 44.727	-118° 14.131	6/28/07	12:45	-48.0	-56.0	-55.0	10.5	7.0	7.0	
CW-06	1	33° 44.596	-118° 14.194	6/28/07	11:09	-46.2	-54.2	-54.7	11.0	8.5	8.0	
CW-07	1	33° 44.656	-118° 14.207	6/28/07	10:30	-46.5	-54.5	-54.5	11.0	8.0	8.0	
CW-08	1	33° 44.704	-118° 14.205	6/28/07	9:49	-42.0	-50.0	-49.0	10.5	7.0	7.0	
CW-09	1	33° 44.665	-118° 14.262	6/28/07	9:01	-45.5	-53.5	-52.5	10.5	7.0	7.0	
CW-10	1	33° 44.608	-118° 14.273	6/28/07	8:24	-45.0	-53.0	-53.0	10.5	8.0	8.0	

3.2 Results of Physical and Chemical Analyses

3.2.1 Physical and Chemical Characteristics of Sediments in IR Site 7

Results of physical and chemical analyses for project sediment are presented in Table 4 through Table 18. All results are expressed in dry weight unless otherwise indicated. Target detection limits are provided in the SAP (Weston 2007). The actual detection limits and raw data for the analyses are provided in Appendix C.

3.2.1.1 Area AOEC A

Metals in 1 ft Intervals
In Area AOEC A, arsenic, cadmium, chromium and silver were detected at concentrations greater than the ER-L, but below their respective ER-M value. Copper, lead, mercury, nickel and zinc were detected at concentrations greater than the ER-M value only in the top four feet of sediment in at least one core location. Copper, lead, mercury and zinc were detected at concentrations greater than the LBNS SMO value only in the top three feet of sediment with the exception of stations AOEC A-04 and AOEC A-05 where mercury and zinc exceeded the LBNS SMO value as deep as four feet. No metals were detected at concentrations in exceedance of their respective TTLC regulatory level.

Grain Size
Sediment within Area AOEC A ranged from 25.9% fine-grained materials (19.7% silt and 6.23% clay) at station A-03 to 81.6% (57.5% silt and 24.1% clay) at station A-04.

Area Wide Composite Sediment Chemistry
Metals were the only chemical detected in Area AOEC A sediment (Table 18). Arsenic, copper, mercury, nickel, and zinc were detected at concentrations that exceeded the corresponding ER-L values, but were below ER-M values, LBNS SMOs, and TTLC regulatory levels. Concentrations of heavy metals of concern ranged from below the detection limit (<0.816 mg/kg, Selenium) to 156 mg/kg for zinc. No pesticides, PAHs or Aroclors were detected. Total Solids were measured at 61.3%.

3.2.1.2 Area AOEC CE

Metals in 1 ft Intervals
In Area AOEC CE, arsenic, copper, lead, nickel and zinc were detected at concentrations greater than the ER-L, but below their respective ER-M value. Mercury was detected at a concentration greater than the ER-M value only in the top two feet of sediment in three core locations. No metals were detected at concentrations in exceedance of their respective LBNS SMOs or TTLC regulatory levels.

Grain Size
Sediment within Area AOEC CE ranged from 15.1% fine-grained materials (11.3% silt and 3.78% clay) at station CE-03 to 48.8% (32.5% silt and 16.3% clay) at station CE-01.

Area Wide Composite Sediment Chemistry
Metals were the only chemical detected in Area AOEC CE sediment (Table 18). Copper was detected at a concentration that exceeded the corresponding ER-L value, but was below ER-M value, LBNS SMO, and TTLC regulatory level. Concentrations of heavy metals of concern ranged from below the detection limit (<0.810 and <0.162 mg/kg for Selenium and Silver, respectively) to 88.8 mg/kg for zinc. No pesticides, PAHs or Aroclors were detected. Total Solids were measured at 61.7%.

3.2.1.3 Area AOEC CW

Metals in 1 ft Intervals
In Area AOEC CW, arsenic, cadmium, chromium, copper, lead and silver were detected at concentrations greater than the ER-L, but below their respective ER-M value. Mercury, nickel and zinc were detected at concentrations greater than the ER-M value in the top four feet of sediment in at least one core location. Nickel was also detected at concentrations greater than the ER-M value from 6 to 7 ft in station CW-10. Mercury and zinc were detected at concentrations greater than the LBNS SMO value only in the top four feet of sediment. No metals were detected at concentrations in exceedance of their respective TTLC regulatory level.

Grain Size
Sediment within Area AOEC CW ranged from 31.3% fine-grained materials (17.3% silt and 14.0% clay) at station CW-02 to 74.0% (58.6% silt and 15.4% clay) at station CW-03.

Area Wide Composite Sediment Chemistry
Metals were the only chemical detected in Area AOEC CW sediment (Table 18). Copper, nickel, and zinc were detected at concentrations that exceeded the corresponding ER-L values, but were below ER-M values, LBNS SMOs, and TTLC regulatory levels. Concentrations of heavy metals of concern ranged from below the detection limit (<0.789, Selenium) to 195 mg/kg for zinc. No pesticides, PAHs or Aroclors were detected. Total Solids were measured at 63.4%.

Table 4. Summary of Total Solids and Metals in Station AOEC A-01 and AOEC A-02 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC A-01											AOEC A-02									
					A-01 0-1	A-01 1-2	A-01 2-3	A-01 3-4	A-01 4-5	A-01 5-6	A-01 6-7	A-01 7-8	A-01 8-9	A-01 9-10	A-01 10-11	A-02 0-1	A-02 1-2	A-02 2-3	A-02 3-4	A-02 4-5	A-02 5-6	A-02 6-7	A-02 7-8	A-02 8-9	A-02 9-10
General Chemistry																									
Solids, Total (%)	-	-	-	-	66.4	70.5	72.2	73.3	68.8	75.7	71.5	70	70.4	70.5	71.8	48.1	54.8	73	70	72.1	70.3	79.1	77.1	76.4	73.6
Metals (mg/kg)																									
Arsenic	**8.2**	**70**	**500**	-	**12.1**	5.46	4.36	4.06	**20.8**	7.8	4.87	**12.2**	**8.7**	**9.31**	**8.44**	**19.4**	**37.6**	**10.5**	**11.8**	7.16	**8.35**	4.32	2.77	6.29	1.69
Cadmium	**1.2**	**9.6**	**100**	-	0.654	<0.142	<0.139	<0.136	0.21	0.137	<0.140	0.152	<0.142	<0.142	<0.139	1.1	**1.9**	0.416	0.288	0.156	0.28	<0.126	<0.130	<0.131	<0.136
Chromium	**81**	**370**	**500**	-	42.8B	21.1B	15.0B	17.7B	32.7B	29.2B	32.3B	41.7B	39.6B	40.2B	40.7B	**87.8B**	**84.1B**	33.5B	34.2B	22.6B	38.9B	15.5B	11.0B	20.0B	23.3B
Copper	**34**	**270**	**2500**	**254**	**177**	25.4	8.56	11.6	**45.7**	32.8	**36.8**	**42**	**38.7**	**40.2**	**43.3**	**337**	**568**	**603**	**64.8**	**50.5**	**103**	27.1	7.53	23.6	29
Lead	**46.7**	**218**	**1000**	**100**	**151**	28.3	2.38	2.92	10	6.4	6.98	9.22	8.27	8.55	8.67	**116**	**133**	**83.6**	18	10.5	21	5.46	2.21	6.44	4.68
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.722**	0.0564	<0.0278	<0.0273	0.111	0.0812	<0.0280	0.0704	0.0686	0.0874	0.0698	**0.635**	**3.04**	**1.45**	**0.166**	0.109	0.13	0.0804	<0.0260	0.0859	0.0583
Nickel	**20.9**	**51.6**	**2000**	-	**23.5**	13.8	10.3	12.6	**26.5**	**23.7**	**26.5**	**30.9**	**28.1**	**29.5**	**29.3**	**42.8**	**43.9**	20.2	**25.8**	17	19.9	11.4	8.91	17.9	**22.2**
Selenium	-	-	**100**	-	0.872	<0.709	<0.693	0.77	1.05	1.02	1.06	1.7	1.33	1.45	1.35	<1.04	<0.912	<0.685	<0.714	<0.693	<0.711	<0.632	<0.649	<0.654	<0.679
Silver	**1**	**3.7**	**500**	**3.5**	0.414	<0.142	<0.139	<0.136	<0.145	<0.132	<0.140	0.152	<0.142	<0.142	<0.139	0.966	**1.06**	0.222	0.154	<0.139	<0.142	<0.126	<0.130	<0.131	<0.136
Zinc	**150**	**410**	**5000**	**307**	**243**	68.9	36.4	47.5	87.2	88.4	92.5	106	96.2	100	99.4	**377**	**423**	145	126	72.9	145	46.7	28.9	54.7	72

Table 5. Summary of Total Solids and Metals in Station AOEC A-03 and AOEC A-04 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC A-03										AOEC A-04							
					A-03 0-1	A-03 1-2	A-03 2-3	A-03 3-4	A-03 4-5	A-03 5-6	A-03 6-7	A-03 7-8	A-03 8-9	A-03 9-10	A-04 0-1	A-04 1-2	A-04 2-3	A-04 3-4	A-04 4-5	A-04 5-6	A-04 6-7	A-04 7-8
General Chemistry																						
Solids, Total (%)	-	-	-	-	67.1	68.4	58.9	76	73.6	74.6	76.7	72.4	71.8	71.5	48	49.7	61.8	61.6	65.7	67.9	71.8	75.3
Metals (mg/kg)																						
Arsenic	**8.2**	**70**	**500**	-	**11.3**	**15.4**	**21.8**	3.74	2.75	2.33	1.96	1.58	1.45	1.54	**19.9**	**28.1**	**11.1**	**21.3**	**15.9**	**11.2**	**9.56**	**9.9**
Cadmium	**1.2**	**9.6**	**100**	-	**1.78**	**3.17**	**3.28**	0.192	<0.136	0.216	<0.130	<0.138	<0.139	<0.140	0.983	**1.95**	1.01	0.969	0.306	0.199	0.217	0.222
Chromium	**81**	**370**	**500**	-	**126B**	**102B**	**145B**	18.0B	20.0B	31.7B	23.7B	20.6B	17.8B	18.9B	**82.9B**	**101B**	55.9B	65.2B	41.8B	34.2B	30.8B	38.4B
Copper	**34**	**270**	**2500**	**254**	**365**	**440**	**377**	29	22.7	**39.6**	25.7	21.6	20.1	16.6	**234**	**430**	**309**	**228**	**54.2**	**36.4**	**44.5**	**50**
Lead	**46.7**	**218**	**1000**	**100**	**449**	**283**	**422**	32.8	8.06	11	6.63	4.3	3.94	3.43	**87**	**111**	**71**	**59.2**	16	10.2	11.4	12.1
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.199**	**0.325**	**0.763**	0.0312	<0.0272	0.0987	0.143	0.0577	<0.0279	<0.0280	**0.567**	**1.1**	**2.47**	**1.7**	**0.16**	0.1	0.108	0.0597
Nickel	**20.9**	**51.6**	**2000**	-	**26.8**	**30.7**	**43.5**	12.9	**23.7**	**31**	20.8	17.6	15.2	14.9	**45.9**	**50.2**	**33.1**	**40.9**	**32.5**	**25.9**	**23.1**	**31.9**
Selenium	-	-	**100**	-	1.58	<0.731	<0.849	<0.658	<0.679	<0.670	<0.652	<0.691	<0.696	<0.699	<1.04	3.24	2.28	2.44	<0.761	<0.736	<0.696	<0.664
Silver	**1**	**3.7**	**500**	**3.5**	0.43	**1.57**	0.894	<0.132	<0.136	<0.134	<0.130	<0.138	<0.139	<0.140	0.813	**1.05**	0.517	0.526	0.162	<0.147	<0.139	<0.133
Zinc	**150**	**410**	**5000**	**307**	**746**	**1020**	**1590**	90.3	73.6	80.7	64.1	55.9	57.6	56.8	**324**	**416**	**298**	**225**	111	90.9	84.3	104

* All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
Bold outline around cell = the measured concentration exceeds the analyte's respective LBNS SMOs value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

Table 6. Summary of Total Solids and Metals in Station AOEC A-05 and AOEC A-06 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC A-05											AOEC A-06										
					A-05 0-1	A-05 1-2	A-05 2-3	A-05 3-4	A-05 4-5	A-05 5-6	A-05 6-7	A-05 7-8	A-05 8-9	A-05 9-10	A-05 10-11	A-06 0-1	A-06 1-2	A-06 2-3	A-06 3-4	A-06 4-5	A-06 5-6	A-06 6-7	A-06 7-8	A-06 8-9	A-06 9-10	A-06 10-11
General Chemistry																										
Solids, Total (%)	-	-	-	-	56.9	61.1	62.1	57.5	64.2	55.1	68	63.6	64.1	70.5	74.9	55.5	55.8	54.9	67.4	76.7	78.4	76.5	71.6	70.1	70.7	72
Metals (mg/kg)																										
Arsenic	**8.2**	**70**	**500**	-	**20.6**	**14.9**	**12.8**	**15.7**	**15.9**	**19.3**	**13.6**	**17.2**	**13.4**	**8.36**	**11.3**	**22.3**	**30.6**	**17.8**	**13.4**	5.66	**9.47**	6.99	8.03	**10.4**	**9.42**	**9.9**
Cadmium	**1.2**	**9.6**	**100**	-	0.967	0.931	**2.13**	**2.69**	0.598	0.526	0.326	0.487	0.317	0.181	0.213	**1.35**	**1.24**	**1.4**	0.385	<0.130	0.147	<0.131	<0.140	<0.143	<0.141	<0.139
Chromium	**81**	**370**	**500**	-	**95.1B**	69.4B	56.5B	49.3B	38.1B	45.7B	42.2B	44.2B	44.3B	28.8B	34.2B	75.2B	72.4B	60.4B	32.8B	15.4B	30.9B	28.8B	28.0B	28.8B	23.1B	33.6B
Copper	**34**	**270**	**2500**	**254**	**177**	**183**	**149**	**143**	**58.8**	**69.9**	**55.9**	**61.9**	**57**	31.7	**42.2**	**212**	**244**	**202**	**55.3**	13.2	**38.3**	30.7	**34.3**	32.2	25.2	**49.9**
Lead	**46.7**	**218**	**1000**	**100**	**158**	**52.5**	**47.1**	43.4	21.1	28.6	16.1	26.2	20	9.3	11.7	**93.8**	**110**	**62.5**	20.2	3.24	7.59	4.92	5.82	6.64	4.46	6.63
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.66**	**2**	**0.694**	**0.627**	**0.338**	**0.166**	**0.154**	0.137	0.0698	0.0374	0.0495	**0.605**	**0.901**	**1.2**	0.108	**0.156**	0.0443	<0.0262	0.0322	<0.0286	<0.0283	<0.0278
Nickel	**20.9**	**51.6**	**2000**	-	**71.4**	**79.1**	**53.8**	**56.4**	**32.9**	**35.7**	**34.5**	**35.7**	**35.6**	**22.5**	**27.7**	**42.2**	**45.9**	**45.9**	**27.5**	12.3	**27**	**26.4**	**25.5**	**25.9**	**21.4**	**30.3**
Selenium	-	-	**100**	-	<0.879	<0.818	1.42	3.22	<0.779	1.28	<0.735	<0.786	<0.780	<0.709	<0.668	0.951	1.04	1.96	<0.742	<0.652	<0.638	<0.654	<0.698	<0.713	<0.707	<0.694
Silver	**1**	**3.7**	**500**	**3.5**	0.519	0.378	0.462	0.752	0.255	0.312	0.171	0.253	0.193	<0.142	<0.134	0.807	0.756	0.747	0.212	<0.130	<0.128	<0.131	<0.140	<0.143	<0.141	<0.139
Zinc	**150**	**410**	**5000**	**307**	**348**	**198**	**185**	**504**	117	131	118	130	121	76.2	88.2	**303**	**314**	**230**	103	42.6	82.7	77	80	80.2	69.1	90.2

Table 7. Summary of Total Solids and Metals in Station AOEC A-07 and AOEC CE-01 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC A-07									AOEC CE-01							
					A-07 0-1	A-07 1-2	A-07 2-3	A-07 3-4	A-07 4-5	A-07 5-6	A-07 6-7	A-07 7-8	A-07 8-9	CE-01 0-1	CE-01 1-2	CE-01 2-3	CE-01 3-4	CE-01 4-5	CE-01 5-6	CE-01 6-7	CE-01 7-8
General Chemistry																					
Solids, Total (%)	-	-	-	-	54.6	57.3	58.3	69.5	75.6	76	76.4	76.3	76.1	54.9	65.9	68.7	63.7	77.4	74.7	74.7	71.1
Metals (mg/kg)																					
Arsenic	**8.2**	**70**	**500**	-	**15.7**	**25.8**	**20.1**	**12.7**	6.4	5.35	4.12	4.39	5.2	**19.4**	**10.1**	**9.43**	**12.7**	6.17	5.32	**12**	**13.7**
Cadmium	**1.2**	**9.6**	**100**	-	1.13	**2.93**	**1.91**	0.853	0.243	0.243	<0.131	<0.131	<0.131	0.819	0.312	0.438	0.605	<0.129	<0.134	0.164	0.297
Chromium	**81**	**370**	**500**	-	59.6B	**97.0B**	**86.0B**	52.5B	35.6B	24.8B	20.4B	20.1B	27.1B	71.8B	37.9B	37.5B	43.5B	25.3B	16.4B	20.4B	27.4B
Copper	**34**	**270**	**2500**	**254**	**196**	**303**	**323**	**161**	**57.2**	**40.1**	19.2	20.9	27.7	**154**	**56.2**	**50.7**	**65.5**	21	15.3	18.6	**38.9**
Lead	**46.7**	**218**	**1000**	**100**	**74.1**	**310**	**122**	**61.6**	27	18.9	4.25	5.22	6.81	**67.5**	19.5	10.9	14.7	6.09	4.58	4.86	8.88
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.376**	**1.14**	**2.47**	**0.353**	0.144	0.0883	<0.0262	<0.0263	0.0614	**0.569**	**0.284**	0.111	0.149	0.0656	0.0311	<0.0268	**0.196**
Nickel	**20.9**	**51.6**	**2000**	-	**36.4**	**51.6**	**45.4**	**35.1**	**31.7**	20.4	17.5	17.9	**24.1**	**41.3**	**26.1**	**29.7**	**35.1**	19	13.4	16.7	**23.8**
Selenium	-	-	**100**	-	0.978	1.07	1.37	1.01	<0.661	<0.658	<0.654	<0.655	<0.657	<0.911	<0.759	<0.728	<0.785	<0.646	<0.669	<0.669	<0.703
Silver	**1**	**3.7**	**500**	**3.5**	0.589	**1.43**	0.833	0.37	<0.132	<0.132	<0.131	<0.131	<0.131	0.665	0.208	<0.146	0.168	<0.129	<0.134	<0.134	<0.141
Zinc	**150**	**410**	**5000**	**307**	**303**	**991**	**538**	**240**	124	122	63.6	60.9	73.8	**256**	109	103	122	63.5	46.1	54.9	82.3

* All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
Bold outline around cell = the measured concentration exceeds the analyte's respective LBNS SMOs value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

Table 8. Summary of Total Solids and Metals in Station AOEC CE-02 and AOEC CE-03 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CE-02								AOEC CE-03							
					CE-02 0-1	CE-02 1-2	CE-02 2-3	CE-02 3-4	CE-02 4-5	CE-02 5-6	CE-02 6-7	CE-02 7-8	CE-03 0-1	CE-03 1-2	CE-03 2-3	CE-03 3-4	CE-03 4-5	CE-03 5-6	CE-03 6-7	CE-03 7-8
General Chemistry																				
Solids, Total (%)	-	-	-	-	59.3	62.8	74.4	73.3	71.1	71.2	70.8	70.8	61.7	66.2	72	72.6	73.3	78.5	76.9	75.1
Metals (mg/kg)																				
Arsenic	**8.2**	**70**	**500**	-	**11.8**	**8.67**	5.34	5.9	4.83	3.61	**19.5**	3.05	**15.2**	**11.6**	4.23	2.96	2.45	3.02	5.4	**14.8**
Cadmium	**1.2**	**9.6**	**100**	-	0.455	0.268	<0.134	<0.136	<0.141	0.73	<0.141	<0.141	0.562	0.399	<0.139	<0.138	0.443	0.152	<0.130	<0.133
Chromium	**81**	**370**	**500**	-	48.4B	32.5B	32.0B	27.4B	20.6B	40.2B	28.8B	20.3B	59.2B	44.9B	17.2B	18.9B	16.5B	13.3B	13.0B	14.6B
Copper	**34**	**270**	**2500**	**254**	**106**	**35.2**	**36.1**	**35.4**	22.3	**55.8**	**36.9**	21.5	**101**	**67.7**	10.9	21.8	16.8	12	13.1	14.8
Lead	**46.7**	**218**	**1000**	**100**	**48.2**	10.8	6.69	7.71	3.89	10.6	6.41	4.2	46	29.4	3.41	4.95	3.24	2.48	2.45	2.7
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.403**	**0.188**	0.0559	0.0586	0.0402	0.123	0.0495	<0.0283	**0.384**	**0.157**	0.0325	0.0478	0.0374	<0.0255	0.0332	<0.0267
Nickel	**20.9**	**51.6**	**2000**	-	**28.2**	**24.2**	**28.7**	**23.7**	18.8	**33.2**	**25.1**	17.5	**36.4**	**28.9**	12.1	14.8	13.5	11.9	11.4	12.6
Selenium	-	-	**100**	-	1.94	<0.796	<0.672	<0.682	<0.703	<0.702	<0.706	<0.706	<0.810	<0.755	<0.694	<0.689	<0.682	<0.637	<0.650	<0.666
Silver	**1**	**3.7**	**500**	**3.5**	0.447	<0.159	<0.134	<0.136	<0.141	0.382	<0.141	<0.141	0.449	0.303	<0.139	<0.138	<0.136	<0.127	<0.130	<0.133
Zinc	**150**	**410**	**5000**	**307**	**183**	85.9	89.1	80.6	59.9	113	76.5	57.3	**209**	139	47.2	54.5	47	34.3	40	45.7

Table 9. Summary of Total Solids and Metals in Station AOEC CE-04 and AOEC CE-05 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CE-04								AOEC CE-05							
					CE-04 0-1	CE-04 1-2	CE-04 2-3	CE-04 3-4	CE-04 4-5	CE-04 5-6	CE-04 6-7	CE-04 7-8	CE-05 0-1	CE-05 1-2	CE-05 2-3	CE-05 3-4	CE-05 4-5	CE-05 5-6	CE-05 6-7	CE-05 7-8
General Chemistry																				
Solids, Total (%)	-	-	-	-	55.2	63.9	73.4	73.9	70.9	76.6	76	73.5	61.6	61.5	73.5	74.1	75.6	70.7	77.3	78.3
Metals (mg/kg)																				
Arsenic	**8.2**	**70**	**500**	-	**18.4**	**20.3**	7.49	7.89	4.66	2.84	2.47	8.1	**16.1**	**16.8**	5.67	2.49	3.29	2.38	1.8	1.64
Cadmium	**1.2**	**9.6**	**100**	-	0.737	0.936	0.308	0.196	<0.141	<0.131	<0.132	<0.136	0.505	0.441	0.141	<0.135	<0.132	<0.141	<0.129	<0.128
Chromium	**81**	**370**	**500**	-	72.2B	62.1B	30.5B	24.0B	23.7B	16.1B	13.4B	24.5B	60.3B	55.1B	18.7B	15.5B	14.0B	15.2B	14.3B	14.3B
Copper	**34**	**270**	**2500**	**254**	**153**	**130**	**37**	28.3	27.7	15.1	12.4	28.5	**111**	**68.3**	16.5	15.8	13.1	14.6	13.8	13.8
Lead	**46.7**	**218**	**1000**	**100**	**74.9**	**63**	18.2	8.54	6.43	3.09	2.77	4.35	**55.9**	22.9	6.77	4.08	2.6	3.45	2.91	2.75
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.62**	**0.808**	0.109	0.0723	**0.375**	**0.191**	<0.0264	<0.0273	**0.426**	**0.228**	0.0573	0.0406	<0.0265	0.0661	0.038	0.029
Nickel	**20.9**	**51.6**	**2000**	-	**40.6**	**39.5**	**22.8**	18.3	20.5	13.6	11	**22.1**	**35**	**40.4**	14.2	13.4	12	14	12.7	12.2
Selenium	-	-	**100**	-	1.09	1.17	<0.681	0.754	<0.705	<0.653	<0.658	<0.680	<0.812	1.4	<0.680	<0.675	<0.661	<0.707	<0.647	<0.639
Silver	**1**	**3.7**	**500**	**3.5**	0.665	0.676	0.181	<0.135	<0.141	<0.131	<0.132	<0.136	0.504	0.313	<0.136	<0.135	<0.132	<0.141	<0.129	<0.128
Zinc	**150**	**410**	**5000**	**307**	**250**	**223**	89.7	65.5	63.6	44.6	38.5	77.1	**198**	138	52.1	46.2	42.3	47.3	41.4	40.4

* All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
Bold outline around cell = the measured concentration exceeds the analyte's respective LBNS SMOs value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

Table 10. Summary of Total Solids and Metals in Station AOEC CE-06 and AOEC CE-07 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CE-06								AOEC CE-07							
					CE-06 0-1	CE-06 1-2	CE-06 2-3	CE-06 3-4	CE-06 4-5	CE-06 5-6	CE-06 6-7	CE-06 7-8	CE-07 0-1	CE-07 1-2	CE-07 2-3	CE-07 3-4	CE-07 4-5	CE-07 5-6	CE-07 6-7	CE-07 7-8
General Chemistry																				
Solids, Total (%)	-	-	-	-	56.1	60.7	64.6	77	77.6	79.1	78	77.6	56.1	57.7	66.6	69.4	78.3	73.9	77.5	71.7
Metals (mg/kg)																				
Arsenic	**8.2**	**70**	**500**	-	**15.4**	**15**	**15.2**	2.61	2.48	1.59	1.22	1.17	**19.4**	**21.5**	**11.2**	**8.22**	1.69	2.44	1.04	4.45
Cadmium	**1.2**	**9.6**	**100**	-	0.52	0.661	0.425	<0.130	<0.129	<0.126	<0.128	<0.129	0.641	0.802	0.307	0.239	<0.128	<0.135	<0.129	0.234
Chromium	**81**	**370**	**500**	-	60.1B	51.9B	57.1B	17.9B	15.1B	12.7B	13.7B	12.5B	72.3B	67.8B	45.4B	33.6B	11.2B	13.2B	12.2B	40.2B
Copper	**34**	**270**	**2500**	**254**	**112**	**97.1**	**65.1**	17.9	13.4	13.1	13	11.4	**152**	**134**	**51.6**	**39.4**	9.91	11.5	12.3	**50.1**
Lead	**46.7**	**218**	**1000**	**100**	**51.6**	**50.6**	20.8	4.64	3.24	4.51	3.39	2.26	**68.7**	**70.6**	15.8	12.8	2.25	2.49	2.3	10.9
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.464**	**0.625**	**0.155**	0.126	0.0301	0.0502	0.0315	<0.0258	**0.506**	**0.793**	0.0795	0.0753	<0.0256	0.0278	0.0653	0.0876
Nickel	**20.9**	**51.6**	**2000**	-	**34.8**	**31.4**	**41.6**	13.8	11.9	11.6	11.7	15.9	**39.8**	**40.8**	**34.1**	**26.5**	9.32	11.3	10.8	**33.1**
Selenium	-	-	**100**	-	1.17	1.32	1.04	<0.649	<0.644	<0.632	<0.641	<0.644	1.39	1.2	0.786	<0.720	<0.639	<0.677	<0.645	0.832
Silver	**1**	**3.7**	**500**	**3.5**	0.509	0.481	0.258	<0.130	<0.129	<0.126	<0.128	<0.129	0.621	0.611	0.196	<0.144	<0.128	<0.135	<0.129	<0.139
Zinc	**150**	**410**	**5000**	**307**	**192**	**228**	144	49.6	42.3	39.4	40.6	46.3	**251**	**257**	120	95.8	33.1	38.5	38.1	112

Table 11. Summary of Total Solids and Metals in Station AOEC CE-08 and AOEC CE-09 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CE-08								AOEC CE-09							
					CE-08 0-1	CE-08 1-2	CE-08 2-3	CE-08 3-4	CE-08 4-5	CE-08 5-6	CE-08 6-7	CE-08 7-8	CE-09 0-1	CE-09 1-2	CE-09 2-3	CE-09 3-4	CE-09 4-5	CE-09 5-6	CE-09 6-7	CE-09 7-8
General Chemistry																				
Solids, Total (%)	-	-	-	-	57.7	64.9	77.1	76.5	72.6	68.6	74.8	74	53.1	58.2	60.9	76.1	75.6	75.3	76.5	76.5
Metals (mg/kg)																				
Arsenic	**8.2**	**70**	**500**	-	**19.3**	**12.4**	**8.69**	3.47	2.55	5.67	4.91	3.28	**20.2**	**19.4**	**17.5**	8.1	3.7	2.34	1.62	2.38
Cadmium	**1.2**	**9.6**	**100**	-	0.733	0.452	0.143	<0.131	<0.138	<0.146	<0.134	<0.135	0.867	0.575	0.516	0.164	<0.132	<0.133	<0.131	<0.131
Chromium	**81**	**370**	**500**	-	68.9B	42.0B	29.4B	19.7B	30.5B	28.6B	17.7B	17.3B	60.1B	49.3B	56.8B	25.2B	18.8B	20.5B	12.8B	21.6B
Copper	**34**	**270**	**2500**	**254**	**133**	**65.4**	29.3	19.5	**35.4**	33.2	18.5	17	**149**	**82.5**	**76.5**	26.3	23.2	20	13.5	23.4
Lead	**46.7**	**218**	**1000**	**100**	**65.6**	29.9	7.47	4.55	6.21	6.14	3.7	3.3	**84.8**	36.5	30	7.67	6.39	3.85	2.7	3.5
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.347**	**0.173**	0.0277	<0.0262	0.0336	<0.0292	<0.0268	<0.0271	**0.881**	**0.23**	**0.181**	0.0575	0.0539	<0.0266	<0.0262	0.043
Nickel	**20.9**	**51.6**	**2000**	-	**40.5**	**26.9**	**22.1**	16.1	**27.4**	**24.7**	15.2	14.7	**36.2**	**37.6**	**40.2**	20.2	15.6	17.3	11	17.3
Selenium	-	-	**100**	-	1.09	0.787	<0.649	<0.654	<0.689	<0.729	<0.668	<0.676	<0.942	<0.859	0.989	<0.657	<0.661	<0.664	<0.654	<0.654
Silver	**1**	**3.7**	**500**	**3.5**	0.594	0.299	<0.130	<0.131	<0.138	<0.146	<0.134	<0.135	0.627	0.35	0.317	<0.131	<0.132	<0.133	<0.131	<0.131
Zinc	**150**	**410**	**5000**	**307**	**251**	143	71.5	54.9	77	73.4	50.3	51.2	**251**	**164**	**157**	70	58.4	61.6	40.6	58

* All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
Bold outline around cell = the measured concentration exceeds the analyte's respective LBNS SMOs value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

Table 12. Summary of Total Solids and Metals in Station AOEC CW-01 and AOEC CW-02 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CW-01								AOEC CW-02							
					CW-01 0-1	CW-01 1-2	CW-01 2-3	CW-01 3-4	CW-01 4-5	CW-01 5-6	CW-01 6-7	CW-01 7-8	CW-02 0-1	CW-02 1-2	CW-02 2-3	CW-02 3-4	CW-02 4-5	CW-02 5-6	CW-02 6-7	CW-02 7-8
General Chemistry																				
Solids, Total (%)	-	-	-	-	55.6	67.3	73.2	73.6	74.9	78	73.5	73.4	48.8	52.1	59	56.5	62.8	69.9	77.6	77
Metals (mg/kg)																				
Arsenic	**8.2**	**70**	**500**	-	**11.8**	7.05	3.13	**8.5**	3.83	7.9	5.43	6.35	**16.7**	**22.8**	**13.8**	**10.4**	7.02	1.38	2.4	1.41
Cadmium	**1.2**	**9.6**	**100**	-	0.439	0.234	<0.137	0.189	0.446	0.13	<0.136	<0.136	0.635	0.804	0.428	0.284	0.187	<0.143	<0.129	<0.130
Chromium	**81**	**370**	**500**	-	46.0B	25.1B	14.1B	24.8B	17.8B	15.8B	21.9B	18.0B	61.4B	61.6B	42.7B	33.8B	26.1B	7.79B	11.3B	22.4B
Copper	**34**	**270**	**2500**	**254**	**87.7**	**37.5**	9.01	32	29.5	20.7	27.3	23.8	**132**	**129**	**60.3**	**40.2**	32.6	8.91	11.3	23.7
Lead	**46.7**	**218**	**1000**	**100**	45.1	19.4	2.54	7.57	4.73	4.09	5.25	4.82	**64.5**	**74.6**	23.1	14.4	10.8	2.2	2.57	5.71
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.568**	0.139	<0.0274	0.0703	0.0421	**0.445**	0.045	0.0739	**0.856**	**1.04**	**0.396**	**0.184**	0.128	<0.0287	<0.0258	0.0321
Nickel	**20.9**	**51.6**	**2000**	-	**26.9**	16.1	10.7	**24.1**	16.5	15.3	20.9	17.9	**35.7**	**35.8**	**33**	**26.2**	20.8	7.89	10.3	19.3
Selenium	-	-	**100**	-	<0.899	<0.743	<0.683	<0.679	<0.668	<0.641	<0.680	<0.681	<1.02	<0.960	<0.847	<0.885	<0.796	<0.715	<0.644	<0.649
Silver	**1**	**3.7**	**500**	**3.5**	0.482	0.174	<0.137	<0.136	0.206	<0.128	<0.136	<0.136	0.59	0.67	0.25	<0.177	<0.159	<0.143	<0.129	<0.130
Zinc	**150**	**410**	**5000**	**307**	**175**	93.9	46.3	75.8	65.9	54.8	68.2	61.1	**220**	**247**	126	94.5	78.9	65.7	45.1	64.3

Table 13. Summary of Total Solids and Metals in Station AOEC CW-03 and AOEC CW-04 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CW-03								AOEC CW-04							
					CW-03 0-1	CW-03 1-2	CW-03 2-3	CW-03 3-4	CW-03 4-5	CW-03 5-6	CW-03 6-7	CW-03 7-8	CW-04 0-1	CW-04 1-2	CW-04 2-3	CW-04 3-4	CW-04 4-5	CW-04 5-6	CW-04 6-7	CW-04 7-8
General Chemistry																				
Solids, Total (%)	-	-	-	-	50.6	56.3	55.3	71.3	71.9	79.6	78.7	77.3	49.1	64.2	69.4	75.9	74.3	80.6	77.4	67.9
Metals (mg/kg)																				
Arsenic	**8.2**	**70**	**500**	-	**12.2**	**14.4**	**16.9**	3.08	**10.5**	**8.74**	5.17	3.61	**14.6**	**11.3**	3.54	5.13	5.78	4.57	5.04	6.19
Cadmium	**1.2**	**9.6**	**100**	-	0.439	0.567	0.662	<0.140	0.168	<0.126	<0.127	0.131	0.518	0.362	<0.144	<0.132	<0.135	<0.124	<0.129	<0.147
Chromium	**81**	**370**	**500**	-	53.1B	52.5B	49.8B	14.0B	34.7B	31.7B	19.8B	18.2B	57.3B	38.7B	14.5B	22.5B	28.1B	20.2B	21.9B	26.0B
Copper	**34**	**270**	**2500**	**254**	**67.2**	**108**	**96**	10.9	**35.8**	32.5	27.2	20.1	**89.2**	**45.5**	9.61	25	**36.8**	31.9	28.4	32.5
Lead	**46.7**	**218**	**1000**	**100**	34	**54.4**	**49.9**	2.94	11.6	10.8	5.95	5.8	42.6	21.8	2.85	7.49	8.82	6.07	6.96	6.25
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.347**	**0.581**	**0.728**	<0.0281	0.0609	0.0533	0.0486	0.0531	**0.473**	**0.23**	0.0544	0.0645	0.078	0.0448	**0.188**	0.0657
Nickel	**20.9**	**51.6**	**2000**	-	**34.1**	**31.2**	**32.7**	11	**30.3**	**28.8**	18.1	16.6	**37.2**	**56.5**	10.7	19.3	**24.7**	17.4	19.3	**24.7**
Selenium	-	-	**100**	-	<0.988	<0.888	<0.904	<0.701	<0.695	<0.628	<0.635	<0.647	<1.02	<0.779	<0.720	<0.659	<0.673	<0.620	<0.646	<0.736
Silver	**1**	**3.7**	**500**	**3.5**	0.34	0.528	0.56	<0.140	<0.139	<0.126	<0.127	<0.129	0.419	0.22	<0.144	<0.132	<0.135	<0.124	<0.129	<0.147
Zinc	**150**	**410**	**5000**	**307**	146	**194**	**203**	43.7	103	81.2	63.7	58.2	**185**	109	48.3	82.4	76.9	60.7	68.2	78.9

* All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
Bold outline around cell = the measured concentration exceeds the analyte's respective LBNS SMOs value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

Table 14. Summary of Total Solids and Metals in Station AOEC CW-05 and AOEC CW-06 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CW-05							AOEC CW-06							
					CW-05 0-1	CW-05 1-2	CW-05 2-3	CW-05 3-4	CW-05 4-5	CW-05 5-6	CW-05 6-7	CW-06 0-1	CW-06 1-2	CW-06 2-3	CW-06 3-4	CW-06 4-5	CW-06 5-6	CW-06 6-7	CW-06 7-8
General Chemistry																			
Solids, Total (%)	-	-	-	-	50	62.3	62.6	67.5	71.7	80	74.6	43.6	48.6	53.5	71.2	65.6	70.5	68.2	68.3
Metals (mg/kg)																			
Arsenic	**8.2**	**70**	**500**	-	**12.7**	**15.5**	5.54	3.62	5.99	3.84	4.16	**13.7**	**18.7**	**22.5**	**16.8**	**20.9**	2.87	4.75	5.74
Cadmium	**1.2**	**9.6**	**100**	-	0.456	0.557	0.17	<0.148	0.243	<0.125	0.473	0.512	0.895	**1.48**	**1.22**	0.165	<0.142	<0.147	<0.146
Chromium	**81**	**370**	**500**	-	54.3	54.3	23.0B	16.0B	27.0B	20.6B	17.1B	64.4	73.1	75	51.7	29.5	20.1	19.7	25.6
Copper	**34**	**270**	**2500**	**254**	**64.2**	**111**	24.6	10.1	25	25.2	24.5	**98.9**	**168**	**200**	**148**	32	20.8	23.4	**49.6**
Lead	**46.7**	**218**	**1000**	**100**	32.4	**58**	12.7	2.95	6.88	5.16	5.09	46.1	**79.7**	**98.6**	**70.2**	7.92	4.35	4.82	8.67
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.237**	**0.697**	0.0792	<0.0297	0.0524	0.0528	0.125	**0.44**	**0.485**	**1.46**	**0.943**	0.0746	0.0419	0.0353	0.0697
Nickel	**20.9**	**51.6**	**2000**	-	**48.8**	**30.2**	14.5	11.4	**23.1**	18	**43.9**	**39.7**	**40.3**	**38.8**	**27.4**	**24.9**	16.5	17.9	**22.5**
Selenium	-	-	**100**	-	<1.00	<0.803	<0.799	<0.741	<0.697	<0.625	<0.670	<1.15	<1.03	<0.935	<0.702	<0.762	<0.709	<0.733	<0.732
Silver	**1**	**3.7**	**500**	**3.5**	0.301	0.551	<0.160	<0.148	<0.139	<0.125	0.323	0.449	0.744	0.919	0.705	0.222	<0.142	<0.147	0.23
Zinc	**150**	**410**	**5000**	**307**	142	**204**	75.6	48.3	102	66.2	55.9	**195**	**271**	**326**	**242**	77.2	59.2	61.4	72.5

Table 15. Summary of Total Solids and Metals in Station AOEC CW-07 and AOEC CW-08 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CW-07								AOEC CW-08						
					CW-07 0-1	CW-07 1-2	CW-07 2-3	CW-07 3-4	CW-07 4-5	CW-07 5-6	CW-07 6-7	CW-07 7-8	CW-08 0-1	CW-08 1-2	CW-08 2-3	CW-08 3-4	CW-08 4-5	CW-08 5-6	CW-08 6-7
General Chemistry																			
Solids, Total (%)	-	-	-	-	53.1	60.4	63.8	71.5	70.9	68.9	79	71.6	64	67.1	73.3	76.3	76.7	74.1	77.8
Metals (mg/kg)																			
Arsenic	**8.2**	**70**	**500**	-	**12.2**	**12.7**	**13.8**	6	5.86	**10.7**	**10.6**	**18.2**	5.9	4.22	6.94	7	7.45	6.36	**8.55**
Cadmium	**1.2**	**9.6**	**100**	-	0.497	0.467	0.518	0.173	<0.141	0.19	0.165	0.335	0.176	<0.149	<0.136	<0.131	<0.130	<0.135	<0.129
Chromium	**81**	**370**	**500**	-	58.9	54.7	46.3	26.2	25.4	36.2	27.5	21.2	26.0B	19.6B	26.9B	28.4B	19.2B	16.8	20.9
Copper	**34**	**270**	**2500**	**254**	**74.4**	**71.8**	**84**	26.5	22.2	**35.8**	28.4	27	28.9	16.5	25.8	28.1	19.1	17.8	20.2
Lead	**46.7**	**218**	**1000**	**100**	34.5	36.1	42.3	10.9	6.12	8.89	7.43	7.86	12.6	6.33	5.09	5.74	4.39	3.62	4.81
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.259**	**0.503**	**0.495**	0.075	0.0443	**0.163**	0.0594	0.118	0.109	<0.0299	0.0526	0.0563	<0.0261	<0.0270	0.0569
Nickel	**20.9**	**51.6**	**2000**	-	**36.4**	**34.3**	**26.9**	17.2	19	**26.6**	20.8	18.4	**22.4**	14	**22.8**	**23.6**	16.1	16.1	16.5
Selenium	-	-	**100**	-	<0.942	<0.828	<0.784	<0.699	<0.705	<0.726	<0.633	<0.698	<0.781	<0.745	<0.682	<0.655	<0.652	<0.675	<0.643
Silver	**1**	**3.7**	**500**	**3.5**	0.351	0.358	0.421	<0.140	<0.141	<0.145	<0.127	<0.140	<0.156	<0.149	<0.136	<0.131	<0.130	<0.135	<0.129
Zinc	**150**	**410**	**5000**	**307**	**160**	147	**160**	73.4	69.1	89.7	72	64.7	80.9	60.7	76.6	89.4	56.6	60.1	57.6

* All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
Bold outline around cell = the measured concentration exceeds the analyte's respective LBNS SMOs value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

Table 16. Summary of Total Solids and Metals in Station AOEC CW-09 and AOEC CW-10 and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC CW-09							AOEC CW-10							
					CW-09 0-1	CW-09 1-2	CW-09 2-3	CW-09 3-4	CW-09 4-5	CW-09 5-6	CW-09 6-7	CW-10 0-1	CW-10 1-2	CW-10 2-3	CW-10 3-4	CW-10 4-5	CW-10 5-6	CW-10 6-7	CW-10 7-8
General Chemistry																			
Solids, Total (%)	-	-	-	-	53	62.6	60.3	61.5	65.6	76.3	64	54	51.6	50.8	51.5	53.3	68.3	79.1	74.2
Metals (mg/kg)																			
Arsenic	**8.2**	**70**	**500**	-	**14.7**	**12.8**	8.11	4.44	3.68	3.62	4.46	**14**	**16.5**	**23.2**	**29.8**	**12**	7.78	**12.9**	6.08
Cadmium	**1.2**	**9.6**	**100**	-	0.535	0.457	0.258	<0.163	<0.152	<0.131	<0.156	0.477	0.655	1.13	**2.16**	0.992	0.158	0.199	<0.135
Chromium	**81**	**370**	**500**	-	64.0B	56.0B	31.4B	17.9B	16.4B	22.4B	25.3B	67.1B	75.6B	**89.6B**	**95.6B**	52.2B	27.9B	38.3B	31.4B
Copper	**34**	**270**	**2500**	**254**	**73**	**73.1**	**40.6**	12.5	12	22.9	29.9	**93.8**	**94.5**	**238**	**267**	**121**	**36**	**50.8**	**43.1**
Lead	**46.7**	**218**	**1000**	**100**	32.8	32.9	16.8	3.98	2.8	4.63	5.5	41.1	45	**99.5**	**148**	**91.7**	11.1	11.3	8.7
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.202**	**0.226**	**0.645**	<0.0326	0.0888	0.0285	0.0485	**0.356**	**0.291**	**1.22**	**1.6**	**0.423**	**0.352**	0.13	0.0885
Nickel	**20.9**	**51.6**	**2000**	-	**42.4**	**35.4**	19.8	13	13.2	19.9	**22.3**	**49.6**	**47.1**	**46.7**	**67.1**	**38.8**	**24.5**	**72.2**	**25.8**
Selenium	-	-	**100**	-	1.22	0.879	<0.829	<0.813	<0.762	<0.655	<0.781	<0.926	1.16	1.53	1.77	<0.938	<0.732	0.755	<0.674
Silver	**1**	**3.7**	**500**	**3.5**	0.317	0.315	0.169	<0.163	<0.152	<0.131	<0.156	0.392	0.445	0.972	**1.19**	0.682	<0.146	0.135	<0.135
Zinc	**150**	**410**	**5000**	**307**	**164**	**151**	103	53.9	58.9	70.8	76.6	**193**	**193**	**357**	**457**	**248**	83.5	97.6	97.1

* All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
Bold outline around cell = the measured concentration exceeds the analyte's respective LBNS SMOs value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

Table 17. Summary of Grain Size Analysis of IR Site 7 Project Sediment

Grain Size	AOEC A							AOEC CE									AOEC CW									
	A-01	A-02	A-03	A-04	A-05	A-06	A-07	CE-01	CE-02	CE-03	CE-04	CE-05	CE-06	CE-07	CE-08	CE-09	CW-01	CW-02	CW-03	CW-04	CW-05	CW-06	CW-07	CW-08	CW-09	CW-10
Gravel (%)	0.439	0.445	0.359	0.000	0.000	0.201	0.055	2.805	0.004	0.101	0.979	0.184	0.000	0.160	0.140	0.047	0.090	0.000	0.000	0.022	0.657	0.247	0.372	0.297	0.126	2.33
Sand (%)	40.7	46.3	73.7	18.4	23.3	40.9	61.3	48.4	55.8	84.8	67.0	75.3	69.0	66.8	70.1	71.0	56.1	68.6	26.1	37.2	37.1	45.2	50.9	68.1	61.4	35.4
Silt (%)	46.4	39.7	19.7	57.5	51.9	46.0	28.8	32.5	33.6	11.3	23.9	17.4	19.8	20.9	21.2	17.1	35.8	17.3	58.6	46.2	44.1	38.6	32.9	25.1	27.9	40.1
Clay (%)	12.5	13.6	6.23	24.1	24.8	12.9	9.83	16.3	10.5	3.78	8.07	7.13	11.2	12.1	8.60	11.9	8.06	14.0	15.4	16.6	18.1	16.0	15.8	6.54	10.6	22.2

Table 18. Summary of Physical/Chemical Analysis of IR Site 7 Project Sediment Composites and a Comparison to Published ER-L and ER-M Sediment Quality Values, Long Beach Naval Station Sediment Management Objectives, and TTLC Regulatory Levels

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC-A Comp.	AOEC-CE Comp.	AOEC-CW Comp.
General Chemistry							
Solids, Total (%)	-	-	-	-	61.3	61.7	63.4
Metals (mg/kg)							
Arsenic	**8.2**	**70**	**500**	-	**10.7**	6.35	8.2
Cadmium	**1.2**	**9.6**	**100**	-	0.392	0.205	0.231
Chromium	**81**	**370**	**500**	-	35.5B	26.4B	30.1B
Copper	**34**	**270**	**2500**	**254**	**77.5**	**35.9**	**57.6**
Lead	**46.7**	**218**	**1000**	**100**	20	12.7	6.85
Mercury	**0.15**	**0.71**	**20**	**0.9**	**0.311**	0.115	0.126
Nickel	**20.9**	**51.6**	**2000**	-	**27.2**	20.9	**24.9**
Selenium	-	-	**100**	-	<0.816	<0.810	<0.789
Silver	**1**	**3.7**	**500**	**3.5**	0.2	<0.162	0.17
Zinc	**150**	**410**	**5000**	**307**	**156**	88.8	**195**
Pesticides (µg/kg).							
2,4'-DDD	-	-	**1000**	-	<1.6	<1.6	<1.6
2,4'-DDE	-	-	**1000**	-	<1.6	<1.6	<1.6
2,4'-DDT	-	-	**1000**	-	<1.6	<1.6	<1.6
4,4'-DDD	**2**	**20**	**1000**	-	<1.6	<1.6	<1.6
4,4'-DDE	**2.2**	**27**	**1000**	-	<1.6	<1.6	<1.6
4,4'-DDT	**1**	**7**	**1000**	-	<1.6	<1.6	<1.6
PAHs (µg/kg)							
Acenaphthene	**16**	**500**	-	-	<33	<32	<32
Acenaphthylene	**44**	**640**	-	-	<33	<32	<32
Anthracene	**85.3**	**1100**	-	-	<33	<32	<32
Benzo (a) Ant	**261**	**1600**	-	-	<33	<32	<32
Benzo (a) Pyr	**430**	**1600**	-	-	<33	<32	<32
Benzo (b) Flu	-	-	-	-	<33	<32	<32
Benzo (g,h,i)	-	-	-	-	<33	<32	<32
Benzo (k) Flu	-	-	-	-	<33	<32	<32
Chrysene	**384**	**2800**	-	-	<33	<32	<32
Dibenz (a,h)	**63.4**	**260**	-	-	<33	<32	<32
Fluoranthene	**600**	**5100**	-	-	<33	<32	<32
Fluorene	**19**	**540**	-	-	<33	<32	<32
Indeno (1,2,3	-	-	-	-	<33	<32	<32
Naphthalene	**160**	**2100**	-	-	<33	<32	<32
Phenanthrene	**240**	**1500**	-	-	<33	<32	<32
Pyrene	**665**	**2600**	-	-	<33	<32	<32
Total PAHs	**4022**	**44792**	-	**5400**	0.0	0.0	0.0
Aroclors (µg/kg)							
Aroclor-1016	-	-	-	-	<16	<16	<16
Aroclor-1221	-	-	-	-	<16	<16	<16
Aroclor-1232	-	-	-	-	<16	<16	<16

Analyte	ER-L	ER-M	TTLC	LBNS SMOs	AOEC-A Comp.	AOEC-CE Comp.	AOEC-CW Comp.
Aroclor-1242	-	-	-	-	<16	<16	<16
Aroclor-1248	-	-	-	-	<16	<16	<16
Aroclor-1254	-	-	-	-	<16	<16	<16
Aroclor-1260	-	-	-	-	<16	<16	<16
Aroclor-1262	-	-	-	-	<16	<16	<16

*All values in dry weight except where noted.
Bold = The measured concentration exceeds the analyte's respective ER-L value.
Bold and Yellow = the measured concentration exceeds the analyte's respective ER-M value.
Bold and Orange = the measured concentration exceeds the analyte's respective TTLC value.
< = Below the method detection limit indicated.
B= Analyte was present in associated method blank.

3.2.2 Chemical Characteristics of Elutriates and Site Water

Results of physical and chemical analyses for project sediment elutriates and site water are presented in Table 19. Target detection limits are provided in the SAP (Weston 2007). The actual detection limits and raw data for the analyses are provided in Appendix C.

3.2.2.1 Area AOEC A Elutriates

Metals were the only chemicals detected in Area AOEC A elutriate (Table 19). Arsenic, chromium, copper, and nickel were detected at a concentration less than the corresponding Daily Max Criteria (SWRCB, Cal/EPA 2006). Concentrations of heavy metals of concern ranged from below the detection limit to 0.00944 mg/L for arsenic. No pesticides, PAHs or Aroclors were detected.

3.2.2.2 Area AOEC CE Elutriates

Metals were the only chemicals detected in Area AOEC CE elutriate (Table 19). Arsenic and chromium were detected at a concentration less than the corresponding Daily Max Criteria. Concentrations of heavy metals of concern ranged from below the detection limit to 0.00718 mg/L for arsenic. No pesticides, PAHs or Aroclors were detected.

3.2.2.3 Area AOEC CW Elutriates

Metals were the only chemicals detected in Area AOEC CW elutriate (Table 19). Arsenic and chromium were detected at a concentration less than the corresponding Daily Max Criteria. Concentrations of heavy metals of concern ranged from below the detection limit to 0.00579 mg/L for arsenic. No pesticides, PAHs or Aroclors were detected.

3.2.2.4 Site Water from IR Site 7

Metals were the only chemicals detected in IR Site 7 Site Water (Table 19). Chromium, copper, and nickel were detected at a concentration less than the corresponding Daily Max Criteria. Concentrations of heavy metals of concern ranged from below the detection limit to 0.0072 mg/L for chromium. No pesticides, PAHs or Aroclors were detected.

Table 19. Summary of Physical/Chemical Analysis of IR Site 7 Project Sediment Elutriates and Site Water and a Comparison to California Ocean Plan Water Quality Objectives

Analyte	Daily Max Criteria California Ocean Plan	IR-Site-7-Water	AOEC A Elutriate	AOEC CE Elutriate	AOEC CW Elutriate
Metals (mg/L)					
Arsenic	**0.032**	<0.0010	0.00944	0.00718	0.00579
Cadmium	**0.004**	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	**0.008**	0.0072	0.00259	0.00383	0.00281
Copper	**0.012**	0.0024	0.00104	<0.0010	<0.0010
Lead	**0.008**	<0.0010	<0.0010	<0.0010	<0.0010
Mercury	**0.00016**	<0.0000177	<0.0000177	<0.0000177	<0.0000177
Nickel	**0.02**	0.0012	0.00123	<0.0010	<0.0010
Selenium	**0.06**	<0.0010	<0.0010	<0.0010	<0.0010
Silver	**0.0028**	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	**0.08**	<0.0050	<0.0050	<0.0050	<0.0050
Pesticides (µg/L)					
2,4'-DDD	-	<0.050	<0.050	<0.050	<0.050
2,4'-DDE	-	<0.050	<0.050	<0.050	<0.050
2,4'-DDT	-	<0.050	<0.050	<0.050	<0.050
4,4'-DDD	-	<0.050	<0.050	<0.050	<0.050
4,4'-DDE	-	<0.050	<0.050	<0.050	<0.050
4,4'-DDT	-	<0.050	<0.050	<0.050	<0.050
PAHs (µg/L)					
1-Methylnaphthalene	-	<1.0	<1.0	<1.0	<1.0
2-Methylnaphthalene	-	<1.0	<1.0	<1.0	<1.0
Acenaphthene	-	<1.0	<1.0	<1.0	<1.0
Acenaphthylen	-	<1.0	<1.0	<1.0	<1.0
Anthracene	-	<1.0	<1.0	<1.0	<1.0
Benzo (a) Ant	-	<1.0	<1.0	<1.0	<1.0
Benzo (a) Pyr	-	<1.0	<1.0	<1.0	<1.0
Benzo (b) Flu	-	<1.0	<1.0	<1.0	<1.0
Benzo (g,h,i)	-	<1.0	<1.0	<1.0	<1.0
Benzo (k) Flu	-	<1.0	<1.0	<1.0	<1.0
Chrysene	-	<1.0	<1.0	<1.0	<1.0
Dibenz (a,h)	-	<1.0	<1.0	<1.0	<1.0
Fluoranthene	-	<1.0	<1.0	<1.0	<1.0
Fluorene	-	<1.0	<1.0	<1.0	<1.0
Indeno (1,2,3	-	<1.0	<1.0	<1.0	<1.0
Naphthalene	-	<1.0	<1.0	<1.0	<1.0
Phenanthrene	-	<1.0	<1.0	<1.0	<1.0
Pyrene	-	<1.0	<1.0	<1.0	<1.0
Total PAHs	-	0.0	0.0	0.0	0.0
Aroclors (µg/L)					
Aroclor-1016	-	<0.50	<0.50	<0.50	<0.50
Aroclor-1221	-	<0.50	<0.50	<0.50	<0.50
Aroclor-1232	-	<0.50	<0.50	<0.50	<0.50
Aroclor-1242	-	<0.50	<0.50	<0.50	<0.50

Analyte	Daily Max Criteria California Ocean Plan	IR-Site-7-Water	AOEC A Elutriate	AOEC CE Elutriate	AOEC CW Elutriate
Aroclor-1248	-	<0.50	<0.50	<0.50	<0.50
Aroclor-1254	-	<0.50	<0.50	<0.50	<0.50
Aroclor-1260	-	<0.50	<0.50	<0.50	<0.50

Bold = The measured concentration exceeds the analyte's respective Daily Max Criteria.

3.3 Quality Control Results

3.3.1 Physical Analysis of Sediments

All grain size analyses met QA/QC criteria specified by American Society for Testing and Materials (ASTM) or USEPA guidelines for this measurement.

3.3.2 Chemical Analysis

Method reporting limits (MRLs) for target analytes were greater than or equal to method detection limits (MDLs) and above instrument detection limits as described by USEPA SW-846 protocol. MDLs are listed in Weston's SAP.

3.3.2.1 Sediment

All chemical analyses met QA/QC criteria. Laboratory contamination was controlled through the analysis of procedural blanks on a minimum frequency of one per batch. All analytes in the procedural blanks were below reporting limits with the exception of chromium. Each method blank (except one) detected a minor concentration of chromium. However chromium concentrations in each sample were greater than ten times the amount in the associated method blank; therefore, this should not affect the sample data.

Accuracy of the project data was indicated by analysis of matrix spikes, surrogate spikes, and/or laboratory control samples on a minimum frequency of one per batch. Several metals including cadmium, copper, chromium, lead, mercury, nickel, selenium and zinc had matrix spike recoveries outside control limits in one or more batches. However, in all cases the corresponding laboratory control was within acceptable limits; therefore, the sample data was reported without further clarification. Four PAH compounds had high matrix spike recoveries. However, the corresponding laboratory control sample was in control and all PAHs were undetectable in the project samples; therefore, this did not have an effect on the sample data. Nitrobenzene-d5 and 2-Fluorobiphenyl had high surrogate recoveries. However, all PAHs were undetectable in project samples; therefore, this did not have an effect on the sample data. Laboratory control samples were all within acceptable control limits for metals. Three PAH compounds had high laboratory control sample recoveries. However, all PAHs were undetectable in project samples; therefore, this did not have an effect on the sample data.

Precision of the project data was determined by analysis of duplicate matrix spikes, blank spikes, and/or duplicate test sample analysis on a minimum frequency of one per batch. Several metals including copper, chromium, lead, mercury, nickel, selenium and zinc had duplicate matrix spike recoveries outside control limits in one or more batches. However, in all cases the corresponding laboratory control was within acceptable limits; therefore, the sample data was reported without further clarification. 4,4' DDT had duplicate RPD value that was above the established control limit. However, the corresponding laboratory control sample was in control; therefore, the sample data was reported without further clarification.

3.3.2.2 Elutriates and Site Water

All chemical analyses met QA/QC criteria. Laboratory contamination was controlled through the analysis of procedural blanks on a minimum frequency of one per batch. All analytes in the procedural blanks were below reporting limits.

Accuracy of the project data was indicated by analysis of matrix spikes, surrogate spikes, and/or laboratory control samples on a minimum frequency of one per batch with the exception of site water. Matrix spikes were not performed on site water due to insufficient sample volume. Chromium, nickel and zinc had matrix spike recoveries below control limits. However, the corresponding laboratory control sample was in control; therefore, the sample data was reported without further clarification.

Nitrobenzene-d5 had high surrogate recoveries. However, all PAHs were undetectable in project samples; therefore, this did not have an effect on the sample data. Laboratory control samples were all within acceptable control limits.

Precision of the project data was determined by analysis of duplicate matrix spikes, blank spikes, and/or duplicate test sample analysis on a minimum frequency of one per batch. Nickel had duplicate matrix spike recoveries below control limits. However, the corresponding laboratory control sample was in control; therefore, the sample data was reported without further clarification.

4.0 CONCLUSIONS

- No pesticides, PAHs or Aroclors were detected in the sediment composite samples. No metals were detected at concentrations greater than corresponding ER-M values in the sediment composite samples.
- No pesticides, PAHs or Aroclors were detected in elutriate composite samples and site water. No metals were detected at concentrations greater then the California Ocean Plan's Daily Max Criteria in elutriate composite samples and site water.

Comparisons to LBNS SMO

- Area AOEC A - Depth to clean area is achieved by removing the top 3 feet in northern and western portions of site. Depth to clean area is achieved by removing the top 4 feet in core locations A-04 and A-05.
- Area AOEC CE – All sediment evaluated met the clean up standards.
- Area AOEC CW – Evaluated sediment met the clean up standards in most of the test area. Depth to clean area is achieved by removing the top 4 feet in the southwestern portion of site near the wharf face (CW-06 and CW-10), and by removing the top 2 feet in the southeastern portions of site (CW-02).

5.0 REFERENCES

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Appendix A
Field Core Logs and Photographs

Appendix B
Chain of Custodies

Appendix C
Chemistry