SAMPLING ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN BUDD INLET SEDIMENT SITE

Prepared for

Washington State Department of Ecology

Prepared by

Anchor QEA, LLC

720 Olive Way

Suite 1900

Seattle, Washington 98101

On behalf of

Port of Olympia

915 Washington Street NE

Olympia, Washington 98501

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LIST OF ACRONYMS AND ABBREVIATIONS

%R	percent recovery
°C	degrees Celsius
AO	Agreed Order
ARI	Analytical Resources, Inc.
CCV	continuing calibration verification
cm	centimeter
COC	chain of custody
CPT	cone penetration test
Cs-137	Cesium-137
CSL	Cleanup Screening Level
CSO	combined sewer outfall
CU	consolidated undrained
D/Fs	dioxin and furans
DGPS	differential global positioning system
DMMO	Dredged Material Management Office
DMMP	Dredged Material Management Program
DNR	Department of Natural Resources
DQO	data quality objective
Dup	duplicate
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management System
EISDGM	Existing Information Summary and Data Gaps Memorandum
FC	field coordinator
GC	geochronological core
GC/MS	gas chromatograph/mass spectrometer
HASP	Health and Safety Plan
HDPE	high density polyethylene
IAP	Interim Action Plan
HWA	HWA GeoSciences Inc
ID	identification

LCS	laboratory control sample
LOTT	Lacey-Olympia-Tumwater-Thurston County Clean Water Alliance
m/s	millimeters per second
MDL	method detection limit
MLLW	mean lower low water
MRL	method report limit
MS	matrix spike
MSD	matrix spike duplicate
MTCA	Model Toxics Control Act
NAD 83	North American Datum of 1983
NCDF	nearshore confined disposal facility
ng/kg	nanograms per kilograms
NOAA	National Oceanic Atmospheric Administration
PAH	polycyclic aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, and completeness
Pb-210	Lead-210
PCB	polychlorinated biphenyl
POBI	Port of Olympia Budd Inlet
Port	Port of Olympia
PQL	practical quantitation limits
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RL	reporting limit
RPD	relative percent difference
SAP	sampling analysis plan
SAPA	Ecology's Sediment Sampling Analysis Plan Appendix
SB	soil boring
SC	sediment core
SS	surface sediment
SMS	sediment management standards
SPT	Standard Penetration Test

SQS	Sediment Quality Standard
SRM	standard reference material
SVOC	semivolatile organic compound
TEQ	toxic equivalency
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency
VST	Vane shear test
WAC	Washington Administrative Code
Work Plan	Budd Inlet Sediment Site Work Plan

1 INTRODUCTION

This Sampling Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) has been prepared as required by an amendment to the Agreed Order (AO) No. DE 6083 (Ecology 2008a) between the Port of Olympia (Port) and the Washington State Department of Ecology (Ecology). It is an appendix (Appendix A) to the Budd Inlet Sediment Site Work Plan (Work Plan) (Anchor QEA 2012a). The Work Plan and the first amendment to the AO (Ecology 2012) describe six tasks for site investigation and remediation evaluation activities; this SAP/QAPP is a component of Task 1 as described in the Work Plan.

The Existing Information Summary and Data Gaps Memorandum (EISDGM) (Anchor QEA 2012b), also prepared as a component of Task 1 of the Work Plan under separate cover, summarizes existing data from previous investigations. It identifies data gaps required to identify and analyze Interim Action alternatives and prepare the Interim Action Plan (IAP). The Interim Action alternatives and the IAP are identified as Tasks 4 and 5 in both the Work Plan and AO amendment. This SAP/QAPP describes the sampling and analysis activities intended to supplement the existing data and fill the data gaps identified in the EISDGM (Anchor QEA 2012b).

This SAP/QAPP identifies the purpose and objectives of the data collection and specifies field and quality assurance/quality control (QA/QC) procedures to be implemented during field sampling activities and laboratory analyses. This SAP/QAPP was developed in accordance with Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008b) and Ecology's Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology 2004). It meets the requirements of Washington Administrative Code (WAC) 173-340-820, Model Toxics Control Act (MTCA); and WAC 173-204-600, Sediment Management Standards (SMS).

A Health and Safety Plan for field sampling activities is also provided in the Work Plan (Anchor QEA 2012a, Appendix B), as required in Task 1 of the amended AO, and presents guidance for field health and safety procedures and considerations.

2 PROJECT AND SITE DESCRIPTION AND TASK OVERVIEW

2.1 Project Description

The Port and Ecology signed AO No. DE 6083 on December 5, 2008, which requires the Port to perform remedial actions in response to releases of hazardous substances at the Budd Inlet Sediments Site (Ecology 2008a). In compliance with the AO, the Port completed an Interim Action to remove elevated concentrations of dioxin and furans (D/Fs) in sediment from portions of the berth area adjacent to its docking facility in West Bay of Budd Inlet. The project also served as a pilot study to assess the characteristics of the in-place sediments and analysis of the benefits of proposed dredging technologies for future cleanup of Budd Inlet.

The AO was amended on February 15, 2012, requiring the Port to

> "conduct additional remedial actions at a portion of a facility where there has been a release or threatened release of hazardous substances. The site boundaries have not yet been defined. The remedial actions required by the Amendment include investigations into the nature and extent of contamination in the Study Area (Figure 1-1), into the potential sources of contamination to sediments in the vicinity of the Port's peninsula in Budd Inlet, preparation of an Investigation Report to support the identification and analysis of remedial action alternatives to address sediments containing contaminants above applicable cleanup levels in the Study Area, and preparation of an IAP." (Ecology 2012)

2.2 Site Description

The Port is located in the northern portion of the City of Olympia on a peninsula within Budd Inlet, which is a small embayment in southern Puget Sound (Figure 1-1). Budd Inlet is divided into the West and East Bays in the southernmost point of Budd Inlet. The Port peninsula consists of approximately 150 acres. The Study Area is approximately 271 acres and includes the aquatic areas adjacent to property owned by the Port as well as the Port's berthing areas, under pier areas, and log pond in West Bay, and areas adjacent to Port property north of the peninsula and in East Bay (Figure 1-1). The Interim Action remediation boundary may extend beyond the Study Area.

2.2.1 West Bay

The Olympia Harbor federal navigation channel extends into Budd Inlet West Bay and widens into a turning basin near its southern end, adjacent to the Port's Marine Terminal berthing area (Figure 1-1). The navigation channel is 500 feet wide, and the turning basin is 900 feet wide, each of which is authorized to elevation -30 feet mean lower low water (MLLW). The Port manages the harbor area under a Port Management Agreement with the Washington State Department of Natural Resources (DNR). Along the Marine Terminal, the harbor area is mostly defined as a 54-foot-wide swath that extends from the south end of the Marine Terminal to the north end and beyond (Figure 1-1). This narrow swath extends from the face of the Port's Marine Terminal pier landward, thus including the under-pier area of the Marine Terminal. Waterward of the Marine Terminal, the Port's berthing areas are within the federal turning basin (Port of Olympia 2008).

The Marine Terminal is approximately 60 acres and provides approximately 2,500 lineal feet of wharf and 76,000 square feet of warehousing. Three modern ships, or a combination of vessels, can be hosted simultaneously at the Marine Terminal. Current land use immediately adjacent to the berths and turning basin includes log storage yards and loading docks (Port of Olympia 2008).

The area south of the Study Area includes a boat basin and waterfront shops and restaurants. West Bay also contains three marinas: Fiddlehead, Martin, and the Olympia Yacht Club. Within West Bay, five contaminated sites under separate AOs with Ecology are located along the western shoreline: West Bay Marina, Hardel Mutual Plywood, Reliable Steel, Solid Wood, and Industrial Petroleum, Inc. (Figure 1-1).

At the southern end of West Bay, the Deschutes River drains into Capitol Lake. This area was once an estuary where freshwater from the Deschutes River intermingled with saltwater from Budd Inlet. The lake was created in 1951 as a reflection pond for the state capital by installing an earthen dam and an 82-foot-wide tide gate with spillways across the mouth of the Deschutes River under the 5th Avenue Bridge in Olympia (USGS 2006). The flow of freshwater into West Bay is controlled by gated discharges from Capitol Lake.

2.2.2 East Bay

A second federal navigation channel is authorized from north of the peninsula that extends into East Bay and is authorized to elevation -13 feet MLLW. The primary commercial facilities in East Bay are Swantown Marina and Swantown Boatworks, located on the eastern side of the peninsula (Figure 1-1). The federal navigation channel also extends to the boat launch ramp located just north of Swantown Marina. Swantown Marina has been in operation since 1983 and is owned and operated by the Port and maintains slips for approximately 700 vessels. Swantown Boatworks provides vessel service, haulout, and a vessel storage facility.

Two contaminated sites under AOs with Ecology are located on the Port's peninsula adjacent to the East Bay (Figure 1-1). The Cascade Pole cleanup site is located on the north end of the peninsula that includes a portion of the sediment within East Bay, and the East Bay redevelopment site is on the southern portion of the peninsula.

Moxlie Creek, which originates from an artesian spring approximately 1.5 miles south of Budd Inlet, flows into East Bay through a mile-long culvert that discharges into the southern end of East Bay (Thurston County 2007). East Bay was placed on the 1998 303(d) impaired water list for polychlorinated biphenyls (PCBs) based on a single composite sample of mussel tissue collected from the culvert at the mouth of Moxlie Creek (Ecology 2003 as cited in SAIC 2008).

2.3 Related Sites and Activities

2.3.1 Former Cascade Pole Site

The former Cascade Pole site is excluded from the Study Area since it is being investigated and remediated under a separate AO between the Port and Ecology (Figure 1-1). Post remediation compliance monitoring is ongoing for the Cascade Pole site and the results will continue to be evaluated and addressed, as needed by the Port under the separate AO. The most recent compliance monitoring results from October 2012 (as shown on Figure 4-3) indicate that surface sediment D/F concentrations continue to be below the site-specific cleanup level established in 2002 (80 nanograms per kilogram [ng/kg]), ranging from 1.2 to

34.1 ng/kg. However, the 2012 compliance monitoring results also show that polycyclic aromatic hydrocarbon (PAH) concentrations have increased above the site-specific cleanup level for most PAHs since the 2007 monitoring event. The Port conducted supplemental sampling in January 2013 to further characterize the extent of the elevated PAH concentrations and better understand potential sources of the PAH contamination. The 2012 and 2013 data will be considered as part of the source evaluation and identification and evaluation of Interim Action alternatives for the remainder of the Study Area. Archived sediment collected from three locations (CP-21, CP-29, and CP-34) in January 2013 will be tested for D/Fs and have been included in this SAP/QAPP (Section 4.1.1).

2.3.2 Proposed Maintenance Dredging Activities

The Port anticipates conducting maintenance dredging activities along the Marine Terminal berth area and at the Swantown Boatworks haulout as shown in Figure 1-1. Maintenance dredging will be conducted along the southern 1,540 feet of the Marine Terminal to the maintenance dredge elevation of -42 feet MLLW within the first 20 feet from the pier face and to -38 feet MLLW within the remaining 90 feet (to 110 feet from the pier face). The Port also plans to dredge within the operational areas of the boat haulout to the maintenance dredge elevation of -12 feet MLLW. The dredging is anticipated to begin during the 2013/2014 dredge season for each maintenance dredge area. The berth area dredging may occur over multiple dredge seasons. A portion of the sediment sampling described in this SAP/QAPP is intended to evaluate the new sediment surface (i.e., z-layer) to assess the quality of the new sediment surface following completion of maintenance dredging. The subsurface sediment samples identified in this SAP/QAPP will also define the vertical extent of contamination at the Marine Terminal and Swantown Boatworks. Depending on the results of the sampling prior to maintenance dredging, an anti-degradation sand cover layer may be placed on the new sediment surface following maintenance dredging to comply with Ecology's anti-degradation policy.

2.4 Task Description

The primary focus of this investigation is to collect data to determine nature and extent of sediment contamination, identify and evaluate Interim Action alternatives, and evaluate potential ongoing sources of contamination to the sediment. As discussed in the Work Plan and EISDGM, D/Fs are the primary contaminant of interest within the Study Area; therefore, the sediment field investigation activities are focused on characterizing the nature and extent of D/Fs within the Study Area. A subset of sediment samples will also be tested for SMS chemicals to determine whether the sediments contain those additional contaminants, and if so, the nature and extent of the contamination. Additional information will be collected to better understand geotechnical characteristics and the net sedimentation rate within the Study Area to support the identification and evaluation of Interim Action alternatives. Section 4 of this SAP/QAPP presents additional details on the sample design for each sample type.

Depending on the results of the sampling described in this SAP/QAPP, and in consultation with Ecology, additional data collection activities may be necessary. Potential data collection activities may include additional sampling to better understand nature, extent, and sources of contamination in the Study Area, other sampling to identify an appropriate cleanup level for the Study Area, or sampling to aid in designing a remedial action for the Study Area. Additional required sampling activities will be described in a SAP/QAPP addendum to be reviewed and approved by Ecology.

2.5 Field Investigation Project Schedule

Sampling will begin within one month after approval of this SAP/QAPP by Ecology. The Anchor QEA project manager will coordinate with the Port. It is anticipated that field sampling activities can be completed in four weeks. The anticipated schedule for the field investigation activities is described below in calendar days:

- **Implement Investigation Work Pla**n: Thirty (30) days from Ecology's approval of the final Investigation Work Plan
- **Draft Investigation Report:** Ninety (90) days from completion of field sampling activities and receipt of final validated data
- **Final Investigation Report and submittal of data to Ecology's Environmental Information Management System (EIM):** Ninety (90) days after receipt of Ecology's final comments on the Draft Investigation Report

If additional sampling activities are required, a supplemental field investigation schedule will be included in a SAP/QAPP addendum.

3 PROJECT MANAGEMENT AND RESPONSIBILITIES

This section describes the overall project management strategy for implementing and reporting for the SAP/QAPP.

3.1 Project Planning and Coordination

Dan Berlin of Anchor QEA will be the overall project manager responsible for developing and completing the SAP/QAPP. Following SAP/QAPP approval by Ecology, Mr. Berlin will be responsible for administrative coordination to ensure the timely and successful completion of the sampling, analyses, and reporting. On behalf of the Port, he will provide a copy of the approved SAP/QAPP to Ecology and to the sampling and testing subcontractors. Mr. Berlin will discuss and coordinate any significant deviations from the approved SAP/QAPP with the Ecology and the Port.

Mr. Berlin will be responsible for preparation of the Investigation Report to support the remediation activities. The Investigation Report will summarize the sampling effort, analytical methods, QA/QC narrative, and analytical results. The content of the Investigation Report is further described in Section 9 of this SAP/QAPP.

3.2 Field Sample Collection

David Gillingham of Anchor QEA, or his designee, will serve as the field coordinator (FC) and will provide overall direction to the field sampling in logistics, personnel assignments, and field operations. The FC will supervise field collection of the sediment and water samples and will be responsible for ensuring accurate positioning and recording of sample locations, depths, and identification; ensuring conformity to sampling and handling requirements, including field decontamination procedures; physical evaluation and documentation of the samples; and delivery of the samples to the laboratory.

Anchor QEA will ensure that sediment and water samples are stored under proper conditions while in its custody until delivery to the laboratory. The FC will be responsible for summarizing field sampling activities. This summary will include details of the sampling effort, sample preparation, sample storage and transport procedures, field quality assurance, and document any deviation from the final SAP.

The sampling and analysis will be completed with equipment owned or rented by Anchor QEA. All subconsultants will follow the protocols established in this SAP/QAPP.

3.3 Laboratory Preparation and Analyses

Sue Dunnihoo of Analytical Resources, Inc. (ARI), Tukwila, Washington, will be responsible for physical and chemical analyses of sediment samples. Ms. Dunnihoo will ensure that the submitted samples are handled and analyzed in accordance with the Puget Sound Estuary Program (PSEP) analytical testing protocols and QA/QC requirements, and the requirements specified in this SAP/QAPP (Section 8). ARI will provide certified, pre-cleaned sample containers and sample preservatives as appropriate and prepare a data package containing all analytical and QA/QC results.

Hewitt Jeter of Mass Spec Services, Orangeburg, New York, will perform the Cesium-137 (Cs-137) and Lead-210 (Pb-210) analyses of the geochronology sediment cores. Hewitt Jeter will serve as the laboratory project manager for Mass Spec Services.

Harold Benny of HWA GeoSciences Inc (HWA), Bothell, Washington, will be responsible for geotechnical analyses. Mr. Benny will ensure that the submitted samples are handled and analyzed in accordance with the ASTM geotechnical testing protocols and QA/QC requirements, and the requirements specified in this SAP/QAPP (Section 8). HWA will provide pre-cleaned sample containers as appropriate and prepare a data package containing test results.

3.4 Quality Assurance/Quality Control Management

Delaney Peterson of Anchor QEA, or her designee, will serve as QA/QC manager for this project and will be responsible for all coordination with the analytical laboratory. She will perform oversight for both the field sampling and laboratory programs. She will be kept fully informed of field program procedures and progress during sample collection and laboratory activities during sample preparation. She will record and correct any activities that vary from this SAP/QAPP. Upon completion of the sampling and analytical program, she will review laboratory QA/QC results and incorporate findings into the Investigation

Report. Any QA/QC problems will be brought to the attention of Ecology as soon as possible to discuss issues related to the problem and to evaluate potential solutions.

4 SAMPLE DESIGN

The methods and procedures for the collection of field samples, sampling schedule, rationale for the sampling design, and design assumptions for locating and selecting environmental samples are detailed in the following sections. All sampling procedures will comply with Ecology protocols or other approved sample collection standards established for the Study Area. All sample types to be collected for this investigation and their locations are presented on Figure 4-1. Subsequent figures provide a focused description of sampling locations for surface sediment and subsurface sediment based on sample type.

4.1 Sediment Chemistry

Sampling and testing of surface and subsurface sediment will support the characterization of the nature and extent and evaluation of potential sources of contamination.

4.1.1 Surface Sediment

Surface sediment sampling is being conducted to further define the nature and extent of contamination for D/Fs and SMS chemicals within the Study Area. Surface sediment data will also serve to provide more information on potential ongoing sources of contamination, which may be subject to further investigation, as described in Section 4.5 of this SAP/QAPP. The objectives of the Study Area surface sediment sampling are as follows:

- Delineate the horizontal nature and extent of contamination
- Fill spatial data gaps
- Evaluate sediment in the vicinity of potential ongoing sources (i.e., outfalls or urban creeks) or in the vicinity of know historical contamination

Within West Bay, additional objectives are described below:

- Support the evaluation of whether a concentration gradient exists between the Port and other cleanup sites along the western shoreline of the West Bay
- Document surface sediment concentrations in the log pond
- Reoccupy several previously sampled locations that would support an evaluation of natural recovery, including within and near the Berths 2 and 3 Interim Action area and underpier area

Within East Bay, additional objectives are described below:

- Document surface sediment concentrations in Swantown Marina
- Re-occupy or sample near several previously sampled locations that would support an evaluation of natural recovery, including the vicinity of Swantown Marina and Swantown Boatworks, and Cascade Pole

All surface sediment samples will be analyzed for D/Fs, PAHs, and physical parameters (grain size, total organic carbon [TOC], total solids). A subset of samples will be tested for SMS parameters at locations near potential source input areas (e.g., near historical upland sources, permitted discharges, key stormwater outfalls). Surface sediment will be archived for SMS parameters at all locations. The sediment sample design, which includes the location, analyses, and purpose for each surface sediment sample location, is summarized on Table 4-1a. Surface sediment sample locations are shown on Figures 4-2 and 4-3.

Bioassay testing may be conducted to further delineate the eventual cleanup boundary. However, bioassay testing is not currently proposed to be conducted on surface sediment samples collected as part of this field effort. If sediment samples exceed the Sediment Quality Standard (SQS) or Cleanup Screening Level (CSL) chemical criteria, and the Port or Ecology chooses to confirm the presence of an adverse effect on biological resources using bioassay testing (as described in WAC 173-204-315), additional sediment would be collected to conduct testing. If bioassay testing is required, an additional SAP/QAPP addendum would be prepared and reviewed by Ecology.

This SAP/QAPP does not include any sample collection to define regional background concentrations. In the event that the current SMS rule revision process supports the use of regional background concentrations to establish cleanup criteria for contaminated sites, additional sampling outside the Study Area may be required. If additional sampling is conducted by the Port, an additional SAP/QAPP addendum will be prepared and reviewed by Ecology.

4.1.2 Subsurface Sediment

Subsurface sediment sampling will further define the nature and extent of contamination. Samples from each subsurface sediment core will be tested for D/Fs, with a subset tested for SMS chemicals depending on location. The objectives of the subsurface sediment samples in the Study Area are intended to:

- Delineate the vertical nature and extent of contamination
- Fill spatial data gaps
- Confirm concentrations below deepest historical dredge elevations (e.g., in native)
- Evaluate natural recovery trends
- Evaluate the concentrations in the anticipated sediment surface layer to be exposed as part of maintenance dredging activities in 2013/2014 at the Marine Terminal and Swantown Boatworks (i.e., z-layer)
- Evaluate the underpier Marine Terminal sediment

Subsurface sediment sampling will be conducted in the following areas:

- West Bay, including within the federal turning basin and navigation channel, south of the turning basin, in underpier areas, within the Berths 2 and 3 Interim Action area, within the proposed 2013/2014 maintenance dredge area, and in the log pond
- North of the peninsula
- East Bay, including within the federal navigational channel, Swantown Marina, south of Swantown Marina, within the proposed 2013/2014 maintenance dredge area, near Moxlie Creek, and on the East Bay mudflats near potential sources of contamination

The subsurface sediment sample locations are presented on Figures 4-4 through 4-10 and summarized on Table 4-1b. Figures 4-4 through 4-10 describe existing subsurface sediment concentrations, which were used to identify locations and testing intervals for subsurface sediment cores collected as part of this investigation. Specific sample intervals identified on Table 4-1b are generally based on the following guidelines:

- For samples with known dredge records (within the federal turning basin and navigation channels and Swantown Marina and Swantown Boatworks areas), sample intervals have been targeted for analysis at 1-foot intervals at and below the deepest extent of historical dredging (as presented on Figures 2-8 and 2-9 of the EISDGM [Anchor QEA 2012b]).

- Samples from cores within the proposed 2013/2014 maintenance dredge area activities at the Marine Terminal and Swantown Boatworks will be targeted to characterize the post-dredge sediment surface (i.e., z-layer) based on a 2-foot sample interval. For the Marine Terminal area, the z-layer is located between -44 to -46 feet MLLW within the first 20 feet of the pier face (based on a 2-foot allowable overdredge beyond the maintenance dredge elevation of -42 feet MLLW) and between -40 to -42 feet MLLW within the area 90 to 110 feet from the pier face (based on a 2-foot allowable overdredge beyond the maintenance dredge elevation of -38 feet MLLW). For the Swantown Boatworks area, the z-layer is located between -14 and -16 feet MLLW (based on a 2-foot allowable overdredge beyond the maintenance dredge elevation of -12 feet MLLW). Additional samples will be archived below the z-layer to confirm the vertical extent of contamination.
- Samples from cores collected under the Marine Terminal pier have been targeted for analysis at 2-foot intervals due to the uncertainty associated with the vertical extent of contamination. Several underpier cores have also been located along transects based on existing subsurface sediment data.
- Upper samples from cores collected near potential sources of contamination may be tested to better understand historic contaminant trends of sediment inputs from nearby outfalls or drainages based on the results of the co-located surface grab samples. Other samples will also be archived pending results of core sample intervals selected for testing along with paired surface sediment samples at the same location. The collection locations are near outfalls and creek drainages along the west shoreline of West Bay, along the east shoreline of East Bay, and at the Lacey-Olympia-Tumwater-Thurston County Clean Water Alliance (LOTT) combined sewer overflow (CSO) discharge north of the Port's peninsula.
- Samples from sediment cores collected near two geochronology cores (see Section 4.4) will be collected at 6-inch intervals to better understand chemical trends for an evaluation of natural recovery.

Table 4-1b identifies specific sediment samples to be automatically tested and archived from each sediment core. It is anticipated that some archived sediment samples will be selected for analytical testing based on results of sediment from the initial round of testing (shown on Table 4-1b). Selection of archived sediment samples to be tested will be identified in consultation with Ecology.

4.2 Geotechnical Data

Geotechnical data is being collected to support and evaluate Interim Action alternatives within the Study Area. An extensive amount of geotechnical data from the Port's peninsula is available and presented on Figure 2-21 of the EISDGM (Anchor QEA 2012b). Additional data collection to support the goals of this investigation are listed below and further described in the following subsections:

- Borings at in-water and upland locations of the log pond to support evaluation of a potential nearshore confined disposal facility (NCDF)
- Borings at the face of the Marine Terminal apron to support evaluation of the feasibility evaluation for installation of a sheetpile wall at the face of the pier
- Cone penetration tests (CPT) in the upland area adjacent to the log pond and through the Marine Terminal apron to further characterize the under pier slope at the Marine Terminal
- Vane shear tests (VST) at in-water locations were in situ capping of contaminated sediment may be evaluated

The geotechnical sample locations consist of 8 soil borings (6 in-water, 2 upland), up to 10 VSTs for sediment locations, and 3 CPTs within the Study Area. Proposed geotechnical locations are presented in on Figure 4-11 with the sample location, location depth, sample intervals, and analysis presented on Table 4-1c.

4.2.1 Log Pond Testing

The shoreline and in-water subsurface conditions near the log pond area and northwestern region of the Port peninsula are not adequately defined for geotechnical evaluation. The potential use of the log pond as a NCDF requires additional subsurface characterization and geotechnical soil and sediment data to support development of a potential NCDF Interim Action alternative. In-water and upland characterization of subsurface conditions will also support a site-specific seismic hazard evaluation. In addition, in-water borings will supplement the evaluation of berm stability and settlement of a potential NCDF option.

4.2.2 Borings at the Face of the Marine Terminal Pier

Additional subsurface explorations and geotechnical testing is needed along the fender line of the Marine Terminal. Borings will be collected at various points along the apron fender line for purposes of evaluating the feasibility of installing a sheetpile wall to support the toe of the underpier slope.

4.2.3 Cone Penetration Testing

Deep CPTs will be performed immediately upland of the log pond. The CPTs will use shear wave velocity measurements and pore pressure dissipation testing to investigate the potential head pressure of artesian groundwater conditions that has been identified at the site by other firms. The shear wave velocity measures will support the site-specific seismic hazard evaluation for Interim Action alternatives. CPTs performed along the Marine Terminal may be conducted after coring through the apron to characterize the near-surface sediments to evaluate Interim Action alternatives.

4.2.4 Vane Shear Testing

Where capping will potentially be performed, VSTs of sediments will be used to evaluate cap bearing capacity and stability. Actual locations and number of VSTs may vary at the time of testing to due weather conditions, access, and equipment limitations.

4.3 Jet Probe Transects

Jet probe measurements will be collected along four transects to provide additional information on the composition of the underpier slope of the Marine Terminal. Riprap is visible along the upper portion of the underpier slope in the intertidal area and is present part way down the slope, but the lower extent and amount of accumulated fine grained sediment on top of the rock is unknown. The jet probe transects will provide elevations of exposed rock as well as the lower extent of buried rock along the slope. The probing will also provide thickness of soft sediment located above the rock. This will support evaluation of the Interim Action alternatives for the underpier area.

4.4 Geochronology Data

Sedimentation rates in the Study Area will be estimated using additional geochronology data. While geochronology cores were collected by Ecology in 2008 (SAIC 2008), none were located within the Study Area. The data will support the evaluation of sediment deposition patterns and the potential for use of natural recovery as a remedial option for portions of the Study Area. A description of the depositional environment at each location will be developed by examining the vertical profiles of radioisotope concentrations in conjunction with stratigraphic and sediment bed property information. This approach produces the best estimate of long-term average sedimentation rates.

The following conditions were considered in the selection of the number and locations of sediment cores for this study:

- Samples should provide reasonable spatial coverage throughout the Study Area to capture potential variations in the depositional environment
- Samples should be representative of the different hydrological regimes present within the Study Area (e.g., West Bay and East Bay)
- Samples should be taken from areas that have not been dredged after approximately 1964, since 1963 is the peak year for Cs-137
- Samples should not be taken in areas that are anticipated to have experienced excessive erosion or continual mixing

Geochronological cores will be used to evaluate long-term stability and sedimentation rates, which are determined using radioisotope abundances of Cs-137 and Pb-210. Average sedimentation rates will be calculated for interpretable cores. Four proposed geochronology core sampling locations are presented on Figure 4-12 and summarized in Table 4-1d.

The results of the geochronology analyses will be used with the existing data presented in the EISDGM to develop a weight-of-evidence characterization of the depositional environment in various portions of the Study Area. In addition to estimating sedimentation rates, the geochronology analyses may also provide additional insights. These include potential temporal variations in deposition rates from propwash, and the extent to which episodic events (as evidenced by disturbances in the vertical profiles of Cs-137 and Pb-210) may have affected erosion and deposition in the Study Area. Other information used to estimate sediment deposition rates will include empirical data based on current bathymetry compared to elevations of previous known dredge events.

4.5 Stormwater Solids Sampling

In compliance with the requirements of AO No. 8499, and the associated Ecology-approved Work Plan for Port of Olympia Source Control Investigations (Anchor QEA 2011), the Port currently routinely monitors the accumulation of solids in Port catch basins and performs periodic cleanouts within basins A and B to pursue continued reductions in D/F concentrations in catch basin solids. The Port plans to conduct additional conveyance system monitoring in 2013 using the methods described in the Port's Source Control Monitoring Work Plan (Anchor QEA 2013).

Additional source tracing activities beyond the Port's property boundary may be required to further understand the potential for ongoing sources of contamination into the Study Area. Additional activities may be required if specific sediment samples indicate sufficiently elevated concentrations may be originating from a specific area or outfall. Additional investigation activities may occur in specific drainage conveyance systems that are suspected to be the source of elevated sediment concentrations. Depending on the type of system (e.g., CSO or storm drain) and owner (e.g., private or City of Olympia), additional source tracing investigation activities will be coordinated with Ecology and the conveyance system owner. Any additional source tracing activities would be documented in an addendum to the SAP/QAPP.

5 SAMPLE COLLECTION, PROCESSING, AND HANDLING PROCEDURES

This section describes activities methods and procedures to complete the investigation for each data collection activity.

5.1 Station and Sample Identification and Nomenclature

Each sample will be assigned a unique alphanumeric identifier according to the following method:

- Each sample identification (ID) will be identified by *Project Name- Sample Method-Location Number-Sample Type Depth*
  - The project name will be identified by four letters: POBI for Port of Olympia Budd Inlet
  - Sample method will be identified by two letters: SS for surface sediment, SC for sediment core, SB for soil or sediment boring, CPT for cone penetration test, VST for vane shear test and GC for geochronological core)
  - Sample location number will be in order by sample method beginning with -01 (e.g., SS-01)
  - Sample depth will be identified by the upper and lower sample collection depth. Surface grab depth and geotechnical core intervals are measured in centimeters (cm) and sediment core and soil boring intervals are measured in feet. For example, a sample ID for the first sediment grab location will be POBI-SS-0-10 and from the 0- to 2-foot interval of a sediment core will be POBI-SC-0-2
- A field duplicate collected from a sample will be identified by the addition of "Dup" to the sample number. A duplicate sample of the above sediment grab example would be POBI-SS-01-10 Dup.

5.2 Station Positioning

Horizontal positioning will be determined by the sampling vessel's onboard differential global positioning system (DGPS) based on target coordinates shown in Tables 4-1a thru 4-1d. Measured station positions will be converted to latitudinal and longitudinal coordinates to the nearest 0.01 second. The accuracy of measured and recorded horizontal coordinates is typically less than 1 meter and will be within 2 meters according to PSEP guidance.

Northing and easting coordinates of the vessel will be updated every second and displayed directly on a computer onboard the vessel. The coordinates will then be processed in real time and stored at the time of sampling using the DGPS software package. Washington State Plane Coordinates, North, North American Datum of 1983 (NAD 83) will be used for the horizontal datum.

The vertical elevation of each station will be measured using a fathometer or lead line. This depth will be corrected for tidal influence to obtain the depth of the mudline relative MLLW. Tidal elevation will be estimated by using the National Oceanic Atmospheric Administration (NOAA) predicted tides in Budd Inlet (Station ID 9446969). Periodic water line measurements to a survey point located at the southeast corner of the wharf will be conducted to evaluate the accuracy of the NOAA predicted data.

A checkpoint will be located at a known fixed point that is accessible by the sampling vessel (such as a pier face, dock, piling, or similar structure) to ensure the accuracy of the navigation system. At the beginning and end of each day, the vessel will be stationed at the check point, a DGPS reading will be taken, and the two readings will be compared. The two position readings should agree, within the limits of survey vessel operational mobility, to within 1 to 2 meters.

5.3 Collection Methods

The various sediment and soil sampling methods are described in the section by sample type: sediment grabs, sediment cores, and soil borings. The sample design is presented in Tables 4-1a through 4-1d and includes location ID, sample ID, collection method, and collection depths, analyses, and rationale for each sample type.

5.3.1 Sediment

5.3.1.1 Sampling Platform

Surface and subsurface sediment will be collected from a vessel specifically designed to support environmental sampling activities by a qualified operator. The vessel will be equipped with a DGPS, an A-frame and winch, seawater pumps, and a depth sounder. Surface sediment samples will be collected with a modified van Veen-type power grab sampler. The subsurface sediment cores will be collected using a vibracore. The vessel will be equipped with a frame and winch, seawater pumps, DGPS, and depth sounder.

5.3.1.2 Surface Sediment Sample Collection and Processing

Surface sediment samples for laboratory analyses from the 0- to 10-cm biologically active zone will be collected for physical and chemical testing. A grab sampler will be used in accordance with PSEP (1997a) and Ecology's Sediment Sampling Analysis Plan Addendum (SAPA) (Ecology 2008b) protocols, or by hand using a stainless steel bowl and spoon at intertidal locations (e.g., along the eastern shoreline of East Bay or mudflat north of the peninsula) during a low tide.

The grab sampler is used to collect large volume, surficial sediment samples. The sampler utilizes a hinged jaw assembly for sample collection. Upon contact with sediments, the jaws are drawn shut to collect the sample. The grab sampler will be used to collect samples in the following manner:

- Maneuver the vessel to the sampling location using a DGPS to within 1 to 2 m of the target sampling location
- Open the decontaminated grab sampler jaws to the deployment position
- Draw the winch cable to the grab sampler taut and vertical
- Lower the sampler through the water column to the bottom at a speed of approximately 0.3 meters per second (m/s)
- Close the jaws of the sampler when the sampler reaches the bottom, and record the time and DGPS coordinates
- Retrieve the sampler, raising it at approximately 0.3 m/s
- Evaluate the retrieved sediment sample aboard the vessel and against the following PSEP acceptability criteria:
  - Grab sampler is not overfilled (i.e., sediment surface is not against the top of sampler)
  - Sediment surface is relatively flat, indicating minimal disturbance or winnowing (For the wood debris characterization samples, acceptable grab samples will allow for minor surface disturbance)
  - Overlying water is present, indicating minimal leakage

  - Overlying water has low turbidity, indicating minimal sample disturbance
  - Desired penetration depth is achieved

- Siphon off overlying water and use a stainless steel spoon to collect a 0- to 10-cm sediment layer from inside the sampler, taking care not to collect sediment in contact with the sides of the sampler
- Place the collected sediment in a stainless steel mixing bowl and when sufficient sample volume has been collected, homogenize the sediment using a stainless steel spoon
- Place homogenized sediment immediately into appropriate pre-labeled sample containers (Table 5-1) and place immediately on ice and maintain at 4 degrees Celsius (°C) until delivered to ARI

Sample Collection Forms and Daily Log notes of all grab samples will be maintained as samples are collected and correlated to the sampling location map. The following information will be included on the Sample Collection Form or Daily Log:

- Water depth to mudline surface
- Location of each grab sample as determined by DGPS
- Date and time of collection of each sediment grab sample
- Names of field supervisor and person(s) collecting and logging the sample
- Observations made during sample collection including weather conditions, complications, ship traffic, and other details associated with the sampling effort
- Location and sample ID
- Physical soil description in accordance with ASTM procedures (ASTM D 2488 and ASTM D 2487 - Unified Soil Classification System) including soil type, density and consistency of soil, and color
- Odor (e.g., hydrogen sulfide, petroleum)
- Vegetation and debris (e.g., wood chips or fibers, paint chips, concrete, sand blast grit, and metal debris)
- Biological activity (e.g., detritus, shells, tubes, bioturbation, and live or dead organisms)
- Presence of oil sheen
- Any other distinguishing characteristics or features

- Any deviation from the approved sampling plan

5.3.1.3 Subsurface Sediment Core Collection

Sediment cores will be collected at each location using a vibracore. A vibracore collects a continuous profile of subsurface sediments by using a high frequency vibrating coring device that penetrates into the underlying sediments with minimal distortion. A vibracore is ideal for collecting long, relatively undisturbed cores from a variety of sediment types.

For this project, the sediment cores will be collected using a decontaminated aluminum core tube barrel. The core tube caps will be removed just prior to placement into the vibracore. Care will be taken during sampling to avoid contact of the sample tube with potentially contaminated surfaces. Extra sample tubes will be available during sampling operations for uninterrupted sampling in the event of a potential core tube breakage or contamination. However, core tubes suspected to have been accidentally contaminated may be decontaminated as follows:

- Rinse and pre-clean with potable water
- Wash and scrub the tubes in a solution of laboratory grade, non-phosphate-based soap and potable water
- Rinse with potable water
- Rinse three times with distilled water
- Seal both ends of each core tube with aluminum foil

Vibracore sediment samples will be collected in the following manner:

- Maneuver the vessel to the proposed sample location
- Secure a decontaminated core tube the length of the desired penetration depth to the vibracore assembly and deploy it from the vessel
- Deploy the corer by winch and send it to the bottom, where the vibracorer will then be energized and lowered to the target coring depth
- Continuously monitor the penetration of the core barrel during the coring operation
- Collect a continuous core sample to the designated coring depth or until refusal, whichever is reached first

- Measure and record the location of the core and measure the depth to sediment using a survey tape attached to the vibracore head assembly
- Measure and record the depth of core penetration
- Extract the core from the sediment using the winch
- Spray off the assembly and core barrel, while they are suspended from the A-frame, and then place them on the vessel deck
- Remove the core tube from the vibracore assembly once on board the vessel and then evaluate the core for acceptability and measure the length of the sediment from the top of the core tube to calculate percent recovery

Acceptance criteria for sediment core samples are as follows:

- Overlying water is present and the surface is intact
- The core tube appears intact without obstruction or blocking
- Recovery is greater than 75 percent of the penetration depth
- Target penetration depth is achieved, unless refusal occurs after three attempts for which the deepest penetrating core will be sampled

If sample acceptance criteria are not achieved, the core will be rejected unless an acceptable core is collected from subsequent attempts at the location. The FC can accept a core if sediment characteristics do not allow for the collection of an acceptable sample. The core location can also be relocated a short distance if an acceptable core cannot be collected at the location.

Acceptable cores will have the extra tube cut off near the sediment surface and be capped and stored upright in an insulated box on the vessel. Cores longer than 6 feet in length will be cut into smaller sections (up to 4 feet long) so they can be transported to the processing facility in a vertical position, if possible, and so they will fit in the insulated storage box on the vessel and at the processing facility. The core tube will be labeled with permanent black marker and scribed with the location ID and an arrow pointing to the top of core. At the end of the day, the cores will be taken to the processing facility where they will be processed the following day.

Logs and field notes of all core samples will be maintained as samples are collected and correlated to the sampling location map. The following information will be included in this log:

- Mudline elevation of each core station sampled relative to MLLW
- Location of each core station as determined by DGPS
- Date and time of collection of each sediment core sample
- Names of field supervisor and person(s) collecting and logging the sample
- Observations made during sample collection including weather conditions, complications, ship traffic, and other details associated with the sampling effort
- The sample station number
- Core tube penetration depth
- Sediment core length
- Percent recovery (core length/penetration depth)
- Any deviation from the approved sampling plan

5.3.1.4 Core Processing

Core processing will be conducted one core at a time at the processing facility, which may be at ARI or at an on-site Port of Olympia facility, depending on availability. Transported cores will be handled consistent with ASTM procedures (ASTM D 4220) and stored upright. The cores will be stored cool or on ice until they can be processed in the order in which they were collected. Cores may be held for a maximum of 72 hours before processing. Core processing will be conducted by Anchor QEA staff.

Cores will be cut for logging and sampling by removing the core caps and cutting the core tube longitudinally with a circular saw. The core will be split into two halves with decontaminated stainless steel spatulas. If the core was divided into sections for easier transport, this step will be repeated for each section until the entire core is extracted. The entire length of each core will be logged, even if deeper than the target sample depth. Prior to sampling, color photographs will be taken and a sediment description of each core will be recorded on the core log. The following parameters will be noted:

- Sample recovery

- In situ sample intervals/elevations based on correction for compaction and recovery assuming uniform compaction
- Physical soil description in accordance with ASTM procedures (ASTM D 2488 and ASTM D 2487 - Unified Soil Classification System) including soil type, density and consistency of soil, and color
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratification, structure, and texture
- Vegetation and debris (e.g., wood chips or fibers, paint chips, concrete, sand blast grit, and metal debris)
- Biological activity (e.g., detritus, shells, tubes, bioturbation, and live or dead organisms)
- Presence of oil sheen
- Any other distinguishing characteristics or features

Starting at the mudline, the core will be sectioned into sample intervals based on the in situ sample design (Table 4-1b) for each location. The sample design intervals may vary slightly based on sediment lithology and observations. In situ sample intervals will be established based on correction for compaction and recovery assuming uniform compaction. This method will provide the best estimate of elevations related to the vertical extent of contamination for remedial alternative evaluation and related to the post-dredge surface in the proposed maintenance dredge areas (e.g., z-samples collected for DMMP evaluation).

The sampled intervals from each core will be homogenized by thoroughly mixing with stainless steel utensils until the sediment appears uniform in color and texture. The homogenized sediment sample will be placed into the appropriate sample jars (Table 5-1) and stored on ice until submitted to ARI. Each jar will be firmly sealed and clearly labeled with the name of the project, sample number, type of analysis, date, time, and initials of the person preparing the sample.

5.3.2 Geotechnical Analysis Sediment and Soil Borings

5.3.2.1 Sampling Platform

Soil and sediment borings will be collected using a hollow stem auger or mud-rotary drill rig. The sediment boring locations in the log pond will be advanced using a drill rig stationed on a barge anchored with spuds or other appropriate methods.

5.3.2.2 Geotechnical Boring Sample Collection and Processing

Borings will be performed by a subcontracted driller who will be selected at the time of work based on availability. Qualified drillers with barge experience that will be considered include Boart Longyear, Cascade Drilling, Gregory Drilling, and Holocene Drilling. The borings in the log pond and along the fender line at the Marine Terminal will be advanced to a targeted depth of 50 to 60 feet below the existing mudline. The upland shoreline soil borings will be collected to a targeted depth of 100 feet below ground surface sediment and soil boring samples will be collected using a standard split spoon sampler for geotechnical index testing and Shelby tubes for geotechnical consolidation, strength, and bulk density testing.

Sediment and soil boring geotechnical samples will be collected at regular intervals from the mudline downward using two methods: split-spoon and Shelby tube. Geotechnical index test samples will be collected using a split spoon sampler so that Standard Penetration Test (SPT) blow counts can be recorded. Index tests will include moisture content, grain size distribution, Atterberg limits, and specific gravity. Geotechnical strength tests, consolidation, and bulk density will be obtained using stainless steel, thin-wall Shelby tubes, which reduces sample disturbance relative to split-spoon testing.

The split-spoon sampler and Shelby tube will be used to collect geotechnical samples in the borings. An observational approach will be used to determine the appropriate sampler required for sampling of the soil unit encountered. In general, the split-spoon sampler will be used for coarse-grained, granular soils and in fine-grained units between Shelby tube samples. Shelby tube sampling will be performed within fine-grained soil units at intervals determined at the discretion of the Anchor QEA geologist or engineer on site. Typically, an effort will be made to extract a sample near the top and middle of the fine-grained soil unit.

A drill rig will be used to advance a casing to the top of the sample interval. Where split-spoon samplers are used, the SPT will be initiated. To collect the sample, the split-spoon sampler uses a calibrated hammer system (equivalent to 60 percent of the delivered energy from a 140-pound hammer that free falls 30 inches) to advance the 2-inch outside diameter (1-3/8-inch inner diameter of opening) sampler a total of 18 inches below the casing. For samples that require minimal sample disturbance, the drill rig operator will hydraulically push a 3-inch-diameter Shelby tube below the deepest edge of the casing to collect a 24-inch-long sample.

The borings will be logged by an engineering geologist or geotechnical engineer from Anchor QEA. The following data will be recorded on the boring log:

- Sampling location, time, tide, and depth of water to sediment (as measured by lead line) for subtidal locations (i.e., log pond)
- Elevation of location as measured from MLLW from subtidal locations
- Location coordinates from DGPS
- Names of field personnel collecting and handling the cores
- Observations made during boring collection, including weather conditions, complications, ship traffic, and other details associated with the sampling effort
- Physical description of the sampler (e.g., intact, bent)
- Length and depth intervals of each section
- SPT blow counts over the 18-inch drive, in 6-inch intervals
- Sample recovery, depicted graphically on the log
- Soil classification, as interpreted based on visual observation of the sample
- Driller observations regarding drilling action, such as the presence of gravel or cobbles, hard drilling, or stratigraphic changes between sample intervals.
- Any deviation from the approved SAP/QAPP

5.3.2.3 Split Spoon Samples

Split-spoon samples will be opened in the field and logged by the engineering geologist or geotechnical engineer. The following observations will be noted on the field log for each split spoon sample:

- SPT blow counts over the 18-inch drive, in 6-inch intervals
- Sample recovery, depicted graphically on the log
- Density and stiffness based on blow count
- Physical soil description in accordance with ASTM procedures (ASTM D 2488 and ASTM D 2487 – Unified Soil Classification System) including soil type, density and consistency of soil, and color
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratification, structure, and texture
- Vegetation and debris (e.g., woodchips or fibers, paint chips, concrete, sand blast grit, and metal debris)
- Biological activity (e.g., detritus, shells, tubes, bioturbation, and live or dead organisms)
- Presence of oil sheen

Once these notes have been made, the sample will be removed from the split-spoon sampler, placed into sample containers, and sealed. The sample containers will be labeled with the sample identification number, packed in a cooler, and delivered to the laboratory for geotechnical testing. Sediment samples for geotechnical index testing (water content, specific gravity, Atterberg limits, and grain size) will be placed in appropriately sized, pre-cleaned, labeled jars according to Table 5-1.

5.3.2.4 Shelby Tube Samples

Upon retrieving the sample from the bore hole, an estimate of sample recovery will be made by the Anchor QEA field staff and then both ends of the tube will be capped and sealed to minimize water loss from the sample. Samples will be stored free of elevated temperatures and remain vertical during storage and throughout transportation. An appropriate degree of caution will be exercised to prevent further disturbance of the sample during transporting to the laboratory.

Geotechnical strength, consolidation, and bulk density test samples will be retained within their respective Shelby tubes until ready for processing at the geotechnical laboratory. Sediment in the Shelby tubes will be extracted for geotechnical testing by the laboratory. Up to three samples from each Shelby tube will be tested. All Shelby tubes from the boring will be logged according to the same protocols for the split-spoon samples as described in Section 5.3.2.3 of this SAP/QAPP. Soil from Shelby tubes will be extracted by the geotechnical laboratory within appropriate timeframes as close to the time of testing as practicable.

5.3.3 Jet Probe

The in-water jet probing locations along the underpier slope of the Marine Terminal will be advanced using a pump stationed on an assist boat with a diver assisting in guiding the probe with a jet of water. The jet of water allows the probe to penetrate deeper into the sediment by loosening compacted sediment below the mudline. Jet probing generates little turbidity in the water since the activity is conducted below the mudline, but additional precautions will be taken to minimize turbidity. Probing will be performed along four transects at in-water locations along the slope of the Marine Terminal. Transects will be located relative to known fixed features at the Marine Terminal (e.g., pile bent numbers), and probes will be conducted at regular spacing along the transect based on easily identified visible features along the transect line (e.g., a tape measure setup along the transect, pile row numbers, etc.).

Data collected from jet probing explorations include documentation of debris, contacts of hard geologic units, and any other obstructions that may cause refusal. The results of the exploration will be logged by the diver at the time of probing.

5.3.4 Geochronological Data

Subsurface sediment cores for geochronology analysis will be collected using the same vibracorer and vessel as described in Section 5.3.1.1 of this SAP/QAPP. The core will be advanced into the sediment to achieve a target penetration depth at each location (Table 4-1d), or to refusal. At each sample location, water depth, penetration depth, and core recovery will be measured and recorded in the core collection log. The time and date of core collection will also be recorded. Care will be taken to minimize the amount of vibration to achieve the target penetration depth, which will minimize the amount of disturbance in the core sample and improve the results of the radioisotope dating analysis.

Following core collection, each high-resolution core will be split horizontally and samples will be extracted in 2-cm increments using a hydraulic extruder jack with clean spatulas to minimize contamination. The outer layer (0.25 to 0.5 cm) of each 2-cm section will be trimmed off the sample to avoid sampling any sediment that has come into contact with the wall of the core tube. Each 2-cm section will then be placed into a jar directly without homogenization. This process will be repeated for each sediment sample interval, including those that will be archived. The physical characteristics of each sample interval will be determined by visual inspection in the field and recorded. These characteristics include general sediment type using the Unified Soil Classification System and approximate grain size (i.e., fine, medium, or coarse). The samples will be placed into jars, labeled, and stored appropriately as specified in Table 5-1.

Every third segment of the sediment core (e.g., 0 to 2 cm, 6 to 8 cm, 12 to 14 cm, etc.) will be submitted for laboratory analysis for Cs-137 and Pb-210, TOC, and total solids. Samples (2 cm thick) that are not submitted for laboratory analysis will be archived in jars prepared identically to the samples that are submitted to the laboratory. The number of segments submitted for laboratory analysis for each core will vary because of differences in total sediment core lengths collected (see Table 4-1d).

One sample from each geochronology sediment core segment will be submitted to Mass Spec Services for Cs-137 and Pb-210 analyses and to ARI for grain size, TOC, and total solids analyses. Sediment core segments not selected for laboratory analyses will be archived according to the requirements in Table 5-1 for future analyses, if needed. The samples being submitted for Cs-137 and Pb-210 analyses may be stored at room temperature.

5.4 Field Quality Assurance Samples

Field QA samples will be collected, along with the environmental samples, to identify possible problems resulting from sample collection or sample processing in the field. The collection of field QA samples includes homogenized field duplicates and matrix spike/matrix spike duplicates (MS/MSDs) as described below. Field duplicates will be collected at a frequency of 1 per 20 samples collected. A field duplicate is a second sample collected from the same homogenized sediment sample (same bowl) as the first sample. MS/MSD samples will be collected at a frequency of 1 per sampling event or 1 in 20 samples processed, whichever is more frequent.

Field duplicate samples will be prepared by homogenizing sufficient sample volume from a location. The field duplicate will be labeled as described in Section 5.1 and analyzed for the same constituent list as the original sample.

For every 20 samples, additional MS/MSD sample volume (8 ounces) will be collected to ensure that the laboratory has sufficient sample volume to run the program-required analytical QA/QC samples for analysis. MS/MSD samples will be identified on sample labels and the chain of custody (COC), and will retain the same sample identifier as the original sample. All field QA samples will be documented in the field logbook and verified by the QA/QC manager or designee.

5.5 Sample Handling Procedures

Filled sample containers for chemistry and geotechnical analyses will be stored in coolers containing ice to maintain the samples at 4 °C until delivery to the analytical laboratory.

All working surfaces and instruments will be thoroughly cleaned, decontaminated, and covered with aluminum foil to minimize outside contamination between sampling events. Disposable gloves will be discarded after processing each core sample and replaced prior to handling decontaminated instruments or work surfaces.

Sample containers will be kept in packaging as received from the analytical laboratory until use; a sample container will be withdrawn only when a sample is to be collected and will be returned to a cooler containing completed samples.

5.6 Equipment Decontamination Procedures

Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sediment must meet high standards of cleanliness. All equipment and instruments used that are in direct contact with the sediment collected for analysis will be made of glass, stainless steel, or high density polyethylene (HDPE), and will be cleaned prior to each day's use and between sampling or compositing events. Decontamination of all items will follow PSEP protocols. The decontamination procedure is as follows:

- Perform pre-wash rinse with site water
- Wash with solution of laboratory-grade, non-phosphate based soap (e.g., Alconox®)
- Rinse with site water
- Rinse three times with laboratory-grade distilled water
- Cover all decontaminated items with aluminum foil
- Store in clean area or closed container for next use

5.7 Sample Containers

The analytical lab will provide certified, pre-cleaned, U.S. Environmental Protection Agency- (USEPA-) approved containers for all samples (Table 5-1). Prior to shipping, the analytical laboratory will add preservative, where required, according to PSEP (PSEP 1997a) and SAPA (Ecology 2008c) protocols.

5.8 Sample Identification and Labels

Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. The following information will be recorded on the container label at the time of collection:

- Project name
- Sample identification
- Date and time of sample collection
- Preservative type (if applicable)

Samples will be uniquely identified with a sample identification that at a minimum specifies sample matrix, sample number, sample location, and type of sample as described in Section 5.

5.9 Waste Management

All sediment remaining after sampling will be washed overboard at the collection site prior to moving to the next sampling station. Any sediment spilled on the deck of the sampling vessel will be washed into the surface waters at the collection site. Excess sediment remaining after processing of the Shelby tubes at ARI will be placed into a 55-gallon drum and disposed in an appropriate manner using the procedures outlined in ARI's Chemical Hygiene Plan. Remaining sediment after core processing will be stored in 55-gallon drum at the processing facility. Filled drums with sediment will be disposed of by the Port using a waste management contractor.

Soil cuttings generated during the boring activities will be placed into a 55-gallon drum onboard the barge or on the Marine Terminal, depending on collection location. Filled drums with soil cuttings will be sent by the drilling subcontractor for offsite disposal as part of its contract. Drums will be properly labeled, kept closed, and stored separately from other incompatible wastes (e.g., liquid solvents).

All disposable sampling materials and personnel protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavy-duty garbage bags for disposal.

6 SAMPLE TRANSPORT AND CHAIN-OF-CUSTODY PROCEDURES

This section addresses the sampling program requirements for maintaining custody of the samples throughout the sample collection and delivery process.

6.1 Sample Custody Procedures

Samples are considered to be in one's custody if they are in the custodian's possession or view, in a secured location (under lock) with restricted access, or in a container that is secured with an official seal such that the sample cannot be reached without breaking the seal.

COC procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the COC form. Each sample will be represented on a COC form the day it is collected. All data entries will be made using an indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, and then dating and initialing the change. Blank lines or spaces on the COC form will be lined-out and dated and initialed by the individual maintaining custody.

A COC form will accompany each cooler of samples to the analytical laboratory. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. Copies of all COC forms will be retained in the project files.

6.2 Sample Delivery and Receipt Requirements

All chemistry and geotechnical samples will be hand delivered to ARI no later than the day after collection. The geochronology sediment samples for Pb-210 and Cs-137 analyses will be shipped to Mass Spec Services. The samples for geochronology do not need to be stored on ice and may be maintained at room temperature. The persons transferring custody of the sample container will sign the COC form upon transfer of sample possession to the analytical laboratory. When the samples are delivered to the laboratory, the receiver will record the condition of the samples on a sample receipt form. COC forms will be used internally in the laboratory to track sample handling and final disposition.

7 CHEMICAL AND PHYSICAL ANALYTICAL TESTING

Sediment samples will be submitted for chemical and physical analyses. All sediment samples selected for testing will be analyzed for D/Fs, which are the primary chemicals of interest, and PAHs. A subset of samples will be analyzed for the full SMS analyte list (Ecology 1995) including metals, semi-volatile organic compounds (SVOCs), PCBs, TOC, grain size, and moisture content (i.e., total solids). Table 7-1 provides the analyte list and the target laboratory reporting limit (RL) for each analyte for sediment.

The SAPA (Ecology 2008b) specifies sampling and testing protocols for the chemical and physical characterization of sediment. The Washington State and the Dredged Material Management Program (DMMP) User's Manual describes the sampling and testing protocols for dredge sediment characterization (DMMO 2009). Method detection limits will be below the RLs specified in Table 7-1, if technically feasible. To achieve the required RLs, some modifications to the methods may be necessary. These modifications from the specified analytical methods will be provided by the laboratory at the time of establishing the laboratory contract. The modifications must be approved by Ecology prior to implementation. Chemical and physical testing will be conducted at ARI, which is accredited by the National Environmental Laboratories Accreditation Program. All chemical and physical testing will adhere to the most recent PSEP and Dredged Material Management Office (DMMO) analysis protocols and QA/QC procedures (PSEP 1986, and 1997b and c; DMMO 2010). For D/F analysis, the information contained in the Revised Supplemental Information on Polychlorinated Dioxins and Furans for Use in Preparing a Quality Assurance Project Plan (USACE 2010) will be followed.

Geotechnical testing (laboratory and in situ) from borings along the Marine Terminal pierface and in the log pond will be performed in accordance with the ASTM standards and performed either in situ or by ARI depending on the analysis. For geochronology samples, Cs-137 and Pb-210 laboratory testing will be performed in accordance with the ASTM D 3649-06 standard by Mass Spec Services.

In completing chemical analyses for this project, the contract laboratory is expected to meet the following minimum requirements:

- Adhere to the methods outlined in this SAP/QAPP, including methods referenced for each analytical procedure (Table 7-1)
- Deliver hard copy and electronic data as specified
- Meet reporting requirements for deliverables
- Meet turnaround times for deliverables
- Implement QA/QC procedures including data quality objectives (DQOs), laboratory quality control requirements, and performance evaluation testing requirements (Tables 7-2 and 7-3)
- Notify the project QA/QC Manager of any QA/QC problems when they are identified to allow for quick resolution
- Allow laboratory and data audits to be performed, if deemed necessary

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, standard reference materials, laboratory control samples, matrix replicates, matrix spikes, surrogate spikes (for organic analyses), and method blanks. Table 7-2 lists the frequency of analysis for laboratory QC samples and Table 7-3 summarizes the DQOs for precision, accuracy, and completeness.

Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. All samples are diluted and reanalyzed if target compounds are detected at levels that exceed their respective established calibration ranges. Any cleanups will be conducted prior to the dilutions. The QC sample results will be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the QA/QC Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

8 QUALITY ASSURANCE PROJECT PLAN

This section establishes QA objectives and functional activities associated with the sediment sampling to complete the MTCA investigation and plan for future sediment cleanup actions at the Study Area. The methods and QA procedures described in this QAPP will be followed during various data collection activities.

The goal of this QAPP is to ensure that data of sufficiently high quality are generated to support the DQOs. This section describes project management responsibilities, sampling and analytical QA/QC procedures, assessment and oversight, and data reduction, validation, and reporting. This QAPP was prepared following Ecology's SAPA and QAPP guidance documents (Ecology 2004 and 2008c). Analytical QA/QC procedures were also developed based on the analytical protocols and quality assurance guidance of the PSEP and DMMP (PSEP 1986, and 1997b and c; DMMO 2010). The SAPA recommended quality control limits for conventional parameters, organic chemicals, and metals that are presented in Table 7-2.

Field and laboratory activities must be conducted in such a manner that the results meet specified quality objectives and are fully defensible. Guidance for QA/QC is derived from the protocols developed for the PSEP and DMMP (PSEP 1986, and 1997b and c; DMMO 2010), and the USEPA SW-846, the USEPA Contract Laboratory Program (USEPA 1986, 1999, 2004, and 2008).

8.1 Laboratory Quality Control

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, standard reference materials, laboratory control samples, matrix replicates, MS, surrogate spikes (for organic analyses), and method blanks. Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the QA/QC Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

8.1.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used prior to the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. Calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analysis of samples. Continuing calibration verifications (CCV) will be performed daily prior to any sample analysis to track instrument performance. The frequency of CCVs varies with method. For gas chromatograph/mass spectrometer (GC/MS) methods, one CCV will be analyzed every 12 hours. For GC/MS, metals, and inorganic methods, one CCV will be analyzed for every 10 field samples, or daily, whichever is specified in the method. If the ongoing continuing calibration is out of control, the analysis must come to a halt until the source of the control failure is eliminated or reduced to meet control specifications. All project samples analyzed while instrument calibration was out of control will be reanalyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to, or immediately following, CCV at the instrument for each type of applicable analysis.

8.1.2 Laboratory Duplicates and Replicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates and replicates are subsamples of the original sample that are prepared and analyzed as a separate sample.

8.1.3 Matrix Spikes/Matrix Spike Duplicates

Analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing duplicate MS analyses, information on the precision of the method is also provided for organic analyses.

8.1.4 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the method report limit (MRL) of any single target analyte or compound. If a laboratory method blank exceeds this criterion for any analyte or compound, and the concentration of the analyte or compound in any of the samples is less than 5 times the concentration found in the blank (10 times for common contaminants), analyses must stop and the source of contamination must be eliminated or reduced.

8.1.5 Laboratory Control Samples

Laboratory control samples (LCS) are analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The LCS is a matrix-dependent spiked sample prepared at the time of sample extraction along with the preparation of sample and the MSs. The LCS will provide information on the precision of the analytical process, and when analyzed in duplicate, will provide accuracy information as well.

8.1.6 Standard Reference Materials

Standard reference materials (SRM) are analyzed to assess possible matrix affects at all stages of sample preparation and analysis. The SRM is a matrix-matched sample that is carried through all aspects of preparation and analysis as a field sample and has a known concentration of target analytes. Puget Sound SRM will be used for D/F and PCB analyses (DMMO 2012). Performance will be evaluated using the DQOs listed in Table 7-3 and as outlined in in DMMO (2010) and Ecology (2008a).

8.2 Laboratory Data Package

The laboratories will prepare a detailed laboratory data package documenting all activities associated with the sample analyses. The following information will be included in this data package:

- **Project Narrative:** A detailed narrative that describes the samples received, analyses performed, and corrective actions undertaken.

- **Chain-of-Custody Documentation:** Laboratory policy requires that COC documentation be available for all samples received. The COC will document basic sample demographics such as client and project names, sample identification, analyses requested, and special instructions.
- **Data Summary Form:** A tabular listing of concentrations or detection limits for all target analytes. The data summary form will also list other pertinent information such as amount of sample analyzed, dilution factors, sample processing dates, extract cleanups, and surrogate recoveries.
- **QC Summary:** Includes results of all QC analyses, specifically recovery information. LCSs are reported with each batch. Additional QC analyses may include laboratory replicates, MS/MSDs, and SRMs.
- **Instrument Calibration Forms and Raw Data:** Includes initial and continuing calibration summaries and instrument tuning data, laboratory bench sheets, and logbook pages.

8.3 Data Quality Objectives and Criteria

The DQO for this project is to ensure that the data collected are of known and acceptable quality so that the project objectives described above can be achieved. The quality of the laboratory data is assessed by precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. Definitions of these parameters and the applicable QC procedures are given below. Applicable quantitative goals for these data quality parameters are listed or referenced below.

8.3.1 Precision

Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling, and laboratory analysis that includes the following:

- **Repeatability:** The random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions

- **Reproducibility:** The random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material

In the laboratory, *within-batch* precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The *batch-to-batch* precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

Field precision will be evaluated by the collection of field duplicates for chemistry samples at a frequency of 1 in 20 samples. Field chemistry duplicate precision will be screened against a RPD of 50 percent for sediment samples and 35 percent for water samples. However, no data will be qualified based solely on field homogenization duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit (MDL), where the percent error (expressed as RPD) increases. The equation used to express precision is as follows:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2}$$

Where:

RPD = relative percent difference

C_1 = larger of the two observed values

C_2 = smaller of the two observed values

8.3.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. Laboratory-fortified (i.e., matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix.

Accuracy is expressed as percent recovery (%R) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination). Analytical laboratories utilize several QC measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples, and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, either the net, or total, bias can be evaluated in a measurement.

Laboratory accuracy will be evaluated against quantitative matrix spike and surrogate spike recovery performance criteria provided by the laboratory. Accuracy can be expressed as a percentage of the true or reference value, or as a %R in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U) / Csa$$

Where:

%R	= percent recovery
S	= measured concentration in the spiked aliquot
U	= measured concentration in the unspiked aliquot
Csa	= actual concentration of spike added

Field accuracy will be controlled by adherence to sample collection procedures outlined in Section 5.4 of this SAP/QAPP.

8.3.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. Assuming those objectives are met, the samples collected should be considered adequately representative of the environmental conditions they are intended to characterize.

8.3.4 Comparability

Comparability expresses the confidence with which one dataset can be evaluated in relation to another dataset. For this program, comparability of data will be established through the use of standard analytical methodologies and reporting formats, and of common traceable calibration and reference materials.

8.3.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$C = \frac{(\text{Number of acceptable data points}) \times 100}{(\text{Total number of data points})}$$

The DQO for completeness for all components of this project is 100 percent. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

8.3.6 Sensitivity

Analytical sensitivities must be consistent with or lower than the regulated criteria values in order to demonstrate compliance with this SAP. When they are achievable, target reporting limits specified in this SAP/QAPP will be at least a factor of 2 less than the analyte's corresponding regulated criteria value. If reporting limits lower than criteria are not achieved, the QA/QC Manager will work with the laboratory to ensure that, if at all possible, re-analyses are performed and reporting limits lower than criteria are achieved.

The MDL is defined as the minimum concentration at which a given target analyte can be measured and reported with 99 percent confidence that the analyte concentration is greater than 0. Laboratory MDLs will be used to evaluate the method sensitivity or applicability prior to the acceptance of a method for this program. Laboratory RLs are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions for that particular method.

The sample practical quantitation limits (PQLs) will be reported by the laboratory and will take into account any factors relating to the sample analysis that might decrease or increase the reporting limit (e.g., dilution factor, percent moisture, sample volume, sparge volume). In the event that the RL and PQL are elevated for a sample due to matrix interferences and subsequent dilution or reduction in the sample aliquot, causing the SMS criteria to be exceeded, the data will be evaluated by Anchor QEA and the laboratory to determine if an alternative course of action is required or possible. If this situation cannot be resolved readily (i.e., detection limits less than criteria achieved), Ecology will be contacted to discuss an acceptable resolution.

8.4 Data Validation and Verification

Laboratory data will be provided in both PDF and EQuIS electronic format. Once data are received from the laboratory, QC procedures will be followed to provide an accurate evaluation of the data quality. The data will be validated in accordance with the project-specific DQOs (Table 7-3), analytical method criteria, and the laboratory's internal performance standards based on their Standard Operating Procedures. A Stage 2A-level data quality review (equivalent to a QA1 review) will be performed by Anchor QEA (or a subconsultant), in accordance with USEPA National Functional Guidelines (USEPA 2004, 2008, 2009). However, D/F data will be validated at a Stage 4 level (USEPA 2009) by a subconsultant using the DQOs outlined in the SAPA (Ecology 2008b). At a minimum, the following QC procedures will be evaluated for both Stage 2A and Stage 4 levels:

- Data completeness
- Holding times
- Method blanks
- Surrogate recoveries
- Detection limits
- RLs
- LCSs
- MS/MSDs
- SRMs

The results of the data quality review, including text assigning qualifiers in accordance with the USEPA National Functional Guidelines and a tabular summary of qualifiers will be overseen by the QA/QC Manager, who will conduct final review and confirmation of the validity of the data. A copy of the validation report will be submitted by the QA/QC Manager and will be presented as an appendix to the Investigation Report.

Laboratory data, which will be electronically provided and loaded into the database, will undergo a 10 percent check against the laboratory hard copy data. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. The accuracy of all manually entered data will be verified by a second party. Data tables will be exported from EQuIS database to Microsoft Excel tables.

9 INVESTIGATION REPORT

The Investigation Report, prepared by Anchor QEA, will document all activities associated with collecting, compositing, transporting, and chemically analyzing sediment samples. The laboratory data packages will be included as appendices and also submitted in electronic formats. The following will be included in the Investigation Report:

- Summary of all field activities including a description of any deviations from the approved SAP/QAPP
- Locations of sediment sampling stations in state plane coordinates to the nearest foot (Washington North Zone), and in latitude and longitude in degrees and minutes to four decimal places (NAD 83); all vertical elevations of mudline and water surface will be reported to the nearest 0.1 foot
- A project map with actual sampling locations
- A QA/QC narrative for laboratory results
- Summary data results tables
- Presentation of D/F results and summary of comparison of SMS chemical results with SMS criteria, as shown in Table 9-1

Hard copies of field data will be provided with the Investigation Report and laboratory analysis results and associated QA/QC data will be available. Results of the laboratory analyses will be submitted to Ecology in EIM format. The Investigation Report will be submitted to Ecology within 90 days from completion of field sampling activities and receipt of final validated data.

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TABLES

Table 4-1a
Surface Sediment Sample Design

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-01	POBI-SS-01-0-10	1040484	634669	West Bay south of Study Area, near previously sampled location	Nature and extent, and natural recovery evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-02	POBI-SS-02-0-10	1041139	634774	Study Area West Bay, Fiddlehead Marina, near outfalls	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-03	POBI-SS-03-0-10	1041145	635141	Study Area West Bay, near Fiddlehead Marina, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-04	POBI-SS-04-0-10	1040838	635302	Study Area West Bay, near Marine Terminal Berth 1, re-occupy previously sampled location	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-05	POBI-SS-05-0-10	1040390	635121	Study Area West Bay, offshore of Fiddlehead Marina	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-06	POBI-SS-06-0-10	1040939	635557	Study Area West Bay, south of Marine Terminal Berth 1	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-07	POBI-SS-07-0-10	1040397	635564	Study Area West Bay	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-08	POBI-SS-08-0-10	1040020	635554	Study Area West Bay	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-09	POBI-SS-09-0-10	1039485	635507	West Bay west of Study Area, near Garfield Creek	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-10	POBI-SS-10-0-10	1040914	635987	Study Area West Bay, underpier Marine Terminal Berth 1	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-11	POBI-SS-11-0-10	1040459	635941	Study Area West Bay, turning basin	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-12	POBI-SS-12-0-10	1040017	635952	Study Area West Bay	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-13	POBI-SS-13-0-10	1040858	636539	Study Area West Bay, underpier Marine Terminal Berth 3, near outfall, near previously sampled location	Nature and extent, source, and natural recovery evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-14	POBI-SS-14-0-10	1040438	636440	Study Area West Bay	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-15	POBI-SS-15-0-10	1039960	636453	Study Area West Bay	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-16	POBI-SS-16-0-10	1039422	636473	West Bay west of Study Area, near outfall, near former Solid Wood Inc.	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-17	POBI-SS-17-0-10	1040814	637185	Study Area West Bay, underpier Marine Terminal Berth 3 North, near previously sampled location, near historical core BI-C5 that had acenaphthene and mercury SQS exceedance in the 6 - 7 ft interval	Nature and extent, source, and natural recovery evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-18	POBI-SS-18-0-10	1040719	637308	Study Area West Bay, Marine Terminal Berth 3 pierface, near previously sampled location, near historical core BI-C5 that had acenaphthene and mercury SQS exceedance in the 6 - 7 ft interval	Nature and extent, source, and natural recovery evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-19	POBI-SS-19-0-10	1040849	637448	Study Area West Bay, log pond, near previously sampled location, near outfall	Nature and extent, source, and natural recovery evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-20	POBI-SS-20-0-10	1040662	637586	Study Area West Bay, near previously sampled location, north of Marine Terminal Berth 3, west of log pond	Nature and extent, and natural recovery evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-21	POBI-SS-21-0-10	1039986	637529	Study Area West Bay	Nature and extent evaluation	D/Fs, SMS SVOCs, grain size, TS, and TOC	2 - 16-oz jars
SS-22	POBI-SS-22-0-10	1039581	637518	West Bay west of Study Area, near Reliable Steel, Inc.	Nature and extent evaluation	D/Fs, SMS SVOCs, grain size, TS, and TOC	2 - 16-oz jars
SS-23	POBI-SS-23-0-10	1040771	638056	Study Area West Bay, near log pond	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-24	POBI-SS-24-0-10	1040259	638040	Study Area West Bay, navigation channel	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-25	POBI-SS-25-0-10	1039835	638054	Study Area West Bay, re-occupy previously sampled location	Nature and extent, and natural recovery evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-26	POBI-SS-26-0-10	1039544	637999	West Bay west of Study Area, near Hardel Mutual Plywood	Nature and extent evaluation	D/Fs, SMS SVOCs, grain size, TS, and TOC	2 - 16-oz jars
SS-27	POBI-SS-27-0-10	1039446	638609	West Bay west of Study Area, near Hardel Mutual Plywood	Nature and extent evaluation	D/Fs, SMS SVOCs, grain size, TS, and TOC	2 - 16-oz jars
SS-28	POBI-SS-28-0-10	1039851	638672	Study Area West Bay	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-29	POBI-SS-29-0-10	1040085	638440	Study Area West Bay	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-30	POBI-SS-30-0-10	1040825	638531	Study Area north of peninsula	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-31	POBI-SS-31-0-10	1040906	639272	Study Area north of peninsula, near previously sampled location, near outfall	Nature and extent, source, and natural recovery evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	2 - 16-oz jars
SS-32	POBI-SS-32-0-10	1041184	638394	Study Area north of peninsula, near Cascade Pole cleanup site, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-33	POBI-SS-33-0-10	1041337	638563	Study Area north of peninsula, near Cascade Pole cleanup site	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-34	POBI-SS-34-0-10	1041425	639272	Study Area north of peninsula, near Cascade Pole cleanup site	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-35	POBI-SS-35-0-10	1042465	639298	Study Area north of peninsula, near Cascade Pole cleanup site	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-36	POBI-SS-36-0-10	1042995	638191	Study Area East Bay, near breakwater, near Cascade Pole cleanup site	Nature and extent, and source evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-37	POBI-SS-37-0-10	1043607	638404	East Bay eastern shoreline, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-38	POBI-SS-38-0-10	1042940	637674	Study Area East Bay, Swantown Marina north	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-39	POBI-SS-39-0-10	1043735	637696	East Bay eastern shoreline, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-40	POBI-SS-40-0-10	1042750	637375	Study Area East Bay, Swantown Marina north, near peninsula shoreline, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-41	POBI-SS-41-0-10	1042946	637431	Study Area East Bay, Swantown Marina north	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-42	POBI-SS-42-0-10	1043223	637313	Study Area East Bay, Swantown Marina central, near navigation channel	Nature and extent evaluation	D/Fs, PAHs grain size, TS, and TOC	2 - 16-oz jars
SS-43	POBI-SS-43-0-10	1043052	637092	Study Area East Bay, Swantown Marina central	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-44	POBI-SS-44-0-10	1043605	637096	East Bay eastern shoreline, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-45	POBI-SS-45-0-10	1043080	636796	Study Area East Bay, Swantown Marina south	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-46	POBI-SS-46-0-10	1043757	636697	East Bay eastern shoreline, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-47	POBI-SS-47-0-10	1043101	636427	Study Area East Bay, Swantown Marina south	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-48	POBI-SS-48-0-10	1043088	636201	Study Area East Bay, south of Swantown Marina	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-49	POBI-SS-49-0-10	1043398	636213	Study Area East Bay, navigation channel	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-50	POBI-SS-50-0-10	1043847	636281	East Bay eastern shoreline, near outfalls	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-51	POBI-SS-51-0-10	1042976	635926	Study Area East Bay, near Swantown service dock	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-52	POBI-SS-52-0-10	1043275	635933	Study Area East Bay, near Swantown service dock	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-53	POBI-SS-53-0-10	1043348	635518	Study Area East Bay, near peninsula shoreline, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-54	POBI-SS-54-0-10	1043738	635567	East Bay, east of Study Area	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-55	POBI-SS-55-0-10	1043984	635689	East Bay eastern shoreline, near outfalls	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-56	POBI-SS-56-0-10	1043356	635149	Study Area East Bay, near peninsula shoreline	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-57	POBI-SS-57-0-10	1043901	634915	East Bay eastern shoreline, near outfalls	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
SS-58	POBI-SS-58-0-10	1043395	634699	Study Area East Bay, near peninsula shoreline	Nature and extent evaluation	D/Fs, PAHs, grain size, TS, and TOC	2 - 16-oz jars
SS-59	POBI-SS-59-0-10	1043382	634338	Study Area East Bay, near peninsula shoreline, near outfall	Nature and extent, and source evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar

Location ID	Sample ID	X Coordinate	Y Coordinate	Sample Location Description	Purpose	Analyses[a]	Archive
SS-60	POBI-SS-60-0-10	1043551	634239	East Bay, re-occupy previously sampled location, near Moxlie Creek outfall	Nature and extent, source, and natural recovery evaluation	D/Fs and SMS chemicals, grain size, TS, and TOC	1 - 8-oz jar
CP-21[b]	To be provided with the results	1041996	638165	Cascade Pole shoreline, near outfall	Nature and extent, and source evaluation for D/Fs	D/Fs	NA
CP-29[b]	To be provided with the results	1042933	637844	Study Area East Bay, Swantown Marina north	Nature and extent evaluation	D/Fs	NA
CP-34[b]	To be provided with the results	1043159	638124	Study Area East Bay, navigation channel	Nature and extent evaluation	D/Fs	NA

Notes:
All surface sediment grabs will be collected using a grab sampler by collecting sediment from the top 10 cm from within the sampler
a. See Table 5-1 for container type and size.
b. Samples were collected and analyzed by the Port in January 2013; the D/F results from these samples will be included in the data report.
D/F = dioxin and furan
ft = feet
PAHs = polycyclic aromatic hydrocarbons
NA = not applicable
oz = ounce
SMS = Sediment Management Standards
SQS = Sediment Quality Standard
TOC = total organic carbon
TS = total solids

Table 4-1b
Subsurface Sediment Sample Design

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-01	1040215	635259	Study Area West Bay, near previously sampled location	0	-8	8	10	0 - 0.5 0.5 - 1.0 1.0 - 1.5 1.5 - 2.0 2 - 3 (X) 3 - 4 (X) 4 - 6 6 - 8 (X) 8 - 10 10 - 12 (X)	6	0	4	The 0.5-ft sample intervals will be sampled to pair with geochronology results from GC-01 for the top 2 ft, 1-ft sample intervals from 2 to 5 ft, and 2-ft sample intervals from 4 to 10 ft to evaluate the vertical extent of D/F chemical contamination and natural recovery trends. At depth the 4 - 6 ft and 8 - 10 ft intervals will be analyzed. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-02	1040790	635272	Study Area West Bay, near previously sampled location	-17	-24	6	10	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X) 4 - 5 (X) 5 - 6 6 - 7 7 - 8 (X) 8 - 9 (X) 9 - 10 (X)	2	0	8	The 5 - 6 ft and 6 - 7 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-03	1040931	635560	Study Area West Bay, south of Marine Terminal, near outfall	-18	-18	NA	12	0 - 2 2 - 4 4 - 6 6 – 8 (X) 8 - 10 (X) 10 – 12 (X)	3	3	3	The 0 – 2 ft, 2 - 4 ft and 4 - 6 ft intervals analyzed to evaluate vertical extent of D/F and SMS contamination near outfall. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-04	1040858	635711	Study Area West Bay, pierface Marine Terminal Berth 1 within proposed 2013/2014 dredge area	-35	-42	7	14	7 - 9 (X) 9 - 11 (Z) 11 - 13 (X)	1	0	2	Core collected with proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -44 to -46 ft MLLW. Dredge depth anticipated to be -42 ft MLLW with up to 2 ft of overdredge (to -44-ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth. The 2-ft intervals above and below the z-layer will be archived.

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-05	1040492	635687	Study Area West Bay, turning basin	-31	-34	3	6	0 - 1 (X) 1 - 2 (X) 2 - 3 3 - 4 4 - 5 (X) 5 - 6 (X)	2	0	4	The 2 - 3 ft and 3 - 4 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-06	1040908	635876	Study Area West Bay, underpier Marine Terminal Berth 1	-6	NA	NA	10	0 - 0.5 0.5 - 1.0 1.0 - 1.5 1.5 - 2.0 2 - 4 (X) 4 - 6 6 - 8 (X) 8 - 10 (X)	5	0	3	The 0.5-ft sample intervals will be sampled to pair with geochronology results from GC-02 for the top 2 ft and 2-ft sample intervals from 2 to 10 ft evaluate the vertical extent of D/F chemical contamination and natural recovery trends
SC-07	1040862	635880	Study Area West Bay, pierface Marine Terminal Berths 1 and 2 within proposed 2013/2014 dredge area	-30	-42	12	16	12 - 14 (X) 14 - 16 (Z)	1	0	1	Core collected with proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -44 to -46 ft MLLW. Dredge depth anticipated to be -42 ft MLLW with up to 2 ft of overdredge (to -44 ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth. The interval above the z-layer will be archived.
SC-08	1040795	635868	Study Area West Bay, berth area Marine Terminal Berths 1 and 2 within proposed 2013/2014 dredge area	-37	-40	3	8	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 5 (Z) 5 - 6 (X) 6 - 7 (X) 7 - 8 (X)	1	0	6	Core collected with proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -40 to -42 ft MLLW. Dredge depth anticipated to be -38 ft MLLW with up to 2 ft of overdredge (to -40 ft MLLW). A 2-ft sample interval will be collected and analyzed to the anticipated z-layer depth. The 1-ft intervals above below the z-layer will be archived.
SC-09	1040163	636024	Study Area West Bay, turning basin	-27	-34	7	10	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X) 4 - 5 (X) 5 - 6 (X) 6 - 7 7 - 8 8 - 9 (X) 9 - 10 (X)	2	0	8	The 6 - 7 ft and 7 - 8 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-10	1040842	636115	Study Area West Bay, pierface Marine Terminal Berths 1 and 2 within proposed 2013/2014 dredge area	-33	-42	9	14	9 - 11 (X) 11 - 13 (Z) 13 - 14 (X)	1	0	2	Core collected with proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -44 to -46 ft MLLW. Dredge depth anticipated to be -42 ft MLLW with up to 2 ft of overdredge (to -44 ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth. The 2-ft interval above and the 1-ft interval below the z-layer will be archived.
SC-11	1040883	636116	Study Area West Bay, underpier Marine Terminal Berths 1 and 2	-13	NA	NA	12	0 - 2 (X) 2 - 4 4 - 6 (X) 6 - 8 8 - 10 (X) 10 - 12 (X)	2	2	4	The 2 - 4 ft and 6 - 8 ft intervals analyzed to evaluate vertical extent of D/F and SMS contamination under the pier. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-12[b]	1040892	636402	Study Area West Bay, underpier Marine Terminal Berth 2	1	NA	NA	12	0 - 2 (X) 2 - 4 4 - 6 (X) 6 - 8 8 - 10 (X) 10 - 12 (X)	2	2	4	The 2 - 4 ft and 6 - 8 ft intervals analyzed to evaluate vertical extent of D/F and SMS contamination under the pier. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-13	1040819	636402	Study Area West Bay, pierface Marine Terminal Berth 2 within proposed 2013/2014 dredge area	-38	-42	4	10	4 - 6 (X) 6 - 8 (Z) 8 - 9 (X) 9 - 10 (X)	1	0	3	Core collected in proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -44 to -46 ft MLLW. Dredge depth anticipated to be -42 ft MLLW with up to 2 ft of overdredge (to -44 ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth. The 2-ft interval above and the 1-ft intervals below the z-layer will be archived.
SC-14	1039416	636507	Outside of Study Area West Bay, western shoreline near outfall	3	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-15	1040812	636586	Study Area West Bay, pierface Marine Terminal Berth 2 within proposed 2013/2014 dredge area	-35	-42	7	14	7 - 9 (X) 9 - 11 (Z) 11 - 12 (X) 12 - 13 (X) 13 - 14 (X)	1	0	4	Core collected with proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -44 to -46 ft MLLW. Dredge depth anticipated to be -42 ft MLLW with up to 2 ft of overdredge (to -44 ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth. The 2 ft interval above and the 1 ft intervals below the z-layer will be archived.

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-16	1040126	636615	Study Area West Bay, turning basin	-28	-33	5	8	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X) 4 - 5 5 - 6 6 - 7 (X) 7 - 8 (X)	2	0	6	The 4 - 5 ft and 5 - 6 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-17	1040842	636868	Study Area West Bay, underpier Marine Terminal Berth 3 South	-6	NA	NA	12	0 - 2 (X) 2 - 4 4 - 6 (X) 6 - 8 8 - 10 (X) 10 - 12 (X)	2	2	4	The 2 - 4 ft and 6 - 8 ft intervals analyzed to evaluate vertical extent of D/F and SMS contamination under the pier. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-18	1040780	636949	Study Area West Bay, pierface Marine Terminal Berth 3 South within proposed 2013/2014 dredge area	-38	-42	4	14	4 - 6 (X) 6 - 8 (Z) 8 - 9 (X) 9 - 10 (X)	1	0	3	Core collected in proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -44 to -46 ft MLLW. Dredge depth anticipated to be -42 ft MLLW with up to 2 ft of overdredge (to -44 ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth. The 2-ft interval above and the 1-ft intervals below the z-layer will be archived.
SC-19[b]	1040820	637150	Study Area West Bay, underpier Marine Terminal Berth 3 North	-2	NA	NA	12	0 - 2 (X) 2 - 4 4 - 6 (X) 6 - 8 8 - 10 (X) 10 - 12 (X)	2	2	4	Near historical acenaphthene and mercury SQS exceedance in the 6 - 7 ft interval of core BI-C5. The 2 - 4 ft and 6 - 8 ft intervals analyzed to evaluate vertical extent of D/F and SMS contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-20	1040777	637123	Study Area West Bay, pierface Marine Terminal Berth 3 North within proposed 2013/2014 dredge area	-27	NA	NA	16	11 - 13 (X) 13 - 15 (Z) 15 - 16 (X)	1	0	2	Core collected along northern slope of proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer). Anticipated slope cut elevation is -38 ft MLLW with up to 2-ft overdredge (to -40 ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth (-40 to -42 ft MLLW). A 2-ft interval above and the 1-ft interval below the z-layer will be archived.
SC-21	1040388	637318	Study Area West Bay, turning basin	-31	-33	2	6	0 - 1 (X) 1 - 2 2 - 3 3 - 4 (X) 4 - 5 (X) 5 - 6 (X)	2	0	4	The 1 - 2 ft and 2 - 3 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-22	1040766	637246	Study Area West Bay, pierface Marine Terminal Berth 3 North	-26	-42	16	16	0 - 2 (X) 2 - 4 (X) 4 - 6 (X) 6 - 8 8 - 10 (X) 10 - 12 12 - 14 (X) 14 - 16	3	3	5	Near historical acenaphthene and mercury SQS exceedance in the 6 - 7 ft interval of core BI-C5. The 6 - 8 ft, 10 - 12 ft, and 14 - 16 ft intervals analyzed to evaluate vertical extent of D/F and SMS contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-23[b]	1040800	637254	Study Area West Bay, underpier Marine Terminal Berth 3 North	-9	NA	NA	12	0 - 2 (X) 2 - 4 (X) 4 - 6 (X) 6 - 8 8 - 10 10 - 12 (X)	2	2	4	Near historical acenaphthene and mercury SQS exceedance in the 6 - 7 ft interval of core BI-C5. The 6 - 8 ft and 8 - 10 ft intervals analyzed to evaluate vertical extent of D/F and SMS contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-24	1040916	637452	Study Area West Bay, log pond, near previously sampled location, near outfall	-7	NA	NA	8	0 - 1 (X) 1 - 2 (X) 2 - 3 3 - 4 4 - 5 (X) 5 - 6 (X) 6 - 7 (X) 7 - 8 (X)	2	0	6	The 2 - 3 ft and 3 - 4 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-25	1040431	637837	Study Area West Bay, navigation channel	-32	-35	3	6	0 - 1 (X) 1 - 2 (X) 2 - 3 3 - 4 4 - 5 (X) 5 - 6 (X)	2	0	4	The 2 - 3 ft and 3 - 4 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-26	1040896	637876	Study Area West Bay, log pond	-9	NA	NA	8	0 - 1 (X) 1 - 2 (X) 2 - 3 3 - 4 4 - 5 (X) 5 - 6 (X) 6 - 7 (X) 7 - 8 (X)	2	0	6	The 2 - 3 ft and 3 - 4 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-27	1040483	638460	Study Area north of peninsula	-33	-36	3	6	0 - 1 (X) 1 - 2 (X) 2 - 3 3 - 4 4 - 5 (X) 5 - 6 (X)	2	0	4	The 2 - 3 ft and 3 - 4 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-28	1040470	639044	Study Area West Bay, navigation channel	-33	-36	3	6	0 - 1 (X) 1 - 2 (X) 2 - 3 3 - 4 4 - 5 (X) 5 - 6 (X)	2	0	4	The 2 - 3 ft and 3 - 4 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-29	1040859	638855	Study Area north of peninsula	-1	NA	NA	4	0 - 1 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	1	0	3	Top interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-30	1041160	638941	Study Area north of peninsula, near Cascade Pole cleanup site	1	NA	NA	4	0 - 1 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	1	0	3	Top interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-31	1040868	639243	Study Area north of peninsula, near previously sampled location, near outfall	-4	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-32	1042413	639266	Study Area north of peninsula, near Cascade Pole cleanup site	-3	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-33	1043617	638360	Outside of Study Area East Bay, eastern shoreline near outfall	4	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-34	1043161	638309	Study Area East Bay, East Bay navigation channel	-16	-18	2	4	0 - 1 (X) 1 - 2 2 - 3 (X) 3 - 4 (X)	1	0	3	1 - 2 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-35	1042910	638110	Study Area East Bay, East Bay navigation channel near launch ramp	-12	-14	2	4	0 - 1 (X) 1 - 2 2 - 3 (X) 3 - 4 (X)	1	0	3	The 1 - 2 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-36	1042712	637959	Study Area East Bay, East Bay navigation channel near launch ramp	-9	-12	3	6	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 4 - 5 (X) 5 - 6 (X)	1	0	5	The 3 - 4 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-37	1042919	637430	Study Area East Bay, Swantown Marina	-13	-15	2	4	0 - 1 (X) 1 - 2 (X) 2 - 3 3 - 4 (X)	1	0	3	The 2 - 3 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-38	1043728	637649	Outside of Study Area East Bay, eastern shoreline near outfall	9	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-39	1043313	637283	Study Area East Bay, East Bay navigation channel	-14	-18	4	10	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X) 4 - 5 5 - 6 (X) 6 - 8 (X) 8 - 10 (X)	1	0	7	The 4 - 5 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-40	1043613	637046	Outside of Study Area East Bay, eastern shoreline near outfall	4	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-41	1043053	636794	Study Area East Bay, south of Swantown Marina	-12	-16	4	5	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 4 - 5 (X)	1	0	4	The 3 - 4 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-42	1043886	636240	Outside of Study Area East Bay, eastern shoreline near outfall	10	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-43	1043395	636236	Study Area East Bay, East Bay navigation channel	-12	-16	4	6	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 4 - 5 5 - 6 (X)	2	0	4	The 3 - 4 ft and 4 - 5 ft intervals analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Most Recent mudline elevation (ft MLLW)	Historical Dredge Depth/Native Alluvium elevation (ft MLLW)	Estimated accumulated sediment since last dredge event (ft)	Target core penetration depth (ft)[a]	Sample Intervals (X = archive) (Z = z-sample)	Sample Count			Purpose and Analyses
									D/F and Conventionals	SMS	Archive	
SC-44	1042993	635977	Study Area East Bay, Swantown Boatworks	-11	-12	1	4	0 - 1 (X) 1 - 2 2 - 3 (X) 3 - 4 (X)	1	0	3	The 1 - 2 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-45	1043305	635979	Study Area East Bay, Swantown Boatworks	-11	-15	4	5	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 4 - 5 (X)	1	0	4	The 3 - 4 ft interval analyzed to evaluate vertical extent of D/F contamination. Additional sample intervals may be analyzed depending on the results of the analyzed interval.
SC-46	1043239	635686	Study Area East Bay, in Swantown Boat haulout proposed 2013/2014 dredge area	-6	-14	8	14	6 - 8 (X) 8 - 10 (Z) 10 - 11 (X) 11 - 12 (X)	1	0	3	Core collected with proposed 2013/2014 dredge area to evaluate new sediment surface (z-layer) at -14 to -16. Dredge depth anticipated to be -12 ft MLLW with up to 2-ft of over2 ft of overdredge (to -14 ft MLLW). A 2-ft sample interval will be collected and analyzed from the anticipated z-layer depth. The 2-ft intervals above and below the z-layer will be archived.
SC-47	1043356	635462	Study Area East Bay, adjacent to southern extent of peninsula shoreline	10	NA	NA	8	0 - 1 1 - 2 2 - 3 (X) 3 - 4 (X) 4 - 6 (X) 6 - 8 (X)	2	2	4	Top two intervals analyzed to evaluate vertical extent of D/F and SMS contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-48	1043871	634889	Outside of Study Area East Bay, eastern shoreline near outfall	9	NA	NA	4	0 - 1 (X) 1 - 2 (X) 2 - 3 (X) 3 - 4 (X)	0	0	4	Core co-located with grab sample. 1-ft sample intervals will be archived. Sample analysis to further evaluate the vertical extent of contamination is dependent on the results of the surface grab sample.
SC-49	1043410	634657	Study Area East Bay, adjacent to southern extent of peninsula shoreline	-6	NA	NA	8	0 - 1 1 - 2 2 - 3 (X) 3 - 4 (X) 4 - 6 (X) 6 - 8 (X)	2	2	4	Top two intervals analyzed to evaluate vertical extent of D/F and SMS contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.
SC-50	1043486	634216	Study Area East Bay, near Moxlie Creek outfall	8	NA	NA	10	0 - 1 1 - 2 2 - 3 3 - 4 (X) 4 - 6 (X) 6 - 8 (X) 8 - 10 (X)	3	3	4	Top three intervals analyzed to evaluate vertical extent of D/F and SMS contamination. Additional sample intervals may be analyzed depending on the results of the analyzed intervals.

Notes:

a. All sediment cores will be collected using a vibracore, which has a maximum penetration depth of 16 ft (15ft core).
b. Cores SC-12, SC-19, and SC-23 may be potentially located in the vicinity of riprap under the pier. These locations may be moved down slope below the toe of the riprap, unless adequate sediment can be collected on top of the riprap, depending on the depth that core refusal is reached.

D/F = dioxin and furan
ft = feet
MLLW = mean lower low water
NA = not available
SMS = Sediment Management Standards
X = archive sample interval
Z = z-sample interval

Table 4-1c
Sample Design for Geotechnical Data

Location ID	Northing	Easting	Approx. Depth (ft bgs)	Sample Count[a]	Range of Sample Intervals[b] (ft)	Moisture Content	Specific Gravity	Grain Size	Hydro-meter	Atterberg Limits	CU-TX	UU-TX	One-Dimensional Oedometer	Rationale for Proposed Boring and Tests
						SS/ST	SS/ST	SS	SS	ST	ST	ST	ST	
Soil Borings														
SB-1	1040799	635874	50	up to 15	2.5 – 10	15	2	3	3	3	0	2	2	To characterize the in-water subsurface conditions along potential sheet pile toe wall alignment
SB-2	1040741	636603	50	up to 15	2.5 – 10	15	2	3	3	3	2	0	2	To characterize the in-water subsurface conditions along potential sheet pile toe wall alignment
SB-3	1040683	637275	50	up to 15	2.5 – 10	15	2	3	3	3	2	2	4	To characterize the in-water subsurface conditions along potential sheet pile toe wall alignment
SB-4	1041134	637455	100	up to 30	2.5 – 10	30	2	4	4	4	2	2	4	To characterize the upland subsurface conditions at deeper depths for NCDF design and obtain blow counts for seismic site classification and design
SB-5	1040971	637681	50	up to 15	2.5 – 10	15	2	3	3	3	0	2	2	To characterize the in-water subsurface conditions for NCDF design
SB-6	1040752	637893	100	up to 30	2.5 – 10	30	2	4	4	4	2	2	4	To characterize the in-water subsurface conditions at deeper depths for NCDF design and obtain blow counts for seismic site classification and design
SB-7	1041099	637955	50	up to 15	2.5 – 10	15	2	3	3	3	2	0	2	To characterize the upland subsurface conditions for NCDF design
SB-8	1040869	638208	50	up to 15	2.5 – 10	15	2	3	3	3	2	2	2	To characterize the in-water subsurface conditions for NCDF design
Cone Penetration Tests														
CPT-1	1040918	635962	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To further characterize the under pier slope at the Marine Terminal
CPT-2	1040870	636497	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To further characterize the under pier slope at the Marine Terminal
CPT-3	1041168	637518	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To further characterize the under pier slope at the Marine Terminal
Vane Shear Tests														
VST-1	1040790	635272	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-2	1040215	635259	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-3	1039986	637529	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-4	1039886	637997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-5	1039994	638936	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-6	1040771	638056	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-7	1040825	638531	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered

Location ID	Northing	Easting	Approx. Depth (ft bgs)	Sample Count[a]	Range of Sample Intervals[b] (ft)	Moisture Content	Specific Gravity	Grain Size	Hydro-meter	Atterberg Limits	CU-TX	UU-TX	One-Dimensional Oedometer	Rationale for Proposed Boring and Tests
						SS/ST	SS/ST	SS	SS	ST	ST	ST	ST	
VST-8	1040906	639272	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-9	1042993	635977	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered
VST-10	1043356	635462	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	To evaluate cap bearing capacity and stability of sediment where in situ capping may be considered

Notes:
a. Actual number of samples is dependent on depth of boring soil types encountered
b. Sample spacing will be 2.5 to 5 ft for sampling with standard split-spoon except where stratigraphic changes are encountered. Shelby tube sampling will be every 10 ft
bgs = below ground surface
CU-TX = consolidated-undrained tri-axial compression test
ft = feet
NA = not applicable
NCDF= nearshore confined disposal facility
SS = standard split-spoon sampler
ST = Shelby tube
UU-TX = unconsolidated-undrained tri-axial compression test

Table 4-1d
Geochronology Sample Design

Location ID	X Coordinate	Y Coordinate	Sample Location Description	Existing mudline elevation (ft MLLW)	Historical Elevation Native Alluvium (ft MLLW)	Assumed Sedimentation Rate	Target core penetration depth	Analysis Depth Rationale	Sample Collection/Analyses
POBI-GC-01	1040095	635121	Study Area West Bay south	-0.52	-0.21	2 cm/yr	6 ft (190 cm)	Assuming a deposition rate of 2 cm/yr since 1963 (50 yrs), the Cs-137 peak is anticipated to be approximately 100 cm below mudline	Samples will be collected the entire depth of the core in 2-cm increments. Every third sample segment[a] of the sediment core to 100 cm will be tested for Pb-210 and Cs-137, TOC, and total solids. All other sample segments will be archived.
POBI-GC-02	1040925	635829	Study Area West Bay, underpier Marine Terminal Berth 1	0.91	-27.32b	4 cm/yr	7 ft (220 cm)	Assuming a deposition rate of 4 cm/yr since 1963 (50 yrs), the Cs-137 peak is anticipated to be approximately 200 cm below mudline	Samples will be collected the entire depth of the core in 2-cm increments. Every third sample segment[a] of the sediment core to 200 cm will be tested for Pb-210 and Cs-137, TOC, and total solids. All other sample segments will be archived.
POBI-GC-03	1039841	639152	Study Area West Bay north	-6.33	-7.71	1 cm/yr	3 ft (90 cm)	Assuming a deposition rate of 1 cm/yr since 1963 (50 yrs), the Cs-137 peak is anticipated to be approximately 50 cm below mudline	Samples will be collected the entire depth of the core in 2-cm increments. Every third sample segment[a] of the sediment core to 50 cm will be tested for Pb-210 and Cs-137, TOC, and total solids. All other sample segments will be archived.
POBI-GC-04	1043539	635539	Study Area East Bay, between Swantown Marina and Swantown Boatworks	-12.66	-7.5[b]	1 cm/yr	3 ft (90 cm)	Assuming a deposition rate of 1 cm/yr since 1963 (50 yrs), the Cs-137 peak is anticipated to be approximately 50 cm below mudline	Samples will be collected the entire depth of the core in 2-cm increments. Every third sample segment[a] of the sediment core to 50 cm will be tested for Pb-210 and Cs-137, TOC, and total solids. All other sample segments will be archived.

a. Third increment (e.g., 0-2 cm, 6-8 cm, 12-14 cm, etc.)
b. Elevations were interpolated using nearby bathymetry
MLLW = mean lower low water
cm = centimeter
Cs-137 = cesium-137
ft = feet
Pb-210 = lead-210
TOC = total organic carbon
yr = year

Table 5-1
Guidelines for Sample Handling and Storage

Parameter	Container Size and Type[a]	Holding Time	Preservative
Metals	4-oz glass jar	6 months; 28 days for Hg	Cool/4°C
		3 years; 28 days for Hg	Freeze[b]/-18°C
Semivolatile organic compounds and Polychlorinated Biphenyls	8-oz glass jar	14 days until extraction	Cool/4°C
		1 year until extraction	Freeze/-18°C
		40 days after extraction	Cool/4°C
Dioxins and furans	8-oz amber glass jar	1 year until extraction	Freeze -18°C
		1 year after extraction	Freeze -18°C
Polycyclic aromatic hydrocarbons	dioxin furan jar	14 days until extraction	Cool/4°C
		1 year until extraction	Freeze/-18°C
		40 days after extraction	Cool/4°C
Total solids and total organic carbon	8-oz glass jar	14 days	Cool/4°C
		6 months	Freeze -18°C
Grain size	16-oz glass or plastic jar	none	none
Specific gravity	8-oz glass or plastic jar	none	none
Atterberg limits	8-oz glass or plastic jar	none	none
Moisture content	8-oz glass or plastic jar	none	none
Bulk density	3-in diameter Shelby tube	none	none
Consolidated undrained tri-axial testing	3-in diameter Shelby tube	none	none
Unconsolidated undrained tri-axial testing	3-in diameter Shelby tube	none	none
One dimensional consolidation	3-in diameter Shelby tube	none	none
Cesium-137 and Lead-210	4-oz glass jar	1 year	none
Archive	8 or 16-oz glass jar[c]	14 days until extraction	Cool/4°C
		1 year until extraction	Freeze/-18°C

Notes:
a. All sample containers will have lids with Teflon® inserts
b. Samples will be analyzed for mercury before freezing
c. Container size depends on available amount of extra sediment; at a minimum 8 ounces will be archived, and as much as 32 ounces at locations with limited testing

°C = degrees Celsius
in = inch
oz = ounce

Table 7-1
Analyte List, Analytical Methods, and Reporting Limits

Parameter	Analytical Method	Reference	Reporting Limit
Conventional parameters, %			
Grain size[a]			
Gravel	sieve/hydrometer or sieve/pipette	ASTM D421/422or PSEP 1986	0.1
Sand	sieve/hydrometer or sieve/pipette	ASTM D421/422or PSEP 1986	0.1
Silt	sieve/hydrometer or sieve/pipette	ASTM D421/422or PSEP 1986	0.1
Clay	sieve/hydrometer or sieve/pipette	ASTM D421/422or PSEP 1986	0.1
Fines	sieve/hydrometer or sieve/pipette	ASTM D421/422or PSEP 1986	0.1
Total solids	oven-dried	PSEP 1986 or ASTM D2216	0.1
Total organic carbon	combustion	Plumb 1981	0.1
Metals, mg/kg dry weight			
Arsenic	ICP-AES or ICP-MS	6010B/6020	10
Cadmium	ICP-AES or ICP-MS	6010B/6020	0.5
Chromium	ICP-AES or ICP-MS	6010B/6020	10
Copper	ICP-AES or ICP-MS	6010B/6020	10
Lead	ICP-AES or ICP-MS	6010B/6020	4
Mercury	CVAA	7471A	0.05
Silver	ICP-AES or ICP-MS	6010B/6020	0.6
Zinc	ICP-AES or ICP-MS	6010B/6020	15
Polycyclic aromatic hydrocarbons, µg/kg dry weight			
Naphthalene	GC/MS	8270D	20
Acenaphthylene	GC/MS	8270D	20
Acenaphthene	GC/MS	8270D	20
Fluorene	GC/MS	8270D	20
Phenanthrene	GC/MS	8270D	20
Anthracene	GC/MS	8270D	20
2-Methylnaphthalene	GC/MS	8270D	20
Fluoranthene	GC/MS	8270D	20
Pyrene	GC/MS	8270D	20
Benzo(a)anthracene	GC/MS	8270D	20
Chrysene	GC/MS	8270D	20

Parameter	Analytical Method	Reference	Reporting Limit
Total benzo(b+j+k)fluoranthenes	GC/MS	8270D	40
Benzo(a)pyrene	GC/MS	8270D	20
Indeno(1,2,3-cd)pyrene	GC/MS	8270D	20
Dibenz(a,h)anthracene	GC/MS	8270D/SIM	5
Benzo(g,h,i)perylene	GC/MS	8270D	20
Volatile Organic Compounds, µg/kg dry weight			
1,4-Dichlorobenzene	GC/MS	8270D/SIM	5
1,2-Dichlorobenzene	GC/MS	8270D/SIM	5
1,2,4-Trichlorobenzene	GC/MS	8270D/SIM	5
Hexachlorobenzene	GC/MS	8270D/SIM	5
Phthalates, µg/kg dry weight			
Dimethyl phthalate	GC/MS	8270D/SIM	5
Diethyl phthalate	GC/MS	8270D/SIM	5
Di-n-butyl phthalate	GC/MS	8270D	20
Butyl benzyl phthalate	GC/MS	8270D/SIM	5
Bis(2-ethylhexyl) phthalate	GC/MS	8270D	25
Di-n-octyl phthalate	GC/MS	8270D	20
Phenols, µg/kg dry weight			
Phenol	GC/MS	8270D/SIM	5
2-Methylphenol	GC/MS	8270D/SIM	5
4-Methylphenol	GC/MS	8270D/SIM	10
2,4-Dimethylphenol	GC/MS	8270D/SIM	20
Pentachlorophenol	GC/MS	8270D/SIM	50
Miscellaneous Extractables, µg/kg dry weight			
Benzyl Alcohol	GC/MS	8270D	20
Benzoic Acid	GC/MS	8270D	400
Dibenzofuran	GC/MS	8270D	20
Hexachlorobutadiene	GC/MS	8270D	20
N-Nitrosodiphenylamine	GC/MS	8270D	20
PCBs, µg/kg dry weight			
Polychlorinated biphenyls	GC/ECD	8082	20
Dioxin/furans, ng/kg dry weight			
Dioxins			
2,3,7,8-TCDD	HRGC/HRMS	1613B	1
1,2,3,7,8-PeCDD	HRGC/HRMS	1613B	1

Parameter	Analytical Method	Reference	Reporting Limit
1,2,3,4,7,8-HxCDD	HRGC/HRMS	1613B	2.5
1,2,3,6,7,8-HxCDD	HRGC/HRMS	1613B	2.5
1,2,3,7,8,9-HxCDD	HRGC/HRMS	1613B	2.5
1,2,3,4,6,7,8-HpCDD	HRGC/HRMS	1613B	2.5
OCDD	HRGC/HRMS	1613B	5
Furans			
2,3,7,8-TCDF	HRGC/HRMS	1613B	1
1,2,3,7,8-PeCDF	HRGC/HRMS	1613B	2.5
2,3,4,7,8,-PeCDF	HRGC/HRMS	1613B	1
1,2,3,4,7,8-HxCDF	HRGC/HRMS	1613B	2.5
1,2,3,6,7,8-HxCDF	HRGC/HRMS	1613B	2.5
1,2,3,7,8,9-HxCDF	HRGC/HRMS	1613B	2.5
2,3,4,6,7,8-HxCDF	HRGC/HRMS	1613B	2.5
1,2,3,4,6,7,8-HpCDF	HRGC/HRMS	1613B	2.5
1,2,3,4,7,8,9-HpCDF	HRGC/HRMS	1613B	2.5
OCDF	HRGC/HRMS	1613B	5
Geotechnical			
Atterberg limits (%)	NA	ASTM D 4318	0.1
Specific gravity	pycnometer	ASTM D 854	0.01
Bulk density (g/cc)	NA	ASTM D 2937	0.1
Grain size	sieve/hydrometer	ASTM D421/422	0.1
Moisture content	NA	ASTM D 2216	0.1
CU tri-axial testing	NA	ASTM D 4767	NA
UU tri-axial testing	NA	ASTM D-2850	NA
One dimensional consolidation	NA	ASTM D 2435	NA
Geochronology			
Lead-210 (pCi/g)	Radiochemical isolation/beta assay of Bi-210 daughter product	ASTM D 3649 - 06	0.2
Cesium-137 (pCi/g)	Direct gamma spectral analysis	ASTM D 3649 - 06	0.2
Total solids	oven-dried	PSEP 1986 or ASTM D2216	0.1
Total organic carbon	combustion	Plumb 1981	0.1

Notes:

a. Grain size will be performed by PSEP method for all sediment management standard chemistry samples, and ASTM D421/422 for all geotechnical samples

µg/kg = micrograms per kilogram

ASTM = American Society for Testing and Materials

CU = consolidated undrained

CVAA = cold vapor atomic absorption

g/cc = gram per cubic centimeter
GC/ECD = gas chromatography/electron capture detection
GC/MS = gas chromatography/mass spectrometry
HRGC/HRMS = high-resolution gas chromatography/high-resolution mass spectrometry
ICP-AES = inductively coupled plasma-atomic emission spectrometry
ICP-MS = inductively coupled plasma-mass spectrometry
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
pCi/g dw = picocurie per gram
PSEP = Puget Sound Estuary Program
UU = unconsolidated undrained

Table 7-2

Field and Laboratory Quality Assurance/Quality Control Sample Analysis Summary for Sediment and Soil

Analysis Type	Field Duplicate	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	SRM/LCS	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Grain size	NA	Each batch[a]	NA	NA	NA	NA	NA	NA	NA
Total solids	1 per 20 samples	Each batch[a,b]	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total organic carbon	1 per 20 samples	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Metals	1 per 20 samples	Daily	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Dioxin/Furans	1 per 20 samples	As needed[c]	Every 12 hours	NA[d]	NA	NA	NA	1 per 20 samples	NA[d]
Semivolatile organics	1 per 20 samples	As needed[c]	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
Polychlorinated biphenyls[d]	1 per 20 samples	As needed[c]	1 per 10 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
Bulk density	NA	NA	NA	NA	NA	NA	NA	NA	NA
Atterberg limits	NA	NA	NA	NA	NA	NA	NA	NA	NA
Specific gravity	NA	NA	NA	NA	NA	NA	NA	NA	NA
Moisture content	NA	NA	NA	NA	NA	NA	NA	NA	NA
CU tri-axial testing	NA	NA	NA	NA	NA	NA	NA	NA	NA

Analysis Type	Field Duplicate	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	SRM/LCS	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
UU tri-axial testing	NA	NA	NA	NA	NA	NA	NA	NA	NA
One-dimensional consolidation	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cesium-137	NA	As needed[c]	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA
Lead-210	NA	As needed[c]	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA

Notes:

a. Calibration and certification of drying ovens and weighing scales are conducted bi-annually
b. Initial calibration verification and calibration blank must be analyzed at the beginning of each batch
c. Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed
d. PCBs will have all detects confirmed via second column confirmation. The second column must be of a dissimilar stationary phase from the primary column and meet all method requirements for acceptance.

CU = consolidated undrained
LCS = laboratory control sample
NA = not applicable
SRM = standard reference material
UU = unconsolidated undrained

Table 7-3
Data Quality Objectives for Sediment and Soil

Parameter	Precision	Accuracy	Completeness
Grain size	± 20% RPD	NA	95%
Total solids	± 20% RPD	NA	95%
Total organic carbon	± 20% RPD	65-135% R	95%
Metals	± 35% RPD	75-125% R	95%
Dioxin/Furans	± 50% RPD	50-140% R	95%
Semivolatile organic compounds	± 50% RPD	50-150% R	95%
Polychlorinated biphenyls	± 50% RPD	50-150% R	95%
Bulk density	± 20% RPD	NA	95%
Atterberg Limits	NA	NA	95%
Specific gravity	NA	NA	95%
Cesium-137	± 30% RPD	70 - 130% R	95%
Lead-210	± 30% RPD	70 - 130% R	95%

Notes:
NA = not applicable
R = recovery
RPD = relative percent difference

Table 9-1
Sediment Management Standards Regulatory Criteria

Parameter	SMS Criteria	
	SQS	CSL
Metals, mg/kg dry weight		
Arsenic	57	93
Cadmium	5.1	6.7
Chromium	260	270
Copper	390	390
Lead	450	530
Mercury	0.41	0.59
Silver	6.1	6.1
Zinc	410	960
Polycyclic aromatic hydrocarbons, mg/kg OC		
Total LPAH[a]	370	780
Naphthalene	99	170
Acenaphthylene	66	66
Acenaphthene	16	57
Fluorene	23	79
Phenanthrene	100	480
Anthracene	220	1,200
2-Methylnaphthalene	38	64
Total HPAHs[b]	960	5,300
Fluoranthene	160	1,200
Pyrene	1,000	1,400
Benzo(a)anthracene	110	270
Chrysene	110	460
Total benzo(b+j+k)fluoranthenes	230	450
Benzo(a)pyrene	99	210
Indeno(1,2,3-cd)pyrene	34	88
Dibenz(a,h)anthracene	12	33
Benzo(g,h,i)perylene	31	78
Chlorinated hydrocarbons, mg/kg OC		
1,4-Dichlorobenzene	3.1	9
1,2-Dichlorobenzene	2.3	2.3
1,2,4-Trichlorobenzene	0.81	1.8
Hexachlorobenzene	0.38	2.3

Parameter	SMS Criteria	
	SQS	CSL
Phthalates, mg/kg OC		
Dimethyl phthalate	53	53
Diethyl phthalate	61	110
Di-n-butyl phthalate	220	1,700
Butyl benzyl phthalate	4.9	64
Bis(2-ethylhexyl) phthalate	47	78
Di-n-octyl phthalate	58	4,500
Phenols, µg/kg dry weight		
Phenol	420	1,200
2-Methylphenol	63	63
4-Methylphenol	670	670
2,4-Dimethylphenol	29	29
Pentachlorophenol	360	690
Miscellaneous Extractables, µg/kg dry weight		
Benzyl alcohol	57	73
Benzoic acid	650	650
Miscellaneous Extractables, mg/kg OC		
Dibenzofuran	15	58
Hexachlorobutadiene	3.9	6.2
N-Nitrosodiphenylamine	11	11
PCBs, mg/kg OC		
Total PCBs[c]	12	65
Dioxin/Furans, ng/kg dry weight		
Dioxin Furan TEQ[d,e]	---	---

Notes:

a. Total LPAHs consists of the sum of anthracene, acenaphthylene, acenaphthene, phenanthrene, fluorene, and naphthalene
b. Total HPAHs consists of the sum of pyrene, benzo(g,h,i)perylene, indeno(1,2,3 cd)pyrene, benzo(b)fluoranthene, fluoranthene, benzo(k)fluoranthene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, and benz(a)anthracene
c. Total PCBs consists of the sum of all Aroclors
d. Dioxin Furan TEQ is calculated using the methods described in van den Berg et al., 2006
e. Currently, there are no SMS criteria for Dioxin Furan TEQ; in coordination with Ecology regional background concentrations Dioxin Furan TEQ may be developed and depending on the timing of the approved SMS rule revisions

µg/kg = microgram per kilogram
CSL = Cleanup Screening Level
HPAH = high-molecular-weight polycyclic aromatic hydrocarbon
LPAH = low-molecular-weight polycyclic aromatic hydrocarbon

mg/kg = milligram per kilogram
mg/kg OC = milligram per kilogram organic carbon normalized
ng/kg = nanogram per kilogram
PCB = polychlorinated biphenyl
SMS = Sediment Management Standard
SQS = Sediment Quality Standard
TEQ = toxic equivalency

FIGURES

ATTACHMENT A
SAMPLING INVESTIGATION FIELD FORMS AND LOGS

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-014-MJR-FEATURES.dwg Fig 1-1

Jan 17, 2013 1:43pm chewett

SOURCE: Aerial image from ESRI data. Basemap from Port of Olympia, dated June 2008.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Cleanup Site

Proposed 2013/2014 Dredge Area

0 600
Scale in Feet

ANCHOR QEA

Figure 1-1
Site Overview
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site

Proposed Geochron Location	Outfall
Proposed Nature and Extent Core Location	Sediment Remediation Boundary
Proposed Surface Grab Location	Contaminated Sites
Proposed Soil Boring	Surface Water Inflow
Proposed Vane Shear Test (VST)	Drainage Subbasin
Proposed Cone Penetration Test (CPT)	Study Area
Existing Surface Grab Location	Berth Area Boundary
Existing Core Location	

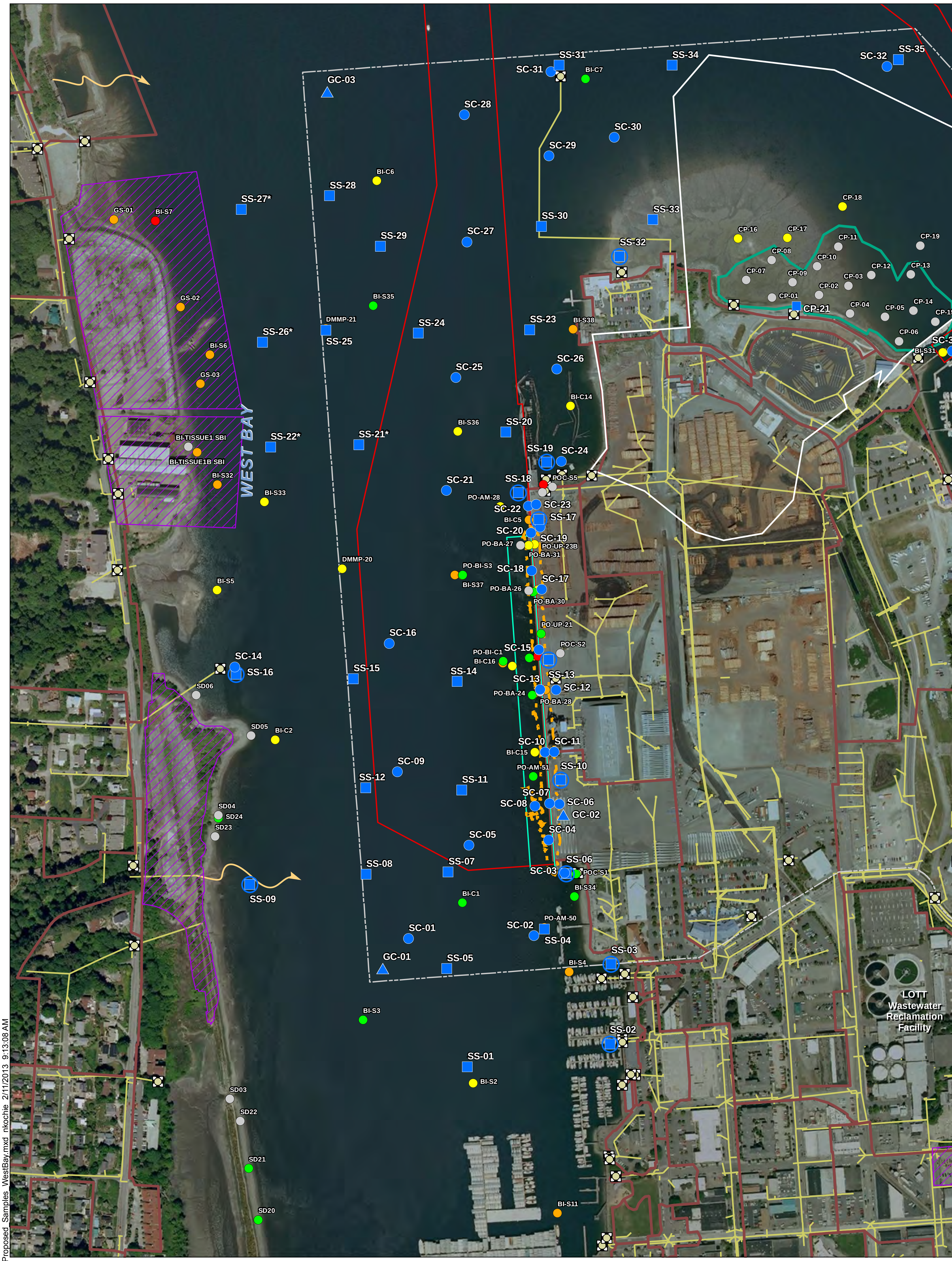
Note:
* = Sample will also be analyzed for SVOCs.

Feet
0 250 500 750 1,000

Q:\Jobs\080166-01_Port-of-Olympia\Maps\SAP_QAPP\Sample Overview.mxd nkochie 2/11/2013 9:18:55 AM

ANCHOR QEA

Figure 4-1
Overview of All Proposed Sample Types and Locations
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site



- Proposed Geochron Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab With Dioxin/Furan Testing
- Proposed Surface Grab Location With SMS and Dioxin/Furan Testing
- Sediment Remediation Boundary
- 2013/2014 Dredge Area
- Outfall
- Contaminated Sites
- Surface Water Inflow
- Drainage Subbasin
- Conveyance Line
- Berth Area Boundary
- Study Area

Surface Sediment Dioxin TEQ (ng/kg)

- < 5
- 6 - 10
- 11 - 20
- 21 - 40
- > 40

Feet

0 225 450 675 900

Notes:
1. * = Sample will also be analyzed for SVOCs.
2. All surface sediment sample results were collected from 0-10 cm, except for CP-01 thru CP-15 that were collected from 0-1ft.

Q:\Jobs\080166-01_Port-of-Olympia\Maps\SAP_QAPP\Proposed_Samples_WestBay.mxd nkochie 2/11/2013 9:13:08 AM

ANCHOR QEA

Figure 4-2
Proposed and Existing Surface Sediment Sampling Locations – West Bay
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site

Figure 4-3
Proposed and Existing Surface Sediment Sampling Locations – East Bay
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site

ANCHOR QEA

SOURCE: Aerial image from ESRI data. Basemap from Port of Olympia, dated June 2008.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

- Cascade Pole Cleanup Site/2009 Interim Action Boundary
- Proposed 2013/2014 Dredge Area
- Federal Navigation Channel
- Existing Core Location
- Existing Core Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab Location
- Outfall

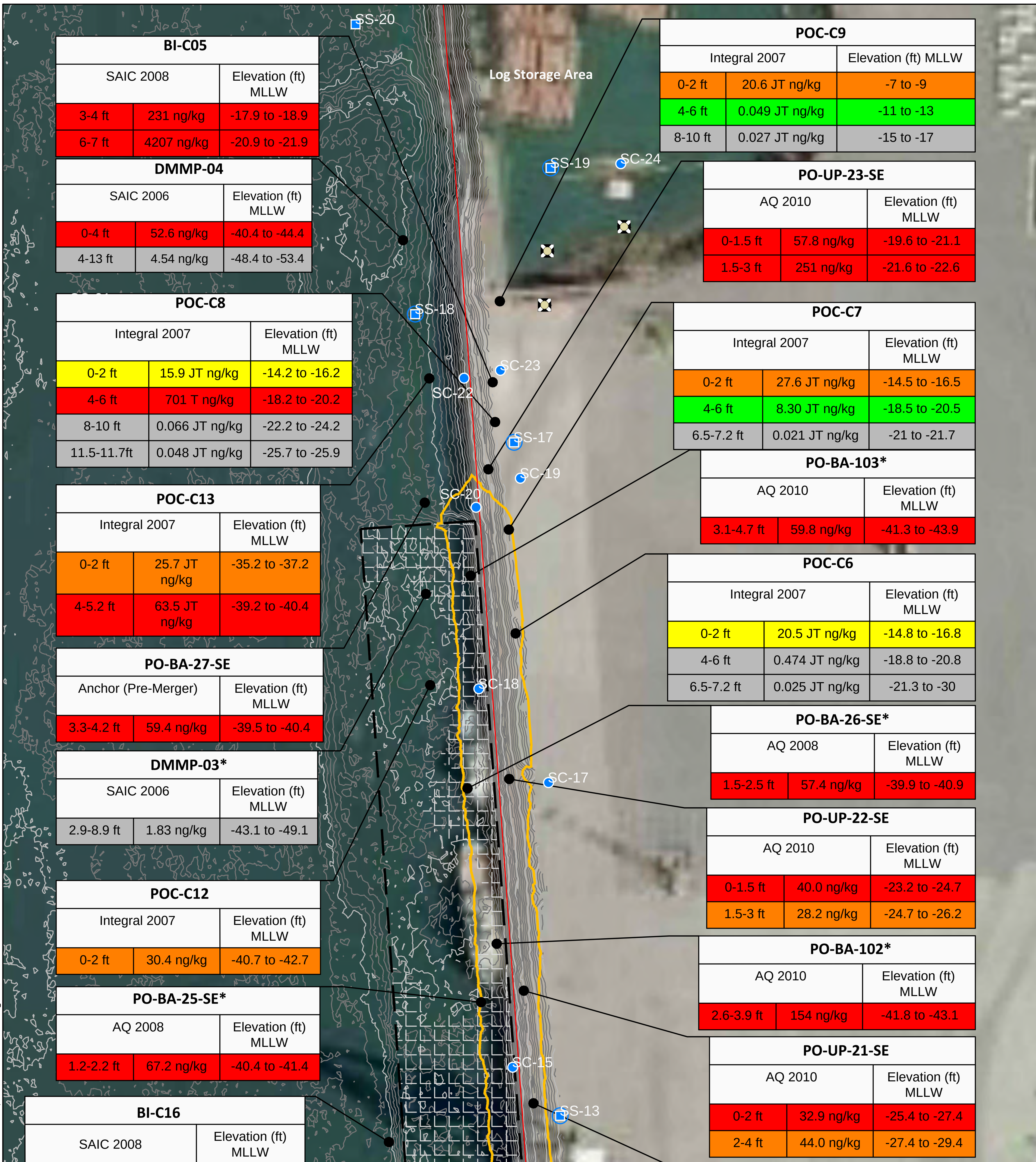
0 800
Scale in Feet

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-007-OVERVIEW-MAP.dwg FIG 1

Feb 25, 2013 10:14am chewett

ANCHOR QEA

Figure 4-4
Overview of Proposed and Existing Core Locations
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site



BI-C05		
SAIC 2008		Elevation (ft) MLLW
3-4 ft	231 ng/kg	-17.9 to -18.9
6-7 ft	4207 ng/kg	-20.9 to -21.9

DMMP-04		
SAIC 2006		Elevation (ft) MLLW
0-4 ft	52.6 ng/kg	-40.4 to -44.4
4-13 ft	4.54 ng/kg	-48.4 to -53.4

POC-C8		
Integral 2007		Elevation (ft) MLLW
0-2 ft	15.9 JT ng/kg	-14.2 to -16.2
4-6 ft	701 T ng/kg	-18.2 to -20.2
8-10 ft	0.066 JT ng/kg	-22.2 to -24.2
11.5-11.7ft	0.048 JT ng/kg	-25.7 to -25.9

POC-C13		
Integral 2007		Elevation (ft) MLLW
0-2 ft	25.7 JT ng/kg	-35.2 to -37.2
4-5.2 ft	63.5 JT ng/kg	-39.2 to -40.4

PO-BA-27-SE		
Anchor (Pre-Merger)		Elevation (ft) MLLW
3.3-4.2 ft	59.4 ng/kg	-39.5 to -40.4

DMMP-03*		
SAIC 2006		Elevation (ft) MLLW
2.9-8.9 ft	1.83 ng/kg	-43.1 to -49.1

POC-C12		
Integral 2007		Elevation (ft) MLLW
0-2 ft	30.4 ng/kg	-40.7 to -42.7

PO-BA-25-SE*		
AQ 2008		Elevation (ft) MLLW
1.2-2.2 ft	67.2 ng/kg	-40.4 to -41.4

BI-C16		
SAIC 2008		Elevation (ft) MLLW

POC-C9		
Integral 2007		Elevation (ft) MLLW
0-2 ft	20.6 JT ng/kg	-7 to -9
4-6 ft	0.049 JT ng/kg	-11 to -13
8-10 ft	0.027 JT ng/kg	-15 to -17

PO-UP-23-SE		
AQ 2010		Elevation (ft) MLLW
0-1.5 ft	57.8 ng/kg	-19.6 to -21.1
1.5-3 ft	251 ng/kg	-21.6 to -22.6

POC-C7		
Integral 2007		Elevation (ft) MLLW
0-2 ft	27.6 JT ng/kg	-14.5 to -16.5
4-6 ft	8.30 JT ng/kg	-18.5 to -20.5
6.5-7.2 ft	0.021 JT ng/kg	-21 to -21.7

PO-BA-103*		
AQ 2010		Elevation (ft) MLLW
3.1-4.7 ft	59.8 ng/kg	-41.3 to -43.9

POC-C6		
Integral 2007		Elevation (ft) MLLW
0-2 ft	20.5 JT ng/kg	-14.8 to -16.8
4-6 ft	0.474 JT ng/kg	-18.8 to -20.8
6.5-7.2 ft	0.025 JT ng/kg	-21.3 to -30

PO-BA-26-SE*		
AQ 2008		Elevation (ft) MLLW
1.5-2.5 ft	57.4 ng/kg	-39.9 to -40.9

PO-UP-22-SE		
AQ 2010		Elevation (ft) MLLW
0-1.5 ft	40.0 ng/kg	-23.2 to -24.7
1.5-3 ft	28.2 ng/kg	-24.7 to -26.2

PO-BA-102*		
AQ 2010		Elevation (ft) MLLW
2.6-3.9 ft	154 ng/kg	-41.8 to -43.1

PO-UP-21-SE		
AQ 2010		Elevation (ft) MLLW
0-2 ft	32.9 ng/kg	-25.4 to -27.4
2-4 ft	44.0 ng/kg	-27.4 to -29.4

Matchline - See Figure 4-6

REFERENCES:

Anchor Environmental, 2008. Interim Action Plan, Port of Olympia Berths 2 and 3. Prepared for Port of Olympia.

Anchor QEA, 2010. 15-Month Monitoring Results for Berth 2 and 3 Interim Cleanup Action Pilot Study. Prepared for Washington State Department of Ecology. September 2010.

Integral Consulting, Inc., 2007. Draft Data Summary Report West Bay Sediment Characterization Study Berths 2 and 3 Interim Action Project. Prepared for Port of Olympia. November 2007.

SAIC, 2006. Data Report. Olympia Federal Navigation Channel and the Port of Olympia Berthing Area, Olympia, Washington. Prepared for U.S. Army Corps of Engineers, Seattle District. August 2006.

SAIC, 2008. Sediment Characterization Study Budd Inlet, Olympia, Washington. Prepared for Washington State Department of Ecology. March 2008.

LEGEND:

Dioxin TEQ (ng/kg)
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

- Existing Core Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab Location with Dioxin/Furan Testing
- Proposed Surface Grab Location with SMS and Dioxin/Furan Testing
- Outfall

SOURCE: Aerial photograph dated March 14, 2011. Bathymetric survey provided by USACE, dated February 12, 2011.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:
1. * - Sample is within a dredged area. Depth intervals were calculated based on the new mudline elevation. Data may not be representative of current conditions. Data are total dioxin/furan TEQ 2005 (Mammal) (U=0 DL) in ng/kg.
2. Core intervals and/or core samples that were dredged are not shown.
3. The higher of the parent or duplicate dioxin TEQ is reported for samples with field duplicates.

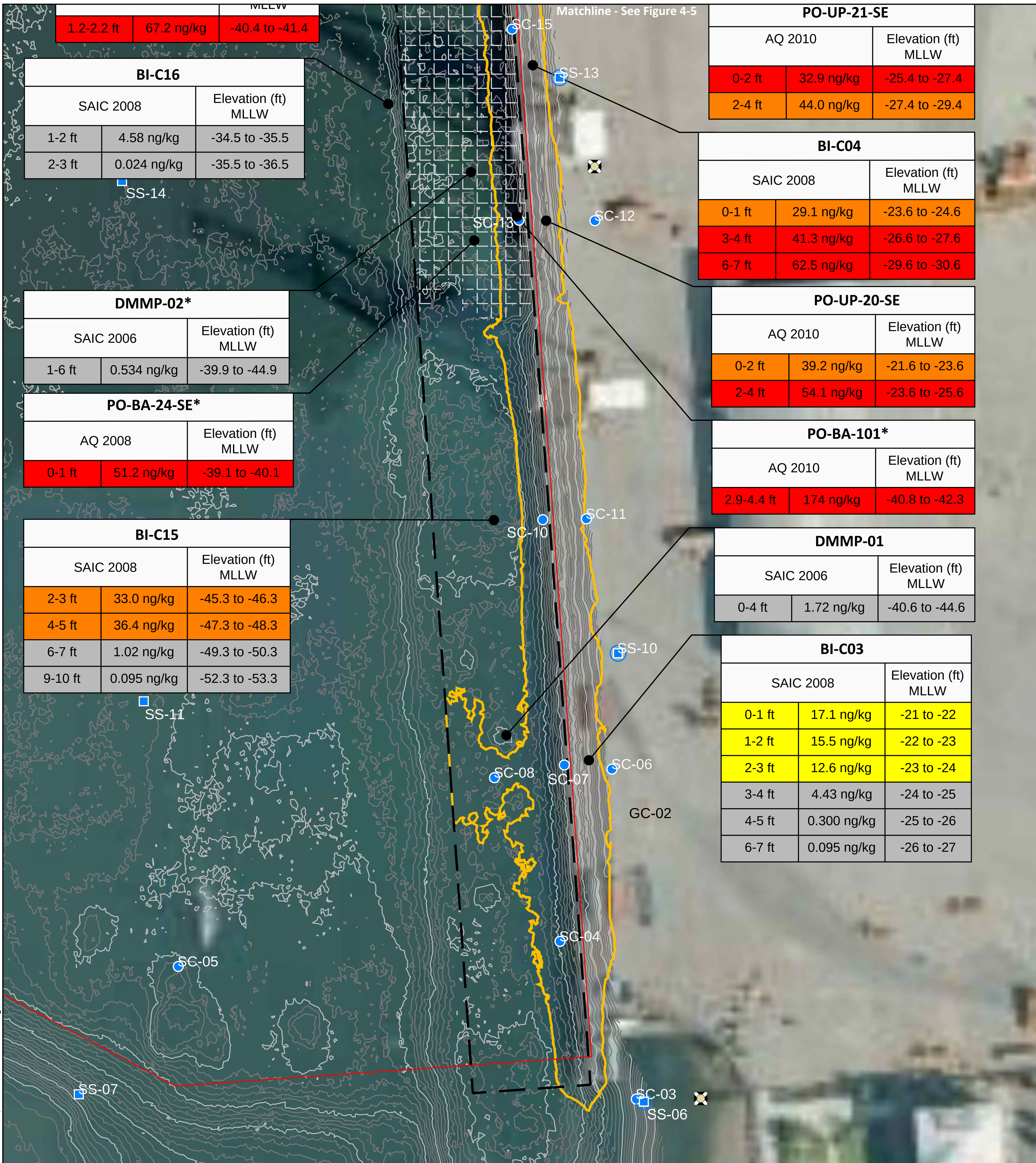
LEGEND:
- 2009 Interim Action Removal Boundary
- Berth Area
- Proposed 2013/2014 Maintenance Dredge Area
- Existing Bathymetry (1' and 5' Contours)

0 100
Scale in Feet

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-009-FIG 3.dwg 4-5
Feb 25, 2013 10:14am chewett

ANCHOR QEA

Figure 4-5
Proposed and Existing Core Locations – Berth Area North
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site



		MLLW
1.2-2.2 ft	67.2 ng/kg	-40.4 to -41.4

BI-C16

SAIC 2008		Elevation (ft) MLLW
1-2 ft	4.58 ng/kg	-34.5 to -35.5
2-3 ft	0.024 ng/kg	-35.5 to -36.5

DMMP-02*

SAIC 2006		Elevation (ft) MLLW
1-6 ft	0.534 ng/kg	-39.9 to -44.9

PO-BA-24-SE*

AQ 2008		Elevation (ft) MLLW
0-1 ft	51.2 ng/kg	-39.1 to -40.1

BI-C15

SAIC 2008		Elevation (ft) MLLW
2-3 ft	33.0 ng/kg	-45.3 to -46.3
4-5 ft	36.4 ng/kg	-47.3 to -48.3
6-7 ft	1.02 ng/kg	-49.3 to -50.3
9-10 ft	0.095 ng/kg	-52.3 to -53.3

PO-UP-21-SE

AQ 2010		Elevation (ft) MLLW
0-2 ft	32.9 ng/kg	-25.4 to -27.4
2-4 ft	44.0 ng/kg	-27.4 to -29.4

BI-C04

SAIC 2008		Elevation (ft) MLLW
0-1 ft	29.1 ng/kg	-23.6 to -24.6
3-4 ft	41.3 ng/kg	-26.6 to -27.6
6-7 ft	62.5 ng/kg	-29.6 to -30.6

PO-UP-20-SE

AQ 2010		Elevation (ft) MLLW
0-2 ft	39.2 ng/kg	-21.6 to -23.6
2-4 ft	54.1 ng/kg	-23.6 to -25.6

PO-BA-101*

AQ 2010		Elevation (ft) MLLW
2.9-4.4 ft	174 ng/kg	-40.8 to -42.3

DMMP-01

SAIC 2006		Elevation (ft) MLLW
0-4 ft	1.72 ng/kg	-40.6 to -44.6

BI-C03

SAIC 2008		Elevation (ft) MLLW
0-1 ft	17.1 ng/kg	-21 to -22
1-2 ft	15.5 ng/kg	-22 to -23
2-3 ft	12.6 ng/kg	-23 to -24
3-4 ft	4.43 ng/kg	-24 to -25
4-5 ft	0.300 ng/kg	-25 to -26
6-7 ft	0.095 ng/kg	-26 to -27

REFERENCES:
Anchor Environmental, 2008. Interim Action Plan, Port of Olympia Berths 2 and 3. Prepared for Port of Olympia.
Anchor QEA, 2010. 15-Month Monitoring Results for Berth 2 and 3 Interim Cleanup Action Pilot Study. Prepared for Washington State Department of Ecology. September 2010.
Integral Consulting, Inc., 2007. Draft Data Summary Report West Bay Sediment Characterization Study Berths 2 and 3 Interim Action Project. Prepared for Port of Olympia. November 2007.
SAIC, 2006. Data Report. Olympia Federal Navigation Channel and the Port of Olympia Berthing Area, Olympia, Washington. Prepared for U.S. Army Corps of Engineers, Seattle District. August 2006.
SAIC, 2008. Sediment Characterization Study Budd Inlet, Olympia, Washington. Prepared for Washington State Department of Ecology. March 2008.

LEGEND:
Dioxin TEQ (ng/kg)
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

- Existing Core Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab Location with Dioxin/Furan Testing
- Proposed Surface Grab Location with SMS and Dioxin/Furan Testing
- Outfall

SOURCE: Aerial photograph dated March 14, 2011. Bathymetric survey provided by USACE, dated February 12, 2011.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:
1. * - Sample is within a dredged area. Depth intervals were calculated based on the new mudline elevation. Data may not be representative of current conditions. Data are total dioxin/furan TEQ 2005 (Mammal) (U=0 DL) in ng/kg.
2. Core intervals and/or core samples that were dredged are not shown.
3. The higher of the parent or duplicate Dioxin TEQ is reported for samples with field duplicates.

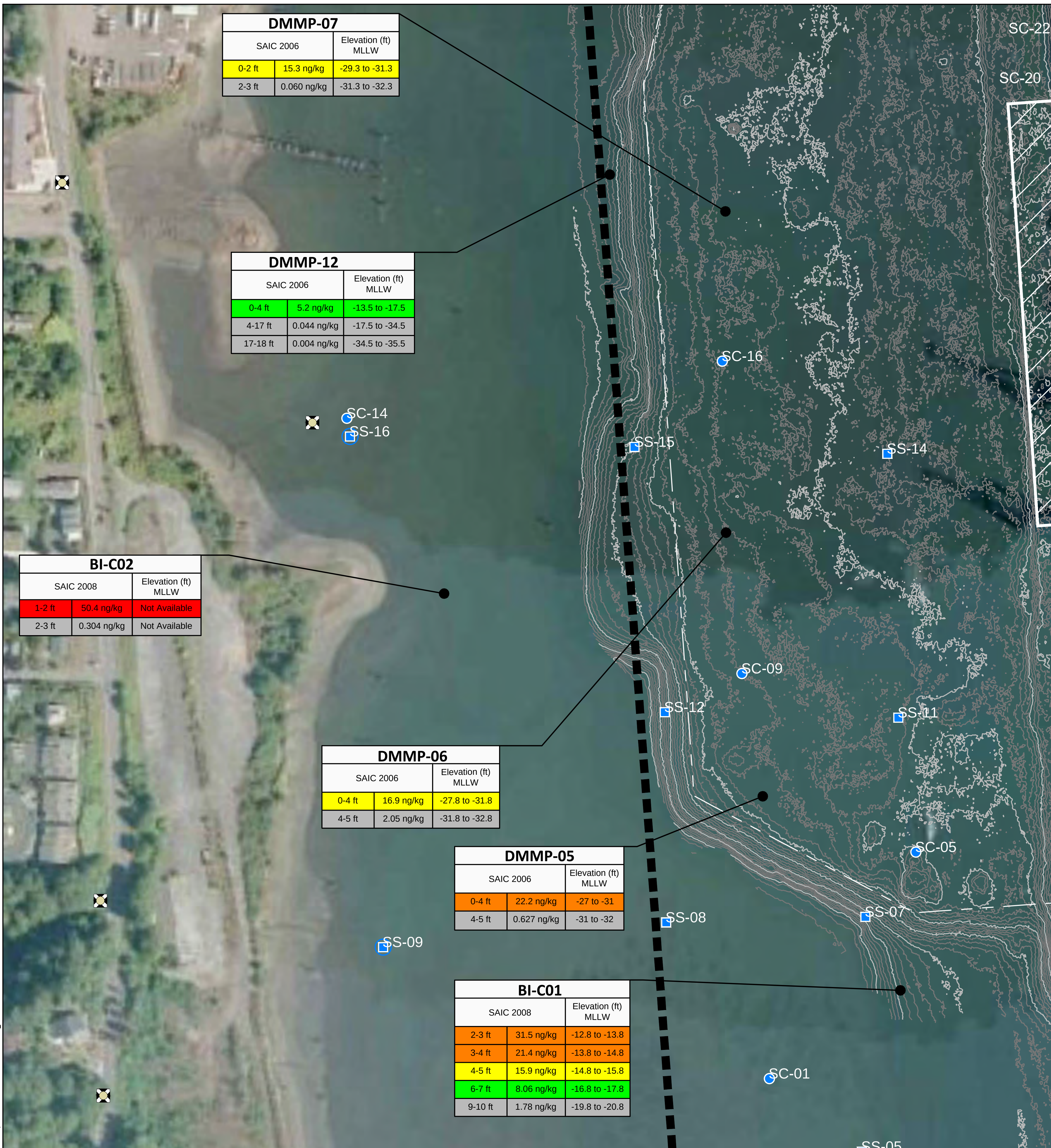
LEGEND:
- 2009 Interim Action Removal Boundary
- Berth Area
- Proposed 2013/2014 Maintenance Dredge Area
- Existing Bathymetry (1' and 5' Contours)

0 100
Scale in Feet

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-009-FIG 3.dwg 4-6
Jan 17, 2013 1:44pm chewett

ANCHOR QEA

Figure 4-6
Proposed and Existing Core Locations – Berth Area South
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site



DMMP-07

SAIC 2006		Elevation (ft) MLLW
0-2 ft	15.3 ng/kg	-29.3 to -31.3
2-3 ft	0.060 ng/kg	-31.3 to -32.3

DMMP-12

SAIC 2006		Elevation (ft) MLLW
0-4 ft	5.2 ng/kg	-13.5 to -17.5
4-17 ft	0.044 ng/kg	-17.5 to -34.5
17-18 ft	0.004 ng/kg	-34.5 to -35.5

BI-C02

SAIC 2008		Elevation (ft) MLLW
1-2 ft	50.4 ng/kg	Not Available
2-3 ft	0.304 ng/kg	Not Available

DMMP-06

SAIC 2006		Elevation (ft) MLLW
0-4 ft	16.9 ng/kg	-27.8 to -31.8
4-5 ft	2.05 ng/kg	-31.8 to -32.8

DMMP-05

SAIC 2006		Elevation (ft) MLLW
0-4 ft	22.2 ng/kg	-27 to -31
4-5 ft	0.627 ng/kg	-31 to -32

BI-C01

SAIC 2008		Elevation (ft) MLLW
2-3 ft	31.5 ng/kg	-12.8 to -13.8
3-4 ft	21.4 ng/kg	-13.8 to -14.8
4-5 ft	15.9 ng/kg	-14.8 to -15.8
6-7 ft	8.06 ng/kg	-16.8 to -17.8
9-10 ft	1.78 ng/kg	-19.8 to -20.8

REFERENCES:

SAIC, 2006. Data Report. Olympia Federal Navigation Channel and the Port of Olympia Berthing Area, Olympia, Washington. Prepared for U.S. Army Corps of Engineers, Seattle District. August 2006.

SAIC, 2008. Sediment Characterization Study Budd Inlet, Olympia, Washington. Prepared for Washington State Department of Ecology. March 2008.

LEGEND:

Dioxin TEQ (ng/kg)
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

- Existing Core Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab Location with Dioxin/Furan Testing
- Outfall

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-010-FIG 4.dwg 4-7

Jan 17, 2013 1:44pm chewett

SOURCE: Aerial photograph dated March 14, 2011.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:

1. * - Sample is within a dredged area. Depth intervals were calculated based on the new mudline elevation. Data may not be representative of current conditions. Data are total dioxin/furan TEQ 2005 (Mammal) (U=0 DL) in ng/kg.
2. Core intervals and/or core samples that were dredged are not shown.
3. The higher of the parent or duplicate dioxin TEQ is reported for samples with field duplicates.

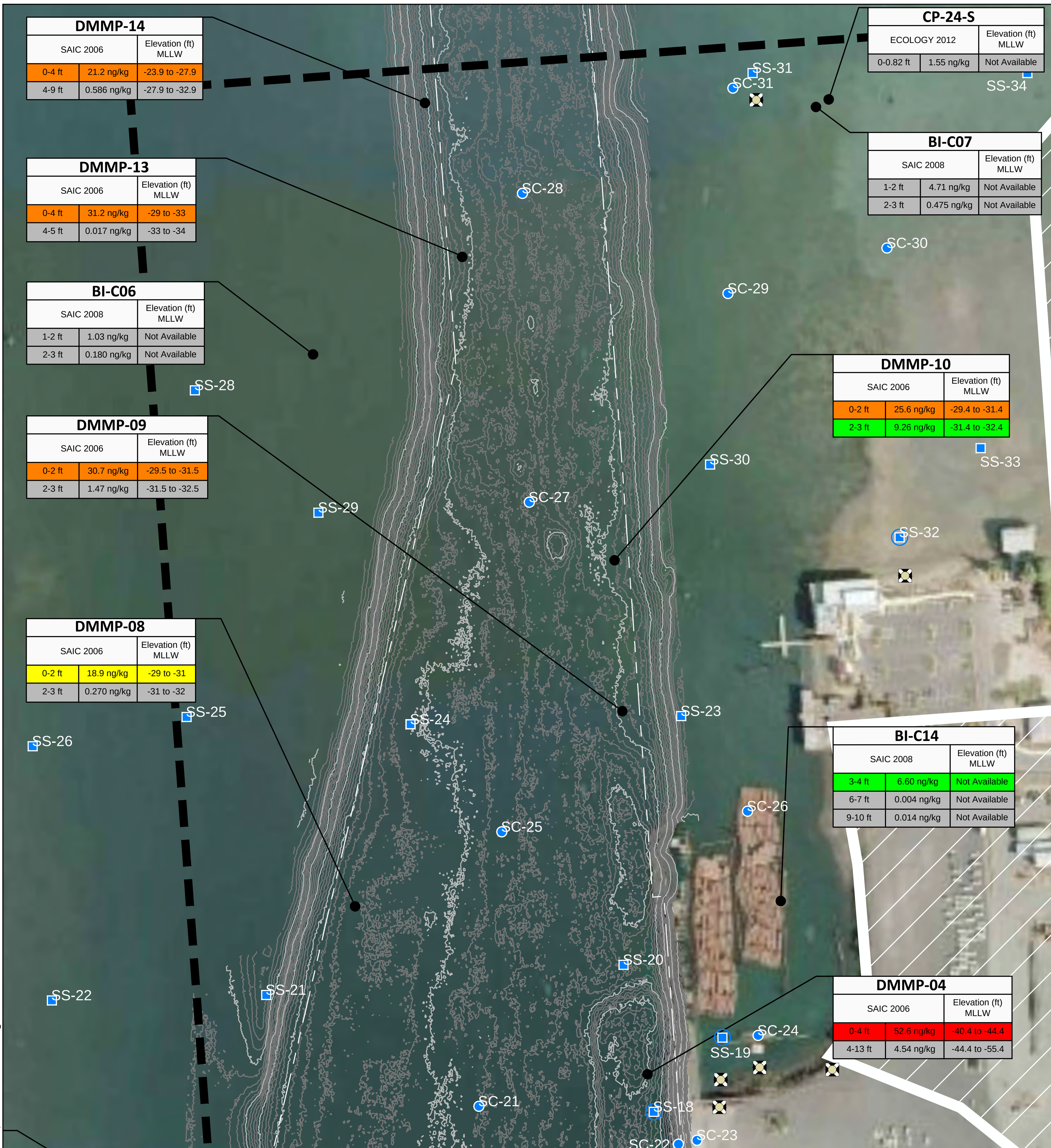
LEGEND:

- Cascade Pole Cleanup Site
- Conceptual Area Study Boundary
- Federal Navigation Channel
- Existing Bathymetry (1' and 5' Contours)

0 200
Scale in Feet

ANCHOR QEA

Figure 4-7
Proposed and Existing Core Locations – West Bay North
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site



REFERENCES:

Ecology (Washington State Department of Ecology), 2012. Environmental Information Management database. Accessed February 2012. Available at: http://www.ecy.wa.gov/eim

SAIC, 2006. Data Report. Olympia Federal Navigation Channel and the Port of Olympia Berthing Area, Olympia, Washington. Prepared for U.S. Army Corps of Engineers, Seattle District. August 2006.

SAIC, 2008. Sediment Characterization Study Budd Inlet, Olympia, Washington. Prepared for Washington State Department of Ecology. March 2008.

LEGEND:

Dioxin TEQ (ng/kg)
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

- Existing Core Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab Location with Dioxin/Furan Testing
- Proposed Surface Grab Location with SMS and Dioxin/Furan Testing
- Outfall

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-011-FIG 5.dwg 4-8

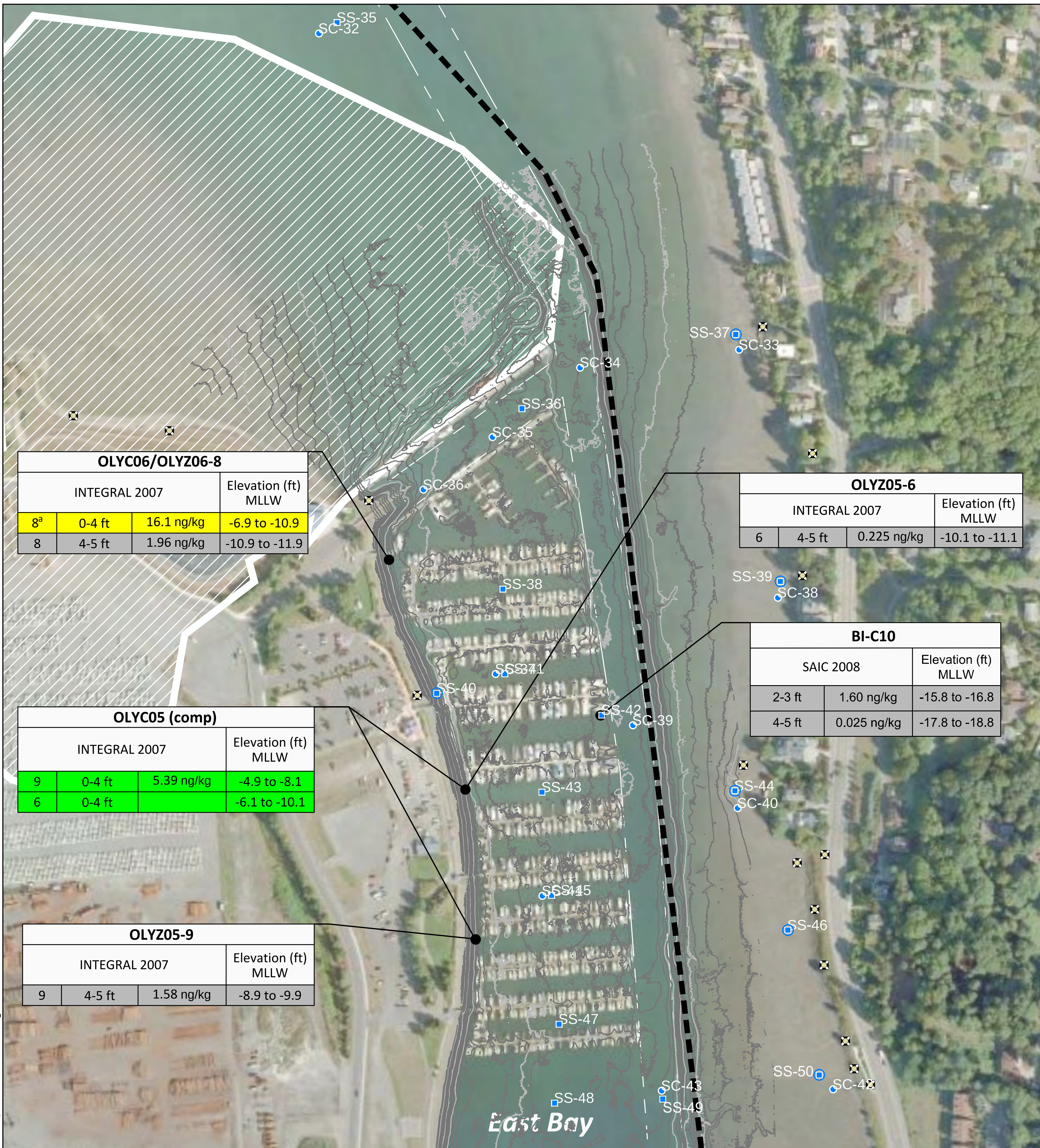
SOURCE: Aerial photograph dated March 14, 2011.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:
1. * - Sample is within a dredged area. Depth intervals were calculated based on the new mudline elevation. Data may not be representative of current conditions. Data are total dioxin/furan TEQ 2005 (Mammal) (U=0 DL) in ng/kg.
2. Core intervals and/or core samples that were dredged are not shown.
3. The higher of the parent or duplicate dioxin TEQ is reported for samples with field duplicates.

LEGEND:
- Cascade Pole Cleanup Site
- Conceptual Area Study Boundary
- Federal Navigation Channel
- Existing Bathymetry (1' and 5' Contours)

0 200
Scale in Feet

Jan 17, 2013 1:44pm chewett

Figure 4-8
Proposed and Existing Core Locations – West Bay South
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site



OLYC06/OLYZ06-8

INTEGRAL 2007			Elevation (ft) MLLW
8[a]	0-4 ft	16.1 ng/kg	-6.9 to -10.9
8	4-5 ft	1.96 ng/kg	-10.9 to -11.9

OLYZ05-6

INTEGRAL 2007			Elevation (ft) MLLW
6	4-5 ft	0.225 ng/kg	-10.1 to -11.1

BI-C10

SAIC 2008		Elevation (ft) MLLW
2-3 ft	1.60 ng/kg	-15.8 to -16.8
4-5 ft	0.025 ng/kg	-17.8 to -18.8

OLYC05 (comp)

INTEGRAL 2007			Elevation (ft) MLLW
9	0-4 ft	5.39 ng/kg	-4.9 to -8.1
6	0-4 ft		-6.1 to -10.1

OLYZ05-9

INTEGRAL 2007			Elevation (ft) MLLW
9	4-5 ft	1.58 ng/kg	-8.9 to -9.9

REFERENCES:
Integral Consulting, Inc., 2007. Draft PSDDA Sediment Characterization Report. East Bay Dredging Project, Olympia, WA. Prepared for Port of Olympia. February 2007
SAIC, 2008. Sediment Characterization Study Budd Inlet, Olympia, Washington. Prepared for Washington State Department of Ecology. March 2008.

LEGEND:
Dioxin TEQ (ng/kg)
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

- Existing Core Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab Location with Dioxin/Furan Testing
- Proposed Surface Grab Location with SMS and Dioxin/Furan Testing
- Outfall

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-012-FIG 6.dwg 4-9
Jan 17, 2013 1:45pm chewett

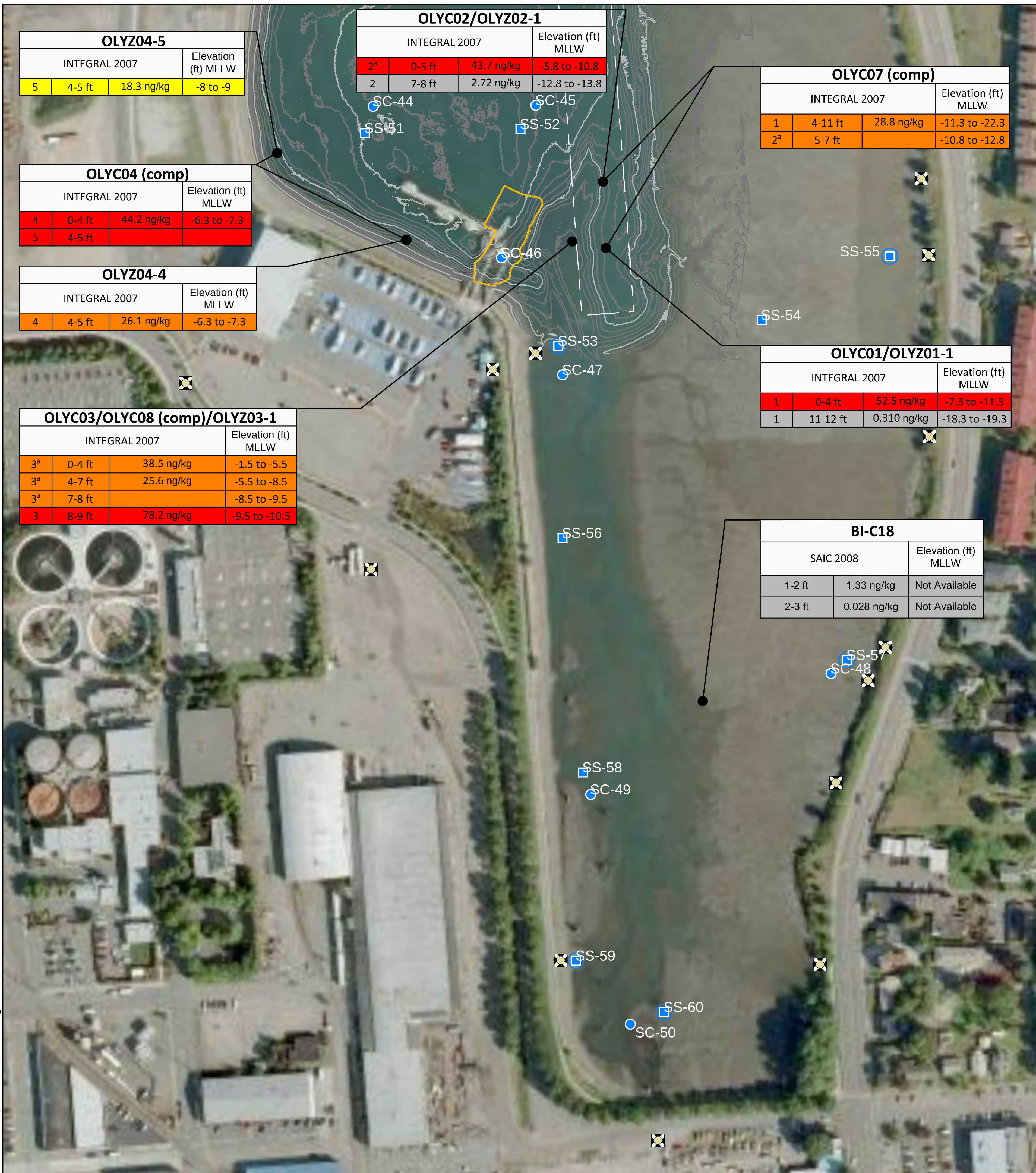
SOURCE: Aerial photograph dated March 14, 2011.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:
1. Data are total dioxin/furan TEQ 2005 (Mammal) (U=0 DL) in ng/kg.
2. The higher of the parent or duplicate dioxin TEQ is reported for samples with field duplicates.

LEGEND:
- Cascade Pole Cleanup Site
- Conceptual Area Study Boundary
- Federal Navigation Channel
- Existing Bathymetry (1' and 5' Contours)

0 200
Scale in Feet

ANCHOR QEA

Figure 4-9
Proposed and Existing Core Locations – East Bay North
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site



OLYZ04-5

INTEGRAL 2007			Elevation (ft) MLLW
5	4-5 ft	18.3 ng/kg	-8 to -9

OLYC02/OLYZ02-1

INTEGRAL 2007			Elevation (ft) MLLW
2[a]	0-5 ft	43.7 ng/kg	-5.8 to -10.8
2	7-8 ft	2.72 ng/kg	-12.8 to -13.8

OLYC07 (comp)

INTEGRAL 2007			Elevation (ft) MLLW
1	4-11 ft	28.8 ng/kg	-11.3 to -22.3
2[a]	5-7 ft		-10.8 to -12.8

OLYC04 (comp)

INTEGRAL 2007			Elevation (ft) MLLW
4	0-4 ft	44.2 ng/kg	-6.3 to -7.3
5	4-5 ft		

OLYZ04-4

INTEGRAL 2007			Elevation (ft) MLLW
4	4-5 ft	26.1 ng/kg	-6.3 to -7.3

OLYC01/OLYZ01-1

INTEGRAL 2007			Elevation (ft) MLLW
1	0-4 ft	52.5 ng/kg	-7.3 to -11.3
1	11-12 ft	0.310 ng/kg	-18.3 to -19.3

OLYC03/OLYC08 (comp)/OLYZ03-1

INTEGRAL 2007			Elevation (ft) MLLW
3[a]	0-4 ft	38.5 ng/kg	-1.5 to -5.5
3[a]	4-7 ft	25.6 ng/kg	-5.5 to -8.5
3[a]	7-8 ft		-8.5 to -9.5
3	8-9 ft	78.2 ng/kg	-9.5 to -10.5

BI-C18

SAIC 2008		Elevation (ft) MLLW
1-2 ft	1.33 ng/kg	Not Available
2-3 ft	0.028 ng/kg	Not Available

REFERENCES:
Integral Consulting, Inc., 2007. Draft PSDDA Sediment Characterization Report. East Bay Dredging Project, Olympia, WA. Prepared for Port of Olympia. February 2007
SAIC, 2008. Sediment Characterization Study Budd Inlet, Olympia, Washington. Prepared for Washington State Department of Ecology. March 2008.

LEGEND:
Dioxin TEQ (ng/kg)
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

- Existing Core Location
- Proposed Nature and Extent Core Location
- Proposed Surface Grab Location with Dioxin/Furan Testing
- Proposed Surface Grab Location with SMS and Dioxin/Furan Testing
- Outfall

SOURCE: Aerial photograph dated March 14, 2011. Bathymetric survey dated July, 2010.
HORIZONTAL DATUM: Washington State Plane South, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:
1. Data are total dioxin/furan TEQ 2005 (Mammal) (U=0 DL) in ng/kg.
2. The higher of the parent or duplicate dioxin TEQ is reported for samples with field duplicates.

LEGEND:
- Proposed 2013/2014 Maintenance Dredge Area
- Federal Navigation Channel
- Existing Bathymetry (1' and 5' Contours)

0 120
Scale in Feet

K:\Projects\0166-Port of Olympia\Budd Inlet Interim Action\0166-RP-013-FIG 7.dwg 4-10
Jan 17, 2013 1:45pm chewett

ANCHOR QEA

Figure 4-10
Proposed and Existing Core Locations – East Bay South
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site

ANCHOR QEA

Figure 4-11
Proposed Geotechnical Sample Locations
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site

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ANCHOR QEA

Figure 4-12
Proposed Geochronological Sample Locations
Sampling Analysis Plan and Quality Assurance Project Plan
Port of Olympia Budd Inlet Sediment Site

ATTACHMENT A
SAMPLING INVESTIGATION FIELD FORMS AND LOGS

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LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME________________________________ BORING #______________

PROJECT NUMBER____________________________________ DATE BEGAN____________

GEOLOGIST/ENGINEER_________________________________ DATE COMPLETED_______

DRILLING CONTRACTOR_______________________________ TOTAL DEPTH__________

DRILLING METHOD___________________________________ SHEET______OF_______

HOLE DIAMETER_____________________________________

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA						DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	Field location of boring
		SAMPLING METHOD	SAMPLE NUMBER	FID / PID (ppm)	RECOVERY (feet)	BLOWS / 6 INCHES	DEPTH SAMPLED			LITHOLOGIC DESCRIPTION
								1		
								2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								0		
								1		
								2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								0		

Remarks:

Chain of Custody Record & Laboratory Analysis Request COC#

ANCHOR QEA

Date: ______
Laboratory : ______
Project Name: ______
Project Number: ______
Project Manager: ______
Phone Number: ______
Shipment Method: ______

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers																			Comments
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							

1 See SAP Table 2 for analyte lists and test methods

2 Only analyzed if there is insuffcient volume for the porewater analysis

Additional notes/comments: ______

Relinquished By:	Company: Anchor QEA LLC.	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Daily Log

ANCHOR QEA

Anchor QEA L.L.C.
720 Olive Way, Suite 1900
Seattle, WA 98101
Phone 206.287.9130 Fax 206.287.9131

PROJECT NAME: ______________________ **DATE:** ____________

SITE ADDRESS: ______________________ **PERSONNEL:** ____________

WEATHER:	**WIND FROM:**	N	NE	E	SE	S	SW	W	NW	LIGHT	MEDIUM	HEAVY
		SUNNY		CLOUDY		RAIN			?	**TEMPERATURE:**	° F .	° C

[Circle appropriate units]

TIME	**COMMENTS**
See Field Logs for detailed logging and sampling	
Equipment on site:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site
Safety infractions, Important comments/instructions to contractors

Signature: ______________________________

Jet Probe Logging Form

Project Name:		**Date:**	
Contractor:		**Project Number:**	
Vertical Datum:	MLLW	MLW	Other: NGVD29
Depth Measurement:	Sounder	Leadline	Other:

Station I.D.:		
Lat/Northing:		
Long/Easting:		
Time:		
(A) Measured Water Depth:		
(B) Tide Height:		
(C) Mudline Elevation:		
(C = -A+B include sign of tide height as reported)		
(D) Estimated Penetration:		
(E) BBC Elevation:		
(E = C-D include sign of mudline as calculated)		
Description of Probe Drive:		

Observations

Sheen:	none, slight, mod, strong	none, slight, mod, strong
Sheen Type:	blossom, continuous	blossom, continuous
Odor:	none, slight, mod, strong H_2S, petroleum, septic	none, slight, mod, strong H_2S, petroleum, septic
Comments:		

Recorded by: ______________________

Sediment Core Collection Log

Page __ of __

Job: ____________________ **Station ID:** ____________________

Job No: ____________________ **Attempt No.** ____________________

Field Staff: ____________________ **Date:** ____________________

Contractor: ____________________ **Logged By:** ____________________

Vertical Datum: ____________________ **Horizontal Datum:** ____________________

Field Collection Coordinates:

Lat/Northing: ____________________ Long/Easting: ____________________

A. Water Depth

DTM Depth Sounder: ____________________

DTM Lead Line: ____________________

B. Water Level Measurements

Time: ____________________

Height: ____________________

Source: ____________________

C. Mudline Elevation

____

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:

Core Accepted: Yes / No

Core Tube Length: ____________________

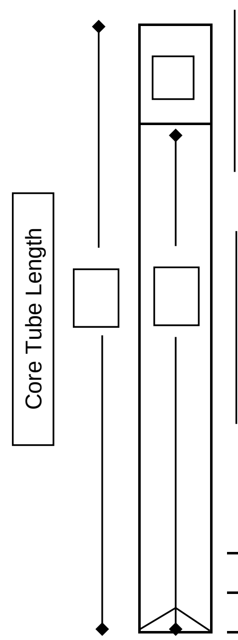
Drive Penetration: ____________________

Headspace Measurement: ____________________

Recovery Measurement: ____________________

Recovery Percentage: ____________________

Total Length of Core To Process: ____________________



Drive Notes:

Sections To Process:

A: ____________________

B: ____________________

C: ____________________

D: ____________________

Core Field Observations and Description:	Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

Sediment Core Processing Log

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Job:	Station ID:
Job No.	Date/Time:
No. of Sections:	Core Logged By:
Drive Length:	Attempt #:
Recovery:	Type of Core ☐ Mudmole ☐ Vibracore ☐ Other
% Recovery:	Diameter of Core (inches)
Notes:	Core Quality ☐ Good ☐ Fair ☐ Poor ☐ Disturbed

Recovered Length (ft)	Size % G	Size % S	Size % F	PID	**Classification and Remarks** (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Sample	Subsample	Summary Sketch

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Surface Sediment Field Log

Job: | Station:
Job No: | Date:
Field Staff: | Sample Method:
Contractor: | Target Coordinates: Lat.
Horizontal Datum: | Long.

Water Height

DTM Depth Sounder: ______________

DTM Lead Line: ______________

Tide Measurements

Time: ______

Height: ______

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Mudline Elevation (lower low water-large tides): calculated after sampling

Notes: ______________

Grab #	Time	Actual Coordinates		Sample Accept (Y/N)	Recovery Depth (cm)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
		Longitude/Easting	Lattidue/ Northing			

Sample Description: surface cover, (density), moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Sample Containers:

Analyses:

Vane Shear Log Form

Project: ______________________

Location: ______________________

Technician: ______________________

Date: ______________________

Vane Diameter	Vane constant (α)
16mm (0.63")	2
20mm (0.78")	1
25.4mm (1")	0.5
65mm (2.56")	0.029

$S_U = \alpha \times Scale$

Horizontal Datum: ______________________

Test Location ID	Coordinates		Test Time	Water Depth in feet	Test Depth below Mudline in feet	Vane Diameter in mm	Vane Scale Reading in kPa	Undrained Shear Strength (S_U)		Test Type		Notes
	Easting	Northing						in kPa	in lbs/ft^2	Peak [P] Residual [R]		
										P	R	
										P	R	
										P	R	
										P	R	
										P	R	
										P	R	
										P	R	
										P	R	
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										P	R	
										P	R	
										P	R	
										P	R	
										P	R	
										P	R	

Note - 1 kPa = 20.89 psf