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Memorandum

To: Anne Summers and Marcel Hermans – Port of Portland
From: Ben Hung, Todd Thornburg, and John Verduin, PE – Anchor Environmental, L.L.C.
CC: Krista Koehl and Jim McKenna – Port of Portland; Tom Schadt and Elizabeth Appy – Anchor Environmental, L.L.C.
Date: November 30, 2007
Re: Proposed Sampling and Analysis Plan for Additional Sediment Quality Characterization for Phase I of the Removal Action Port of Portland— Terminal 4 Removal Action and Maintenance Dredging T4 slip 3

This memorandum presents the proposed sampling and analysis plan (SAP) to conduct additional sampling and sediment quality testing at the Port of Portland's Marine Terminal 4. One objective of the additional sampling and sediment quality testing is to provide vertical constraints for the design of Phase I of the Removal Action (Phase I) dredge prism. Another objective is to confirm the sediment quality characteristics within the dredge prism required for navigation maintenance by providing more recent data specifically for those sediments. Because the planned maintenance dredge area is within Slip 3 in an area designated for dredging by EPA in the Action Memorandum (May 2006), EPA has indicated a desire to incorporate the dredging into Phase I of the removal action. As requested, the specific plans for the maintenance dredging area are being provided to EPA for review and consideration in a separate technical memorandum. To ensure efficient review and approvals for meeting the timeframe for the 2008 work window, the SAP includes additional samples from within the area planned for maintenance dredging.

Although both areas to be dredged are within the Superfund Site and evaluated under the Action Memorandum, the terms Phase I area and maintenance dredge prism will be used to distinguish the two prisms due to the different sediment quality characteristics and rationale for moving the two dredge areas up into Phase I of removal action implementation.

A secondary objective of this sampling event is to obtain additional material from within the dredge prisms to perform additional disposal characterization testing once the dredge prisms

have been finalized. An aliquot from each new sample interval will be containerized and archived for potential inclusion in separate composites representing the dredge prisms. Once the dredge prisms have been finalized, archived material from intervals within each dredge prism will be composited into two composite samples (one from each dredge prism – Phase I and maintenance dredge area) and submitted for appropriate analysis. This analysis will focus on determining suitability and relevant requirements for the disposal operations. (NOTE TO REVIEWERS: our thinking on preparing a composite sample for disposal for each dredge prism is in case one project gets delayed for some unknown/unforeseen reason then we will have each dredge prism characterized for disposal and will be able to move forward).

As presented in the *Abatement Measures Proposal* (Anchor 2007), Phase I dredging activities in Slip 3 will focus on the highest risk surface sediments, removing surface materials with PEC exceedance ratios greater than 20. Figure 1 shows the proposed Phase I dredge areas (as well as the proposed maintenance dredging area). The Phase I target footprints will be removed down to dredge elevations established using existing and proposed cores located within the dredge footprints. These dredge elevations will be established to remove materials above a PEC exceedance ratio of 10 within the footprints. Based on current information, the Phase I dredge cuts will vary in thickness up to 3 feet within the footprints shown on the drawings. Cores will be collected within these footprints to provide a higher density of information on which to base the design and refine the dredge elevations. In addition, archived sample intervals from locations T4-B411-03 and T4-B411-04 representing intervals shallower than -46.0 NGVD will be analyzed to provide additional information on which to base the design. These archived intervals were collected during the Terminal 4 Early Action sampling effort in January 2007 (Sediment Quality Characterization Adjacent the Sheetpile Wall in Slip 3).

Eight sediment cores will be taken from within the Phase I dredge prism in Slip 3. One additional Phase I core will be taken near Berth 414 to help bound the relatively high concentration area at T4-B414-01. Additionally, two cores will be taken from within the maintenance dredging prism to confirm the sediment quality characteristics within the maintenance dredge prism. Sample locations and additional coring information is provided in Table 1. Figure 1 depicts the proposed core locations for Phase I and maintenance dredging.

The Phase I cores in Slip 3 will improve the accuracy of the target dredge elevations. The cores were located based on existing sediment chemistry data, site bathymetry and the sheet pile wall stability conditions. Two cores (-05 and -07) will be located within a trough that is below elevation -46 feet NGVD and within 50 feet of the sheet pile wall. Dredge cuts within this trough are limited due to wall stability concerns. These cores will help determine depth of contamination in this area.

Concentrations within Slip 3 generally decrease rapidly with depth. A target coring depth of eight feet is anticipated to be deep enough to determine the depth of contamination at locations near the head of the slip (-01 through -07). The depth of contamination is anticipated to be deepest at T4-PI-08, so a ten foot coring depth is specified at that location. A target coring depth of 8 feet is also proposed at locations T4-PI-09 and at the maintenance dredging locations T4-MD-01 and T4-MD-02.

Field Operations and Equipment

The field operations, equipment, sample handling and analysis will be performed using the previously approved procedures specified in the 2004 *Terminal 4 Early Action Engineering Evaluation/Cost Analysis Work Plan* (BBL 2004), Appendix A, Field Sampling Plan and Quality Assurance Project Plan.

Sediment cores will be collected using a vibracore with a 3-inch or 4-inch-diameter core barrel deployed from the sampling vessel. A subcontractor will provide the vessel, vessel operator, vibracore, and coring technician. The depth of recovery will be measured and recorded. If the depth of penetration is evident from a mudline trace on the core barrel, this depth will also be recorded. Sampling depths will be corrected for coring-induced compaction by multiplying the observed depth in the core by a compaction correction factor (equals penetration depth divided by recovery depth).

As samples are collected, logs and field notes of sediment sampling activities and observations will be maintained in a project notebook. Included in this documentation will be the following:

- Estimated elevation of each sediment sample (relative to the NGVD project datum)
- Positioning information, including coordinates and/or measurements
- Date and time of sampling

- Field descriptions of the sediment
- Log of sample IDs and compositing scheme
- Chronological occurrence of events during sampling operations
- Deviations, if any, from the specifications of this SAP

Sample Handling

The sediment cores and river water will be taken to a facility on shore for processing and preparation for shipping to the laboratory. Sediment cores will be kept vertical until such time as they are split and core logs are prepared. Sediment cores will be sectioned into 1-foot intervals.

Containerized sediment will be transported to the laboratory under proper chain-of-custody procedures for further processing and testing after subsampling and compositing is completed. The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container and consultant's office address) to enable positive identification.

A sufficient amount of material from each interval will be containerized for use in a dredge prism composite that will be tested for disposal characteristics. This material will be archived at the laboratory until after the dredge prism is defined. An aliquot from each sample interval representing the dredge prism will be composited to prepare the sample. This composite may also include material from the previously archived sample intervals. A TCLP test will be performed on the composite. The parameters that will be performed on the leachate from the TCLP will be determined based on the bulk sediment chemistry data from the intervals within the dredge prism.

Laboratory Analysis

Analytical Resources, Inc. (ARI) in Tukwila Washington will perform the bulk sediment testing. All of the core intervals from the Phase I dredge prism will be analyzed upon receipt by the lab. All of the core intervals from the maintenance dredging cores representing elevation -43 NGVD and higher will be analyzed. Archived sample intervals from locations T4-B411-03 and T4-B411-04 within the Phase I dredge prism will be removed from the archive and analyzed at the same time as the newly collected intervals.

The following analysis will be performed for sediment quality characterization:

- Semivolatile organics
- Total petroleum hydrocarbons (diesel and motor oil range)
- Metals (Cd, Pb, Zn)
- DDTs
- PCBs
- Total organic carbon
- Moisture content
- Grain size (sample volume permitting)

The following analysis will be performed for disposal characterization:

- TCLP (Leachate will be analyzed to determine concentrations of site COPCs, or a subset of site COPCs. Selected TCLP parameters will be based on the results of bulk sediment chemistry data from within the dredge prism)

The specific parameters, methods, and detection limits are provided on Table 2.

References

Blasland, Bouck, & Lee, Inc. (BBL). 2004. *Work Plan, Terminal 4 Early Action Engineering Evaluation/Cost Analysis*. Report prepared for Port of Portland, Portland, Oregon. February 23, 2004.

Attachments

Table 1 – Proposed Sample Locations and Compositing Scheme

Table 2 – Parameters, Methods, and Detection Limits

Figure 1 – Sample Location Plan

Table 1 - Proposed Sample Locations and Coring Information
Phase I - Terminal 4 Removal Action
Port of Portland

Sample ID	Northing	Easting	Estimated Mudline Depth (NGVD)	Target Core Length
T4-PI-01	713364.167	7620455.997	-42 feet	8 feet
T4-PI-02	713280.715	7620433.570	-35 feet	8 feet
T4-PI-03	713352.414	7620280.883	-45 feet	8 feet
T4-PI-04	713370.212	7620177.795	-41 feet	8 feet
T4-PI-05	713183.766	7619991.165	-46 feet	8 feet
T4-PI-06	713364.167	7620455.997	-46 feet	8 feet
T4-PI-07	713280.715	7620433.570	-45 feet	8 feet
T4-PI-08	713352.414	7620280.883	-39 feet	10 feet
T4-PI-09	712893.4924	7619692.630	-12 feet	8 feet
T4-MD-01	713494.370	7619742.129	-38 feet	8 feet
T4-MD-02	713519.020	7619480.006	-38 feet	8 feet

Table 2 - Parameters, Methods, Detection and Reporting Limits for Bulk Sediment
Phase I - Terminal 4 Removal Action
Port of Portland

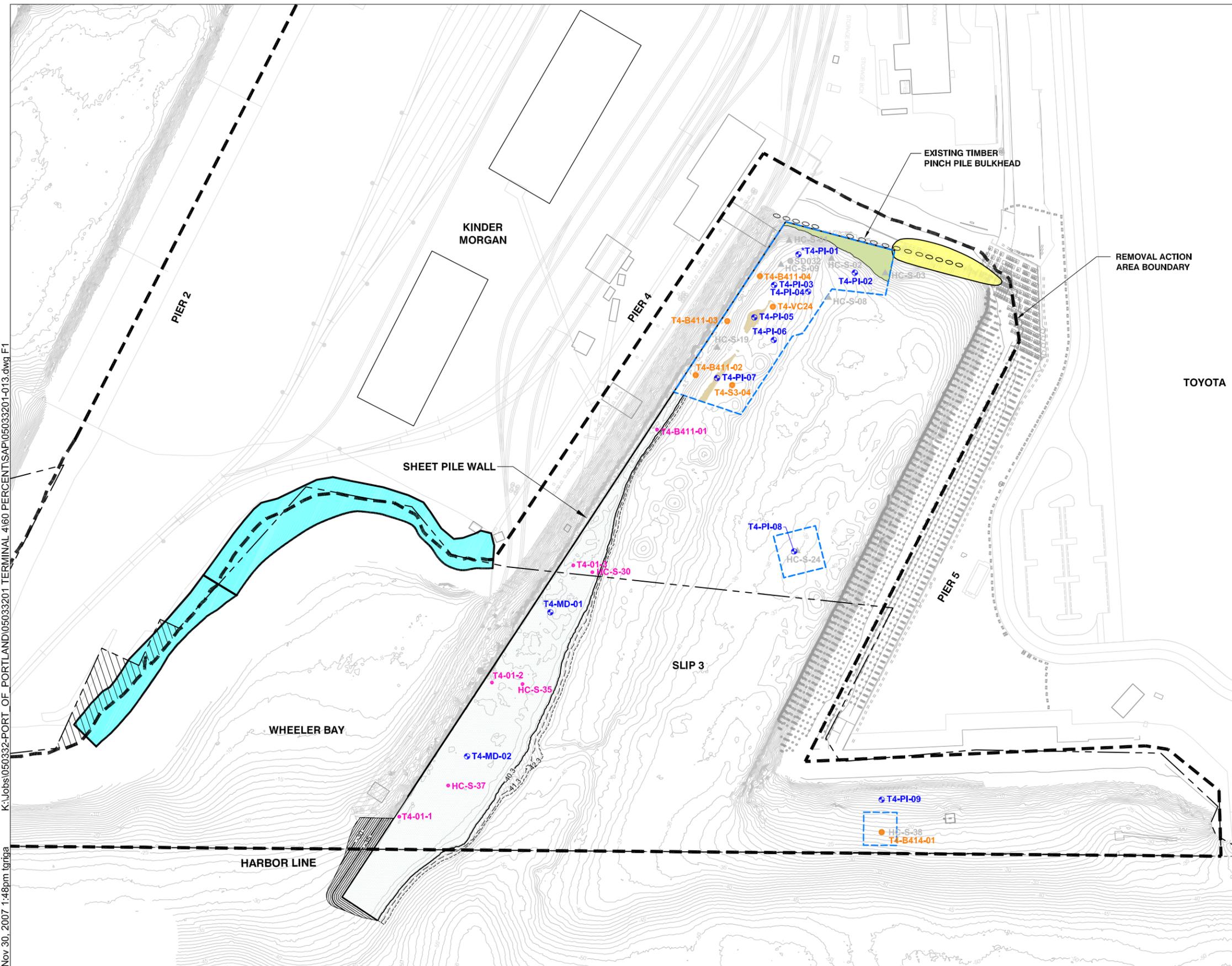
Parameter	Analytical Method	Method Detection Limit	Method Reporting Limit
Conventionals		Percent	Percent
Total organic carbon	Plumb, 1981	41	200
Grain Size	ASTM D422/PSEP	--	0.10%
Moisture Content	Method 160.3	--	0.01%
Metals		(mg/kg)	(mg/kg)
Arsenic	6020	0.04	0.2
Cadmium	6020	0.02	0.2
Chromium	6020	0.12	0.5
Copper	6020	0.21	0.5
Lead	6020	0.36	1
Mercury	7471	0.005	0.05
Nickel	6020	0.16	0.5
Silver	6020	0.01	0.2
Zinc	6020	3.57	4
Semivolatile Organics		(ug/kg)	(ug/kg)
Naphthalene	8270-SIM	2.74	6.7
2-Methylnaphthalene	8270-SIM	3.34	6.7
Acenaphthylene	8270-SIM	2.47	6.7
Acenaphthene	8270-SIM	4.29	6.7
Fluorene	8270-SIM	3.58	6.7
Phenanthrene	8270-SIM	4.47	6.7
Anthracene	8270-SIM	3.25	6.7
Fluoranthene	8270-SIM	3.4	6.7
Pyrene	8270-SIM	3.46	6.7
Benz(a)anthracene	8270-SIM	6.18	6.7
Chrysene	8270-SIM	2.74	6.7
Benzo(b)fluoranthene	8270-SIM	6.02	6.7
Benzo(k)fluoranthene	8270-SIM	5.88	6.7
Benzo(a)pyrene	8270-SIM	2.39	6.7
Indeno(1,2,3-cd)pyrene	8270-SIM	3.39	6.7
Dibenz(a,h)anthracene	8270-SIM	5.59	6.7
Benzo(g,h,i)perylene	8270-SIM	3.45	6.7
Dimethyl phthalate	8270-SIM	1.59	13.4
Diethyl phthalate	8270-SIM	4.255	13.4
Di-n-butyl phthalate	8270-SIM	2.95	13.4
Butylbenzyl phthalate	8270-SIM	0.885	13.4
Bis(2-ethylhexyl) phthalate	8270-SIM	11.9	13.4
Di-n-octyl phthalate	8270-SIM	3.4	13.4
Total Petroleum Hydrocarbons		(mg/kg)	(mg/kg)
TPH-diesel	NW-TPHDx	1.89	5
TPH-motor oil	NW-TPHDx	3.27	10
Pesticides		(ug/kg)	(ug/kg)
4,4'-DDE	8081A	0.548	2
4,4'-DDD	8081A	0.417	2
4,4'-DDT	8081A	0.646	2
2,4'-DDE	8081A	0.917	2
2,4'-DDD	8081A	0.921	2
2,4'-DDT	8081A	1.261	2

Table 2 - Parameters, Methods, Detection and Reporting Limits for Bulk Sediment
Phase I - Terminal 4 Removal Action
Port of Portland

Parameter	Analytical Method	Method Detection Limit	Method Reporting Limit
PCBs		(ug/kg)	(ug/kg)
Aroclor 1016	8082	1.12	4
Aroclor 1221	8082	-	4
Aroclor 1232	8082	-	4
Aroclor 1242	8082	-	4
Aroclor 1248	8082	-	4
Aroclor 1254	8082	-	4
Aroclor 1260	8082	1.33	4
Aroclor 1262	8082	-	4
Aroclor 1268	8082	-	4
Disposal Characterization			
TCLP (Prep Method 1311)	TBD ¹	TBD	TBD

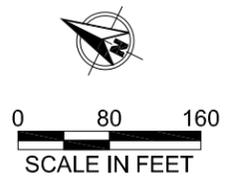
1. To be determined based on bulk sediment chemistry results and disposal facility requirements.

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- T4-PI-04 PROPOSED SAMPLE LOCATION AND DESIGNATION (* COLLECT SAMPLES AS CLOSE TO RIPRAP SLOPE AS POSSIBLE)
- PROPOSED PHASE I DREDGE AREAS
- POTENTIAL NO-DREDGE AREA (BELOW ELEVATION -46 FEET NGVD AND WITHIN 50 FEET OF THE SHEET PILE WALL)
- T4-B411-04 PREVIOUS SURFACE AND SUBSURFACE SAMPLE LOCATION WITHIN THE PROPOSED PHASE I DREDGE AREAS WHERE DEPTH OF CONTAMINATION IS CONSTRAINED
- ▲ HC-S-03 PREVIOUS SURFACE SAMPLE LOCATION WITHIN THE PHASE I DREDGE AREAS WHERE DEPTH OF CONTAMINATION IS UNCONSTRAINED
- T4-01-2 EXISTING SURFACE AND SUBSURFACE SAMPLE LOCATION WITHIN THE B410/411 MAINTENANCE DREDGE AREA
- HEAD OF SLIP 3 CAP
- AREA OF EXPECTED RIPRAP MATERIAL
- WHEELER BAY SHORELINE STABILIZATION
- CITY OF PORTLAND PROPERTY
- DSL PROPERTY LINE
- BERTH 410/411 MAINTENANCE DREDGE AREA

NOTES:
 1. HORIZONTAL DATUM: PORT OF PORTLAND LOCAL PROJECTION (INTERNATIONAL FEET)
 VERTICAL DATUM: NGVD 29-47
 CONTOUR INTERVAL = 1 FT
 2. BATHYMETRIC SURVEY BY PORT OF PORTLAND DATED MAY, 2007



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Figure 1
 Proposed Maintenance Dredge and Phase I Removal Action Design Core Locations
 Terminal 4 Removal Action
 Portland, Oregon