Characterization Report

PORT OF PORTLAND

Port of Portland
Portland, Oregon

September 17, 2004

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Characterization Report

Respectfully submitted,

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Acronyms and Abbreviations

ADCM	acoustic Doppler current meter
ADCP	acoustic Doppler current profiler
AINW	Archaeological Investigations Northwest
AOC	Administrative Order on Consent
ASTM	American Society for Testing and Materials
bgs	below ground surface
ºC	degrees Celsius
CAS	Columbia Analytical Services
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm/sec	centimeters per second
COPC	chemical(s) of potential concern
CPT	cone penetrometer test
CRD	Columbia River Datum
CST	column settling test
CU	consolidated-undrained
DDT	dichlorodiphenyltrichloroethane
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
DQO	data quality objective
DRET	dredging elutriate test
EE/CA	engineering evaluation/cost analysis
FCR	Field Change Request
FSP	field sampling plan
ft/ft	foot per foot (also feet per feet)
g/L	grams per liter
GPS	global positioning system
HCM	hydrogeologic conceptual model
KMBT	Kinder Morgan Bulk Terminals
LL	liquid limit
LWG	Lower Willamette Group
MET	modified elutriate test
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/L	milligrams per liter
MRL	method reporting limit
mS/cm	milliSeimens per centimeter
MSL	mean sea level
MSS	Marine Sampling Systems
mV	millivolts
NGVD	National Geodetic Vertical Datum

Acronyms and Abbreviations (cont.)

NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NTCRA	Non-Time-Critical Removal Action
NTU	nephelometer turbidity unit
OAR	Oregon Administrative Regulation
OCR	overconsolidation ratio
ORP	oxidation reduction potential
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pcf	pounds per cubic foot
PEC	probable effects concentration
PL	plastic limit
Port	Port of Portland
psf	pounds per square foot
psi	pounds per square inch
psia	pounds per square inch absolute
PVC	polyvinyl chloride
QAPP	quality assurance project plan
RI/FS	remedial investigation/feasibility study
SC	specific conductivity
SCPT	seismic cone penetrometer test
SQG	sediment quality guideline
SPR	Standard Penetration Resistance
SPT	Standard Penetration Test
SVOC	semivolatile organic compound
TCLP	toxicity characteristics leaching procedure
TCLT	thin-column leaching test
tDDT	total DDT
TE	tidal efficiency
TEC	threshold effects concentration
tPAH	total PAH
TPH	total petroleum hydrocarbons
TOC	total organic carbon
TSCA	Toxic Substances Control Act
tsf	tons per square foot
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
USEPA	U.S. Environmental Protection Agency
UU	unconsolidated-undrained
YSI	Yellow Springs Instrument Company, Inc.

Executive Summary

Background and Purpose

In 2000, the U.S. Environmental Protection Agency (USEPA) added the Portland Harbor Superfund Site to the National Priorities List pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. In fall 2001, the USEPA and ten of the Superfund Site's potentially responsible parties entered into an Administrative Order on Consent for Remedial Investigation/Feasibility Study (RI/FS). The RI/FS will characterize the nature and extent of contamination and assess the biological and human health risks at the Superfund Site. The Administrative Order on Consent also allows Early Actions to be conducted to address known contamination at specific locations within the Superfund Site.

Prior to the listing of the Superfund Site, the Port of Portland (Port) had completed an RI of the sediments at marine Terminal 4 under Oregon Department of Environmental Quality oversight. Because known contamination exists, the Port is conducting a Non-Time-Critical Removal Action (NTCRA) under an Administrative Order on Consent for Removal Action (the AOC) executed by the Port and USEPA in October 2003.

The AOC requires the Port to conduct an engineering evaluation and cost analysis (EE/CA) of various alternatives for the Terminal 4 Removal Action consistent with USEPA guidance on conducting NTCRAs. In the EE/CA, Removal Action alternatives will be developed, compared, and ranked to assess their relative performance at meeting specific objectives. To facilitate the EE/CA process, existing data from the Terminal 4 Removal Action Area were evaluated to determine whether those data provide information necessary and sufficient for evaluating Removal Action alternatives. The review of existing data identified gaps in information ("data gaps") specific to physical, engineering, hydrogeologic, sediment quality, dredged sediment quality, and hydraulics and sedimentation characteristics of the Removal Action Area. For each data gap, data quality objectives (DQOs) were developed in the work plan to describe the type of data needed, use of the data, methods for obtaining the data, and quality control criteria for the data. It is important to note that throughout the analysis of the data presented in this report, and in the development of the EE/CA Removal Action alternatives, additional data gaps may be determined. If this occurs, additional efforts, including field studies, may be necessary.
This Removal Action Area characterization report summarizes the field exploration, sampling, testing, and analytical activities conducted to meet a subset of the DQOs related to physical, engineering, hydrogeologic, sediment quality, dredged sediment quality, and hydraulics and sedimentation characteristics of the Removal Action Area. This report presents information that will be used during the EE/CA to develop, compare, and rank Removal Action alternatives for their relative performance at meeting specific Removal Action Objectives.

Goals and Objectives

In the EE/CA work plan, gaps in the data and information that will be needed for evaluating Removal Action alternatives were identified. The work plan established specific goals and objectives for the field and laboratory activities undertaken during the characterization phase to fill data gaps. Section 2 of the characterization report describes the DQOs for those activities. In addition, Section 2 details the specific activities that were executed

to fill the data gaps. The specific data gaps identified in the EE/CA work plan and their status following completion of this characterization report are summarized in Table ES-1 below:

Table ES-1
Current Status of Data Gaps Identified in the EE/CA Work Plan

Characterization Group	**Data Gap Identified**	**Current Status of Data Gap**	**Characterization Report Section**
Physical	A lead-line survey below the piers.	Complete	Data will be evaluated in the context of the EE/CA.
Physical	A topographic grid survey.	**Not Complete**	**Slope transect surveys at designated locations to be performed subsequently.**
Engineering	Adequate spatial coverage of geotechnical explorations providing Standard Penetration Test (SPT) N-values; to be used in numerical modeling and other geotechnical analyses.	Complete	Numerical modeling will be presented in the EE/CA
Engineering	Geotechnical engineering properties of sediments/soil; to be used as input to geotechnical analyses.	Complete	Geotechnical analysis will be presented as part of the EE/CA
Engineering	Dynamic soil properties from shear wave velocity profiles and SPT N-values; to be used as input to soil-structure interaction and geotechnical analyses.	Complete	Geotechnical and modeling analysis will be presented as part of the EE/CA.
Hydrogeologic	Terminal 4-specific data for hydrogeological characterization of hydrologic units and their interactions.	**Partially Complete**	**Additional groundwater elevation data will be gathered during the wet season. Additional formation-specific information may be necessary to support modeling.**

Characterization Group	Data Gap Identified	Current Status of Data Gap	Characterization Report Section
Hydrogeologic	The potential influence of Gatton's Slough, a natural ravine that appears to be in-filled with low-permeability organic silt and clay deposits, on Terminal 4 hydrology.	Complete	Further analysis will be refined in the EE/CA.
Hydrogeologic	Hydrostratigraphic information about Terminal 4 sufficient to allow an evaluation of Removal Action alternatives.	Complete	Further analysis will be refined in the EE/CA.
Sediment Quality	Surface sediment quality, i.e., the nature and lateral extent of contamination.	Complete	Spatial analysis of contamination will be presented in the EE/CA.
Sediment Quality	Under-pier sediment quality.	Complete	Analysis will be presented in the EE/CA.
Sediment Quality	Subsurface sediment quality, i.e., the nature and vertical extent of contamination.	Complete	Analysis will be presented in the EE/CA.
Dredged Sediment Quality	Data to aid in assessing potential impacts to water quality during dredging.	Complete	Analysis will be presented in the EE/CA.
Dredged Sediment Quality	Data to aid in assessing onsite disposal.	**Partially Complete**	**TCLT data are pending completion of the chemical analysis.**
Dredged Sediment Quality	Data to aid in assessing offsite disposal.	Complete	Analysis will be presented in the EE/CA.
Hydraulics and Sedimentation	Data sufficient to estimate the amount of deposition likely to occur in the Removal Action Area and the chemical and physical characteristics of the deposited sediment.	**Partially Complete**	**Additional data will need to be collected under higher river stage conditions.**
Hydraulics and Sedimentation	Data on basin hydrology to allow an assessment of the range of flow conditions that may be expected during the Removal Action.	Complete	Analysis will be presented in the EE/CA.

Characterization Group	Data Gap Identified	Current Status of Data Gap	Characterization Report Section
Hydraulics and Sedimentation	Cross-sectional river velocity measurements for use in future hydrodynamic modeling.	Complete	Analysis will be presented in the EE/CA.
Hydraulics and Sedimentation	Velocity measurements within the slips to characterize current circulation.	Complete	Analysis will be presented in the EE/CA.
Hydraulics and Sedimentation	River stage measurements at the Removal Action Area near the mouth of the Willamette River or at a downstream location during high-flow periods that can be correlated to U.S. Geological Survey flow measurements.	**Partially Complete**	**Additional data will need to be collected under higher river stage conditions.**
Hydraulics and Sedimentation	Characterization of the river bottom over the study area.	Complete	Analysis and compilation of bathymetric data will be presented in the EE/CA.

A number of field and testing activities were conducted to gather the information needed to close these data gaps. Those activities and how they relate to activities proposed in the work plan are outlined in Section 2.

The goals and objectives of the field and laboratory activities proposed in the EE/CA work plan were achieved in accordance with that plan. Deviations from the work plan are summarized in Section 2 of the characterization report and more fully documented in Section 3. Work plan deviations are limited and fall into two broad categories: those necessitated by field conditions (for instance, an inability to core to a target depth because of refusal) and those formally approved through the Field Change Request process (for instance, a change from diver sampling to boat-based sampling at locations found to be unsafe for divers).

Field Exploration and Testing of Samples

During a field program conducted in March, April, and May 2004, numerous exploration and data gathering activities were executed in accordance with the EE/CA work plan. Section 3 of the characterization report describes the methodologies for activities undertaken during the field program — including such tasks as in-water and upland geotechnical borings, monitoring well installation, groundwater monitoring, cone penetrometer tests, sediment sampling, and the deployment of sediment traps — and outlines the laboratory analyses and field tests conducted on the resulting soil, sediment, leachate, elutriate, surface water, and groundwater samples.

Briefly stated, the following tasks were executed:

- Four in-water geotechnical borings were installed using mud rotary techniques. Soil samples collected from these borings were classified onsite and submitted to a subcontracted laboratory for geotechnical testing.

- A total of ten in-water cone penetrometer tests were completed to assess subsurface conditions and provide data to estimate geotechnical properties of soil/sediment.

- Three of the ten in-water cone penetrometer tests were completed to develop shear wave velocity profiles of the soils (relevant to soil behavior during earthquakes).

- Eleven in-water shallow mud rotary borings were completed for sediment sampling.

- One upland mud rotary geotechnical boring was completed to provide engineering data for evaluating slope and pier stability.

- Upland seismic cone penetrometer tests were conducted to determine dynamic soil properties of the upland soils above mudline elevation.

- Eleven monitoring wells were installed in the Terminal 4 upland: two shallow, five intermediate, one intermediate/deep, and three deep wells.

- Groundwater monitoring was conducted weekly between April 29 and June 3, 2004 at the 11 newly installed wells, as well as at four shallow wells previously installed by others.

- Samples of surface sediment (defined for this work as the top 1 foot below mudline) were collected at 32 locations (two in Berth 401, 15 in Slip 1, four in Wheeler Bay, nine in Slip 3, and two north of Berth 414).

- Samples of under-pier sediment were collected at 13 locations. Most under-pier samples were collected from the surface; two were collected from 0 to 2 feet below mudline.

- Samples of subsurface sediment were collected from 33 locations at 2-foot intervals below the top 1 foot.

- Two composite sediment samples were created, one representing sediment cores from Berth 401 and Slip 1, the other representing sediment cores from Wheeler Bay, Slip 3, and north of Berth 414.

- All sediment samples were submitted to a subcontracted laboratory for analysis of selected total metals, polycyclic aromatic hydrocarbons (PAHs) and phthalates, total DDT (i.e., the summation of the 2,4'- and 4,4'- isomers of DDT, DDD, and DDE), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons, total organic carbon, and grain size.

- In addition, the two composite sediment samples were analyzed for hazardous waste characteristics and were subjected to specialty procedures that yielded elutriate and leachate (i.e., aqueous) samples. Those

samples were analyzed for use in predicting potential water quality impacts during dredging, the settling characteristics of the sediment within a confined disposal facility (CDF), and potential short-term water quality impacts from a CDF.

- Hydraulics and sedimentation data were collected through the use of acoustic Doppler current profilers (ADCPs) to obtain cross-sectional velocity measurements for the Willamette River and Slips 1 and 3; acoustic Doppler current meters (ADCMs) were deployed in Slip 3; sediment traps were deployed in Slips 1 and 3 and Berth 414; and pressure transducers and a tide gage were installed to gather water level measurements in Slip 3 and at a location 3 miles downstream of Terminal 4.

Results of Field Tests and Laboratory Analyses

Section 4 of the characterization report summarizes the results of tests and analyses conducted in the field and by the subcontracted laboratories, including:

- visual classification of soil samples in the field;
- forty-two grain size analyses on discrete samples and three on composite samples;
- twenty-five Atterberg limits tests;
- three consolidation tests;
- triaxial compression tests on two samples;
- shear strength tests on four discrete samples and three composite samples;
- weekly groundwater monitoring at 15 wells;
- weekly depth to groundwater measurements at 15 wells;
- chemical analysis of 32 surface sediment, 14 under-pier sediment, 167 subsurface sediment, and eight sediment trap samples;
- specialty testing of composite sediment samples to be used in determining dredged sediment quality and the suitability of dredged sediment for onsite or offsite disposal during evaluation of the Removal Action alternatives; and
- ADCP, ADCM, and water level measurements.

Section 4 also discusses the quality of the data. Data quality can generally be summarized as follows:

- Geotechnical test results are in accordance with the standard of care required by the test methods and of good quality.

- Weekly groundwater monitoring was conducted April 29 to June 3, 2004, and pressure transducers were installed starting April 16, 2004. Groundwater parameters, especially dissolved oxygen, measured prior to May 5 and pressure transducer readings made prior to April 22 do not meet data quality objectives (DQOs) because of equipment malfunctions; all other groundwater data meet DQOs.

- All chemistry data for bulk sediment and sediment trap samples were found to be acceptable for use as qualified, and no data were rejected.

- All chemistry data for sediment elutriate and leachate samples were found to be acceptable for use as qualified, and no data were rejected.

- The cross-sectional velocity measurements obtained during the ADCP survey are valid and appropriate for use in the EE/CA, as are the current velocity and turbidity data obtained for Slip 3 with the ADCM units. The water level measurements recorded downstream and within Slip 3 are consistent and reasonable.

It is important to note that the weather was generally dry during the monitoring period and river flow was low. Therefore, the ADCP, ADCM, sediment trap, and water level data are representative only of such conditions and are not representative of the wide range of conditions possible in the Terminal 4 area, including periods of higher river flow and greater rainfall.

Findings

Section 5 of the characterization report discusses the test results presented in Section 4, with emphasis on what the test results and other data generated during the field program, in some cases in combination with previously existing data, indicate about various characteristics of the Removal Action Area. These characteristics can generally be summarized as follows:

Geotechnical engineering characteristics:

- A soil unit described as brown, loose to medium dense sand was encountered in the upland borings across Terminal 4. Saturated portions of the sand are likely prone to liquefaction during strong seismic shaking.

- A soil unit described as very soft, organic silt and clay was generally encountered in the top portion of in-water explorations. The results of consolidation tests indicate that these soils are highly compressible and would likely settle significantly under structural loads or the weight of fill. It is expected that these soils are normally consolidated and have very low undrained shear strengths.

- A soil unit described as very soft to medium stiff organic and inorganic silts and clays was encountered in upland explorations mainly to the east of the historical shoreline and east of Slips 1 and 3. Because this soil was encountered east of Slips 1 and 3, its geotechnical engineering characteristics would affect only upland structures underlain by this material, which exhibits relatively high compressibility. Heavy upland structures and fill placed on these deposits could potentially be subject to excessive time-dependent consolidation settlements.

- A soil unit described as interbedded silt and sand (medium stiff to stiff/medium dense) was encountered east of Gatton's Slough. This material may be normally consolidated to slightly overconsolidated at depths below 60 feet. Portions of these soils likely exhibit moderate compressibility, and undrained shear strength of the cohesive soils likely varies with depth based on the state of consolidation.

- A soil unit described as dark grey, loose to medium dense sand underlies large portions of the Terminal 4 area west of Gatton's Slough and was generally encountered below the fill in upland explorations and

below the surficial sediments in in-water explorations. The combination of fairly low density and small fines content of this material makes the saturated portions of the sand potentially prone to liquefaction during strong seismic shaking.

- Gravel and gravel and sand were encountered in the deep monitoring wells below the dark grey native sands. Because of its depth, this soil unit is not likely to impact structures or construction activities at the surface, although it will affect hydrogeologic aspects of the project.

Hydrogeologic characteristics:

- Groundwater elevations varied across Terminal 4 and were higher in the upland portions than at near-river locations. Horizontal hydraulic gradients were toward the river for groundwater in the upland fill, Unconsolidated Alluvial Deposits, and Troutdale Gravel, the three hydrostratigraphic units of interest. Because groundwater elevations were greater than river stage, groundwater was discharging to the Willamette River during the monitoring period. Estimated horizontal groundwater flow velocities may vary over five orders of magnitude in the various soil types encountered.

- The data indicate that vertical groundwater flow at Terminal 4 is dynamic and may be influenced by different factors, such as river stage or resistance to flow by fine-grained materials, at different locations. Vertical hydraulic gradients were primarily upward at some locations (e.g., intermediate to shallow groundwater at monitoring well cluster T4-MW02) and primarily downward at others (e.g., shallow to intermediate groundwater at T4-MW05 and intermediate to deep groundwater at T4-MW02), while vertical hydraulic gradient reversals were observed between shallow and intermediate groundwater and between intermediate and deep groundwater at T4-MW01 and T4-MW06.

- Tidally and precipitation-induced changes in the Willamette River stage caused changes in groundwater elevation that were similar in magnitude and direction for groundwater in the Unconsolidated Alluvial Deposits and Troutdale Gravel at monitoring well cluster T4-MW06.

- River stage-induced groundwater elevation changes were also observed for shallow, intermediate, and deep groundwater at T4-MW01, for shallow and intermediate groundwater at T4-MW04, for shallow groundwater at T4-MW06, and for deep groundwater at T4-MW02 and T4-MW03. The observed tidal effects in deep groundwater at the upland well locations (T4-MW02 and T4-MW03) likely indicate that the Troutdale Aquifer is under semi-confining conditions.

- Groundwater elevations and vertical and horizontal hydraulic gradients will likely vary at different river stages, particularly for groundwater in the upland fill during periods of higher river stage. During the monitoring period, the Willamette River stage was relatively low; additional groundwater data should be collected during a higher river stage to evaluate the effect of higher river stage on groundwater elevation and vertical and horizontal hydraulic gradients at Terminal 4.

Sediment quality characteristics:

Chemical concentrations in sediments were evaluated against two sediment quality guidelines: threshold effects concentrations (TECs); and probable effects concentrations (PECs). The TEC is a low effects guideline that

represents concentrations below which toxicity effects are unlikely to be observed in freshwater benthic invertebrates. The PEC is a probable effects guideline that represents concentrations above which toxicity effects are likely to be observed in freshwater benthic invertebrates. Additionally, a number of potentially bioaccumulative compounds such as PCBs, DDTs, and various metals will be evaluated and fully explored in the EE/CA risk assessment.

Exceedance ratios were calculated by dividing the chemical concentration by the TEC and PEC. A TEC exceedance ratio of greater than 1 indicates a concentration greater than the TEC. A PEC exceedance ratio of greater than 1 indicates a concentration greater than the PEC.

TEC exceedances are numerous and widespread. PEC exceedances, representing the highest chemical concentrations, are summarized below:

Surface Sediment

- some PAHs in some samples of Slip 1 surface sediment; the maximum PEC exceedance ratio for total PAHs was 2;
- total DDT in one Slip 1 surface sediment sample, with a PEC exceedance ratio of less than 2;
- total PCBs in one Slip 1 surface sediment sample, with a PEC exceedance ratio of less than 2;
- lead in one Wheeler Bay surface sediment sample, with a PEC exceedance ratio of less than 2;
- some PAHs in one sample of Wheeler Bay surface sediment; the PEC exceedance ratio for total PAHs in that sample was less than 2;
- lead in two samples and zinc in one sample of Slip 3 surface sediment; the lead PEC exceedance ratios were 2 and 5, and the zinc PEC exceedance ratio was less than 2; and
- some PAHs in some samples of Slip 3 surface sediment; the maximum PEC exceedance ratio for total PAHs was 26.

Under-Pier Sediment

- cadmium, lead, and zinc in one sample of Slip 1 under-pier sediment; the PEC exceedance ratios were 1, 15, and 2, respectively;
- some PAHs in two samples of Slip 1 under-pier sediment;
- cadmium, lead, and/or zinc in some samples of Slip 3 under-pier sediment; the maximum PEC exceedance ratios were 2, 13, and 4, respectively, all in the same sample; and
- some PAHs in some samples of Slip 3 under-pier sediment; the maximum PEC exceedance ratio for total PAHs was 18.

Subsurface Sediment

- zinc in one sample of Berth 401 subsurface sediment (not extending below 3 feet below mudline), with a PEC exceedance ratio of less than 2;
- lead and zinc in one sample of Slip 1 subsurface sediment, with PEC exceedance ratios of 2 and 1, respectively;

- some PAHs in some samples of Slip 1 subsurface sediment; however, total PAH concentrations in those samples were below the PEC;
- total DDD in one sample of Slip 1 subsurface sediment, with a PEC exceedance ratio of 2;
- lead and mercury in one sample of Wheeler Bay subsurface sediment, with PEC exceedance ratios of 24 and 1, respectively;
- some PAHs in some samples of Wheeler Bay subsurface sediment; the maximum PEC exceedance ratio for total PAHs was 4;
- mercury in one sample and lead in five samples of Slip 3 subsurface sediment; all had PEC exceedance ratios of 2 or less;
- some PAHs in some samples of Slip 3 subsurface sediment; the maximum PEC exceedance ratio for total PAHs was 3;
- total DDD and total DDT in one sample of Slip 3 subsurface sediment, with PEC exceedance ratios of 2 and 1, respectively; and
- total PCBs in one sample of Slip 3 subsurface sediment, with a PEC exceedance ratio of less than 2.

Dredged sediment quality characteristics:

- During the EE/CA**,** the results of two dredging elutriate tests will be compared to relevant surface water quality criteria to evaluate potential impacts to surface water during dredging.

- During the EE/CA, the results of one column settling test and one modified elutriate test will be evaluated to aid in determining design characteristics for a CDF.

- Two composite samples analyzed for characteristics that could impact offsite disposal decisions did not display hazardous waste characteristics, and toxicity characteristics leaching procedure (TCLP) concentrations for the samples were below the TCLP criteria. In addition, the two composite samples passed the paint filter test, indicating the material would likely be acceptable for transport from Terminal 4.

Hydraulics and sedimentation characteristics:

- Hydraulics within Slips 1 and 3 are affected by variations in river flow, river stage, ship-induced currents, and, to a lesser extent, localized currents from stormwater discharges.

- In general, river-induced currents in the slips will be low in velocity compared to the river velocity.

- Although river-induced currents have an influence on hydraulics of the Removal Action Area, current velocities are dominated by propeller-induced currents.

- Propeller-induced currents cause circulation and increased velocities and turbidity levels far from the paths that ships take in Slip 3.

- Sediment redistribution and transport by propeller-induced currents have important effects on overall hydrodynamics and sediment transport in the Removal Action Area.

- Ongoing river-induced sedimentation of suspended sediments occurs nearly continuously throughout the Removal Action Area. The periodic redistribution of this material affects long-term sediment accumulation patterns within the slips.

- The data gathered during the field program are representative of low-flow, low-rainfall conditions and so do not support characterization of hydraulics and sedimentation in the slips under high-flow, high-rainfall conditions.

- Although propeller-induced currents appear to be a more significant factor in sediment transport within the slips than are river-induced currents, the data are not appropriate for modeling potential sediment redistribution.

1. Introduction and Purpose

In 2000, the U.S. Environmental Protection Agency (USEPA) added the Portland Harbor Superfund Site (Superfund Site or Site) to the National Priorities List (NPL) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. § 9601, *et seq*. (CERCLA or Superfund) (USEPA, 2001). As is shown on Figure 1-1, the Superfund Site Initial Study Area encompasses about 6 miles of the Willamette River in Portland, Oregon and includes the Terminal 4 facility. The Port of Portland (Port) owns Terminal 4 and leases land there to several marine tenants. Figure 1-2 shows a 2002 aerial view of Terminal 4.

In fall 2001, the USEPA and ten of the Superfund Site's potentially responsible parties entered into an Administrative Order on Consent for a Remedial Investigation/Feasibility Study (RI/FS), CERCLA-10-2001-0240 (USEPA, 2001). The RI/FS will characterize the nature and extent of contamination and assess the biological and human health risks at the Superfund Site. The Administrative Order on Consent allows Early Actions to be conducted to address known contamination at specific locations within the Superfund Site. Contaminants found in Terminal 4 sediment samples during an RI led by the Oregon Department of Environmental Quality (DEQ) led to a determination that a removal action at Terminal 4 is warranted. Accordingly, the Port is conducting a Non-Time-Critical Removal Action under an Administrative Order on Consent for Removal Action (here after the AOC), CERCLA 10-2004-0009, executed by the Port and USEPA in October 2003. The Terminal 4 Removal Action Area, which is defined in the AOC, is shown on Figure 1-3.

The AOC requires the Port to conduct an engineering evaluation and cost analysis (EE/CA) of various alternatives for the Terminal 4 Removal Action. In the EE/CA, Removal Action alternatives will be developed, compared, and ranked to assess their relative performance at meeting specific objectives associated with the evaluation criteria of effectiveness, implementability, and cost. To facilitate the EE/CA process, existing data from the Terminal 4 Removal Action Area were first evaluated to determine whether they provide information necessary and sufficient to allow comparison of Removal Action alternatives, selection of a preferred alternative, preparation of a design, and implementation of the selected alternative. This evaluation of the existing data identified a number of data gaps associated with the characteristics of the Removal Action Area and with the impact of these characteristics on the selection, definition, and evaluation of Removal Action alternatives. For each data gap, data quality objectives (DQOs) were developed in accordance with USEPA guidance (USEPA, 2000) describing the type of data needed, use of the data, methods for obtaining the data, and other requirements such as accuracy, repeatability and quality control. These DQOs were presented in the EE/CA work plan (BBL, 2004a).

A field characterization effort was designed to meet a subset of the DQOs, namely those specific to physical, engineering, hydrogeologic, sediment quality, dredged sediment quality, and hydraulics and sedimentation characteristics of the Removal Action Area. The EE/CA work plan, which included a field sampling plan (FSP) and quality assurance project plan (QAPP), specified the sampling and analysis tasks that would be carried out to fill these data gaps and address the associated DQOs.

This characterization report summarizes the field exploration, sampling, testing, and laboratory activities carried out under the work plan and associated documents to meet these DQOs. Specific results and findings, as well as data quality and usability, are discussed for the data generated by these activities. The data presented in this

characterization report will provide additional information needed during preparation of the EE/CA to address those data gaps important to identifying Removal Action alternatives and also to facilitate the comparative evaluation of these alternatives for their ability to meet Removal Action Objectives.

This document is organized in the following manner:

Section 2 provides a detailed comparison of the scope of field exploration, sampling, testing, and analytical activities as proposed in the work plan and as executed, together with a discussion of deviations from the work plan.

Section 3 describes the overall methodology for the field exploration, sampling, testing, and analytical activities with details of the procedures, equipment, and standard methods followed during these activities.

Section 4 summarizes the results of the exploration, sampling, testing, and analytical activities in text, tables, and figures, with comments on the quality of the data. All data collected are attached in appendices in paper-copy and electronic formats.

Section 5 provides a brief summary of the understanding of the site conditions based on the data collected during the field exploration, sampling, testing, and analytical activities.

2. Goals and Objectives of the Field Program

In the EE/CA work plan (BBL, 2004a), gaps in the data and information that will be needed for evaluating Removal Action alternatives for the Terminal 4 Removal Action Area were identified. The work plan established specific goals and objectives for the field and laboratory activities to be undertaken during the characterization phase of the project for the purpose of filling data gaps in the physical, engineering, hydrogeologic, sediment quality, dredged sediment quality, and hydraulics and sedimentation characteristics of the Removal Action Area.

In this section of the Removal Action Area characterization report, the data gaps identified in the EE/CA work plan are reviewed; the activities conducted to fill those data gaps are briefly described; and deviations from the work plan are summarized. The latter two topics are then expanded upon in Section 3.

The goals and objectives of the field and laboratory activities proposed in the EE/CA work plan were achieved in accordance with that plan. Work plan deviations fall into two broad categories: deviations necessitated by field conditions (for instance, an inability to core to a target depth because of refusal) and deviations formally approved through the Field Change Request process (for instance, a change from diver sampling to boat-based sampling at locations found to be unsafe for divers).

2.1 Identification of Data Gaps

The objective of the field and laboratory activities was to fill data gaps identified in the EE/CA work plan (BBL, 2004a). In the EE/CA work plan, data were evaluated to identify gaps for the following areas:

- history, cultural resources, and land use;
- physical characteristics;
- ecological and human health risk characteristics;
- engineering characteristics;
- hydrogeologic characteristics;
- recontamination source characteristics;
- sediment quality characteristics;
- dredged sediment quality characteristics; and
- hydraulics and sedimentation characteristics.

Of these, the following three areas are not further discussed in this characterization report for the reasons specified:

- No data gaps were identified in the area of history, cultural resources, and land use. The history and land use are sufficiently understood and existing cultural resource information, subject to acceptance by the Tribes, is sufficient to perform the work specified for the EE/CA. During the collection of sediment and soil samples from cores and boreholes, Archaeological Investigations Northwest (AINW) of Portland, Oregon monitored the samples for artifacts or other archaeological deposits to meet the

substantive provisions of the National Historic Preservation Act within the framework of CERCLA. AINW's report is presented in Appendix I.

- Data gaps were identified in the area of ecological and human health risk characteristics. These data gaps, however, cannot be filled by the characterization effort alone. Ecological and human health risks can be fully evaluated only in the context of the Removal Action alternatives. This process will be completed during the preparation of the EE/CA through the comparative evaluation of the Removal Action alternatives.

- Data for use in determining recontamination source characteristics are now being collected and will be discussed in a separate memorandum.

Data gaps were identified in the areas of physical, engineering, hydrogeologic, sediment quality, dredged sediment quality, and hydraulics and sedimentation characteristics. One of the two data gaps identified for physical characteristics (a lead-line survey below the piers) is interconnected with the engineering characteristics of the under-pier areas and discussed with the engineering characteristics. The other physical characteristics data gap (a topographical grid survey) was considered more appropriate to address after Removal Action alternatives are selected; accordingly, this data collection activity will be performed at a later stage.

Similarly, certain data gaps identified for engineering characteristics (i.e., slope stability, settlement and consolidation assessment, and liquefaction potential assessment) can be addressed only after the Removal Action alternatives are selected. Therefore, these data gaps will be filled during preparation of the EE/CA and the development and evaluation of the alternatives.

In the process of identifying data gaps, DQOs were established to ensure that new data collected to fill the gaps would be of appropriate quantity and quality. The development of DQOs for the Removal Action is detailed in the work plan and reiterated here in Table 2-1. Section 7 of the work plan proposed the rationale, scope, and specifications for the field investigation, sampling, testing, and laboratory activities proposed for filling data gaps in the six areas addressed, including methods, equipment, procedures, and operating and testing protocols and standards to meet the DQOs.

The following subsections discuss in detail these specifications, any deviations from them, and whether the deviations have affected the DQOs. The following discussion is also summarized in Table 2-2 to facilitate verification that the characterization effort presented in this report followed the scope and specifications set forth in the work plan.

2.2 Engineering Characteristics

The DQO for engineering characteristics was to collect sufficient engineering data to support development of Removal Action alternatives in the EE/CA. As discussed in the work plan (BBL, 2004a), various technologies within the primary methods of dredging and capping have specific data needs. This section briefly describes known engineering characteristics of the Removal Action Area, reiterates data gaps identified in the work plan,

describes field work and laboratory procedures conducted during the March 2004 to April 2004 Terminal 4 field program, and explains how the data gaps have been filled with the data generated during that program.

On the basis of a review of available information, the known engineering characteristics of the Removal Action Area were found to be limited in terms of the geotechnical properties of sediment/soil. These limitations include index parameters, shear strength, and consolidation.

Following the rationale presented in the EE/CA work plan (BBL, 2004a), the engineering characteristics data gaps are summarized as follows:

- adequate spatial coverage (i.e., location, number, and depth) of geotechnical explorations providing Standard Penetration Test (SPT) N-values per American Society for Testing and Materials (ASTM) D 1586; to be used in empirical correlations to estimate soil parameters as input to numerical modeling and other geotechnical analyses;
- adequate characterization of geotechnical engineering properties of sediment/soil, including in-situ density, gradation, plasticity of fine-grained sediment/soil (i.e., Atterberg limits), organic content, specific gravity, consolidation, and triaxial shear strength; to be used as input to geotechnical analyses; and
- dynamic soil properties derived from shear wave velocity profiles and SPT N-values; to be used as input to soil-structure interaction and geotechnical analyses.

The following field activities and laboratory procedures were conducted to fill the data gaps:

- One upland mud rotary geotechnical boring was drilled by the active Kinder Morgan Bulk Terminals (KMBT) pier.

- One upland seismic cone penetrometer test (SCPT) exploration was conducted, including testing of shear wave velocities for the depth of the exploration.

- Four in-water mud rotary geotechnical borings were drilled within Slip 1 and Slip 3.

- Ten in-water cone penetrometer test (CPT) explorations were conducted within Slip 1, Slip 3, and Wheeler Bay, including testing of shear wave velocities for three of the CPTs for the full depth of the exploration.

- Field observation and classification of sediment/soil type was performed during sampling, and field testing of fine-grained soils for unconfined compressive strength was conducted using a pocket penetrometer.

- Field observations of vibracoring were made and piston sampling of recent sediment for thickness and physical properties was performed.

- Geotechnical laboratory testing of disturbed samples was performed (i.e., in-situ density, gradation, Atterberg limits, organic content, specific gravity), as was geotechnical laboratory testing of relatively

undisturbed samples (i.e., consolidation, U.S. Army Corps of Engineers [USACE]-modified consolidation, consolidated-undrained [CU] shear strength, and unconsolidated-undrained [UU] shear strength).

Section 3.1 describes the locations, numbers, and execution details for the field activities and laboratory procedures conducted to fill data gaps in the area of engineering characteristics. Filling these data gaps facilitated the development of geotechnical analysis cross sections within the slips and Wheeler Bay; the cross sections will support specific engineering analyses necessary to the evaluation of Removal Action alternatives.

2.2.1 Summary of Field Changes

Field activities related to engineering characteristics were completed in general accordance with the EE/CA work plan (BBL, 2004a). Deviations are summarized below. Details are provided in Section 3.1.6.

- A proposed mud rotary boring with testing of shear wave velocities (T4-GE03L) was changed to a seismic cone penetrometer with testing of shear wave velocities (T4-CP11); this was done under a formal Field Change Request (FCR) and was approved by USEPA.

- Total depths for explorations were generally as proposed in the work plan, but varied as a result of conditions encountered in the field.

- The overall scope of the geotechnical laboratory testing was essentially the same as proposed in the work plan, with appropriate adjustments reflecting conditions encountered in the field.

2.3 Hydrogeologic Characteristics

To analyze disposal technologies for the Removal Action, an understanding of relevant site geology and hydrogeology is required. Regional and Terminal 4-specific data are available; however, Terminal 4-specific data gaps were identified. This section briefly describes the regional and Terminal 4-specific geology and hydrogeology, reiterates data gaps identified in the Terminal 4-specific hydrogeologic characterization, and describes the field and laboratory work conducted and how the data gaps have been filled as a result of that work.

The regional geology of the Portland Basin and Willamette Valley is made up of the following major geologic formations, listed from youngest to oldest:

- **Unconsolidated Alluvial Deposits** (Pleistocene to Recent). These recent river and historical flood deposits consist of two main units (McFarland and Morgan, 1997):

  – Recent Alluvium. Deposition processes within the Willamette River have blanketed the low-lying areas with recent alluvium in and adjacent to the river. The recent alluvium consists of deposits of silt, sand, and gravel.

- Glaciofluvial Flood Deposits. Floods from Glacial Lake Missoula, which flowed up the Portland Basin and Willamette Valley from the Columbia River, deposited a thick sequence of sand, with layers of gravel, cobbles, and boulders.

- **Troutdale Formation** (Pliocene). This deposit includes both consolidated and unconsolidated sand, gravel, and cobbles and may be on the order of 100 feet in thickness at the Removal Action Area (BBL, 2004a).

- **Sandy River Mudstone Formation** (Miocene to Pliocene). This deposit is predominantly fine-grained, consisting of siltstone and claystone, and thins near the Tualatin Mountains to the west of Terminal 4.

- **Columbia River Basalt Group** (Miocene). This unit consists of a series of basalt flows originating from eastern Washington that spread over large areas of the Pacific Northwest.

Surficial geology for Terminal 4 consists of recent alluvium and artificial upland fill (Hart Crowser, 2000). The following geologic units have been identified for anticipated depths of interest at Terminal 4 (BBL, 2004a):

- Upland fill;
- Unconsolidated Alluvial Deposits; and
- Troutdale Formation.

Previous regional investigations have identified the following hydrogeologic (i.e., hydrostratigraphic) units (Swanson et al., 1993; McFarland and Morgan, 1997):

- **Unconsolidated Sedimentary Aquifer**. This aquifer comprises recent alluvial deposits and primarily Pleistocene catastrophic flood deposits that mantle much of the Portland Basin.

- **Troutdale Gravel Aquifer**. This aquifer is a highly productive sand and gravel deposit, and carefully constructed wells can yield up to 2,000 gallons per minute (McFarland and Morgan, 1997).

- **Undifferentiated Fine-Grained Units**. This unit is a sequence of confining units and aquifers. Subunits that may occur at depth below the Removal Action Area include Confining Unit 1, Troutdale Sandstone Aquifer, Confining Unit 2, Sand and Gravel Aquifer, and the Columbia River Basalt Group.

The Troutdale Gravel Aquifer serves as a regional drinking water supply for the City of Portland. In the vicinity of Terminal 4, the Troutdale Gravel Aquifer may discharge to the Willamette River, with groundwater moving upward through the fine-grained alluvium (Bridgewater Group, 2003).

In addition to the hydrostratigraphic units described for the regional hydrogeology, the uplands of Terminal 4 also include groundwater in the fill material. Groundwater in fill material is common to the Portland Harbor and Portland Basin in general, involving reclaimed or modified land, and is highly variable in gradation, hydraulic conductivity, and water quality (BBL, 2004a).

Groundwater elevation data collected in the Slip 3 uplands by Hart Crowser (2000) in 1999 suggested the presence of a downward vertical gradient between the upland fill material and the Unconsolidated Alluvial Deposits at depths of less than 45 feet. Groundwater elevations and horizontal gradients in upland fill material and Unconsolidated Alluvial Deposits in Slip 3 uplands were influenced by water levels in the Willamette River and groundwater flow was toward the river (Hart Crowser, 2000). Vertical and horizontal gradient data are currently unavailable for groundwater in upland portions of Slip 1 and Wheeler Bay and was a focus of the EE/CA field investigation.

Additional hydrogeologic investigations were proposed in the EE/CA work plan to address identified data gaps (BBL, 2004a). These data gaps are elaborated as follows:

- Terminal 4-specific data for hydrogeologic characterization of Slip 1 and Wheeler Bay uplands and deeper hydrologic units (e.g., deeper Unconsolidated Alluvial Deposits and Troutdale Gravel Aquifer) and the interaction of the deeper hydrologic units with shallower hydrologic units were not available.

- The potential influence of Gatton's Slough, a natural ravine that appears to be in-filled with low-permeability organic silt and clay deposits (BBL, 2004a), on Terminal 4 hydrogeology was unknown.

- Available Terminal 4 hydrostratigraphic information was insufficient to adequately develop and evaluate Removal Action alternatives.

To evaluate interactions of groundwater within the various hydrostratigraphic units in the upland area and the Removal Action Area, and to evaluate the interaction of upland area groundwater with the Willamette River and with sediments in the Removal Action Area, additional data needs were determined to revolve around the following analysis requirements:

- development of a general hydrologic model for the Terminal 4 Removal Action Area; and
- support for groundwater flow and contaminant transport modeling.

These analysis requirements will support activities for both the Terminal 4 Removal Action and upland source control evaluations.

Field and laboratory activities were conducted to fill the identified data gaps. These activities included:

- Installation of three monitoring well clusters near the Willamette River. One shallow well (e.g., less than 40 feet bgs), three intermediate wells (e.g., 45 to 80 feet bgs), and two deep wells (e.g. greater than 145 feet bgs) were installed to evaluate hydrogeologic factors influencing contaminant transport characteristics for sediments residing at the base of the slips.

- Installation of one well cluster at the Gatton's Slough organic silt/clay in Slip 1. One intermediate/deep well was installed to evaluate hydrogeologic characteristics of the in-filled material within Gatton's Slough.

- Installation of two monitoring well clusters upgradient of the slips. One shallow well, two intermediate wells, and one deep well were installed to evaluate hydrogeologic characteristics in the deeper portions of the upland area subsurface.

- Surveying of monitoring well top-of-casing elevations and ground surface elevations. Top-of-casing elevations were used in conjunction with depth to groundwater measurements to determine potentiometric surfaces of and vertical gradients between the three hydrostratigraphic units of interest beneath Terminal 4 (i.e., upland fill, Unconsolidated Alluvial Deposits, and Troutdale Gravel).

- Field observation of characteristics of soils from well borings and laboratory grain size testing of select soil samples. These analyses were conducted to estimate hydrologic parameters based on empirical relations and published values in the technical literature. Well details for four shallow monitoring wells (T4-MW01S, T4-MW02S, T4-MW03S, and T4-MW04S) installed by others were also reviewed for soil characteristics and well completion information.

Because the Removal Action is proceeding on a separate schedule from the upland investigations, the number of monitoring wells necessary for this study were installed during the field program. However, selected locations for the new monitoring wells were coordinated with the upland activities. Monitoring well installation methods are described in Section 3.2.1. Soil characteristics and grain size analyses are described in Section 4.1.2.

To fill data gaps in existing knowledge regarding hydrogeologic characteristics relevant to the analysis of Removal Action technologies, the following tasks were performed:

- Hydraulic connectivity of upland fill material to Unconsolidated Alluvial Deposits was evaluated.

- Groundwater contour maps were developed for each of the three hydrostratigraphic units of interest (i.e., upland fill, Unconsolidated Alluvial Deposits, and Troutdale Gravel), including an evaluation of horizontal flow gradients.

- Seasonal changes within each of the three units were evaluated to the extent possible within the time frame of the study. This was accomplished by water-level monitoring and by extrapolating data collected within the EE/CA data collection period based on seasonal trends and existing data from Hart Crowser (2000).

- Vertical groundwater gradients between hydraulically separate units were calculated.

- Groundwater flow characteristics of in-filled Gatton's Slough were evaluated.

- A hydrogeologic conceptual model was developed.

The results of these tasks are presented in Sections 4.2 and 5.2.

2.3.1 Summary of Field Changes

Field activities related to hydrogeologic characteristics were completed in general accordance with the EE/CA work plan (BBL, 2004a). Deviations are summarized below. Details are provided in Section 3.2.2.

- Completion depths for monitoring wells were generally as proposed in the work plan, but varied as a result of conditions encountered in the field.

- Sonic drilling methods were used instead of Becker® drilling techniques for installation of monitoring wells T4-MW01D, T4-MW02D, T4-MW03I/D, and T4-MW06D. These wells were completed to depths of approximately 165 feet bgs or greater.

- Planned deep monitoring well T4-MW05D was not installed because of greater than expected depths to the Troutdale Gravel and because it was determined that adequate information was obtained from other deep wells. Based on information from other deep wells, it was determined that the interaction between contaminated sediment and the Troutdale Gravel is less likely than originally believed. The change was approved by USEPA under FCR-3 (BBL, 2004b).

2.4 Sediment Quality Characteristics

The sediment quality characteristics of the Removal Action Area need to be sufficiently well understood so that the lateral and vertical extent (i.e., the area and volume) of contaminated sediment can be established to develop and evaluate the Removal Action alternatives.

Data gaps in information about the sediment quality characteristics were identified as:

- surface sediment quality, i.e., nature and lateral extent of contamination;
- under-pier sediment quality; and
- subsurface sediment quality, i.e., nature and vertical extent of contamination.

These data gaps are generally associated with the sediment in its present place; filling these data gaps will assist in establishing the extent of the sediment to be removed. The new data will also be used to estimate residual contamination, if it is determined to exist, and thus will serve as important inputs to the streamlined ecological and human health risk assessments that will be performed as part of the evaluation of the long-term effectiveness of the Removal Action alternatives.

Information about dredged sediment quality characteristics is relevant to describing sediment behavior during dredging and transportation to onsite or offsite disposal. Data gaps in dredged sediment quality characteristics are discussed in Section 2.5.

2.4.1 Surface Sediment Quality

Surface sediment is defined for this work as 0 to 1 foot below mudline. Surface sediment chemistry data will be used to evaluate the nature and lateral extent of contamination in the Removal Action Area. Insufficient surface sediment data for that evaluation was identified as a data gap. As a result, surface sediment samples were collected throughout the Removal Action Area. The surface sediment samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc); semivolatile organic compounds (SVOCs, including polycyclic aromatic hydrocarbons [PAHs] and phthalates); total dichlorodiphenyltrichloroethane (tDDT, which includes 2,4'-DDE, 2,4'-DDD, 2,4'-DDT, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT); polychlorinated biphenyls (PCBs, as Aroclors); total petroleum hydrocarbon (TPH) gasoline-range organics, diesel-range organics, and residual-range organics; total organic carbon (TOC); and grain size. Section 3.3.1 describes the number and locations of surface sediment samples collected during the field program.

2.4.2 Under-Pier Sediment Quality

No existing under-pier sediment data were identified, which constituted a data gap. Under-pier surface sediment chemistry data are needed to determine whether removal action is required under the piers, as well as to determine the potential lateral extent of contamination under the piers. Therefore, under-pier surface sediment samples were collected in the Removal Action Area, including Berth 401, Berth 405, Berth 408, Berth 410, Berth 411, and the former Berth 412. Under-pier surface sediment samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc); SVOCs (including PAHs and phthalates); tDDT; PCBs (as Aroclors); TPH gasoline-range organics, diesel-range organics, and residual-range organics; TOC; and grain size. Section 3.3.2 describes the number and locations of under-pier surface sediment samples collected during the field program.

2.4.3 Subsurface Sediment Quality

Subsurface (i.e., deeper than 1 foot below mudline) sediment chemistry data will be used to determine the nature and vertical extent of contamination in the Removal Action Area. Insufficient subsurface sediment data for that evaluation was identified as a data gap. As a result, subsurface sediment samples were collected in the Removal Action Area, including Berth 401, Slip 1, Wheeler Bay, Slip 3, and north of Berth 414. Subsurface sediment samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc); SVOCs (including PAHs and phthalates); tDDT; PCBs (as Aroclors); TPH gasoline-range organics, diesel-range organics, and residual-range organics; TOC; and grain size. Section 3.3.3 describes the number and locations of subsurface sediment samples collected during the field program.

2.4.4 Summary of Field Changes

Field activities related to sediment quality characteristics were generally completed in accordance with the EE/CA work plan (BBL, 2004a). Deviations are summarized below. Details are provided in Section 3.3.4.

2.4.4.1 Surface Sediment Quality

Surface sediment sampling and analysis were performed in accordance with the EE/CA work plan (BBL, 2004a). No deviations were made to the specifications set forth in the work plan.

2.4.4.2 Under-Pier Sediment Quality

Under-pier sediment sampling and analysis were performed in accordance with the EE/CA work plan (BBL, 2004a) with the following exceptions:

- Fifteen locations were proposed for under-pier surface sediment sampling; 13 under-pier surface sediment samples were collected. Two locations were omitted because, despite multiple attempts, access was blocked or insufficient surface sediment was retrieved.

- Under-pier surface sediment samples were proposed for collection by scuba divers using hand-held core tubes. Five locations were determined unsafe for diver sampling. As a result, these locations were sampled from a small boat using a hand-operated push core sampler, as described in FCR-4 (BBL, 2004c). An under-pier surface sediment sample was not collected at one of these locations due to repeated refusal.

2.4.4.3 Subsurface Sediment Quality

Subsurface sediment sampling and analysis were performed in accordance with the EE/CA work plan (BBL, 2004a) with the following exceptions:

- Thirty-two locations were proposed for subsurface sediment sampling; 33 locations were sampled. Location T4-VC33 was added near Berth 411 for characterization purposes associated with the Berth 411 deepening.

- Ten vibracore locations were later reoccupied with a shallow mud rotary drill rig on a barge to obtain collocated sediment samples using conventional in-water geotechnical sampling techniques, as described in FCR-5 (BBL, 2004d).

2.5 Dredged Sediment Quality Characteristics

Dredged sediment quality characteristics need to be understood sufficiently well to assist in the development and evaluation of Removal Action alternatives that involve dredging and subsequent transportation of the sediment to onsite or offsite disposal.

Data gaps in information about the dredged sediment quality characteristics were identified as:

- data to aid in assessing potential impacts to water quality during dredging;
- data to aid in assessing onsite disposal; and
- data to aid in assessing offsite disposal.

The data gathered for each of these assessments are discussed below.

2.5.1 Potential Water Quality Impacts During Dredging

Dredging elutriate data are required for assessing potential short-term water quality impacts during dredging, a component of the evaluation of Removal Action alternatives for their overall short-term effectiveness. Dredging elutriate tests (DRETs) were performed in accordance with protocols outlined in DiGiano et al. (1995) on two composite samples created for the DRETs: one composite of the cores collected from Berth 401 and Slip 1 and the other of the cores collected from Wheeler Bay, Slip 3, and north of Berth 414. The composite sediment samples consisted of representative subsamples of the top 11 feet (i.e., 0 to 11 feet below mudline) of each core. The DRET elutriate samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc); SVOCs (including PAHs and phthalates); tDDT; PCBs (as Aroclors); TPH diesel-range organics and residual-range organics; ammonia; sulfide; and total suspended solids (TSS). Section 3.4.1 describes the DRET analysis.

2.5.2 Sediment Quality Characteristics Impacting Onsite Disposal

Certain sediment quality characteristics need to be understood sufficiently well so that Removal Action alternatives involving onsite disposal can be adequately developed and evaluated. These characteristics are:

- settling velocity of the dredged material;
- short-term water quality impacts from a confined disposal facility (CDF); and
- long-term water quality impacts from a CDF.

Settling velocities were evaluated through column settling tests (CSTs). Short-term water quality impacts were evaluated through modified elutriate tests (METs). Long-term water quality impacts were evaluated through thin-column leaching tests (TCLTs).

2.5.2.1 Settling Velocity of the Dredged Material

A CST was performed in accordance with protocols outlined in USACE (1987) to evaluate the settling velocity of dredged material placed in a CDF. The CST was performed on a composite sediment sample consisting of the cores from Wheeler Bay, Slip 3, and north of Berth 414. The composite sediment sample consisted of representative subsamples of the top 11 feet (i.e., 0 to 11 feet below mudline) of each core. The aqueous samples generated during the CST were analyzed for TSS. Section 3.4.3 describes the CST analysis.

2.5.2.2 Potential Short-Term Water Quality Impacts from a CDF

A MET was completed to evaluate potential short-term water quality impacts from a CDF. The MET was performed in accordance with protocols outlined in Palermo (1985). The MET was performed on a composite sediment sample consisting of cores from Wheeler Bay, Slip 3, and north of Berth 414. The composite sediment sample consisted of representative subsamples of the top 11 feet (i.e., 0 to 11 feet below mudline) of each core. The MET elutriate was analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc); SVOCs (including PAHs and phthalates); tDDT; PCBs (as Aroclors); and TSS. Section 3.4.4 describes the MET analysis.

2.5.2.3 Potential Long-Term Water Quality Impacts from a CDF

A TCLT was completed to evaluate potential long-term water quality impacts from a CDF. The TCLT was performed in accordance with protocols outlined in Myers et al. (1996). The TCLT was performed on a composite sediment sample consisting of cores from Wheeler Bay, Slip 3, and north of Berth 414. The composite sediment sample consisted of representative subsamples of the top 11 feet (i.e., 0 to 11 feet below mudline) of each core. The TCLT leachate was analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc); SVOCs (including PAHs and phthalates); tDDT; and PCBs (as Aroclors). Section 3.4.2 describes the TCLT analysis, which is still ongoing.

2.5.3 Sediment Quality Characteristics Impacting Offsite Disposal in a Subtitle D Landfill

Certain sediment quality characteristics need to be understood sufficiently well so that Removal Action alternatives involving offsite disposal can be adequately developed and evaluated. These data needs include:

- chemical data relevant to a hazardous waste determination;
- chemical data relevant to a Toxic Substances Control Act (TSCA) waste determination; and
- chemical and physical data relevant to landfill acceptance criteria.

For the offsite disposal of dredged sediment to be feasible, the dredged sediment must be deemed suitable for disposal at a Subtitle D landfill. The following landfill acceptance criteria are used in making that assessment:

- a hazardous waste determination;

- toxicity characteristics leaching procedure (TCLP) testing;
- a TSCA determination;
- data on the generation and loss of free liquid; and
- additional landfill-specific acceptance criteria.

Two composite sediment samples were analyzed for hazardous waste determination, TCLP, and generation and loss of free liquid. One of these composite sediment samples consisted of cores collected from Berth 401 and Slip 1; the other consisted of cores from Wheeler Bay, Slip 3, and north of Berth 414. The composite sediment samples consisted of representative subsamples of the top 11 feet (i.e., 0 to 11 feet below mudline) of each core.

The two composite sediment samples were analyzed for ignitability, corrosivity, and reactivity for the hazardous waste determination. TCLP leachates of the two composite sediment samples were analyzed for the TCLP list of metals, pesticides, herbicides, volatile organic compounds, and SVOCs. The two composite sediment samples also underwent paint filter tests to evaluate the generation and loss of free liquid.

PCB data generated from the analysis of surface and subsurface sediment samples will be evaluated as part of the TSCA determination. TPH data generated from the analysis of surface and subsurface sediment samples will be evaluated against landfill acceptance criteria for TPH.

2.5.4 Summary of Field Changes

Field activities related to dredged sediment quality characteristics were completed in accordance with the EE/CA work plan (BBL, 2004a) with the exceptions described below. Details are provided in Section 3.4.5.

2.5.4.1 Potential Water Quality Impacts During Dredging

- Composite samples T4-CM1 and T4-CM2 for DRET analysis were to include sediment from the interval representing 0 to 11 feet below mudline of each core. However, in locations where core recovery length was less than 11 feet, sediment from 0 foot below mudline to the bottom of the core was included in the composite.

- Because of poor recovery at some locations, there was insufficient sediment from certain intervals to include in composite T4-CM1.

- Composite T4-CM2 contained sediment from all cores within the designated area except T4-VC33, which was selected for sampling after completion of the T4-CM2 composite.

- The DRET elutriate samples were not analyzed for TPH gasoline-range organics.

2.5.4.2 Sediment Quality Characteristics Impacting Onsite Disposal

- As described above, sample T4-VC33 was not included in the T4-CM2 composite for CST, MET, and TCLT analyses.

2.5.4.3 Sediment Quality Characteristics Impacting Offsite Disposal in a Subtitle D Landfill

- As described above, the number and depths of samples included in composites differed slightly from what was proposed in the EE/CA work plan.

2.6 Hydraulics and Sedimentation Characteristics

As the work plan stated, the degree to which the Terminal 4 shoreline and local bathymetry influence river stage in the Willamette River should be adequately understood so that potential changes to river flood stages as a result of berth modification by a Removal Action alternative can be adequately evaluated. The basic data types of interest include:

- basin hydrology data;
- water stage measurement and corresponding flow measurement;
- upstream flow data; and
- velocity measurements.

These data were considered of interest to support the following evaluations in the EE/CA:

- assessment of recontamination potential from upstream and local sources of chemicals of potential concern (COPC) loading to the Removal Action Area;
- evaluation of sediment transport processes within the Removal Action Area so that the Removal Action and associated activities may be designed and implemented in a way that minimizes future recontamination potential and maintenance dredging requirements; and
- assessment of the degree to which the Terminal 4 shoreline and local bathymetry influence river stage in the Willamette River.

The assessment of the potential for post-Removal Action recontamination due to upstream sources will focus primarily on the deposition of particulate-bound COPCs on sediment particles transported from upstream. Bed load transport of COPCs and the transport of dissolved-phase COPCs to the Removal Action Area will not be a primary focus of the evaluation, because contaminants are primarily associated with fine particles. The assessment of the potential for recontamination due to local sources will include the evaluation of stormwater outfalls, wind-blown materials, groundwater plumes, and the redistribution of sediments within the slips as a result of propeller scour.

The interaction between river and berth hydraulics in the Removal Action Area is affected by fluctuations in river conditions, variations in sediment supply from upstream and stormwater sources, and the impacts of propeller scour from shipping operations. The evaluation of sediment transport in the Removal Action Area will be facilitated through the development of a mathematical hydrodynamic and sediment transport model and an analysis of available empirical data and data collected during the EE/CA field program. Hydrodynamics in the Removal Action Area will be simulated using a model of the Lower Willamette River developed using the USACE's RMA-2 hydrodynamic model coupled with the SED2D sediment transport model to predict flow circulation and sedimentation patterns. RMA-2 is a two-dimensional depth-averaged finite element hydrodynamic model used to compute water surface elevations and horizontal velocity components. SED2D, the sediment transport companion to the RMA-2 model, is a two-dimensional model used to compute depth-averaged sediment transport using the flows computed by RMA-2. To evaluate potential sedimentation patterns at Terminal 4 due to river influences, SED2D will be run in deposition-only mode for several representative grain sizes to estimate the relative spatial variation in sedimentation patterns.

The above-stated basic data types of interest for the scoping of the field investigations were elaborated as follows:

- an estimate of the amount of deposition likely to occur in the Removal Action Area of particles borne by upstream flow and the chemical and physical characteristics of the deposited sediment;
- basin hydrology data, such as monthly flow statistics, the effect of any upstream dams on flow, and similar information to allow an assessment of the range of flow conditions that may be expected during the Removal Action;
- cross-sectional river velocity measurements to allow future hydrodynamic modeling;
- velocity measurements at several locations within the slip areas to characterize eddy circulation and differentiate between (1) low or moderate river flow in the absence of vessel activity, (2) high river flow in the absence of vessel activity, and (3) vessel activity;
- river stage measurements at the Removal Action Area near the mouth of the Willamette River or at some downstream location during high-flow periods that can be correlated in time to U.S. Geological Survey (USGS) flow measurements; and
- characterization of the river bottom over the study area.

A summary of the field activities and analyses conducted to address these data needs, as well as any deviations from the EE/CA work plan, follows.

2.6.1 Recontamination Source Characterization

Potential sources of post-Removal Action recontamination are currently being evaluated in a separate action. The EE/CA work plan outlined two initiatives of in-river source characterization to support the evaluation of potential upstream sources of recontamination:

- measurement of particle-phase COPC concentrations on sediment collected through the deployment of sediment traps and bed load samplers; and

- measurement of contaminant concentrations in water quality samples collected upstream of the Removal Action Area during stormwater events.

Following submittal of the EE/CA work plan, it was decided to perform only sediment trap sampling during the current field program. The stormwater analysis will be conducted under a separate action by the Port.

The deployment and retrieval of sediment traps during the field program is discussed in Section 2.6.5.

2.6.2 Basin Hydrology Characteristics

Basin hydrology data, including flow statistics, river-stage statistics, and rainfall data, were compiled over the field data collection period and are presented in Section 4.5.6. An evaluation of historical basin hydrology data will also be conducted during the EE/CA to allow an assessment of the range of flow conditions that may be expected during the Removal Action.

2.6.3 Cross-Sectional River Velocity Measurements

The methodology, protocol, and procedures for the collection of cross-sectional river velocity measurements were outlined in the EE/CA work plan (BBL, 2004a), which specified the collection of three rounds of velocity depth profiles along eight transects running part way across the Willamette River from the Terminal 4 shoreline and along four transects across Slips 1 and 3. The velocity depth profiles were to be collected using a boat-mounted acoustic Doppler current profiler (ADCP). The objective of the ADCP survey was to provide "snapshots" of the magnitude and direction of flow in the river adjacent to Terminal 4 and within the slips, in order to evaluate flow and circulation patterns caused by the river and to support the development of future hydrodynamic models.

One round, consisting of four ADCP survey cycles, was completed along 14 preplanned transects on March 25, 2004, coinciding with the ebb portion of a spring tide. During the survey, it was noted that the flow patterns in Slips 1 and 3 exhibited low velocities and indicated minimal influence from the river. It was also noted that a ship departing from Slip 3 induced currents that persisted throughout the slip for some time. As a result, the second ADCP survey was postponed until there were higher flow conditions in the river or the survey could be conducted in conjunction with a ship departure from Slip 3. However, low-flow conditions were observed throughout April and May 2004, and the survey could not be coordinated with a ship departure in the time frame. Therefore, the second ADCP survey was not conducted.

The ADCP survey methods are discussed in Section 3.5.1 and the survey results are presented in Section 4.5.2.

2.6.4 Oceanographic Arrays

The EE/CA work plan (BBL, 2004a) outlines the activities associated with the deployment of four moored oceanographic arrays to collect near-bottom velocity, turbidity, and sedimentation data within and immediately

upstream of the Removal Action Area. Sediment traps were placed at all four locations as originally planned. The scope of the oceanographic data collection was subsequently refined to focus on Slip 3, where two equipment arrays were deployed. Those arrays consisted of sediment traps and velocity and turbidity meters (i.e., acoustic Doppler current meters [ADCMs]). In Slip 3, the units were bottom-mounted, diver-deployed sensors that each consisted of an ADCM mounted 3 feet above the river bottom to record turbidity, current velocity, and direction at each location. One unit was deployed in the southeast corner of the slip and one near the mouth of the slip, co-located with the sediment traps at these locations.

The goal of the oceanographic data collection was to characterize eddy circulation and differentiate between (1) currents and turbidity levels during low or moderate river flow in the absence of vessel activity, (2) high river flow in the absence of vessel activity, and (3) vessel activity. The objective was to assess the effects of variation in river condition, stormwater runoff events, and vessel activity on hydrodynamic conditions within Slip 3.

ADCM deployment and retrieval in Slip 3 occurred over three periods: March 18 through April 6, 2004; April 6/7 through April 26, 2004; and April 27 through May 17, 2004. The ADCM configuration, deployment, and retrieval are discussed in Section 3.5.3. The ADCM data are presented in Section 4.5.4, including an evaluation of the data in conjunction with a log of vessel movement within Slip 3 during the deployment period.

2.6.5 Sediment Trap Sampling

The goal of the sediment trap sampling effort was to evaluate potential COPC fluxes resulting from the deposition of suspended particles and associated chemicals. The objective was to measure the sediment mass depositional flux over the study period and COPC concentrations associated with the sediment particles collected in the traps. As discussed, the equipment arrays were bottom-mounted to avoid interference from vessel movements. The amended sediment trap deployment and retrieval activities included:

- providing sediment traps consisting of 15 glass tubes mounted on a weighted frame and covered with a turbulence baffle at the mouth; sodium azide solution was used to reduce bacterial decay of organic material and potential disturbance of the samples by aquatic organisms;

- installing four sediment traps (one in Slip 1, two in Slip 3, and one near the upstream end of Terminal 4) for two 30-day periods; and

- collecting samples from each trap for chemical and physical analyses following each deployment period.

Sediment traps A through D were deployed on March 18 and 19, 2004. The four traps were harvested on April 6 and 7, 2004. One of the sediment traps was relocated upstream of Outfall No. 53 to differentiate between upstream river flow and discharges from Outfall No. 53. This change was formally requested and approved under FCR-6 (BBL, 2004g). Relocating the sediment traps allowed samples to be collected outside of the potential influence of Outfall No. 53. Following approval of FCR-6, the following activities were conducted during the week of April 26, 2004:

- One sediment trap platform was installed at the upstream end of Berth 416, upstream of Outfall No. 53. The platform was deployed near the river bottom by strapping it to a piling.

- Sediment traps were redeployed at three existing locations (Slip 1, Slip 3, and immediately upstream of Slip 3), and one trap was deployed at the new location near the upstream end of Berth 416.

Sediment traps deployed during the second round were recovered on May 17, 2004. Data on local precipitation during the deployment interval were obtained from the National Weather Service's website for Portland, Oregon to assess the influence of precipitation on sediment loading in the traps. The construction, deployment, and retrieval of the sediment traps are discussed in Section 3.5.2. Sediment trap data are presented in Section 4.5.3.

2.6.6 River Stage Measurements

The EE/CA work plan (BBL, 2004a) describes activities associated with the installation of tide gages near the downstream end of Slip 3 and at a location approximately 1.25 miles downstream of the Removal Action Area. The water surface elevation data obtained from these locations will be used to evaluate the interaction between river and berth hydraulics in the Removal Action Area.

Additional information related to the Removal Action Area was obtained following submittal of the EE/CA work plan. As a consequence, additional details related to the methodology, protocols, and procedures for the river stage measurements were subsequently developed. The amended data collection activities were documented and approved in FCR-1 (BBL, 2004f). The amended scope of work for the river stage measurements included:

- collecting water surface elevations at a suitable location approximately 1.25 miles downstream of Terminal 4 and upstream of the confluence of the Multnomah Channel (exact location to be determined in the field based on access);

- establishing the tide gage location to the Columbia River Datum (CRD), field surveying to a vertical accuracy of within 0.1 foot, and programming the gages so that the water depth measurements were automatically converted and stored as elevation;

- recording water level measurements within Slip 3 using pressure transducers installed on the ADCM sensors;

- measuring the water surface elevation from shore following pressure transducer deployment to allow the conversion of relative water surface fluctuations to actual surface elevations; and

- recording water levels at 5-minute intervals for a 60-day period.

The water surface elevations were recorded from March 23 to May 18, 2004 in general accordance with the amended scope of work. The configuration and deployment of the tide gage and pressure transducers/data loggers are described in Section 3.5.4. Water surface elevation data are presented in Section 4.5.5.

2.6.7 Bathymetric Data for the Removal Action Area

The following bathymetric data for the Removal Action Area were obtained from the Lower Willamette Group (LWG) and the Port for use in completing the EE/CA:

- Results of a multibeam bathymetric survey completed in May 2003 over the entire Removal Action Area were obtained from the LWG. The bathymetric data were generated in support of the LWG's RI/FS of the Portland Harbor Superfund Site.

- Results of a multibeam bathymetric survey completed in 2004 for Slip 3 were obtained from the Port. The data were generated under the Port's ongoing maintenance dredging program for Slip 3.

The bathymetric data are discussed in Section 5.5.

2.6.8 Summary of Field Changes

FCR-1 (BBL, 2004f) refined the scope of work for the hydraulics and sedimentation portion of the study. FCR-6 (BBL, 2004g) then detailed specific changes to accomplish the general changes described in FCR-1. Key points are summarized below. Details are provided in Section 3.5.5.

2.6.8.1 Cross-Sectional River Velocity Measurements

Following submittal of the EE/CA work plan, the scope of work for the ADCP survey was modified when it became evident that the first round of velocity depth profiles adequately described low-flow conditions and that high-flow conditions were not likely to occur during the study period. Initially, the second ADCP survey was postponed; ultimately, it was cancelled when high-flow conditions failed to occur.

The survey transect layout was also slightly revised in the field based on observed conditions to include one additional transect running all the way across the river.

2.6.8.2 Oceanographic Arrays

Because of potential interferences from vessel movement within the slips, bottom-mounted oceanographic arrays were used instead of moored arrays.

Four locations were originally identified for ADCM deployment. As approved in FCR-1 (BBL, 2004f), ADCMs were deployed at only two locations, both in Slip 3.

2.6.8.3 Sediment Trap Sampling

One of the sediment traps was relocated upstream of Outfall No. 53 for the second round of data collection. This change was made to differentiate between upstream river sources and discharge from Outfall No. 53. This change was formally requested and approved under FCR-6 (BBL, 2004g).

2.6.8.4 River Stage Measurements

The EE/CA work plan called for the installation of tide gages downstream of the Removal Action Area and in the downstream end of Slip 3. Under FCR-1 (BBL, 2004f), the plan was altered to call for the installation of two pressure transducers in Slip 3. The downstream tide gage was retained.

The EE/CA work plan called for river stage measurements during high-flow periods. River stage measurements were made only during low-flow conditions because no high-flow conditions occurred during the monitoring period.

Data Type	Table 2-1 Data Quality Objectives Development						
	Problem Statement	**Required Decision**	**Decision Inputs**	**Study Boundaries**	**Decision Rule**	**Decision Error Limits**	**Design for Obtaining Data**
History	The history of Terminal 4 should be sufficiently understood to evaluate for EE/CA purposes the influence of Terminal 4 operations on the nature and extent of contamination in the Removal Action Area.	Determine what activities could have contributed contamination and where.	Decision will require understanding of Terminal 4 history.	Terminal 4 property.	Terminal 4 history should be understood well enough to leave no substantial gaps in chronological continuity.	Not applicable.	None required. Existing information is sufficient.
Cultural Resources	The history of Terminal 4 should be sufficiently understood to evaluate the potential impact of the Removal Action on cultural resources within the Removal Action Area.	Determine what operational or spatial controls might be necessary during implementation of the Removal Action.	Decision will require understanding of Terminal 4 history.	Terminal 4 property.	Terminal 4 history should be understood well enough to leave no substantial gaps in chronological continuity.	Not applicable.	Oral histories may be required and would be gathered by others, independently from the Terminal 4 Removal Action. Samples, boreholes, and cores will be examined during collection for artifacts.
Land Use	The current and potential future land use of Terminal 4 should be understood well enough to identify potential constraints on the Removal Action.	Determine if current and potential future Terminal 4 land use could limit the type or location of Removal Action.	Decision will require a planning-level understanding of potential future land use and a thorough understanding of current land use at Terminal 4.	Terminal 4 property.	Current and potential future land use at Terminal 4 should be understood well enough to avoid conflicts with the Removal Action.	Not applicable.	Current Port operations and potential future Terminal 4 uses are subject to ongoing business planning processes.
Physical Characteristics	The physical configuration of the Removal Action Area should be sufficiently understood to safely and effectively explore the area and propose a Removal Action.	Determine the dimensions and other physical parameters of the Removal Action Area.	The decision will require bathymetric, topographic, geologic, and built-structure information.	The Removal Action Area and the immediately adjacent slopes and upland areas.	The physical configuration of the Removal Action Area will need to be known well enough to support evaluation of Removal Action alternatives and, ultimately, design.	Standard survey limits will apply.	Existing topography and bathymetry are sufficient for EE/CA except topographic information for above water line embankment slopes, to be gained by topographic surveys.

Data Type	Table 2-1 Data Quality Objectives Development						
	Problem Statement	**Required Decision**	**Decision Inputs**	**Study Boundaries**	**Decision Rule**	**Decision Error Limits**	**Design for Obtaining Data**
Ecological Health	The potential exposure pathways from sediment to ecological receptors should be sufficiently understood to confirm that they will be sufficiently attenuated by the Removal Action or, if not, that residual risk is acceptable.	Slip 3 and Wheeler Bay: Determine whether post-Removal Action risks are acceptable. Slip 1: Determine (1) extent of Removal Action needed in slip and (2) whether post-Removal Action risks are acceptable.	For the analysis of alternatives in the EE/CA, comparison will require data on the projected surface sediment chemistry to relevant sediment criteria. Once the selected Removal Action has been implemented, but prior to closure, confirmation sampling will be used to assess the actual residual risk.	Removal Action Area.	Benthos and Fish: 95% upper confidence limit (UCL95) for mean post-Removal Action surface sediment concentration in each unit, or other appropriate exposure unit, should not exceed chemical-specific SQGs. Upper Trophic Level Consumers: Aggregate exposure from Terminal 4 sediment should not exceed chemical- and receptor-specific lowest observed adverse effects level (LOAEL)-based reference dose. (Based on UCL95 exposure point concentrations). The Port will also provide risk estimates corresponding to the no observed adverse effects level (NOAEL). Additionally, potentially bioaccumulative compounds (PBTs) will be addressed in the risk assessment for representative receptors to address residual risk for the EE/CA alternatives.	Implied error rate is 5% or less chance that mean exposure will exceed relevant criterion.	Evaluation of existing habitat data and coordination with collection and evaluation of sediment chemistry data.

Data Type	Table 2-1 Data Quality Objectives Development						
	Problem Statement	**Required Decision**	**Decision Inputs**	**Study Boundaries**	**Decision Rule**	**Decision Error Limits**	**Design for Obtaining Data**
Human Health	The potential exposure pathways from sediment to human users should be sufficiently understood to confirm that they will be sufficiently attenuated by the Removal Action or, if not, that residual risk from sediment is acceptable.	Determine whether post-Removal Action risk is acceptable for Removal Action alternatives.	Decision will require (1) data on surface sediment chemistry (projected post-Removal Action), AND (2) data on other exposure parameters (bioaccumulation, intake parameters, etc.) OR site-specific sediment quality guidelines (SQGs) from harborwide risk assessment if available.	Removal Action Area.	Remove contaminated sediment to ensure that contaminant levels are not above ARARS or above risk-based goals when ARARS are not available or are not protective. Other factors (e.g., detection limits, background) and uncertainties may also be considered. For carcinogenic effects in humans, USEPA's Superfund program uses 10^{-6} to 10^{-4} as an acceptable cancer risk range; for non-cancer effects, the goal is to limit exposures to levels below the reference dose (RfD). Oregon DEQ defines acceptable cancer risk as 10^{-6} for individual chemicals and 10^{-5} for multiple chemicals in deterministic risk assessments. Both USEPA acceptable risk for Superfund and Oregon DEQ acceptable risk levels will be addressed in the EE/CA.	Implied error rate is 5% or less chance that mean exposure will exceed relevant criterion.	Sediment sampling and development of exposure scenarios appropriate to Removal Action alternatives.
Engineering Characteristics	The engineering properties of the sediments should be sufficiently understood to evaluate short-term effectiveness of actions such as capping or dredging.	Determine if the sediments in the Removal Action Area can be effectively dredged using available equipment and/or capped using accepted technology.	Decision will require knowledge of physical properties of the sediments including standard penetration test, grain size, moisture content, Atterberg limits, organic content, bulk density, specific gravity, consolidation, and shear strength.	Removal Action Area.	The engineering properties of the sediments should be known at a level consistent with standard of practice in the Pacific Northwest for sediment remediation and other shoreline projects.	Accuracy of the individual geotechnical tests is set forth in the appropriate ASTM Method.	For sediment, utilize 10% to 20% of all vibracore sampling locations to obtain samples. Drill 3 geotechnical borings over the water. Perform 7 seismic cone penetrometer tests (SCPT) in-water. Laboratory testing to be comprised of particle size distribution test, Atterberg limits test, moisture content test, specific gravity test, organic content, triaxial testing (shear strength), and consolidation testing (compressibility). Obtain tip resistance, sleeve friction and pore pressure parameters as well as shear wave profiles from SCPTs.
	The properties of sediments within the Removal Action Area and the properties of soils in the vicinity of the Removal Action Area should be sufficiently understood to evaluate the interaction of sediments and nearby slopes, structures, and fixtures caused by Removal Action.	Determine the maximum practical dredging elevation adjacent to existing slopes and structures.	Decision will require geotechnical borings and related standard penetration tests as well as index testing of selected samples.	The Removal Action Area and immediately adjacent slopes and upland areas.	The engineering properties of the soils on the margins of the Removal Action Area should be known at a level consistent with the standard of practice for evaluation of slope stability using models such as Plaxis.	Accuracy of the individual geotechnical tests is set forth in the appropriate ASTM Method.	Drill boreholes at 6 locations. These boreholes will be completed as clustered monitoring wells. Drill 1 deep geotechnical boring for upland shear wave velocity profile testing. Drill 2 geotechnical borings. Laboratory testing to be comprised of particle size distribution test, Atterberg limits test, moisture content, specific gravity test, organic content, triaxial testing (shear strength), and consolidation testing (compressibility).

Data Type	Table 2-1 Data Quality Objectives Development						
	Problem Statement	**Required Decision**	**Decision Inputs**	**Study Boundaries**	**Decision Rule**	**Decision Error Limits**	**Design for Obtaining Data**
	The Removal Action Area itself should be sufficiently understood to evaluate the feasibility of onsite disposal of contaminated sediments.	Determine the feasibility of construction of a disposal facility within the Removal Action Area.	Decision will require geotechnical borings and related standard penetration tests as well as index testing of selected samples.	The Removal Action Area in general and critical areas such as those where closure berms or adjacent structures could present feasibility limitations for onsite disposal.	The engineering properties of the sediments within the Removal Action Area and in immediately adjacent areas should be known to a level consistent with the standard of practice for evaluation of onsite disposal.	Accuracy of the individual geotechnical tests is set forth in the appropriate ASTM Method.	Utilize 10% to 20% of samples at vibracore locations. Drill 2 geotechnical borings. Perform 7 SCPT within the slips and 3 SPCT in front of the slips. Collect in-situ soil parameters using the SPT test. Laboratory testing to be comprised of particle size distribution test, Atterberg limits test, moisture content test, specific gravity test, organic content, triaxial testing (shear strength), and consolidation testing (compressibility). Obtain tip resistance, sleeve friction and pore pressure parameters as well as shear wave profiles from SCPTs.
Hydrogeologic Characteristics	The Removal Action Area should be sufficiently understood to evaluate the feasibility of onsite disposal or in-situ capping of contaminated sediments.	Will contaminated sediments disposed of onsite be effectively contained for the long term?	Decision will require knowledge of hydrogeologic regime and groundwater quality.	Terminal 4 property surrounding the Removal Action Area, as necessary.	Hydrogeologic regime and groundwater quality information should be sufficiently understood to provide inputs to typical models such as ModFlow and MT3D.	Accuracy based on appropriate laboratory standards.	Perform elutriate testing to assess partitioning of absorbed contaminants into liquid phase during Removal Action. Perform thin-column leaching test to assess the long-term leaching potential of sediment to be disposed at disposal facilities or capped in situ.
Recontamination Source Characterization	Sources within and immediately adjacent to Removal Action Area could contribute contaminants in sufficient mass to ultimately recontaminate the Removal Action Area.	Determine if sources on or immediately adjacent to the Removal Action Area may result in recontamination.	Decision will require knowledge of contaminant mass loading from sources such as stormwater and groundwater.	Terminal 4 property surrounding the Removal Action Area, as necessary.	Mass loadings should be sufficiently understood to assess the potential for recontamination using models such as WASP, if necessary, or more simple approaches, if possible.	Mass loadings will need to be quantified such that analysis of recontamination within a 50- to 100-year design life will be possible.	Collect stormwater samples from outfalls, install monitoring wells and collect groundwater quality samples. (Note: these samples to be collected by others under Terminal 4 Slip 1 upland study.)
	Other sources of contamination to the river could contribute contaminants in sufficient mass to ultimately recontaminate the Removal Action Area.	Determine if other sources will result in contamination.	Decision will require knowledge of contaminant mass loading from offsite sources such as nearby facilities and upriver industrial and agricultural sources.	The Willamette River upstream and in the vicinity of Terminal 4.	Mass loadings should be sufficiently understood to assess the potential for recontamination using models such as WASP, if necessary, or more simple approaches, if possible.	Mass loadings will need to be quantified such that analysis of recontamination within a 50- to 100-year design life will be possible.	Analyze existing information for river water quality, analyze existing information on Willamette River sedimentation and sediment chemistry, and analyze suspended and bedload transport rates. Collect additional chemistry information on suspended sediment.
	Historical and existing sources of contaminants may be declining and future recontamination potential could be significantly lower than historical or present-day potential.	Evaluate historical concentration trends in sediment to determine whether or not sources are declining and whether or not present-day measured recontamination potential will be representative of the future trends.	Determination will require obtaining data on historical sediment concentration trends from sediment core profiles.	Removal Action Area.	Sediment cores must be obtainable from long-term depositional areas in the Removal Action Area. Detailed core chemistry profiles will also be needed.	Approximately +/- 2 ft vertically.	Qualitatively evaluate core chemistry profiles for better determination of change in sediment concentrations with depth.

Table 2-1
Data Quality Objectives Development

Data Type	Problem Statement	Required Decision	Decision Inputs	Study Boundaries	Decision Rule	Decision Error Limits	Design for Obtaining Data
Sediment Quality	The areal extent of surface sediment contamination should be delineated to determine the areal extent of sediment that requires remediation.	Determine areal extent of surface sediment contamination.	Decision will require evaluation of existing surface sediment chemistry data and collection of surface sediment samples for chemistry analysis to provide adequate coverage of the Removal Action Area.	Removal Action Area.	Surface sediment quality should be sufficiently understood to assess the areal extent of sediment contamination.	Approximately +/- 50 to 100 ft horizontally, the assumed length and width of a dredge sub-prism.	Collect surface sediment samples in the Removal Action Area and analyze for chemistry.
	The quality of surface sediment under the piers should be evaluated to determine if remediation is required for under-pier sediment.	Determine under-pier surface sediment quality.	Decision will require collection of under-pier surface sediment samples for chemistry analysis.	Under-pier areas within Removal Action Area.	Under-pier surface sediment quality should be sufficiently understood to assess the need for under-pier sediment remediation.	Approximately +/- 50 to 100 ft horizontally.	Collect under-pier surface sediment samples in the Removal Action Area and analyze for chemistry.
	The vertical extent of subsurface sediment contamination should be delineated to determine the depth and volume of sediment that requires remediation.	Determine vertical extent of subsurface sediment contamination.	Decision will require evaluation of existing subsurface sediment chemistry data and collection of subsurface sediment samples for chemistry analysis to provide adequate coverage of the Removal Action Area.	Removal Action Area.	Subsurface sediment quality should be sufficiently understood to assess the vertical extent of sediment contamination.	Approximately +/- 1 ft vertically, the assumed allowable amount of overdredge.	Collect subsurface sediment samples in the Removal Action Area and analyze for chemistry.
Dredged Sediment Transport and Disposal	The onsite transport and disposal characteristics of the sediments within the Removal Action Area should be understood.	Determine the effectiveness of onsite transport and disposal technologies.	Decision will require physical and chemical analysis of the contaminated sediments.	Removal Action Area.	Settling behavior, elutriate concentration, and leaching behavior should be understood at a level necessary to evaluate on-site disposal technologies.	Corps of Engineers protocols will apply.	Sediment samples will be tested for settling velocity, dredging and modified elutriate behavior, and column leaching behavior.
	The offsite transport and disposal characteristics of the sediments within the Removal Action Area should be understood.	Determine the effectiveness of offsite transport and disposal technologies.	Decision will require physical and chemical analysis of the contaminated sediments.	Removal Action Area.	Dewatering behavior, water treatment requirements, and disposal facility-specific testing requirements should be understood at a level sufficient to evaluate offsite disposal.	Facility-specific.	Sediment samples will be tested for generation and loss of free liquids, pore water quality, and disposal facility-specific tests.

Data Type	Table 2-1 Data Quality Objectives Development						
	Problem Statement	**Required Decision**	**Decision Inputs**	**Study Boundaries**	**Decision Rule**	**Decision Error Limits**	**Design for Obtaining Data**
Hydraulics and Sedimentation	Velocity and associated bed shear stress patterns in the Removal Action Area will likely control sedimentation rates important to evaluating recontamination potential.	Identify what areas will be most subject to sedimentation and how sedimentation will vary spatially in the Removal Action Area.	Decision will require an understanding of the spatial (two-dimensional) variation in flow velocities and associated bed shear stresses for a range of flow conditions.	Terminal 4 project area and section of Willamette River bounded by the project area.	Velocity patterns (location, direction and magnitude) and bed shear stresses (location and magnitude) should be measured and/or computed on a grid or scale of sufficient resolution to resolve the main flow circulation pathways and bathymetric variations.	Desired accuracy of velocity predictions or measurements is approximately +/- 0.2 ft/sec.	Measure velocity profiles along transects within Slips 1 and 3 of the Terminal 4 project area and across the Willamette River at the upstream, mid-point, and downstream boundary of the Removal Action Area. Compute velocities and shear stresses using the RMA2 hydrodynamic model, utilizing measured values for model calibration.
	The degree to which the Terminal 4 shoreline and local bathymetry influence river stage should be understood so that potential changes to river flood stages as a result of berth modifications can be predicted.	Determine if flood stage will be appreciably impacted by activities in the Removal Action Area.	Decision will require flood stage simulations for existing conditions and post-Removal Action conditions (and potentially during removal if local flow constrictions are put in place, such as sheet pile).	Main channel of the Willamette River to a distance upstream where changes in the local river geometry can be shown to have a minimal impact on river stage.	Terminal 4 modifications as a result of Removal Action should not have any appreciable impact on upstream or downstream flood stage.	Predicted flood stage for existing conditions and modified conditions using a river hydraulics model with accuracy of at least +/- 0.5 ft, or equal to accuracy of existing, accepted flood stage models for the Willamette River.	Obtain model inputs for existing flood stage simulations for the Willamette River, simulate existing conditions for the 100-yr flood, and modify river cross sections to reflect Removal Action at the Terminal 4 area and then repeat the 100-yr flood simulation. Compare water surface elevation predictions for each case.

This table was also presented in the EE/CA work plan (BBL, 2004a). Because no data gaps were identified for history, cultural, and land use and ecological and human health risk characteristics, and because recontamination source characteristics will be discussed in a separate memorandum, these characteristics are not discussed in the characterization report.

Table 2-2 Comparison of Proposed and Executed Field and Testing Activities	
Proposed in the EE/CA Work Plan (BBL, 2004a)	**Executed During the EE/CA Field Program**
Physical Characteristics	
Complete topographic survey on slopes at low river stage	Topographic survey of slopes was not performed during the EE/CA field program and is reserved for detailed design of Removal Action alternatives. The available data provides sufficient coverage to allow reliable estimation of slope inclination for engineering analysis. Slope inclination will be obtained based on the data from bathymetric surveys, which include the submerged portion of slopes except for inaccessible areas, combined with existing data from previous upland topographic surveys. During EE/CA implementation, upon selecting the analysis cross sections based on engineering characteristics data, slope transects will be performed to verify slope inclination assumptions at the analysis cross sections. Under-pier slopes in Slip 1 will not be accessible for safety reasons; other slopes may have similar access problems.
Complete lead-line survey below piers	A lead-line survey was performed on April 21, 2004 to measure water depth and associated sediment conditions along the length of Slip 3 in the vicinity of Pier 5, as access permitted; see Table 3-12 for results
Engineering Characteristics	
Perform six geotechnical borings (i.e., four in-water and two upland, including the upland seismic properties boring)	Four in-water geotechnical borings were performed; see Section 3.1.1. One upland geotechnical boring was performed; see Section 3.1.4. One upland SCPT was performed as a substitute to the remaining upland geotechnical boring; see Section 3.1.5.
Perform ten in-water SCPT or CPT explorations	Seven in-water CPTs and three in-water SCPTs were performed; see Section 3.1.2. One upland SCPT was performed as a substitute for a geotechnical boring; see Section 3.1.5
Perform one upland seismic properties boring	One upland SCPT was performed; see Section 3.1.5
Analyze selected geotechnical samples from borings for moisture content, grain size, Atterberg limits, organic content, specific gravity, consolidation, density, and shear strength	Geotechnical testing is summarized on Table 4-1; results are reported on Tables 4-2 through 4-5

Table 2-2 Comparison of Proposed and Executed Field and Testing Activities	
Proposed in the EE/CA Work Plan (BBL, 2004a)	**Executed During the EE/CA Field Program**
Additional work not included in the EE/CA work plan	Eleven in-water shallow mud rotary borings were installed to supplement vibracores; this was not in the EE/CA work plan and was approved as a field change
Hydrogeologic Characteristics	
Install three monitoring well clusters near the Willamette River screened within each hydrostratigraphic unit influencing contaminant transport	Monitoring well clusters T4-MW01, T4-MW04, and T4-MW06 were installed
Install one intermediate/shallow monitoring well cluster at the Gatton's Slough organic silt/clay in Slip 1	Monitoring well cluster T4-MW03 was installed
Install two monitoring well clusters upgradient of the slips screened within each hydrostratigraphic unit	Monitoring well clusters T4-MW02 and T4-MW05 were installed
Survey monitoring well top-of-casing elevations and ground surface elevations	See Table 3-7 for well completion details
Perform TCLTs	TCLTs are ongoing
Perform testing of sediment sorption/desorption characteristics[1]	The sediment sorption/desorption tests may be performed, if necessary[1] based on the results of still ongoing TCLTs
Perform limited groundwater monitoring study that includes pressure transducers to measure real-time variation in water level and periodic monitoring of conventional parameters	• Weekly groundwater monitoring was performed April 29, 2004 through June 3, 2004; see Table D-1 for results • Pressure transducers were used to "continuously" monitor groundwater pressure at one-minute intervals at T4-MW06I and T4-MW06D; see Figure 4-2 for pressure transducer data
Perform grain size analyses for correlations to determine hydrogeologic parameters	Grain size data are summarized on Table 4-2
Develop hydrogeologic conceptual model	See Section 5.2.5 for discussion of hydrogeologic conceptual model
Determine hydraulic connectivity of groundwater in upland fill material to groundwater in recent alluvial deposits	See Figures 5-5 through 5-8, Table 5-1, and Section 5.2.2 for vertical hydraulic gradients and potential flow directions between groundwater in upland fill material and recent alluvial deposits and Section 5.2.5 for discussion of hydrogeologic conceptual model
Determine groundwater contour maps for three hydrostratigraphic units of interest[2]	See Figures 5-18 through 5-23 for shallow, intermediate, and deep groundwater contour maps

Table 2-2 Comparison of Proposed and Executed Field and Testing Activities	
Proposed in the EE/CA Work Plan (BBL, 2004a)	**Executed During the EE/CA Field Program**
Determine seasonal changes within three hydrostratigraphic units of interest[2] by water level monitoring and extrapolation from Hart Crowser (2000)	See Section 5.2.5 for discussion of hydrogeologic conceptual model
Determine horizontal and vertical groundwater hydraulic gradients	See Section 5.2.2 and Table 5-1 for vertical hydraulic gradients and Section 5.2.3 for horizontal hydraulic gradients
Determine groundwater flow characteristics of in-filled Gatton's Slough	See Figure 5-6 for hydrogeologic cross section through Gatton's Slough and Section 5.2.5 for discussion of hydrogeologic conceptual model
Verify upland horizontal hydraulic gradients in the Troutdale Aquifer	See Figures 5-22 and 5-23 and Section 5.2.3 for horizontal hydraulic gradients in the Troutdale Aquifer
Sediment Quality Characteristics	
Collect 32 surface sediment samples (17 in Berth 401 and Slip 1 and 15 in Wheeler Bay, Slip 3, and north of Berth 414) from top 1.0 foot	Surface sediment was collected at all 32 proposed locations (T4-VC01 through T4-VC32)
Analyze surface sediment samples for metals[3], SVOCs[4], total DDT[5], PCBs, TPH, TOC, and grain size	Surface sediment analytical results are reported on Tables 4-7 through 4-11
Collect 15 under-pier sediment samples	Under-pier sediment was collected at 13 locations; of the remaining two locations, one was not accessible and one had insufficient surface sediment for sampling
Analyze under-pier sediment samples for metals[3], SVOCs[3], total DDT, PCBs, TPH, TOC, and grain size	Under-pier sediment analytical results are reported on Tables 4-12 through 4-14
Collect 32 subsurface sediment cores (17 in Berth 401 and Slip 1 and 15 in Wheeler Bay, Slip 3, and north of Berth 414) by vibracore to target core length of 15 feet or point of refusal	Subsurface sediment was collected at 33 locations (T4-VC01 through T4-VC33); the 33rd location was added for characterization associated with Berth 411 deepening
Analyze subsurface sediment samples representing five 2-foot intervals beginning 1 foot below surface and extending to 11 feet below the surface for metals[3], SVOCs[4], total DDT[5], PCBs, TPH, TOC, and grain size; archive the remaining intervals for possible analysis	Subsurface sediment analytical results are reported on Tables 4-15 through 4-19; the remaining intervals are archived for possible additional analysis

Table 2-2 Comparison of Proposed and Executed Field and Testing Activities	
Proposed in the EE/CA Work Plan (BBL, 2004a)	**Executed During the EE/CA Field Program**
Dredged Sediment Quality Characteristics	
Perform two DRETs on sediment composites from Slip 1 and Slip 3 cores; analyze elutriates for metals[3], SVOCs[4], total DDT, PCBs, and TPH	DRET analytical results are reported on Table 4-20
Perform one CST on sediment composite from Slip 3; analyze aqueous samples for TSS	CST results are reported on Table 4-21
Perform one MET on sediment composite from Slip 3; analyze elutriate for metals[3], SVOCs[4], total DDT, and PCBs	MET results are reported on Table 4-22
Perform one TCLT on sediment composite from Slip 3; analyze leachate for metals[3], SVOCs[4], total DDT, and PCBs	TCLTs are ongoing
Analyze two sediment composites from Slip 1 and Slip 3 cores for hazardous waste determination[6], TCLP, generation and loss of free liquid[7], and landfill-specific acceptance criteria	TCLP results are reported on Table 4-23; see Section 4.4.4 for discussions of hazardous waste determination, generation and loss of free liquid, and landfill-specific acceptance criteria
Hydraulics and Sedimentation Characteristics	
Collect three rounds of velocity measurements (along eight transects halfway across the Willamette River adjacent to the Removal Action Area and four transects across Slips 1 and 3) using boat-mounted ADCP to differentiate between the following situations: low or moderate river flow in the absence of vessel activity, high river flow in the absence of vessel activity, and vessel activity	ADCP survey was conducted on March 25, 2004; the number of surveys was changed to two via FCR-1; the second survey was postponed until river stage was higher and was ultimately cancelled
Deploy four oceanographic arrays (ADCM, turbidity sensor, and sediment traps) within each slip to collect time series near-bottom velocity, turbidity, and sedimentation data	• Four sediment traps were deployed; the traps were harvested twice, for a total of eight samples; analytical results are reported on Table 4-24 • Two ADCMs, fitted with turbidity sensors, were deployed in Slip 3; see Figures 4-18, 4-19, and 4-25 for the data
Deploy three tide gages (near Berth 414 and at upstream and downstream locations) to measure water surface elevations	Water surface elevations were recorded using pressure transducers at two locations in Slip 3 and a tide gage at one downstream location, per FCR-1
Characterize the river bottom over the model domain	Recent bathymetry data for the Removal Action Area have been compiled and are presented in Section 4.5.7

Notes:

[1] if TCLT results indicate that contaminant mass loading from sediment to surface water would occur
[2] upland fill, Unconsolidated Alluvial Deposits, and Troutdale Gravel
[3] arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc
[4] including PAHs and phthalates
[5] with contingency for possible analysis of selected samples for pesticides
[6] ignitability, corrosivity, reactivity
[7] paint filter test

ADCM = acoustic Doppler current meter
ADCP = acoustic Doppler current profiler
CPT = cone penetrometer test
CST = column settling test
DRET = dredging elutriate test
FCR = field change request
PAH = polycyclic aromatic hydrocarbon
PCBs = polychlorinated biphenyls, as Aroclors
SCPT = seismic cone penetrometer test
SVOCs = semivolatile organic compounds
TCLP = toxicity characteristics leaching procedure, including TCLP metals, pesticides, herbicides, SVOCs, and VOCs
TCLT = thin-layer column leaching test
TOC = total organic carbon
TPH = total petroleum hydrocarbons
TSS = total suspended solids
VOC = volatile organic compound

3. Field Exploration and Testing Activities

This section expands on the summary information in Section 2 by providing a detailed narrative of the field and laboratory activities conducted to execute the EE/CA work plan (BBL, 2004a). Methodologies for activities undertaken during the field program — including such tasks as in-water and upland geotechnical borings, monitoring well installation, groundwater monitoring, cone penetrometer tests, sediment sampling, and the deployment of sediment traps — are described, and the laboratory analyses conducted on the resulting soil, sediment, leachate, elutriate, surface water, and groundwater samples are outlined. In addition, the rationales for deviations from the EE/CA work plan, which were summarized in Section 2, are more fully documented.

Figures are provided to illustrate the locations of borings, monitoring wells, and sampling stations, as well as to aid in conceptualizing some of the sampling and testing activities. Tables are provided to summarize key information, such as the coordinates and depths of geotechnical explorations, test results for geotechnical parameters measured in the field, and subsurface sediment conditions.

3.1 Engineering Characteristics

This section describes the work performed to address engineering characteristics data gaps during the March to April 2004 field program and provides the resulting data. The field exploration and testing activities were conducted in general accordance with the EE/CA work plan (BBL, 2004a); field changes are detailed below for each activity. The following exploration activities were performed at Terminal 4:

- in-water mud rotary geotechnical borings;
- in-water cone penetrometer;
- in-water shallow mud rotary piston/split-spoon sampling;
- upland mud rotary geotechnical boring;
- upland seismic cone penetrometer; and
- hollow-stem auger monitoring wells.

Figure 3-1 illustrates the locations of explorations used for evaluating engineering characteristics, with the exception of some monitoring wells and vibracores. Vibracoring (described in Section 3.3) provided sediment samples that were tested for grain size distribution and other physical properties. Hollow-stem auger explorations (described in Section 3.2) and the blow counts associated with the SPT sampling methodology also provide a primary source of data to address the engineering characteristics data gaps. Additionally, drilling of hollow-stem auger monitoring wells and associated sample collection were performed in a manner to optimize the geotechnical engineering quality of the information. Sonic explorations are described in Section 3.2, because that field activity was conducted to specifically address hydrogeologic characteristics data gaps. Note, however, that the sonic explorations provide a relatively continuous sample of soil; therefore, the subsurface information available from visual classification and laboratory testing of grain size is used in the cross sections that assist in the interpretation of engineering characteristics.

Table 3-1 provides coordinates for the geotechnical explorations based on global positioning system (GPS) data. Table 3-2 provides the target depths of geotechnical explorations as proposed in the EE/CA work plan and the actual depths achieved in the field. Table 3-3 provides unconfined compressive strength values determined in the field. Table 3-4 provides engineering characteristics data from shallow mud rotary piston sampling/oversized split spoon. Table 3-5 provides the range of measured shear wave velocities in seismic cone penetrometer explorations. Table 3-6 summarizes subsurface sediment/soil conditions from geotechnical borings.

With the exception of existing data presented in the EE/CA work plan, the engineering characteristics data that will be used to support the EE/CA is contained in this report and its appendices. Appendix A provides logs of geotechnical borings and monitoring wells. Appendix B provides logs of cone penetrometer explorations. Appendix C provides results of geotechnical laboratory testing. Engineering characteristics data obtained from geotechnical laboratory testing are discussed in Section 4.1. Section 5.1 provides cross sections to be used for the EE/CA that incorporate exploration logs and inferred geology.

3.1.1 In-Water Mud Rotary Geotechnical Borings

GeoTech Explorations of Portland, Oregon drilled four in-water geotechnical borings using mud rotary techniques. A 20-foot by 40-foot spud barge supplied by GeoTech Exploration's subcontractor, Mark Marine, was used as the floating plant for the work. A tugboat and support boat were mobilized with the barge for barge positioning and to transport personnel to and from the work area, respectively. The barge was also used for other in-water explorations conducted during the field program, with the exception of vibracoring. At each exploration location, the barge was navigated to station locations based on GPS information. Once on station, spuds were set such that deployment was generally within about 15 feet of the proposed location. A Mobile™ B-59 drill rig was used to set casing and advance a 4-7/8-inch-diameter tri-cone bit. To maintain separation of drilling fluid from the surrounding water column, a 5-inch-diameter temporary casing was lowered into the sediment. This provided a solid pipe from above the barge deck to below mudline before drilling began. Soon after drilling began, a bentonite-based drilling fluid was circulated into the borehole to maintain borehole stability and remove cuttings. Cuttings and excess drilling fluid were placed in 55-gallon drums for later testing and disposal. Drums were moved to a designated drum staging area following each day's drilling activity. Daily field reports were prepared to document the work performed and the subsurface conditions encountered. Appendix A provides further detail on the mud rotary drilling method and procedures.

Sampling was achieved primarily through the use of a 2-inch-diameter (1-1/2-inch inner diameter) split spoon to collect disturbed SPT sediment/soil samples. The SPT sampling provides a standardized hammer blow count (i.e., blows per 12 inches of advancement over an 18-inch interval using a 140-pound hammer free falling 30 inches). This methodology is the standard of practice in geotechnical analysis for predicting the engineering behavior of soil. The disturbed SPT sampling was performed in general accordance with ASTM D 1586 and the EE/CA work plan. The sampling plan called for a relatively continuous sample interval for the upper 20 feet below mudline, followed by a 5-foot interval to 100 feet below mudline, then a 10-foot interval for the remaining depth, if applicable. If fine-grained sediment was encountered near the mudline or in deeper alluvial deposits, attempts were made to obtain a relatively undisturbed sample using an Osterberg piston sampler or a Shelby tube sampler (refer to Appendix A for further detail on these sampling methods). Additionally, if fine-

grained sediment from split-spoon sampling was in a state of limited disturbance, pocket penetrometer field testing was performed (refer to Section 3.1.1.2). Associated sample collection and processing are described below in Section 3.1.1.1. After the target depth was reached, or after the borehole terminated prior to the target depth, the borehole was grouted with bentonite grout. Following grouting, the drill rod and casing were removed and stowed for movement to the next location.

AINW monitored the drilling of selected in-water geotechnical borings for artifacts or other archaeological deposits to meet the substantive provisions of the National Historic Preservation Act within the framework of CERCLA. AINW's report is presented in Appendix I.

3.1.1.1 Sample Collection, Processing, and Transport

Once drilling with the tri-cone bit reached the sample depth, the rod was pulled in segments, the drilling bit was removed, and a split-spoon sampler was added to replace the bit for subsequent sampling. The geotechnical sampling was predominantly accomplished by split spoon using the SPT sampler and procedures. However, if conditions were encountered that facilitated collection of relatively undisturbed, fine-grained sediment/soil, a thin-walled tube sample was attempted.

Osterberg piston and Shelby tube samplers employ a thin-walled stainless steel tube pressed pneumatically or hydraulically into the sediment; the intent is to avoid disturbing the in-situ soil particle arrangement and porewater volumetric content. This procedure is used to collect samples representative of the intact condition for advanced soil testing of soil shear strength and consolidation.

Additionally, ring-lined samples were collected for density testing. In this method of sample collection, a series of brass rings is lined inside the inner diameter of the split-spoon sampler; upon sample processing, the ring can be removed and sediment/soil maintained in an intact condition, although somewhat disturbed from the action of driving the sampler through the soil.

Disturbed SPT samples were immediately processed onsite, which involved classifying the soil in accordance with ASTM D 2488 (Visual-Manual Procedure) for components, color, and moisture content. This classification protocol provides valuable information about engineering characteristics when compiled into geologic cross sections in the area of engineering interest. The samples were then subsampled for geotechnical testing and placed in a water-tight container and/or Ziploc® bag for transport to the laboratory under chain of custody. Relatively undisturbed thin-walled tube samples were retrieved from the drill rod, and wax was immediately placed on either end of the sample liner to hold the soil in place and maintain the moisture content. These samples were stored vertically in a prefabricated and padded storage container provided by the geotechnical laboratory, Soil Technology of Bainbridge Island, Washington, and were picked up within one to two weeks of sampling.

Standard ASTM methods were followed during the work. ASTM sampling procedures for the techniques discussed in this section are:

- ASTM D 1586 for standard penetration test and split-barrel sampling of soil (ASTM, 1999)

- ASTM D 1587 for thin-walled tube geotechnical sampling of soil (ASTM, 2000b)
- ASTM D 3550 for ring-lined, split-barrel drive sampling of soil (ASTM, 2001)
- ASTM D 4220 for preserving and transporting undisturbed soil samples (ASTM, 2000c)

Table 3-6 summarizes subsurface sediment/soil conditions encountered in geotechnical borings and the corresponding SPT N-value range measured during sampling. Appendix A provides additional information regarding undisturbed sampling procedures.

3.1.1.2 Pocket Penetrometer Field Test

Field testing using a pocket penetrometer device was performed to provide unconfined compressive strength values for fine-grained soil samples. The device includes a spring-loaded rod that is pressed into the soil at a relatively slow and uniform rate, which indents and shears the soil. The resistance is taken up in the spring, which is calibrated to load in tons per square foot, and a reading is displayed on the pocket penetrometer based on the amount of spring compression for a specific set amount of penetration into the sample. The shearing of the soil occurs rapidly, and pore pressure in proximity to the shear surface is increased; therefore, the test measures the strength in an approximately undrained mode of shearing. The undrained shear strength is approximated as one-half of the unconfined compressive strength value reading on the pocket penetrometer (Holtz and Kovacs, 1981; Terzaghi et al., 1996). The results of this field test are influenced by a number of factors (e.g., sample disturbance, operator experience, strain rate, sample heterogeneity, sand content) and should be carefully considered as very rough approximations of the actual values.

Table 3-3 provides pocket penetrometer values as approximate unconfined compressive strength in tons per square foot. Note that these data are not intended for design purposes, and interpretation of the data from this field test should be performed by a qualified engineer.

Appendix C provides additional information regarding this field testing method and procedures.

3.1.2 In-Water Cone Penetrometer

GeoTech Explorations performed ten in-water cone penetrometer test (CPT) explorations using standardized equipment. The CPT and seismic cone penetrometer test (SCPT) explorations were performed in general accordance with ASTM D 5778 for electronic friction and piezocone penetration testing of soil (ASTM, 2000a). Seismic testing of shear wave velocity profile was performed for three of the ten in-water locations, as described below in Section 3.1.2.1.

Figure 3-2 depicts a typical electronic cone penetrometer, which closely resembles the device used in the EE/CA field program. This advanced technology involves hydraulically pushing an instrumented probe at a constant rate while measurements of resistance from sediment/soil at the cone tip and cone sleeve are recorded in real time. Additionally, water pressure that occurs behind the cone tip is measured and used in data reduction and interpretation. The water pressure measured is a combination of the hydrostatic water pressure below the groundwater surface and excess porewater pressure induced during probe advancement. In general, the tip resistance and sleeve friction are higher while in sand, and porewater pressure follows a hydrostatic pressure

profile. Conversely, while in silt and/or clay, the tip resistance is somewhat lower, sleeve friction varies depending on cohesion and consistency of the sediment/soil, and porewater pressure tends to be in excess of hydrostatic pressure because of the development of excess pore pressure in the fine-grained sediment/soil around the cone tip.

The CPT device was mounted on the mud rotary drill rig and was tightly secured onto the barge, because the CPT relies on a force applied to the rod for advancing the probe by sufficiently exceeding the resistance of sediment/soil, which can be considerable. For the field program, the CPT device was connected to the hydraulics of the drilling rig to provide the driving force. A set of two concentric casings were temporarily placed from the barge deck to below the mudline to provide lateral rigidity to the cone and avoid damage during advancement (i.e., 2-inch-diameter casing inside a 5-inch-diameter casing). The distance that the casing sinks under its own weight and/or is hydraulically pressed into the sediment also determines the depth over which no data are collected. Because data collection begins at the tip of the embedded casing, a plan was developed during the pre-mobilization phase to perform two stages of data collection for in-water CPTs. The stages consisted of an initial uncased stage in which the probe was lowered and pressed into the soft sediment until the inclinometer on the probe indicated the rods were beginning to bend under the force; the probe was then withdrawn and the casing was set for the remainder of the exploration. This procedure enabled data collection for some of the soft sediment that might not otherwise have been possible. This two-stage procedure was not necessary for all CPT explorations, because the sediment in many locations was sand and dense enough to hold the casing at a shallow embedment below mudline. After reaching the target depth or refusal depth, the CPT was withdrawn and grouted during withdrawal with bentonite grout.

Appendix B provides additional information on the CPT method and field procedures.

3.1.2.1 Seismic Testing of Shear Wave Velocity

The shear wave velocity profile of soils will be used to determine the magnification and/or attenuation properties for the soil profile above the Troutdale Gravel, consisting of sediment and deeper alluvial deposits. These data will be used to evaluate the technical feasibility of certain alternatives during earthquakes. To provide the shear wave velocity profile at in-water locations, the specially instrumented SCPT (refer to Figure 3-2 depicting representative components) was used, along with a submersible seismic energy source (i.e., shear wave generator) fabricated by GeoTech Explorations. Appendix B provides further detail concerning the fabrication and deployment of this device.

To develop the shear wave velocity profile, the rate that shear wave energy propagates through soil is measured based on the time for energy from the source to reach the depth of the geophones/accelerometers contained in the SCPT (refer to Figure 3-2). The source was allowed to sink into the sediment, and tests were then performed for the full depth of the SCPT exploration by temporarily stopping the advancement of the cone penetrometer to conduct the test.

Table 3-5 provides the range of shear wave velocities for each of the SCPTs (including the upland location discussed in Section 3.1.5). GeoTech Explorations processed the data and has indicated that the data appear representative and to meet expectations, with the exception that some data for shallow sediment were suspect because the shear wave generator apparently continued to settle, causing an apparent increase in shear wave

velocity values. Data associated with that apparent increase have been treated as outliers and are not presented on the SCPT logs in Appendix B. GeoTech Explorations noted some additional SCPT data that might have some inaccuracy due to specific subsurface conditions: SCPT T4-CP06 at discrete depth intervals between 20 and 75 feet. The EE/CA will include analysis of SCPTs for seismic response and liquefaction potential, among other engineering characteristics. Data interpretation will include some consideration of these discrete zones of suspect data, which may ultimately be deleted or otherwise weighted on the basis of professional judgment to reflect possible inaccuracy.

3.1.3 In-Water Shallow Mud Rotary Piston/Split-Spoon Sediment Sampling

GeoTech Explorations drilled 11 in-water shallow mud rotary borings for piston samples or oversized split-spoon samples to provide sediment sample volume to supplement vibracores where initial sampling attempts did not achieve recovery.

Section 3.3 elaborates on this field activity, which was not in the EE/CA work plan and was added as a field change to gather additional information on sediment quality characteristics. The oversized split-spoon sample collection procedure for sediment quality also provides some information on engineering characteristics. A 300-pound hammer with a 30-inch fall height was used to drive the 3-inch-diameter sampler. The sampling method resembles the Standard Penetration Test described in Section 3.1.1, with the exception that the penetration test using the oversized sampler provides an N-value blow count based on a non-standard energy. (The N-value is the number of hammer blows to advance the split-spoon sampler 12 inches over an 18-inch interval.) The N-value can be used to assist in the evaluation of sediment density/consistency and additional engineering characteristics parameters.

Table 3-4 provides engineering characteristics data based on the N-value recorded for oversized split-spoon sampling.

3.1.4 Upland Mud Rotary Geotechnical Boring

Upland mud rotary drilling followed similar procedures as described in Section 3.1.1 with the exception that none of the specialized equipment and considerations for in-water work were necessary. The same Mobile™ B-59 drill rig used for in-water mud rotary drilling was demobilized from the barge and transported directly to the drilling site at T4-GE04L, which was the single upland location for upland mud rotary drilling (refer to Section 3.1.6.4). Plastic sheeting was placed below the rig to contain minor spills during the mixing of bentonite drilling fluid and the filtering of cuttings from the drilling fluid. Additionally, steel casing was installed to a depth of 50 feet to prevent the migration of any contaminants encountered to deeper elevations.

This geotechnical boring is located next to the KMBT active pier, so coordination was necessary to avoid impacting tenant operations. This area also corresponds with a stratigraphy of fill over interbedded alluvial deposits initially reported in the EE/CA work plan (based on Hart Crowser, 2000 and Gerwick, 1959), which was verified by explorations performed during the field program. As discussed in meetings with the USEPA and stakeholders, the Port's active pier factors into Removal Action alternatives for Slip 3 with respect to

dredging or combined dredging/capping. The geotechnical boring at this location provides engineering characteristics data for evaluating the stability of the slopes and pier under certain Removal Action alternatives. This exploration was intended to provide subsurface soil conditions behind the pier structure.

3.1.4.1 Sample Collection, Processing, and Transport

Sample collection and processing were similar to the procedures described for in-water mud rotary drilling in Section 3.1.1.1. For upland borings, the drilling rig was also positioned on the borehole location using GPS, and casing was advanced to 50 feet prior to drilling. As indicated, during drilling of T4-GE04L, a number of fine-grained soil layers of varying consistency were encountered for the full depth of the exploration; therefore, the number of relatively undisturbed samples collected was higher for this boring than for other geotechnical borings. Samples were carefully handled and packed vertically for transport to the laboratory. The sampling intervals also followed the same program, involving a 5-foot sample interval because the target depth in this location was above 100 feet.

Appendix A provides additional information regarding the relatively undisturbed sediment/soil sampling methods described in this section.

3.1.4.2 Pocket Penetrometer Field Test

Table 3-3 provides pocket penetrometer values for T4-GE04L as approximate unconfined compressive strength in tons per square foot.

3.1.5 Upland Seismic Cone Penetrometer

GeoTech Explorations performed the upland SCPTs in general accordance with ASTM D 5778. The procedure described in Section 3.1.2 for in-water explorations is similar to that used for the upland SCPTs. The Mobile™ B-59 mud rotary drill rig and SCPT instrumentation were demobilized from the barge and moved to T4-CP11 (formerly T4-GE03L) (Figure 3-1). Seismic testing of shear wave velocity was performed for this exploration as discussed below.

3.1.5.1 Seismic Testing of Shear Wave Velocity

Shear wave velocity measurements were taken at T4-CP11 (formerly T4-GE03L) to develop a profile for the full depth of the exploration following procedures similar to those described in Section 3.1.2.1, but without the fabricated shear wave generator. For the upland exploration energy source, a sledge hammer striking a steel plate provided the necessary energy, which is the standard approach for upland downhole seismic testing. Appendix C provides further information on the procedure for upland seismic testing of shear wave velocities.

The data address the engineering characteristics data gap of dynamic soil properties for the upland soils above mudline elevation and furthermore provide additional spatial coverage throughout the full depth of the exploration in the vicinity of T4-CP11. Table 3-5 provides the shear wave velocity range results.

3.1.6 Detail of Field Changes

The geotechnical borings were performed in accordance with the EE/CA work plan (BBL, 2004a) with deviations as detailed below.

3.1.6.1 In-Water Mud Rotary Geotechnical Borings

Some depths achieved in the field deviated from the target depths proposed in the work plan. Because the barge could not remain on location overnight and because safety concerns meant that work on the barge could not continue beyond daylight hours, the drilled depth for an exploration was determined by the production achieved for the day. If conditions slowed the drilling process, target depths were not reached. The two deeper geotechnical borings at the head of the slips were affected by this time constraint and did not achieve target depths. Additionally, in order to get closer to the target depths, the sampling interval was switched to 10 feet prior to achieving a depth of 50 feet if the production for a given day was affected. Table 3-2 provides the achieved and target depths for the geotechnical borings. Note that the achieved depths and sampling intervals are considered sufficient for the EE/CA.

3.1.6.2 In-Water Cone Penetrometer

Table 3-2 provides exploration depths actually achieved compared to target depths proposed in the EE/CA work plan. Some of the in-water cone penetrometer explorations failed to reach target depth due to refusal of the substrate. Results from explorations that did not meet the target depth are considered suitable for use in the EE/CA.

3.1.6.3 In-Water Shallow Mud Rotary Sampling

The methodology that was used in the field was not proposed in the EE/CA work plan, but was added to improve sample volume for certain vibracore locations and depths. Refer to Section 3.3.4.3 in the discussion of sediment sampling for details.

3.1.6.4 Upland Mud Rotary Geotechnical Borings

A deviation occurred with the substitution of an SCPT for an upland mud rotary boring with seismic testing of shear wave velocities. Several considerations factored into this field change, which was formally approved under FCR-2 (BBL, 2004h). The cone penetrometer device and testing equipment were already mobilized to the field and available to perform the exploration and seismic testing. Due to the consistency of the geologic materials in this area west of the former shoreline, it was determined that information from the SCPT could be substituted for soil samples and SPT N-values provided by drilling. Further, the efficiency of using SCPT and collecting seismic testing data in real time, combined with cost savings and the potential for improved data quality, outweighed the more commonly performed drilling-based approach that had been proposed. The

drilling-based approach requires completion of a specialized borehole using Portland cement grout, and a specialty contractor is required to perform the testing after sufficient set up time has elapsed for the grout, generally within a few days of drilling.

3.1.6.5 Upland Cone Penetrometer

The change from mud rotary geotechnical boring to SCPT is discussed above. Additionally, as shown in Table 3-2, the target depth was not achieved. The depth was selected based on the consistency of geotechnical exploration results west of the former shoreline and the time available for completing the SCPT exploration. Note that the achieved depth is sufficient for the EE/CA.

3.2 Hydrogeologic Characterization

In March 2004, BBL installed six monitoring well clusters, with a total of 11 monitoring wells, in the upland area of Terminal 4 (see Figure 3-3) to address data needs for hydrogeologic characterization. Four additional shallow wells were installed by others in April 2004 as part of the clusters. Monitoring well logs for these wells are provided in Appendix A, and Table 3-7 provides well completion details. As described in Section 5.2, data generated from installation of the monitoring well clusters were used to define the hydrogeologic site conceptual model. In addition, data may be used to evaluate potential transport of constituents of potential concern from capped sediments or from sediments placed in an onsite CDF.

3.2.1 Monitoring Well Installation

BBL installed 11 monitoring wells in March 2004, which included:

- two shallow wells (T4-MW05S and T4-MW06S);
- five intermediate wells (T4-MW01I, T4-MW02I, T4-MW04I, T4-MW05I, and T4-MW06I);
- one intermediate/deep well (T4-MW03I/D); and
- three deep wells (T4-MW01D, T4-MW02D, and T4-MW06D).

Table 3-7 and the monitoring well boring logs in Appendix A provide details regarding well completion, such as bore diameter and screened interval, for these 11 wells. Shallow and intermediate depth monitoring wells (less than 80 feet bgs) completed in the fill and Unconsolidated Alluvial Deposits were installed using hollow-stem auger methods. Deep monitoring wells (greater than 145 feet bgs) completed in the Troutdale Gravel and below the fine-grained material in Gatton's Slough were installed using sonic drilling methods. Monitoring wells were installed following methods provided in the work plan (BBL, 2004a) and were completed in accordance with Oregon Administrative Regulation (OAR) 690 Division 240 Construction, Maintenance, Alteration, Conversion and Abandonment of Monitoring Wells, Geotechnical Holes, and Other Holes in Oregon, as well as in conformance with Oregon DEQ guidance (available at http://www.deq.state.or.us/wmc/tank/documents/monwell.pdf).

Four shallow monitoring wells (T4-MW01S, T4-MW02S, T4-MW03S, and T4-MW04S) were installed by others in April 2004 using push probe technology. Details regarding monitoring well completion, such as bore diameter and screened interval, for these wells are provided in Table 3-7. BBL did not provide oversight for the installation or completion of these monitoring wells and cannot attest to the quality of the data provided for these wells; however, the draft data were reviewed for this report. Details of the installation methods and procedures for these four monitoring wells will be provided in the Terminal 4 Slip 1 Upland Facility Phase I Data Summary Report (due to DEQ in August 2004). Final installation and completion data for these four monitoring wells will be incorporated into the EE/CA as appropriate.

Heaving sand conditions were encountered below the water table during drilling at all monitoring well locations. Potable water was added to the formation during drilling at all monitoring well locations, with the exception of monitoring well T4-MW05S, to mitigate heaving sand conditions. The depth to groundwater and volume of potable water added during drilling were recorded by the field personnel. Depth to groundwater data are provided on the monitoring well logs in Appendix A, and the volume of potable water added during drilling is reported on Table 3-7.

3.2.1.1 Hollow-Stem Auger Drilling Methods

Two shallow monitoring wells (T4-MW05S and T4-MW06S) and five intermediate depth monitoring wells (T4-MW01I, T4-MW02I, T4-MW04I, T4-MW05I, and T4-MW06I) were installed by GeoTech Explorations using hollow-stem auger techniques. Detailed procedures for installing groundwater monitoring wells using the hollow-stem auger method were presented in the FSP appended to the EE/CA work plan (BBL, 2004a). Installation methods are summarized below.

For each monitoring well installed using hollow-stem auger drilling methods, the boring location was identified and a work zone was established. During boring advancement, representative soil samples were collected following ASTM D 1586 for the Standard Penetration Test (ASTM, 1999). SPT was performed in accordance with ASTM D 1586 to provide an approximate measure of soil density and consistency. The test requires that a standard sampler (i.e., 2-inch-outside-diameter split spoon) be driven into the subsurface material using standard energy (i.e., 12 inches of advancement over an 18-inch interval using a 140-pound hammer with a 30-inch free fall). The Standard Penetration Resistance (SPR) was measured by the number of blows required to drive the sampler approximately 6 inches. SPR blow counts for select intervals are shown on the monitoring well boring logs in Appendix A. Representative soil samples were collected and fully described, including soil type, color, texture, and consistency. Soil sample depth intervals and physical descriptions were recorded in a field notebook and are provided on the monitoring well boring logs in Appendix A. Select soil samples were retained for further geophysical testing as described in Section 4.2.4.

3.2.1.2 Sonic Drilling Methods

One intermediate/deep monitoring well (T4-MW03I/D) and three deep monitoring wells (T4-MW01D, T4-MW02D, and T4-MW06D) were installed by GeoTech Explorations using sonic drilling methods. In general, sonic drilling methods use a combination of rotary power, hydraulic pull-down pressure, and mechanically

generated oscillations to advance a dual line of drill pipe. A top-mounted hydraulically powered drill head transmits the rotary power, hydraulic down pressure, and vibratory power directly to the dual line of pipe. The entire drill string is vibrated at a frequency between 50 and 150 hertz, or cycles per second. This combination of forces advances the inner core barrel sampler through unconsolidated deposits. Continuous samples are collected within the inner core barrel sampler. The outer core is advanced to hold the boring open.

For each monitoring well installed using sonic drilling methods, the boring location was identified and a work zone was established. During boring advancement, continuous samples were collected within the inner core barrel sampler. Information regarding approximate measure of soil density and consistency is generally not available from monitoring wells installed using the sonic drilling method, as was the case for this project. Continuous soil samples were described, including soil type, color, texture, and consistency. Soil sample depth intervals and physical descriptions were recorded in a field notebook and are provided on the monitoring well boring logs in Appendix A. Select soil samples were retained for further geophysical testing as described in Section 4.2.4.

3.2.1.3 Monitoring Well Construction

All monitoring wells were installed following methods provided in the work plan (BBL, 2004a) and were completed in accordance with OAR 690 Division 240 Construction, Maintenance, Alteration, Conversion and Abandonment of Monitoring Wells, Geotechnical Holes, and Other Holes in Oregon, as well as in conformance with DEQ guidance. Monitoring well construction details are provided on the monitoring well boring logs in Appendix A and are summarized in Table 3-7. All monitoring wells were constructed of 2-inch-diameter, flush-threaded polyvinyl chloride (PVC) slotted well screen and blank riser casing. The screen length for all wells was 10 feet with the exception of T4-MW05S, which had a screen length of 5 feet. The slot size of all screens was 0.010 inch. A blank riser was installed from the top of the screen to approximately just below grade for flush-mounted monitoring wells. When the monitoring well assembly was set in place, a washed silica sand pack was placed in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen. The sand pack was consistent with the screen slot size and the soil particle size in the screened interval. A hydrated bentonite seal with a minimum thickness of 2 feet was then placed in the annular space above the sand pack. During extraction of the augers or sonic drilling barrels, a cement/bentonite grout was pumped through a tremie pipe to fill the annular space from the bentonite seal to a depth of approximately 2 feet bgs. A 10-inch-diameter curb box was placed over the riser casing and secured with a neat Portland cement seal. The cement seal extended approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and was sloped to promote drainage away from the well. The PVC riser was sealed using an unvented expandable locking plug. Monitoring wells were labeled with the appropriate designation on both the inner and outer well casings. Each well was equipped with a lock.

3.2.1.4 Monitoring Well Development

In late March and early April 2004, monitoring wells were developed following methods provided in the work plan (BBL, 2004a) and OAR 690 Division 240 (as described in Section 3.2.1.3) and in conformance with DEQ guidance. A Waterra articulating pump was used for surging of groundwater in the well and a Grundfos

submersible pump was used for purging groundwater from the well. Groundwater pH, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP), specific conductivity (SC), and turbidity were monitored during monitoring well development. The volume of groundwater purged from each well was approximately equivalent to or greater than the amount of potable water added during drilling to minimize sand heaving, plus five well volumes. The total volume of groundwater purged from each monitoring well during development is provided in Table 3-7.

3.2.1.5 Surveying of Monitoring Wells

Monitoring well locations and elevations were surveyed by the Port's Survey Department (Table 3-7). Northing and easting (horizontal) location measurements were recorded to one decimal place. Elevations were measured to the nearest 0.01 foot National Geodetic Vertical Datum (NGVD) and were converted to Columbia River Datum (CRD).

3.2.1.6 Handling of Investigation-Derived Waste

Investigation-derived waste was handled in accordance with the EE/CA work plan (BBL, 2004a). Excess soil from the installation of monitoring wells was placed into 55-gallon drums and stored temporarily at the onsite drum staging area at Pier 1, Slip 1. Development water from intermediate and deep monitoring wells was transferred to Baker tanks for temporary storage at the onsite drum staging area. Water from shallow monitoring wells was stored separately in 55-gallon drums at the onsite drum staging area.

3.2.2 Detail of Field Changes

Field activities related to hydrogeologic characteristics were completed in accordance with the EE/CA work plan (BBL, 2004a) with deviations summarized below.

Completion depths for monitoring wells were generally as proposed in the work plan, but varied due to conditions encountered in the field. Target completion depths were 30 feet bgs for shallow wells, 60 or 80 feet bgs for intermediate wells, 130 feet bgs for the intermediate/deep well in Gatton's Slough, and 180 feet bgs for deep wells. As shown in Table 3-7, actual completed depths ranged from approximately 18 to 40 feet bgs for shallow wells, 45 to 74 feet bgs for intermediate wells, 190 feet bgs for the intermediate/deep well in Gatton's Slough, and 165 to 218 feet bgs for the deep wells.

Sonic drilling methods were used in place of Becker® drilling techniques for installation of monitoring wells T4-MW01D, T4-MW02D, T4-MW03I/D, and T4-MW06D per FCR-2 (BBL, 2004h). Sonic drilling techniques are considered equivalent in technical merit to Becker® drilling techniques for the soil conditions expected at Terminal 4. Monitoring well installations using sonic drilling techniques were performed by GeoTech Explorations, which was already under contract with BBL for shallow and intermediate monitoring well installation and CPT probing at Terminal 4.

Planned deep monitoring well T4-MW05D was not installed because of greater than expected depths to the Troutdale Gravel; it was deemed that sufficient information could be collected from the three other deep wells such that the fourth deep well was not necessary. As described in the March 22, 2004 Weekly Field Report (BBL, 2004e) and FCR-3 (BBL, 2004b), geological information indicated the depth to Troutdale Gravel was from 100 to 170 feet bgs. However, the Troutdale Gravel was encountered at a depth of 205 feet bgs at monitoring well T4-MW06D.

3.2.3 Weekly Groundwater Monitoring

Weekly groundwater monitoring began on April 29, 2004 following completion and development of the monitoring wells; weekly monitoring ended on June 3, 2004. The six weekly groundwater monitoring events consisted of measuring depth to groundwater and groundwater temperature, pH, DO, SC, and ORP. During weekly groundwater monitoring events, monitoring well caps were first removed on all wells in a monitoring well cluster. Depth to groundwater was then measured to the nearest 0.01 inch using a Heron Instruments, Inc. (Heron) water level meter. Depth to groundwater was measured for each monitoring well from the surveyor's mark on the north side of the inner casing and was recorded directly into an electronic spreadsheet using a portable computer. Depth to groundwater measurements were converted to groundwater elevations in feet CRD and feet NGVD and are presented in Table D-1, Appendix D.

Groundwater parameter values were measured using an in-well Yellow Springs Instrument Company, Inc. (YSI) 600 XLM sonde with probe attachments for pH, DO, SC, and ORP. Prior to each weekly groundwater monitoring event, the YSI sonde was calibrated following manufacturer's specifications. Calibration of the sonde is discussed in Section 4.2.1. To measure groundwater parameters, the sonde was lowered to the middle of the screened interval of the monitoring well, approximately 5 feet above the bottom of the well. The sonde was left in place for five minutes to allow groundwater parameters to stabilize. Groundwater parameters were then measured and recorded directly into an electronic spreadsheet using a portable computer. Groundwater temperature was measured in degrees Celsius (ºC); DO was measured in milligrams per liter (mg/L); SC was measured in milliSeimens per centimeter (mS/cm); and ORP was measured in millivolts (mV). Groundwater parameter values (temperature, pH, SC, DO, and ORP) are presented in Table D-1, Appendix D.

Pressure transducers were installed into monitoring wells T4-MW06I and T4-MW06D on April 16, 2004. Prior to that installation, the initial water level was measured in both wells using the Heron water level meter and recorded in an electronic spreadsheet so that pressure transducer data could be correlated with groundwater elevation. One In-Situ mini-Troll pressure transducer with a pressure rating of 15 pounds per square inch (psi) for a range of 0 to 35 feet of water and a cable length of 50 feet was installed into monitoring well T4-MW06I starting on April 16, 2004 and ending on June 3, 2004. One In-Situ mini-Troll pressure transducer with a pressure rating of 100 psi for a range of 0 to 231 feet of water and a cable length of 100 feet was installed into monitoring well T4-MW06D starting on April 16, 2004 and ending on June 3, 2004. The pressure transducers were set to measure the height (in feet) of the column of water above the pressure transducers. Measurements of water column height were recorded by the pressure transducer at one-minute intervals. During each weekly groundwater monitoring event, the pressure transducer measurements were halted, the pressure transducer data were downloaded to a laptop computer, and the pressure transducers were removed so that the YSI sonde could be lowered into the monitoring wells. Once groundwater measurements were recorded, the pressure transducers were replaced into the monitoring wells to their original depths and measurements of the water column height

resumed. Pressure transducer data were converted to groundwater elevations in feet CRD. This conversion was performed by summing the initial depth to water and the initial pressure transducer reading to calculate an initial depth for the transducer. Then the initial pressure transducer reading and all subsequent pressure transducer readings were subtracted from the initial summed depth to calculate depth to groundwater. The depth to groundwater data were then converted to groundwater elevations by subtracting the depth to groundwater from the top-of-casing elevation. Pressure transducer data are presented in Section 4.2.

On April 22, 2004, after downloading the first set of pressure transducer data from monitoring well T4-MW06D, it was determined that the pressure transducer was incorrectly reading the water column height. On April 24, 2004, the original pressure transducer at monitoring well T4-MW06D was replaced with a pressure transducer determined to be functioning properly. On May 25, 2004, during a download of pressure transducer data from monitoring well T4-MW06I, it was determined that power supply to the pressure transducer had been lost. This faulty pressure transducer was returned to In-Situ and the data were partially recovered. A new pressure transducer was placed into monitoring well T4-MW06I on May 28, 2004.

3.3 Sediment Quality Characteristics

This section discusses field exploration and testing activities conducted to fill data gaps associated with sediment quality characteristics. The discussion is subdivided into surface sediment, under-pier sediment, and subsurface sediment.

3.3.1 Surface Sediment

Samples of surface sediment were collected at 32 locations (T4-VC01 through T4-VC32), which encompassed two locations in Berth 401, 15 locations in Slip 1, four locations in Wheeler Bay, nine locations in Slip 3, and two locations north of Berth 414. Sampling occurred between March 2, 2004 and March 11, 2004 and was conducted as specified in the EE/CA work plan (BBL, 2004a) and FCR-5 (BBL, 2004d), except as noted below. Marine Sampling Systems (MSS) of Burley, Washington performed the vibracore explorations. Sampling stations were located by MSS using an onboard GPS. Field-verified location coordinates are listed in Table 3-8. Figure 3-4 shows the surface sediment sample locations. The boat-mounted vibracore was equipped with a 4-inch aluminum barrel and stainless steel cutterhead. Figure 3-5 shows the MSS boat and vibracore apparatus, as well as deployment of the vibracore apparatus. Core tubes were penetrated to a depth of 15 feet below mudline or to refusal.

As described in the EE/CA work plan (BBL, 2004a), the acceptable core recovery was 60% of the penetration depth. Some locations were shifted slightly to achieve acceptable recovery because sediment conditions precluded penetration of the vibracore tube to acceptable depths. Multiple cores were proposed at all locations to obtain adequate sample volume. Although fewer cores were retained than initially proposed in the EE/CA work plan at some locations, at least one core was retained at each location. Table 3-9 summarizes the dates the cores were taken, the number of cores retained at each location, and the penetration and recovery length of each core.

At each of the 32 locations, the top 1 foot (i.e., 0 to 1 foot below mudline) of the core was collected as the surface sediment sample; the remainder of each core was sampled at 2-foot intervals for the subsurface sediment samples, as described in Section 3.3.3. Figure 3-6 summarizes the sampling intervals.

Cores were kept on ice until they were processed on shore. AINW monitored and approved the collection of sediment samples from selected vibracore locations to meet the substantive provisions of the National Historic Preservation Act within the framework of CERCLA. AINW's report is presented in Appendix I. Each core was logged to determine the geological characteristics with depth. These logs are presented in Appendix A. Surface sediment samples were submitted to Columbia Analytical Services (CAS) of Kelso, Washington for analysis of:

- total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs (including PAHs and phthalates);
- tDDT;
- PCBs (as Aroclors);
- TPH gasoline-range organics, diesel-range organics, and residual-range organics;
- TOC; and
- grain size.

Analytical results are presented in Section 4.3.

As required by the EE/CA work plan, one field duplicate sediment sample was collected per approximately every ten samples collected. Table 3-10 summarizes the field duplicates.

3.3.2 Under-Pier Sediment

Under-pier sediment samples were collected March 9 and 10, 2004 and April 20 and 21, 2004 from 13 of 15 proposed locations, i.e., at T4-UP01 through T4-UP10 and T4-UP12 through T4-UP14. Under-pier sediment samples were collected as specified in the EE/CA work plan (BBL, 2004a) and FCR-4 (BBL, 2004c), except as noted below. Field-verified under-pier locations are listed in Table 3-11 and shown on Figure 3-7.

Nine under-pier explorations (at stations T4-UP01, T4-UP02, T4-UP06 through T4-UP10, T4-UP12, and T4-UP13) were performed by a USEPA scuba dive team supervised by Paul Krause of BBL, who navigated the sampling vessel to the correct location using a GPS unit. Under-pier dive samples were collected using pre-cleaned 1-foot-long or 3-foot-long Lexan push-core tubes approximately 4 inches in diameter. When the cores could not achieve sufficient recovery, 16-ounce and/or 8-ounce wide-mouth glass jars were used to scoop sediment from the surface. The samples were sealed and kept on ice until they were processed on shore. At each location except T4-UP09 and T4-UP10, a surface (i.e., 0 to 1 foot below mudline) sediment sample was collected; at T4-UP09 and T4-UP10, samples were collected 0 to 2 feet below mudline.

At locations unsafe for divers, hand-operated push cores were used to collect under-pier sediment as specified in FCR-4. The push cores were used at approximately the same locations as proposed for the diver samples. Occasionally a location was shifted slightly to obtain better recovery. If a push core was successful, the location

was transcribed from the handheld GPS unit and recorded in the field notes. Push cores were performed by hand with a 2-inch-diameter by 3-foot-long acrylic tube attached to a 40-foot PVC push handle, which made it possible to sample from a boat. Figure 3-8 shows the push core unit before deployment. Once the acrylic sample tube was pulled up onto the boat, samples were measured for recovery length, logged, sealed in sediment bags, and kept on ice until they could be processed.

Under-pier sediment samples were not obtained at locations T4-UP11 and T4-UP15. Location T4-UP11 was under Pier 4 in Slip 3 along the KMBT property (Figure 3-7). During both sampling events, a ship was in berth at Pier 4 for multiple days, precluding access to the under-pier area. Multiple attempts were made to collect sediment at T4-UP15, but sufficient sediment was not observed at this location. Wood debris was noted in the core barrel, and multiple attempts resulted in shattered and broken core barrels, indicating hard substrate on the bottom (Figure 3-9).

To obtain information on the water depth and substrate on the inside of the old wood pile wall in Pier 5 at Slip 3, the water depths were probed using a lead-line survey when an area was accessible by boat. This survey indicated hard substrate with no apparent sediment in the area of T4-UP15. The lead-line survey, performed on April 21, 2004, used a weighted and calibrated tape line to measure water depth and associated sediment conditions (e.g., hard bottom, soft sediment, wood substrate) along the length of Slip 3 in the vicinity of Pier 5. During this survey, time, water depth, and apparent substrate material were recorded. The location coordinates and results of the lead-line survey are shown in Table 3-12. The survey was performed just inside the pier piling field along the slip side of the pilings. Boat access farther into the piling field was infeasible because the pilings were submerged approximately 2 inches below the water surface. Based on information gathered during this survey, the push core was used in areas likely to have sufficient sediment for collection of a sample. In this manner, a sample was obtained at T4-UP14. However, no sediment was collected after multiple attempts near the proposed location for T4-UP15.

Under-pier samples were kept on ice until they were processed on shore. Each sample was logged; Table 3-13 summarizes the under-pier sample descriptions. Under-pier sediment samples were submitted to CAS for analysis of:

- total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs (including PAHs and phthalates);
- tDDT;
- PCBs (as Aroclors);
- TPH gasoline-range organics, diesel-range organics, and residual-range organics;
- TOC; and
- grain size.

Analytical results for under-pier sediment samples are presented in Section 4.3. As required by the EE/CA work plan, one field duplicate sediment sample was collected for approximately every 10 samples collected. Table 3-10 summarizes the field duplicates.

3.3.3 Subsurface Sediment

Subsurface sediment samples were collected from 33 locations (T4-VC01 through T4-VC33) and as specified in the EE/CA work plan, except as noted below. Subsurface sediment samples for chemistry analysis were collected at 2-foot intervals below the top foot used as the surface sediment sample (i.e., subsurface sediment was sampled at 1 to 3 feet, 3 to 5 feet, etc.). Figure 3-10 shows a map of the subsurface sediment sample locations. Vibracore sampling is described in Section 3.3.1. A schematic of the subsurface sample intervals is shown on Figure 3-6.

To supplement sediment collected at some vibracore locations having limited recovery, piston/oversized split-spoon samples were collected below the deepest vibracore sediment samples using mud rotary drilling, as outlined in FCR-5 (BBL, 2004d). GeoTech Explorations performed the drilling. Piston sampling took place on March 23 and 26 and on April 2, 5, 13, and 14, 2004. Piston core sampling was also performed at added location T4-VC33 to supplement information on sediment quality near Berths 410 and 411. Figure 3-11 conceptualizes the differences between the vibracore and the piston/oversized split-spoon sediment sampling systems. Samples were taken with a piston or Osterberg sampler at the surface from 0 to 1 foot below mudline; with an oversized (3-inch-diameter by 2-foot-long) split spoon at 5 to 7 feet below mudline; and then at 5-foot intervals (i.e., 10 to 12 feet, 15 to 17 feet below mudline, etc.) until the depth of interest indicated in FCR-5 was reached. These samples were collected by first using mud rotary drilling techniques to drill down to the sample interval of interest. Then the decontaminated split spoon was driven 2 feet farther using a 300-pound hammer. The split-spoon sediment sample was then brought to the deck of the barge, opened, and sampled from the split spoon using a decontaminated stainless steel spoon into either a decontaminated stainless steel bowl or a glass sample jar, depending on the amount of recovery.

Cores were kept on ice until they were processed on shore. Drilling activities were logged, and the samples were described. Appendix A presents the vibracore and piston sampling logs. Samples were then submitted to CAS for archiving or analysis of:

- total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs (including PAHs and phthalates);
- tDDT;
- PCBs (as Aroclors);
- TPH gasoline-range organics, diesel-range organics, and residual-range organics;
- TOC; and
- grain size.

Analytical results for subsurface sediment samples are presented in Section 4.3.

As required by the EE/CA work plan, one field duplicate sediment sample was collected for approximately every 10 samples collected. Table 3-10 summarizes the field duplicates.

3.3.4 Detail of Field Changes

Sediment sampling and analysis were performed in accordance with the EE/CA work plan (BBL, 2004a) with deviations summarized below.

3.3.4.1 Surface Sediment

Surface sediment sampling and analysis were performed in accordance with the EE/CA work plan (BBL, 2004a).

3.3.4.2 Under-Pier Sediment

Fifteen locations were proposed for under-pier surface sediment sampling; 13 under-pier surface sediment samples were collected. Sample T4-UP11 was not collected because ships docked at Berth 410 blocked access to T4-UP11 during the under-pier sampling events. Sample T4-UP15 was not collected because of insufficient surface sediment in the vicinity of T4-UP15. Approximately ten attempts were made at T4-UP15, with repeated sampler refusal. No appreciable surface sediment was observed at this location.

Under-pier surface sediment samples were proposed for collection by scuba divers using hand-held core tubes. Locations T4-UP01, T4-UP02, T4-UP06, T4-UP07, T4-UP08, T4-UP09, T4-UP10, T4-UP12, and T4-UP13 were collected in that manner. Locations T4-UP03, T4-UP04, and T4-UP05 were determined unsafe for diver sampling because of the unstable above-pier warehouse that is scheduled for demolition in summer 2004. Locations T4-UP14 and T4-UP15 were determined unsafe for diver sampling because of the submerged pile field, associated submerged structures, and limited visibility. As a result, locations T4-UP03, T4-UP04, T4-UP05, T4-UP14, and T4-UP15 were sampled from a small boat using a hand-operated push core sampler, as described in FCR-4 (BBL, 2004c). The push core sampler, a 2-inch Lexan barrel, was pushed into the sediment to the greatest depth attainable. The sediment was extruded into a clean polyethylene bag for transport to shore for processing. Sediment samples were processed on shore in accordance with the EE/CA work plan. An under-pier surface sediment sample was not collected at T4-UP15 because of frequent refusal at this location.

3.3.4.3 Subsurface Sediment

Thirty-two locations were proposed for subsurface sediment sampling; 33 locations were sampled. Location T4-VC33 was added near Berth 411 to test the hollow-stem auger method close to the pier face. . T4-VC33 was sampled by hollow-stem auger drill rig rather than by vibracore because it was determined that hollow-stem auger would be more effective given sediment conditions near Berth 411. Hollow-stem auger was also used to collect geotechnical data near Berth 411.

The remaining 32 subsurface sediment samples were proposed for collection by vibracore. The target vibracore penetration depth was 15 feet below the mudline. The EE/CA work plan stated that acceptable recovery length was 60% of the penetration depth.

Ten vibracore locations were later reoccupied with a shallow mud rotary drill rig on a barge to obtain sediment samples using conventional in-water geotechnical sampling techniques, as described in FCR-5 (BBL, 2004d). Four core locations (T4-VC03, T4-VC12, T4-VC28, and T4-VC32) were reoccupied because the vibracore retained less than 60% recovery of the penetration depth. Two core locations (T4-VC04 and T4-VC17) were reoccupied because the vibracore retained less than 9 feet of sediment, but greater than 60% of the penetration depth. These two samples met refusal before the target penetration depth of 15 feet. Four core locations (T4-VC20, T4-VC21, T4-VC22, and T4-VC31) were reoccupied because sediment chemistry results for material at the bottom of the core indicated possible contamination. Sediment samples were collected using an oversized split-spoon sampler equipped with a 3-inch barrel.

3.4 Dredged Sediment Quality Characteristics

Sediment samples were collected for use in determining dredged sediment quality characteristics as specified in the EE/CA work plan (BBL, 2004a), except as noted below. Two composite sediment samples were collected:

- T4-CM1, which included sediment cores from Berth 401 and Slip 1; and
- T4-CM2, which included sediment cores from Wheeler Bay, Slip 3, and north of Berth 414.

The same procedure described in Section 3.3.3 was followed to sample these cores, except that composite cores were not sectioned into surface and subsurface intervals; the entire length of the core, down to 11 feet below mudline, was used in the composite. Figure 3-6 shows a schematic of the core composites. The sediment was retained on ice in stainless steel pots until all core locations necessary for the composite had been sampled. Once all cores were sampled, a stainless steel drill paddle was used to homogenize the composite samples until consistent color and texture were achieved. The sediment was then placed into the appropriate containers and submitted to Soil Technology of Bainbridge Island, Washington for DRET, TCLT, CST, and MET analyses, as described below. Aliquots of the two composite samples were also submitted to CAS for analysis of:

- total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs (including PAHs and phthalates);
- tDDT;
- PCBs (as Aroclors);
- TPH gasoline-range organics, diesel-range organics, and residual-range organics;
- TOC;
- grain size;
- TCLP;
- ignitability;
- corrosivity; and
- reactivity.

Composite sample T4-CM2 was also submitted to Soil Technology for grain size analysis and consolidation tests. The results of these analyses are presented in Appendix C.

In addition to the composite samples, surface water samples were also collected for use in the DRET, MET, and CST analyses. The surface water samples were collected in Slips 1 and 3 on March 23, 2004 by submerging polyethylene tubing approximately 2 feet below the water surface. A peristaltic pump was used to collect the water samples, and the water was stored in 5-gallon plastic carboys. The carboys were submitted to Soil Technology, and aliquots of the surface water samples were submitted to CAS for analysis of:

- total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs (including PAHs and phthalates);
- tDDT;
- PCBs (as Aroclors);
- TPH gasoline-range organics, diesel-range organics, and residual-range organics;
- TOC;
- TSS;
- ammonia; and
- total sulfide.

During surface water collection, a YSI sonde was used to measure ambient pH, temperature, SC, DO, and turbidity of the surface water.

3.4.1 Dredging Elutriate Test

DRET results are used to determine potential water quality impacts during dredging. The DRET simulates the release of sediment-bound and porewater constituents into the receiving water column at the point of dredging.

Composite sediment samples T4-CM1 and T4-CM2 were submitted to Soil Technology for the DRET analysis. The water for the DRET consisted of two surface water samples collected from Slips 1 and 3. The DRET was performed in accordance with protocols outlined in DiGiano et al. (1995). The composite sediment and surface water samples were collected as described in Section 3.4.

Using the sediment and surface water provided, slurry with a 1:250 solids-to-water volume ratio (solids concentration of 10 grams per liter) was produced. The slurry was thoroughly mixed in a carboy by hand shaking. Next, the slurry was aerated for one hour using compressed air through a bubble trap. The slurry then settled for one hour. Figure 3-12 illustrates this test.

After settling, supernatant water samples were extracted from the midpoint between the fluid surface and the settling interface. The extract was centrifuged to obtain dissolved samples. The DRET elutriate samples were then submitted to CAS for analysis of:

- metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs;
- tDDT;
- PCBs;
- TPH diesel-range organics and residual-range organics;
- ammonia;

- total sulfide; and
- TSS.

Analytical results for the DRET elutriate samples are presented in Section 4.4.

3.4.2 Thin-Column Leaching Test

The TCLT acts as a laboratory-scale model of peak leachate contaminant concentrations from dredged material deposited in a CDF. The TCLT is still ongoing, and results will be presented in a separate memorandum when the test is complete.

3.4.3 Column Settling Test

Onsite disposal in a CDF is assessed with the column settling test. The CST provides information on the settling characteristics of dredged material in a containment area. The CST was performed in accordance with protocols outlined in USACE (1987). Composite sediment sample T4-CM2 and surface water from Slip 3 were used for the CST. The composite sediment and surface water samples were collected as described in Section 3.4.

To begin the CST, a slurry was produced using the composite sediment sample and surface water from Slip 3; the slurry had a water-to-sediment ratio of 4:1 by volume. This ratio was based on the expected water-to-sediment ratio of dredged material at the Removal Action Area. The slurry was thoroughly mixed with a mechanized mixer and then pumped into the test column. The test column is an 8-foot-tall plastic column with a diameter of approximately 8 inches. The test column has sample ports at 1-foot or closer intervals in the lower 3 feet of the column and at 0.5-foot intervals in the upper 3 feet of the column. The sampling ports sample from the center of the column. To produce a uniform concentration of suspended solids, compressed air is injected at the base of the column during this step. The first sample was taken after the fluid surface, or the zone settling interface, was below the highest port. Samples were collected from all sampling ports above the settling interface. Subsequent samples were taken from any ports above the interface at 2, 4, 6, 12, 24, 48, 96, 144, 216, 288, and 360 hours. The time of extraction, sampling port height, and height of the interface were recorded for each sample. Samples were analyzed for TSS. See Figure 3-13 for an illustration of this test. Analytical results for the CST are presented in Section 4.4.

3.4.4 Modified Elutriate Test

The MET provides information for assessing onsite disposal in a CDF. The MET simulates dissolved and particulate associated concentrations of contaminants in the effluent from the CDF and was completed to evaluate short-term water quality impacts from a CDF. The MET was conducted following guidelines in Palermo (1985). Composite sediment sample T4-CM2 and surface water from Slip 3 were submitted to Soil Technology for the MET, and the resulting elutriate samples were submitted to CAS for analysis. The composite sediment and surface water samples were collected as described in Section 3.4.

For the MET slurry, the water-to-sediment ratio was 4:1 based on volume. The slurry was mixed in a carboy by hand-shaking. The slurry was then aerated for one hour using compressed air through a bubble trap. The slurry

settled for the anticipated field mean retention time of the dredge-material slurry in the CDF, up to a maximum of 24 hours. Figure 3-14 illustrates this test.

After settling, supernatant water samples were extracted from the midpoint between the fluid surface and the settling interface. Samples were analyzed for total and dissolved fractions. The dissolved samples were obtained by centrifuging the extract. The MET elutriate samples were submitted to CAS for analysis for the following constituents:

- metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs;
- tDDT;
- PCBs; and
- TSS.

Analytical results for the MET are presented in Section 4.4.

3.4.5 Detail of Field Changes

DRET, MET, CST, TCLT, TCLP, hazardous waste determination, and paint filter test sampling and analysis were performed in accordance with the EE/CA work plan (BBL, 2004a) with deviations summarized below.

3.4.5.1 DRET

DRETs were proposed for two composite sediment samples: T4-CM1 from Berth 401 and Slip 1 and T4-CM2 from Wheeler Bay, Slip 3, and north of Berth 414. The composite samples were to include sediment from the interval representing 0 to 11 feet below mudline of each core. However, in locations where core recovery length was less than 11 feet, sediment from 0 foot below mudline to the bottom of the core was included in the composite.

Composite T4-CM1 contained sediment from all the cores in the designated area except the 0- to 1-foot below mudline interval for T4-VC01, T4-VC02, T4-VC03, T4-VC04, and T4-VC05; the 5- to 7-feet below mudline interval for T4-VC03; and the 7- to 9-feet below mudline interval for T4-VC02 and T4-VC04. Because of poor recovery at these locations, there was insufficient sediment from these intervals to include in the composite.

Composite T4-CM2 contained sediment from all cores within the designated area except T4-VC33, an additional location sampled in Slip 3 (discussed in Section 3.3.4.3). T4-VC33 was selected for sampling after completion of the T4-CM2 composite and therefore was not included in the composite.

The DRET elutriate samples were analyzed for the proposed list of constituents excepting TPH gasoline-range organics. TPH gasoline-range organics were infrequently detected, at concentrations near the method reporting limit, in sediment samples. Because of this, TPH gasoline-range organics were not analyzed in the DRET elutriate samples.

3.4.5.2 CST, MET, and TCLT

Composite T4-CM2 was proposed for the CST, MET, and TCLT analyses. As described in Section 3.4.5.1 above, sample T4-VC33 was not included in the T4-CM2 composite.

3.4.5.3 TCLP, Hazardous Waste Determination, and Paint Filter Test

The hazardous waste determination, TCLP test, and paint filter test were to be performed on composite sediment samples T4-CM1 and T4-CM2. As described in Section 3.4.5.1 above, the number and depths of samples included in the composites differed slightly from what was proposed in the EE/CA work plan (BBL, 2004a).

3.5 Hydraulics and Sedimentation Characteristics

The field activities to collect hydraulic and sedimentation characteristics data were performed in accordance with the EE/CA work plan (BBL, 2004a), FCR-1 (BBL, 2004f), and FCR-6 (BBL, 2004g). The physical oceanographic field operations were executed by Blue Water Engineering of Port Townsend, Washington under the general guidance of BBL.

Acoustic Doppler current profilers (ADCPs), sediment traps, single point current meters, pressure transducers, and a tide gage were utilized to collect data within the Removal Action Area from mid-March to mid-May of 2004. The areas of instrument deployment included Slips 1 and 3 and nearby upstream and downstream locations in the Willamette River.

3.5.1 Cross-Sectional Velocity Measurements

Cross-sectional velocity measurements were obtained for the Willamette River and Slips 1 and 3 by conducting an ADCP survey on March 25, 2004. The survey consisted of more than 60 ADCP track lines run along 14 pre-planned transects (Figure 3-15). The survey was conducted from high slack water until low slack water as predicted by National Oceanic and Atmospheric Administration (NOAA) tide tables. During the survey, four cycles of each of the 14 track lines were completed. A fifth cycle of the cross-river transect (Track Line 14) was also completed at the end of the survey. Table 3-14 lists the coordinates of the starting point, turn points, and end point of each ADCP track line. Table 3-15 provides the starting times for each track line for each survey cycle.

The ADCP measurements provide “snapshots” of the magnitude and direction of flow velocities in the river adjacent to Terminal 4 and within the slips, which are used to evaluate flow and circulation patterns. The ADCP survey was timed to coincide with a spring tide on March 25, 2004. The daily average flow of the Willamette River on this date, as recorded by the USGS gage at Portland, was 24,000 cubic feet per second (cfs).

Details of the ADCP equipment and methods are provided in Appendix H.

3.5.2 Sediment Trap Sampling

Sediment traps provide a means to collect and concentrate suspended sediment particles over time. The analysis of sediment trap samples indicates the average physical characteristics and chemical constituency of the sediments deposited in the trap during the deployment period and provides a basis for estimating average sediment depositional fluxes to the bed during the trap deployment period. Due to their configuration and location within the water column, the sediment traps measure the influx of finer-grained suspended solids that settle within the Removal Action Area, as opposed to sediment bedload. Bedload is the term used for the movement of larger-grained particles that roll, bounce, wash, etc. over the bottom or in a sediment layer close to the bottom. Based on the hydrodynamic data collected during the recent field program, the bedload transport of COPCs to the Removal Action Area is not expected to be significant.

Four sediment traps were constructed and deployed in and just upstream of the Removal Action Area. The sediment trap deployment locations are shown on Figure 3-16. Detailed information is provided below.

3.5.2.1 Sediment Trap Design

The primary criteria in designing the sediment trap configurations and sampling program for Terminal 4 were:

- selecting a construction material suitable for low-level chemical analysis of the organic COPCs (e.g., DDT and PCBs);
- sizing the diameter of the traps and establishing sufficiently long deployment periods to collect an adequate amount of material for analysis;
- sizing the length of the traps to avoid turbulence-induced disruption of the samples while maintaining a low profile in areas where vessels may navigate; and
- using inert, non-toxic materials.

Sediment Trap Tube Sizing

The sediment trap tubes were sized to capture the required minimum sediment mass for chemical analysis over a deployment period of approximately one month. The target sample mass was 20 grams (dry weight). As a result, the primary design criterion was the expected average sediment depositional flux during the deployment period.

To minimize sample processing prior to chemical analysis, moisture content was also a consideration. The sediment trap sample processing procedures were designed to minimize total sample volume to the degree possible.

Available TSS data for the Willamette River at Ross Island (River Mile 15) show a strong correlation between flow and TSS concentrations. At low flows, TSS concentrations at Ross Island range from less than 10 mg/L to

approximately 100 mg/L. A conservatively low estimate of average TSS concentrations (for purposes of sizing the sediment trap tubes) during the period of sediment trap deployment was 20 mg/L.

During low flows, the suspended sediment primarily consists of fine particles, silts, and clays. A settling rate of 1 meter/day was assumed for these sediments. Fine sands, if present, would settle at much greater rates; therefore, the settling rate for fine sediment was considered to be conservatively low. The sediment depositional flux was estimated based on the assumed settling rate (1 meter/day) and TSS concentrations (20 mg/L). Based on a 30-day deployment period, the surface area of the sediment traps needed to supply 20 grams of sediment for analysis was then computed. The surface area calculation is presented in Table 3-16.

The calculation summarized in Table 3-16 indicates that a 3 x 5 array of 3-inch tubes would capture sufficient sediment mass for chemical analysis (based on a safety factor of 2.0). To check this calculation, the calculated sedimentation rates were compared to the sedimentation analysis completed by the Port of Portland for the Removal Action Area. The Port of Portland's sedimentation analysis (Port of Portland, 2002) suggests that sedimentation rates in the Removal Action Area are on the order of several tenths of a foot per year, although the analysis relied on a comparison of bathymetry surveys that do not have sufficient accuracy to confidently determine changes at that scale. A number of the surveys suggest areas of erosion, but overall indicate significant rates of sedimentation in the slips, consistent with the need for periodic maintenance dredging. The depositional flux estimated based on an average TSS concentration of 20 mg/L and a settling rate of 1 meter/day would translate to a sedimentation rate of about 0.5 centimeter per year, assuming a porosity of 40%. This is lower than sedimentation rates suggested by the Port of Portland's analysis. Therefore, the sediment trap design appeared to be adequate to provide sufficient material for chemical analysis, and the number of trap tubes and tube diameters were constructed according to these calculations.

Literature suggests that sediment tubes should have an aspect ratio (height/diameter) of about 7:1, and possibly as high as 10:1, to minimize loss of sediment due to turbulence. Sediment trap sampling in rivers can be less effective than in lakes or oceans, and higher aspect ratios help prevent loss of sediment, although practical trap handling considerations favor a lower aspect ratio. For a 3-inch-diameter collection tube, an aspect ratio of 7:1 gives a 21-inch-high trap. Trap tubes were constructed to a length of approximately 21 inches plus the length of the test tube-shaped bottom, for a total length of approximately 23 inches.

The sediment traps were also equipped with turbulence baffles to protect trapped samples from turbulence. A 2-inch-thick baffle was constructed of four layers of ½-inch x ½-inch styrene plastic grid material to divide the large opening of the trap tubes into many smaller openings.

Trap Tube Material

Pyrex glass was used as the material for trap tube construction to reduce potential concerns associated with contaminant repartitioning or potential interferences associated with leaching of plasticizers or other chemicals from plastic materials.

Sediment Trap Construction

Each sediment trap assembly included 15 approximately 3-inch-diameter vertical glass tubes to trap sediment, a magazine to hold the tubes, a turbulence baffle placed over the trap to minimize the resuspension of trapped sediment, and a magazine housing to encase the magazine. Mounting bases were also constructed to secure the magazine housing in a fixed location. These were either concrete platforms for traps placed on the river bed or wooden platforms for traps attached to pilings. Figure 3-17 shows the sediment trap components. Figure 3-18 illustrates construction details for the housing and magazine. Construction of the turbulence baffle is shown on Figure 3-19. Figure 3-20 depicts construction and deployment of the sediment trap platform. Construction methods for each component are described in Appendix H.

3.5.2.2 Biocide Use and Deployment Procedures and Locations

The process for using biocide solution and the procedures and locations of the sediment trap deployment are described below.

Biocide Solution

A biocide solution was used in the sediment traps to minimize the potential for sample disturbance caused by aquatic biota entering the trap assembly. A 2.8% solution of sodium azide (NaN_3) was used as a biocide over the period of deployment. Approximately 0.5 liter of solution was used in each of the 60 trap tubes. The sodium azide solution is more dense than water, so the traps were first filled approximately two-thirds full with river water collected from the public boat launch upstream of Terminal 4. A funnel with a tube attached to reach the bottom of the trap was then used to add the sodium azide, which displaced the water and rested on the bottom of the trap. The traps were then topped off with river water and capped with plastic caps that were removed following trap deployment.

Some researchers have suggested that filling sediment traps with a dense solution may result in reduced capture of particles due to boundary layer turbulence effects. This possibility was minimized by filling the trap only about 1/3 full with sodium azide solution.

Deployment Procedures and Locations

The sediment trap deployment locations and deployment periods are listed in Table 3-17 and the deployment locations are also shown on Figure 3-16. Two traps were deployed in Slip 3 during the first deployment period from March 18 and 19, 2004 to April 26, 2004. One trap was located near the east end (back) of Slip 3 (trap A) in approximately 45 feet of water; the other was near the west end (mouth) of the slip (trap B) in approximately 42 feet of water. The traps were positioned near the southern side of the slip to avoid damage from ships that enter and leave Slip 3 on a diagonal pattern from the northeast to the southwest. In addition, one sediment trap was placed in Slip 1 (trap D) in approximately 40 feet of water near the south side of the slip and just west of the quay at Berth 408. The fourth trap (trap C) was secured to a mounting platform strapped to a vertical piling located immediately downstream of Berth 414 near the upstream end of Terminal 4.

During the second deployment period from April 26 to May 17, 2004, sediment traps were redeployed at the same locations in Slip 1 (trap D), Slip 3 East (trap C), and the vertical piling immediately downstream of Berth 414 (trap A). The fourth trap (trap B) was placed at a location upstream of Berth 415, near Berth 416, as shown on Figure 3-16.

The following sequence of tasks was conducted when deploying the sediment traps:

- Trap location coordinates were entered into navigation software.
- The concrete bases were taken out to the location one at a time and lowered to the bottom using a cable winch and boom. This activity was performed one day before trap deployment, which allowed any resuspended sediment to dissipate.
- A temporary buoy was attached to each base.
- The sediment traps (with filled sample tubes) were brought to the location and lowered with the boom. A diver guided each trap onto the base, attached the bungees, removed the turbulence baffle and then the tube caps, then replaced the turbulence baffle and secured it with a bungee diagonally across the top of the trap. Care was taken not to resuspend sediments at the trap location during deployment.
- The temporary buoy was removed, and a weighted rope was run from the base to a marked piling near shore for locating the trap for retrieval.

3.5.2.3 Sample Harvesting and Processing Procedures

Sediment samples deposited in the traps were harvested by Blue Water Engineering. Sediment trap recovery date and times are summarized in Table 3-17. To recover the traps, a diver removed the turbulence baffle, capped the tubes, and attached the lifting harness to the trap. The trap was then lifted to the platform on the back of the boat using a winch and boom setup and transported back to the boat launch. The trap, full of water, was then hauled to Terminal 4. The sediment traps were handled so as not to disturb the sediment during transport.

At Terminal 4, the traps were placed in a tray and approximately 10 inches of water and ice to form an ice bath. The ice bath was used to limit the potential for desorption or loss of organic material caused by warming.

The contents of representative tubes from each trap were photographed, and detailed physical descriptions of the contents of each trap were recorded by BBL field staff. The water and sodium azide in the traps was then decanted to 55-gallon waste drums for testing and disposal. The water was decanted with a peristaltic pump until there was about ½-inch of water remaining above the sediments. The small amount of water remaining in the trap was used to slurry the sediment, and the slurry was poured off into a stainless steel bowl. One squirt of deionized water was used to rinse material on the sides of the tubes into the bowl. The amount of rinse water was limited to prevent repartitioning of the sample. Care was taken, however, to flush essentially all of the

sediment particles into the bowl so that a total sediment mass calculation could be conducted from the analytical data. Sediment from all the tubes of one sediment trap was combined and homogenized in a stainless steel bowl. The homogenized sediment was placed into appropriate sample containers. Samples were stored in coolers with ice prior to delivery to the laboratory for analysis.

3.5.2.4 Chemical and Physical Analyses

Sediment samples were collected in the four sediment traps over two deployment periods, for a total of eight samples. Upon completion of each deployment period, the samples were harvested as described above and submitted to CAS for analysis of:

- total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs (including PAHs and phthalates);
- pesticides (including total DDD, total DDE, and total DDT);
- PCBs (as Aroclors);
- TPH gasoline-range organics, diesel-range organics, and residual-range organics;
- TOC;
- total solids; and
- grain size.

Sediment trap sample analysis results are presented in Section 4.5.3.

3.5.3 Velocity and Turbidity Sensors Deployment and Retrieval

Two Nortek Aquadopp™ acoustic Doppler current meters (ADCMs) were used to measure currents, turbidity, and water levels in Slip 3. The ADCMs were deployed at a height of approximately 1 meter above the river bed near each of the two sediment trap locations in Slip 3. The coordinates and deployment and retrieval dates for each of the ADCMs are summarized in Table 3-18. Details on the ADCM configuration are provided in Appendix H.

The ADCMs integrate Doppler velocity measurements with data from standard sensors, such as temperature, pressure, tilt, and compass. The instrument is 22 inches long by 3 inches in diameter and is equipped with an internal recorder, batteries, and a complete suite of Windows® software. Each ADCM was fitted with a D&A Instrument Co. OBS-3 turbidity sensor and a pressure transducer to record water levels. The OBS-3 uses an optical backscatter sensor to measure turbidity in nephelometer turbidity units (NTUs). During each deployment, the ADCM deployment depths were calibrated to a shore-side benchmark to better than +/- 0.05 foot. The Aquadopp data loggers were programmed to record current meter, turbidity, and water level readings every 10 minutes for a 1-minute period. The measurements collected over the 1-minute period were then averaged.

3.5.4 Tide Gage Installation and Operation and Water Level Measurements

The Willamette River water surface elevation was recorded within Slip 3 and at a location approximately 3 miles downstream of Terminal 4 over March 23 to May 18, 2004. Within Slip 3, water levels were recorded using pressure transducers and data loggers installed on each ADCM unit. A Coastal Leasing Macrotide tide gage was used to measure changes in river elevation downstream of Terminal 4 at a location directly across the river from the head of the Multnomah Channel. The tide gage was installed on a piling at the upstream end of the main dock at the Georgia Pacific facility. The approximate tide gage and pressure transducer locations are shown on Figure 3-21. Details on the tide gage configuration are provided in Appendix H.

The tide gage elevation was established relative to the CRD and was programmed so that water depth measurements recorded by the gage were automatically converted and recorded as elevation above the CRD. Water level measurements at the tide gage location were initiated after the gage elevation had been established through a field survey with a minimum vertical accuracy of 0.1 foot. The gage was installed for a 60-day period and data downloads were conducted at 20-day intervals following installation. Water levels were recorded at 10-minute intervals.

The two pressure transducers attached to the ADCM units in Slip 3 recorded water level measurements every 10 minutes. The value recorded was an average of measurements collected over a 1-minute period. The units recorded the water level measurements as meters of water from which a constant theoretical atmospheric pressure was subtracted. As a result, the recorded depth did not represent true water depth. A true record of atmospheric pressure for Portland International Airport was obtained from the National Climatic Data Center in Ashville, North Carolina through the Oregon Climatic Center in Corvallis, Oregon. These records allowed the water level data to be corrected for changes in atmospheric pressure and to be referenced to the CRD.

3.5.5 Detail of Field Changes

This section summarizes Field Change Requests FCR-1 and FCR-6.

3.5.5.1 Field Change Request 1

FCR-1 (BBL, 2004f) refined and amended the scope of data collection activities outlined in the EE/CA work plan (BBL, 2004a) on the basis of additional information and input from the oceanographic subcontractor and from BBL's hydrodynamic experts. The refined scope of work as identified in FCR-1 is briefly summarized below:

- Collect cross-sectional river velocity (ADCP) measurements at transects running across and part way across the river from the Terminal 4 shoreline and across the entrance to Slips 1 and 3.

- Collect two rounds of velocity measurements approximately 20 days apart beginning in March 2004.

- Include one transect running across the river and multiple transects crossing Slip 3, Wheeler Bay, and Slip 1.

- Collect the ADCP measurements during the ebb portion of a 12-hour tidal cycle.

- Collect water surface elevation measurements at tide gages established to CRD and installed approximately 1.25 miles downstream of Terminal 4 and upstream of the confluence with Multnomah Channel.

- In Slip 3, record water level measurements using a pressure transducer on the ADCM sensor, eliminating the need for a second tide gage at the Terminal 4 location.

- Install four sediment traps – one in Slip 1, two in Slip 3, and one near the upstream end of Terminal 4 – for two 30-day periods.

- Install two bottom-mounted ADCMs in Slip 3.

3.5.5.2 Field Change Request 6

FCR-6 (BBL, 2004g) authorized adjustments to the scope of work on the basis of additional information regarding river conditions during the period of sediment trap deployment and additional information related to potential influences from Outfall No. 53 on sediment trap samples. The major changes arising from FCR-6 are summarized below:

- The second ADCP survey was postponed until flow conditions in the river rose or until the survey could be coordinated with a ship departure. Ultimately, the second survey was cancelled.

- Following harvesting of the four sediment traps in early April, three of the traps were redeployed to their original locations (Slip 1, Slip 3, and upstream of Slip 3), while one of the traps was redeployed to a new location upstream of Berths 414/415 and Outfall No. 53. The purpose of redeploying at the new location was to obtain samples outside of the potential influence of the outfall.

Table 3-1
Geotechnical Exploration Locations

Sample ID	Coordinates (a)	
	Northing	Easting
T4-CP01	714483	7618857
T4-CP02	714555	7619179
T4-CP03	714509	7620102
T4-CP04	714502	7620337
T4-CP05	713713	7619212
T4-CP06	713758	7619427
T4-CP07	713854	7619622
T4-CP08	713333	7619393
T4-CP09	713352	7619807
T4-CP10	713234	7620401
T4-GE01W	714558	7619079
T4-GE02W	714541	7619669
T4-GE03L	714508	7620087
T4-GE04L	713586	7620072
T4-GE05W	713369	7619565
T4-GE06W	713284	7620054

(a) Coordinates are NAD 83, state plane Oregon North, international feet

Table 3-2
Geotechnical Exploration Depths

Exploration ID	Target Depth in Feet (bgs)	Actual Depth in Feet
T4-GE01W	120	111.5
T4-GE02W	80	81.5
T4-GE03L (T4-CP11)	160	120.6
T4-GE04L	90	95
T4-GE05W	140	101.5
T4-GE06W	70	71.5
T4-CP01	80	80.5
T4-CP02	80	80.4
T4-CP03	80	75.5
T4-CP04	80	63.8
T4-CP05	80	80.7
T4-CP06	80	78.7
T4-CP07	80	80.5
T4-CP08	80	68.6
T4-CP09	80	80.4
T4-CP10	80	87.6

(a) bgs = below ground surface

Table 3-3
Pocket Penetrometer Measurements for Geotechnical Borings

Geotechnical Exploration ID	Sample Depth Interval in Feet (bgs)	SPT N-Value	Approx. Unconfined Compressive Strength, tsf
T4-GE01W	0-2	NA	0.02 to 0.05
T4-GE02W	0-2	NA	0.02 to 0.1
T4-GE04L	25-28	4	0.8
T4-GE04L	71.5-73.5	NA	1.0
T4-GE04L	91.5-93.5	NA	1.3 to 2.8
T4-GE06W	0-2	NA	0 to 0.03
T4-GE06W	3.5-5.5	NA	0.03 to 0.08

(a) Corrected for enlarged adapter foot used for soft cohesive sediment/soil obtained by multiplying by 0.0625.
(b) Accuracy is considered one decimal place; reported accuracy for results less than 0.1 is provided to show the values after the correction factor of note (a) is applied.
(c) bgs = below ground surface
(d) tsf = tons per square foot
(e) SPT = Standard Penetration Test

Table 3-4
Engineering Characteristics Data from Over-sized Split-Spoon Sampling

Exploration ID	Sample Depth in Feet (bgs)	Mid-Sample Elevation in CRD	Sediment Primary Component	N-Value	Estimated Equivalent SPT Density/ Consistency Classification	Location
T4-PS01	5-7	-51	Sand	23	Medium Dense	Berth 401
T4-PS01	10-12	-56	Silt	17	Very Stiff	Berth 401
T4-PS01	15-17	-61	Silt	37	Hard	Berth 401
T4-PS03	5-7	-39	Sand	4	Very Loose	Slip 1
T4-PS03	10-12	-44	Sand	23	Medium Dense	Slip 1
T4-PS03	15-17	-49	Sand	12	Medium Dense	Slip 1
T4-PS04	5-7	-35	Sand	5	Loose	Slip 1
T4-PS04	10-12	-40	Sand	5	Loose	Slip 1
T4-PS04	15-17	-45	Sand	20	Medium Dense	Slip 1
T4-PS12	2.5-4.5	-16.5	Sand	8	Loose	Slip 1
T4-PS12	10-12	-24	Sand	11	Medium Dense	Slip 1
T4-PS12	15-17	-29	Sand	12	Medium Dense	Slip 1
T4-PS17	5-7	-28	Silt	0	Very Soft	Wheeler Bay
T4-PS17	10-12	-33	Sand	14	Medium Dense	Wheeler Bay
T4-PS17	15-17	-38	Sand	11	Medium Dense	Wheeler Bay
T4-PS20	5-7	-30	Silt	0	Very Soft	Wheeler Bay
T4-PS20	10-12	-35	Silt	0	Very Soft	Wheeler Bay
T4-PS20	15-17	-40	Silt	5	Medium Stiff	Wheeler Bay
T4-PS20	20-22	-45	Sand	13	Medium Dense	Wheeler Bay
T4-PS20	25-27	-50	Sand	24	Medium Dense	Wheeler Bay
T4-PS20	30-32	-55	Sand	21	Medium Dense	Wheeler Bay
T4-PS21	5-7	-15	Silt	0	Very Soft	Wheeler Bay
T4-PS21	10-12	-20	Sand	5	Loose	Wheeler Bay
T4-PS21	15-17	-25	Sand	1	Very Loose	Wheeler Bay
T4-PS21	20-22	-30	Sand	2	Very Loose	Wheeler Bay
T4-PS21	25-27	-35	Sand	20	Medium Dense	Wheeler Bay
T4-PS21	30-32	-40	Sand	26	Medium Dense	Wheeler Bay
T4-PS22	0-2	-48	Sand	10	Loose	Slip 3
T4-PS22	5-7	-53	Sand	18	Medium Dense	Slip 3
T4-PS22	10-12	-58	Sand	16	Medium Dense	Slip 3
T4-PS22	15-17	-63	Sand	23	Medium Dense	Slip 3
T4-PS22	25-27	-73	Sand	28	Medium Dense	Slip 3
T4-PS22	30-32	-78	Sand	46	Dense	Slip 3
T4-PS28	0-2	-42	Gravel	3	Very Loose	Slip 3
T4-PS28	2-4	-44	Gravel	24	Medium Dense	Slip 3
T4-PS28	5.5-7.5	-47.1	Sand	17	Medium Dense	Slip 3
T4-PS28	10-12	-52	Sand	38	Medium Dense	Slip 3
T4-PS28	15-17	-57	Sand	21	Dense	Slip 3
T4-PS31	5.5-7.5	-29.8	Silt	0	Very Soft	Berth 414
T4-PS31	10.5-12.5	-34.8	Silt	0	Very Soft	Berth 414
T4-PS31	15.5-17.5	-39.8	Sand	33	Dense	Berth 414
T4-PS31	20.5-22.5	-44.8	Sand	35	Dense	Berth 414
T4-PS31	25-27	-49	Sand	24	Medium Dense	Berth 414
T4-PS31	30-32	-54	Sand	26	Medium Dense	Berth 414
T4-PS32	5-7	-46	Sand	3	Very Loose	Berth 414
T4-PS32	10-12	-51	Sand	20	Medium Dense	Berth 414
T4-PS32	15-17	-56	Sand	16	Medium Dense	Berth 414

CRD = Columbia River Datum
bgs = below ground surface
SPT = Standard Penetration Test

Table 3-5
Shear Wave Velocity Data

Exploration ID	Shear Wave Velocity Range (meters/sec)	Shear Wave Velocity Range (feet/sec)
T4-CP03	110 to 285	360 to 935
T4-CP06	115 to 290	375 to 950
T4-CP09	160 to 260	525 to 850
T4-GE03L (T4-CP11)	140 to 240	460 to 785

(a) Shear wave velocity data generally above 20 feet for in-water seismic testing were removed due to inaccuracy (refer to Section 3.1 in the text for further information). Due to this necessary elimination of data, shallow sediment having anticipated lower shear wave velocities is not represented.

Table 3-6
Summary of Subsurface Conditions and SPT N-Value Ranges

Boring T4-GEO1W

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
0 to 3.6	-34.5 to -38.1	Very soft Organic SILT/CLAY	NA
3.6 to 17	-38.1 to -51.5	Loose, dark grey, SAND	6 to 8
17 to 110	-51.5 to -144.5	Medium dense, dark grey SAND	11 to 28
110 to 111.5	-144.5 to -146	Dense, dark grey SAND	36

Boring T4-GEO2W

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
0 to 4	-35.5 to -39.5	Very soft Organic CLAY	NA
4 to 17	-39.5 to -52.5	Loose, dark grey, SAND	6 to 11
17 to 80	-52.5 to -115.5	Medium dense, dark grey SAND	12 to 26
80 to 81.5	-115.5 to -117	Dense, dark grey SAND	36

Boring T4-GEO4L

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
0 to 2	31 to 29	Asphalt over GRAVEL	NA
2 to 25	29 to 6	Medium dense to dense, brown SAND (FILL?)	21 to 47
25 to 37	6 to -6	Soft to medium stiff, Organic SILT/CLAY over SILT	3 to 6
37 to 53	-6 to -22	Loose to medium dense, dark grey SAND with interbedded Silt	5 to 16
53 to 80	-22 to -49	Medium stiff to stiff SILT with interbedded Sand	5 to 11
80 to 92	-49 to -61	Very stiff to hard SILT	17 to 46
92 to 95	-61 to -64	Medium stiff Organic SILT	5

Boring T4-GEO5W

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
0 to 2	-44 to -46	Interbedded SAND and CLAY	NA
2 to 12	-46 to -56	Loose, dark grey, SAND	3 to 12
12 to 100	-56 to -144	Medium dense, dark grey SAND	13 to 34
100 to 101.5	-144 to -145.5	Dense, dark grey SAND	35

Table 3-6
Summary of Subsurface Conditions and SPT N-Value Ranges

Boring T4-GEO6W

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
0 to 7.5	-41 to -48.5	Very soft Organic CLAY	WOR
7.5 to 38	-48.5 to -79	Medium dense, dark grey SAND with Silt	10 to 27
38 to 48	-79 to -89	Medium stiff SILT and Sandy SILT	4 to 6
48 to 71.5	-89 to -112.5	Medium dense, dark grey SAND	19 to 23

Table 3-6
Summary of Subsurface Conditions and SPT N-Value Ranges

Monitoring Wells T4EA-MW01I/D

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
0 to 31	30 to -1	Loose to medium dense, brown SAND (FILL?)	5 to 12
31 to 60	-1 to -30	Loose to medium dense, dark grey SAND	7 to 24
60 to 187.5	-30 to -157.5	Dense to very dense, dark grey SAND	37 to > 50 [1)]
187.5 to 205	-157.5 to -175	Dark grey GRAVEL, little Sand and Silt	NA

[1)] No SPT N-values below 71.5 ft bgs.

Monitoring Wells T4EA-MW02I/D

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
0 to 25	33.5 to 8.5	Loose to medium dense, brown SAND (FILL?)	7 to 14
25 to 28	8.5 to 5.5	Medium stiff SILT	5
28 to 45.5	5.5 to -12	Very loose to loose, dark grey SAND with Silt	2 to 8
45.5 to 90	-12 to -56.5	Soft to medium stiff Organic CLAY/SILT	3 to 9 [2)]
90 to 145	-56.5 to -111.5	Soft to medium stiff CLAY/SILT (organic?)	NA
145 to 165	-111.5 to -131.5	Dark grey GRAVEL, little Sand and Silt	NA

[2)] No SPT N-values below 76.5 ft bgs.

Monitoring Wells T4EA-MW03D

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
1.5 to 26	31.5 to 5.5	Brown SAND (Fill?)	NA
26 to 35	5.5 to -3.5	Dark grey SAND	NA
35 to 75	-3.5 to -43.5	(Very soft to medium stiff), Organic CLAY	NA
75 to 95	-43.5 to -63.5	Interlayered SAND and SILT	NA
95 to 180	-63.5 to -148.5	(Very soft to medium stiff), SILT and Clayey SILT	NA
180 to 195	-148.5 to -163.5	Dark grey GRAVEL and SAND (some Silt)	NA

Table 3-6
Summary of Subsurface Conditions and SPT N-Value Ranges

Monitoring Wells T4EA-MW04I

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
1 to 23	30 to 7	Loose to medium dense, brown SAND (FILL?)	7 to 13
23 to 38	7 to -8	Very soft to soft SILT	WHO to 3
38 to 48	-8 to -18	Very loose, dark grey SAND, interbedded Silt	3 to 4
48 to 65	-18 to -35	Medium dense, dark grey SAND	21 to 28

Monitoring Wells T4EA-MW05S/I

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
2 to 17.5	33 to 15.5	Loose to medium dense, brown SAND (FILL?)	8 to 12
17.5 to 28	15.5 to 5	Very soft to medium stiff, SILT and Organic CLAY	2 to 8
28 to 38	5 to -5	Interlayered SILT and Silty SAND	2 to 4
38 to 53	-5 to -20	Soft to medium stiff SILT/CLAY	2 to 7
53 to 61	-20 to -28	Medium dense, dark grey SAND	24
61 to 65.5	-28 to -32.5	Dark grey GRAVEL, little Sand and Silt	> 50

Monitoring Wells T4EA-MW06S/I/D

Depth Interval in Feet	Elevation in Feet (CRD)	Generalized Soil Description	SPT N-value range
1.5 to 35	32.5 to -2.5	Loose to medium dense, brown SAND (FILL?)	7 to 14
35 to 41.5	-2.5 to -9	Loose to medium dense, dark grey SAND	9 to 11
41.5 to 65	-9 to -32.5	Medium dense, dark grey SAND	12 to 21
65 to 76.5	-32.5 to -44	Very dense, dark grey SAND	68 to 91 [3)]
76.5 to 200	-44 to -167.5	Dark grey SAND	NA
200 to 228	-167.5 to -195.5	Dark grey GRAVEL, little Sand and Silt	NA

[3)] No SPT N-values below 76.5 ft bgs.
bgs = below ground surface
CRD = Columbia River Datum
SPT = Standard Penetration Test

Table 3-7. Groundwater Monitoring WellLocation, Completion, and Development Data Summary

Well ID[f]	Date Installed	Coordinates[a]		Top of Inner Casing Elevation[b]		Monument Ground Surface Elevation (ft CRD)	Total Depth (feet)	Screen Interval		Borehole Diameter At Screen (ft)	Water Added during Develop-ment (gallons)	Approx. Well Volume (gallons) (Through Sand/Screen Zone Only)	Development Volume for 5 Well Volumes (gallons)	Total Calculated Development Volume (gallons)	Actual Development Volume (gallons)[d]
		Northing	Easting	(ft NGVD)	(ft CRD)			From Depth (ft bgs)	To Depth (ft bgs)						
T4-MW01S[f]	4/6/2004	715157.7	7618979.3	31.37	29.63	30.04	35	25	35	0.85	NA	NA	NA	NA	NA
T4-MW01I	3/10/04	715152.6	7618971.1	31.37	29.63	30.05	70	69.85	70.35	0.85	500	16	79	579	583
T4-MW01D	3/31/04	715163.8	7618971.7	31.30	29.56	30.06	205	194.6	204.4	0.85	1500	15	76	1576	1592
T4-MW02S[f]	4/8/04	714999.8	7621229.0	35.18	33.44	33.75	30	20	30	0.85	NA	NA	NA	NA	NA
T4-MW02I	3/9/04	714992.4	7621232.7	34.77	33.03	33.41	75	35.1	44.9	0.85	250	20	100	350	366
T4-MW02D	3/23/04	714995.3	7621221.7	34.75	33.01	33.50	165	154.6	164.4	0.50	1100[c]	5	27	1127	1140
T4-MW03S[f]	4/6/04	714749.8	7620500.8	32.79	31.05	31.51	30	20	30	0.85	NA	NA	NA	NA	NA
T4-MW03I/D	3/21/04	714743.4	7620498.1	32.65	30.91	31.37	195	179.90	189.70	0.50	1800	6	29	1829	1830
T4-MW04S[f]	3/29/04	714009.9	7619894.0	31.23	29.49	29.67	43	32.00	43.00	0.85	NA	NA	NA	NA	NA
T4-MW04I	3/11/04	714001.4	7619890.5	31.18	29.44	29.83	65	50.25	60.05	0.85	150	17	87	237	440
T4-MW05S	3/8/04	713477.0	7621072.4	34.32	32.58	32.81	21.5	13.4	18.2	0.85	0	3	17	17	10[e]
T4-MW05I	3/8/04	713469.3	7621067.6	34.22	32.48	32.80	65.7	55.2	65.0	0.85	100	16	80	180	300
T4-MW06S	3/4/04	712930.8	7619822.1	33.93	32.19	32.50	40.2	29.85	39.65	0.85	250	16	78	328	510
T4-MW06I	3/5/04	712936.2	7619814.7	33.91	32.17	32.53	75	63.8	73.6	0.85	600	16	81	681	681
T4-MW06D	3/18/04	712923.1	7619831.1	34.04	32.30	32.79	228	208.3	218.1	0.50	2100	6	30	2130	2130

Notes:

(a) Coordinates are NAD 83, state plane Oregon North.

(b) Elevation is surveyed to north side of inner casing.

(c) Volume of water added during development is estimated based on information provided by the drilling subcontractor.

(d) Development volumes are in general accordance to OAR 690-240-0485 and Oregon DEQ guidance. Development within coarser formation materials beyond the calculated volume was not performed due to parameter stabilization and reduction of turbidity to clear conditions.

(e) Development was attempted on April 4, 2004 for T4-MW05S. However, low groundwater yield at this location limited groundwater recovery and groundwater remained turbid. Prior to sampling, additional groundwater withdrawal will be attempted to supplement development. The required development volume shown has been calculated to reflect the measured water level in the well at the time of development.

(f) Shallow monitoring wells T4EA-MW01S, T4EA-MW02S, T4EA-MW03S, and T4EA-MW04S were installed by others. BBL did not provide oversight for the installation and completion of these wells and cannot attest to the quality of the data provided for these wells.

ft CRD = feet Columbia River Datum

ft bgs = feet below ground surface

cf = cubic feet

NA = Not applicable

NGVD = National Geodetic Vertical Datum

Table 3-8
Vibracore Sample Locations

Core ID	Sample Type (a)	Coordinates (b)	
		Northing	Easting
T4-VC01	discrete	715,404	7,618,577
T4-VC02	discrete	714,935	7,618,683
T4-VC03	discrete	714,705	7,618,825
T4-VC04	discrete	714,680	7,618,991
T4-VC05	discrete	714,627	7,619,281
T4-VC06	discrete	714,630	7,619,582
T4-VC06C	composite	714,625	7,619,585
T4-VC07	discrete	714,625	7,619,751
T4-VCO7C	composite	714,635	7,619,752
T4-VC08	discrete	714,539	7,619,925
T4-VC08C	composite	714,541	7,619,923
T4-VC09	discrete	714,612	7,620,094
T4-VC09C	composite	714,611	7,620,085
T4-VC09G	geotech	714,611	7,620,084
T4-VC10	discrete	714,610	7,620,341
T4-VC10C	composite	714,615	7,620,340
T4-VC11	discrete	714,504	7,619,045
T4-VC11C	composite	714,500	7,619,042
T4-VC11G	geotech	714,501	7,619,036
T4-VC12	discrete	714,438	7,619,168
T4-VC12C	composite	714,436	7,619,179
T4-VC13	discrete	714,382	7,619,455
T4-VC13C	composite	714,390	7,619,461
T4-VC13G	geotech	714,381	7,619,438
T4-VC14	discrete	714,454	7,619,721
T4-VC14C	composite	714,454	7,619,725
T4-VC14G	geotech	714,443	7,619,721
T4-VC15	discrete	714,453	7,620,142
T4-VC15C	composite	714,456	7,620,137
T4-VC16	discrete	714,453	7,620,384
T4-VC16C	composite	714,450	7,620,384
T4-VC17	discrete	714,184	7,619,025
T4-VC17C	composite	714,181	7,619,024
T4-VC18	discrete	713,951	7,619,334
T4-VC18C	composite	713,951	7,619,334
T4-VC19	discrete	713,830	7,619,648
T4-VC19C	composite	713,836	7,619,643
T4-VC20	discrete	713,724	7,619,233
T4-VC20C	composite	713,718	7,619,234
T4-VC21	discrete	713,709	7,619,382
T4-VC21C	composite	713,710	7,619,389
T4-VC21G	geotech	713,712	7,619,390
T4-VC22	discrete	713,412	7,619,717
T4-VC22C	composite	713,410	7,619,720
T4-VC23	discrete	713,369	7,620,016
T4-VC23C	composite	713,377	7,620,017
T4-VC23G	geotech	713,369	7,620,010
T4-VC24	discrete	713,376	7,620,329
T4-VC25	discrete	713,356	7,619,416
T4-VC25C	composite	713,350	7,619,415
T4-VC26	discrete	713,226	7,619,590
T4-VC26C	composite	713,224	7,619,588
T4-VC26G	geotech	713,223	7,619,584
T4-VC27	discrete	713,105	7,619,755
T4-VC27C	composite	713,106	7,619,751

Table 3-8
Vibracore Sample Locations

Core ID	Sample Type (a)	Coordinates (b)	
		Northing	Easting
T4-VC28	discrete	713,098	7,620,092
T4-VC28C	composite	713,095	7,620,107
T4-VC29	discrete	713,142	7,620,351
T4-VC29C	composite	713,136	7,620,341
T4-VC29G	geotech	713,137	7,620,335
T4-VC30	discrete	712,977	7,619,573
T4-VC30C	composite	712,982	7,619,568
T4-VC31	discrete	712,585	7,619,773
T4-VC31C	composite	712,588	7,619,769
T4-VC32	discrete	713,237	7,619,950
T4-VC32C	composite	713,239	7,619,945
T4-VC33/PS33	piston/SS	713,453	7,620,193
T4-PS03	piston/SS	714,687	7,618,813
T4-PS04	piston/SS	714,682	7,619,005
T4-PS12	piston/SS	714,392	7,619,231
T4-PS17	piston/SS	714,195	7,619,027
T4-PS20	piston/SS	713,733	7,619,241
T4-PS21	piston/SS	713,796	7,619,513
T4-PS22	piston/SS	713,407	7,619,637
T4-PS28	piston/SS	713,110	7,620,120
T4-PS31	piston/SS	712,593	7,619,792
T4-PS32	piston/SS	713,217	7,619,931

a. Sample type indicates what type of sample was collected from the vibracore. Discrete indicates discrete chemistry samples were collected. Composite indicates samples for the composite used in the dredged sediment quality testing were collected. Geotech indicates samples for geotechnical testing were collected. Piston/SS samples were collected by mud rotary and sampled with piston tubes or oversized split spoon samplers.
b. Coordinates are NAD 83, state plane Oregon North, international feet.

Table 3-9
Vibracore Penetration Depth and Recovered Length of Core

Core ID	Number of Cores Required (a)	Number of Cores Retained (b)	Date Cores Retrieved	Penetration Depth of Core 1 (ft) (c)	Penetration Depth of Core 2 (ft) (c)	Penetration Depth of Core 3 (ft) (c)	Recovered Length of Core 1 (ft) (g)	Recovered Length of Core 2 (ft) (g)	Recovered Length of Core 3 (ft) (g)
T4-VC01	2	1 (d)	3/11/2004	8.6 (f)	NA	NA	5.6	NA	NA
T4-VC02	2	1 (d)	3/8/2004	15	NA	NA	9	NA	NA
T4-VC03	2	1 (d)	3/8/2004	15	NA	NA	7.6	NA	NA
T4-VC04	3	1 (d)	3/9/2004	12 (f)	NA	NA	8.25	NA	NA
T4-VC05	2	1 (d)	3/11/2004	15	NA	NA	9.75	NA	NA
T4-VC06	2	2	3/9/2004 and 3/10/2004	15	15	NA	10.2	10	NA
T4-VC07	2	2	3/10/2004	15	15	NA	9.6	7.6	NA
T4-VC08	2	2	3/10/2004	15	15	NA	11	12.8	NA
T4-VC09	3	3	3/10/2004	15	15	15	14.4	14.4	15
T4-VC10	2	2	3/10/2004	15	15	NA	10	14	NA
T4-VC11	2	3 (e)	3/11/2004	15	15	15	9.5	14	9.6
T4-VC12	2	2	3/11/2004	15	15	NA	8.6	6.5	NA
T4-VC13	2	3 (e)	3/11/2004	15	15	13 (f)	6.5	9.8	9
T4-VC14	3	3	3/11/2004	15	15	15	9.4	8	9.25
T4-VC15	2	2	3/10/2004	15	15	NA	13	13.3	NA
T4-VC16	2	2	3/10/2004	15	15	NA	11.4	10.6	NA
T4-VC17	2	2	3/7/2004 and 3/8/2004	13.75 (f)	15	NA	8.3	7.4	NA
T4-VC18	2	2	3/7/2004	14.5 (f)	14.75 (f)	NA	9	9.7	NA
T4-VC19	2	2	3/7/2004	13.75 (f)	14 (f)	15	8.4	11.2	NA
T4-VC20	2	2	3/7/2004	13 (f)	14 (f)	NA	12	12.5	NA
T4-VC21	3	3	3/7/2004	14 (f)	15	13.75 (f)	12.7	11.8	12.8
T4-VC22	2	2	3/9/2004	15	15	NA	11.25	11.2	NA
T4-VC23	3	3	3/2/2004 and 3/3/2004	15	15	15	9.25	9.75	9.5
T4-VC24	2	2	3/2/2004	15	15	NA	13.5	13.5	NA
T4-VC25	2	2	3/4/2004	15	15	NA	9	5.6	NA
T4-VC25	2	2	3/9/2004	15	15	NA	10.75	9.3	NA
T4-VC26	3	3	3/3/2004	15	15	15	11.2	10	9.2
T4-VC27	2	2	3/3/2004	13	15	NA	11	10	NA
T4-VC28	2	2	3/2/2004 and 3/3/2004	15	15	NA	7	7.3	NA
T4-VC29	3	3	3/3/2004	14 (f)	15	15	10	11.3	9.5
T4-VC30	2	2	3/4/2004	14 (f)	15	NA	10	11	NA
T4-VC31	2	2	3/4/2004	15	15	NA	11.6	9	NA
T4-VC32	2	2	3/3/2004	15	15	NA	7.5	8	NA

Table 3-9
Vibracore Penetration Depth and Recovered Length of Core

NA = Not applicable.

a. Number of cores required per the Work Plan. One core was required from each location for discrete chemistry samples. Additional cores were required if samples were also collected for the chemistry composite and/or the geotechnical composite.

b. Number of cores that were retained for processing.

c. Depth of core penetration in feet below mudline.

d. Only one core was collected at these locations as a result of poor recovery on multiple attempts.

e. Additional cores were collected at these locations as replacements for the chemistry composite and geotechnical composites because insufficient volume was collected from T4-VC01 through T4-VC05.

f. Refusal was met before core penetrated to target depth.

g. Recovered length of core is more than length of core that was processed, as indicated in the core log. The recovered length is the total length of core that was retrieved on the deck of the boat during sampling. Once accepatable cores were retrieved on the deck, the core catch at the bottom of the core tube was removed. This resulted in a processed length of core that was shorter than the recovered length of core.

Table 3-10
Field Duplicate Sample Key

Field Duplicate Sample	Parent Sample	Date Sampled	Type of Sample
T4-VC90	T4-VC23-3-5	3/3/2004	Vibracore
T4-VC91	T4-VC24-7-9	3/3/2004	Vibracore
T4-VC92	T4-VC28-1-3	3/4/2004	Vibracore
T4-VC93	T4-VC29-5-7	3/5/2004	Vibracore
T4-VC94	T4-VC30-1-3	3/8/2004	Vibracore
T4-VC95	T4-VC27-5-7	3/9/2004	Vibracore
T4-VC96	T4-VC19-5-7	3/10/2004	Vibracore
T4-VC97	T4-VC18-7-9	3/11/2004	Vibracore
T4-VC98	T4-VC22-5-7	3/11/2004	Vibracore
T4-VC991	T4-VC04-3-5	3/16/2004	Vibracore
T4-VC992	T4-VC05-7-9	3/16/2004	Vibracore
T4-VC993	T4-VC16-9-11	3/17/2004	Vibracore
T4-VC994	T4-VC08-5-7	3/17/2004	Vibracore
T4-VC995	T4-VC09-9-11	3/17/2004	Vibracore
T4-VC996	T4-VC14-2-3	3/18/2004	Vibracore
T4-VC997	T4-VC02-3-5	3/18/2004	Vibracore
T4-VC998	T4-VC12-5-7	3/19/2004	Vibracore
T4-UP99-0-1	T4-UP10-0-2	3/15/2004	Under-pier

Table 3-11
Under-Pier Sample Locations

Sample ID	Coordinates (a)	
	Northing	Easting
T4-UP01	715,202	7,618,593
T4-UP02	714,952	7,618,708
T4-UP03	714,686	7,619,797
T4-UP04	714,681	7,620,096
T4-UP05	714,659	7,620,289
T4-UP06	714,362	7,619,757
T4-UP07	714,353	7,620,086
T4-UP08	714,339	7,620,284
T4-UP09	713,628	7,619,400
T4-UP10	713,601	7,619,539
T4-UP11 (b)	713,561	7,619,838
T4-UP12	713,524	7,620,114
T4-UP13	713,442	7,620,462
T4-UP14	713,079	7,620,403
T4-UP15	713,096	7,619,789

a. Coordinates are NAD 83, state plane Oregon North, international feet
b. Proposed location; location could not be accessed

Table 3-12
Slip 3 Lead-Line Survey

Date	Time	Northing (a)	Easting (a)	Mudline Elevation (ft CRD) (b)	Bottom Description
4/21/2004	9:34	713,076	7,619,740	-24.4	hard
4/21/2004	9:35	713,085	7,619,789	-20.5	soft
4/21/2004	9:37	713,091	7,619,828	-21.4	hard/wood
4/21/2004	9:38	713,097	7,619,887	-24.9	rocky
4/21/2004	9:39	713,089	7,619,915	-24.1	hard/wood
4/21/2004	9:41	713,095	7,619,969	-27.5	soft
4/21/2004	9:43	713,089	7,620,027	-24.9	hard/wood
4/21/2004	9:44	713,088	7,620,076	-21.4	hard/rocky
4/21/2004	9:46	713,083	7,620,119	-23.7	rocky
4/21/2004	9:47	713,086	7,620,160	-23.9	hard/debris
4/21/2004	9:49	713,077	7,620,196	-23.7	hard/rocky
4/21/2004	9:50	713,072	7,620,247	-21.4	rocky
4/21/2004	9:51	713,075	7,620,291	-23.4	soft
4/21/2004	9:54	713,069	7,620,347	-23.2	wood
4/21/2004	9:55	713,068	7,620,390	-19.8	soft
4/21/2004	9:57	713,074	7,620,439	-14.7	rocky

a. Coordinates are in NAD 83, state plane Oregon North, international feet.
b. Tide board 6.3' at 9:58 AM.
CRD = Columbia River Datum

Table 3-13
Under Pier Sample Descriptions

Sample Identification	Sample Date	Northing (a)	Easting (a)	Sediment Description
T4-UP01	3/9/2004	715,202	7,618,593	Brown fine to medium grain SAND and SILT, trace organics (wood debris on surface); saturated.
T4-UP02	3/9/2004	714,952	7,618,708	Brown fine to medium grain SAND with some silt, trace gravel; saturated.
T4-UP03	4/20/2004	714,686	7,619,797	Dark brown fine to medium grain SAND, some grey clay, little brown silt; saturated.
T4-UP04	4/20/2004	714,681	7,620,096	Dark brown fine to medium grain SAND; loose; saturated; slight sheen.
T4-UP05	4/20/2004	714,659	7,620,289	Dark brown fine to medium grain SAND; saturated. Sheen noted on water surface while sampling.
T4-UP06	3/9/2004	714,362	7,619,757	Light brown silt with some fine to medium grain SAND, trace gravel, trace wood debris; saturated; soft.
T4-UP07	3/9/2004	714,353	7,620,086	Brown fine to medium grain SAND; saturated; loose.
T4-UP08	3/9/2004	714,339	7,620,284	Dark brown fine to medium grain SAND, some silt, trace gravel, trace organics (shells); saturated; loose.
T4-UP09	3/10/2004	713,628	7,619,400	Brown fine to medium grain SAND, some silt, trace organics (wood debris); saturated; loose.
T4-UP10	3/10/2004	713,601	7,619,539	Brown fine to medium grain SAND, some silt; saturated; loose.
T4-UP11	--	--	--	No sample collected because access to sample location was blocked by ships at Berths 410 and 411.
T4-UP12	3/10/2004	713,524	7,620,114	Dark brown gravel with some fine to medium grain SAND, trace shell debris; saturated, loose.
T4-UP13	3/10/2004	713,442	7,620,462	Dark brown gravel with some fine to medium grain SAND, trace shell debris; saturated, loose.
T4-UP14	4/21/2004	713,077	7,620,388	Dark brown fine to medium grain SAND, some silt, trace organics (wood debris), trace yellow sulfur crystals in bottom of core tube; saturated, sulfide odor.
T4-UP15	--	713,095	7,619,769	No recovery. Attempted to collect sample from inside of pier, hit structural debris and riprap, broke bottom of push core.

a. Coordinates are NAD 83, state plane Oregon North, international feet.

Table 3-14
ADCP Track Line Coordinates

No.	Track Line ID	Starting Point		Turn Point		Turn Point		End Point	
		Easting (ft)	Northing (ft)	Easting (ft)	Northing (ft)	Easting (ft)	Northing (ft)	Easting (ft)	Northing (ft)
1	Upstream	7,619,662	713,025	7,619,560	712,980	n/a	n/a	7,618,881	712,673
2	S3_X_East	7,620,320	713,435	n/a	n/a	n/a	n/a	7,620,310	713,080
3	S3_X_Mid	7,619,945	713,495	n/a	n/a	n/a	n/a	7,619,935	713,090
4	S3_X_West	7,619,550	713,550	n/a	n/a	n/a	n/a	7,619,540	713,000
5	S3_A_North	7,620,440	713,320	7,619,365	713,415	n/a	n/a	7,618,681	713,107
6	S3_A_South	7,620,420	713,140	7,619,700	713,210	7,619,500	713,115	7,618,816	712,807
7	WB_A_South	7,619,565	713,880	7,619,220	713,730	n/a	n/a	7,618,536	713,422
8	WB_A_North	7,619,200	714,055	7,619,090	714,010	n/a	n/a	7,618,406	713,702
9	S1_X_East	7,620,025	714,660	n/a	n/a	n/a	n/a	7,620,015	714,375
10	S1_X_Mid	7,619,580	714,740	n/a	n/a	n/a	n/a	7,619,570	714,340
11	S1_X_West	7,619,180	714,750	n/a	n/a	n/a	n/a	7,619,170	714,350
12	S1_A_South	7,619,080	714,320	7,618,980	714,275	n/a	n/a	7,618,296	713,967
13	S1_A_Mid	7,620,350	714,520	7,618,990	714,550	7,618,875	714,500	7,618,191	714,192
14	CRT_Downstream	7,618,865	714,825	7,618,750	714,775	n/a	n/a	7,617,385	714,171

Notes:
1. State plane coordinates are in Oregon state plane - north zone (NAD 83).
2. State plane coordinate units are in international feet (1 foot = 0.3048 m).
3. S3 - Slip 3
4. WB - Wheeler Bay
5. S1 - Slip 1
6. CRT - cross river transect

Table 3-15
ADCP Track Line Start Times

Track Line		Track Line Cycle Number			
No.	**Name**	**1**	**2**	**3**	**4**
1	Upstream	1056	1346	1537	1728
2	S3_X_East	1112	1332	1554	1747
3	S3_X_Mid	1108	1336	1549	1739
4	S3_X_West	1103	1341	1544	1735
5	S3_A_North	1031	1320	1510	1706
6	S3_A_South	1044	1308	1523	1718
7	WB_A_South	1023	1240	1502	1658
8	WB_A_North	1014	1234	1452	1652
9	S1_X_East	0951	1212	1430	1632
10	S1_X_Mid	0957	1217	1436	1636
11	S1_X_West	1002	1221	1441	1640
12	S1_A_South	1006	1226	1445	1645
13	S1_A_Mid	0936	1157	1416	1617
14	CRT_Downstream	0927	1144	1404	1604/1754

Notes:
1. All times are in Local Standard Time on March 25, 2004.
2. All times listed during transect 1 have been advanced 7 minutes.
   The computer clock was observed to be 7 minutes slow for this transect
3. S3 - Slip 3
4. WB - Wheeler Bay
5. S1 - Slip 1
6. CRT - cross river transect

Table 3-16
Sediment Trap Surface Area Calculations

Parameter	Value	Units	Data Source
TSS concentration	20	mg/L, g/m^3	Approximated from data
Settling rate	1	m/d	Estimated
Sediment deposition flux	20	$g/m^2/d$	Calculated
Deployment period	30	days	Approximate deployment period
Deposition mass	600	g/m^2	Calculated
Required mass for analysis	20	grams	CAS
Required trap area	0.033	M^2	Calculated
	52	$inches^2$	Unit conversion from previous line
Tube diameter	3	inches	Approximate
Tube area	7.1	$inches^2$	Calculated
Safety factor	2	-	Contingency overdesign to obtain required mass
Required number of tubes	15	-	Calculated (3x5 array)

mg/L = milligrams per liter
g/m^3 = grams per cubic meter
m/d = meter per day
$g/m^2/d$ = grams per square meter per day
g/m^2 = grams per square meter
m^2 = square meter
$inches^2$ = square inches
CAS = Columbia Analytical Services

Table 3-17
Sediment Trap Location and Deployment Summary

Sediment Trap Location	Sediment Trap Serial Letter	State Plane Coordinates		Geographic Coordinates		Trap Deployment		Trap Recovery	
		Easting (ft)	Northing (ft)	Latitude	Longitude	Date	Time	Date	Time
Slip 1	D	7,619,912	714,453	45.603859	-122.775069	3/18/2004	1656 PST	4/7/2004	0940 PDT
	D	7,619,912	714,453	45.603859	-122.775069	4/26/2004	0956 PDT	5/17/2004	1111 PDT
Slip 3 East	A	7,620,251	713,213	45.600486	-122.773609	3/18/2004	1512 PST	4/6/2004	1034 PDT
	C	7,620,251	713,213	45.600486	-122.773609	4/26/2004	1102 PDT	5/17/2004	1047 PDT
Slip 3 West	B	7,619,805	713,182	45.600368	-122.775347	3/18/2004	1247 PST	4/6/2004	1655 PDT
Toyota Dolphin	C	7,619,827	712,442	45.598339	-122.775183	3/19/2004	1236 PST	4/7/2004	1049 PDT
	A	7,619,827	712,442	45.598339	-122.775183	4/26/2004	1319 PDT	5/17/2004	0840 PDT
Berth 416	B	7,620,953	710,432	45.592917	-122.770564	4/26/2004	1459 PDT	5/17/2004	0920 PDT

Notes:
1. State plane coordinates are in Oregon state plane- north zone (NAD 83).
2. State plane coordinate units are in international feet (1 ft equals 0.3048 meter exactly).
3. Accuracy of positioning system was approximately +/- 3 ft.
PST = Pacific Standard Time
PDT = Pacific Daylight Time

Table 3-18
ADCM Location and Deployment Summary

ADCM Location	Serial Number	State Plane Coordinates		Geographic Coordinates		ADCM Deployment		ADCM Recovery	
		Easting (ft)	Northing (ft)	Latitude	Longitude	Date	Time	Date	Time
Slip 3 East	630	7,620,250	713,199	45.600448	-122.773611	3/18/2004	1455 PST	4/6/2004	0945 PDT
	630	7,620,250	713,199	45.600448	-122.773611	4/6/2004	1600 PDT	4/26/2004	1050 PDT
	630	7,620,250	713,199	45.600448	-122.773611	4/27/2004	0910 PDT	5/17/2004	1400 PDT
Slip 3 West	344	7,619,799	713,164	45.600318	-122.775369	3/18/2004	1325 PST	4/6/2004	1615 PDT
	344	7,619,799	713,164	45.600318	-122.775369	4/7/2004	0900 PDT	4/26/2004	1110 PDT
	344	7,619,799	713,164	45.600318	-122.775369	4/27/2004	0930 PDT	5/17/2004	1410 PDT

Notes:
1. State plane coordinates are in Oregon state plane- north zone (NAD 83).
2. State plane coordinate units are in international feet (1 ft equals 0.3048 meter exactly).
3. Accuracy of positioning system was approximately +/- 3 ft.
PST = Pacific Standard Time
PDT = Pacific Daylight Time

4. Laboratory Results and Findings

This section summarizes the results of tests and analyses conducted by Columbia Analytical Services and Soil Technology, the subcontracted laboratories for the characterization phase of the EE/CA. The key data generated through geotechnical testing (i.e., grain size, Atterberg limits, consolidation, and shear strength), chemistry analysis of bulk sediment, elutriates, and leachates, and groundwater monitoring conducted in the field are summarized in tables. This section also summarizes the quality of the data. Complete results and full data validation reports are presented in the appendices.

All field and laboratory test measurements were found acceptable for use with the exception of some DO measurements made early in the groundwater monitoring program and some pressure transducer readings made shortly after installation, which did not meet DQOs. Both are related to equipment malfunctions that were corrected.

The significance of the findings presented in this section is discussed in Section 5.

4.1 Engineering Characteristics

A geotechnical testing program was carried out to address data gaps identified in the EE/CA work plan (BBL, 2004a). Geotechnical sampling is discussed in Section 3.1 and Appendix A and Appendix C. Representative samples of the materials encountered in the geotechnical explorations were submitted to the subcontracted laboratory for index property, consolidation, and strength testing. Table 4-1 summarizes the geotechnical testing program. This section summarizes the data quality (Section 4.1.1) and the engineering characteristics of the materials (Sections 4.1.2 through 4.1.5) based on the laboratory results.

4.1.1 Data Quality

The geotechnical laboratory testing for this project was performed by Soil Technology of Bainbridge, Washington. Soil Technology's laboratory is equipped in general accordance with ASTM D 3740 – Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction. The testing results submitted by Soil Technology were reviewed and were considered to be in general accordance with the standard of care required by ASTM methods, USACE methods, and other methods described in Appendix C. While the laboratory data for this project appear to be of good quality, as with any geotechnical laboratory testing (or field testing) data, the information must be used with professional engineering judgment.

All geotechnical data are considered to have met the DQOs and were deemed acceptable for use in the EE/CA.

4.1.2 Soil Classification Parameters

Soil samples were visually classified by a field geologist during drilling. The soil descriptions were recorded in general accordance with ASTM D 2488 and are presented on the boring logs in Appendix A. Laboratory testing to verify visual classifications was performed on selected samples. The testing consisted primarily of grain size and Atterberg limits analyses, which were used to modify soil descriptions directly affected by the testing to be in general accordance with ASTM D 2487, Soil Classification for Engineering Purposes. Other index property testing used for engineering characteristics, and to a lesser degree to assist with classification, included moisture content, specific gravity, density, and organic content determinations. These index properties are reported in Appendix C, along with plasticity charts and particle size distribution curves to graphically illustrate the results. Appendix C also presents brief descriptions of the test methods used. A summary of the results is presented below.

4.1.2.1 Grain Size Data

Forty-two grain size analyses were performed on selected samples in general accordance with ASTM D 422. The grain size data are presented in Table 4-2. As indicated in Table 4-2, two of the analyses were performed on composite sediment samples to evaluate the particle size distribution of potential dredge material, which (because of the dredging process and handling for disposal) is generally represented by a composite sample. In addition to the full grain size analyses, the fines contents of two samples were determined using a 200-wash analysis (see Appendix C for a description). This analysis is a modification of ASTM D 422 to include only the mass of sediment passing the U.S. No. 200 sieve. The majority of analyses were performed on dark grey, fine to medium sand that contains approximately 3% to 8% fines. This sand appears to be a fairly thick, native deposit that underlies surficial sediments in the in-water explorations and predominantly granular fill in the upland explorations. Analysis of samples from the upland borings overlying the dark grey native soils, likely to be fill, indicates that this soil is brown, fine to medium sand containing approximately 5% to 15% fines. The sediment/soils that underlie the native dark grey sand deposit consist predominantly of gravel with various amounts of sand and fines. The gravel soils and overlying dark grey sands are believed to be flood deposits that were deposited at the end of the last ice age. Fine-grained, cohesive soils typically contained little sand or coarser material and only one hydrometer test was conducted on this material as part of the geotechnical testing.

Appendix E provides grain size and hydrometer test results generated in conjunction with analytical testing for sediment samples obtained from vibracoring.

4.1.2.2 Soil Plasticity Data

Twenty-five Atterberg limits tests were conducted on selected samples in general accordance with ASTM D 4318. On the basis of the tests, a large number of samples were identified as organic silt and clay. Plasticity data are presented in Table 4-3 and on Figure 4-1. The data on the plasticity chart shown on Figure 4-1 are distinguished as shallow in-water, deep in-water, and upland samples. Based on the Atterberg limits, the surficial in-water sediment samples consist predominantly of cohesive organic silt and clay. Very little cohesive

material of fairly low plasticity was encountered in the in-water borings below the surficial sediments. Some of the upland borings contained deeper deposits of cohesive organic silt and clay. Thick deposits of cohesive organic silt and clay were encountered along Gatton's Slough, which was filled both naturally and artificially during past construction of the slips.

4.1.3 Compressibility and Consolidation Parameters

Consolidation tests were performed on two relatively undisturbed cohesive sediment samples and one composite sediment sample. The consolidation test procedures and consolidation plots are provided in Appendix C. The test results and related data are summarized in Table 4-4 and in the following sections.

4.1.3.1 Consolidation Behavior of Relatively Undisturbed Samples

The two relatively undisturbed samples were obtained from in-water borings T4-GEO1W and T4-GEO6W, which consisted of organic silt and organic clay, respectively. The samples were recovered at shallow depths of 1.1 to 1.3 feet and 4.8 to 5 feet and were both characterized as very soft with relatively high void ratios (refer to Table 4-4). An Osterberg piston sampler was used to minimize sample disturbance and to make recovery possible. The Osterberg piston sampler is described in Appendix A. Sampling of very soft soils is generally difficult and a certain degree of disturbance is expected. However, the magnitude of disturbance and the influence of disturbance on the results are difficult to quantify, especially for normally consolidated soils at low overburden stresses. The stress-strain curves of both samples exhibit no initial reconsolidation portion before the virgin portion of the curve is reached. Instead, the curves appear to start with virgin compression at very low stresses. This is likely the result of samples being normally consolidated and having experienced only small in-situ overburden stresses. In addition, sample disturbance may have obscured the stress-strain relationship to an indeterminate degree. Compression indices of 0.66 and 0.65 indicate that the material is very highly compressible. The coefficients of consolidation obtained during the consolidation tests appear to be about an order of magnitude higher than would be estimated based on the liquid limits of the samples (NAVFAC, 1986). This, along with consideration of sample disturbance effects, requires that all consolidation parameters be used with appropriate professional engineering judgment.

4.1.3.2 Consolidation Behavior of Composite Sediment Sample

Several discrete vibracore sediment samples were used in preparing a composite sediment sample for consolidation testing. The composite was intended to represent dredged sediment placed in an onsite disposal facility to allow estimation of the consolidation behavior of the sediment in a mixed state. Grain size analysis indicates that the composite sample consisted of silty sand with 64% sand, 27% silt, and 9% clay. The sample was carefully placed in the oedometer consolidation testing device at a void ratio of about 1.1 using a spatula, as described in Appendix C. The stress-strain behavior shown on Figure C-35 in Appendix C does not exhibit the straight-line virgin compression curve that is typically observed during consolidation testing. Instead, there appear to be two portions of virgin compression. At stresses below approximately 0.2 tons per square foot (tsf), the compressibility is more than twice as high as the compressibility at stresses above 0.2 tsf (see compression indices and modified compression indices in Table 4-4). The constrained modulus increases with increasing

effective stress and ranges from about 1.4 to 17.6 tsf. As would be expected given the fairly high sand content of the sample, the coefficient of consolidation is higher than that of the relatively undisturbed cohesive sediment samples. Although the sample did not appear to contain a significant amount of organic material and consisted predominantly of granular material, the secondary compression index for the material at the maximum load during the test was determined. As was expected for this material, the secondary compression index is fairly small ($C_\alpha = 0.0065$).

4.1.4 Soil Strength Parameters

Unconsolidated-undrained (UU) and consolidated-undrained (CU) triaxial compression tests were conducted on relatively undisturbed fine-grained cohesive soil samples from boring T4-GEO4L. Appendix C describes the triaxial test procedure for obtaining sediment/soil shear strength engineering characteristics. In the test designations UU and CU, the first term of the two-letter symbol indicates the consolidation state of the sample prior to applying the vertical load intended to shear the sample: "C" indicates the sample is consolidated to a stress state generally representative of the in-situ stress and excess pore pressure is allowed to dissipate during consolidation, while "U" indicates the sample is sheared after a confining stress load is applied without allowing the sample to consolidate. The second term of the two-letter symbol indicates the mode of shearing performed for the test: "U" indicates the testing device is configured such that the pore pressures generated during shearing are not allowed to dissipate. This mode of shearing is intended to represent the behavior of the sediment/soil when it is rapidly loaded and excess pore pressure is introduced, tending to "weaken" the sediment/soil.

The UU tests were performed on samples taken at depths of 61.5 to 62 feet and 72.4 to 72.9 feet to estimate the undrained strength of the cohesive material. The CU tests were conducted on a set of two samples taken at depths between 27.2 and 28.4 feet to estimate the effective strength parameters of the cohesive sediment/soil. In addition to the CU test on the fine-grained cohesive sediment, CU tests were performed on a composited sand sample to estimate the effective strength parameters of the dark grey sand that was encountered in geotechnical borings and monitoring wells throughout the Terminal 4 area. The triaxial test results are summarized in Table 4-5. The test procedure and graphic displays of the results, consisting of stress-strain curves and stress path plots, are presented in Appendix C.

4.1.4.1 General Discussion of Undrained Shear Strength

The behavior of cohesive sediment/soil during undrained shearing is greatly influenced by its stress history or the maximum effective stress the soil experienced in the past. Other factors include primarily soil composition and plasticity of the fine-grained component. The undrained shear strength determined from UU triaxial tests is calculated as the principal stress difference at failure divided by two. Undrained strength is frequently expressed as normalized undrained strength, which is the undrained strength divided by the effective overburden stress (or effective confining stress). For normally consolidated soils with low to moderate plasticity indices, the normalized undrained strength can be estimated from the following equations:

$s_u/\sigma'_v = 0.23 \pm 0.04$ (Jamiolkowski, et al.,1985)

For overconsolidated soils (OCR > 1), the normalized undrained strength is higher and can be estimated as:

$s_u/\sigma'_v = (0.23 \pm 0.04)\ OCR^m$ (Jamiolkowski et al., 1985)

where OCR is the overconsolidation ratio defined as the maximum past effective stress divided by the effective overburden stress. The exponent m varies, but is typically on the order of 0.75 to 0.85.

4.1.4.2 Undrained Strength of Silt and Organic Silt Samples

UU triaxial tests were performed on samples from boring T4-GEO4L that were sampled using thin-walled tubes at depths of 61.5 to 62 feet (Sample 15) and at 72.4 to 72.9 feet (Sample 18). The undrained strengths for Samples 15 and 18 are 1,120 pounds per square foot (psf) and 1,463 psf, respectively. This implies that the shear strength range is representative of a stiff cohesive soil. To determine normalized undrained strengths, the effective overburden stresses for the samples were calculated based on estimated and measured unit weights of the sediment/soils overlying the samples. Samples 15 and 18 had normalized undrained strengths of 0.26 to 0.31. Based on these values, the samples appear to be slightly overconsolidated (i.e., OCR slightly greater than 1) to normally consolidated (i.e., OCR = 1). The latter is expected to be the more common condition for in-water sediment and upland soil.

4.1.4.3 General Discussion of Drained Shear Strength

Drained shear strength parameters can be estimated by conducting CU triaxial tests (i.e., the test procedure in which the sample is allowed to consolidate to a certain confining stress and then sheared undrained). To facilitate this estimation, pore pressures are measured during the test so that the effective stress condition of the sample during testing can be calculated. Table 4-5 presents the estimated drained shear strength parameters in terms of friction angles (ϕ'-angles) based on effective stresses calculated during the test procedure. For each sample tested, the undrained and normalized undrained shear strengths were calculated to provide a general indication of the stress history of the sample at the time of the test. This was only done for samples of cohesive sediment/soils, because the concept of undrained strength is typically not used for relatively free-draining soils such as sand. Even in fine-grained cohesive sediment/soil, the concept of a drained shear strength obtained from CU triaxial testing is one that must be used with appropriate engineering judgment, because the strain rate used in the test is much higher than what is necessary for maintaining a drained condition in fine-grained sediment/soil during shearing. Generally speaking, sediment/soil tends to show increased shear strength with increasing strain rate.

4.1.4.4 Drained Shear Strength of Organic Silt Samples

CU tests were conducted on a set of two samples. Although a set typically consists of three samples, the quantity of sample material was sufficient only for two. The data appear to be of good quality and it is believed that two samples provide reasonable soil strength data for the purpose of this characterization report. Sample 6A (27.3 to 27.8 feet) was consolidated to a confining stress of 2,880 psf, slightly above the estimated effective overburden stress of 2,610 psf. Based on the normalized undrained strength of 0.48, the sample was found to be

overconsolidated when shearing was initiated. Sample 6B (27.9 to 28.4 feet) was consolidated to a higher confining stress of 6,480 psf, which is equal to more than twice its effective overburden stress. The normalized undrained strength of 0.23 indicates that the sample was likely normally consolidated at the time of shearing. Based on the CU test results, ϕ'-angles of 34.3 and 34.9 degrees were calculated for samples 6A and 6B, respectively. Therefore, it is plausible to assume that a ϕ'-angle of 34 degrees would be appropriate for this material and the tested stress range.

4.1.4.5 Drained Shear Strength of Composite Sand Sample

Three subsamples were taken for CU triaxial testing from the single composite sample prepared of discrete sand samples. The objective was to obtain a general approximation from laboratory testing of a representative ϕ'-angle for the dark grey, native sands that were encountered in all of the explorations. This would be compared to estimated friction angles from empirical relationships to SPT N-value and CPT relationships (refer to Section 3.1) for the EE/CA. The discrete samples of sediment were obtained from in-water geotechnical borings T4-GEO1W and T4-GEO5W. These sand samples were often measured in a medium dense and occasionally loose state. Three density determinations on the dark grey sand in boring T4-GEO4L were performed to provide these engineering characteristics data. Dry densities ranged from 81 to 89 pounds per cubic foot (pcf). Using this information, CU samples A, B, and C were prepared at dry densities within that range and the values actually achieved in the laboratory were 89, 87, and 87 pcf, respectively (refer to Table 4-5). Density is the factor that has the greatest influence on the shear strength of sand, expressed in terms of its ϕ'-angle. Other factors include particle shape, grain size distribution, particle surface roughness, moisture content, and particle size, among others. Based on the review of boring logs, visual observation, and laboratory classification of grey sand samples, it was assumed that these factors are more or less the same for the grey sand at Terminal 4. Samples A, B, and C were tested at confining stresses of 720, 2,880, and 6,480 psf, respectively. Sample A exhibited dilative behavior (negative pore pressure response), while Samples B and C both exhibited contractive behavior (positive pore pressure response). This is due mainly to the relationship between density (or void ratio) and confining stress. Calculated ϕ'-angles at relatively low confining stresses tend to be slightly higher than those at higher confining stresses. Therefore, the slightly higher ϕ'-angle for Sample A may be higher than would be expected given the results for the other two samples. The results for Samples B and C at higher confining stresses and a dry density of 87 pcf appear to be more consistent and closer to values that would be expected. The data suggest that for the grey sand at a dry density of 87 pcf, a ϕ'-angle of about 35 degrees is appropriate. For dry densities of less than 87 pcf, a somewhat smaller ϕ'-angle should be used. Effective friction angles for the EE/CA should be selected based on in-situ test methods such as the SPT or CPT in conjunction with engineering judgment and the CU triaxial test results presented here.

4.1.5 Sediment Settling Parameters

Sediment dredged by a hydraulic dredge or conveyed from a barge to shore using a high-solids content pump will result in slurry, a mixture of sediment and water. This slurry may be directed to a CDF for the disposal of the dredged sediment.

Settling refers to those processes in which the dredged slurry is separated into water of low solids concentration and a concentrated slurry. Settling behavior of dredged sediment is influenced by the salinity of the water, the concentration of the slurry, and the flocculation behavior of fine-grained particles. The following types of settling behavior are classified in USACE (1987):

- discrete settling, which is the settling behavior of coarse particles;
- flocculent settling, in which individual sediment particles become attracted and form end-to-edge particle clusters that change settling velocity and compression/consolidation settling behavior;
- zone settling, in which a clear interface between supernatant water and concentrated slurry occurs during settling;
- compression settling, which is the settling behavior of dredged sediment after the thickness is sufficient to compress the sediment under its own weight; and
- consolidation settling, which is the settling behavior of dredged sediment after thickness and rate of placement create a buildup of pore pressure in the voids between sediment particles, causing settlement to occur as a function of time.

Of these types of settling behavior, the first three, either individually or in combination, are associated with the initial placement of slurry and can be determined by the column settling test. CST results can also be used to predict settling velocity.

A CST was performed in general accordance with the EE/CA work plan (BBL, 2004a) on composite sediment sample T4-CM2. The CST provides information to assist in sizing a CDF or other dredged sediment containment area to both (1) meet effluent suspended solids criteria and (2) provide the storage capacity needed to account for settling characteristics (USACE, 1987). Results of the CST are presented in Section 4.4.3.1.

The CST overall showed a relatively rapid propagation of the interface and a corresponding rapid drop in average suspended sediment concentration to about half of the initial concentration within the first 12 hours of the test (i.e., a change of about 5 grams per liter [g/L]), which then slowly declined for the remainder of the 360-hour test (i.e., an additional change of about 3 g/L). The sample contained 63% sand, which settled quickly. The remaining supernatant after the initial discrete settling of sand had a solids concentration of 9.6 g/L, which slowly declined during the test.

4.2 Hydrogeologic Characteristics

This section presents the results of field and laboratory measurements conducted in support of the hydrogeologic characterization, including groundwater parameter data (pH, temperature, SC, DO, and ORP), depth to groundwater and groundwater elevation data, and soil physical characteristics data.

4.2.1 Data Quality

This section briefly describes (1) the procedures used to verify whether all the hydrogeologic data collected during the characterization program met the DQOs presented in the EE/CA work plan (BBL, 2004a); (2) which,

if any, data are considered not to have met the DQOs; and (3) which data have been retained for the evaluation of hydrogeologic conditions at Terminal 4.

Measurements of groundwater levels and groundwater monitoring parameters were made weekly from April 29 through June 3, 2004. Prior to making each week's groundwater parameter measurements, the YSI 600 XLM sonde used for those measurements was calibrated in accordance with manufacturer's guidelines. After the first week, it was noted that the YSI 600 DO probe appeared to have been malfunctioning. The DO content as measured in various wells was significantly different than the DO content measured in the same wells during monitoring well development using a different probe. One of the measurements made during well development had been confirmed with a DO titration test in the field, providing independent confirmation of the DO concentration. The DO membrane in the questionable probe was then replaced and recalibrated following manufacturer's specifications. It calibrated correctly and subsequent DO readings were within the range of values expected on the basis of DO data generated during monitoring well development. Dissolved oxygen measurements for April 29 and 30, 2004 and May 4 and 5, 2004 were likely not representative, but measurements made after May 5, 2004 were accurate to instrument standards.

Initial pressure transducer readings from monitoring well T4-MW06D reflected much lower water levels than were recorded by hand measurement using a Heron water level meter. It was determined that the manufacturer incorrectly delivered a pressure transducer that did not have a sufficient water pressure rating. The initial pressure transducer was subsequently replaced with one appropriately rated for the water pressure in the well. Pressure transducer readings from monitoring well T4-MW06D between April 16, 2004 and April 22, 2004 were discarded. Following replacement of the pressure transducer on April 23, 2004, pressure transducer water level readings correlated to the hand measurements made with the Heron water level probe and were determined to be accurate.

Based on the above, groundwater parameters, especially DO measurements, collected prior to May 5 and groundwater level measurements taken prior to April 22 did not meet DQOs; these data will be used with appropriate engineering-scientific judgment in the evaluation of groundwater characteristics.

All other groundwater data are considered to have met the DQOs and were deemed acceptable for use in the EE/CA.

4.2.2 Groundwater Parameters

As described in Section 3.2.3, weekly groundwater monitoring started on April 29, 2004 following completion and development of the monitoring wells and ended on June 3, 2004. Weekly monitoring consisted of measuring depth to groundwater and groundwater parameters (temperature, pH, DO, SC and ORP). Groundwater parameter data are presented in Appendix D and are summarized in Table 4-6. For the following data presentation, groundwater depth intervals are defined as follows:

- shallow groundwater is the groundwater at monitoring wells T4-MW01S, T4-MW02S, T4-MW03S, T4-MW04S, T4-MW05S, and T4-MW06S;
- intermediate groundwater is the groundwater at monitoring wells T4-MW01I, T4-MW02I, T4-MW04I, T4-MW05I, and T4-MW06I; and

- deep groundwater is the groundwater at monitoring wells T4-MW01D, T4-MW02D, T4-MW03I/D, and T4-MW06D.

As shown in Table 4-6, average groundwater temperatures ranged from 11.8ºC at monitoring well T4-MW02D to 16.8ºC at monitoring well T4-MW04S for the six-week groundwater monitoring period. Groundwater temperatures were generally higher in the shallow groundwater than in the intermediate and deep groundwater, possibly indicating a seasonal influence on groundwater temperatures. Groundwater pH was neutral at most monitoring wells, and the average groundwater pH was 7.4, 7.5, and 7.5 for shallow, intermediate, and deep groundwater, respectively. Elevated average groundwater pH values of 8.8 and 10.1 were observed at monitoring wells T4-MW01I and T4-MW06S, respectively, possibly indicating impacts to groundwater at these locations resulting from activities at Terminal 4. Specific conductivity values generally increased from shallow groundwater to deep groundwater, with average values of 0.35, 0.53, and 0.90 mS/cm for shallow, intermediate, and deep groundwater, respectively, indicating that deep groundwater has a greater solute content than shallow or intermediate groundwater.

The DO content of groundwater was generally below 1 mg/L with the exception of groundwater at monitoring wells T4-MW02D, T4-MW03S, and T4-MW05S, which had average DO values of 3.3, 3.3, and 1.5 mg/L, respectively, indicating that groundwater at Terminal 4 is generally anoxic. As discussed in Section 4.2.1, the DO probe appears to have been malfunctioning during the April 29 monitoring event. The April 29, 2004 DO data are provided in Appendix D, but were excluded from calculations conducted to estimate average DO values.

Average ORP values ranged from 217 mV in groundwater at monitoring well T4-MW01S to -192 mV in groundwater at monitoring well T4-MW04I, indicating that groundwater at Terminal 4 is under mildly to moderately reducing conditions.

On balance, it appears that groundwater pH at Terminal 4 is neutral. Groundwater temperature and specific conductance vary by depth; groundwater temperature decreases with depth, while specific conductance increases with depth. Groundwater is generally anoxic and under mildly to moderately reducing conditions, with no discernable variation with depth.

4.2.3 Depth to Groundwater and Groundwater Elevation Data

As described in Section 3.2.3, depth to groundwater measurements were made on a weekly basis starting on April 29, 2004 and ending on June 3, 2004. Weekly depth to groundwater and groundwater elevation data are presented in Appendix D and summarized in Table 4-6. Groundwater elevations in upland monitoring well clusters T4-MW02, T4-MW03, and T4-MW05 varied by depth. At monitoring well cluster T4-MW02, groundwater elevations were slightly higher for the intermediate depth compared with the shallow depth groundwater; however, groundwater elevations for both depths were about 10 feet greater than deep groundwater elevations. Groundwater elevations at monitoring well T4-MW03S were approximately 4 to 8 feet higher than groundwater elevations at monitoring well T4-MW03I/D, and groundwater elevations at monitoring well T4-MW05S were about 9 feet higher than groundwater elevations at monitoring well T4-MW05I. Fluctuations in groundwater elevations were greater for the deep upland groundwater than for the shallow and intermediate depth groundwater. Groundwater elevations in monitoring well clusters T4-MW01, T4-MW04,

and T4-MW06, which are located near the Willamette River, were similar for all three depths and had greater variation in elevation over time compared with shallow and intermediate depth groundwater at the upland monitoring wells.

As described in Section 3.2, pressure transducers were used to "continuously" monitor groundwater pressure at one-minute intervals at T4-MW06I and T4-MW06D. Groundwater elevation data based on pressure transducer measurements at monitoring wells T4-MW06I and T4-MW06D are presented on Figure 4-2. As seen in the weekly groundwater elevation data, intermediate and deep groundwater elevations were similar, although deep groundwater elevations were typically 0.05 foot lower than intermediate groundwater elevations at this location. Intermediate and deep groundwater elevations fluctuated about 0.7 foot to 2.2 feet on a daily basis in a manner that is indicative of a tidal influence. Groundwater elevations at both depths fluctuated about 6 feet during the period of record.

4.2.4 Soil Textural Characteristics

Geotechnical sampling was performed in the upland area to evaluate certain geotechnical and engineering properties of soils. Sampling methods for the collection of geotechnical samples are presented in Section 3.1, and geotechnical/engineering characteristics of sediments and soils are presented in Section 4.1. This section briefly presents soil physical characteristics for soil samples collected during installation of monitoring wells. Select soil sample intervals were submitted for grain size distribution and Atterberg limits analyses. Results of these analyses are summarized in Tables 4-2 and 4-3 and provided in Appendix C. Stratigraphic descriptions of continuous or discrete boring samples were recorded in field notebooks and are provided on the monitoring well logs in Appendix A.

Shallow monitoring wells were completed in the upland fill material. The upland fill was comprised primarily of well-sorted medium brown fine to medium sand (greater than 92% of total material) with trace amounts of gravel, silt, and clay (Table 4-2 and Appendix A). The thickness of the upland fill material at Terminal 4 varied from approximately 18 feet at upland monitoring well cluster T4-MW05 to about 35 feet at near-river monitoring well cluster T4-MW06 (Appendix A). Upland fill material was thicker at monitoring well clusters closest to the river (31 to 35 feet thick at T4-MW01 and T4-MW06) than at monitoring well clusters located farther upland (18 to 26 feet thick at monitoring well clusters T4-MW02, T4-MW03, T4-MW05, and T4-MW05). Hart Crowser (2000) reported upland fill material thicknesses of approximately 5 to 40 feet.

Intermediate depth wells were completed in the Unconsolidated Alluvial Deposits. Closest to the river (i.e., monitoring well clusters T4-MW01, T4-MW04, and T4-MW06), the Unconsolidated Alluvial Deposits consisted of well-sorted grey, grey-brown, and grey-black fine to medium sand (typically greater than 84% of total material) with lesser amounts of gravel, silt, and clay (Table 4-2 and Appendix A). Farther away from the river (i.e., monitoring well clusters T4-MW02, T4-MW03, and T4-MW05), the Unconsolidated Alluvial Deposits consisted of interbedded layers of sand, silt, and clay (Appendix A). Intermediate depth monitoring wells T4-MW02I, T4-MW03I, and T4-MW05I were completed within coarser-grained layers of material within the Unconsolidated Alluvial Deposits (Appendix A). Based on boring logs for deep monitoring wells, the thickness of the Unconsolidated Alluvial Deposits beneath Terminal 4 ranged from approximately 115 feet at monitoring well T4-MW02D to 160 feet at monitoring well T4-MW06D.

Deep monitoring wells were completed in the Troutdale Formation. The portions of the Troutdale Formation characterized during this investigation consisted of poorly sorted gravel (typically greater than 50% of total material) with lesser amounts of sand, cobble, silt, and clay, in decreasing order of prevalence. The thickness of the Troutdale Formation beneath Terminal 4 was not determined during this investigation.

4.3 Sediment Quality Characteristics

This section generally discusses the results of the sediment chemistry analyses and the quality of the data. Section 5 presents a limited comparison of sediment data to screening levels to identify areas for further consideration in the EE/CA.

Sediment data are discussed below by Removal Action Area subareas. Figure 3-4 shows the boundaries for the subareas, which are:

- Berth 401;
- Slip 1;
- Wheeler Bay;
- Slip 3; and
- North of Berth 414.

These subareas were selected based on an initial evaluation of sediment chemistry, operational considerations, and structural considerations and are not intended to represent final Removal Action Area subareas, which may be reconsidered during the EE/CA.

A number of complex congener families were evaluated by summing certain analytes within the family. Total summations were calculated for PAH compounds, DDD isomers, DDE isomers, and DDT isomers. A summation (Σ) of all DDT isomers and metabolites (i.e., Σ DDTs) is included to identify the sum total of this family of chlorinated pesticides. Total PCBs (as Aroclors) were also calculated.

Total concentrations were calculated using the detected concentrations of individual constituents. Analytes that were not detected (i.e., "non-detects") at the method reporting limit (MRL) were treated as having a concentration of zero. If all the individual constituents in a family of analytes were not detected, the total concentration is reported as non-detect using the highest detection limit (i.e., the highest MRL) for the constituents summed. Total summations were calculated as follows:

Total PAHs: the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene (Swartz, 1999)

Total DDD: the sum of 2,4'-DDD and 4,4'-DDD

Total DDE: the sum of 2,4'-DDE and 4,4'-DDE

Total DDT: the sum of 2,4'-DDT and 4,4'-DDT

Σ DDTs: the sum of total DDD, total DDE, and total DDT

Total PCBs: the sum of Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268.

4.3.1 Data Quality

EcoChem of Seattle, Washington performed the data validation for all surface, under-pier, and subsurface sediment samples and sediment trap samples. In accordance with the EE/CA work plan (BBL, 2004a), both Level IV and Level III data validation were performed. Level IV data validation was performed on data packages K2401559, K2401958, and K2402940, a total of 33 samples. Level III data validation was performed on the remaining sediment samples. No sediment data were rejected as a result of the data validation. The complete data validation reports are presented in Appendix F.

Data precision was evaluated through field, laboratory, matrix spike, and laboratory control sample duplicates and was acceptable. Data accuracy was evaluated through initial and continuing calibration of instruments, surrogate spikes, matrix spikes, and laboratory control samples and was acceptable. Data representativeness was acceptable. The prescribed field and laboratory methods were followed. Data comparability was acceptable. Sampling and analytical methodologies set forth in the QAPP were followed. Data completeness was acceptable. The completeness for this set of data is 100 percent, which exceeds the project-specified goal of 90 percent. Based on the data validation, all of the data were determined to be acceptable for use as qualified.

USEPA also reviewed the first sediment data package, K2401559. USEPA's data validation, along with a summary of how USEPA's recommended qualifiers were incorporated into the sediment chemistry data, is presented in Appendix F.

Field duplicate samples were generally collected at the work plan's specified frequency of one per ten samples. In all, 19 field duplicates of under-pier and subsurface sediment samples were collected. Surface sediment volume was insufficient to allow the collection of field duplicates. Chemistry results for the field duplicates are presented in Appendix F. Field duplicate results as they pertain to data quality are discussed in the data validation reports in Appendix F.

Rinseate blanks were generally collected at the frequency of one per ten vibracore locations as specified in the EE/CA work plan. Four rinseate blank samples were collected from the vibracores and one rinseate blank was collected from the under-pier cores. Rinseate blank chemistry results are presented in Appendix F and discussed as they pertain to data quality in the data validation reports in Appendix F.

4.3.2 Surface Sediment

Surface sediment chemistry data pertain to the nature and lateral extent of contamination. The surface sediment data for Berth 401, Slip 1, Wheeler Bay, Slip 3, and north of Berth 414 are discussed below by subarea and constituent class: metals, SVOCs (PAHs and phthalates), pesticides (including total DDD, total DDE, and total

DDT), PCBs, TPH, conventionals (TOC and total solids), and grain size. Figure 3-4 presents surface sediment sample locations. Surface sediment chemistry results are presented in Appendix E.

4.3.2.1 Berth 401

Two surface sediment samples (T4-VC01-0-1 and T4-VC02-0-1) were collected from Berth 401. Table 4-7 summarizes Berth 401 surface sediment chemistry results.

Metals Results

All of the metals for which Berth 401 surface sediment samples were analyzed were detected in both surface sediment samples.

SVOC Results

All of the 24 PAH compounds for which Berth 401 surface sediment samples were analyzed were detected in both surface sediment samples except biphenyl, which was detected in only one. Concentrations of total detected PAHs ranged from 840 micrograms per kilogram (µg/kg) (T4-VC02-0-1) to 2,103 µg/kg (T4-VC01-0-1).

Four of the six phthalates for which Berth 401 surface sediment samples were analyzed were detected at least once. The four phthalates are dimethyl phthalate, butylbenzyl phthalate, bis(2-ethylhexyl)phthalate, and di-n-octyl phthalate.

Pesticide Results

Of the six DDT compounds for which Berth 401 surface sediment samples were analyzed, 2,4'-DDD was not detected in either sample. The remaining five DDT compounds were detected at least once in the Berth 401 surface sediment samples. The range of Σ DDTs was from 11 µg/kg (T4-VC02-0-1) to 29 µg/kg (T4-VC01-0-1).

PCB Results

Of the nine Aroclors for which Berth 401 surface sediment samples were analyzed, four Aroclors (1242, 1248, 1254, and 1260) were each detected once. Total detected PCB concentrations ranged from 15 µg/kg (T4-VC02-0-1) to 250 µg/kg (T4-VC01-0-1).

TPH Results

TPH organic compounds in the diesel range and residual range were detected in both Berth 401 surface sediment samples. Gasoline-range TPH was not detected in either sample.

Conventionals

TOC concentrations ranged from 1.43 to 1.83% in the Berth 401 surface sediment samples. Total solids ranged from 57.4 to 66.2%.

Grain Size

Grain size analysis indicates that Berth 401 surface sediment samples are generally sandy silts.

4.3.2.2 Slip 1

Fifteen surface sediment samples (T4-VC03-0-1 through T4-VC17-0-1) were collected from Slip 1. Table 4-8 summarizes Slip 1 surface sediment chemistry results.

Metals Results

Of the ten metals for which Slip 1 surface sediment samples were analyzed, all except selenium were detected in all 15 samples; selenium was detected in ten samples.

SVOC Results

All of the 24 PAH compounds for which Slip 1 surface sediment samples were analyzed were detected at least once. Frequency of detection for individual PAH compounds ranged from 12 to 15 samples. Total detected PAHs ranged from 46 µg/kg (T4-VC14-0-1) to 50,422 µg/kg (T4-VC12-0-1).

Three of the six phthalates for which Slip 1 surface sediment samples were analyzed were detected at least once: diethyl phthalate, butylbenzyl phthalate, and bis(2-ethylhexyl)phthalate. The number of Slip 1 surface sediment samples in which these three phthalates were detected ranged from one to 13.

Pesticide Results

All of the six DDT compounds for which Slip 1 surface sediment samples were analyzed were detected at least once. The number of detections ranged from two to 13. The range of Σ DDTs was from 1.3 µg/kg (T4-VC14-0-1) to 75 µg/kg (T4-VC13-0-1).

PCB Results

Of the nine Aroclors for which Slip 1 surface sediment samples were analyzed, two Aroclors (1248 and 1260) were detected. The number of detections ranged from 11 to 14 samples. Total detected PCB concentrations ranged from 5.3 µg/kg (T4-VC14-0-1) to 820 µg/kg (T-VC13-0-1).

TPH Results

Diesel-range, residual-range, and gasoline-range TPHs were detected at least once in the Slip 1 surface sediment samples. The number of Slip 1 surface sediment samples that these TPH compounds were detected in ranged from one to 13.

Conventionals

TOC concentrations ranged from 0.05 to 2.13% in the Slip 1 surface sediment samples. Total solids ranged from 45.0 to 88.1%.

Grain Size

Grain size analysis indicates that Slip 1 surface sediment samples are generally sandy silt.

4.3.2.3 Wheeler Bay

Four surface sediment samples (T4-VC18-0-1 through T4-VC21-0-1) were collected from Wheeler Bay. Table 4-9 summarizes Wheeler Bay surface sediment chemistry results.

Metals Results

All of the metals for which Wheeler Bay surface sediment samples were analyzed were detected in each of the four samples.

SVOC Results

All of the 24 PAH compounds for which Wheeler Bay surface sediment samples were analyzed were detected in each of the four samples. Total detected PAHs ranged from 1,450 µg/kg (T4-VC20-0-1) to 28,921 µg/kg (T4-VC19-0-1).

All of the six phthalates for which Wheeler Bay surface sediment samples were analyzed were detected at least once in the four samples except di-n-butyl phthalate, which was not detected in any sample. The number of detections for individual phthalates ranged from one to three samples.

Pesticide Results

All of the six DDT compounds for which the Wheeler Bay surface sediment samples were analyzed were detected at least once except 2,4'-DDE and 2,4'-DDT, which were not detected in any sample. Frequency of detection ranged from three to four samples. The range of Σ DDTs was from 6.5 µg/kg (T4-VC19-0-1) to 37 µg/kg (T4-VC21-0-1).

PCB Results

Of the nine Aroclors for which Wheeler Bay surface sediment samples were analyzed, two Aroclors (1248 and 1260) were detected in each of the samples. Total detected PCB concentrations ranged from 17 µg/kg (T4-VC20-0-1) to 39 µg/kg (T4-VC18-0-1 and T4-VC19-0-1).

TPH Results

Diesel-range TPH was detected in each of the Wheeler Bay surface sediment samples. Residual-range TPH was detected in three of the four samples. Gasoline-range TPH was not detected in any of the four samples.

Conventionals

TOC concentrations ranged from 1.78 to 2.00% in the Wheeler Bay surface sediment samples. Total solids ranged from 47.6 to 57.2%.

Grain Size

Grain size analysis indicates that Wheeler Bay surface sediment samples are generally silty sand.

4.3.2.4 Slip 3

Nine surface sediment samples (T4-VC22-0-1 through T4-VC29-0-1 and T4-VC32-0-1) were collected from Slip 3. Table 4-10 summarizes Slip 3 surface sediment chemistry results.

Metals Results

All of the ten metals for which the samples were analyzed were detected in all of Slip 3 surface sediment samples except selenium, which was detected in four of the nine samples.

SVOC Results

All of the 24 PAHs for which Slip 3 surface sediment samples were analyzed were detected at least once. Frequency of detection for individual PAHs ranged from seven to nine samples. Total detected PAHs ranged from 15 µg/kg (T4-VC25-0-1) to 602,953 µg/kg (T4-VC24-0-1).

Three of the six phthalates for which Slip 3 surface sediment samples were analyzed were detected at least once: di-n-butyl phthalate, butylbenzyl phthalate, and bis(2-ethylhexyl)phthalate. The number of detections ranged from four to five samples for these three phthalates.

Pesticide Results

Of the six DDT compounds for which Slip 3 surface sediment samples were analyzed, none was detected in samples T4-VC22-0-1 and T4-VC25-0-1. All six were detected at least once in the other seven samples. Frequency of detection of individual pesticides ranged from two to seven samples. The range of Σ DDTs was from 0.57 µg/kg (T4-VC28-0-1) to 22 µg/kg (T4-VC32-0-1).

PCB Results

The nine Aroclors for which Slip 3 surface sediment samples were analyzed were not detected in samples T4-VC22-0-1, T4-VC25-0-1, and T4-VC28-0-1. Aroclor 1260 was detected in the other six samples. Aroclor 1248 was detected in samples T4-VC26-0-1, T4-VC29-0-1, and T4-VC32-0-1. No other Aroclors were detected in Slip 3 surface sediment samples. Total detected PCB concentrations ranged from 6.8 µg/kg (T4-VC27-0-1) to 57 µg/kg (T4-VC32-0-1).

TPH Results

Diesel-range organics and residual-range organics were not detected in T4-VC25-0-1. Diesel-range organics and residual-range organics were detected in the other eight Slip 3 surface sediment samples, excepting diesel-range organics in T4-VC22-0-1 and residual-range organics in T4-VC27-0-1. Gasoline-range TPH was not detected in any of the Slip 3 surface sediment samples.

Conventionals

TOC concentrations ranged from 0.15 to 2.73% in the Slip 3 surface sediment samples. Total solids ranged from 48.7 to 91.5%.

Grain Size

Grain size analysis indicates that Slip 3 surface sediment samples are generally silty sand.

4.3.2.5 North of Berth 414

Two surface sediment samples (T4-VC30-0-1 and T4-VC31-0-1) were collected from north of Berth 414. Table 4-11 summarizes surface sediment chemistry results for the north of Berth 414 subarea.

Metals Results

All of the metals for which the north of Berth 414 surface sediment samples were analyzed were detected in both samples except selenium, which was detected in only one.

SVOC Results

All of the 24 PAH compounds for which the north of Berth 414 surface sediment samples were analyzed were detected in both samples. Total detected PAHs ranged from 971 µg/kg (T4-VC30-0-1) to 6,117 µg/kg (T4-VC31-0-1).

Butylbenzyl phthalate was detected in one of the north of Berth 414 surface sediment samples. The remaining five phthalates for which the samples were analyzed were not detected in either sample.

Pesticide Results

Of the six DDT compounds for which the north of Berth 414 surface sediment samples were analyzed, 2,4'-DDE was not detected in either sample. The remaining five DDT compounds were detected in both of the samples. The range of Σ DDTs was from 10 µg/kg (T4-VC30-0-1) to 11 µg/kg (T4-VC31-0-1).

PCB Results

Of the nine Aroclors for which the north of Berth 414 surface sediment samples were analyzed, Aroclors 1248 and 1260 were detected in both samples. The remaining seven Aroclors were not detected in the two samples. Total detected PCB concentrations ranged from 20 µg/kg (T4-VC30-0-1) to 22 µg/kg (T4-VC31-0-1).

TPH Results

Diesel-range and residual-range TPH were detected in both north of Berth 414 surface sediment samples. Gasoline-range TPH was not detected in either sample.

Conventionals

TOC concentrations ranged from 1.79 to 1.87% in the north of Berth 414 surface sediment samples. Total solids ranged from 50.7 to 51.2%.

Grain Size

Grain size analysis indicates that north of Berth 414 surface sediment samples are generally silty sands.

4.3.3 Under-Pier Sediment

The under-pier sediment data for Berth 401, Slip 1, and Slip 3 are discussed below. Under-pier sediment samples were not collected from the Wheeler Bay or north of Berth 414 subareas. The data are presented by subarea and constituent class: metals, SVOCs (e.g., PAHs and phthalates), pesticides (including total DDD, total DDE, and total DDT), PCBs, TPH, conventionals (e.g., TOC and total solids), and grain size. Figure 3-7 presents under-pier sediment sample locations. Under-pier sediment chemistry results are presented in Appendix E.

4.3.3.1 Berth 401

Two under-pier sediment samples (T4-UP01-0-1 and T4-UP02-0-1) were collected from Berth 401. Table 4-12 summarizes Berth 401 under-pier sediment chemistry results.

Metals Results

All of the metals for which the Berth 401 under-pier sediment samples were analyzed were detected in both samples except selenium, which was not detected in either sample.

SVOC Results

All of the 24 PAH compounds for which the Berth 401 under-pier sediment samples were analyzed were detected in both samples except biphenyl, which was detected in only one. Total detected PAHs ranged from 144 µg/kg (T4-UP02-0-1) to 4,234 µg/kg (T4-UP01-0-1).

Butylbenzyl phthalate and bis(2-ethylhexyl)phthalate were each detected in at least one of the two Berth 401 under-pier surface sediment samples. The remaining four phthalates for which the samples were analyzed were not detected.

Pesticide Results

Four of the six DDT compounds for which the Berth 401 under-pier sediment samples were analyzed were detected at least once. The pesticides 2,4'-DDE and 2,4'-DDT were not detected in either sample. The range of Σ DDTs was from 1.1 µg/kg (T4-UP02-0-1) to 19 µg/kg (T4-UP01-0-1).

PCB Results

Of the nine Aroclors for which the Berth 401 under-pier sediment samples were analyzed, only Aroclors1248 and 1260 were detected at least once. Total detected PCB concentrations ranged from 2.9 µg/kg (T4-UP02-0-1) to 51 µg/kg (T4-UP01-0-1).

TPH Results

Diesel-range organics, residual-range organics, and gasoline-range organics were detected at least once in the two Berth 401 under-pier sediment samples.

Conventionals

TOC concentrations ranged from 0.28 to 1.24% in the Berth 401 under-pier sediment samples. Total solids ranged from 62.5 to 77.3%.

Grain Size

Grain size analysis indicates that Berth 401 under-pier sediment samples are generally slightly silty sands.

4.3.3.2 Slip 1

Six under-pier sediment samples (T4-UP03 through T4-UP08-0-1) were collected from Slip 1. Three of the samples (T4-UP03 through T4-UP05) were collected underneath Berth 405 and three samples (T4-UP06-0-1 through T4-UP08-0-1) were collected underneath Berth 408. Table 4-13 summarizes Slip 1 under-pier sediment chemistry results.

Metals Results

Nine of the ten metals for which Slip 1 under-pier sediment samples were analyzed were detected in each of the six samples. Selenium was detected in one of the six samples.

SVOC Results

All of the 24 PAH compounds for which the Slip 1 under-pier sediment samples were analyzed were detected in each of the six samples except biphenyl, which was detected in only two. Total detected PAHs ranged from 176 µg/kg (T4-UP03) to 16,974 µg/kg (T4-UP07-0-1).

Butylbenzyl phthalate and bis(2-ethylhexyl)phthalate were detected at least once in the Slip 1 under-pier sediment samples. Frequency of detection ranged from one to two samples. The remaining four phthalates were not detected.

Pesticide Results

All of the six DDT compounds for which the samples were analyzed were detected at least once in the Slip 1 under-pier sediment samples. The number of detections for individual DDT compounds ranged from one to six samples. The range of Σ DDTs was from 0.39 µg/kg (T4-UP03) to 14 µg/kg (T4-UP06-0-1).

PCB Results

Aroclors were not detected in Slip 1 under-pier sediment samples T4-UP03 and T4-UP05. Aroclors 1248, 1254, and 1260 were detected at least once in the remaining four Slip 1 under-pier sediment samples. Frequency of detections ranged from one to three samples. Total detected PCB concentrations ranged from 6.6 µg/kg (T4-UP04) to 88 µg/kg (T-UP06-0-1).

TPH Results

Diesel-range organics and residual-range TPH were detected in each of the Slip 1 under-pier sediment samples except T4-UP05 and T4-UP08-0-1, where diesel-range TPH was not detected. Gasoline-range TPH was not detected in any of the Slip 1 under-pier sediment samples.

Conventionals

TOC concentrations ranged from 0.09 to 3.81% in the Slip 1 under-pier sediment samples. Total solids ranged from 36.7 to 75.4%.

Grain Size

Grain size analysis indicates that Slip 1 under-pier sediment samples are generally silty sand.

4.3.3.3 Slip 3

Six under-pier sediment samples (T4-UP09-0-1, T4-UP10-0-1, T4-UP10-0-2, T4-UP12-0-1, T4-UP13-0-1, and T4-UP14) were collected from five locations in Slip 3 (two samples were collected from location T4-UP10). Table 4-14 summarizes Slip 3 under-pier sediment chemistry results.

Metals Results

All of the ten metals for which Slip 3 under-pier sediment samples were analyzed were detected in all six samples, except selenium. Selenium was detected in four samples.

SVOC Results

All of the 24 PAH compounds for which Slip 3 under-pier sediment samples were analyzed were detected in each sample. Total detected PAHs ranged from 3,705 µg/kg (T4-UP09-0-1) to 413,825 µg/kg (T4-UP13-0-1).

Phthalates were not detected in T4-UP12-0-1, T4-UP13-0-1, and T4-UP14. Butylbenzyl phthalate and bis(2-ethylhexyl)phthalate were detected in the three other Slip 3 under-pier sediment samples.

Pesticide Results

Four of the six DDT compounds for which Slip 3 under-pier sediment samples were analyzed were detected at least once. 2,4'-DDE and 2,4'-DDT were not detected in any of the Slip 3 under-pier sediment samples. The frequency of detection for individual DDT compounds ranged from two to five samples. The range of Σ DDTs was from 0.92 µg/kg (T4-UP12-0-1) to 35 µg/kg (T4-UP14-0-1).

PCB Results

PCB Aroclors were not detected in sample T4-UP14. Aroclors 1248 and 1260 were detected at least once in the five other Slip 3 under-pier sediment samples. The frequency of detection ranged from four to five samples. Detected total PCB concentrations ranged from 12 µg/kg (T4-UP12-0-1) to 33 µg/kg (T4-UP13-0-1).

TPH Results

Diesel-range organics and residual-range organics were detected in all of the Slip 3 under-pier sediment samples. Gasoline-range TPH was detected only in samples T4-UP13-0-1 and T4-UP14.

Conventionals

TOC concentrations ranged from 0.24 to 2.83% in the Slip 3 under-pier sediment samples. Total solids ranged from 54.2 to 81.4%.

Grain Size

Grain size analysis indicates that Slip 3 under-pier sediment samples are generally silty sand.

4.3.4 Subsurface Sediment

The subsurface sediment data for Berth 401, Slip 1, Wheeler Bay, Slip 3, and north of Berth 414 are discussed below by subarea and constituent class: metals, SVOCs (e.g., PAHs and phthalates), pesticides (including total DDD, total DDE, and total DDT), PCBs, TPH, and conventionals (e.g., TOC and total solids). Grain size results are not discussed because grain size statistics ignore the lithologic layers present in the subsurface sediment. Figure 3-10 presents subsurface sediment sample locations. Subsurface sediment chemistry results are presented in Appendix E.

4.3.4.1 Berth 401

Vibracores were collected from two locations (T4-VC01 and T4-VC02) from Berth 401 for a total of six subsurface sediment samples. The deepest sediment sample collected at Berth 401 was 7 to 9 feet below mudline. Table 4-15 summarizes Berth 401 subsurface sediment chemistry results.

Metals Results

Of the ten metals for which the Berth 401 subsurface sediment samples were analyzed, arsenic, cadmium, chromium, copper, lead, nickel, and zinc were detected in each of the six samples. Mercury, selenium, and silver were detected at least once in the samples. The frequency of detection for mercury, selenium, and silver ranged from two to five samples.

SVOC Results

All of the 24 PAH compounds for which the Berth 401 subsurface sediment samples were analyzed were detected at least once in the six samples. The number of detections for individual PAHs ranged from three to six samples. Total detected PAHs ranged from 43 µg/kg (T4-VC02-3-5) to 5,054 µg/kg (T4-VC01-1-3). Total PAH subsurface sediment concentrations were highest in the samples from the 1- to 3-feet below mudline interval.

Butylbenzyl phthalate and bis(2-ethylhexyl)phthalate were the only phthalates detected in Berth 401 subsurface sediment samples. Their frequency of detection ranged from one to two samples. The remaining four phthalates for which the samples were analyzed were not detected.

Pesticide Results

Pesticides were not detected in three of the six Berth 401 subsurface sediment samples: T4-VC01-3-5, T4-VC02-5-7, and T4-VC02-7-9. Four of the six DDT compounds for which the samples were analyzed (2,4'-DDD, 2,4'-DDT, 4,4'-DDD, and 4,4'-DDT) were detected in the other three samples. The frequency of detection for these four DDT compounds ranged from one to two samples. The range of Σ DDTs was from 0.10 µg/kg (T4-VC02-3-5) to 21 µg/kg (T4-VC02-1-3). The Σ DDTs in subsurface sediments were highest in the samples from the 1- to 3-feet below mudline interval.

PCB Results

PCBs were not detected in four of the six Berth 401 subsurface sediment samples: T4-VC01-3-5, T4-VC02-3-5, T4-VC02-5-7, and T4-VC02-7-9. Aroclors 1242 and 1254 were the only Aroclors detected in the other two samples. The frequency of detection for these two Aroclors ranged from one to two samples. The range of total detected PCBs was from 140 µg/kg (T4-VC02-1-3) to 151 µg/kg (T4-VC01-1-3). Total PCB subsurface sediment concentrations were highest in samples from the 1- to 3-feet below mudline interval.

TPH Results

Diesel-range organics, residual-range organics, and gasoline-range organics were each detected at least once in the Berth 401 subsurface sediment samples. The frequency of detection ranged from one to three samples.

Conventionals

TOC concentrations ranged from 0.03 to 1.15% in the Berth 401 subsurface sediment samples. Total solids ranged from 74.7 to 83.6%.

4.3.4.2 Slip 1

Vibracores were collected from 15 locations (T4-VC03 through T4-VC17) from Slip 1 for a total of 73 subsurface sediment samples. The deepest sediment sample collected at Slip 1 was 15 to 17 feet below mudline. Table 4-16 summarizes Slip 1 subsurface sediment chemistry results.

Metals Results

Of the ten metals for which the Slip 1 subsurface samples were analyzed, arsenic, cadmium, chromium, copper, lead, nickel, and zinc were detected in each of the 73 samples. Mercury, selenium, and silver were detected at least once. The frequency of detection for mercury, selenium, and silver ranged from 18 to 66 samples.

SVOC Results

All of the 24 PAHs for which the Slip 1 subsurface sediment samples were analyzed were detected at least once. The frequency of detection for individual PAHs ranged from 20 to 68 samples. Total detected PAHs ranged from 0.20 µg/kg (T4-VC14-7-9) to 17,928 µg/kg (T4-VC09-1-3).

Butylbenzyl phthalate, bis(2-ethylhexyl)phthalate, and di-n-octyl phthalate were the only phthalates detected in Slip 1 subsurface sediment samples. Their frequency of detection ranged from one sample to 16 samples. The remaining three phthalates for which the samples were analyzed were not detected.

Pesticide Results

All of the six DDT compounds for which the Slip 1 subsurface sediment samples were analyzed were detected at least once. The frequency of detection for individual DDT compounds ranged from three to 31 samples. The range of Σ DDTs was from 0.07 µg/kg (T4-VC11-5-7) to 106 µg/kg (T4-VC17-3-5).

PCB Results

Aroclors 1248, 1254, 1260, and 1268 were the only Aroclors detected in the Slip 1 subsurface sediment samples. Their frequency of detection ranged from one sample to 24 samples. The remaining five Aroclors for which the samples were analyzed were not detected. The range of total detected PCBs was from 3.3 µg/kg (T4-VC07-5-7) to 244 µg/kg (T4-VC17-3-5).

TPH Results

Diesel-range organics, residual-range organics, and gasoline-range organics were detected at least once in the Slip 1 subsurface sediment samples. The frequency of detection ranged from nine to 39 samples.

Conventionals

TOC concentrations ranged from 0.02 to 2.30% in the Slip 1 subsurface sediment samples. Total solids ranged from 54.2 to 93.0%.

4.3.4.3 Wheeler Bay

Vibracores were collected from four locations (T4-VC18 through T4-VC21) from Wheeler Bay for a total of 25 subsurface sediment samples. The deepest sediment sample collected at Wheeler Bay was 20 to 22 feet below mudline. Table 4-17 summarizes Wheeler Bay subsurface sediment chemistry results.

Metals Results

Of the ten metals for which the Wheeler Bay subsurface samples were analyzed, arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc were detected in each. Selenium and silver were detected at least once in the samples. The frequency of detection for selenium and silver ranged from 18 to 24 samples.

SVOC Results

All of the 24 PAH compounds for which the Wheeler Bay subsurface sediment samples were analyzed were detected in all of the samples. Total detected PAHs ranged from 975 µg/kg (T4-VC19-9-11) to 97,434 µg/kg (T4-VC19-1-3).

Diethyl phthalate, butylbenzyl phthalate, and bis(2-ethylhexyl)phthalate were the only phthalates detected in Wheeler Bay subsurface sediment samples. Their frequency of detection ranged from three to nine samples. The remaining three phthalates for which the samples were analyzed were not detected.

Pesticide Results

All of the six DDT compounds for which the Wheeler Bay subsurface sediment samples were analyzed were detected at least once. The frequency of detection for individual DDT compounds ranged from three to 23 samples. The range of Σ DDTs was from 0.25 µg/kg (T4-VC21-11-13) to 48 µg/kg (T4-VC20-7-9).

PCB Results

Aroclors 1242, 1248, 1254, 1260, and 1268 were the only Aroclors detected in the Wheeler Bay subsurface sediment samples. Their frequency of detection ranged from one sample to 20 samples. The remaining four Aroclors for which the samples were analyzed were not detected. The range of total detected PCBs was from 16 µg/kg (T4-VC21-1-3) to 270 µg/kg (T4-VC20-9-11).

TPH Results

Diesel-range organics, residual-range organics, and gasoline-range organics were detected at least once in the Wheeler Bay subsurface sediment samples. The frequency of detection ranged from 11 to 24 samples.

Conventionals

TOC concentrations ranged from 0.37 to 4.25% in the Wheeler Bay subsurface sediment samples. Total solids ranged from 51.8 to 77.0%.

4.3.4.4 Slip 3

Vibracores were collected from ten locations (T4-VC22 through T4-VC29, T4-VC32, and T4-VC33) from Slip 3 for a total of 51 subsurface sediment samples. The deepest sediment sample collected at Slip 3 was 20 to 22 feet below mudline. Table 4-18 summarizes Slip 3 subsurface sediment chemistry results.

Metals Results

Of the ten metals for which the Slip 3 subsurface sediment samples were analyzed, arsenic, cadmium, chromium, copper, lead, nickel, and zinc were detected in each of the 51 samples. Mercury, selenium, and silver were detected at least once. Their frequency of detection ranged from 22 to 45 samples.

SVOC Results

All of the 24 PAHs for which the Slip 3 subsurface sediment samples were analyzed were detected at least once. The frequency of detection for individual PAHs ranged from 12 to 38 samples. Total detected PAHs ranged from 0.15 µg/kg (T4-VC28-7-9) to 68,860 µg/kg (T4-VC29-1-3).

The six phthalates for which the samples were analyzed were detected at least once. The frequency of detection for individual phthalates ranged from one sample to 14 samples.

Pesticide Results

All of the six DDT compounds for which the Slip 3 subsurface sediment samples were analyzed were detected at least once except 2,4'-DDE, which was not detected. The frequency of detection for individual DDT compounds ranged from five to 11 samples. The range of Σ DDTs was from 0.12 µg/kg (T4-VC24-7-9) to 174 µg/kg (T4-VC29-1-3).

PCB Results

Aroclors 1248, 1254, and 1260 were the only Aroclors detected in the Slip 3 subsurface sediment samples. Their frequency of detection ranged from one to eight samples. The remaining six Aroclors for which the

samples were analyzed were not detected. The range of total detected PCBs was from 21 µg/kg (T4-VC24-1-3) to 1,000 µg/kg (T4-VC29-1-3).

TPH Results

Diesel-range organics, residual-range organics, and gasoline-range organics were detected at least once in the Slip 3 subsurface sediment samples. The frequency of detection ranged from two to 25 samples.

Conventionals

TOC concentrations ranged from 0.03 to 5.71% in the Slip 3 subsurface sediment samples. Total solids ranged from 51.7 to 92.2%.

4.3.4.5 North of Berth 414

Vibracores were collected from two locations (T4-VC30 and T4-VC31) from north of Berth 414 for a total of 12 subsurface sediment samples. The deepest sediment sample collected at north of Berth 414 was 20.5 to 22.5 feet below mudline. Table 4-19 summarizes north of Berth 414 subsurface sediment chemistry results.

Metals Results

Excepting selenium, the ten metals for which the north of Berth 414 subsurface sediment samples were analyzed were detected in each of the samples. Selenium was detected in three samples.

SVOC Results

All of the 24 PAH compounds for which the north of Berth 414 subsurface sediment samples were analyzed were detected at least once in the samples. The frequency of detection for individual PAHs ranged from 10 to 12 samples. Total detected PAHs ranged from 2.3 µg/kg (T4-VC30-9-11) to 5,258 µg/kg (T4-VC31-7-9).

Dimethyl phthalate, diethyl phthalate, butylbenzyl phthalate, and bis(2-ethylhexyl)phthalate were the only phthalates detected in north of Berth 414 subsurface sediment samples. Their frequency of detection ranged from one sample to five samples. The remaining two phthalates for which the samples were analyzed were not detected.

Pesticide Results

All of the six DDT compounds for which the north of Berth 414 subsurface sediment samples were analyzed were detected at least once. The frequency of detection for individual DDT compounds ranged from one sample to nine samples. The range of Σ DDTs was from 0.22 µg/kg (T4-VC31-7-9) to 41 µg/kg (T4-VC30-7-9).

PCB Results

Aroclors 1248, 1260, and 1268 were the only Aroclors detected in the north of Berth 414 subsurface sediment samples. Their frequency of detection ranged from two to seven samples. The remaining six Aroclors for which the samples were analyzed were not detected. The range of total detected PCBs was from 31 µg/kg (T4-VC31-1-3) to 169 µg/kg (T4-VC30-3-5).

TPH Results

Diesel-range organics, residual-range organics, and gasoline-range organics were detected at least once in the north of Berth 414 subsurface sediment samples. The frequency of detection ranged from five to 10 samples.

Conventionals

TOC concentrations ranged from 0.07 to 2.77% in the north of Berth 414 subsurface sediment samples. Total solids ranged from 52.8 to 78.3%.

4.4 Dredged Sediment Quality Characteristics

This section presents the results of the chemistry analyses performed for dredged sediment quality characteristics and the quality of the chemistry data. The discussion is organized by the purposes of the data, which are to aid in determining:

- water quality impacts during dredging;
- sediment quality characteristics impacting onsite disposal; and
- sediment quality characteristics impacting offsite disposal in a subtitle D landfill.

Certain summations were calculated to obtain total values for the sediment, leachate, and elutriate data. Section 4.3 describes how total values were calculated. Section 5 presents a limited evaluation of the dredged sediment data. A more complete analysis will be presented in the EE/CA.

4.4.1 Data Quality

EcoChem of Seattle, Washington performed the data validation for all sediment, leachate, and elutriate samples. In accordance with the data validation requirements set forth in the Quality Assurance Project Plan of the EE/CA work plan (BBL, 2004a), both Level IV and Level III data validation were performed. Level IV data validation was performed on data package K2402978 for a total of six samples. Level III data validation was performed on the remaining samples. No sediment, leachate, or elutriate data were rejected as a result of the data validation. The complete data validation reports are presented in Appendix F. The sediment, leachate, and elutriate data, as qualified, are acceptable for use.

Data precision was evaluated through laboratory, matrix spike, and laboratory control sample duplicates and was acceptable. Data accuracy was evaluated through initial and continuing calibration of instruments, surrogate spikes, matrix spikes, and laboratory control samples and was acceptable. Data representativeness was acceptable. The prescribed field and laboratory methods were followed. Data comparability was acceptable. Sampling and analytical methodologies set forth in the QAPP were followed. Data completeness was acceptable. The completeness for this set of data is 100 percent, which exceeds the project-specified goal of 90 percent. Based on the data validation, all of the data were determined to be acceptable as qualified.

Method blanks collected during the DRETs and METs consisted of deionized water that was run through the laboratory equipment used for the DRET or MET. One method blank each was collected for the DRET and MET. Method blank chemistry results are presented in Appendix F. A discussion of method blank results as they pertain to data quality is presented in the data validation reports in Appendix F.

4.4.2 Water Quality Impacts During Dredging

Two DRETs were performed, one on composite sediment sample T4-CM1-DRET from Berth 401 and Slip 1 using surface water from Slip 1 (T4-CM1) and one on composite sediment sample T4-CM2-DRET from Wheeler Bay, Slip 3, and north of Berth 414 using surface water from Slip 3 (T4-CM2). The DRET chemistry results are presented in Table 4-20. Details of the DRET and results for the original composite sediment samples and surface water samples (prior to their use in the DRET) are presented in Appendix G.

4.4.2.1 T4-CM1-DRET Results

Six of the ten metals for which the sample was analyzed were detected in the T4-CM1-DRET elutriate sample. Those six metals are arsenic, chromium, copper, lead, nickel, and zinc. Cadmium, mercury, selenium, and silver were not detected.

Pyrene was the only PAH detected in the T4-CM1-DRET elutriate sample. The remaining 23 PAHs for which the sample were analyzed were not detected. The total detected PAH concentration was 0.075 micrograms per liter (µg/L) in the elutriate sample. The six phthalates for which the elutriate sample was analyzed were not detected.

The six DDT compounds and nine PCBs for which the elutriate sample was analyzed were not detected.

Diesel-range TPH was not detected in the T4-CM1-DRET elutriate sample. Residual-range TPH was detected in the elutriate sample.

TSS and total sulfide were not detected in the T4-CM1-DRET elutriate sample. Ammonia was detected in the T4-CM1-DRET elutriate.

4.4.2.2 T4-CM2-DRET Results

Eight of the ten metals for which the sample was analyzed were detected in the T4-CM2-DRET elutriate sample. Those eight metals are arsenic, chromium, copper, lead, nickel, selenium, silver, and zinc. Cadmium and mercury were not detected.

Seven PAHs (acenaphthylene, acenaphthene, 2,3,5-trimethylnaphthalene, fluorene, phenanthrene, fluoranthene, and pyrene) of the 24 PAHs for which the sample was analyzed were detected in the T4-CM2-DRET elutriate sample. The total detected PAH concentration was 0.737 µg/L in the elutriate sample. The six phthalates for which the elutriate sample was analyzed were not detected.

The six DDT compounds and nine PCBs analyzed for which the elutriate sample was analyzed were not detected.

Diesel-range TPH and residual-range TPH were not detected in the T4-CM2-DRET elutriate sample.

TSS and total sulfide were not detected in the T4-CM12-DRET elutriate sample. Ammonia was detected in the sample.

4.4.3 Sediment Quality Characteristics Impacting Onsite Disposal

One CST and one MET were performed on composite sediment sample T4-CM2 from Wheeler Bay, Slip 3, and north of Berth 414. The CST is relevant to the settling velocity of the dredged material. The MET is relevant to potential short-term water quality impacts from a CDF.

4.4.3.1 Settling Velocity of the Dredged Material

A CST was performed in general accordance with the EE/CA work plan (BBL, 2004a) on composite sediment sample T4-CM2, which was obtained from vibracoring at locations T4-VC18, through T4-VC32.

The CST apparatus used for determining sediment settling characteristics is shown on Figure 3-13. Table 4-21 provides the settlement settling data results (suspended solids and turbidity concentrations) versus elapsed time. The slurry used in the CST exhibited zone settling behavior; therefore, these data are also tabulated by providing the interface height as a function of time.

The settling velocity for zone settling behavior is obtained from the slope of the straight-line segment of interface height versus time in hours. The velocity between individual sampling points varied considerably, with an average settling velocity of approximately ½ foot per hour for the first 12 hours of the test. The significance of the results of the CST for settling velocity will be evaluated further in the EE/CA.

4.4.3.2 Potential Short-Term Water Quality Impacts from a CDF

This section presents the MET results. The MET was performed on a composite sediment sample from Wheeler Bay, Slip 3, and north of Berth 414 using deionized water. The resulting MET elutriates were analyzed for both total (T4-CM2-MET-T) and dissolved (T4-CM2-MET-D) fractions. The MET chemistry results are presented in Table 4-22. Details of the MET and chemistry results for the original composite sediment sample (prior to its use in the MET) are presented in Appendix G.

Total MET Results

All ten metals for which the sample was analyzed were detected in the T4-CM2-MET-T elutriate sample.

Fifteen of the 24 PAHs for which the sample was analyzed were detected in the T4-CM2-MET-T elutriate sample. The total PAH concentration was 2.6 µg/L. The six phthalates for which the elutriate sample was analyzed were not detected.

All of the six DDT compounds for which the sample was analyzed were detected in the T4-CM2-MET-T elutriate sample. The Σ DDTs concentration was 0.0493 µg/L. Aroclor 1260 was the only Aroclor detected in the T4-CM2-MET-T elutriate sample. The remaining eight Aroclors for which the sample was analyzed were not detected. The total detected PCB concentration was 0.082 µg/L.

TSS was detected in the T4-CM2-MET-T elutriate sample.

Dissolved MET Results

Seven of the ten metals for which the sample was analyzed were detected in the T4-CM2-MET-D elutriate sample. Those seven metals are arsenic, chromium, copper, lead, nickel, silver, and zinc. Cadmium, mercury, and selenium were not detected in the elutriate sample.

Six of the 24 PAHs for which the sample was analyzed were detected in the T4-CM2-MET-D elutriate sample. The total detected PAH concentration was 0.92 µg/L in the elutriate sample. The six phthalates for which the sample was analyzed were not detected.

The only pesticide detected in the T4-CM2-MET-D elutriate sample was 4,4'-DDE. The remaining five DDT compounds for which the sample was analyzed were not detected. The Σ DDTs concentration was 0.0024 µg/L in the elutriate sample. The nine Aroclors for which the sample was analyzed were not detected.

TSS was not detected in the T4-CM2-MET-D elutriate sample.

4.4.4 Sediment Quality Characteristics Impacting Offsite Disposal in a Subtitle D Landfill

This section presents the following data relevant to determining suitability for offsite disposal in a Subtitle D landfill:

- hazardous waste characteristics, including ignitability, corrosivity, reactivity, and TCLP;
- a TSCA determination;
- data on the generation and loss of free liquid (paint filter test); and
- additional landfill-specific acceptance criteria.

Two composite sediment samples were analyzed for hazardous waste characteristics and generation and loss of free liquid. Composite sample T4-CM1 consisted of the cores collected from Berth 401 and Slip 1. Composite sample T4-CM2 consisted of cores from Wheeler Bay, Slip 3, and north of Berth 414. Details of the paint filter test and chemistry results for the original composite sediment samples (prior to their use in the TCLP analysis) are presented in Appendix G.

Discrete surface, under-pier, and subsurface sediment samples were analyzed for PCBs and TPH. These data will be used in the TSCA determination and landfill-specific acceptance determination. Analytical results for discrete sediment sample results are presented in Section 4.3.

4.4.4.1 Hazardous Waste Determination Results

Composite sediment sample T4-CM1 exhibited a flashpoint of greater than 200°F and a pH of 6.92. Total cyanide and reactive sulfide were not detected in T4-CM1. Composite sediment sample T4-CM2 exhibited a flashpoint of greater than 200°F and a pH of 7.01. Total cyanide and reactive sulfide were not detected in T4-CM2.

TCLP chemistry results are summarized in Table 4-23. Three of the eight TCLP metals were detected in sample T4-CM1. The detected metals are barium, chromium, and silver. TCLP pesticides, herbicides, volatile organic compounds, and SVOCs were not detected in sample T4-CM1.

Of the eight TCLP metals, only barium was detected in sample T4-CM2. TCLP pesticides, herbicides, volatile organic compounds, and SVOCs were not detected in sample T4-CM2.

4.4.4.2 TSCA Determination Results

PCB results presented in Section 4.3 will be used for the TSCA determination.

4.4.4.3 Generation and Loss of Free Liquid Results

Composite sediment samples T4-CM1 and T4-CM2 both passed the paint filter test.

4.4.4.4 Landfill-Specific Acceptance Criteria Results

TPH results presented in Section 4.3 will be used for determining compliance with landfill-specific acceptance criteria.

4.5 Hydraulics and Sedimentation Characteristics

In accordance with the EE/CA work plan (BBL, 2004a), cross-sectional velocity measurements, sediment trap sampling, single-point velocity and turbidity sensor measurements, tide gage measurements, and water level measurements using pressure transducers/data loggers were completed to evaluate the hydraulics and sedimentation characteristics of the Removal Action Area. Field observations, laboratory results, and findings related to these sampling activities and measurements are summarized in the following subsections.

4.5.1 Data Quality

The quality of the data generated by several activities related to hydraulics and sedimentation characteristics is discussed in this section.

4.5.1.1 Overall Representativeness of the Data

During the field program, the weather was generally dry and river-flow conditions were low. Although some rainfall occurred, it was below typical seasonal levels. River flows were generally low and declined through the study period. As a result, the study data reflect sediment and COPC transport and loading trends representative of low-flow, low-rainfall periods. Higher sediment loading and transport rates would be anticipated during wet weather and high-flow conditions. The ADCM and ADCP data show low current velocities in the slips, with occasional spikes related to vessel activity. The current velocity data illustrate the relative importance of induced currents from ships as compared to river currents; however, the data do not represent maximum ship-induced current speeds at the ADCM locations, because the data were averaged over a period of one minute and recorded only every ten minutes. Additional current velocity data gathered during high-flow conditions and during vessel movement would be needed to draw conclusions about whether the data are representative of higher-flow, wet-weather periods or periods of vessel movement.

The sediment trap chemistry data are anticipated to reflect sedimentation of mostly very fine-grained sediment transported from upstream areas or sediment resuspended by propeller scour. Although sediment transport rates during higher-flow conditions are expected to be greater than during the study period, contaminant

concentrations in the sediment traps may be lower because of dilution by unimpacted sediment from upstream in the watershed or higher because of greater rates of erosion of upstream contaminated sediment or discharges from stormwater outfalls. Additional information would be needed to determine whether the sediment trap chemistry data are representative of higher-flow, wet-weather periods.

4.5.1.2 Cross-Sectional Velocity Measurements

The cross-sectional velocity measurements obtained during the ADCP survey appear to be valid and appropriate for use in the EE/CA. The data appear consistent with the single-point current velocity measurements obtained for Slip 3 with the ADCM units.

The ADCP instrument has an accuracy of +/- 0.25% of the water velocity relative to the ADCP. The resolution of the ADCP data is approximately 0.03 foot per second and the range is approximately 16.4 feet per second.

4.5.1.3 Sediment Trap Data

EcoChem performed data validation on all sediment samples. Data quality for sediment samples, including sediment trap samples, is discussed in Section 4.3.1. No sediment data were rejected as a result of the data validation. The complete data validation reports are presented in Appendix F. The sediment data, as qualified, are acceptable for use.

No field duplicate samples were collected for sediment trap samples because of limited available sample volume.

4.5.1.4 Single-Point Velocity and Turbidity Data

The current velocity and turbidity data obtained for Slip 3 with the ADCM units appear to be valid and appropriate for use in the EE/CA. The accuracy of the velocity measurements is reported to be 1% of each measured value +/- 0.5 centimeter per second, with an upper measurement threshold of 5 meters per second. The recorded current velocities were well below this upper measurement threshold. The ADCM velocity measurements for Slip 3 appear to be consistent with the data collected during the ADCP survey.

The measured turbidity was within the reported range of the optical backscatter sensor (0 to 2,000 NTUs). The turbidity measurements recorded for Slip 3 appear reasonable.

4.5.1.5 Water Level Measurements

The overall responses in river stage to tidal fluctuations and other factors were consistent between the downstream tide gage at the Georgia Pacific facility and pressure transducers within Slip 3. However, it appears that the water surface elevations measured by the downstream tide gage were consistently approximately 0.5 feet higher than the elevations measured by the Slip 3 pressure transducers. The data obtained from Slip 3 correlate well with the groundwater elevation measurements taken in monitoring wells located on the Terminal 4 property. The reason for the discrepancy between the Slip 3 and downstream water surface elevations is not known.

The Slip 3 pressure transducers have a reported range of 656 feet and an absolute accuracy of 0.5% of full scale. The measurement resolution was reported to be 0.005% of full scale, or 0.033 foot. During each deployment, the pressure transducer deployment depths were calibrated to a shore-side benchmark to better than +/- 0.05 foot. The tide gage has a range of 30 pounds per square inch absolute (psia) and an accuracy of 0.1% of full scale, or approximately 0.8 inch.

4.5.2 Cross-Sectional Velocity Measurements

As described in Section 3.5.1, cross-sectional velocity measurements were obtained for the Willamette River and Slips 1 and 3 by conducting an ADCP survey on March 25, 2004. The survey consisted of four cycles of cross-sectional velocity profiles completed along 14 track lines, with an additional fifth cycle completed for Track Line 14 (the cross-river transect). The locations of each track line are discussed in Section 3.5.1. Representative cross-sectional velocity profiles obtained from the ADCP survey are provided on Figures 4-3 through 4-13. Each figure includes a velocity magnitude profile plot, a stick ship track, and a composite tabular display. The velocity magnitude profile provides a color-coded display of the current velocity magnitude (ft/s) that was measured at points within the cross-sectional profile. The stick ship track provides a plan view of the track line with the average current velocity magnitude (ft/s) and direction measured for points extending laterally along the profile. The magnitude and direction are shown graphically as lines of varying lengths and direction branching off the track line. Overall, the data indicate that there was little or no current observed in the slips during the survey period, while the observed maximum current speed within the Willamette River channel was approximately 1.5 feet per second (during maximum current conditions of the ebb tide).

The complete set of ADCP data is included in Appendix H.

4.5.3 Sediment Trap Sampling Data

As described in Section 3.5.2, four sediment traps (designated A – D) were deployed within and immediately upstream of the Removal Action Area over two periods: from March 18/19 through April 6/7, 2004, and from April 26 through May 17, 2004. Upon completion of each deployment period, one composite sediment sample was collected from each trap, for a total of eight samples.

Sediment trap chemistry and grain size results, as well as field observations made during sample collection, are provided in the following subsections.

4.5.3.1 Sediment Chemistry and Grain Size

The samples were submitted to CAS of Kelso, Washington for analysis of:

- total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc);
- SVOCs (including PAHs and phthalates);
- pesticides (DDT isomers and metabolites);
- PCBs (as Aroclors);

- TPH gasoline-range organics, diesel-range organics, and residual-range organic;
- TOC;
- total solids; and
- grain size.

.

The sample identification numbers consist of the prefix "T4-ST-" to identify the samples as being from the Terminal 4 sediment traps and a unique identifier (e.g., "A040604") that provides the sediment trap designation (A – D) and date of sample collection. Table 4-24 provides the sediment trap chemistry and grain size results. In addition, the total values (i.e., summations) of PAHs, DDTs, and PCBs were calculated for each sample and are also reported on Table 4-24. A description of how the total calculations were made is provided in Section 4.3. Copies of the CAS data packages for the sediment trap chemistry data are provided in electronic format in Appendix H.

All of the metals for which the sediment trap samples were analyzed were detected at least once. All of the 24 PAH compounds for which the sediment trap samples were analyzed were detected in each of the sediment trap samples. Three phthalates (butybenzyl phthalate, bis(2-ethylhexyl)phthalate, and di-n-octyl phthalate) of the six phthalates for which the sediment trap samples were analyzed were detected at least once. All of the six pesticides for which sediment trap samples were analyzed were detected at least once. Four Aroclors (1242, 1248, 1254, and 1260) of the nine Aroclors for which sediment trap samples were analyzed were detected at least once. TPH organic compounds in the diesel range and residual range were detected in all of the sediment trap samples. Gasoline-range TPH was not detected in the sediment trap samples. TOC concentrations ranged from 2.06% to 3.8%. Total solids ranged from 44% to 61.8%. Grain size analysis indicates that sediment trap samples are generally clayey silts with trace sand.

4.5.3.2 Sediment Trap Sampling Field Observations

The sediment traps collected and concentrated suspended sediment particles from the water column at each location during the deployment period. Each sediment trap consisted of 15 vertical glass vials to capture the suspended sediment.

During sample harvesting, distinct layering of the sediment was observed in some of the traps. In some cases, these layers alternated between fine sand layers and silt layers; in other cases, they alternated between darker-colored silt layers and lighter-colored silt layers. It is possible that these layers reflect the periodic suspension of fine sands due to ships moving in or out of the active berthing areas at Terminal 4 or the effects of rain events or variations in river flow. To evaluate the banding, a detailed set of photographs was visually analyzed to count and describe the layering patterns. A record of vessel activity within the terminal during the sampling period was obtained from the Port for use in the evaluation. Additionally, water stage measurements and rainfall data were also obtained and evaluated (see Sections 4.5.5 and 4.5.6 below).

Terminal 4 Vessel Activity

Ship arrival and departure data for Slips 1, 3, and the Toyota platform at Terminal 4 were obtained from the Port for April and May 2004 (Table 4-25). During the first deployment period (from March 18/19 through April 6/7, 2004), five ships arrived or departed from Terminal 4. Of these, three were active in Slip 3 and two were active in the Toyota platform. A barge was on berth in Slip 1; however, no arrival or departure activities occurred in Slip 1 during this period. During the second deployment period (from April 26 through May 17, 2004), 11 ships arrived or departed from Terminal 4. Of these, five visited the Toyota platform and six visited Slip 3.

During field activities within the Removal Action Area, Blue Water Engineering observed a turbidity plume that was generated in Slip 3 as a vessel departed under power.

Sediment Trap Observations from Deployment Period 1

Sediment traps A (Slip 3 East), B (Slip 3 West), and D (Slip 1) were deployed on March 18, 2004. Sediment trap C (Toyota Dolphin) was deployed on March 19, 2004. Traps A and B were recovered on April 6, 2004 and traps C and D were recovered on April 7, 2004. Deployment locations are shown on Figure 3-16.

During sample processing, a photograph was taken of representative vials harvested from each trap, and a detailed physical description was recorded. Inspection of the photographs indicates a distinct banding of fine sand and silty sediment in traps A and B, which were deployed in Slip 3. Similar banding of fine sand was not observed in traps C and D. However, some color variations were observed. The observed banding suggests periodic sediment transport events resulting in the resuspension of fine sands in addition to the sedimentation of silts carried by the river. These sediment transport events are possibly caused by ships calling at the Port or by runoff from storm events.

Photographs of representative vials from each trap and a summary of relevant vessel activity and rainfall events recorded for the City of Portland are provided on Figures 4-14 through 4-22. As shown on Figures 4-14 through 4-18, four layers of sand and four to five layers of silt can be observed in trap A (Slip 3 East). Ship arrival and departure data indicate that three ships arrived at, and departed from, Berth 410 during the deployment period, which may partially explain the observed layering. Precipitation records also indicate that a three-day rain event occurred March 24-26, 2004 (Figure 4-23). A fine sand layer may have been deposited from stormwater outfalls in the area during this event.

Three layers of sand were observed in samples collected from sediment trap B (Slip 3 West), although the photographs do not reveal the observed layers in all the vials (Figures 4-19 and 4-20). Field notes logged at the time of sample harvesting note three layers of sand were present in vials from this trap. The three sand layers correspond to the number of ships departing Slip 3 during this period. Based on the locations of the sediment traps deployed within Slip 3, sediment trap A (Slip 3 East) would be expected to exhibit a higher degree of influence from potential stormwater outfalls relative to sediment trap B (Slip 3 West). This may explain the additional layer of sand observed in the vials from trap A.

Banding consisting of silt layers, suggesting variations in sediment transport during the deployment period, was evident in the observations of sediment trap C deployed at the Toyota Dolphin. Six or seven layers of material were observed in samples collected from this trap (Figure 4-21). Based on the available data, it is relatively

difficult to draw a direct relationship between the layering observed in trap C and vessel activity within Terminal 4. Trap C was located just upstream of Slip 3 and downstream of the Toyota platform (Berths 414 and 415). Vessel activity logs provided by the Port indicate that two ships arrived at and departed from the Toyota facility during the deployment period. Sediment collection in trap C may also have been influenced by the Willamette River or other vessel activity in the area.

A band of darker silt material was observed in trap D (Slip 1) approximately midway within a layer of lighter colored silt, suggesting a loading event may have occurred midway through the sampling period (Figure 4-22). No vessel activity was recorded for Slip 1 during this period, so this banding is potentially related to the March 24-26 rain event and discharges from nearby stormwater outfalls.

Trap Observations from Deployment Period 2

Sediment traps A (Toyota Dolphin), B (Berth 416), C (Slip 3 East), and D (Slip 1) were redeployed on April 26, 2004 and recovered on May 17, 2004, for a deployment period of 22 days. Deployment locations are shown on Figure 3-16.

During sample processing, a photograph was taken of each of the 15 vials harvested from each trap, and a detailed physical description was recorded. Distinct banding of fine, silty sediment in traps B (Berth 416) and C (Slip 3 East) was observed during sample processing. Interpretation of the photographs taken of trap A (Toyota Dolphin) was not possible because of poor photographic quality. Field notes logged at the time of the sample harvesting indicate that the samples contained light brown silt with very small amounts of sand mixed throughout. Photographs of the samples collected from sediment trap D (Slip 1) indicate no visible banding. No vessel activity or significant rainfall events were recorded for Slip 1 during the deployment period. This is consistent with the absence of visible layering in the samples obtained from sediment trap D.

Photographs of representative vials from traps B and C and a summary of relevant vessel activity and rainfall events recorded for the City of Portland are provided on Figures 4-24 through 4-26. Two layers of sand and three layers of silt (Figures 4-24 and 4-25) were apparent in samples collected from trap B (Berth 416). Vessel activity logs provided by the Port do not indicate activity at Berth 416 during the deployment period. Trap C, which was located within the Willamette River, may have been influenced by barge traffic or other vessel activity in the area. However, a direct correlation between the observed layering and vessel activity cannot be determined based on the available data.

A bottom layer of mostly silt with a relatively thick layer of sand in the middle and a top layer of what appears to be mixed silt and sand were observed in samples from trap C deployed at Slip 3 East (Figure 4-26). The observed layering suggests that at least one relatively large sand transport event occurred during this deployment period. Records of vessel activity indicate that one ship visited Berth 411, located at the east end of Slip 3, during the deployment period. This correlates with the observed sediment transport event. Records of vessel activity indicate that four additional ships departed Berth 410 in Slip 3 overall during the deployment period. However, additional distinct banding was not observed.

4.5.4 Single-Point Velocity and Turbidity Meters

Two ADCMs were used to measure current, turbidity, and water levels in Slip 3 over three periods between March 18 and May 17, 2004. The primary data obtained from the ADCMs include the measured speed and direction of flow at each location and the optical backscatter data (used to assess turbidity). Data collected from pressure transducers installed on each of the ADCM units are discussed in Section 4.5.5. Time-series plots of the ADCM velocity and turbidity data are provided on Figures 4-27 and 4-28 for the Slip 3 East and Slip 3 West units, respectively. Dates on which vessels were recorded entering or leaving the area are also indicated on each of the plots. ADCM deployment locations are shown on Figure 3-16.

The data shown on Figures 4-27 and 4-28 indicate that there were generally no detectable currents within Slip 3 during the study period, excepting occasional velocity spikes that appear to correspond with recorded vessel activity within the area. The low current velocities recorded under normal conditions (i.e., no vessel activity) are consistent with the results of the ADCP survey discussed in Section 4.5.2.

The typical minimum optical backscatter (turbidity) measurement during the three deployment periods was 6 NTUs. The instruments also recorded a number of turbidity spikes, ranging between 40 and 300 NTUs, during the trap deployment periods. The average turbidity values recorded by the ADCM at the Slip 3 East location (inner portion of Slip 3) were between 7.5 and 9 NTUs, while the average values recorded at the Slip 3 West location (outer portion of Slip 3) steadily increased over the study period (9, 15, and 23 NTUs, respectively).

4.5.5 Water Level Measurements

The Willamette River water surface elevations were recorded at two locations within Slip 3 and at one location downstream of Terminal 4 over the period from March 23 to May 18, 2004. Within Slip 3, water levels were recorded using pressure transducers/data loggers installed on each ADCM unit. A tide gage was used to measure changes in river elevation downstream of Terminal 4, at a location directly across from the head of the Multnomah Channel on a piling at the Georgia Pacific facility. Pressure transducer and tide gage locations are shown on Figure 3-21.

The pressure transducers recorded changes in water levels within Slip 3. The recorded measurements were then referenced to the CRD during data processing. The tide gage elevation was established relative to the CRD and was programmed so that water depth measurements recorded by the gage were automatically converted and recorded as elevation above the CRD.

A time series plot of the water levels recorded by the Slip 3 East pressure transducer is shown on Figure 4-29. Figure 4-30 provides a time series plot of the water surface elevations measured by the tide gage installed downstream of Terminal 4 at the Georgia Pacific facility. As shown on Figures 4-29 and 4-30, the overall responses in river stage to tidal fluctuations and other factors were similar for the two locations. However, the tide gage river stage values for the downstream location were consistently approximately 0.5 feet higher than the pressure transducer river stage values measured in Slip 3. The data recorded by the Slip 3 pressure transducer correlate well with groundwater level measurements obtained in monitoring wells located on the Terminal 4 property. The reason for the discrepancy between the two measurements is not known.

4.5.6 Historical Basin Hydrology

The overall basin hydrology influences hydrodynamic conditions within the Willamette River. Rainfall, stormwater runoff, variations in river flow, and river stage in both the Willamette and the Columbia Rivers likely influenced the hydrodynamic and sedimentation data collected during the current field program at Terminal 4.

To evaluate the potential impacts of basin hydrology and variations in river conditions on the field data, time series plots and statistical summaries of the following data were compiled for the study period:

- rainfall data for the City of Portland;
- upstream flow of the Willamette River;
- Willamette River stage; and
- Columbia River stage and flow.

4.5.6.1 Rainfall Data

Rainfall data were obtained from the National Weather Service's website for Portland, Oregon (http://www.wrh.noaa.gov/Portland/climate/). The National Weather Service's rainfall gage is located at Station 356751 at the Portland Weather Service Field Office and has been in place since 1940. Recorded rainfall over the period from March 18 through May 18, 2004 is provided on Figure 4-23 and indicates three large rain events of 0.2 inch or greater per day during this period.

4.5.6.2 Willamette River Hydrology

Daily mean stream-flow data for the Willamette River at Portland was obtained from the USGS website (www.usgs.gov) for USGS Gage 14211720, located at River Mile 12.8, approximately 8.3 miles upstream of Terminal 4. Figure 4-31 presents time series plots of the daily mean flow and daily rainfall recorded for this location from March 1 through May 31, 2004. The data indicate that flow within the Willamette River was observed to increase in response to recorded rain events. The daily mean flow varied from 14,200 cfs to 44,840 cfs, with an average value of 24,070 cfs (Table 4-26).

River stage data for the study area were obtained from three separate gages on the Willamette River. Figure 4-32 shows data from the tide gage installed by Blue Water Engineering at the Georgia Pacific facility located downstream of Terminal 4. The gage was deployed from March 24 to May 17, 2004 and recorded data every 10 minutes. Based on the data collected from this gage, the river stage ranged from 2.8 to 8.7 feet. The average measured stage height was 5.1 feet (Table 4-26). For comparison, Figure 4-32 also shows the average daily stage height obtained from USGS Gage 14211720 located at the City of Portland. The USGS gage is located approximately 9.8 miles upstream of the tide gage location at the Georgia Pacific site. Average height for this gage was 5.28 feet and ranged from 3.59 to 8.52 feet (Table 4-26). Figure 4-32 indicates that the two data sets are consistent.

4.5.6.3 Columbia River

River stage data for the Columbia River were obtained for USGS Gage 14105700 at Vancouver, Washington over the period of March 1 through May 31, 2004. Time series plots of the river stage data over this period are provided on Figure 4-33. The average measured gage height was 4.58 feet and ranged from 2.82 to 7.92 feet.

4.5.7 Bathymetric Data

Recent bathymetric data for the Removal Action Area was obtained from the LWG and Port of Portland for use in completing the EE/CA. Results of the multibeam bathymetric surveys completed by the LWG in May 2003 over the entire Removal Action Area and by the Port in 2004 for Slip 3 were incorporated into the existing AutoCAD® base map for the Removal Action Area. The bathymetric surface for the Removal Action Area is depicted on Figure 4-34.

Table 4-1. Number of Laboratory Tests Performed
Terminal 4 - Port of Portland

Exploration No.	Depth in Feet	Split-Spoon (SPT) Samples	Thin-Walled Tube Samples	Moisture Contents	Organic Contents	Specific Gravity Determinations	Density Tests	Grain Size Analyses	Atterberg Limits	Consolidation Tests	UU Triaxial Tests	CU Triaxial Tests
T4-GEO1W	111.5	21	2	13	1	1	---	3	3	1	---	---
T4-GEO2W	81.5	17	2	12	---	---	2	2	2	---	---	---
T4-GEO4L	95	19	6	23	1	1	11	6	11		2	1
T4-GEO5W	101.5	20	1	12	---	---	---	2	1	---	---	---
T4-GEO6W	71.5	17	4	8	2	1	---	3	3	1	---	---
T4EA-MW01I	75	14	0	14	---	---	---	1	---	---	---	---
T4EA-MW01D [1)]	205	NA	NA	25	---	---	---	5	---	---	---	---
T4EA-MW02I	76.5	15	0	15	---	---	---	1	1	---	---	---
T4EA-MW02D [1)]	165	NA	NA	15	---	---	---	2	1	---	---	---
T4EA-MW03D [1)]	195	NA	NA	39	1	---	---	6	1	---	---	---
T4EA-MW04I	65	12	0	12	---	---	---	2	---	---	---	---
T4EA-MW05S	21.5	5	0	5	---	---	---	1	---	---	---	---
T4EA-MW05I	65.7	10	0	10	---	---	---	2	1	---	---	---
T4EA-MW06S	41.5	8	0	8	---	---	---	2	---	---	---	---
T4EA-MW06I	76.5	8	0	8	---	---	---	1	---	---	---	---
T4EA-MW06D [1)]	228	NA	NA	30	---	---	---	3	1	---	---	---
T4-CM1 [2)]	--	---	---	---	---	---	---	1	---	---	---	---
T4-CM2 [3)]	--	---	---	---	---	1	---	1	---	1	---	---
T4-CM3 [4)]	--	---	---	---	---	---	---	1	---	---	---	1

Notes:
[1)] Sonic coring; no split-spoon or thin-walled tube sampling.
[2)] Composite sediment sample for DRET
[3)] Composite sediment sample for consolidation test, CST, TCLT, MET, DRET
[4)] Composite sample of native sand for strength testing.

SPT = Standard Penetration Test
UU = unconsolidated undrained
CU = consolidated undrained
NA = not applicable

Table 4-2. Grain Size Data Summary

Terminal 4 - Port of Portland

Exploration No.	Sample No.	Depth in Feet	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
T4-GEO1W	5	7-8.5	---	---	92.9	7.1	
T4-GEO1W	11	25-26.5	---	---	96.0	4.0	
T4-GEO1W	15	45-46.5	---	0.5	94.3	5.2	
T4-GEO2W	3	4-5.5	---		79.4	20.6	
T4-GEO2W	16	50-51.5	---	0.3	92.3	5.9	1.5
T4-GEO4L	1	5-6.5	---	1.4	86.3	12.3	
T4-GEO4L	4	20-21.5	---	0.3	92.8	6.9	
T4-GEO4L	6	26.5-28.5	---	---		53.4	45.8
T4-GEO4L [1)]	7	37.9-38.2	---	---		18.0	
T4-GEO4L	10	38.5-40	---	---	75.4	19.1	5.5
T4-GEO4L [1)]	15	61.5-62	---	---		78.0	
T4-GEO5W	4	5-6.5	---	---	94.2	5.8	
T4-GEO5W	14	40-41.5	---	0.1	94.8	5.1	
T4-GEO6W	5	7.5-9	---	0.0	94.4	5.6	
T4-GEO6W	10	20-21.5	---	0.8	93.8	5.4	
T4-GEO6W	13	35-36.5	---	---	94.6	5.4	
T4EA-MW01I	13	65-66.5	---	---	97.0	3.0	
T4EA-MW01D	6	13.5-15	---	0.8	84.4	14.8	
T4EA-MW01D	31	75-77.5	---	---	92.4	5.9	1.7
T4EA-MW01D	74	187.5-190	---	74.1	18.8	5.2	1.9
T4EA-MW01D	77	195-197.5	---	61.1	27.2	8.2	3.5
T4EA-MW01D	79	200-202.5	---	79.1	15.1	4.3	1.5
T4EA-MW02I	8	40-41.5	---	---	92.8	7.2	
T4EA-MW02D	61	145-147.5	---	79.6	14.1	5.5	0.8
T4EA-MW02D	67	160-162.5	---	55.7	31.5	8.1	4.7
T4EA-MW03D	3	3-6	---	0.3	93.8	5.9	
T4EA-MW03D	10	20-23.5	---	---	93.1	6.9	
T4EA-MW03D	34	82.5-85	---	---	78.2	21.8	
T4EA-MW03D	75	182.5-184	---	59.3	32.7	8.0	

Table 4-2. Grain Size Data Summary

Terminal 4 - Port of Portland

Exploration No.	Sample No.	Depth in Feet	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
T4EA-MW03D	77	185-187.5	---	44.4	50.8	3.7	1.1
T4EA-MW03D	81	192.5-195	15.3	54.1	26.3	3.0	1.3
T4EA-MW04I	4	20-21.5	---	---	95.2	4.8	
T4EA-MW04I	11	55-56.5	---	---	94.1	5.9	
T4EA-MW05S	3	15-16.5	---	---	94.5	5.5	
T4EA-MW05I	8	55-56.5	---	1.9	87.7	10.4	
T4EA-MW05I	10	65-66.5	---	54.4	35.8	9.8	
T4EA-MW06S	6	30-31.5	---	1.2	93.9	4.9	
T4EA-MW06S	7	35-36.5	---	---	92.6	7.4	
T4EA-MW06I	7	70-71.5	---	---	97.8	2.2	
T4EA-MW06D	80	200-202.5	---	73.6	22.7	2.8	0.9
T4EA-MW06D	84	210-212.5	22.9	52.5	17.7	5.0	1.9
T4EA-MW06D	90	222-225.5	---	59.0	24.9	10.4	5.7
T4-CM1 [2)]	NA	NA	---	---	68.2	23.8	8.0
T4-CM2 [2)]	NA	NA	---	---	64.4	26.7	8.9
T4-CM3 [2)]	NA	NA	---	0.3	94.3	5.4	

Notes:

[1)] 200-Wash analysis

[2)] Composite sample

NA = not applicable

Table 4-3. Atterberg Limits Results Summary
Terminal 4 - Port of Portland

Exploration No.	Sample No.	Depth in Feet	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content	USCS Symbol	Description
T4-GEO1W	1A	0.3-0.4	97	43	54	88%	OH	Organic SILT
T4-GEO1W	1B	1.1-1.3	70	38	32	87%	OH	Organic SILT
T4-GEO1W	2	2.8-3	98	33	65	106%	OH	Organic CLAY
T4-GEO2W	1A	0.6-0.85	90	33	57	103%	OH	Organic CLAY
T4-GEO2W	2	2.6-2.9	96	32	64	87%	OH	Organic CLAY
T4-GEO4L	5	25-26.5	65	40	25	51%	OH	Organic SILT
T4-GEO4L	6	27.2-28.3	59	29	30	50%	OH	Organic CLAY
T4-GEO4L	7A	28.5-30	46	32	14	46%	ML	SILT
T4-GEO4L	8	35-36.5	N.P.	N.P.	N.P.	43%		non-plastic
T4-GEO4L	13	55-56.5	38	34	4	45%	ML	SILT
T4-GEO4L	15	61.5-62	38	25	13	38%	ML	SILT
T4-GEO4L	16	63.5-65	N.P.	N.P.	N.P.	37%		non-plastic
T4-GEO4L	17A	70-71.5	N.P.	N.P.	N.P.	44%		non-plastic
T4-GEO4L	18	72.3-72.8	84	46	38	69%	OH	Organic SILT
T4-GEO4L	20A	80-81.5	36	31	5	40%	ML	SILT
T4-GEO4L	24	92.3-92.6	66	36	30	54%	OH	Organic SILT
T4-GEO5W	1	1.3-1.5	36	21	15	32%	CL	Lean CLAY
T4-GEO6W	3	4.8-5	88	29	59	67%	OH	Organic CLAY
T4-GEO6W	14	40-41.5	42	36	6	49%	ML	SILT
T4-GEO6W	16	45-46.5	38	36	2	48%	ML	SILT
T4EA-MW02I	10	50-51.5	46	26	20	46%	OL	Organic CLAY
T4EA-MW02D	25	55-57.5	53	31	22	52%	OH	Organic SILT
T4EA-MW03D	17	37.5-40	55	24	31	48%	OH	Organic CLAY
T4EA-MW05I	2	25-26.5	56	27	29	45%	OH	Organic CLAY
T4EA-MW06D	20A	45.5-46.5	N.P.	N.P.	N.P.	60%		non-plastic

Notes:
N.P. = non-plastic

Table 4-4. Consolidation Test Results and Parameters
Terminal 4 - Port of Portland

	T4-GEO1W 1.1 - 1.3 ft	T4-GEO6W 4.8 - 5 ft	T4-CM2 Composite Sample	
Remarks	---	---	$\sigma' < 0.2$ tsf	$\sigma' > 0.2$ tsf
Sample Description	Very soft Organic SILT	Very soft Organic CLAY	Silty Sand	
Initial Void Ratio, e_0	2.46	2.16	1.10	
Compression Index, C_C [1)]	0.66	0.65	0.35	0.16
Modified Compression Index, $C_{C\varepsilon}$ [1)]	0.194	0.206	0.166	0.076
Constrained Modulus, D [1)] in tsf	41	18.8	1.4	17.6
Secondary Compression Index, C_α [1)]	ND	ND	0.0065	
Modified Secondary Compression Index, $C_{\alpha\varepsilon}$ [1)]	ND	ND	0.0032	
Coefficient of Consolidation (Average), C_v [1)] in ft^2/day	0.22	0.16	0.30	
Specific Gravity, G_S	2.7	2.72	2.7	
Liquid Limit, LL	70	88	NA	
Plastic Limit, PL	38	29	NA	
Moisture Content (by Weight)	87%	67%	41%	
Solids Content (by Volume)	30%	35%	48%	
Dry Unit Weight, γ_{dry} in pcf	48.7	53.8	80	
Wet Unit Weight, γ in pcf	91.1	90	113	

Notes:
[1)] Interpreted or calculated based on laboratory results.
ND = not determined
tsf = tons per square foot
pcf = pounds per cubic foot

Table 4-5 - Shear Strength Test Results and Parameters

Terminal 4 - Port of Portland

Exploration No.	Sample No.	Description	Depth in Feet	Test Type [1]	s_u [2] in psf	$\sigma'_{v,\ est.}$ [3] in psf	σ'_{3c} [4] in psf	s_u/σ' [5]	ϕ' [6] in degrees	Moisture Content [7]	PI [8]	LL [9]	γ_{wet} [10] in pcf	γ_{dry} [11] in pcf
T4-GEO4L	15	SILT	61.5-62	UU	1,120	4,260	----	0.26	----	38	13	38	116	84
T4-GEO4L	18	Organic SILT	72.4-72.9	UU	1,463	4,660	----	0.31	----	61	38	84	103	64
T4-GEO4L	6A	Organic SILT	27.2-27.7	CU	1,373	(2,610)	2,880	0.48	34.3	51	37	77	109	72
T4-GEO4L	6B	Organic SILT	27.8-28.3	CU	3,003	(2,610)	6,480	0.46	34.9	46	37	77	109	74
Composite	(A)	SAND	----	CU	----	----	720	----	37.2	25	---	---	112	89
Composite	(B)	SAND	----	CU	----	----	2,880	----	35.6	25	---	---	109	87
Composite	(C)	SAND	----	CU	----	----	6,480	----	35.9	25	---	---	109	87

Notes:

[1] UU = unconsolidated undrained triaxial, CU = consolidated undrained triaxial

[2] s_u = undrained shear strength interpreted based on laboratory results

[3] $\sigma'_{v,\ est.}$ = estimated effective in-situ overburden stress based on testing and assumption of soil unit weights

[4] σ'_{3c} = effective confining stress during test

[5] s_u/σ' = normalized undrained strength

[6] ϕ' = effective friction angle interpreted based on laboratory results

[7] Moisture content before test

[8] PI = plasticity index

[9] LL = liquid limit

[10] γ_{wet} = wet unit weight

[11] γ_{dry} = dry unit weight

psf = pounds per square foot

pcf = pounds per cubic foot

Table 4-6. Average, Minimum, and Maximum Groundwater Elevation and Average Groundwater Geochemical Parameter Data

Well	Average Groundwater Elevation (ft CRD)	Minimum Groundwater Elevation (ft CRD)	Maximum Groundwater Elevation (ft CRD)	Groundwater Fluctuation (feet)	Average Temper-ature (°C)	Average pH (std. units)	Average Specific Conductivity (mS/cm)	Average Dissolved Oxygen (mg/L)	Average Oxidation Reduction Potential (mV)
T4-MW01S	5.54	3.61	7.91	4.30	14.1	6.7	0.21	0.69	217
T4-MW01I	5.38	3.59	8.32	4.73	13.7	8.8	0.38	0.52	218
T4-MW01D	5.47	3.73	8.31	4.58	13.3	7.8	0.94	0.37	-91
T4-MW02S	15.52	13.95	16.23	2.28	14.6	6.6	0.45	0.66	-77
T4-MW02I	16.31	16.02	16.66	0.64	14.1	6.6	0.56	0.80	-70
T4-MW02D	5.58	3.88	8.16	4.28	11.8	7.2	0.35	3.30	6
T4-MW03S	11.92	11.25	12.14	0.89	13.8	8.1	0.11	3.25	61
T4-MW03I/D	5.63	3.70	8.11	4.41	12.2	7.1	0.40	0.27	21
T4-MW04S	6.04	3.85	8.07	4.22	16.8	6.6	0.70	1.00	-32
T4-MW04I	5.58	2.93	8.04	5.11	15.8	7.7	0.62	0.36	-192
T4-MW05S	15.88	15.52	16.33	0.81	14.8	6.4	0.15	1.55	130
T4-MW05I	6.70	6.52	6.94	0.42	13.9	7.1	0.62	0.47	-38
T4-MW06S	5.49	3.55	8.11	4.56	15.6	10.1	0.48	0.67	59
T4-MW06I	5.53	3.42	7.85	4.43	14.9	7.4	0.45	0.84	156
T4-MW06D	5.51	3.35	7.75	4.40	13.3	7.7	1.90	0.67	136
Average for Shallow Groundwater					15.0	7.4	0.35	1.31	60
Average for Intermediate Groundwater					14.5	7.5	0.53	0.60	15
Average for Deep Groundwater					12.7	7.5	0.90	1.15	18

Notes:

CRD - Columbia River Datum mS/cm = milliSeimens per centimeter mV = millivolts

°C = degrees Celsius mg/L = milligrams per liter

Dissolved oxygen data from the April 29-30, 2004 monitoring event were not included in calculation of average dissolved oxygen values.

Shallow groundwater includes data from T4-MW01S, T4-MW02S, T4-MW03S, T4-MW04S, T4-MW05S, and T4-MW06S.

Intermediate groundwater includes data from TW-MW01I, T4-MW02I, T4-MW-04I, T4-MW05I, and T4-MW06I.

Deep groundwater includes data from T4-MW01D, T4-MW02D, T4-MW03I/D, and T4-MW06D.

Table 4-7
Summary of Berth 401 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	2	2	NA		NA		3.4	3.8	3.6
Cadmium	2	2	NA		NA		0.23	0.46	0.34
Chromium	2	2	NA		NA		20	30	25
Copper	2	2	NA		NA		28	44	36
Lead	2	2	NA		NA		16	23	19
Mercury	2	2	NA		NA		0.05	0.09	0.072
Nickel	2	2	NA		NA		20	25	22
Selenium	2	2	NA		NA		0.07	0.17	0.12
Silver	2	2	NA		NA		0.26	0.31	0.29
Zinc	2	2	NA		NA		80	111	95
Semivolatile Organics (ug/kg)									
Naphthalene	2	2	NA		NA		14	22	18
2-Methylnaphthalene	2	2	NA		NA		4.8	8.8	6.8
1-Methylnaphthalene	2	2	NA		NA		3.2	5.2	4.2
Biphenyl	2	1	5.1	U	5.1	U	4.8	4.8	4.8
2,6-Dimethylnaphthalene	2	2	NA		NA		3.3	7.7	5.5
Acenaphthylene	2	2	NA		NA		6.7	8.0	7.4
Acenaphthene	2	2	NA		NA		14	26	20
2,3,5-Trimethylnaphthalene	2	2	NA		NA		3.5	11	7.3
Fluorene	2	2	NA		NA		11	22	17
Phenanthrene	2	2	NA		NA		65	170	118
Anthracene	2	2	NA		NA		18	35	27
1-Methylphenanthrene	2	2	NA		NA		6.0	22	14
Fluoranthene	2	2	NA		NA		130	340	235
Pyrene	2	2	NA		NA		150	410	280
Benz(a)anthracene	2	2	NA		NA		69	180	125
Chrysene	2	2	NA		NA		99	240	170
Benzo(b)fluoranthene	2	2	NA		NA		90	230	160
Benzo(k)fluoranthene	2	2	NA		NA		75	190	133
Benzo(e)pyrene	2	2	NA		NA		82	190	136
Benzo(a)pyrene	2	2	NA		NA		98	230	164
Perylene	2	2	NA		NA		47	190	119
Indeno(1,2,3-cd)pyrene	2	2	NA		NA		83	200	142

Table 4-7
Summary of Berth 401 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	2	2	NA		NA		13	32	23
Benzo(g,h,i)perylene	2	2	NA		NA		85	190	138
Dimethyl phthalate	2	1	21	U	21	U	19	19	19
Diethyl phthalate	2	0	21	U	40	U	ND	ND	ND
Di-n-butyl phthalate	2	0	40	U	61	U	ND	ND	ND
Butylbenzyl phthalate	2	1	21	U	21	U	93	93	93
Bis(2-ethylhexyl) phthalate	2	2	NA		NA		490	1,400	945
Di-n-octyl phthalate	2	1	21	U	21	U	29	29	29
Total PAHs (c,d)	2	2	NA		NA		840	2,103	1,471
Pesticides (ug/kg)									
4,4'-DDE	2	2	NA		NA		3.8	7.0	5.4
4,4'-DDD	2	2	NA		NA		4.5	4.7	4.6
4,4'-DDT	2	2	NA		NA		3.1	12	7.6
2,4'-DDE	2	1	4.1	U	4.1	U	0.15	0.15	0.15
2,4'-DDD	2	0	2.1	U	4.1	U	ND	ND	ND
2,4'-DDT	2	1	4.1	U	4.1	U	5.1	5.1	5.1
Total DDD (c,e)	2	2	NA		NA		4.5	4.7	4.6
Total DDE (c,f)	2	2	NA		NA		3.8	7.2	5.5
Total DDT (c,g)	2	2	NA		NA		3.1	17	10
Σ DDTs (c,h)	2	2	NA		NA		11	29	20
PCBs (ug/kg)									
Aroclor 1016	2	0	5.1	U	6.7	U	ND	ND	ND
Aroclor 1221	2	0	11	U	14	U	ND	ND	ND
Aroclor 1232	2	0	5.1	U	6.7	U	ND	ND	ND
Aroclor 1242	2	1	5.1	U	5.1	U	120	120	120
Aroclor 1248	2	1	6.7	U	6.7	U	6.1	6.1	6.1
Aroclor 1254	2	1	11	U	11	U	130	130	130
Aroclor 1260	2	1	6.7	U	6.7	U	8.7	8.7	8.7
Aroclor 1262	2	0	5.1	U	6.7	U	ND	ND	ND
Aroclor 1268	2	0	5.1	U	6.7	U	ND	ND	ND
Total PCBs (c,i)	2	2	NA		NA		15	250	132
Petroleum Hydrocarbons (mg/kg)									

Table 4-7
Summary of Berth 401 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	2	2	NA		NA		41	110	76
Residual Range Organics (RRO)	2	2	NA		NA		220	410	315
Gasoline Range Organics (GRO)	2	0	3.7	U	4.3	U	ND	ND	ND
Conventionals (percent)									
Total organic carbon	2	2	NA		NA		1.43	1.83	1.63
Total solids	2	2	NA		NA		57.4	66.2	61.8
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	2	2	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	2	2	NA		NA		100	100	100
Gravel, Medium No. 4 (4.75 mm)	2	2	NA		NA		100	100	100
Gravel, Fine No. 10 (2.00 mm)	2	2	NA		NA		100	100	100
Sand, Very Coarse No. 20 (0.850 mm)	2	2	NA		NA		99	100	100
Sand, Coarse No. 40 (0.425 mm)	2	2	NA		NA		97	100	98
Sand, Medium No. 60 (0.250 mm)	2	2	NA		NA		90	98	94
Sand, Fine No. 140 (0.106 mm)	2	2	NA		NA		76	95	85
Sand, Very Fine No. 200 (0.0750 mm)	2	2	NA		NA		74	90	82
Silt (0.074 mm)	2	2	NA		NA		58	83	70
Clay (0.005 mm)	2	2	NA		NA		18	29	23
Clay (0.001 mm)	2	2	NA		NA		0	0	0

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-7
Summary of Berth 401 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-8
Summary of Slip 1 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	15	15	NA		NA		2.9	6.1	4.2
Cadmium	15	15	NA		NA		0.12	1.5	0.53
Chromium	15	15	NA		NA		10	32	22
Copper	15	15	NA		NA		14	54	34
Lead	15	15	NA		NA		7.5	126	39
Mercury	15	15	NA		NA		0.009	0.13	0.071
Nickel	15	15	NA		NA		14	25	20
Selenium	15	10	0.07	U	0.12	U	0.05	0.22	0.13
Silver	15	15	NA		NA		0.02	0.79	0.26
Zinc	15	15	NA		NA		51	287	124
Semivolatile Organics (ug/kg)									
Naphthalene	15	15	NA		NA		0.45	360	60
2-Methylnaphthalene	15	14	5.0	U	5.0	U	0.37	330	43
1-Methylnaphthalene	15	13	5.0	U	5.0	U	3.6	190	27
Biphenyl	15	12	5.0	U	5.0	U	2.9	42	9.4
2,6-Dimethylnaphthalene	15	14	5.0	U	5.0	U	0.27	110	22
Acenaphthylene	15	15	NA		NA		0.34	30	12
Acenaphthene	15	15	NA		NA		0.36	1,200	235
2,3,5-Trimethylnaphthalene	15	14	5.0	U	5.0	U	0.24	54	17
Fluorene	15	15	NA		NA		0.37	1,000	177
Phenanthrene	15	15	NA		NA		3.0	4,900	1,134
Anthracene	15	15	NA		NA		0.93	640	200
1-Methylphenanthrene	15	15	NA		NA		0.38	220	63
Fluoranthene	15	15	NA		NA		5.8	9,700	2,068
Pyrene	15	15	NA		NA		10	7,200	1,994
Benz(a)anthracene	15	15	NA		NA		3.3	4,300	1,138
Chrysene	15	15	NA		NA		5.4	5,100	1,372
Benzo(b)fluoranthene	15	15	NA		NA		4.1	6,200	1,552
Benzo(k)fluoranthene	15	15	NA		NA		5.6	4,900	1,268
Benzo(e)pyrene	15	15	NA		NA		4.8	4,300	1,176
Benzo(a)pyrene	15	15	NA		NA		3.0	6,300	1,634
Perylene	15	15	NA		NA		1.7	1,800	527
Indeno(1,2,3-cd)pyrene	15	15	NA		NA		2.4	4,800	1,298

Table 4-8
Summary of Slip 1 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	15	15	NA		NA		0.5	1,100	268
Benzo(g,h,i)perylene	15	15	NA		NA		3.8	4,300	1,182
Dimethyl phthalate	15	0	18	U	100	U	ND	ND	ND
Diethyl phthalate	15	1	18	U	100	U	11	11	11
Di-n-butyl phthalate	15	0	18	U	100	U	ND	ND	ND
Butylbenzyl phthalate	15	13	20	U	20	U	6.1	110	25
Bis(2-ethylhexyl) phthalate	15	9	20	U	170	U	54	580	223
Di-n-octyl phthalate	15	0	18	U	100	U	ND	ND	ND
Total PAHs (c,d)	15	15	NA		NA		46	50,422	12,842
Pesticides (ug/kg)									
4,4'-DDE	15	12	0.40	U	0.40	U	2.3	4.8	3.3
4,4'-DDD	15	13	0.40	U	0.40	U	0.33	4.1	2.3
4,4'-DDT	15	9	0.40	U	0.54	U	0.83	65	11
2,4'-DDE	15	2	0.40	U	0.64	U	0.10	0.21	0.15
2,4'-DDD	15	12	0.40	U	2.3	U	1.2	10	3.0
2,4'-DDT	15	8	0.40	U	7.1	U	0.28	2.5	1.1
Total DDD (c,e)	15	14	0.40	U	0.40	U	0.33	10	4.7
Total DDE (c,f)	15	13	0.40	U	0.40	U	0.10	4.8	3.0
Total DDT (c,g)	15	13	0.40	U	0.40	U	0.28	65	8.3
Σ DDTs (c,h)	15	14	0.40	U	0.40	U	1.3	75	15
PCBs (ug/kg)									
Aroclor 1016	15	0	5.0	U	50	U	ND	ND	ND
Aroclor 1221	15	0	10	U	100	U	ND	ND	ND
Aroclor 1232	15	0	5.0	U	50	U	ND	ND	ND
Aroclor 1242	15	0	5.0	U	50	U	ND	ND	ND
Aroclor 1248	15	11	5.0	U	50	U	4.7	34	15
Aroclor 1254	15	0	5.0	U	64	U	ND	ND	ND
Aroclor 1260	15	14	5.0	U	5.0	U	5.3	820	83
Aroclor 1262	15	0	5.0	U	50	U	ND	ND	ND
Aroclor 1268	15	0	5.0	U	50	U	ND	ND	ND
Total PCBs (c,i)	15	14	10	U	10	U	5.3	820	95
Petroleum Hydrocarbons (mg/kg)									

Table 4-8
Summary of Slip 1 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	15	13	18	U	22	U	13	290	115
Residual Range Organics (RRO)	15	13	71	U	87	U	33	910	381
Gasoline Range Organics (GRO)	15	1	2.8	U	5.0	U	2.0	2.0	2.0
Conventionals (percent)									
Total organic carbon	15	15	NA		NA		0.05	2.13	1.42
Total solids	15	15	NA		NA		45.0	88.1	60.9
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	15	15	NA		NA		96	100	100
Gravel No. 3/8" (9.50 mm)	15	15	NA		NA		96	100	100
Gravel, Medium No. 4 (4.75 mm)	15	15	NA		NA		96	100	100
Gravel, Fine No. 10 (2.00 mm)	15	15	NA		NA		96	100	99
Sand, Very Coarse No. 20 (0.850 mm)	15	15	NA		NA		94	100	99
Sand, Coarse No. 40 (0.425 mm)	15	15	NA		NA		59	100	88
Sand, Medium No. 60 (0.250 mm)	15	15	NA		NA		10	99	71
Sand, Fine No. 140 (0.106 mm)	15	15	NA		NA		2	97	63
Sand, Very Fine No. 200 (0.0750 mm)	15	15	NA		NA		2	96	60
Silt (0.074 mm)	15	15	NA		NA		1	93	53
Clay (0.005 mm)	15	15	NA		NA		0	54	24
Clay (0.001 mm)	15	15	NA		NA		0	38	15

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-8
Summary of Slip 1 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-9
Summary of Wheeler Bay Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)							
Arsenic	4	4	NA	NA	2.8	4.3	3.4
Cadmium	4	4	NA	NA	0.26	1.0	0.54
Chromium	4	4	NA	NA	23	27	24
Copper	4	4	NA	NA	30	39	33
Lead	4	4	NA	NA	15	131	53
Mercury	4	4	NA	NA	0.06	0.079	0.069
Nickel	4	4	NA	NA	19	23	20
Selenium	4	4	NA	NA	0.17	0.26	0.22
Silver	4	4	NA	NA	0.17	0.49	0.28
Zinc	4	4	NA	NA	67	144	100
Semivolatile Organics (ug/kg)							
Naphthalene	4	4	NA	NA	14	69	34
2-Methylnaphthalene	4	4	NA	NA	5.9	51	22
1-Methylnaphthalene	4	4	NA	NA	3.9	34	16
Biphenyl	4	4	NA	NA	2.4	11	6.0
2,6-Dimethylnaphthalene	4	4	NA	NA	3.4	21	12
Acenaphthylene	4	4	NA	NA	5.8	12	9.1
Acenaphthene	4	4	NA	NA	17	350	114
2,3,5-Trimethylnaphthalene	4	4	NA	NA	3.4	73	28
Fluorene	4	4	NA	NA	14	220	75
Phenanthrene	4	4	NA	NA	110	1,900	575
Anthracene	4	4	NA	NA	29	370	117
1-Methylphenanthrene	4	4	NA	NA	8.9	110	36
Fluoranthene	4	4	NA	NA	230	4,400	1,318
Pyrene	4	4	NA	NA	280	4,300	1,343
Benz(a)anthracene	4	4	NA	NA	120	2,900	843
Chrysene	4	4	NA	NA	160	3,500	1,030
Benzo(b)fluoranthene	4	4	NA	NA	160	4,000	1,158
Benzo(k)fluoranthene	4	4	NA	NA	140	3,100	910
Benzo(e)pyrene	4	4	NA	NA	130	2,900	855
Benzo(a)pyrene	4	4	NA	NA	170	3,800	1,123
Perylene	4	4	NA	NA	81	1,200	367
Indeno(1,2,3-cd)pyrene	4	4	NA	NA	140	3,100	923

Table 4-9
Summary of Wheeler Bay Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	4	4	NA		NA		26	800	226
Benzo(g,h,i)perylene	4	4	NA		NA		150	2,700	823
Dimethyl phthalate	4	1	20	U	21	U	8.8	8.8	8.8
Diethyl phthalate	4	2	20	U	21	U	7.4	15	11
Di-n-butyl phthalate	4	0	20	U	52	U	ND	ND	ND
Butylbenzyl phthalate	4	3	21	U	21	U	10	19	15
Bis(2-ethylhexyl) phthalate	4	2	57	U	120	U	73	90	82
Di-n-octyl phthalate	4	1	20	U	21	U	16	16	16
Total PAHs (c,d)	4	4	NA		NA		1,450	28,921	8,646
Pesticides (ug/kg)									
4,4'-DDE	4	4	NA		NA		2.5	4.9	3.2
4,4'-DDD	4	4	NA		NA		2.0	3.3	2.5
4,4'-DDT	4	3	0.88	U	0.88	U	4.7	31	14
2,4'-DDE	4	0	0.40	U	0.73	U	ND	ND	ND
2,4'-DDD	4	3	0.64	U	0.64	U	0.61	1.8	1.3
2,4'-DDT	4	0	0.39	U	1.2	U	ND	ND	ND
Total DDD (c,e)	4	4	NA		NA		2.2	5.1	3.5
Total DDE (c,f)	4	4	NA		NA		2.5	4.9	3.2
Total DDT (c,g)	4	3	0.88	U	0.88	U	4.7	31	14
Σ DDTs (c,h)	4	4	NA		NA		6.5	37	17
PCBs (ug/kg)									
Aroclor 1016	4	0	4.9	U	4.9	U	ND	ND	ND
Aroclor 1221	4	0	10	U	11	U	ND	ND	ND
Aroclor 1232	4	0	4.9	U	4.9	U	ND	ND	ND
Aroclor 1242	4	0	4.9	U	4.9	U	ND	ND	ND
Aroclor 1248	4	4	NA		NA		4.9	13	4.9
Aroclor 1254	4	0	4.9	U	24	U	ND	ND	ND
Aroclor 1260	4	4	NA		NA		11	28	20
Aroclor 1262	4	0	4.9	U	4.9	U	ND	ND	ND
Aroclor 1268	4	0	4.9	U	4.9	U	ND	ND	ND
Total PCBs (c,i)	4	4	NA		NA		17	39	29
Petroleum Hydrocarbons (mg/kg)									

Table 4-9
Summary of Wheeler Bay Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	4	4	NA		NA		46	69	55
Residual Range Organics (RRO)	4	3	150	U	150	U	170	270	223
Gasoline Range Organics (GRO)	4	0	4.1	U	4.8	U	ND	ND	ND
Conventionals (percent)									
Total organic carbon	4	4	NA		NA		1.78	2.00	1.84
Total solids	4	4	NA		NA		47.6	57.2	52.0
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	4	4	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	4	4	NA		NA		100	100	100
Gravel, Medium No. 4 (4.75 mm)	4	4	NA		NA		100	100	100
Gravel, Fine No. 10 (2.00 mm)	4	4	NA		NA		100	100	100
Sand, Very Coarse No. 20 (0.850 mm)	4	4	NA		NA		100	100	100
Sand, Coarse No. 40 (0.425 mm)	4	4	NA		NA		99	100	100
Sand, Medium No. 60 (0.250 mm)	4	4	NA		NA		97	100	99
Sand, Fine No. 140 (0.106 mm)	4	4	NA		NA		89	97	94
Sand, Very Fine No. 200 (0.0750 mm)	4	4	NA		NA		79	92	88
Silt (0.074 mm)	4	4	NA		NA		63	71	67
Clay (0.005 mm)	4	4	NA		NA		26	38	31
Clay (0.001 mm)	4	4	NA		NA		3	17	9

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-9
Summary of Wheeler Bay Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-10
Summary of Slip 3 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	9	9	NA		NA		1.2	15	4.7
Cadmium	9	9	NA		NA		0.09	4.4	1.1
Chromium	9	9	NA		NA		9.2	25	17
Copper	9	9	NA		NA		13	72	31
Lead	9	9	NA		NA		2.6	681	145
Mercury	9	9	NA		NA		0.009	0.13	0.052
Nickel	9	9	NA		NA		14	23	18
Selenium	9	4	0.11	U	0.24	U	0.11	0.25	0.19
Silver	9	9	NA		NA		0.03	1.5	0.37
Zinc	9	9	NA		NA		39	768	187
Semivolatile Organics (ug/kg)									
Naphthalene	9	9	NA		NA		0.27	11,000	1,303
2-Methylnaphthalene	9	8	5.0	U	5.0	U	0.61	2,900	396
1-Methylnaphthalene	9	8	5.0	U	5.0	U	0.24	1,500	208
Biphenyl	9	9	NA		NA		0.44	670	88
2,6-Dimethylnaphthalene	9	8	5.0	U	5.0	U	0.20	660	99
Acenaphthylene	9	8	5.0	U	5.0	U	0.73	130	38
Acenaphthene	9	9	NA		NA		0.33	16,000	1,924
2,3,5-Trimethylnaphthalene	9	7	5.0	U	5.0	U	9.4	170	54
Fluorene	9	8	5.0	U	5.0	U	1.1	9,900	1,346
Phenanthrene	9	9	NA		NA		0.75	66,000	8,131
Anthracene	9	8	5.0	U	5.0	U	3.2	15,000	2,115
1-Methylphenanthrene	9	8	5.0	U	5.0	U	0.9	2,300	348
Fluoranthene	9	9	NA		NA		2.1	110,000	13,891
Pyrene	9	9	NA		NA		2.8	100,000	13,297
Benz(a)anthracene	9	9	NA		NA		1.6	56,000	7,181
Chrysene	9	9	NA		NA		2.1	56,000	7,395
Benzo(b)fluoranthene	9	9	NA		NA		2.2	55,000	7,311
Benzo(k)fluoranthene	9	9	NA		NA		1.6	53,000	6,964
Benzo(e)pyrene	9	9	NA		NA		1.6	36,000	5,003
Benzo(a)pyrene	9	9	NA		NA		1.6	55,000	7,492
Perylene	9	9	NA		NA		1.0	14,000	1,965
Indeno(1,2,3-cd)pyrene	9	9	NA		NA		0.90	36,000	5,074

Table 4-10
Summary of Slip 3 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	9	9	NA		NA		0.22	8,400	1,156
Benzo(g,h,i)perylene	9	9	NA		NA		1.3	26,000	3,975
Dimethyl phthalate	9	0	20	U	200	U	ND	ND	ND
Diethyl phthalate	9	0	20	U	200	U	ND	ND	ND
Di-n-butyl phthalate	9	4	20	U	200	U	7.8	32	15
Butylbenzyl phthalate	9	4	20	U	20	U	4.4	180	53
Bis(2-ethylhexyl) phthalate	9	5	20	U	200	U	40	520	155
Di-n-octyl phthalate	9	0	20	U	200	U	ND	ND	ND
Total PAHs (c,d)	9	9	NA		NA		15	602,953	78,000
Pesticides (ug/kg)									
4,4'-DDE	9	7	0.40	U	0.40	U	0.26	6.0	2.5
4,4'-DDD	9	6	0.40	U	0.40	U	2.0	5.6	3.5
4,4'-DDT	9	6	0.40	U	0.40	U	0.63	10	3.9
2,4'-DDE	9	2	0.40	U	0.93	U	0.30	0.75	0.5
2,4'-DDD	9	7	0.40	U	0.40	U	0.31	3.0	1.7
2,4'-DDT	9	3	0.40	U	0.84	U	0.74	1.4	1.1
Total DDD (c,e)	9	7	0.40	U	0.40	U	0.31	8.6	4.7
Total DDE (c,f)	9	7	0.40	U	0.40	U	0.26	6.0	2.7
Total DDT (c,g)	9	6	0.40	U	0.40	U	0.63	11	4.5
Σ DDTs (c,h)	9	7	0.40	U	0.40	U	0.57	22	11
PCBs (ug/kg)									
Aroclor 1016	9	0	5.0	U	5.2	U	ND	ND	ND
Aroclor 1221	9	0	10	U	11	U	ND	ND	ND
Aroclor 1232	9	0	5.0	U	5.2	U	ND	ND	ND
Aroclor 1242	9	0	5.0	U	5.2	U	ND	ND	ND
Aroclor 1248	9	3	5.0	U	5.1	U	6.0	11	9.3
Aroclor 1254	9	0	5.0	U	28	U	ND	ND	ND
Aroclor 1260	9	6	5.0	U	5.0	U	6.8	53	27
Aroclor 1262	9	0	5.0	U	5.2	U	ND	ND	ND
Aroclor 1268	9	0	5.0	U	5.2	U	ND	ND	ND
Total PCBs (c,i)	9	6	10	U	10	U	6.8	57	32
Petroleum Hydrocarbons (mg/kg)									

Table 4-10
Summary of Slip 3 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	9	7	14	U	14	U	9.1	290	135
Residual Range Organics (RRO)	9	7	54	U	87	U	8.7	790	301
Gasoline Range Organics (GRO)	9	0	2.7	U	4.9	U	ND	ND	ND
Conventionals (percent)									
Total organic carbon	9	8	0.08	U	0.08	U	0.15	2.73	1.23
Total solids	9	9	NA		NA		48.7	91.5	68.8
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	9	9	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	9	9	NA		NA		100	100	100
Gravel, Medium No. 4 (4.75 mm)	9	9	NA		NA		100	100	100
Gravel, Fine No. 10 (2.00 mm)	9	9	NA		NA		100	100	100
Sand, Very Coarse No. 20 (0.850 mm)	9	9	NA		NA		98	100	99
Sand, Coarse No. 40 (0.425 mm)	9	9	NA		NA		61	99	80
Sand, Medium No. 60 (0.250 mm)	9	9	NA		NA		13	97	50
Sand, Fine No. 140 (0.106 mm)	9	9	NA		NA		4	91	41
Sand, Very Fine No. 200 (0.0750 mm)	9	9	NA		NA		3	86	39
Silt (0.074 mm)	9	9	NA		NA		2	73	36
Clay (0.005 mm)	9	9	NA		NA		1	44	18
Clay (0.001 mm)	9	9	NA		NA		0	27	10

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-10
Summary of Slip 3 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-11
Summary of North of Berth 414 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	2	2	NA		NA		2.6	2.9	2.8
Cadmium	2	2	NA		NA		0.26	0.28	0.27
Chromium	2	2	NA		NA		20	24	22
Copper	2	2	NA		NA		29	30	29
Lead	2	2	NA		NA		15	18	16
Mercury	2	2	NA		NA		0.069	0.073	0.071
Nickel	2	2	NA		NA		17	20	18
Selenium	2	1	0.15	U	0.15	U	0.16	0.16	0.16
Silver	2	2	NA		NA		0.15	0.16	0.16
Zinc	2	2	NA		NA		65	72	68
Semivolatile Organics (ug/kg)									
Naphthalene	2	2	NA		NA		10	11	10
2-Methylnaphthalene	2	2	NA		NA		3.6	17	10
1-Methylnaphthalene	2	2	NA		NA		2.5	11	6.8
Biphenyl	2	2	NA		NA		1.4	3.1	2.3
2,6-Dimethylnaphthalene	2	2	NA		NA		1.9	6.1	4.0
Acenaphthylene	2	2	NA		NA		1.5	2.4	2.0
Acenaphthene	2	2	NA		NA		15	87	51
2,3,5-Trimethylnaphthalene	2	2	NA		NA		2.0	2.2	2.1
Fluorene	2	2	NA		NA		9.3	59	34
Phenanthrene	2	2	NA		NA		76	540	308
Anthracene	2	2	NA		NA		16	88	52
1-Methylphenanthrene	2	2	NA		NA		4.2	22	13
Fluoranthene	2	2	NA		NA		150	940	545
Pyrene	2	2	NA		NA		160	890	525
Benz(a)anthracene	2	2	NA		NA		87	570	329
Chrysene	2	2	NA		NA		110	740	425
Benzo(b)fluoranthene	2	2	NA		NA		120	900	510
Benzo(k)fluoranthene	2	2	NA		NA		96	550	323
Benzo(e)pyrene	2	2	NA		NA		95	590	343
Benzo(a)pyrene	2	2	NA		NA		120	740	430
Perylene	2	2	NA		NA		46	240	143
Indeno(1,2,3-cd)pyrene	2	2	NA		NA		100	640	370

Table 4-11
Summary of North of Berth 414 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	2	2	NA		NA		22	150	86
Benzo(g,h,i)perylene	2	2	NA		NA		98	550	324
Dimethyl phthalate	2	0	20	U	20	U	ND	ND	ND
Diethyl phthalate	2	0	20	U	20	U	ND	ND	ND
Di-n-butyl phthalate	2	0	20	U	20	U	ND	ND	ND
Butylbenzyl phthalate	2	1	20	U	20	U	6.7	6.7	6.7
Bis(2-ethylhexyl) phthalate	2	0	20	U	20	U	ND	ND	ND
Di-n-octyl phthalate	2	0	20	U	20	U	ND	ND	ND
Total PAHs (c,d)	2	2	NA		NA		971	6,117	3,544
Pesticides (ug/kg)									
4,4'-DDE	2	2	NA		NA		3.7	3.8	3.8
4,4'-DDD	2	2	NA		NA		2.8	3.1	3.0
4,4'-DDT	2	2	NA		NA		1.4	2.1	1.8
2,4'-DDE	2	0	0.40	U	0.40	U	ND	ND	ND
2,4'-DDD	2	2	NA		NA		1.5	1.8	1.7
2,4'-DDT	2	2	NA		NA		0.36	0.61	0.49
Total DDD (c,e)	2	2	NA		NA		4.3	4.9	4.6
Total DDE (c,f)	2	2	NA		NA		3.7	3.8	3.8
Total DDT (c,g)	2	2	NA		NA		1.8	2.7	2.2
Σ DDTs (c,h)	2	2	NA		NA		10	11	11
PCBs (ug/kg)									
Aroclor 1016	2	0	5.0	U	5.0	U	ND	ND	ND
Aroclor 1221	2	0	10	U	10	U	ND	ND	ND
Aroclor 1232	2	0	5.0	U	5.0	U	ND	ND	ND
Aroclor 1242	2	0	5.0	U	5.0	U	ND	ND	ND
Aroclor 1248	2	2	NA		NA		6.9	9.2	8.1
Aroclor 1254	2	0	14	U	18	U	ND	ND	ND
Aroclor 1260	2	2	NA		NA		13	13	13
Aroclor 1262	2	0	5.0	U	5.0	U	ND	ND	ND
Aroclor 1268	2	0	5.0	U	5.0	U	ND	ND	ND
Total PCBs (c,i)	2	2	NA		NA		20	22	21
Petroleum Hydrocarbons (mg/kg)									

Table 4-11
Summary of North of Berth 414 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	2	2	NA		NA		58	64	61
Residual Range Organics (RRO)	2	2	NA		NA		190	200	195
Gasoline Range Organics (GRO)	2	0	5	U	5	U	ND	ND	ND
Conventionals (percent)									
Total organic carbon	2	2	NA		NA		1.79	1.87	1.83
Total solids	2	2	NA		NA		50.7	51.2	51.0
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	2	2	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	2	2	NA		NA		100	100	100
Gravel, Medium No. 4 (4.75 mm)	2	2	NA		NA		100	100	100
Gravel, Fine No. 10 (2.00 mm)	2	2	NA		NA		100	100	100
Sand, Very Coarse No. 20 (0.850 mm)	2	2	NA		NA		100	100	100
Sand, Coarse No. 40 (0.425 mm)	2	2	NA		NA		92	99	96
Sand, Medium No. 60 (0.250 mm)	2	2	NA		NA		92	98	95
Sand, Fine No. 140 (0.106 mm)	2	2	NA		NA		85	91	88
Sand, Very Fine No. 200 (0.0750 mm)	2	2	NA		NA		78	84	81
Silt (0.074 mm)	2	2	NA		NA		69	70	69
Clay (0.005 mm)	2	2	NA		NA		36	37	37
Clay (0.001 mm)	2	2	NA		NA		16	18	17

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-11
Summary of North of Berth 414 Surface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-12
Summary of Berth 401 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	2	2	NA		NA		1.9	3.8	2.9
Cadmium	2	2	NA		NA		0.15	0.34	0.25
Chromium	2	2	NA		NA		7.2	18	12
Copper	2	2	NA		NA		9.3	24	17
Lead	2	2	NA		NA		7.6	34	21
Mercury	2	2	NA		NA		0.017	0.13	0.072
Nickel	2	2	NA		NA		9.2	18	14
Selenium	2	0	0.09	U	0.11	U	ND	ND	ND
Silver	2	2	NA		NA		0.04	0.20	0.12
Zinc	2	2	NA		NA		49	95	72
Semivolatile Organics (ug/kg)									
Naphthalene	2	2	NA		NA		1.8	82	42
2-Methylnaphthalene	2	2	NA		NA		0.70	25	13
1-Methylnaphthalene	2	2	NA		NA		0.44	11	5.7
Biphenyl	2	1	5.0	U	5.0	U	14	14	14
2,6-Dimethylnaphthalene	2	2	NA		NA		0.41	21	11
Acenaphthylene	2	2	NA		NA		1.7	18	10
Acenaphthene	2	2	NA		NA		1.6	85	43
2,3,5-Trimethylnaphthalene	2	2	NA		NA		0.52	46	23
Fluorene	2	2	NA		NA		1.1	48	25
Phenanthrene	2	2	NA		NA		10	630	320
Anthracene	2	2	NA		NA		5.5	71	38
1-Methylphenanthrene	2	2	NA		NA		1.5	66	34
Fluoranthene	2	2	NA		NA		23	730	377
Pyrene	2	2	NA		NA		33	1,200	617
Benz(a)anthracene	2	2	NA		NA		10	240	125
Chrysene	2	2	NA		NA		16	320	168
Benzo(b)fluoranthene	2	2	NA		NA		13	220	117
Benzo(k)fluoranthene	2	2	NA		NA		14	240	127
Benzo(e)pyrene	2	2	NA		NA		17	240	129
Benzo(a)pyrene	2	2	NA		NA		13	350	182
Perylene	2	2	NA		NA		7.3	110	59
Indeno(1,2,3-cd)pyrene	2	2	NA		NA		12	310	161

Table 4-12
Summary of Berth 401 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	2	2	NA		NA		1.8	31	16
Benzo(g,h,i)perylene	2	2	NA		NA		15	360	188
Dimethyl phthalate	2	0	20	U	20	U	ND	ND	ND
Diethyl phthalate	2	0	20	U	20	U	ND	ND	ND
Di-n-butyl phthalate	2	0	20	U	20	U	ND	ND	ND
Butylbenzyl phthalate	2	1	20	U	20	U	13	13	13
Bis(2-ethylhexyl) phthalate	2	2	NA		NA		33	62	48
Di-n-octyl phthalate	2	0	20	U	20	U	ND	ND	ND
Σ DDTs (c,h)	2	2	NA		NA		144	4,234	2,189
Pesticides (ug/kg)									
4,4'-DDE	2	1	3.2	U	3.2	U	0.21	0.21	0.21
4,4'-DDD	2	1	0.42	U	0.42	U	8.8	8.8	8.8
4,4'-DDT	2	2	NA		NA		0.84	4.2	2.5
2,4'-DDE	2	0	0.42	U	1.0	U	ND	ND	ND
2,4'-DDD	2	1	0.42	U	0.42	U	5.7	5.7	5.7
2,4'-DDT	2	0	0.42	U	1.2	U	ND	ND	ND
Total DDD (c,e)	2	1	0.42	U	0.42	U	15	15	15
Total DDE (c,f)	2	1	3.2	U	3.2	U	0.21	0.21	0.21
Total DDT (c,g)	2	2	NA		NA		0.84	4.2	2.5
Σ DDTs (c,h)	2	2	NA		NA		1.1	19	10
PCBs (ug/kg)									
Aroclor 1016	2	0	5.2	U	5.4	U	ND	ND	ND
Aroclor 1221	2	0	11	U	11	U	ND	ND	ND
Aroclor 1232	2	0	5.2	U	5.4	U	ND	ND	ND
Aroclor 1242	2	0	5.2	U	5.4	U	ND	ND	ND
Aroclor 1248	2	2	NA		NA		2.9	22	12
Aroclor 1254	2	0	5.2	U	19	U	ND	ND	ND
Aroclor 1260	2	1	5.2	U	5.2	U	29	29	29
Aroclor 1262	2	0	5.2	U	5.4	U	ND	ND	ND
Aroclor 1268	2	0	5.2	U	5.4	U	ND	ND	ND
Total PCBs (c,i)	2	2	NA		NA		2.9	51	27
Petroleum Hydrocarbons (mg/kg)									

Table 4-12
Summary of Berth 401 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	2	1	20	U	20	U	200	200	200
Residual Range Organics (RRO)	2	2	NA		NA		30	530	280
Gasoline Range Organics (GRO)	2	1	3.3	U	3.3	U	1.9	1.9	1.9
Conventionals (percent)									
Total organic carbon	2	2	NA		NA		0.28	1.24	0.76
Total solids	2	2	NA		NA		62.5	77.3	69.9
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	2	2	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	2	2	NA		NA		100	100	100
Gravel, Medium No. 4 (4.75 mm)	2	2	NA		NA		100	100	100
Gravel, Fine No. 10 (2.00 mm)	2	2	NA		NA		99	99	99
Sand, Very Coarse No. 20 (0.850 mm)	2	2	NA		NA		93	98	96
Sand, Coarse No. 40 (0.425 mm)	2	2	NA		NA		67	78	73
Sand, Medium No. 60 (0.250 mm)	2	2	NA		NA		23	34	29
Sand, Fine No. 140 (0.106 mm)	2	2	NA		NA		6	23	15
Sand, Very Fine No. 200 (0.0750 mm)	2	2	NA		NA		6	21	14
Silt (0.074 mm)	2	2	NA		NA		5	20	13
Clay (0.005 mm)	2	2	NA		NA		2	7	5
Clay (0.001 mm)	2	2	NA		NA		1	1	1

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-12
Summary of Berth 401 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-13
Summary of Slip 1 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	6	6	NA		NA		2.3	7.0	3.9
Cadmium	6	6	NA		NA		0.17	5.8	1.3
Chromium	6	6	NA		NA		10	24	17
Copper	6	6	NA		NA		13	50	25
Lead	6	6	NA		NA		11	1950	347
Mercury	6	6	NA		NA		0.013	0.12	0.048
Nickel	6	6	NA		NA		14	20	17
Selenium	6	1	0.08	U	0.27	U	0.05	0.22	0.13
Silver	6	6	NA		NA		0.04	0.75	0.21
Zinc	6	6	NA		NA		52	1,000	244
Semivolatile Organics (ug/kg)									
Naphthalene	6	6	NA		NA		1.3	28	9.3
2-Methylnaphthalene	6	6	NA		NA		0.74	21	5.5
1-Methylnaphthalene	6	6	NA		NA		0.46	13	3.3
Biphenyl	6	2	4.9	U	5.0	U	3.5	5.0	4.3
2,6-Dimethylnaphthalene	6	6	NA		NA		0.30	36	8.4
Acenaphthylene	6	6	NA		NA		1.0	46	15
Acenaphthene	6	6	NA		NA		1.7	130	30
2,3,5-Trimethylnaphthalene	6	6	NA		NA		0.50	32	7.8
Fluorene	6	6	NA		NA		1.6	210	50
Phenanthrene	6	6	NA		NA		12	960	239
Anthracene	6	6	NA		NA		2.5	2,500	474
1-Methylphenanthrene	6	6	NA		NA		1.1	140	33
Fluoranthene	6	6	NA		NA		32	2,800	656
Pyrene	6	6	NA		NA		29	2,700	660
Benz(a)anthracene	6	6	NA		NA		13	1,700	448
Chrysene	6	6	NA		NA		21	2,500	676
Benzo(b)fluoranthene	6	6	NA		NA		16	1,200	359
Benzo(k)fluoranthene	6	6	NA		NA		19	1,200	335
Benzo(e)pyrene	6	6	NA		NA		14	920	283
Benzo(a)pyrene	6	6	NA		NA		16	1,000	305
Perylene	6	6	NA		NA		7.7	390	126
Indeno(1,2,3-cd)pyrene	6	6	NA		NA		14	800	232

Table 4-13
Summary of Slip 1 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	6	6	NA		NA		2.0	200	56
Benzo(g,h,i)perylene	6	6	NA		NA		15	590	184
Dimethyl phthalate	6	0	20	U	140	U	ND	ND	ND
Diethyl phthalate	6	0	20	U	140	U	ND	ND	ND
Di-n-butyl phthalate	6	0	20	U	140	U	ND	ND	ND
Butylbenzyl phthalate	6	1	20	U	99	U	51	51	51
Bis(2-ethylhexyl) phthalate	6	2	20	U	23	U	250	620	435
Di-n-octyl phthalate	6	0	20	U	140	U	ND	ND	ND
Total PAHs (c,d)	6	6	NA		NA		176	16,974	4,256
Pesticides (ug/kg)									
4,4'-DDE	6	3	0.40	U	0.43	U	0.32	3.3	2.1
4,4'-DDD	6	4	0.40	U	0.43	U	0.39	3.8	1.8
4,4'-DDT	6	6	NA		NA		0.37	6.6	2.3
2,4'-DDE	6	1	0.40	U	1.1	U	0.15	0.15	0.15
2,4'-DDD	6	2	0.40	U	0.43	U	1.8	3.4	2.6
2,4'-DDT	6	3	0.40	U	0.91	U	0.20	0.6	0.33
Total DDD (c,e)	6	4	0.40	U	0.43	U	0.39	7.2	3.1
Total DDE (c,f)	6	4	0.40	U	0.43	U	0.15	3.3	1.6
Total DDT (c,g)	6	6	NA		NA		0.39	6.6	2.4
Σ DDTs (c,h)	6	6	NA		NA		0.39	14	5.6
PCBs (ug/kg)									
Aroclor 1016	6	0	5.0	U	9.1	U	ND	ND	ND
Aroclor 1221	6	0	10	U	19	U	ND	ND	ND
Aroclor 1232	6	0	5.0	U	9.1	U	ND	ND	ND
Aroclor 1242	6	0	5.0	U	9.1	U	ND	ND	ND
Aroclor 1248	6	2	5.0	U	5.3	U	10	25	18
Aroclor 1254	6	1	5.0	U	40	U	7.4	7.4	7.4
Aroclor 1260	6	3	5.0	U	5.3	U	6.6	63	35
Aroclor 1262	6	0	5.0	U	9.1	U	ND	ND	ND
Aroclor 1268	6	0	5.0	U	9.1	U	ND	ND	ND
Total PCBs (c,i)	6	4	10	U	10	U	6.6	88	37
Petroleum Hydrocarbons (mg/kg)									

Table 4-13
Summary of Slip 1 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	6	4	19	U	23	U	17	190	100
Residual Range Organics (RRO)	6	6	NA		NA		7.7	830	293
Gasoline Range Organics (GRO)	6	0	3.0	U	5.0	U	ND	ND	ND
Conventionals (percent)									
Total organic carbon	6	6	NA		NA		0.09	3.81	1.12
Total solids	6	6	NA		NA		36.7	75.4	63.4
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	6	6	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	6	6	NA		NA		98	100	100
Gravel, Medium No. 4 (4.75 mm)	6	6	NA		NA		94	100	98
Gravel, Fine No. 10 (2.00 mm)	6	6	NA		NA		90	100	97
Sand, Very Coarse No. 20 (0.850 mm)	6	6	NA		NA		87	99	94
Sand, Coarse No. 40 (0.425 mm)	6	6	NA		NA		60	88	73
Sand, Medium No. 60 (0.250 mm)	6	6	NA		NA		15	69	42
Sand, Fine No. 140 (0.106 mm)	6	6	NA		NA		5	56	25
Sand, Very Fine No. 200 (0.0750 mm)	6	6	NA		NA		5	53	23
Silt (0.074 mm)	6	6	NA		NA		24	56	34
Clay (0.005 mm)	6	6	NA		NA		10	22	15
Clay (0.001 mm)	6	6	NA		NA		2	2	2

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-13
Summary of Slip 1 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-14
Summary of Slip 3 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	6	6	NA		NA		3.3	12	5.9
Cadmium	6	6	NA		NA		0.30	10	3.5
Chromium	6	6	NA		NA		13	25	20
Copper	6	6	NA		NA		35	56	41
Lead	6	6	NA		NA		17	1,670	477
Mercury	6	6	NA		NA		0.043	0.12	0.076
Nickel	6	6	NA		NA		15	23	20
Selenium	6	4	0.07	U	0.08	U	0.04	0.17	0.11
Silver	6	6	NA		NA		0.13	3.5	1.1
Zinc	6	6	NA		NA		91	2,050	653
Semivolatile Organics (ug/kg)									
Naphthalene	6	6	NA		NA		43	1,700	387
2-Methylnaphthalene	6	6	NA		NA		29	940	208
1-Methylnaphthalene	6	6	NA		NA		18	490	114
Biphenyl	6	6	NA		NA		8.3	120	36
2,6-Dimethylnaphthalene	6	6	NA		NA		18	250	75
Acenaphthylene	6	6	NA		NA		12	120	36
Acenaphthene	6	6	NA		NA		86	11,000	2,356
2,3,5-Trimethylnaphthalene	6	6	NA		NA		15	220	69
Fluorene	6	6	NA		NA		74	3,400	789
Phenanthrene	6	6	NA		NA		420	32,000	7,228
Anthracene	6	6	NA		NA		110	8,700	1,968
1-Methylphenanthrene	6	6	NA		NA		35	1,800	455
Fluoranthene	6	6	NA		NA		680	64,000	14,775
Pyrene	6	6	NA		NA		710	74,000	16,153
Benz(a)anthracene	6	6	NA		NA		240	41,000	9,632
Chrysene	6	6	NA		NA		280	44,000	9,943
Benzo(b)fluoranthene	6	6	NA		NA		240	44,000	10,160
Benzo(k)fluoranthene	6	6	NA		NA		210	42,000	9,495
Benzo(e)pyrene	6	6	NA		NA		200	32,000	7,525
Benzo(a)pyrene	6	6	NA		NA		250	48,000	11,858
Perylene	6	6	NA		NA		120	13,000	3,132
Indeno(1,2,3-cd)pyrene	6	6	NA		NA		200	31,000	8,222

Table 4-14
Summary of Slip 3 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	6	6	NA		NA		30	6,500	1,605
Benzo(g,h,i)perylene	6	6	NA		NA		200	25,000	6,487
Dimethyl phthalate	6	0	20	U	200	U	ND	ND	ND
Diethyl phthalate	6	0	20	U	200	U	ND	ND	ND
Di-n-butyl phthalate	6	0	20	U	200	U	ND	ND	ND
Butylbenzyl phthalate	6	3	38	U	200	U	8.8	27	18
Bis(2-ethylhexyl) phthalate	6	3	59	U	200	U	61	140	110
Di-n-octyl phthalate	6	0	20	U	200	U	ND	ND	ND
Total PAHs (c,d)	6	6	NA		NA		3,705	413,825	94,781
Pesticides (ug/kg)									
4,4'-DDE	6	5	4.0	U	4.0	U	0.27	3.4	2.1
4,4'-DDD	6	5	4.0	U	4.0	U	0.65	13	4.0
4,4'-DDT	6	2	0.40	U	0.47	U	4.4	14	9.2
2,4'-DDE	6	0	0.40	U	4.0	U	ND	ND	ND
2,4'-DDD	6	4	0.55	U	4.5	U	1.2	4.7	2.2
2,4'-DDT	6	0	0.40	U	4.0	U	ND	ND	ND
Total DDD (c,e)	6	5	4.5	U	4.5	U	0.65	18	5.7
Total DDE (c,f)	6	5	4.0	U	4.0	U	0.27	3.4	2.1
Total DDT (c,g)	6	2	0.40	U	0.47	U	4.4	14	9.2
Σ DDTs (c,h)	6	6	NA		NA		0.92	35	10
PCBs (ug/kg)									
Aroclor 1016	6	0	5.0	U	50	U	ND	ND	ND
Aroclor 1221	6	0	10	U	100	U	ND	ND	ND
Aroclor 1232	6	0	5.0	U	50	U	ND	ND	ND
Aroclor 1242	6	0	5.0	U	50	U	ND	ND	ND
Aroclor 1248	6	4	5.0	U	50	U	5.1	8.0	6.2
Aroclor 1254	6	0	5.0	U	50	U	ND	ND	ND
Aroclor 1260	6	5	50	U	50	U	5.6	33	14
Aroclor 1262	6	0	5.0	U	50	U	ND	ND	ND
Aroclor 1268	6	0	5.0	U	50	U	ND	ND	ND
Total PCBs (c,i)	6	5	100	U	100	U	12	33	19
Petroleum Hydrocarbons (mg/kg)									

Table 4-14
Summary of Slip 3 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	6	6	NA		NA		23	360	143
Residual Range Organics (RRO)	6	6	NA		NA		74	1,200	361
Gasoline Range Organics (GRO)	6	2	3.1	U	4.5	U	1.5	2.3	1.9
Conventionals (percent)									
Total organic carbon	6	6	NA		NA		0.24	2.83	1.51
Total solids	6	6	NA		NA		54.2	81.4	66.4
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	5	5	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	5	5	NA		NA		94	100	98
Gravel, Medium No. 4 (4.75 mm)	5	5	NA		NA		88	100	97
Gravel, Fine No. 10 (2.00 mm)	5	5	NA		NA		86	100	96
Sand, Very Coarse No. 20 (0.850 mm)	5	5	NA		NA		82	100	94
Sand, Coarse No. 40 (0.425 mm)	5	5	NA		NA		53	98	81
Sand, Medium No. 60 (0.250 mm)	5	5	NA		NA		19	94	59
Sand, Fine No. 140 (0.106 mm)	5	5	NA		NA		7	84	47
Sand, Very Fine No. 200 (0.0750 mm)	5	5	NA		NA		6	76	42
Silt (0.074 mm)	5	5	NA		NA		5	65	41
Clay (0.005 mm)	5	5	NA		NA		2	29	15
Clay (0.001 mm)	5	5	NA		NA		8	8	8

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-14
Summary of Slip 3 Under-pier Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-15
Summary of Berth 401 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	6	6	NA		NA		2.5	3.6	3.1
Cadmium	6	6	NA		NA		0.049	0.54	0.17
Chromium	6	6	NA		NA		10	18	12
Copper	6	6	NA		NA		12	28	17
Lead	6	6	NA		NA		2.4	32	10
Mercury	6	5	0.02	U	0.02	U	0.008	0.5	0.14
Nickel	6	6	NA		NA		14	21	17
Selenium	6	2	0.1	U	0.12	U	0.11	0.12	0.12
Silver	6	3	0.02	U	0.02	U	0.03	0.11	0.077
Zinc	6	6	NA		NA		39	566	150
Semivolatile Organics (ug/kg)									
Naphthalene	6	4	5.0	U	5.0	U	1.3	140	62
2-Methylnaphthalene	6	4	5.0	U	5.0	U	1.0	95	42
1-Methylnaphthalene	6	4	5.0	U	5.0	U	0.78	42	20
Biphenyl	6	3	5.0	U	5.0	U	2.2	24	14
2,6-Dimethylnaphthalene	6	4	5.0	U	5.0	U	0.46	74	35
Acenaphthylene	6	4	5.0	U	5.0	U	0.78	28	14
Acenaphthene	6	4	5.0	U	5.0	U	0.93	76	38
2,3,5-Trimethylnaphthalene	6	3	5.0	U	5.0	U	3.6	98	42
Fluorene	6	4	5.0	U	5.0	U	0.9	77	38
Phenanthrene	6	4	5.0	U	5.0	U	3.1	690	305
Anthracene	6	4	5.0	U	5.0	U	1.0	130	68
1-Methylphenanthrene	6	4	5.0	U	5.0	U	0.28	82	33
Fluoranthene	6	4	5.0	U	5.0	U	3.6	900	346
Pyrene	6	4	5.0	U	5.0	U	6.3	1,300	507
Benz(a)anthracene	6	4	5.0	U	5.0	U	3.3	320	131
Chrysene	6	4	5.0	U	5.0	U	4.8	450	178
Benzo(b)fluoranthene	6	4	5.0	U	5.0	U	5.0	310	132
Benzo(k)fluoranthene	6	4	5.0	U	5.0	U	5.3	290	124
Benzo(e)pyrene	6	4	5.0	U	5.0	U	5.8	300	125
Benzo(a)pyrene	6	4	5.0	U	5.0	U	6.9	400	168
Perylene	6	6	NA		NA		0.50	130	41
Indeno(1,2,3-cd)pyrene	6	4	5.0	U	5.0	U	4.6	340	137

Table 4-15
Summary of Berth 401 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	6	4	5.0	U	5.0	U	0.51	38	17
Benzo(g,h,i)perylene	6	4	5.0	U	5.0	U	6.5	380	151
Dimethyl phthalate	6	0	20	U	40	U	ND	ND	ND
Diethyl phthalate	6	0	20	U	40	U	ND	ND	ND
Di-n-butyl phthalate	6	0	20	U	40	U	ND	ND	ND
Butylbenzyl phthalate	6	2	20	U	20	U	17	170	94
Bis(2-ethylhexyl) phthalate	6	1	20	U	76	U	350	350	350
Di-n-octyl phthalate	6	0	20	U	40	U	ND	ND	ND
Total PAHs (c,d)	6	4	5.0	U	5.0	U	43	5,054	2,110
Pesticides (ug/kg)									
4,4'-DDE	6	0	0.40	U	4.0	U	ND	ND	ND
4,4'-DDD	6	2	0.40	U	0.42	U	1.0	2.6	1.8
4,4'-DDT	6	2	0.40	U	4.3	U	0.10	10	5.0
2,4'-DDE	6	0	0.40	U	4.0	U	ND	ND	ND
2,4'-DDD	6	1	0.40	U	4.0	U	5.2	5.2	5.2
2,4'-DDT	6	2	0.40	U	0.42	U	3.7	8.8	6.3
Total DDD (c,e)	6	2	0.40	U	0.42	U	2.6	6.2	4.4
Total DDE (c,f)	6	0	0.40	U	4.0	U	ND	ND	ND
Total DDT (c,g)	6	3	0.40	U	0.42	U	0.10	19	7.5
Σ DDTs (c,h)	6	3	0.40	U	0.42	U	0.10	21	10
PCBs (ug/kg)									
Aroclor 1016	6	0	5.0	U	25	U	ND	ND	ND
Aroclor 1221	6	0	10	U	50	U	ND	ND	ND
Aroclor 1232	6	0	5.0	U	25	U	ND	ND	ND
Aroclor 1242	6	1	5.0	U	25	U	69	69	69
Aroclor 1248	6	0	5.0	U	25	U	ND	ND	ND
Aroclor 1254	6	2	5.0	U	5.3	U	82	140	111
Aroclor 1260	6	0	5.0	U	25	U	ND	ND	ND
Aroclor 1262	6	0	5.0	U	25	U	ND	ND	ND
Aroclor 1268	6	0	5.0	U	25	U	ND	ND	ND
Total PCBs (c,i)	6	2	10	U	11	U	140	151	146
Petroleum Hydrocarbons (mg/kg)									

Table 4-15
Summary of Berth 401 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	6	2	19	U	21	U	55	200	128
Residual Range Organics (RRO)	6	3	73	U	83	U	19	410	186
Gasoline Range Organics (GRO)	6	1	3.0	U	3.3	U	2.3	2.3	2.3
Conventionals (percent)									
Total organic carbon	6	5	0.18	U	0.18	U	0.03	1.15	0.46
Total solids	6	6	NA		NA		74.7	83.6	78.7
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	6	6	NA		NA		99	100	100
Gravel No. 3/8" (9.50 mm)	6	6	NA		NA		99	100	100
Gravel, Medium No. 4 (4.75 mm)	6	6	NA		NA		99	100	99
Gravel, Fine No. 10 (2.00 mm)	6	6	NA		NA		98	100	99
Sand, Very Coarse No. 20 (0.850 mm)	6	6	NA		NA		97	99	98
Sand, Coarse No. 40 (0.425 mm)	6	6	NA		NA		64	87	75
Sand, Medium No. 60 (0.250 mm)	6	6	NA		NA		12	33	23
Sand, Fine No. 140 (0.106 mm)	6	6	NA		NA		4	16	9
Sand, Very Fine No. 200 (0.0750 mm)	6	6	NA		NA		3	14	8
Silt (0.074 mm)	6	6	NA		NA		2	13	6
Clay (0.005 mm)	6	6	NA		NA		0	5	2
Clay (0.001 mm)	6	6	NA		NA		1	1	1

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-15
Summary of Berth 401 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-16
Summary of Slip 1 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	73	73	NA		NA		1.2	6.8	2.9
Cadmium	73	73	NA		NA		0.037	3.4	0.27
Chromium	73	73	NA		NA		6.4	33	17
Copper	73	73	NA		NA		9.4	55	25
Lead	73	73	NA		NA		2.0	242	15
Mercury	73	62	0.016	U	0.02	U	0.009	0.38	0.063
Nickel	73	73	NA		NA		12	30	20
Selenium	73	18	0.04	U	0.13	U	0.03	0.23	0.095
Silver	73	66	0.02	U	0.02	U	0.02	1.4	0.11
Zinc	73	73	NA		NA		27	654	75
Semivolatile Organics (ug/kg)									
Naphthalene	73	43	4.7	U	5.1	U	0.27	580	57
2-Methylnaphthalene	73	35	4.7	U	5.1	U	0.30	160	26
1-Methylnaphthalene	73	33	4.7	U	5.1	U	0.31	83	12
Biphenyl	73	20	4.7	U	5.1	U	2.0	63	12
2,6-Dimethylnaphthalene	73	35	4.7	U	5.1	U	0.18	130	18
Acenaphthylene	73	39	4.7	U	5.1	U	0.28	96	12
Acenaphthene	73	42	4.7	U	5.1	U	0.30	340	48
2,3,5-Trimethylnaphthalene	73	36	4.7	U	5.1	U	0.25	160	22
Fluorene	73	39	4.7	U	5.1	U	0.22	370	43
Phenanthrene	73	37	4.7	U	5.1	U	1.3	1,600	281
Anthracene	73	44	4.7	U	5.1	U	0.22	380	46
1-Methylphenanthrene	73	43	4.7	U	5.1	U	0.17	160	24
Fluoranthene	73	39	4.7	U	5.1	U	2.1	2,500	336
Pyrene	73	43	4.7	U	5.0	U	1.6	3,300	399
Benz(a)anthracene	73	56	4.7	U	5.0	U	0.17	1,800	115
Chrysene	73	59	4.7	U	5.0	U	0.17	2,000	138
Benzo(b)fluoranthene	73	63	4.8	U	5.0	U	0.19	2,300	115
Benzo(k)fluoranthene	73	54	4.7	U	5.0	U	0.21	1,900	116
Benzo(e)pyrene	73	61	4.8	U	5.0	U	0.18	1,700	100
Benzo(a)pyrene	73	49	4.7	U	5.1	U	0.16	2,400	165
Perylene	73	68	4.8	U	5.0	U	0.31	780	122
Indeno(1,2,3-cd)pyrene	73	42	4.7	U	5.1	U	0.22	1,900	153

Table 4-16
Summary of Slip 1 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	73	34	4.7	U	5.1	U	0.22	480	34
Benzo(g,h,i)perylene	73	54	4.7	U	5.1	U	0.15	1,700	122
Dimethyl phthalate	73	0	10	U	80	U	ND	ND	ND
Diethyl phthalate	73	0	10	U	80	U	ND	ND	ND
Di-n-butyl phthalate	73	0	10	U	80	U	ND	ND	ND
Butylbenzyl phthalate	73	10	10	U	80	U	2.5	22	12
Bis(2-ethylhexyl) phthalate	73	16	19	U	150	U	32	470	117
Di-n-octyl phthalate	73	1	10	U	80	U	23	23	23
Total PAHs (c,d)	73	69	5.0	U	5.0	U	0.20	17,928	1,239
Pesticides (ug/kg)									
4,4'-DDE	73	23	0.39	U	0.50	U	0.22	25	4.6
4,4'-DDD	73	24	0.39	U	0.50	U	0.34	43	4.2
4,4'-DDT	73	31	0.39	U	0.52	U	0.07	14	3.4
2,4'-DDE	73	3	0.38	U	2.3	U	0.64	3.0	1.6
2,4'-DDD	73	20	0.39	U	3.6	U	0.27	30	4.1
2,4'-DDT	73	14	0.39	U	13	U	0.13	7.8	2.7
Total DDD (c,e)	73	25	0.39	U	0.52	U	0.34	73	7.4
Total DDE (c,f)	73	23	0.39	U	0.50	U	0.22	25	4.8
Total DDT (c,g)	73	31	0.39	U	1.2	U	0.07	22	4.6
Σ DDTs (c,h)	73	32	0.39	U	0.52	U	0.07	106	14
PCBs (ug/kg)									
Aroclor 1016	73	0	4.6	U	7.0	U	ND	ND	ND
Aroclor 1221	73	0	9.1	U	14	U	ND	ND	ND
Aroclor 1232	73	0	4.6	U	7.0	U	ND	ND	ND
Aroclor 1242	73	0	4.6	U	7.0	U	ND	ND	ND
Aroclor 1248	73	19	4.8	U	6.3	U	3.1	72	25
Aroclor 1254	73	1	4.8	U	270	U	37	37	37
Aroclor 1260	73	24	4.8	U	6.3	U	3.3	180	49
Aroclor 1262	73	0	4.6	U	7.0	U	ND	ND	ND
Aroclor 1268	73	2	4.6	U	7.0	U	15	51	33
Total PCBs (c,i)	73	25	10	U	13	U	3.3	244	70
Petroleum Hydrocarbons (mg/kg)									

Table 4-16
Summary of Slip 1 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	73	23	14	U	25	U	17	580	136
Residual Range Organics (RRO)	73	39	54	U	98	U	7.5	1,200	186
Gasoline Range Organics (GRO)	73	9	2.7	U	4.6	U	1.5	7.1	2.5
Conventionals (percent)									
Total organic carbon	73	65	0.05	U	0.15	U	0.02	2.30	0.69
Total solids	73	73	NA		NA		54.2	93.0	73.0
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	65	65	NA		NA		93	100	100
Gravel No. 3/8" (9.50 mm)	65	65	NA		NA		89	100	100
Gravel, Medium No. 4 (4.75 mm)	65	65	NA		NA		88	100	100
Gravel, Fine No. 10 (2.00 mm)	65	65	NA		NA		86	100	99
Sand, Very Coarse No. 20 (0.850 mm)	65	65	NA		NA		84	100	98
Sand, Coarse No. 40 (0.425 mm)	65	65	NA		NA		51	100	81
Sand, Medium No. 60 (0.250 mm)	65	65	NA		NA		10	100	54
Sand, Fine No. 140 (0.106 mm)	65	65	NA		NA		3	99	41
Sand, Very Fine No. 200 (0.0750 mm)	65	65	NA		NA		2	97	38
Silt (0.074 mm)	65	65	NA		NA		1	89	33
Clay (0.005 mm)	65	65	NA		NA		0	36	13
Clay (0.001 mm)	65	65	NA		NA		0	16	7

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-16
Summary of Slip 1 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-17
Summary of Wheeler Bay Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	25	25	NA		NA		1.8	7.6	3.6
Cadmium	25	25	NA		NA		0.08	0.94	0.47
Chromium	25	25	NA		NA		11	35	23
Copper	25	25	NA		NA		13	99	35
Lead	25	25	NA		NA		2.6	3,130	153
Mercury	25	25	NA		NA		0.009	1.7	0.20
Nickel	25	25	NA		NA		15	28	21
Selenium	25	18	0.074	U	0.22	U	0.10	0.28	0.20
Silver	25	24	0.02	U	0.02	U	0.03	0.53	0.27
Zinc	25	25	NA		NA		40	271	118
Semivolatile Organics (ug/kg)									
Naphthalene	25	25	NA		NA		12	660	180
2-Methylnaphthalene	25	25	NA		NA		3.9	390	100
1-Methylnaphthalene	25	25	NA		NA		1.4	870	108
Biphenyl	25	25	NA		NA		1.9	59	18
2,6-Dimethylnaphthalene	25	25	NA		NA		1.6	510	77
Acenaphthylene	25	25	NA		NA		3.3	98	28
Acenaphthene	25	25	NA		NA		4.1	1,700	286
2,3,5-Trimethylnaphthalene	25	25	NA		NA		0.77	260	63
Fluorene	25	25	NA		NA		2.1	890	181
Phenanthrene	25	25	NA		NA		44	7,300	918
Anthracene	25	25	NA		NA		8.4	1,700	175
1-Methylphenanthrene	25	25	NA		NA		7.2	380	79
Fluoranthene	25	25	NA		NA		38	14,000	1,200
Pyrene	25	25	NA		NA		170	16,000	1,391
Benz(a)anthracene	25	25	NA		NA		70	9,600	639
Chrysene	25	25	NA		NA		95	11,000	766
Benzo(b)fluoranthene	25	25	NA		NA		47	11,000	708
Benzo(k)fluoranthene	25	25	NA		NA		46	11,000	664
Benzo(e)pyrene	25	25	NA		NA		44	9,000	594
Benzo(a)pyrene	25	25	NA		NA		59	13,000	856
Perylene	25	25	NA		NA		23	3,800	314
Indeno(1,2,3-cd)pyrene	25	25	NA		NA		47	10,000	684

Table 4-17
Summary of Wheeler Bay Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	25	25	NA		NA		7.6	2,000	128
Benzo(g,h,i)perylene	25	25	NA		NA		54	9,000	656
Dimethyl phthalate	25	0	10	U	100	U	ND	ND	ND
Diethyl phthalate	25	3	10	U	100	U	7.5	8.7	8.0
Di-n-butyl phthalate	25	0	10	U	180	U	ND	ND	ND
Butylbenzyl phthalate	25	5	10	U	100	U	6.4	110	34
Bis(2-ethylhexyl) phthalate	25	9	20	U	240	U	69	3,000	458
Di-n-octyl phthalate	25	0	10	U	100	U	ND	ND	ND
Total PAHs (c,d)	25	25	NA		NA		975	97,434	7,992
Pesticides (ug/kg)									
4,4'-DDE	25	21	0.40	U	0.41	U	1.1	14	6.0
4,4'-DDD	25	23	0.40	U	0.40	U	0.83	12	4.8
4,4'-DDT	25	19	0.40	U	1.5	U	0.25	16	3.9
2,4'-DDE	25	3	0.40	U	2.0	U	0.37	1.6	0.84
2,4'-DDD	25	21	0.40	U	3.9	U	0.72	8.3	3.2
2,4'-DDT	25	11	0.40	U	2.9	U	0.25	8.2	2.5
Total DDD (c,e)	25	23	0.40	U	0.40	U	0.93	16	7.7
Total DDE (c,f)	25	21	0.40	U	0.41	U	1.1	14	6.1
Total DDT (c,g)	25	20	0.40	U	1.5	U	0.25	21	5.0
Σ DDTs (c,h)	25	24	0.40	U	0.40	U	0.25	48	17
PCBs (ug/kg)									
Aroclor 1016	25	0	5.0	U	11	U	ND	ND	ND
Aroclor 1221	25	0	10	U	11	U	ND	ND	ND
Aroclor 1232	25	0	5.0	U	17	U	ND	ND	ND
Aroclor 1242	25	1	5.0	U	14	U	27	27	27
Aroclor 1248	25	16	5.0	U	7.8	U	6.3	110	32
Aroclor 1254	25	3	5.0	U	240	U	12	52	27
Aroclor 1260	25	20	5.0	U	7.4	U	7.0	170	46
Aroclor 1262	25	0	5.0	U	9.0	U	ND	ND	ND
Aroclor 1268	25	3	5.0	U	5.1	U	20	77	50
Total PCBs (c,i)	25	21	10	U	10	U	16	270	81
Petroleum Hydrocarbons (mg/kg)									

Table 4-17
Summary of Wheeler Bay Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	25	24	18	U	18	U	27	550	192
Residual Range Organics (RRO)	25	23	71	U	76	U	59	840	386
Gasoline Range Organics (GRO)	25	11	3.2	U	4.5	U	2.3	8.0	4.5
Conventionals (percent)									
Total organic carbon	25	24	0.09	U	0.09	U	0.37	4.25	1.80
Total solids	25	25	NA		NA		51.8	77.0	61.6
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	25	25	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	25	25	NA		NA		99	100	100
Gravel, Medium No. 4 (4.75 mm)	25	25	NA		NA		99	100	100
Gravel, Fine No. 10 (2.00 mm)	25	25	NA		NA		99	100	100
Sand, Very Coarse No. 20 (0.850 mm)	25	25	NA		NA		98	100	100
Sand, Coarse No. 40 (0.425 mm)	25	25	NA		NA		49	100	92
Sand, Medium No. 60 (0.250 mm)	25	25	NA		NA		11	100	83
Sand, Fine No. 140 (0.106 mm)	25	25	NA		NA		3	98	74
Sand, Very Fine No. 200 (0.0750 mm)	25	25	NA		NA		3	95	68
Silt (0.074 mm)	25	25	NA		NA		1	93	57
Clay (0.005 mm)	25	25	NA		NA		0	46	26
Clay (0.001 mm)	25	25	NA		NA		0	28	17

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-17
Summary of Wheeler Bay Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-18
Summary of Slip 3 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	51	51	NA		NA		0.90	23	2.9
Cadmium	51	51	NA		NA		0.07	1.8	0.26
Chromium	51	51	NA		NA		8.3	28	15
Copper	51	51	NA		NA		12	54	24
Lead	51	51	NA		NA		2.1	240	23
Mercury	51	45	0.016	U	0.02	U	0.01	2.2	0.079
Nickel	51	51	NA		NA		14	33	19
Selenium	51	22	0.03	U	0.24	U	0.04	2.6	0.32
Silver	51	45	0.02	U	0.03	U	0.02	0.77	0.10
Zinc	51	51	NA		NA		34	263	62
Semivolatile Organics (ug/kg)									
Naphthalene	51	27	4.9	U	5.3	U	0.27	360	41
2-Methylnaphthalene	51	14	4.9	U	5.3	U	0.56	140	35
1-Methylnaphthalene	51	14	4.9	U	5.3	U	0.41	95	21
Biphenyl	51	18	4.9	U	5.3	U	0.29	67	8.8
2,6-Dimethylnaphthalene	51	15	4.9	U	5.3	U	0.15	64	15
Acenaphthylene	51	12	4.9	U	5.3	U	0.25	150	24
Acenaphthene	51	20	4.9	U	5.1	U	0.28	1,000	200
2,3,5-Trimethylnaphthalene	51	13	4.9	U	5.3	U	0.30	120	24
Fluorene	51	19	4.9	U	5.3	U	0.24	510	103
Phenanthrene	51	24	4.9	U	5.3	U	0.24	4,500	713
Anthracene	51	20	4.9	U	5.3	U	0.30	1,200	216
1-Methylphenanthrene	51	19	4.9	U	5.3	U	0.15	340	65
Fluoranthene	51	27	4.9	U	5.3	U	0.24	9,600	1,343
Pyrene	51	38	4.9	U	5.3	U	0.15	13,000	1,139
Benz(a)anthracene	51	23	4.9	U	5.3	U	0.22	6,600	1,071
Chrysene	51	26	4.9	U	5.3	U	0.21	7,400	1,080
Benzo(b)fluoranthene	51	27	4.9	U	5.1	U	0.22	8,600	1,158
Benzo(k)fluoranthene	51	22	4.9	U	5.3	U	0.19	6,600	1,190
Benzo(e)pyrene	51	24	4.9	U	5.3	U	0.19	6,500	1,015
Benzo(a)pyrene	51	23	4.9	U	5.3	U	0.18	9,500	1,526
Perylene	51	37	5.0	U	5.0	U	0.26	2,700	298
Indeno(1,2,3-cd)pyrene	51	17	4.9	U	5.3	U	0.18	7,900	1,680

Table 4-18
Summary of Slip 3 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	51	13	4.9	U	5.3	U	0.65	1,400	432
Benzo(g,h,i)perylene	51	21	4.9	U	5.3	U	0.15	7,100	1,235
Dimethyl phthalate	51	2	10	U	100	U	2.9	5.0	4.0
Diethyl phthalate	51	1	10	U	100	U	8.2	8.2	8.2
Di-n-butyl phthalate	51	14	4.4	U	100	U	3.4	76	15
Butylbenzyl phthalate	51	4	10	U	100	U	3.4	13	7.6
Bis(2-ethylhexyl) phthalate	51	14	10	U	71	U	47	180	90
Di-n-octyl phthalate	51	1	10	U	100	U	8.0	8.0	8.0
Total PAHs (c,d)	51	41	4.9	U	5.1	U	0.15	68,860	6,184
Pesticides (ug/kg)									
4,4'-DDE	51	9	0.40	U	0.48	U	0.36	4.9	3.0
4,4'-DDD	51	9	0.40	U	0.87	U	0.32	64	9.4
4,4'-DDT	51	11	0.40	U	0.46	U	0.12	90	11
2,4'-DDE	51	0	0.40	U	0.79	U	ND	ND	ND
2,4'-DDD	51	8	0.40	U	0.48	U	1.0	16	4.1
2,4'-DDT	51	5	0.40	U	24	U	0.61	3.1	1.4
Total DDD (c,e)	51	9	0.40	U	0.87	U	0.32	80	13
Total DDE (c,f)	51	9	0.40	U	0.48	U	0.36	4.9	3.0
Total DDT (c,g)	51	12	0.40	U	0.46	U	0.12	90	10
Σ DDTs (c,h)	51	12	0.40	U	0.87	U	0.12	174	22
PCBs (ug/kg)									
Aroclor 1016	51	0	5.0	U	50	U	ND	ND	ND
Aroclor 1221	51	0	10	U	100	U	ND	ND	ND
Aroclor 1232	51	0	5.0	U	50	U	ND	ND	ND
Aroclor 1242	51	0	5.0	U	50	U	ND	ND	ND
Aroclor 1248	51	6	5.0	U	50	U	6.7	53	23
Aroclor 1254	51	1	5.0	U	240	U	11	11	11
Aroclor 1260	51	8	5.0	U	6.0	U	10	1,000	163
Aroclor 1262	51	0	5.0	U	50	U	ND	ND	ND
Aroclor 1268	51	0	5.0	U	50	U	ND	ND	ND
Total PCBs (c,i)	51	8	10	U	12	U	21	1,000	181
Petroleum Hydrocarbons (mg/kg)									

Table 4-18
Summary of Slip 3 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	51	10	13	U	24	U	10	340	152
Residual Range Organics (RRO)	51	25	50	U	93	U	5.9	690	138
Gasoline Range Organics (GRO)	51	2	2.7	U	5.0	U	1.3	1.4	1.4
Conventionals (percent)									
Total organic carbon	51	35	0.04	U	0.15	U	0.03	5.71	0.95
Total solids	51	51	NA		NA		51.7	92.2	74.5
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	44	44	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	44	44	NA		NA		100	100	100
Gravel, Medium No. 4 (4.75 mm)	44	44	NA		NA		100	100	100
Gravel, Fine No. 10 (2.00 mm)	44	44	NA		NA		99	100	100
Sand, Very Coarse No. 20 (0.850 mm)	44	44	NA		NA		92	100	99
Sand, Coarse No. 40 (0.425 mm)	44	44	NA		NA		39	100	75
Sand, Medium No. 60 (0.250 mm)	44	44	NA		NA		7	100	41
Sand, Fine No. 140 (0.106 mm)	44	44	NA		NA		2	96	30
Sand, Very Fine No. 200 (0.0750 mm)	44	44	NA		NA		2	87	26
Silt (0.074 mm)	44	44	NA		NA		1	68	22
Clay (0.005 mm)	44	44	NA		NA		0	35	9
Clay (0.001 mm)	44	44	NA		NA		0	15	3

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-18
Summary of Slip 3 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-19
Summary of North of Berth 414 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Metals (mg/kg)									
Arsenic	12	12	NA		NA		1.9	4.3	3.0
Cadmium	12	12	NA		NA		0.07	1.6	0.58
Chromium	12	12	NA		NA		8.5	29	20
Copper	12	12	NA		NA		13	36	30
Lead	12	12	NA		NA		2.2	125	38
Mercury	12	12	NA		NA		0.015	0.71	0.19
Nickel	12	12	NA		NA		14	21	18
Selenium	12	3	0.05	U	0.16	U	0.18	0.23	0.20
Silver	12	12	NA		NA		0.03	0.59	0.28
Zinc	12	12	NA		NA		35	326	135
Semivolatile Organics (ug/kg)									
Naphthalene	12	11	5.0	U	5.0	U	11	250	97
2-Methylnaphthalene	12	11	5.0	U	5.0	U	2.9	150	57
1-Methylnaphthalene	12	11	5.0	U	5.0	U	1.6	170	47
Biphenyl	12	10	5.0	U	5.0	U	3.5	26	12
2,6-Dimethylnaphthalene	12	11	5.0	U	5.0	U	2.0	210	49
Acenaphthylene	12	11	5.0	U	5.0	U	0.68	70	22
Acenaphthene	12	11	5.0	U	5.0	U	2.6	320	84
2,3,5-Trimethylnaphthalene	12	11	5.0	U	5.0	U	1.5	240	46
Fluorene	12	11	5.0	U	5.0	U	2.5	180	58
Phenanthrene	12	12	NA		NA		0.42	690	265
Anthracene	12	11	5.0	U	5.0	U	3.1	130	57
1-Methylphenanthrene	12	11	5.0	U	5.0	U	1.8	180	41
Fluoranthene	12	12	NA		NA		0.52	800	344
Pyrene	12	12	NA		NA		0.66	1,400	475
Benz(a)anthracene	12	11	5.0	U	5.0	U	5.6	320	171
Chrysene	12	12	NA		NA		0.25	460	214
Benzo(b)fluoranthene	12	12	NA		NA		0.25	510	183
Benzo(k)fluoranthene	12	11	5.0	U	5.0	U	6.3	390	173
Benzo(e)pyrene	12	12	NA		NA		0.21	440	175
Benzo(a)pyrene	12	12	NA		NA		0.21	550	243
Perylene	12	11	5.0	U	5.0	U	3.3	210	95
Indeno(1,2,3-cd)pyrene	12	11	5.0	U	5.0	U	7.7	580	236

Table 4-19
Summary of North of Berth 414 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Dibenz(a,h)anthracene	12	10	5.0	U	5.0	U	5.3	94	36
Benzo(g,h,i)perylene	12	12	NA		NA		0.22	630	236
Dimethyl phthalate	12	1	10	U	20	U	4.9	4.9	4.9
Diethyl phthalate	12	1	10	U	20	U	7.5	7.5	7.5
Di-n-butyl phthalate	12	0	10	U	29	U	ND	ND	ND
Butylbenzyl phthalate	12	2	10	U	20	U	7.5	7.5	7.5
Bis(2-ethylhexyl) phthalate	12	5	10	U	33	U	37	72	56
Di-n-octyl phthalate	12	0	10	U	20	U	ND	ND	ND
Total PAHs (c,d)	12	12	NA		NA		2.3	5,258	2,330
Pesticides (ug/kg)									
4,4'-DDE	12	9	0.40	U	0.40	U	0.22	15	5.9
4,4'-DDD	12	9	0.40	U	0.40	U	0.43	12	6.3
4,4'-DDT	12	8	0.40	U	0.40	U	1.6	6.8	4.0
2,4'-DDE	12	1	0.40	U	2.2	U	1.2	1.2	1.2
2,4'-DDD	12	9	0.40	U	0.40	U	0.28	10	4.4
2,4'-DDT	12	8	0.40	U	0.71	U	0.25	3.7	1.7
Total DDD (c,e)	12	9	0.40	U	0.40	U	0.71	22	11
Total DDE (c,f)	12	9	0.40	U	0.40	U	0.22	15	6.0
Total DDT (c,g)	12	9	0.40	U	0.40	U	0.25	11	5.1
Σ DDTs (c,h)	12	11	0.40	U	0.40	U	0.22	41	18
d									
PCBs (ug/kg)									
Aroclor 1016	12	0	5.0	U	5.0	U	ND	ND	ND
Aroclor 1221	12	0	10	U	10	U	ND	ND	ND
Aroclor 1232	12	0	5.0	U	5.0	U	ND	ND	ND
Aroclor 1242	12	0	5.0	U	5.0	U	ND	ND	ND
Aroclor 1248	12	7	5.0	U	5.0	U	9.0	73	34
Aroclor 1254	12	0	5.0	U	130	U	ND	ND	ND
Aroclor 1260	12	7	5.0	U	14	U	22	96	56
Aroclor 1262	12	0	5.0	U	13	U	ND	ND	ND
Aroclor 1268	12	2	5.0	U	5.0	U	20	49	35
Total PCBs (c,i)	12	8	10	U	10	U	31	169	87
Petroleum Hydrocarbons (mg/kg)									

Table 4-19
Summary of North of Berth 414 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)		Maximum Detection Limit (a)		Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)
Diesel Range Organics (DRO)	12	10	17	U	22	U	15	620	217
Residual Range Organics (RRO)	12	10	66	U	85	U	20	950	389
Gasoline Range Organics (GRO)	12	5	3.1	U	4.5	U	1.9	13	6.3
Conventionals (percent)									
Total organic carbon	12	11	0.06	U	0.06	U	0.07	2.77	1.62
Total solids	12	12	NA		NA		52.8	78.3	63.8
Grain Size (percent) (j)									
Gravel No. 3/4" (19.0 mm)	12	12	NA		NA		100	100	100
Gravel No. 3/8" (9.50 mm)	12	12	NA		NA		100	100	100
Gravel, Medium No. 4 (4.75 mm)	12	12	NA		NA		99	100	100
Gravel, Fine No. 10 (2.00 mm)	12	12	NA		NA		99	100	100
Sand, Very Coarse No. 20 (0.850 mm)	12	12	NA		NA		99	100	99
Sand, Coarse No. 40 (0.425 mm)	12	12	NA		NA		66	99	88
Sand, Medium No. 60 (0.250 mm)	12	12	NA		NA		11	98	69
Sand, Fine No. 140 (0.106 mm)	12	12	NA		NA		4	94	61
Sand, Very Fine No. 200 (0.0750 mm)	12	12	NA		NA		3	90	58
Silt (0.074 mm)	12	12	NA		NA		2	73	49
Clay (0.005 mm)	12	12	NA		NA		1	41	24
Clay (0.001 mm)	12	12	NA		NA		0	22	10

ND = All sample results were non-detect. There is no maximum, minimum, or average detected concentration.
NA = All sample results were detected. There is no maximum or minimum detection limit.
U = Non-detect.
a. The maximum and minimum detection limits are for non-detect results only.
b. The average detected concentration calculation includes detected results only. Non-detect results are not included.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.

Table 4-19
Summary of North of Berth 414 Subsurface Sediment Chemistry Data

Compounds	Number of Samples	Number of Detections	Minimum Detection Limit (a)	Maximum Detection Limit (a)	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration (b)

h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.

i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

j. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-20
DRET Elutriate Chemistry Results

Sample ID:	T4-CM1-Dret	T4-CM2-Dret
Lab ID:	K2402978-004	K2403382-001
Date Sampled:	04/20/2004	05/05/2004
Metals (ug/L)		
Arsenic	0.9	0.8
Cadmium	0.02 U	0.04 U
Chromium	1.11	1.77
Copper	5.08	4.25
Lead	1.63	1.86
Mercury	0.2 U	0.2 U
Nickel	1.3	1.65
Selenium	0.7 U	0.4 B
Silver	0.03 U	0.03
Zinc	5.62	6.7
Semivolatile Organics (ug/L)		
Naphthalene	0.40 U	0.39 U
2-Methylnaphthalene	0.40 U	0.39 U
1-Methylnaphthalene	0.40 U	0.39 U
Biphenyl	0.40 U	0.39 U
2,6-Dimethylnaphthalene	0.40 U	0.39 U
Acenaphthylene	0.40 U	0.099 J
Acenaphthene	0.40 U	0.19 J
2,3,5-Trimethylnaphthalene	0.40 U	0.027 J
Fluorene	0.40 U	0.096 J
Phenanthrene	0.40 U	0.13 J
Anthracene	0.40 U	0.39 U
1-Methylphenanthrene	0.40 U	0.39 U
Fluoranthene	0.40 U	0.092 J
Pyrene	0.075 J	0.13 J
Benz(a)anthracene	0.40 U	0.39 U
Chrysene	0.40 U	0.39 U
Benzo(b)fluoranthene	0.40 U	0.39 U
Benzo(k)fluoranthene	0.40 U	0.39 U
Benzo(e)pyrene	0.40 U	0.39 U
Benzo(a)pyrene	0.40 U	0.39 U
Perylene	0.40 U	0.39 U
Indeno(1,2,3-cd)pyrene	0.40 U	0.39 U
Dibenz(a,h)anthracene	0.40 U	0.39 U
Benzo(g,h,i)perylene	0.40 U	0.39 U
Dimethyl phthalate	9.9 U	9.6 UJ
Diethyl phthalate	9.9 U	9.6 U
Di-n-butyl phthalate	9.9 U	9.6 U
Butylbenzyl phthalate	9.9 U	9.6 U
Bis(2-ethylhexyl) phthalate	9.9 U	9.6 U
Di-n-octyl phthalate	9.9 U	9.6 U
Total PAHs (a,b)	0.075 J	0.737 J
Pesticides (ug/L)		
4,4'-DDE	0.099 U	0.097 U
4,4'-DDD	0.099 U	0.097 U
4,4'-DDT	0.099 U	0.097 U
2,4'-DDE	0.099 U	0.097 U
2,4'-DDD	0.099 U	0.097 U
2,4'-DDT	0.099 U	0.097 U
Total DDD (a,c)	0.099 U	0.097 U

Table 4-20
DRET Elutriate Chemistry Results

Sample ID:	T4-CM1-Dret	T4-CM2-Dret
Lab ID:	K2402978-004	K2403382-001
Date Sampled:	04/20/2004	05/05/2004
Total DDE (a,d)	0.099 U	0.097 U
Total DDT (a,e)	0.099 U	0.097 U
ΣDDTs (a,f)	0.099 U	0.097 U
PCBs (ug/L)		
Aroclor 1016	0.099 U	0.097 U
Aroclor 1221	0.099 U	0.097 U
Aroclor 1232	0.099 U	0.097 U
Aroclor 1242	0.099 U	0.097 U
Aroclor 1248	0.099 U	0.097 U
Aroclor 1254	0.099 U	0.097 U
Aroclor 1260	0.099 U	0.097 U
Aroclor 1262	0.099 U	0.097 U
Aroclor 1268	0.099 U	0.097 U
Total PCBs (a,g)	0.099 U	0.097 U
Petroleum Hydrocarbons (ug/L)		
Diesel Range Organics (DRO)	250 U	250 U
Residual Range Organics (RRO)	57 J	500 U
Conventionals (mg/L)		
Total suspended solids	5 U	5 U
Ammonia as Nitrogen	0.57	0.68
Total Sulfide	0.05 U	0.05 U

U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.
a. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
b. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
c. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
d. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
e. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
f. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes c, d, and e for the definitions of total DDD, total DDE, and total DDT, respectively.
g. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 4-21. Column Settling Test Results

Elapsed Time in Hours	Port Height in Feet	Suspended Solids in g/L	Percent of Initial Concentration	Turbidity in NTU	Surface Water Height in Feet	Solids Interface Height in Feet
0					6.92	6.92
0.05					6.92	6.92
0.12					6.92	6.92
0.3					6.92	6.92
0.33					6.92	3.71
0.5					6.92	2.49
1	6.5	9.53	100	9130	6.92	1.56
1	6	9.52	100	9220		
1	5.5	9.54	100	9250		
1	5	9.63	100	9100		
1	4.5	9.55	100	9720		
1	4	9.54	100	9590		
1	3.5	9.69	100	9100		
1	3	9.70	100	9780		
1	2	9.71	100	9250		
2	6.5	7.57	78.82	7830	6.84	1.16
2	6	7.64	79.61	7840		
2	5.5	7.71	80.28	7820		
2	5	7.69	80.07	8210		
2	4.5	7.70	80.24	8030		
2	4	7.75	80.70	7820		
2	3.5	7.74	80.61	7760		
2	3	7.70	80.16	8030		
2	2	6.86	71.45	8230		
4	6.5	6.16	64.16	6600	6.76	1.08
4	6.5			6820		
4	6	6.39	66.57	6830		
4	6	6.32	65.87			
4	5.5	6.41	66.78	6920		
4	5	6.52	67.91	6820		
4	4.5	6.53	67.99	7200		
4	4	6.51	67.82	7070		
4	3.5	6.50	67.70	6900		
4	3	6.48	67.49	6870		
4	2	6.42	66.91	6830		
6	6.5	5.37	55.91	6270	6.68	1.03
6	6	5.86	61.08	6470		
6	5.5	5.95	61.99	6520		
6	5	6.00	62.53	6490		
6	4.5	5.98	62.28	6580		
6	4	6.07	63.20	6600		
6	3.5	6.06	63.08	6600		
6	3	6.02	62.66	6660		
6	2	6.07	63.24	6600		
6	2	6.10	63.49	6600		
12	6.5	4.04	42.08	4700	6.59	0.95
12	6	5.07	52.83	5880		
12	5.5	5.37	55.91	6230		

Table 4-21. Column Settling Test Results

Elapsed Time in Hours	Port Height in Feet	Suspended Solids in g/L	Percent of Initial Concentration	Turbidity in NTU	Surface Water Height in Feet	Solids Interface Height in Feet
12	5	5.42	56.41	6090		
12	4.5	5.46	56.87	6100		
12	4	5.44	56.66	6070		
12	3.5	5.39	56.16	6160		
12	3	5.50	57.24	6160		
12	2	5.60	58.33	6250		
24	6.5	1.99	20.75	2160	6.5	0.89
24	6	4.39	45.74	5190		
24	5.5	4.74	49.37	5340		
24	5	4.94	51.41	5590		
24	4.5	4.96	51.70	5560		
24	4	5.06	52.74	5780		
24	4			5700		
24	3.5	5.12	53.33	5750		
24	3	5.05	52.58	5660		
24	2	5.01	52.16	5710		
24	1	5.10	53.08	5640		
24	1	5.10	53.08			
48	6	3.52	36.66	4090	6.4	0.84
48	5.5	4.10	42.70	4790		
48	5	4.35	45.33	4930		
48	4.5	4.47	46.54	5120		
48	4	4.59	47.79	5340		
48	3.5	4.64	48.29	5400		
48	3	4.69	48.87	5250		
48	2	4.80	49.99	5370		
48	1	4.87	50.70	5310		
96	6	2.80	29.16	3030	6.3	0.81
96	5.5	3.46	36.08	3920		
96	5	3.78	39.41	4320		
96	4.5	3.96	41.29	4410		
96	4	4.16	43.37	4650		
96	3.5	4.22	43.91	4680		
96	3	4.29	44.66	4730		
96	2	4.44	46.24	5040		
96	1	4.50	46.91	5050		
96	1	4.52	47.12	5050		
144	6	1.94	20.25	1990	6.18	0.81
144	5.5	2.91	30.29	3285		
144	5	3.22	33.58	3750		
144	4.5	3.44	35.87	3875		
144	4	3.62	37.74	4180		
144	3.5	3.70	38.54	4165		
144	3	3.78	39.37	4470		
144	2	3.99	41.54	4535		
144	1	4.22	43.91	4700		
216	6	0.92	9.62	1370	6.07	0.8
216	5.5	2.42	25.16	2750		

Table 4-21. Column Settling Test Results

Elapsed Time in Hours	Port Height in Feet	Suspended Solids in g/L	Percent of Initial Concentration	Turbidity in NTU	Surface Water Height in Feet	Solids Interface Height in Feet
216	5	2.83	29.45	3175		
216	4.5	3.02	31.50	3465		
216	4	3.25	33.87	3700		
216	3.5	3.28	34.12	3720		
216	3.5	3.43	35.75			
216	3	3.47	36.16	3850		
216	2	3.62	37.75	4100		
216	1	3.84	40.04	4300		
216	1			4430		
288	5.5	2.09	21.75	2310	5.94	0.79
288	5	2.55	26.58	2955		
288	4.5	2.78	29.00	3170		
288	4	2.96	30.79	3325		
288	3.5	3.11	32.41	3595		
288	3	3.19	33.25	3650		
288	2	3.38	35.20	3810		
288	1	3.50	36.50	4045		
360	5.5	0.87	9.08	650	5.66	0.79
360	5	2.22	23.08	2490		
360	4.5	2.51	26.16	2870		
360	4	2.70	28.16	2985		
360	3.5	2.83	29.45	3235		
360	3	2.96	30.83	3355		
360	2	3.15	32.83	3655		
360	1	3.32	34.54	3825		
360	1	3.28	34.20	3860		

g/L = grams per liter
NTU = nephelometer turbidity units

Table 4-22
MET Elutriate Chemistry Results

Sample ID:	T4-CM2-Met-T	T4-CM2-Met-D
Lab ID:	K2403058-001	K2403058-002
Date Sampled:	04/23/2004	04/23/2004
Metals (ug/L)		
Arsenic	15.5	2.6
Cadmium	2.05	0.06 U
Chromium	118	3.37
Copper	250	15.9
Lead	178	4.72
Mercury	0.6	0.05 U
Nickel	88.9	2.6
Selenium	4.3 B	1.7 U
Silver	1.96	0.15
Zinc	573	12.8
Semivolatile Organics (ug/L)		
Naphthalene	0.39 UJ	0.39 U
2-Methylnaphthalene	0.39 UJ	0.39 U
1-Methylnaphthalene	0.39 UJ	0.39 U
Biphenyl	0.11 UJ	0.39 U
2,6-Dimethylnaphthalene	0.39 UJ	0.39 U
Acenaphthylene	0.092 J	0.11 J
Acenaphthene	0.096 J	0.43
2,3,5-Trimethylnaphthalene	0.024 J	0.041 J
Fluorene	0.39 J	0.11 J
Phenanthrene	0.27 J	0.39 U
Anthracene	0.047 J	0.39 U
1-Methylphenanthrene	0.39 UJ	0.39 U
Fluoranthene	0.46 J	0.17 J
Pyrene	0.85 J	0.10 J
Benz(a)anthracene	0.11 J	0.39 U
Chrysene	0.17 J	0.39 U
Benzo(b)fluoranthene	0.39 J	0.39 U
Benzo(k)fluoranthene	0.092 J	0.39 U
Benzo(e)pyrene	0.39 J	0.39 U
Benzo(a)pyrene	0.39 J	0.39 U
Perylene	0.064 J	0.39 U
Indeno(1,2,3-cd)pyrene	0.39 UJ	0.39 U
Dibenz(a,h)anthracene	0.39 UJ	0.39 U
Benzo(g,h,i)perylene	0.39 UJ	0.39 U
Dimethyl phthalate	9.6 UJ	9.6 U
Diethyl phthalate	9.6 UJ	9.6 U
Di-n-butyl phthalate	9.6 UJ	9.6 U
Butylbenzyl phthalate	9.6 UJ	9.6 U
Bis(2-ethylhexyl) phthalate	9.6 UJ	9.6 U
Di-n-octyl phthalate	9.6 UJ	9.6 U
Total PAHs (a,b)	2.6	0.92
Pesticides (ug/L)		
4,4'-DDE	0.015 J	0.0024 J
4,4'-DDD	0.011 J	0.096 U
4,4'-DDT	0.0072 J	0.096 U
2,4'-DDE	0.0019 J	0.096 U
2,4'-DDD	0.011 J	0.096 U
2,4'-DDT	0.0032 J	0.096 U
Total DDD (a,c)	0.022 J	0.096 U

Table 4-22
MET Elutriate Chemistry Results

Sample ID:	T4-CM2-Met-T	T4-CM2-Met-D
Lab ID:	K2403058-001	K2403058-002
Date Sampled:	04/23/2004	04/23/2004
Total DDE (a,d)	0.0169 J	0.0024 J
Total DDT (a,e)	0.0104 J	0.096 U
ΣDDTs (a,f)	0.0493 J	0.0024 J
PCBs (ug/L)		
Aroclor 1016	0.096 U	0.096 U
Aroclor 1221	0.096 U	0.096 U
Aroclor 1232	0.096 U	0.096 U
Aroclor 1242	0.096 U	0.096 U
Aroclor 1248	0.096 U	0.096 U
Aroclor 1254	0.098 U	0.096 U
Aroclor 1260	0.082 J	0.096 U
Aroclor 1262	0.096 U	0.096 U
Aroclor 1268	0.096 U	0.096 U
Total PCBs (a,g)	0.082 J	0.096 U
Conventionals (mg/L)		
Total suspended solids	3300	5 U

U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.
NC = Total PAH value was not calculated because of rejected results.
T in sample ID indicates a total sample.
D in sample ID indicates a dissolved sample.
a. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
b. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
c. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
d. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
e. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
f. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes c, d, and e for the definitions of total DDD, total DDE, and total DDT, respectively.
g. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 4-23
TCLP Chemistry Results

Sample ID:	T4-CM1	T4-CM2
Lab ID:	K2402055-004	K2401845-007
Date Sampled:	03/23/2004	03/11/2004
Metals (mg/L)		
Arsenic	0.1 U	0.1 U
Barium	0.5 B	1
Cadmium	0.01 U	0.01 U
Chromium	0.004 B	0.01 U
Lead	0.05 U	0.05 U
Mercury	0.001 U	0.001 UJ
Selenium	0.1 U	0.1 U
Silver	0.01 J	0.01 U
Pesticides (mg/L)		
gamma-BHC (Lindane)	0.0005 U	0.0005 U
Heptachlor	0.0005 U	0.0005 U
Heptachlor Epoxide	0.0005 U	0.0005 U
Endrin	0.0005 U	0.0005 U
Methoxychlor	0.001 U	0.001 U
Chlordane	0.005 U	0.005 U
Toxaphene	0.01 U	0.01 U
Herbicides (ug/L)		
2,4-D	100 U	100 U
2,4,5-TP (Silvex)	20 U	20 U
Volatile Organics (mg/L)		
Vinyl Chloride	0.08 U	0.08 U
1,1-Dichloroethene (1,1-DCE)	0.20 U	0.20 U
2-Butanone (MEK)	8.0 U	8.0 U
Chloroform	0.20 U	0.20 U
Carbon Tetrachloride	0.20 U	0.20 U
1,2-Dichloroethane (EDC)	0.20 U	0.20 U
Benzene	0.20 U	0.20 U
Trichloroethene (TCE)	0.20 U	0.20 U
Tetrachloroethene (PCE)	0.20 U	0.20 U
Chlorobenzene	0.20 U	0.20 U
1,4-Dichlorobenzene	0.20 U	0.20 U
Semivolatile Organics (mg/L)		
Pyridine	0.50 UJ	0.50 UJ
2-Methylphenol	0.10 U	0.10 U
Hexachloroethane	0.10 UJ	0.10 U
4-Methylphenol	0.10 U	0.10 U
Nitrobenzene	0.10 U	0.10 U
Hexachlorobutadiene	0.10 UJ	0.10 U
2,4,6-Trichlorophenol	0.10 U	0.10 U
2,4,5-Trichlorophenol	0.10 U	0.10 U
2,4-Dinitrotoluene	0.10 U	0.10 U
Hexachlorobenzene	0.10 UJ	0.10 UJ
Pentachlorophenol (PCP)	0.25 U	0.25 U

U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Table 4-24
Sediment Trap Chemistry Results

Sample ID:	T4-ST-A040604	T4-ST-B040704	T4-ST-C040704	T4-ST-D040804	T4-ST-A052004	T4-ST-B052004	T4-ST-C052004	T4-ST-D052004
Lab ID:	K2402611-001	K2402611-002	K2402611-003	K2402611-004	K2403760-001	K2403760-002	K2403760-003	K2403760-004
Date Sampled:	04/06/2004	04/07/2004	04/07/2004	04/08/2004	05/20/2004	05/20/2004	05/20/2004	05/20/2004
Location	Slip 3 East	Slip 3 West	Toyota Dolphin	Slip 1	Toyota Dolphin	Berth 416	Slip 3 East	Slip 1
Metals (mg/kg)								
Arsenic	7	5.8	4	9.09 J	4.5 J	4.9 J	6.8 J	4.9 J
Cadmium	2.02	1.37	0.3	0.56	0.3	0.23	1.68	0.369
Chromium	23.1 J	22.4 J	21.1 J	57.2	32.6	28.4	31.9	35
Copper	50.4 J	39.2 J	31.6 J	68.3	47.3	35.6	53.7	38.4
Lead	274	115	14.6	70.7	18.4	12.5	306	29.8
Mercury	0.163	0.084	0.056	NA	0.079	0.07	0.072	0.109
Nickel	22.3 J	20.9 J	16.4 J	38.5	25.7 J	23.4 J	32.6 J	24.3 J
Selenium	0.24 U	0.47	0.17 U	0.77	0.36 U	0.2 U	0.16 U	0.25 U
Silver	0.76	0.44	0.21	0.754	0.343	0.242	0.56	0.545
Zinc	302 J	217 J	80.2 J	262 J	111 J	96 J	332 J	126 J
Semivolatile Organics (ug/kg)								
Naphthalene	240	79 J	16	45	13	4.7 J	140	13
2-Methylnaphthalene	110	29 J	6.1	23	6.3	2.6 J	66	5.9 J
1-Methylnaphthalene	82 J	22 J	3.7 J	14	3.6 J	1.7 J	41	4.0 J
Biphenyl	55 J	17 J	2.4 J	7.6 J	2.2 J	1.4 J	25	2.2 J
2,6-Dimethylnaphthalene	70 J	19 J	5.3	11 J	3.8 J	1.6 J	32	4.8 J
Acenaphthylene	130	32 J	7.1	21	5.9	2.7 J	50	6.9 J
Acenaphthene	780	120 J	8.4	120	11	6.5	400	13
2,3,5-Trimethylnaphthalene	120	36 J	3.3 J	7.5 J	3.3 J	0.94 J	40	3.1 J
Fluorene	460	100 J	9.5	69	9.2	5.7	240	9.4 J
Phenanthrene	3,900	630 J	56	910	54 J	28	2,100	100
Anthracene	1,000	190 J	18	160	18	6.4	500	26
1-Methylphenanthrene	230	51 J	5.8	52	5.2 J	2.0 J	140	8.2 J
Fluoranthene	8,000	1,600 J	110	2,300	110 J	40	4,600	290
Pyrene	6,600	1,600 J	99	1,600	110 J	37	4,100	250
Benz(a)anthracene	4,400	810 J	41	1,200	59 J	13	3,000	150
Chrysene	5,000	950 J	66	1,600	79 J	20	3,100	210
Benzo(b)fluoranthene	5,000	990 J	53	1,800	77 J	21	3,600	250
Benzo(k)fluoranthene	4,500	840 J	41	1,400	64 J	13	3,000	160
Benzo(e)pyrene	3,900	790 J	44	1,300	64 J	16	2,700	190
Benzo(a)pyrene	6,300	1,100 J	50	1,800	81 J	15 J	4,300 J	230 J
Perylene	1,700	340 J	29	540	28 J	6.4	1,100	69
Indeno(1,2,3-cd)pyrene	5,600 J	890 J	48 J	1,700 J	76 J	14 J	4,000 J	220 J

Table 4-24
Sediment Trap Chemistry Results

Sample ID:	T4-ST-A040604	T4-ST-B040704	T4-ST-C040704	T4-ST-D040804	T4-ST-A052004	T4-ST-B052004	T4-ST-C052004	T4-ST-D052004
Lab ID:	K2402611-001	K2402611-002	K2402611-003	K2402611-004	K2403760-001	K2403760-002	K2403760-003	K2403760-004
Date Sampled:	04/06/2004	04/07/2004	04/07/2004	04/08/2004	05/20/2004	05/20/2004	05/20/2004	05/20/2004
Location	Slip 3 East	Slip 3 West	Toyota Dolphin	Slip 1	Toyota Dolphin	Berth 416	Slip 3 East	Slip 1
Dibenz(a,h)anthracene	1,300 J	170 J	11 J	440 J	9.4 J	1.8 J	700 J	29 J
Benzo(g,h,i)perylene	4,800	910 J	52	1,500	66 J	15	2,900	190
Dimethyl phthalate	100 U	10 UJ	100 U	260 U	11 UJ	10 UJ	50 U	90 U
Diethyl phthalate	100 U	10 UJ	100 U	260 U	11 UJ	10 UJ	50 U	90 U
Di-n-butyl phthalate	100 U	10 UJ	100 U	260 U	11 UJ	10 UJ	50 U	90 UJ
Butylbenzyl phthalate	56 J	3.7 J	100 U	58 J	3.7 J	3.4 J	190 J	90 UJ
Bis(2-ethylhexyl) phthalate	330	44 J	340	1,700	60 J	77 J	72 J	430 J
Di-n-octyl phthalate	100 U	2.9 J	21 J	85 J	22 UJ	20 UJ	100 UJ	180 UJ
Total PAHs (a,b)	46,310	9,041 J	575	13,025	691	213	29,130	1,708
Pesticides (ug/kg)								
4,4'-DDE	2.7 J	2.4 J	1.9	4.3 J	2.4 J	1.2	4.0 U	2.8 J
4,4'-DDD	5.9	6.8	1.1	2.0 U	1.3	0.48	4.0 U	0.80 J
4,4'-DDT	10 J	12 J	1.8 J	25	4.5	0.40 U	4.0 U	0.87 U
2,4'-DDE	4.9 U	4.9 U	0.40 UJ	1.3 U	0.19 J	0.40 U	4.0 U	0.87 U
2,4'-DDD	13 J	4.1 J	0.40 U	1.3 U	0.42 U	0.40 U	4.0 U	0.87 U
2,4'-DDT	4.9 U	4.9 U	0.40 U	1.7	1.9	1.6	4.0 U	0.87 U
Total DDD (a,c)	19	11	1.1	2.0 U	1.3	0.48	4.0 U	0.80 J
Total DDE (a,d)	2.7 J	2.4 J	1.9	4.3 J	2.6 J	1.2	4.0 U	2.8 J
Total DDT (a,e)	10 J	12 J	1.8 J	27	6.4	1.6	4.0 U	0.87 U
ΣDDTs (a,f)	32	25	4.8	31	10	3.3	4.0 U	3.6 J
PCBs (ug/kg)								
Aroclor 1016	62 U	61 U	5.0 U	12 U	5.0 U	5.0 U	50 U	11 U
Aroclor 1221	130 U	130 U	10 U	23 U	10 U	10 U	100 U	22 U
Aroclor 1232	62 U	61 U	5.0 U	12 U	5.0 U	5.0 U	50 U	11 U
Aroclor 1242	62 U	61 U	8.5	12 U	5.0 U	5.0 U	50 U	11 U
Aroclor 1248	62 U	61 U	5.0 U	24 J	6.3	5.0 U	50 U	12
Aroclor 1254	62 U	61 U	11 J	31 U	8.4 J	7.4	50 U	14 J
Aroclor 1260	62 U	61 U	12	34	12	8.8	50 U	16
Aroclor 1262	62 U	61 U	5.0 U	12 U	5.0 U	5.0 U	50 U	11 U
Aroclor 1268	62 U	61 U	5.0 U	12 U	5.0 U	5.0 U	50 U	11 U
Total PCBs (a,g)	130 U	130 U	32	58	27	16	100 U	42
Petroleum Hydrocarbons (mg/kg)								
Diesel Range Organics (DRO)	170 J	110 J	64 J	190 J	110 J	72 J	160 J	150 J

Table 4-24
Sediment Trap Chemistry Results

Sample ID:	T4-ST-A040604	T4-ST-B040704	T4-ST-C040704	T4-ST-D040804	T4-ST-A052004	T4-ST-B052004	T4-ST-C052004	T4-ST-D052004
Lab ID:	K2402611-001	K2402611-002	K2402611-003	K2402611-004	K2403760-001	K2403760-002	K2403760-003	K2403760-004
Date Sampled:	04/06/2004	04/07/2004	04/07/2004	04/08/2004	05/20/2004	05/20/2004	05/20/2004	05/20/2004
Location	Slip 3 East	Slip 3 West	Toyota Dolphin	Slip 1	Toyota Dolphin	Berth 416	Slip 3 East	Slip 1
Residual Range Organics (RRO)	340 J	270 J	220 J	690 J	350 J	240 J	290 J	460 J
Gasoline Range Organics (GRO)	4.5 U	4.3 U	4.0 U	4.8 U	7.9 U	6.6 U	7.2 U	9.3 U
Conventionals (percent)								
Total organic carbon	2.64	2.71	2.06	3.8	2.98	2.51	3.01	3.68
Total solids	56.1	58.5	61.8	44	47.4	53.7	51.5	44.5
Grain Size (percent) (h)								
Gravel No. 3/4" (19.0 mm)	100	100	100	NA	100	100	100	100
Gravel No. 3/8" (9.50 mm)	100	100	100	NA	100	100	100	100
Gravel, Medium No. 4 (4.75 mm)	100	100	100	100	100	100	100	100
Gravel, Fine No. 10 (2.00 mm)	100	100	100	100	100	100	100	100
Sand, Very Coarse No. 20 (0.850 mm)	99.7	99.8	99.9	100	100	99.4	99.9	100
Sand, Coarse No. 40 (0.425 mm)	97.3	96.1	99.2	100	99.5	91.1	98.5	99.9
Sand, Medium No. 60 (0.250 mm)	88.2	83.7	98.7	99.9	97.9	68.9	94.2	99.7
Sand, Fine No. 140 (0.106 mm)	80.1	77.0	97.8	99.7	95.6	64.4	90.4	98.9
Sand, Very Fine No. 200 (0.0750 mm)	77.3	75.0	96.3	99.6	92.9	63.6	88.3	98.6
Silt (0.074 mm)	67.7	66.6	75.5	34.9	73.9	59.4	73.9	88.1
Clay (0.005 mm)	34.6	32.9	43.9	NA	42.3	24.5	43.1	66.2
Clay (0.001 mm)	14.7	12.8	25.0	NA	23.4	3.7	24.8	53.2

Table 4-24
Sediment Trap Chemistry Results

NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

a. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
b. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
c. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
d. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
e. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
f. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes c, d, and e for the definitions of total DDD, total DDE, and total DDT, respectively.
g. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).
h. Grain size analysis was performed by sieve and hydrometer (ASTM D 422). There were occasional calibration discrepancies between the sieves and hydrometer which are inherent in the method. These discrepancies occasionally resulted in an increase in the percent passing fraction between very fine sand and silt. As these discrepancies are inherent in the method, the data are considered acceptable for use.

Table 4-25
Terminal 4 Vessel Activity Summary
April and May 2004

APRIL 2004

BERTH	CARGO	VESSEL NAME	ARRIVAL		DEPARTURE		SLIP
			DATE	TIME	DATE	TIME	
405	----	BOAZ	O/B	----	----	----	1
410	S/A	SANKO RANGER	3/29/2004	16:55	4/1/2004	4:50	3
410	S/A	PACIFIC HOPE	4/1/2004	6:00	4/3/2004	17:00	3
415	S/A	ANSAC LEGACY	4/3/2004	17:40	4/5/2004	23:25	3
410	S/A	KOM	4/7/2004	5:05	4/8/2004	14:40	3
410	S/A	MARINA II	4/8/2004	15:45	4/12/2004	12:45	3
415	S/A	ANSAC ASIA	4/12/2004	13:30	4/17/2004	4:25	3
410	S/A	STAR DROTTINGER	4/18/2004	15:50	4/19/2004	16:25	3
415	S/A	STAR BETTINA	4/19/2004	18:35	4/22/2004	2:00	3
410	S/A	SUN SUMA	4/22/2004	20:35	4/23/2004	6:30	3
415	S/A	ASAHI SUNRISE	4/23/2004	7:30	4/24/2004	18:30	3
415	AUTO	OVERSEAS JOYCE	4/5/2004	5:25	4/5/2004	13:55	Toyota
410	AUTO	GLOBAL HIGHWAY	4/7/2004	9:20	4/7/2004	14:15	Toyota
410	AUTO	WASHINGTON HIGHWAY	4/9/2004	14:30	4/10/2004	12:50	Toyota
415	AUTO	FUGI	4/13/2004	14:30	4/13/2004	22:45	Toyota
410	AUTO	BALTIC HIGHWAY	4/15/2004	9:50	4/15/2004	15:40	Toyota
410	AUTO	CENTURY LEADER # 3	4/19/2004	6:40	4/19/2004	13:25	Toyota
415	AUTO	NEW NADA	4/23/2004	8:05	4/23/2004	14:00	Toyota
415	AUTO	GREELAKE	4/27/2004	23:25	4/28/2004	13:35	Toyota

MAY 2004

BERTH	CARGO	VESSEL NAME	ARRIVAL		DEPARTURE		SLIP
			DATE	TIME	DATE	TIME	
405	BRG	BOAZ	O/B	----	----	----	----
410	S/A	THIA CHRYSSOLA	5/6/2004	5:10	5/9/2004	15:35	3
411	S/A	KITE ARROW	5/9/2004	16:05	5/10/2004	22:10	3
410	S/A	SANKO RADIANCE	5/10/2004	22:30	5/12/2004	12:45	3
410	S/A	ANATOLI	5/12/2004	13:05	5/14/2004	20:20	3
410	S/A	STAR EVIA	5/15/2004	4:35	5/15/2004	23:50	3
410	S/A	ANSAC HARMONY	5/17/2004	5:45	----	----	3
415	AUTO	CENTURY LEADER # 1	5/1/2004	11:55	5/1/2004	22:50	Toyota
415	AUTO	OVERSEAS JOYCE	5/4/2004	9:04	5/4/2004	14:20	Toyota
414	AUTO	NEW CENTURY 1	5/7/2004	1:35	5/7/2004	12:55	Toyota
415	AUTO	WASHINGTON HIGHWAY	5/11/2004	10:45	5/11/2004	16:20	Toyota

Table 4-26
Summary of Stream Gage Data for the Willamette and Columbia Rivers

	Gage Name					
	Willamette River at Portland	**Willamette River at Morrison St.**	**Georgia Pacific Gage**	**Columbia River at St. Helens**	**Columbia River at Vancouver**	**Columbia River at Vancouver**
Gage Information						
Agency	USGS	NOAA	BBL	NOAA	NOAA	USGS
Data Type	Average daily	6 minute	10 minute	6 minute	6 minute	Average daily
Gage ID	14211720	9439221	n/a	9439201	9440083	14105700
Latitude	45° 31'07"	45° 30.6'	45° 37' 9"	45° 51.9'	45° 37.9'	45° 36'27"
Longitude	122° 40'00"	122° 40.4'	122° 47' 14"	122° 47.8'	122° 41.8'	121° 10'20"
Data Period	03/01/04 to 05/31/04	03/03/04 to 05/31/04	3/24/04 to 5/17/04	03/01/04 to 5/31/04	03/01/04 to 5/31/04	03/01/04 to 05/31/04
Discharge (cfs)						
Maximum Discharge	44800	N/A	N/A	N/A	N/A	291000
Minimum Discharge	14200	N/A	N/A	N/A	N/A	103000
Average Discharge	24070.33	N/A	N/A	N/A	N/A	174862.07
10th Percentile Discharge	17000	N/A	N/A	N/A	N/A	128000
90th Percentile Discharge	34100	N/A	N/A	N/A	N/A	227000
Gage Height (feet)						
Maximum Gage Height	8.52	5.06	8.72902	6.46	7.14	7.92
Minimum Gage Height	3.59	-1.68	2.87836	0.13	0.46	2.82
Average Gage Height	5.29	1.13	5.12	2.92	3.20	4.59
10th Percentile Gage Height	4.13	-0.44	3.70695	1.43	1.69	3.411
90th Percentile Gage Height	6.6	2.67	6.6157	4.42	4.72	5.888

Notes:

1. USGS data downloaded from USGS website for Surface Water Data in Oregon (http://waterdata.usgs.gov/or/nwis/sw)
2. NOAA data downloaded from http://co-ops.nos.noaa.gov/
3. USGS and NOAA gage data converted from original datum to Columbia River Datum per conversion tables provided by Mr. Charles Wiley, Port of Portland. The validity of the conversion tables is uncertain.
4. Georgia Pacific Gage data provided by Blue Water Engineering relative to CRD.

cfs = cubic feet per second.

5. Removal Action Area Characteristics

This section discusses the findings presented in Section 4, with emphasis on what the test results and other data generated during the field program, in some cases in combination with previously existing data, indicate about various characteristics of the Removal Action Area. Engineering characteristics that may have significant impacts on design aspects of the Removal Action at Terminal 4 are discussed by soil unit. Hydrogeologic characteristics and groundwater data are discussed and a hydrogeologic conceptual model is presented. Sediment chemistry analytical results are compared to sediment quality guidelines. Dredged sediment quality characteristics are summarized; the tests performed to determine dredged sediment quality characteristics will be relevant to the EE/CA's forthcoming analysis of Removal Action alternatives. Finally, this section presents a general characterization of hydraulics and sedimentation in the Removal Action Area.

5.1 Engineering Characteristics

This section briefly discusses geology in the Terminal 4 area and the engineering characteristics of the sediments and soils encountered during the field program. The information collected during the field investigations and subsequent laboratory analyses has been compiled to establish a conceptual geologic model. This model delineates the various soil layers that have the same or similar geologic and geotechnical engineering descriptions and likely the same engineering characteristics. Customarily, the conceptual geologic model is presented in geologic/geotechnical cross sections.

The locations of the geologic/geotechnical cross sections are provided on Figure 5-1, together with the locations of the various explorations, such as borings, monitoring wells, and CPTs. The vibracore and piston boring locations are shown on Figure 3-10. The initial interpretation of the conceptual geologic model is provided in cross-sections A-A', B-B', and C-C', shown on Figures 5-2 through 5-4.

The conceptual geologic model will be further refined during the EE/CA by incorporating existing subsurface information from previous deep borings into the cross sections and adjusting the interpretation of the conceptual geologic model as necessary.

5.1.1 Terminal 4 Area Geology

As stated in the EE/CA work plan (BBL, 2004a), the following geologic units are identified in published information for the sediment/soil profile at the Terminal 4 area:

- Recent Sediment. Typically very soft organic silt recently deposited by alluvial processes and continually reworked.

- Unconsolidated Alluvial Deposits. Natural river deposits and older glacial flood deposits within the low-lying Portland Basin of the Willamette Valley. This deposit was encountered during the EE/CA field program for the complete depth of most of the explorations.

- Troutdale Gravel. The hydrogeologic unit description for the well-graded silt through cobble/boulder-sized gravel observed in samples from deep wells at Terminal 4. Maps of the Troutdale Formation, which is a diagnostically well-cemented sand and gravel, indicate the formation is in proximity to Removal Action Area, but possibly not at the Removal Action Area (McFarland and Morgan, 1997). This is consistent with the results of monitoring well drilling/sampling, which led to observations of sediment/soil resembling the Troutdale Formation, but without strong cementing. Some minor cementing was noted in samples during the field program, possibly indicating the deposits have been reworked by the river.

- Sandy River Mudstone Formation. This deposit is predominantly fine-grained, consisting of siltstone and claystone, which were not encountered in explorations for the EE/CA.

- Columbia Basalt Group. This deposit was not encountered in explorations for the EE/CA.

5.1.2 Generalized Subsurface Conditions

As described in Section 2.2, the geotechnical engineering field program consisted of four in-water geotechnical borings, one upland geotechnical boring, ten in-water CPTs, and one upland CPT. Additional subsurface information relevant to the assessment of engineering characteristics was also obtained during the installation of 11 monitoring wells to depths ranging from 21.5 to 228 feet. The locations of the explorations are shown on Figure 5-1. The boring and CPT logs are presented in Appendices A and B respectively.

The soils encountered during these exploration activities are listed as follows:

Brown, Loose to Medium Dense Sand (Upland Explorations). All upland explorations encountered brown, loose to medium dense (occasionally dense) sand below the ground surface beneath surficial coverings. The thickness of the sand layer ranges from approximately 17 to 35 feet. Based on grain size analyses, the sand contains approximately 5% to 15% fines. This material likely consists of fill that was placed during construction of Slip 1 and Slip 3.

Very Soft Organic Silt and Clay (Recent Sediment/In-Water Explorations). This material was generally encountered in the top portion of the in-water explorations. The thickness of the very soft organic silt and clay layer varies widely and is discussed in more detail in Section 5.1.3.

Very Soft to Medium Stiff Organic and Inorganic Silts and Clays (Upland Explorations). These cohesive soils were encountered mainly to the east of the historical shoreline and east of Slip 1 and Slip 3 (Figure 5-1). Monitoring wells T4-MW03 and T4-MW05 encountered a 10- to 20-foot layer of sand and silt interbedded within this deposit. The cohesive soils encountered in monitoring wells T4-MW02 and T4-MW03 are likely the bottom of historical Gatton's Slough (refer to Figure 5-1) and reach substantial depths of 140 to 180 feet.

Interbedded Silt and Sand (Medium Stiff to Stiff/Medium Dense). This material was encountered east of historical Gatton's Slough in explorations CP03, CP04, CP10, and GEO4L. It appears that this unit is somewhat

a transition zone between the dark grey sand containing small amounts of fines located to the west of historical Gatton's Slough and thicker deposits of cohesive material on the upland side farther to the east. The interbedded silts and sands were encountered below recent soft sediments in the CPTs and below fill and a layer of silt in boring GEO4L. The layering can best be discerned on the CPT logs presented in Appendix B. The CPTs encountered this material to their termination depths, between 63 and 80 feet. GEO4L encountered very stiff to hard silt and medium stiff organic silt below a depth of 80 feet.

Dark Grey, Loose to Medium Dense Sand. Large portions of the Terminal 4 area located west of historical Gatton's Slough are underlain by dark grey sand with fines contents (i.e., silt and clay-sized particles) ranging from about 3% to 8%. This sediment/soil was deposited by natural riverine depositional processes, but the alluvial deposits here are also associated with glacial catastrophic floods. This deposit was generally encountered below the fill in the upland explorations and below the surficial sediments in the in-water explorations. The sand is generally in a medium dense state to fairly great depths of up to 100 feet and deeper. Loose to medium dense sands were encountered at shallower depths.

Gravel (Troutdale Gravel). Deposits of gravel and mixtures of gravel and sand were encountered in the deep monitoring wells below the dark grey native sands. This deposit likely consists of the Troutdale Formation. The top of this deposit was generally encountered at depths ranging from 145 to 200 feet.

5.1.3 Thickness of Recent Soft Sediments

Thirty-two vibracores were recovered in Slip 1, Slip 3, Wheeler Bay, at Berth 401, and north of Berth 414, primarily to obtain sediment samples for chemical analyses. In addition, piston borings and in-water borings were utilized to recover additional sediment samples to augment the vibracore sampling. These exploration data were also used to estimate the thickness of the recent soft sediments and their engineering characteristics. The vibracore and piston sampling locations are shown on Figure 3-10.

The thickness of the recent soft sediments in each of the areas is discussed below.

- Slip 1: The soft sediment cover generally ranges from about 0 foot to 3 feet. Almost half of the sediment cores did not encounter any soft sediment and recovered predominantly sand. A thick deposit of surficial cohesive material was encountered in front of Berth 405 near the east end of Slip 1 (vibracores VC09 and VC15). The thickness in this area exceeds 13 to 15 feet.

- Slip 3: The majority of explorations in Slip 3 encountered practically no soft sediment cover overlying the grey sands. A deep cohesive deposit was encountered in front of Berth 411 (vibracore VC24). The thickness in this area exceeded 12 feet. A few other vibracores (VC26 and VC32) encountered 3.5 to 4 feet of cohesive material.

- Wheeler Bay: The thickness of soft sediment in Wheeler Bay increases approaching the open waters of the river. Sediments closer to the land are approximately 3 to 5 feet in thickness, while cohesive soil deposits closer to the river exceed 12 feet in thickness.

- Berth 401: Based on two vibracores, the soft sediment in this area is approximately 1 foot thick.

- North of Berth 414: Based on two vibracores, the soft sediment thickness in this area is between about 2 and 4 feet.

5.1.4 Geotechnical Engineering Characteristics

A geotechnical engineering laboratory program supplemented the field program to further characterize the sediments and soils encountered in the explorations. The laboratory testing results are described in more detail in Section 4.1 of this report. The following sections provide a general discussion of the geotechnical engineering characteristics of the recent sediments and older sediments and soils encountered in the explorations.

The basic geologic soil units were identified above in Sections 5.1.1 and 5.1.2. A preliminary interpretation of the soil stratigraphy is illustrated on the cross sections shown on Figures 5-2 through 5-4. Engineering characteristics that may have significant impacts on design aspects of the Removal Action at Terminal 4 are discussed here in general terms by soil unit. Once design alternatives have been developed, the data presented in this report will be used to provide input and recommendations for specific design tasks. The soil units identified in the Terminal 4 area have the following general characteristics:

Brown, Loose to Medium Dense Sand (Upland Explorations). This soil unit likely consists of fill and was encountered in the upland borings across Terminal 4. The sand contains fairly small amounts of fines (5% to 15%). The grain-size characteristics of the sand are fairly uniform across Terminal 4. Based on experience with similar material of similar density, the saturated portions of the sand are likely prone to liquefaction during strong seismic shaking. Liquefaction can generally result in significant strength reduction and could potentially cause fairly large settlements and slope failures during and following seismic shaking. The liquefaction potential of these soils will be further analyzed during the EE/CA and subsequent design. Appropriate seismic design parameters required for such analyses have not yet been established and are not the purpose of this report.

Very Soft, Organic Silt and Clay (Recent Sediments). Based on laboratory tests performed on samples from the in-water borings, the recent sediments overlying the grey, loose to medium dense sands consist predominantly of very soft organic silt and clay with liquid limits ranging from about 70 to nearly 100 and moisture contents ranging from 67% to 106% (refer to Table 4-3). The fines content of these sediments generally ranges from 51% to 96%, with average fines content ranging from 75% to 85% in the five areas identified in Section 5.1.3.

Consolidation tests were performed on two samples consisting of very soft organic silt and clay. The results indicate that these soils are highly compressible and would likely settle significantly under structural loads or the weight of fill, e.g., a berm or cap. Based on consolidation and plasticity results, as well as on testing conducted in the field (including pocket penetrometer tests, torvane tests, and Standard Penetration Resistance), it is expected that these soils are normally consolidated and have very low undrained shear strengths. The undrained strength of the very soft sediments is estimated to be on the order of about 20 to 140 pounds psf.

Very Soft to Medium Stiff Organic and Inorganic Silts and Clays (Upland Explorations). Because this soil unit was encountered east of Slip 1 and Slip 3, its geotechnical engineering characteristics would affect only upland structures underlain by this material. Relatively large portions of this material consist of organic clay and silt with liquid limits ranging from 46 to 55 and moisture contents between 46% and 52%. These plasticity data indicate that this material exhibits relatively high compressibility. Due to the estimated, relatively high compressibility of this soil, heavy upland structures and fill placed on these deposits could potentially be subject to excessive time-dependent consolidation settlements. The presence of the material affects hydrogeologic aspects at the Terminal 4 area. Gatton's Slough deposits, located within and at the head of Slip 1, add complexity to engineering and hydrogeologic characteristics in this area.

Interbedded Silt and Sand (Medium Stiff to Stiff/Medium Dense). Based on boring GEO4L, this unit contains interbedded layers of sand, silt of varying plasticity (non-plastic to plasticity index of 30; refer to Table 4-3), and organic cohesive soils with liquid limits exceeding 50. SPT and CPT data indicate that the sands are likely in a medium dense state (SPT N-values ranging from about 10 to 15). The cohesive soils appear to be in a medium stiff to stiff state (SPT N-values ranging from about 5 to 10). Based on strength testing (unconsolidated-undrained triaxial compression; refer to Section 4.1.4.2), this material may be normally consolidated to slightly overconsolidated at depths below 60 feet. Since the in-water soils have not been exposed to drying, it is likely that the cohesive material underlying the eastern portions of Slip 1 and Slip 3 is also in a normally consolidated to slightly overconsolidated state. Portions of these soils likely exhibit moderate compressibility. Undrained shear strength of the cohesive soils likely varies with depth based on the state of consolidation. The liquefaction potential of this soil deposit will be evaluated once the seismic design parameters have been established for this project.

Dark Grey, Loose to Medium Dense Sand. The presence of this soil unit affects a large portion of the area to the west of Gatton's Slough. Based on the grain size data collected in this soil unit (refer to Table 4-2 and particle size distribution curves presented in Appendix C), the material generally has fines contents ranging from 3% to 8%. Based on in-situ SPT and CPT data, this material is in a medium dense state (SPT N-values of 10 to 30) to depths exceeding about 80 to 110 feet. High Standard Penetration Resistances encountered at shallower depths in monitoring wells T4-MW01 and T4-MW06 may not be representative based on the results from adjacent explorations. Lower densities in the loose range (SPT N-values of 4 to 10) were encountered at shallower depths below surficial covering that consisted of recent sediments in the in-water explorations and fill in the upland explorations. The loose grey sand layer ranges between 3 and 14 feet in thickness.

Liquefaction potential is often assessed based on the Standard Penetration Resistance (SPT N-value) and the fines content of granular soils. The combination of fairly low density and small fines content of this material makes the saturated portions of the sand potentially prone to liquefaction during strong seismic shaking, resulting in excessive settlement and loss of strength. The loose deposits and large portions of the medium dense material could potentially liquefy during a design-level seismic event. However, it is difficult to predict the extent of liquefaction because the design seismic event has not been established.

Gravel (Troutdale Gravel). Because of the great depth at which this soil unit was encountered, the Troutdale mainly affects hydrogeologic aspects of this project and is not likely to impact structures or construction activities at the surface.

5.2 Hydrogeologic Characteristics

In this section, hydrogeologic information in support of the Terminal 4 hydrogeologic conceptual model (HCM) is presented and discussed. The HCM is based primarily on information provided from hydrogeologic cross sections developed from monitoring well boring logs and on groundwater elevation, river stage, and precipitation data. The HCM will be used in support of the EE/CA to evaluate contaminant transport aspects of certain Removal Action alternatives, for example, sediment capping or placement in an onsite CDF.

5.2.1 Hydrogeologic Cross Sections

Three hydrogeologic cross sections were developed using information obtained from monitoring well boring logs. Locations of the hydrogeologic cross sections are shown on Figure 5-5. Hydrogeologic cross-section A-A' (Figure 5-6) is placed through upland monitoring well clusters T4-MW02 and T4-MW03 and the near-river monitoring well cluster T4-MW01. Hydrogeologic cross-section B-B' (Figure 5-7) is placed through upland monitoring well cluster T4-MW05 and the near-river monitoring well cluster T4-MW06. Hydrogeologic cross-section C-C' (Figure 5-8) is placed through near-river monitoring well clusters T4-MW01, T4-MW04, and T4-MW06 as well as Slip 1 and Slip 3.

Hydrogeologic cross-sections A-A', B-B', and C-C' show the relative locations of the upland fill material, Unconsolidated Alluvial Deposits, and Troutdale Gravel hydrostratigraphic units. The upland fill materials are composed of medium brown fine sands. Based on monitoring well boring logs from this investigation (Appendix A) and from information provided in a previous upland investigation at Terminal 4 (Hart Crowser, 2000), the fine sands range in thickness from about 40 feet near the river to 5 feet in some upland portions of Terminal 4. Based on monitoring well boring logs from this investigation (Appendix A) and from information provided in a previous upland investigation at Terminal 4 (Hart Crowser, 2000), the upland fill material was placed directly on top of the sediments that comprise the Unconsolidated Alluvial Deposits.

Near the river (monitoring well clusters T4-MW01, T4-MW04, and T4-MW06), the Unconsolidated Alluvial Deposits consist of dark grey to black, fine to medium sand that is about 160 feet in thickness. In the upland portions of Terminal 4 (monitoring well clusters T4-MW02, T4-MW03, and T4-MW05), the Unconsolidated Alluvial Deposits are primarily composed of interbedded layers of fine sand, silt, clayey silt, and silty clay. Sediments in the Unconsolidated Alluvial Deposits in the vicinity of Gatton's Slough (monitoring well clusters T4-MW02 and T4-MW03) are finer grained than are sediments in the Unconsolidated Alluvial Deposits in the vicinity of monitoring well cluster T4-MW05. Monitoring well T4-MW05I was completed in a layer of medium to coarse sand and fine to medium gravel that was not observed in the Unconsolidated Alluvial Deposits sampled from the T4-MW03I/D and T4-MW02D borings. The sediments of the Unconsolidated Alluvial Deposits are 120 to 150 feet in thickness in the upland portion of Terminal 4.

Gravel from the Troutdale formation was encountered at depths ranging from -114 feet CRD at monitoring well T4-MW02D to -168 feet CRD at monitoring well T4-MW06D (Figures 5-6 through 5-8). Gravel encountered in boring samples from monitoring well T4-MW05I likely is not associated with Troutdale Gravel given the higher elevation (-22.2 feet CRD) at which the monitoring well T4-MW05I gravels were encountered (Figure 5-7).

5.2.2 Groundwater Elevation Data

5.2.2.1 Weekly Groundwater Elevation Data

As described in Section 3.2, depth to groundwater measurements were conducted approximately weekly from April 29, 2004 through June 3, 2004. As described in Section 4.2, depth to groundwater values were converted to groundwater elevations (see Appendix D). Weekly groundwater elevation data are presented on Figures 5-9 through 5-14 for monitoring well clusters T4-MW01 through T4-MW06, respectively.

To evaluate the potential interaction of groundwater flow among the three hydrostratigraphic units of interest at Terminal 4 (i.e., upland fill material, Unconsolidated Alluvial Deposits, and Troutdale Gravel), vertical hydraulic gradients were estimated from groundwater elevation and monitoring well completion data. For each monitoring well cluster, elevation differences between shallow and intermediate groundwater were calculated by subtracting the elevation of intermediate groundwater from the elevation of shallow groundwater (Table 5-1). The maximum and minimum elevation differences were chosen for estimating vertical gradients to capture the complete range of conditions observed during the monitoring period. As shown on Table 5-1, negative values indicate an upward gradient. For example, the negative elevation difference observed between monitoring wells T4-MW01S and T4-MW01I (-0.41 feet on 6/3/2004) indicates that the groundwater elevation at T4-MW01S (7.91 feet CRD) was lower than the groundwater elevation at T4-MW01I (8.32 feet CRD).

Vertical hydraulic gradients can indicate the potential for and direction of groundwater flow. Vertical hydraulic gradients were estimated by dividing groundwater elevation differences by the distance between the midpoint elevations of screened intervals (Table 5-1). For the purposes of this investigation, the magnitude of the vertical hydraulic gradient (absolute value) was described as follows:

- small vertical hydraulic gradients were less than 0.01 ft/ft;
- moderate vertical hydraulic gradients were between 0.01 and 0.1 ft/ft; and
- large vertical hydraulic gradients were greater than 0.1 ft/ft.

A positive vertical hydraulic gradient value indicates downward hydraulic gradient, and a negative vertical hydraulic gradient value indicates upward hydraulic gradient. A vertical hydraulic gradient of zero indicates no vertical hydraulic gradient. "Typical" vertical hydraulic gradients and gradient directions for the May 13, 2004 monitoring event are shown on the hydrogeologic cross sections (Figures 5-6 through 5-8).

Groundwater elevations for shallow, intermediate, and deep groundwater at monitoring well cluster T4-MW01 were similar for each monitoring event but varied by about 4.6 feet during the monitoring period (Figure 5-9). The vertical gradients between shallow and intermediate groundwater were small in magnitude and ranged from -0.01 to 0.002 foot per foot (ft/ft). The vertical hydraulic gradients between intermediate and deep groundwater were also small in magnitude and ranged from -0.001 to 0.00007 ft/ft (Table 5-1). These data indicate that vertical hydraulic gradients were small and that vertical hydraulic gradient reversals (i.e., a change from upward vertical hydraulic gradient to downward vertical hydraulic gradient or vice versa) between shallow and intermediate groundwater and between intermediate and deep groundwater occurred at this location during the monitoring period.

Intermediate and deep groundwater elevations were lower than shallow groundwater elevations and deep groundwater elevations were lower than intermediate groundwater elevations at monitoring well cluster T4-MW02 for each monitoring event (Figure 5-10). Shallow groundwater elevations declined by about 0.5 foot and intermediate groundwater elevations declined by about 0.7 foot from late April to early June 2004, indicating that fluctuations in shallow and intermediate groundwater elevation were small at this location compared with fluctuation in groundwater elevations observed at monitoring well cluster T4-MW01 (Figures 5-9 and 5-10). Variations in groundwater elevations for deep groundwater at T4-MW02D during the monitoring period, about 4.2 feet, were similar to the variations in deep groundwater elevation observed at T4-MW01D (Figures 5-9 and 5-10). Vertical hydraulic gradients between shallow and intermediate groundwater were moderate to large in magnitude and ranged from -0.2 to -0.01 ft/ft, indicating an upward vertical hydraulic gradient (Table 5-1). Vertical hydraulic gradients between intermediate and deep groundwater were moderate in magnitude and ranged from 0.07 to 0.1 ft/ft, indicating a downward vertical hydraulic gradient from intermediate to deep groundwater (Table 5-1). No vertical hydraulic gradient reversals between shallow and intermediate or between intermediate and deep groundwater were observed at this location during the monitoring period.

Shallow groundwater elevations were higher than intermediate/deep groundwater elevations at monitoring well cluster T4-MW03 (Figure 5-11). Shallow groundwater elevations varied by about 0.9 foot and intermediate/deep groundwater elevations varied by about 4.4 feet during the monitoring period. The variations in groundwater elevations at this location were similar to variations observed at monitoring well cluster T4-MW02 (Figures 5-10 and 5-11). Vertical hydraulic gradients between the shallow and intermediate/deep groundwater were moderate in magnitude and ranged from 0.02 to 0.05 ft/ft, indicating a downward vertical hydraulic gradient from shallow groundwater to intermediate/deep groundwater at this location (Table 5-1). No vertical hydraulic gradient reversals between shallow and intermediate/deep groundwater were observed at this location during the monitoring period.

Shallow and intermediate groundwater elevations at monitoring well cluster T4-MW04 were similar during the monitoring period and varied by about 4.5 feet in a manner similar to that observed at monitoring well cluster T4-MW01 (Figures 5-9 and 5-12). Vertical hydraulic gradients between the shallow and intermediate groundwater were none to moderate in magnitude and ranged from 0.00 to 0.06 ft/ft, indicating a primarily downward vertical hydraulic gradient from shallow groundwater to intermediate groundwater at this location (Table 5-1). No vertical hydraulic gradient reversals between shallow and intermediate/deep groundwater were observed at this location during the monitoring period.

Shallow groundwater elevations were higher than intermediate groundwater elevations at monitoring well cluster T4-MW05 (Figure 5-13). Shallow groundwater elevations declined by about 0.8 foot, similar to the decline in groundwater elevation observed at T4-MW02 (Figures 5-10 and 5-13). Intermediate groundwater elevations increased by about 0.4 foot during the monitoring period in a manner not observed for intermediate groundwater at the other monitoring well cluster locations (Figures 5-10 through 5-14). Vertical hydraulic gradients between the shallow and intermediate groundwater were large in magnitude and were about 0.2 ft/ft, indicating a downward vertical hydraulic gradient from shallow groundwater to intermediate groundwater at this location (Table 5-1). No vertical hydraulic gradient reversals between shallow and intermediate/deep groundwater were observed at this location during the monitoring period.

Groundwater elevations for shallow, intermediate, and deep groundwater at monitoring well cluster T4-MW06 were similar for each monitoring event but varied by about 4.6 feet during the monitoring period (Figure 5-14). The vertical hydraulic gradients between shallow and intermediate groundwater were small to moderate in magnitude and ranged from -0.02 to 0.02 ft/ft, indicating that vertical hydraulic gradient reversals between shallow groundwater and intermediate groundwater occurred at this location (Table 5-1). Vertical hydraulic gradients between intermediate and deep groundwater were small in magnitude and ranged from -0.003 to 0.002 ft/ft (Table 5-1). These data indicate that vertical hydraulic gradient reversals occurred at this location during the monitoring period.

Fluctuations in groundwater elevations greater than 4.0 feet were observed for shallow, intermediate, and deep groundwater at near-river monitoring well clusters T4-MW01, T4-MW04, and T4-MW06 and for deep groundwater at upland monitoring well clusters T4-MW02 and T4-MW03 (Figures 5-9 through 5-14). The similarities in the variation of groundwater elevations indicate that a hydraulic connection exists between these depths and locations. Shallow and intermediate groundwater elevations at upland monitoring well clusters T4-MW02, T4-MW03, and T4-MW05 were small (<1.0 foot) relative to the variations in groundwater elevations observed at the near-river monitoring well clusters (Figures 5-9 through 5-14). Hydraulic connectivity between shallow and intermediate groundwater at these locations may be impeded by layers of fine-grained materials within the Unconsolidated Alluvial Deposits and Gatton's Slough in the upland portion of Terminal 4.

Downward vertical hydraulic gradients were observed between shallow and intermediate groundwater at monitoring well clusters T4-MW03, T4-MW04, and T4-MW05 and between intermediate and deep groundwater at monitoring well cluster T4-MW02 (Table 5-1). Upward vertical hydraulic gradients were observed between shallow and intermediate groundwater at monitoring well cluster T4-MW02 (Table 5-1). Vertical hydraulic gradient reversals occurred between shallow and intermediate groundwater and between intermediate and deep groundwater at near-river monitoring well clusters T4-MW01 and T4-MW06 (Table 5-1). The magnitude of the vertical hydraulic gradient was small to moderate at near-river monitoring well clusters T4-MW01, T4-MW04, and T4-MW06 and was moderate to large at upland monitoring well clusters T4-MW02, T4-MW03, and T4-MW04.

These data indicate that vertical groundwater flow at Terminal 4 is dynamic and may be influenced by different factors, such as river stage or resistance to flow by fine-grained materials, at different locations. For example, variation in river stage may cause gradient reversals between hydrostratigraphic units at the near-river locations; however, at monitoring well cluster T4-MW02, horizontal groundwater flow in the Unconsolidated Alluvial Deposits may be hindered due to the confining nature of fine-grained materials located in downgradient Gatton's Slough.

5.2.2.2 Pressure Transducer Data

As described in Section 3.2, pressure transducers were used to "continuously" monitor groundwater pressure at 1-minute intervals at monitoring wells T4-MW06I and T4-MW06D. These pressure data were converted to groundwater elevations. In addition, as described in Section 3.5, a pressure transducer was used to continuously monitor Willamette River stage in Slip 3 at 10-minute intervals. Concurrent continuous groundwater elevation data and continuous stage data were available for a one-month period from April 17 to May 17, 2004 (Figure 5-

15). Weekly and continuous groundwater elevation data for monitoring well cluster T4-MW06 were compared with Willamette River stage and daily precipitation, as shown on Figures 5-15 through 5-17. Daily precipitation data for Portland International Airport were obtained from the NOAA website (http://www.wrh.noaa.gov/Portland/climate/).

The 1-minute interval groundwater elevation data and 10-minute river stage data are shown on Figure 5-15, along with daily precipitation, for the period of record. These same data are shown on Figure 5-16 for the two-week period from April 30 through May 13, 2004. The Willamette River stage was tidally affected, and tidal stage fluctuations ranged from about 0.8 foot to 2.8 feet. Groundwater elevation also appeared to be tidally affected; daily groundwater elevation fluctuations ranged from about 0.7 foot to 2.2 feet. Daily precipitation amounts ranged from 0 to 0.46 inch.
A 24-hour moving average was applied to the Willamette River stage and groundwater elevation data for monitoring wells T4-MW06I and T4-MW06D (Figure 5-17). The 24-hour moving average was used to damp the effects of the tidal fluctuations and can therefore be considered indicative of river stage changes resulting from precipitation. Willamette River stage and shallow, intermediate, and deep groundwater elevations were observed to increase in response to inputs of water from precipitation events (Figure 5-17).

A strong relationship between river stage intermediate (R^2 = 0.987, p = 0) and deep (R^2 = 0.983, p = 0) groundwater elevation was observed during the monitoring period at monitoring well cluster T4-MW06. When river stage changed, groundwater elevation changed in a similar manner (Figures 5-15 through 5-17). This effect was observed for both tidally influenced changes in river stage as well as precipitation-induced changes in river stage. There was a time lag of about zero to 15 minutes between changes in the river stage and changes in the groundwater elevations, i.e., groundwater elevation changes lagged behind river stage changes by less than about 1/4 hour at this location. Because the groundwater elevation data were recorded at 1-minute intervals and river stage was recorded at 10-minute intervals, a more precise estimate of lag time is not possible.

Based on weekly groundwater elevation data, the influence of change in river stage was also observed in shallow groundwater at monitoring wells T4-MW01S, T4-MW04S, and T4-MW06S in intermediate groundwater at monitoring wells T4-MW01D and T4-MW04I, and in deep groundwater at T4-MW01D, T4-MW02D, and T4-MW03I/D (Figures 5-9 through 5-14). These observations indicated that in the upland fill material and in the Unconsolidated Alluvial Deposits at nearshore locations (i.e., monitoring well clusters T4-MW01, T4-MW04, and T4-MW06), shallow, intermediate, and deep groundwater was hydraulically connected to and groundwater elevations were influenced by variations in stage in the Willamette River.

Tidal influences were not observed in shallow and intermediate groundwater at upland monitoring well clusters T4-MW02, T4-MW03, and T4-MW05. Finer-grained materials that are present in the upland portions of the Unconsolidated Alluvial Deposits (including Gatton's Slough) likely dampened the tidal pressure effect so that the tidal signal was no longer observed in shallow and intermediate groundwater at the upland monitoring well clusters. The elevation of the contact between the upland fill material and Unconsolidated Alluvial Deposits was greater than river stage at upland monitoring well clusters for the period of record (Figures 5-6 through 5-8). Therefore, tidal fluctuation in river stage likely was not propagated through fine-grained Unconsolidated Alluvial Deposits to shallow groundwater at these upland locations. Tidal effects may be observed farther upland in shallow and intermediate groundwater during periods of higher river stage.

The magnitude and timing of variations in groundwater elevations at upland monitoring wells T4-MW02D and T4-MW03I/D were similar to the magnitude and timing of variations in groundwater elevations at near-river monitoring wells T4-MW01D and T4-MW06D (Figures 5-9, 5-10, 5-11, and 5-14). Therefore, it is likely that fluctuations in river stage affected deep groundwater elevations as far upland as monitoring well cluster T4-MW02, indicating that river stage influences groundwater elevations farther upland within the Troutdale Gravel as compared with the upland fill material and Unconsolidated Alluvial Deposits. This tidal influence on deep groundwater at monitoring well T4-MW02 suggests that the Troutdale Gravel was under semi-confined conditions due to the presence of fine-grained materials in the Unconsolidated Alluvial Deposits above the Troutdale Gravel in this portion of Terminal 4 (Fetter, 1994).

Tidal efficiency (TE) relates the amplitude of groundwater elevation fluctuations in an aquifer to the amplitude of fluctuation at the tidal boundary, which at Terminal 4 is the Willamette River. Tidal efficiency at monitoring well cluster T4-MW06 was estimated by dividing the change in groundwater elevation over a single tidal cycle by the change in river stage for the same tidal cycle. Tidal efficiency in intermediate and deep groundwater at monitoring well cluster T4-MW06 ranged from about 0.7 to 0.8 for the monitoring period, indicating that intermediate and deep groundwater are strongly influenced by the Willamette River at this location. Because only weekly depth to groundwater measurements were performed at other monitoring well clusters, TEs could not be calculated for other locations at Terminal 4.

As shown on Figure 5-20, river stage was generally greater than groundwater elevation at monitoring wells T4-MW06I and T4-MW06D at high tide (at high river stage during a tidal cycle) and lower than groundwater elevation at low tide (at low river stage during a tidal cycle). For T4-MW06I groundwater elevations, river stage was about 0.1 to 0.4 feet greater than groundwater elevation at high tide and about 0.1 to 0.4 feet less than groundwater elevation at low tide. For T4-MW06D groundwater elevations, river stage was about 0.1 to 0.6 feet greater than groundwater elevation at high tide and about 0.1 to 0.35 feet less than groundwater elevation at low tide. Average groundwater elevation at T4-MW06I from April 27 through May 17, 2004 (5.13 feet CRD) was 0.1 feet greater than average river stage for this same period (5.03 feet CRD). This information indicates that relatively short-duration (i.e., 1-hour) hydraulic gradient reversals occurred during the monitoring period, but there was a net discharge of groundwater from the Unconsolidated Alluvial Deposits to the river at this location for this time period. Average groundwater elevation at T4-MW06D (5.02 feet CRD) was 0.01 feet lower than river stage (5.03 feet CRD) for the April 27 through May 17, 2004 time period. This difference of 0.01 feet is within the margin of error for the stage and groundwater elevation measurements and was inconclusive with respect to net discharge of deep groundwater from the Troutdale Gravel to the river at this location during the monitoring period.

5.2.3 Groundwater Elevation Contours

Groundwater elevation contour maps were developed for shallow, intermediate, and deep groundwater (Figures 5-18 through 5-23). These groundwater elevation contour maps were based on groundwater measurements performed on April 29, 2004 and May 13, 2004. Groundwater elevations were compared with river stage for each of these dates. Since river stage is tidally affected and can vary by about 2 feet between low tide and high tide, the range of stage values for the time period during which groundwater elevation measurements were made was used for comparison with the groundwater elevations. For April 29, 2004, river stage ranged from 5.44 to

6.16 feet CRD during the 11:00 to 15:00 time period. For May 13, 2004, river stage ranged from 3.36 to 3.97 feet CRD during the 11:30 to 16:40 time period.

Shallow groundwater elevations ranged from 3.55 feet CRD at monitoring well T4-MW06S to 16.02 feet CRD at monitoring well T4-MW05S on April 29, 2004, and from 5.56 feet CRD at monitoring well T4-MW01S to 15.80 feet CRD at monitoring well T4-MW05S on May 13, 2004 (Figures 5-18 and 5-19). As shown on Figures 5-18 and 5-19, the horizontal hydraulic gradient direction for shallow groundwater was toward the Willamette River. Horizontal hydraulic gradient in shallow groundwater ranged from approximately 0.0002 to 0.02 ft/ft for both monitoring events depending upon location at Terminal 4. The average horizontal hydraulic conductivity was approximately 0.01 ft/ft. Gradients were steepest at the eastern ends of Slip 1 and Slip 3.

Intermediate groundwater elevations ranged from 2.93 feet CRD at monitoring well T4-MW04I to 16.47 feet CRD at monitoring well T4-MW02I on April 29, 2004, and from 5.59 feet CRD at monitoring well T4-MW01I to 16.27 feet CRD at monitoring well T4-MW02I on May 13, 2004 (Figures 5-20 and 5-21). As shown on Figures 5-20 and 5-21, the horizontal hydraulic gradient direction for intermediate groundwater was toward the Willamette River. Horizontal hydraulic conductivity ranged from approximately 0.005 to 0.02 ft/ft for both monitoring events depending upon location at Terminal 4. The average horizontal hydraulic gradient in intermediate groundwater was approximately 0.012 ft/ft for the April 2, 2004 monitoring event and 0.009 ft/ft for the May 13, 2004 monitoring event.

Deep groundwater elevations ranged from 3.35 feet CRD at monitoring well T4-MW06D to 4.17 feet CRD at monitoring well T4-MW02D on April 29, 2004, and from 5.66 feet CRD at monitoring well T4-MW01D to 5.99 feet CRD at monitoring well T4-MW03D on May 13, 2004 (Figures 5-22 and 5-23). As shown on Figure 5-22, the horizontal hydraulic gradient direction for deep groundwater was toward the Willamette River on April 29, 2004. Groundwater elevation contours were not drawn for the deep groundwater data for May 13, 2004 (Figure 5-23). However, because the groundwater elevation at T4-MW01D was less than groundwater elevations at T4-MW03I/D and T4-MW02D, the horizontal gradient was toward the river. The average horizontal hydraulic gradient in deep groundwater was approximately 0.0005 ft/ft on April 29, 2004.

5.2.4 Groundwater Flow Parameters

Hart Crowser (2000) reported the results of a limited pumping test that was conducted in 1994 at monitoring well MW-2 located less than 50 feet from the head of Slip 3. Monitoring well MW-2 was screened within the lower 14 feet of the upland fill material and upper 16 feet of the Unconsolidated Alluvial Deposits. At monitoring well MW-2, the upland fill material consisted of sand and the Unconsolidated Alluvial Deposits consisted of layers of sand, silt, clayey silt, silty clay, and clay (Hart Crowser, 2000). The results of the pumping test suggested a horizontal hydraulic conductivity of about 0.023 centimeters per second (cm/sec) (65 feet/day) (Hart Crowser, 2000). This falls within the expected range of hydraulic conductivity values of 10^{-3} to 10^{-1} cm/sec (2.8 to 280 feet/day) for clean sands (Freeze and Cherry, 1979). Given the similar grain sizes of the upland fill material and Unconsolidated Alluvial Deposits in the near-river portion of Terminal 4 at monitoring well clusters T4-MW01, T4-MW04, and T4-MW06 (Figures 5-6 through 5-8), the horizontal hydraulic conductivity value of 0.023 cm/sec likely is representative for the upland fill material and sandy layers of the Unconsolidated Alluvial Deposits.

Pumping tests have not been conducted at Terminal 4 monitoring wells completed in finer-grained layers of the Unconsolidated Alluvial Deposits or the Troutdale Gravel. Based on descriptions of soils from monitoring well boring logs (Appendix A), the expected range of horizontal hydraulic conductivities for finer-grained layers of the Unconsolidated Alluvial Deposits is 10^{-6} to 10^{-4} cm/sec for silt (0.0028 to 0.028 feet/day) (Freeze and Cherry, 1979). The expected range of horizontal hydraulic conductivities is 10^{-1} to 10 cm/sec for gravel (280 to 28,000 feet/day) (Freeze and Cherry, 1979,)

Groundwater flow velocity is estimated from the following equation:

$$v = Ki/\eta_e$$

where v is velocity, K is horizontal hydraulic conductivity, i is the horizontal hydraulic gradient, and η is the effective soil porosity.

The effective soil porosity, η_e, was not measured. For unconsolidated sediments, total porosity typically is 0.25 to 0.40 for gravel, 0.25 to 0.50 for sand, and 0.35 to 0.50 for silt (Freeze and Cheery, 1979). Effective soil porosity typically is less than total porosity. Assuming (1) the horizontal gradients discussed above in Section 5.2.3, (2) typical values for effective porosity for poorly sorted gravel (0.30), well-sorted sand (0.30), and silt (0.40), and (3) typical hydraulic conductivities for gravel (2,800 feet/day) and silt (0.0028 feet/day), horizontal groundwater velocities within the different geologic materials encountered in monitoring well borings at Terminal 4 may be approximately as follows:

Deposit	Horizontal Hydraulic Conductivity (feet/day)	Average Horizontal Hydraulic Gradient (ft/ft)	Effective Soil Porosity	Horizontal Groundwater Velocity (feet/day)
Gravel	2,800	0.0005	0.30	5
Sand	65	0.01	0.30	2
Silt	0.0028	0.01	0.40	10^{-4}

These groundwater flow velocity estimates are provided only to illustrate the potential range of hydrogeologic parameters within the various geologic materials encountered at Terminal 4 based on literature values. These groundwater flow velocity estimates are intended as "order-of-magnitude" estimates and should be refined using site-specific measurements for risk assessment or engineering design purposes.

5.2.5 Hydrogeologic Conceptual Model

The hydrogeologic regime at Terminal 4 is complex due to the heterogeneous grain size and differences in lateral extent in the upland fill and alluvial deposits. In addition, there is a distinctly strong hydraulic connection to Willamette River stage variations within an area generally defined as west of the former shoreline and within the Troutdale Gravel. This hydraulic connection is dampened by the presence of interbedded fine-grained silt and clay layers within the natural deposits that are generally east of the former shoreline within the

Unconsolidated Alluvial Deposits. Therefore, a generalized interpretation of the hydrogeologic conceptual model relative to groundwater flow and gradient behavior is made by defining two primary areas at Terminal 4 separated by the general location of the former shoreline, which is shown on Figures 3-1 and 3-3. Upland fill material consisted primarily of well-sorted fine to medium sand; Unconsolidated Alluvial Deposits consisted of fine sand at near-river monitoring well cluster locations (T4-MW01, T4-MW04, and T4-MW06) and of interbedded layers of well sorted fine sand, silt, and clay at upland monitoring well cluster locations (T4-MW02, T4-MW03, and T4-MW05); and Troutdale Gravel consisted primarily of poorly sorted fine to medium gravel (Figures 5-5 through 5-8 and Appendix A).

For the western portion of Terminal 4 (west of the former shoreline), the two geologic units of upland fill and Unconsolidated Alluvial Deposits combine as essentially one hydrostratigraphic unit that is above the underlying hydrostratigraphic unit of the Troutdale Gravel. The separation of the units is due to considerable differences in gradation and the resulting likelihood of order-of-magnitude differences in hydraulic conductivities, but the hydraulic connection is evident based on groundwater level monitoring data. The similarity of grain size characteristics between the upland fill and underlying Unconsolidated Alluvial Deposits, which are both composed of fine to medium sand with less than 15% fines content and which are differentiated primarily by color, is a reasonable indicator that their similar transmissivity characteristics will cause the two units to function as a single hydrostratigraphic unit.

For the eastern portion of Terminal 4 (east of the former shoreline), there are three hydrostratigraphic units, which include the sands of the upland fill material; the finer-grained sands, silts, and clays of the Unconsolidated Alluvial Deposits; and the gravels of the Troutdale Gravel. The finer-grained materials of the Unconsolidated Alluvial Deposits act as an aquitard for the Troutdale Gravel.

The relationship between the two primary hydrogeologic areas and the overall hydrogeologic conceptual model may be subject to revision during the EE/CA following additional groundwater monitoring to be performed during higher river stage elevations.

Groundwater elevations varied across Terminal 4 and were higher in the upland portions of Terminal 4 (i.e., at monitoring well clusters T4-MW02, T4-MW03, and T4-MW05) than at near-river portions of Terminal 4 (i.e., at monitoring well clusters T4-MW01, T4-MW04, and T4-MW06) (Figures 5-9 through 5-14). The net horizontal hydraulic gradient was toward the river for groundwater in upland fill material, Unconsolidated Alluvial Deposits, and Troutdale Gravel (Figures 5-18 through 5-23). However, short-duration (i.e., 1-hour) gradient reversals were recorded for the Unconsolidated Alluvial Deposits and Troutdale Gravel and were associated with tidal changes in the river.

Estimated horizontal groundwater velocities may vary over five orders of magnitude in the various soil types encountered at Terminal 4. More definitive estimates of groundwater flow velocities based on site-specific measurements of hydrogeologic parameters in various soil types at Terminal 4 should be developed for use in the EE/CA.

Tidal fluctuations caused changes in groundwater elevations in the intermediate depth groundwater at monitoring well T4-MW06I. However, based on average river stage (5.036 feet CRD) and monitoring well T4-MW06I groundwater elevation (5.132 feet CRD) for the April 27 through May 17 time period, there was a net potential for discharge of groundwater to the river. Based on the similarity between shallow and intermediate

groundwater elevations at monitoring well clusters T4-MW01, T4-MW04, and T4-MW06, shallow groundwater is expected to respond similarly to tidal variations in river stage, but net discharge will be to the river. At monitoring well T4-MW06D, average groundwater elevation (5.022 feet CRD) was slightly less than river stage. The difference between average river stage and monitoring well T4-MW06D groundwater elevation is within the margin of error for the measurement of water levels and is therefore inconclusive with respect to exchange of water between the Willamette River and the Troutdale Gravel at this location.

Vertical hydraulic gradients were primarily upward at some locations (e.g., intermediate to shallow groundwater at monitoring well cluster T4-MW02) and primarily downward at some locations (e.g., shallow to intermediate groundwater at monitoring well cluster T4-MW05 and intermediate to deep groundwater at monitoring well cluster T4-MW02) (Table 5-1 and Figures 5-6 through 5-8), while vertical hydraulic gradient reversals were observed between shallow and intermediate groundwater and between intermediate and deep groundwater at monitoring well clusters T4-MW01 and T4-MW06 (Table 5-1). Variations in river stage may cause gradient reversals between hydrostratigraphic units at the near-river locations. At monitoring well cluster T4-MW02, horizontal groundwater flow in the Unconsolidated Alluvial Deposits may be hindered due to the confining nature of fine-grained materials located in downgradient Gatton's Slough, resulting in the observed upward vertical gradients from the Unconsolidated Alluvial Deposits to the upland fill material and downward vertical gradients from the Unconsolidated Alluvial Deposits to the Troutdale Gravel during the monitoring period.

As demonstrated by the correlation between Willamette River stage and intermediate and deep groundwater elevations at monitoring well cluster T4-MW06, tidal and precipitation-induced changes in the Willamette River stage caused changes in groundwater elevation that were similar in magnitude and direction for groundwater in the Unconsolidated Alluvial Deposits and Troutdale Gravel at this location (Figures 5-15 through 5-17). The TE for intermediate and deep groundwater at monitoring well cluster T4-MW06 was on the order of 0.7 to 0.8. Based on the magnitude of change in weekly groundwater elevations observed at monitoring well clusters T4-MW01 and T4-MW04 and at monitoring wells T4-MW02D and T4-MW03D, the TE is expected to be similar in magnitude to but slightly less than the TE at monitoring well cluster T4-MW06.

Based on weekly groundwater elevation data, river stage-induced groundwater elevation changes were also observed for shallow, intermediate, and deep groundwater at monitoring well cluster T4-MW01, for shallow and intermediate groundwater at monitoring well cluster T4-MW04, and for deep groundwater at monitoring well clusters T4-MW02 and T4-MW03 (Figures 5-9 through 5-14). The observed tidal effects in deep groundwater at the upland well locations (monitoring well clusters T4-MW02 and T4-MW03) likely indicate that the Troutdale Aquifer is under semi-confining conditions due to the presence of finer-grained materials within the Unconsolidated Alluvial Deposits in the upland portion of Terminal 4.

These observations were based primarily on data collected during field work performed in support of the EE/CA. Groundwater elevations and vertical and horizontal hydraulic gradients likely will vary at different river stages, particularly for groundwater in the upland fill material during periods of higher river stage. Willamette River continuous stage data were collected in Slip 3 at Terminal 4 from March 24 to May 17, 2004 (Figure 4-29). During this period, minimum river stage was 2.43 feet CRD, maximum river stage was 7.99 feet CRD, and mean river stage was 4.66 feet CRD. According to stage exceedance statistics for the Willamette River at the USGS Portland Gage, from 1990 to 2001 the 99% exceedance stage was 3.4 feet CRD, the 1% exceedance stage was 17.6 feet CRD, and the 50% exceedance stage was 6.7 feet CRD (Port of Portland, 2002). The USGS gage is located approximately 6 miles upriver from Terminal 4, and river stage will be higher at the

USGS gage than at Terminal 4. However, the USGS stage data illustrate that during the March 24 to May 17, 2004 monitoring period, the Willamette River stage was relatively low and that a river stage as high as 17 feet CRD can be expected on an approximately annual basis at Terminal 4.

Hart Crowser (2000) presented seasonal groundwater elevation contours for shallow groundwater for November 1988 and February, May, August, and November 1999. Monitoring wells used to develop these groundwater elevation contours were primarily screened across the bottom portion of the upland fill material and top portion of the Unconsolidated Alluvial Deposits (Hart Crowser, 2000). Groundwater elevation data presented in Hart Crowser (2000) are representative of shallow groundwater at the site and are not representative of groundwater elevations for deeper portions of the Unconsolidated Alluvial Deposits and the Troutdale Gravel. The Hart Crowser (2000) groundwater elevation contours indicated that upland shallow groundwater horizontal gradients and inferred flow directions were toward the Willamette River during all five monitoring periods. According to Willamette River discharge data for the USGS Willamette River gage (http://www.usgs.gov), flow in the Willamette River was low during each of the five monitoring periods relative to the maximum observed flow during the November 1998 through November 1999 time period. For the five monitoring periods, Willamette River discharge was greatest during the February 1999 monitoring period (approximately 59,000 cfs), while a maximum flow of approximately 240,000 cfs occurred in late December 1998 (http://www.usgs.gov). To evaluate the effect of higher river discharge and stage on groundwater elevation and vertical and horizontal hydraulic gradients at Terminal 4, additional groundwater elevation data should be collected during periods of higher river discharge and stage.

5.3 Sediment Quality Characteristics

This section presents a limited evaluation of the sediment data, including sediment lithology; surface, under-pier, and subsurface sediment distributions of COPCs; and a comparison of sediment data to sediment quality guidelines (SQGs). This limited evaluation was performed to identify areas for further consideration in the EE/CA and includes the evaluation of:

- surface sediment quality characteristics (i.e., the nature and lateral extent of contamination);
- under-pier sediment quality characteristics; and
- subsurface sediment quality characteristics (i.e., the nature and vertical extent of contamination).

The data evaluated in this section do not represent all the sediment data available for the Removal Action Area. There are historical sediment data, collected prior to the EE/CA field activities. The historical data, which are summarized in the EE/CA work plan (BBL, 2004a), may be used during the EE/CA but are not discussed in this characterization report.

Sediment data are discussed below by Removal Action Area subareas. Figure 3-4 shows the boundaries for the following subareas:

- Berth 401;
- Slip 1;
- Wheeler Bay;

- Slip 3; and
- North of Berth 414.

These subareas were selected based on an initial evaluation of sediment chemistry, operational considerations, and structural considerations. These subareas were selected after an initial evaluation and are not intended to represent final Removal Action Area subareas, which will be determined during the EE/CA.

Sediment data were compared to SQGs, including the threshold effects concentrations (TECs) (MacDonald et al., 2000a) and the probable effects concentrations (PECs) (MacDonald et al., 2000a), to preliminarily delineate the horizontal and vertical extent of contaminated sediments. The use of these guidelines does not imply that they should or would be used as cleanup levels for the Removal Action Area. The TEC is a low (i.e., threshold) effects guideline that represents concentrations below which toxicity effects are unlikely to be observed in freshwater benthic invertebrates. The PEC is a probable effects guideline that represents concentrations above which toxicity effects are likely to be observed in freshwater benthic invertebrates.

Sediment data are sometimes discussed as exceedance ratios, terminology that is used in this report. An exceedance ratio is the concentration of a constituent in a sediment sample result divided by the SQG. A TEC exceedance ratio of greater than 1 indicates a concentration greater than the TEC. A PEC exceedance ratio of greater than 1 indicates concentration greater than the PEC.

The SQGs used in this analysis are all toxicity-based for freshwater benthic invertebrates. Bioaccumulation-based SQGs are not widely available. Bioaccumulation effects will be evaluated after the Removal Action alternatives have been identified and will be used to assess the effectiveness of the alternatives.

5.3.1 Surface Sediment Quality Characteristics

The surface sediment data for Berth 401, Slip 1, Wheeler Bay, Slip 3, and north of Berth 414 are discussed below. The data are presented by Removal Action Area subarea and then by constituent class (metals, SVOCs, pesticides, and PCBs). A number of complex congener families were evaluated using summations of certain analytes within the family. Section 4.3 discusses the congener families evaluated and presents the technique used to calculate the summations. In the following sections, contaminants (i.e., individual analytes and congeners, where applicable) are described in terms of actual concentration values as well as in terms of exceedance ratios with respect to TEC and PEC SQGs.

TPH data are not discussed in this section, because there are no PEC and TEC criteria for these compounds. TPH, conventionals (TOC and total solids), and grain size data are discussed in Section 4.3.2. PEC and TEC SQGs also are not available for phthalates, which are therefore discussed without comparison to SQGs. Butylbenzyl phthalate and bis(2-ethylhexyl)phthalate are the only phthalates specifically discussed, because they were the most frequently detected and were detected at the highest concentrations of the phthalates analyzed. All phthalate results for surface sediment samples are discussed in Section 4.3.2.

The lateral extent of lead and zinc, total PAH, Σ DDT, and total PCB concentrations in surface sediment is presented in Figures 5-24, 5-25, 5-26, and 5-27, respectively.

5.3.1.1 Berth 401

Berth 401 surface sediment data are compared to SQGs in Table 5-2. There were no PEC exceedances in Berth 401 surface sediment data. Excepting pesticides, TEC exceedances occurred only in sample T4-VC01-0-1. Both Berth 401 surface sediment samples (T4-VC01-0-1 and T4-VC02-0-1) contained pesticide concentrations above the TEC.

Metals

All metals results were below the PEC in Berth 401 surface sediment samples. Metals concentrations in sample T4-VC02-0-1 were below the PEC and TEC. Sample T4-VC01-0-1 contained copper and nickel concentrations above the TEC. The remaining metals were not detected at concentrations above the TEC in Berth 401 surface sediment samples. Copper and nickel concentrations in sample T4-VC01-0-1 were less than twice the TEC, indicating concentrations were just slightly above the TEC. The concentrations of lead and zinc in Berth 401 surface sediment samples are shown on Figure 5-24.

SVOCs

All individual and total PAH concentrations were less than the PEC in Berth 401 surface sediment samples. Concentrations of individual and total PAHs in sample T4-VC02-0-1 were below the PEC and TEC. Concentrations of pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, and total PAHs in sample T4-VC01-0-1 were greater than the TEC. The remaining PAHs were not detected at concentrations above the TEC in Berth 401 surface sediment samples. The total PAH TEC exceedance ratio was less than 2 in sample T4-VC01-0-1. Total PAH concentrations in Berth 401 surface sediment sample are shown on Figure 5-25.

Butylbenzyl phthalate was detected in one Berth 401 surface sediment sample at a concentration of 93 µg/kg. Bis(2-ethylhexyl)phthalate was detected in both Berth 401 surface sediment samples. The maximum Berth 401 surface sediment concentration of bis(2-ethylhexyl)phthalate was 1,400 µg/kg.

Pesticides

All pesticide concentrations were less than the PEC in Berth 401 surface sediment samples. Total DDE, total DDT, and Σ DDT concentrations in at least one Berth 401 surface sediment sample were greater than the TEC. The remaining pesticide results were below the TEC in Berth 401 surface sediment samples. The maximum Σ DDTs TEC exceedance ratio was 5 in sample T4-VC01-0-1. Σ DDT concentrations in Berth 401 surface sediment samples are shown on Figure 5-26.

PCBs

All PCB concentrations were less than the PEC in Berth 401 surface sediment samples. The concentration of total PCBs was less than the PEC and TEC in sample T4-VC02-0-1. The total PCB concentration was greater than the TEC in sample T4-VC01-0-1, with an exceedance ratio of 4. Total PCB concentrations in Berth 401 surface sediment samples are shown on Figure 5-27.

5.3.1.2 Slip 1

Slip 1 surface sediment data are compared to SQGs in Table 5-3. Surface sediment samples from T4-VC12 and T4-VC13 and Berth 405 contain concentrations of PAHs, pesticides, and PCBs above the SQGs. Surface sediment samples from Berth 408 contain concentrations of metals, PAHs, pesticides, and PCBs above the SQGs. Slight TEC exceedances for metals, PAHs, and pesticides are widespread in Slip 1 surface sediment samples.

Metals

All metals results were below the PEC in Slip 1 surface sediment samples. Metals concentrations in samples T4-VC10-0-1, T4-VC13-0-1, and T4-VC14-0-1 were below the PEC and TEC. Cadmium, copper, lead, nickel, and zinc concentrations were above the TEC in at least one Slip 1 surface sediment sample. The remaining metals were not detected at concentrations above the TEC in Slip 1 surface sediment samples. Cadmium, copper, and nickel TEC exceedance ratios in Slip 1 surface sediment samples were all less than 2, indicating concentrations were just slightly above the TEC. Lead and zinc exceedance ratios were less than 2 except in samples T4-VC15-0-1 and T4-VC16-0-1, with exceedance ratios between 2 and 3. The concentrations of lead and zinc in Slip 1 surface sediment samples are shown on Figure 5-24.

SVOCs

Concentrations of individual and total PAHs in samples T4-VC03-0-1, T4-VC10-0-1, and T4-VC14-0-1 were below the PEC and TEC. Concentrations of phenanthrene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, fluorene, dibenz(a,h)anthracene, and total PAHs were each above the PEC in at least one of the following samples: T4-VC07-0-1, T4-VC09-0-1, T4-VC12-0-1, T4-VC13-0-1, T4-VC15-0-1, and T4-VC16-0-1. The maximum PEC exceedance ratio for total PAHs was 2 in sample T4-VC12-0-1. All PAHs having TEC criteria had exceedances in at least one Slip 1 surface sediment sample. Total PAH concentrations in Slip 1 surface sediment samples are shown on Figure 5-25.

Butylbenzyl phthalate was detected in 13 Slip 1 surface sediment samples, with a maximum concentration of 110 µg/kg in T4-VC16-0-1. Bis(2-ethylhexyl)phthalate was detected in nine Slip 1 surface sediment samples. The maximum Slip 1 surface sediment concentration of bis(2-ethylhexyl)phthalate was 580 µg/kg in T4-VC16-0-1.

Pesticides

Pesticide concentrations in samples T4-VC10-0-1, T4-VC12-0-1, and T4-VC14-0-1 were below the PEC and TEC. Total DDT concentrations were greater than the PEC in sample T4-VC13-0-1, with a PEC exceedance ratio of less than 2. The remaining pesticide concentrations were less than the PEC in Slip 1 surface sediment samples. Total DDD, total DDE, total DDT, and Σ DDT concentrations were greater than the TEC in at least one Slip 1 surface sediment sample. Σ DDT concentrations in Slip 1 surface sediment samples are shown on Figure 5-26.

PCBs

The total PCB concentrations in samples T4-VC03, T4-VC04, T4-VC05, T4-VC06, T4-VC07, T4-VC08, T4-VC10, T4-VC11, T4-VC12, T4-VC14, and T4-VC17 were below the PEC and TEC. Sample T4-VC13-0-1 contained total PCB concentrations greater than the PEC, with a PEC exceedance ratio of less than 2. The remaining Slip 1 surface sediment samples contained total PCB concentrations below the PEC. Samples T4-VC09-0-1, T4-VC13-0-1, T4-VC15-0-1, and T4-VC16-0-1 contained total PCB concentrations greater than the TEC. The remaining total PCB concentrations in Slip 1 surface sediment samples were below the TEC. Total PCB concentrations in Slip 1 surface sediment samples are shown on Figure 5-27.

5.3.1.3 Wheeler Bay

Wheeler Bay surface sediment data are compared to SQGs in Table 5-4. Surface sediment sample T4-VC18-0-1 contained lead at a concentration above the PEC, and sample T4-VC19-0-1 contained concentrations of PAHs above the PEC. Slight TEC exceedances for PAHs and pesticides are widespread in Wheeler Bay surface sediment samples.

Metals

Metals concentrations in sample T4-VC20-0-1 were less than the PEC and TEC. The concentration of lead in sample T4-VC18-0-1 was above the PEC, with a PEC exceedance ratio of less than 2. The remaining metals concentrations in Wheeler Bay surface sediment samples were below the PEC. Cadmium, copper, lead, nickel, and zinc concentrations were above the TEC in at least one Wheeler Bay surface sediment sample. The remaining metals were not detected at concentrations above the TEC. Cadmium, copper, nickel, and zinc TEC exceedance ratios were all less than 2, indicating concentrations were just slightly above the TEC. Lead TEC exceedance ratios were less than 2 except in sample T4-VC18-0-1, which had a TEC exceedance ratio of 3. The concentrations of lead and zinc in Wheeler Bay surface sediment samples are shown on Figure 5-24.

SVOCs

Concentrations of phenanthrene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, and total PAHs were above the PEC in sample T4-VC19-0-1, which had a PEC exceedance ratio for total PAHs of less

than 2. All PAHs having TEC criteria had at least one exceedance in Wheeler Bay surface sediment samples. Total PAH concentrations in Wheeler Bay surface sediment samples are shown on Figure 5-25.

Butylbenzyl phthalate was detected in three Wheeler Bay surface sediment samples, with a maximum concentration of 19 µg/kg in T4-VC20-0-1. Bis(2-ethylhexyl)phthalate was detected in two Wheeler Bay surface sediment samples. The maximum Wheeler Bay surface sediment concentration of bis(2-ethylhexyl)phthalate was 90 µg/kg in T4-VC20-0-1.

Pesticides

All pesticide concentrations were below the PEC in Wheeler Bay surface sediment samples. Total DDD, total DDE, total DDT, and Σ DDT concentrations were greater than the TEC in at least one Wheeler Bay surface sediment sample. The highest Σ DDTs TEC exceedance ratio was 7, which occurred in sample T4-VC21-0-1. Σ DDT concentrations in Wheeler Bay surface sediment samples are shown on Figure 5-26.

PCBs

All Wheeler Bay surface sediment samples had total PCB concentrations below the PEC and TEC. Total PCB concentrations in Wheeler Bay surface sediment samples are shown on Figure 5-27.

5.3.1.4 Slip 3

Slip 3 surface sediment data are compared to SQGs in Table 5-5. Slip 3 surface sediment samples from the vicinity of Berth 411 contained PEC exceedances of lead, zinc, and PAHs. Surface sediment samples from the former Pier 5 contained concentrations of lead and PAHs above the PEC. Total PAH concentrations were above the PEC in five Slip 3 surface sediment samples.

Metals

Metals concentrations in samples T4-VC22-0-1, T4-VC25-0-1, T4-VC27-0-1, and T4-VC28-0-1 were less than the PEC and TEC. Concentrations of lead and zinc in sample T4-VC24-0-1 and of lead in sample T4-VC29-0-1 were above the PEC. The PEC exceedance ratios for lead were 5 in T4-VC24-0-1 and 2 in T4-VC29-0-1. The PEC exceedance ratio for zinc in sample T4-VC24-0-1 was less than 2. Arsenic, cadmium, copper, lead, nickel, and zinc concentrations were above the TEC in at least one Slip 3 surface sediment sample. TEC exceedance ratios for cadmium, copper, lead, and zinc were greater than 2 in T4-VC24-0-1. TEC exceedance ratios for lead and zinc in samples T4-VC29-0-1 and T4-VC32-0-1 were greater than 2. TEC exceedance ratios for arsenic, cadmium, copper, lead, nickel, and zinc were below 2, indicating concentrations just slightly above the TEC. The concentrations of lead and zinc in Slip 3 surface sediment samples are shown on Figure 5-24.

SVOCs

The concentrations of individual and total PAHs in samples T4-VC22-0-1 and T4-VC25-0-1 were below the PEC and TEC. Naphthalene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, and total PAH concentrations were above the PEC in at least one of the following samples: T4-VC23-0-1, T4-VC24-0-1, T4-VC26-0-1, T4-VC29-0-1, and T4-VC32-0-1. The maximum PEC exceedance ratio for total PAHs was 26 in sample T4-VC24-0-1. All the PAHs having TEC criteria (i.e., naphthalene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, and total PAHs) had concentrations above the TEC in at least one Slip 3 surface sediment sample. Total PAH concentrations in Slip 3 surface sediment sample are shown on Figure 5-25.

Butylbenzyl phthalate was detected in four Slip 3 surface sediment samples at a maximum concentration of 180 µg/kg in T4-VC24-0-1. Bis(2-ethylhexyl)phthalate was detected in five Slip 3 surface sediment samples. The maximum Slip 3 surface sediment concentration of bis(2-ethylhexyl)phthalate was 520 µg/kg in T4-VC27-0-1.

Pesticides

All pesticide concentrations were below the PEC in Slip 3 surface sediment samples. The concentrations of pesticides in samples T4-VC22-0-1, T4-VC25-0-1, T4-VC27-0-1, and T4-VC28-0-1 were less than the PEC and TEC. Total DDD, total DDE, total DDT, and Σ DDT concentrations were greater than the TEC in at least one Slip 3 surface sediment sample. The highest exceedance ratio for Σ DDTs was 4 in sample T4-VC32-0-1. Σ DDT concentrations in Slip 3 surface sediment samples are shown on Figure 5-26.

PCBs

All Slip 3 surface sediment samples contained total PCB concentrations below the PEC and TEC. Total PCB concentrations in Slip 3 surface sediment samples are shown on Figure 5-27.

5.3.1.5 North of Berth 414

North of Berth 414 surface sediment data are compared to SQGs in Table 5-6. North of Berth 414 surface sediment samples contained concentrations of pesticides above the TEC but below the PEC. The concentrations of metals, PAHs, and PCBs in north of Berth 414 surface sediment samples were less than the PEC and TEC.

Metals

All metals results were below the PEC and TEC in north of Berth 414 surface sediment samples. The concentrations of lead and zinc in north of Berth 414 surface sediment samples are shown on Figure 5-24.

SVOCs

All PAH concentrations were below the PEC and TEC in sample T4-VC30-0-1. Sample T4-VC31-0-1 contained concentrations of PAHs above the TEC. The total PAH exceedance ratio was 3. Total PAH concentrations in north of Berth 414 surface sediment sample are shown on Figure 5-25.

Butylbenzyl phthalate was detected in one north of Berth 414 surface sediment sample (T4-VC31-0-1) at a concentration of 6.7 µg/kg. Bis(2-ethylhexyl)phthalate was not detected in the two north of Berth 414 surface sediment samples.

Pesticides

All pesticide concentrations were below the PEC in north of Berth 414 surface sediment samples. Total DDD, total DDE, and Σ DDT concentrations were above the TEC. The highest TEC exceedance ratio for Σ DDTs was 2 in sample T4-VC31-0-1. Σ DDT concentrations in north of Berth 414 surface sediment samples are shown on Figure 5-26.

PCBs

All total PCB concentrations were below the PEC and TEC in north of Berth 414 surface sediment samples. Total PCB concentrations in north of Berth 414 surface sediment samples are shown on Figure 5-27.

5.3.2 Under-Pier Sediment Quality Characteristics

The under-pier sediment data for Berth 401, Slip 1, and Slip 3 are discussed below. The data are presented by Removal Action Area subarea and then by constituent class (metals, SVOCs, pesticides, and PCBs). TPH data are not discussed in this section, because there are no PEC and TEC criteria for these compounds. TPH, conventionals (TOC and total solids), and grain size data are discussed in Section 4.3.3. PEC and TEC SQGs also are not available for phthalates, which are therefore discussed without comparison to SQGs. Butylbenzyl phthalate and bis(2-ethylhexyl)phthalate are the only phthalates specifically discussed, because they were the most frequently detected and were detected at the highest concentrations of the phthalates analyzed. All phthalate results for under-pier sediment samples are discussed in Section 4.3.3.

The lateral extent of lead and zinc, total PAH, Σ DDT, and total PCB concentrations in under-pier sediment is presented on Figures 5-24, 5-25, 5-26, and 5-27, respectively.

5.3.2.1 Berth 401

Berth 401 under-pier sediment data are compared to SQGs in Table 5-7. There were no PEC exceedances in Berth 401 under-pier sediment samples. Sample T4-UP01-0-1 contained concentrations of PAHs and pesticides above the TEC.

Metals

All metals results were below the PEC and TEC in Berth 401 under-pier sediment samples. The concentrations of lead and zinc in Berth 401 under-pier sediment samples are shown on Figure 5-24.

SVOCs

All PAH concentrations were less than the PEC in Berth 401 under-pier sediment samples. Concentrations of individual and total PAHs in sample T4-UP02-0-1 were below the PEC and TEC. Concentrations of phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, and total PAHs were greater than the TEC in sample T4-UP01-0-1. The TEC exceedance ratio for this sample for total PAHs was 2. The remaining PAHs were not detected at concentrations above the TEC in Berth 401 under-pier sediment samples. The Total PAH concentrations in Berth 401 under-pier sediment sample are shown on Figure 5-25.

Butylbenzyl phthalate was detected in one Berth 401 under-pier sediment sample (T4-UP01-0-1) at a concentration of 13 µg/kg. Bis(2-ethylhexyl)phthalate was detected in both Berth 401 under-pier sediment samples. The maximum Berth 401 under-pier sediment concentration of bis(2-ethylhexyl)phthalate was 62 µg/kg in sample T4-UP01-0-1.

Pesticides

All pesticide concentrations were less than the PEC in Berth 401 under-pier sediment samples. Pesticide concentrations in sample T4-UP02-0-1 were below the PEC and TEC. Total DDD, total DDT, and Σ DDT concentrations were greater than the TEC in sample T4-UP01-0-1. The Σ DDTs TEC exceedance ratio was 3 for this sample. The remaining pesticide results were below the TEC in Berth 401 under-pier sediment samples. Σ DDT concentrations in Berth 401 under-pier sediment samples are shown on Figure 5-26.

PCBs

All PCB concentrations were less than the PEC and TEC in Berth 401 under-pier sediment samples. Total PCB concentrations in Berth 401 under-pier sediment samples are shown on Figure 5-27.

5.3.2.2 Slip 1

Slip 1 under-pier sediment data are compared to SQGs in Table 5-8. Slip 1 under-pier sediment concentrations for metals and PAHs were above the PEC in samples from Berth 408. Berth 405 sediment samples contained metals, PAH, pesticide, and PCB concentrations below the PEC and TEC.

Metals

The metals concentrations in samples T4-UP03, T4-UP04, and T4-UP05 were below the PEC and TEC. Concentrations of cadmium, lead, and zinc were above the PEC in sample T4-UP07-0-1. The exceedance ratios

for cadmium, lead, and zinc were 1, 15, and 2, respectively, in this sample. Cadmium, copper, lead, and zinc concentrations were above the TEC in Slip 1 under-pier sediment samples. The remaining metals were not detected at concentrations above the TEC in Slip 1 under-pier sediment samples. Excepting sample T4-UP07-0-1, cadmium, copper, lead, and zinc TEC exceedance ratios were all less than 2, indicating concentrations were just slightly above the TEC. The concentrations of lead and zinc in Slip 1 under-pier sediment samples are shown on Figure 5-24.

SVOCs

The concentrations of individual and total PAHs in samples T4-UP03, T4-UP04, and T4-UP05 were below the PEC and TEC. Concentrations of anthracene, fluoranthene, pyrene, benz(a)anthracene, and chrysene were above the PEC in at least one of the following samples: T4-UP06-0-1 and T4-UP07-0-1. Concentrations of fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, and total PAHs were above the TEC in at least one of the following samples: T4-UP06-0-1, T4-UP07-0-1, and T4-UP08-0-1. The maximum total PAH TEC exceedance ratio was 10 in sample T4-UP07-0-1. Total PAH concentrations in Slip 1 under-pier sediment sample are shown on Figure 5-25.

Butylbenzyl phthalate was detected in one Slip 1 under-pier sediment sample (T4-UP06-0-1) at a concentration of 51 µg/kg. Bis(2-ethylhexyl)phthalate was detected in two Slip 1 under-pier sediment samples, with a maximum concentration of 620 µg/kg in T4-UP06-0-1.

Pesticides

All pesticide concentrations were below the PEC in Slip 1 under-pier sediment samples. Pesticide concentrations in samples T4-UP03, T4-UP04, T4-UP05, and T4-UP08-0-1 were below the PEC and TEC. Total DDD, total DDE, total DDT, and Σ DDT concentrations were greater than the TEC in at least one of the following samples: T4-UP06-0-1 and T4-UP07-0-1. The highest Σ DDTs TEC exceedance ratio was 2 in sample T4-UP06-0-1. Σ DDT concentrations in Slip 1 under-pier sediment samples are shown on Figure 5-26.

PCBs

All total PCB concentrations were below the PEC in Slip 1 under-pier sediment samples. Total PCB concentrations in samples T4-UP03, T4-UP04, T4-UP05, T4-UP07-0-1, and T4-UP08-0-1 were less than the PEC and TEC. Sample T4-UP06-0-1 contained total PCB concentrations greater than the TEC, with an exceedance ratio of less than 2. Total PCB concentrations in Slip 1 under-pier sediment samples are shown on Figure 5-27.

5.3.2.3 Slip 3

Slip 3 under-pier sediment data are compared to SQGs in Table 5-9. Slip 3 under-pier sediment samples contained concentrations of cadmium, lead, zinc, and PAHs above the PEC.

Metals

Concentrations of cadmium, lead, and zinc were above the PEC in at least one of the following samples: T4-UP12-0-1, T4-UP13-0-1, and T4-UP14. The maximum PEC exceedance ratios for cadmium, lead, and zinc were 2, 13, and 4, respectively, all in sample T4-UP13-0-1. Arsenic, cadmium, copper, lead, and zinc concentrations were above the TEC in at least one Slip 3 under-pier sediment sample. Arsenic and copper TEC exceedance ratios were less than 2. Cadmium TEC exceedance ratios were greater than 2 in the three samples that had cadmium TEC exceedances (T4-UP12-0-1, T4-UP13-0-1, and T4-UP14). Lead and zinc TEC exceedance ratios were greater than 2 in samples T4-UP12-0-1, T4-UP13-0-1, and T4-UP14. The concentrations of lead and zinc in Slip 3 under-pier sediment samples are shown on Figure 5-24.

SVOCs

Naphthalene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, and total PAH concentrations were above the PEC in at least one of the following samples: T4-UP12-0-1, T4-UP13-0-1, and T4-UP14. The maximum PEC exceedance ratio for total PAHs was 18 in sample T4-UP13-0-1. All the PAHs having TEC criteria (i.e., naphthalene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, and total PAHs) had concentrations above the TEC in at least one Slip 3 under-pier sediment sample. Total PAH concentrations in Slip 3 under-pier sediment sample are shown on Figure 5-25.

Butylbenzyl phthalate was detected in three Slip 3 under-pier sediment samples, with a maximum concentration of 27 µg/kg in T4-UP10-0-1. Bis(2-ethylhexyl)phthalate was detected in three Slip 3 under-pier sediment samples, with a maximum concentration of 140 µg/kg in T4-UP10-0-1.

Pesticides

All pesticide concentrations were below the PEC in Slip 3 under-pier sediment samples. Pesticide concentrations in samples T4-UP10-0-1 and T4-UP12-0-1 were below the PEC and TEC. Total DDD, total DDE, total DDT, and Σ DDT concentrations were greater than the TEC in at least one Slip 3 under-pier sediment sample. The highest exceedance ratio for Σ DDTs was 6 in sample T4-UP14. Σ DDT concentrations in Slip 3 under-pier sediment samples are shown on Figure 5-26.

PCBs

All total PCB concentrations in Slip 3 under-pier sediment samples were below the PEC and TEC. Total PCB concentrations in Slip 3 under-pier sediment samples are shown on Figure 5-27.

5.3.3 Subsurface Sediment Quality Characteristics

The subsurface sediment data for Berth 401, Slip 1, Wheeler Bay, Slip 3, and north of Berth 414 are discussed below. The data are presented by Removal Action Area subarea and then by constituent class (metals, SVOCs, pesticides, and PCBs). TPH data are not discussed in this section, because there are no PEC and TEC criteria for these compounds. TPH, conventionals (TOC and total solids), and grain size data are discussed in Section 4.3.4. PEC and TEC SQGs also are not available for phthalates, which are therefore discussed without comparison to SQGs. Butylbenzyl phthalate and bis(2-ethylhexyl)phthalate are the only phthalates specifically discussed, because they were the most frequently detected and were detected at the highest concentrations of the phthalates analyzed. All phthalate results for subsurface sediment samples are discussed in Section 4.3.4.

The locations of geologic cross sections at the Removal Action Area are shown on Figure 5-28. The cross sections are shown on Figures 5-29 through 5-40.

5.3.3.1 Berth 401

Berth 401 subsurface sediment data are compared to SQGs in Table 5-2. Figure 5-29 presents the geologic cross section for Berth 401. Figure 5-41 shows chemistry results for lead, zinc, total PAHs, total PCBs, and Σ DDTs posted on the geologic cross section. Sediments at Berth 401 consist of a thin layer of silt (approximately 1 foot in thickness) underlain by sand. Potentially contaminated sediment appears to be limited to the silt layer and the upper 2 feet of the sand layer at Berth 401. TEC and PEC exceedances do not extend below 3 feet below mudline in the Berth 401 subsurface sediment samples.

Metals

Zinc is the only metal with concentrations above the PEC in Berth 401 subsurface sediment samples. Samples T4-VC01-1-3 and T4-VC02-1-3 contain zinc TEC exceedances. The concentration of zinc in sample T4-VC02-1-3 is above the PEC, with an exceedance ratio of less than 2. The concentration of mercury in sample T4-VC02-1-3 is above the TEC, with an exceedance ratio of 3. The remaining metals were not detected at concentrations above the TEC in Berth 401 subsurface sediment samples. Metals concentrations in Berth 401 subsurface sediment samples below 3 feet below mudline did not exceed the PEC and TEC.

SVOCs

All PAH concentrations were below the PEC in Berth 401 subsurface sediment samples. Concentrations of phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, and total PAHs were greater than the TEC in at least one of the following samples: T4-VC01-1-3 and T4-VC02-1-3. The remaining PAHs were not detected at concentrations above the TEC. The maximum total PAH TEC exceedance ratio was 3 in sample T4-VC01-1-3. Berth 401 subsurface sediment samples from below 3 feet below mudline did not contain PAH concentrations greater than the TEC or PEC.

Butylbenzyl phthalate was detected in two Berth 401 subsurface sediment samples at a maximum concentration of 170 µg/kg (T4-VC01-1-3). Bis(2-ethylhexyl)phthalate was detected in one Berth 401 subsurface sediment sample at a concentration of 350 µg/kg (T4-VC01-1-3).

Pesticides

All pesticide concentrations were below the PEC in Berth 401 subsurface sediment samples. Total DDD, total DDT, and Σ DDT concentrations were greater than the TEC in at least one of the following samples: T4-VC01-1-3 and T4-VC02-1-3. The remaining pesticide results were below the TEC. The maximum TEC exceedance ratio for Σ DDTs was 4 in sample T4-VC02-1-3. Pesticide concentrations were below the TEC and PEC in Berth 401 subsurface sediment samples from below 3 feet below the mudline.

PCBs

All PCB concentrations were below the PEC in Berth 401 subsurface sediment samples. Total PCB concentrations were greater than the TEC in samples T4-VC01-1-3 and T4-VC02-1-3. The maximum TEC exceedance ratio was 2 in sample T4-VC01-1-3. Total PCB concentrations in Berth 401 subsurface sediment samples below 3 feet below mudline did not exceed the TEC and PEC.

5.3.3.2 Slip 1

Slip 1 subsurface sediment data are compared to SQGs in Table 5-3. Figures 5-29 through 5-32 present the geologic cross sections for Slip 1. Figures 5-41 through 5-44 show chemistry results for lead, zinc, total PAHs, total PCBs, and Σ DDTs posted on the geologic cross sections. Sediments at Slip 1 generally consist of a thin layer of silt underlain by sand. The layer of silt ranges from approximately 1 foot to 3 feet in thickness in the western portion of the slip (west of about T4-VC08), except at T4-VC17, where the silt layer is about 5 feet thick. East of this, the silt layer is thicker, generally greater than 11 feet in thickness. The two exceptions to this stratigraphy in Slip 1 are (1) in the vicinity of T4-VC10 and (2) in the vicinity of T4-VC13 and T4-VC14. In both areas, there is a sand layer underlain by a silt layer underlain by a sand layer.

Metals

Metals concentrations in subsurface sediment samples from locations T4-VC03, T4-VC06, T4-VC13, and T4-VC14 were below the PEC and TEC. Concentrations of lead and zinc in sample T4-VC15-1-3 are greater than the PEC, with exceedance ratios of 2 and 1, respectively. The remaining Slip 1 subsurface sediment samples contained metals concentrations below the PEC.

TEC metals exceedances are limited to the 1-foot to 3-feet below mudline interval in Slip 1 subsurface sediment samples, except in the vicinity of Berth 405, Berth 408, and locations T4-VC12 and T4-VC17. TEC exceedance ratios within the 1-foot to 3-feet below mudline interval are less than 2 except in sample T4-VC07-1-3, which contains concentrations of lead and zinc with TEC exceedance ratios of 2 and 2, respectively. At locations T4-VC12 and T4-VC17, TEC exceedances for metals extended to 5 feet below mudline. The concentrations of copper, lead, mercury, nickel, and zinc were above the TEC in at least one of the following subsurface sediment

samples: T4-VC12-1-3, T4-VC12-3-5, T4-VC17-1-3, and T4-VC17-3-5. The TEC exceedance ratios for these metals were 2 or less. Metals concentrations below 5 feet below mudline were below the TEC in T4-VC12 and T4-VC17 subsurface sediment samples. Subsurface sediment samples from Berth 405 (locations T4-VC08, T4-VC09, and T4-VC10) and Berth 408 (locations T4-VC15 and T4-VC16) contained metals TEC exceedances to a depth of at least 11 feet below mudline (i.e., the deepest samples collected at each location). Location T4-VC08 contained TEC exceedances of nickel in a number of subsurface sediment samples, with exceedance ratios of less than 2. Location T4-VC09 contained TEC exceedances of cadmium, copper, lead, nickel, and zinc in subsurface sediment samples. Concentrations of cadmium, copper, and nickel in T4-VC09 subsurface sediment samples were less than two times the TEC. Concentrations of lead and zinc contained TEC exceedance ratios of 2 or less in samples T4-VC09-1-3 and T4-VC09-3-5. Sample T4-VC10-5-7 contained concentrations of copper, mercury, and nickel above the TEC, with exceedance ratios of less than 2. The remaining subsurface sediment samples at location T4-VC10 were below the PEC and TEC. Locations T4-VC15 and T4-VC16 contained TEC exceedances of cadmium, copper, lead, mercury, nickel, and zinc in subsurface sediment samples. Sediment sample T4-VC15-1-3 contained concentrations of cadmium, lead, and zinc with TEC exceedance ratios of 3, 7, and 5, respectively. The remaining metals TEC exceedance ratios in subsurface sediment samples at locations T4-VC15 and T4-VC16 were less than 2.

SVOCs

The concentrations of individual and total PAHs in subsurface sediment samples from locations T4-VC08, T4-VC10, and T4-VC13 were below the PEC and TEC. Samples T4-VC07-1-3, T4-VC09-1-3, and T4-VC17-3-5 contained PAH PEC exceedances. Total PAH concentrations for these samples were below the PEC.

PAH TEC exceedances occur in the 1-foot to 3-feet below mudline sediment samples except at locations T4-VC04, T4-VC07, T4-VC09, T4-VC12, T4-VC14, T4-VC15, and T4-VC17. These locations can generally be grouped as representing locations near the mouth of the slip (T4-VC04, T4-VC12, and T4-VC17), locations near Berth 405 (T4-VC07 and T4-VC09), and locations near Berth 408 (T4-VC14 and T4-VC15). At the mouth of the slip, TEC exceedances at location T4-VC04 occur in the 1-foot to 3-feet below mudline interval except for a TEC exceedance of pyrene in sample T4-VC04-10-12, with a TEC exceedance ratio of less than 2. Location T4-VC12 contains PAH TEC exceedances in the 1-foot to 3-feet and 3- to 5-feet below mudline intervals, with a maximum total PAH TEC exceedance ratio of 2 in sample T4-VC12-3-5. Sediment samples below this interval contain PAHs at concentrations below the TEC. Location T4-VC17 contains PAH TEC exceedances in the 1-foot to 3-feet, 3- to 5-feet, and 5- to 7-feet below mudline intervals, with a maximum total PAH exceedance ratio of 7 in sample T4-VC17-3-5. Sediment samples below these intervals contain PAH concentrations below the TEC. At Berth 405, PAH TEC exceedances are limited to the upper 5 feet of sediment at locations T4-VC07 and T4-VC09. The maximum total PAH TEC exceedance ratio is 11 in sample T4-VC09-1-3. Sediment samples from T4-VC07 and T4-VC09 collected below 5 feet below the mudline contain PAHs below the TEC. At location T4-VC14, subsurface sediment PAH exceedances are limited to sample T4-VC14-5-7, with a total PAH exceedance ratio of less than 2. At location T4-VC15, PAH exceedance is limited to 5 feet below mudline. The maximum total PAH exceedance ratio is 3 in sample T4-VC15-1-3.

Butylbenzyl phthalate was detected in ten Slip 1 subsurface sediment samples at a maximum concentration of 22 µg/kg in T4-VC09-1-3. Bis(2-ethylhexyl)phthalate was detected in 16 Slip 1 subsurface sediment samples, with a maximum concentration of 470 µg/kg in T4-VC04-3-5.

Pesticides

Pesticide concentrations in subsurface sediment samples at locations T4-VC03, T4-VC06, T4-VC08, T4-VC10, and T4-VC13 were below the PEC and TEC. Total DDD concentrations were greater than the PEC in sample T4-VC17-3-5, with an exceedance ratio of 2. The remaining pesticide concentrations were below the PEC in Slip 1 subsurface sediment samples.

Locations T4-VC04, T4-VC05, T4-VC15, and T4-VC16 contained pesticide TEC exceedances in the 1-foot to 3-feet below mudline interval. Locations T4-VC07, T4-VC09, T4-VC11, T4-VC12, and T4-VC17 contained pesticide exceedances down to 5 feet below mudline. Sample T4-VC14-5-7 contained concentrations of pesticides above the TEC.

PCBs

All total PCB concentrations in Slip 1 subsurface sediment samples were below the PEC. Subsurface sediment samples at locations T4-VC03, T4-VC04, T4-VC05, T4-VC06, T4-VC08, T4-VC10, T4-VC13, T4-VC14, and T4-VC16 contained total PCB concentrations below the PEC and TEC.

Locations near the mouth of Slip 1, near Berth 405, and near Berth 408 contained total PCB concentrations above the TEC. Locations near the mouth of the slip included T4-VC11, T4-VC12, and T4-VC17. Total PCB exceedances did not extend below 5 feet below mudline at these locations. The maximum total PCB TEC exceedance ratio was 4 in sample T4-VC17-3-5. At locations in the vicinity of Berth 405 (T4-VC07 and T4-VC09), total PCB TEC exceedances do not extend below 5 feet below mudline, with a maximum exceedance ratio of 3 in sample T4-VC09-3-5. At Berth 408 (T4-VC15), total PCB exceedances do not extend below 3 feet below mudline, with an exceedance ratio of 3 in sample T4-VC15-1-3.

5.3.3.3 Wheeler Bay

Wheeler Bay subsurface sediment data are compared to SQGs in Table 5-4. Figures 5-29, 5-33, and 5-34 present the geologic cross sections for Wheeler Bay. Figures 5-41, 5-45, and 5-46 show chemistry results for lead, zinc, total PAHs, total PCBs, and Σ DDTs posted on the geologic cross sections. Sediments at Wheeler Bay generally consist of silt underlain by sand. The layer of silt ranges from approximately 2 to 3 feet in thickness near the shore (T4-VC18 and T4-VC19) to greater than 12 feet in thickness in the center of the bay and near the harbor line (T4-VC20 and T4-VC21).

Metals

Concentrations of lead and mercury were above the PEC in sample T4-PS21-15-17, with exceedance ratios of 24 and 1, respectively. The remaining Wheeler Bay subsurface sediment samples had metals concentrations below the PEC.

Metals TEC exceedances in locations T4-VC18 and T4-VC19 were limited to the 3- to 5-feet and 1-foot to 3-feet below mudline intervals, respectively. Metals exceedance ratios (including copper and lead) were less than

2 in samples T4-VC18-3-5 and T4-VC19-1-3. Locations T4-VC20 and T4-VC21 contained metals TEC exceedances to the bottom of the core, 22 feet below mudline. These two locations contained copper, lead, mercury, nickel, and zinc TEC exceedances. Copper exceedance ratios were less than 2 except in sample T4-PS21-15-17, which had an exceedance ratio of 3. Nickel and mercury exceedance ratios were less than 2, excepting mercury in sample T4-PS21-15-17 with an exceedance ratio of 9. Lead and zinc exceedance ratios were greater than 2 in samples T4-VC20-7-9 and T4-PS21-15-17.

SVOCs

Concentrations of PAHs were above the PEC in samples T4-VC19-1-3, T4-VC20-11-13, T4-PS20-15-17, T4-VC21-7-9, T4-VC21-9-11, and T4-PS21-15-17. The maximum total PAH PEC exceedance ratio of 4 occurred in sample T4-VC19-1-3. Concentrations of at least one PAH were above the TEC in each Wheeler Bay subsurface sediment sample except samples T4-VC20-1-3 and T4-VC21-1-3.

Butylbenzyl phthalate was detected in five Wheeler Bay subsurface sediment samples, with a maximum concentration of 110 µg/kg in T4-PS21-15-17. Bis(2-ethylhexyl)phthalate was detected in nine Wheeler Bay subsurface sediment samples, with a maximum concentration of 3,000 µg/kg in T4-VC20-5-7.

Pesticides

All pesticide concentrations were below the PEC in Wheeler Bay subsurface sediment samples. Total DDD, DDE, total DDT, and Σ DDT concentrations in at least one Wheeler Bay subsurface sediment sample were greater than the TEC. The highest Σ DDTs exceedance ratio was 9 in sample T4-VC20-7-9.

PCBs

All total PCB concentrations in Wheeler Bay subsurface sediment samples were below the PEC. Total PCB concentrations in samples T4-VC18-3-5 and T4-VC19-3-5 were above the TEC, with exceedance ratios of less than 2. At location T4-VC20, total PCB exceedances occurred in sample intervals 5 to 7 feet, 7 to 9 feet, 9 to 11 feet, 11 to 13 feet, and 15 to 17 feet (no sample was taken at 13 to 15 feet). The maximum TEC exceedance ratio of 4 occurred in sample T4-VC20-9-11. At location T4-VC21, total PCB exceedances occurred in sample intervals 5 to 7 feet, 7 to 9 feet, 9 to 11 feet, and 11 to 13 feet. The maximum TEC exceedance ratio of 2 occurred in sample T4-VC21-5-7.

5.3.3.4 Slip 3

Slip 3 subsurface sediment data are compared to SQGs in Table 5-5. Figures 529 and 5-35 through 5-40 present the geologic cross sections for Slip 3. Figures 5-41 and 5-47 through 5-52 show chemistry results for lead, zinc, total PAHs, total PCBs, and Σ DDTs posted on the geologic cross sections. Sediments at Slip 3 generally consist of silt underlain by sand. The silt layer is not present near Berths 410 and 411, particularly at locations T4-VC22, T4-VC23, and T4-PS33.

Metals

Metals concentrations in subsurface sediment samples from locations T4-VC23, T4-VC25, and T4-VC27 were below the PEC and TEC. Concentrations of mercury in sample T4-VC22-9-11 and lead in samples T4-VC24-1-3, T4-VC29-1-3, T4-VC29-3-5, T4-VC32-1-3, and T4-VC32-3-5 were above the PEC. PEC exceedance ratios were 2 or less for mercury and lead in these samples.

Locations T4-VC22, T4-VC24, T4-VC26, T4-VC28, T4-VC29, T4-VC32, and T4-VC33 contained subsurface sediment samples with concentrations above the TEC of at least one of the following metals: arsenic, cadmium, copper, mercury, nickel, lead, and zinc. Exceedance ratios for these metals tended to be less than 2 except for lead and mercury in sample T4-VC22-9-11, which had exceedance ratios of greater than 2.

SVOCs

Concentrations of individual and total PAHs in subsurface sediment samples from locations T4-VC22, T4-VC23, T4-VC25, T4-VC27, T4-VC28, and T4-VC33 were below the PEC and TEC. Concentrations of PAHs in samples T4-VC24-1-3, T4-VC26-1-3, T4-VC29-1-3, T4-VC29-3-5, T4-VC32-1-3, and T4-VC32-3-5 were above the PEC, with the maximum total PAH PEC exceedance ratio of 3 in sample T4-VC29-1-3. TEC PAH exceedance ratios occur at location T4-VC24 to 1 foot to 3 feet below mudline and locations T4-VC26, T4-VC29, and T4-VC32 to 3 to 5 feet below mudline. Sample T4-VC32-15-17 also contained concentrations of PAHs above the TEC.

Butylbenzyl phthalate was detected in four Slip 3 subsurface sediment samples at a maximum concentration of 13 µg/kg in T4-VC26-1-3. Bis(2-ethylhexyl)phthalate was detected in 14 Slip 3 subsurface sediment samples, with a maximum concentration of 180 µg/kg in T4-VC32-3-5.

Pesticides

Pesticide concentrations in subsurface sediment samples from locations T4-VC22, T4-VC23, T4-VC24, T4-VC25, T4-VC27, T4-VC28, and T4-VC33 were below the PEC or TEC. Concentrations of total DDD and total DDT were above the PEC in sample T4-VC29-1-3, with exceedance ratios of 2 and 1, respectively.

T4-VC26 contained pesticide TEC exceedances down to 5 to 7 feet below mudline, with a maximum TEC exceedance ratio for Σ DDTs of 5 in sample T4-VC26-3-5. Location T4-VC29 contained TEC pesticide exceedances down to 3 to 5 feet, with a maximum exceedance ratio for Σ DDTs of 33 in sample T4-VC29-1-3. T4-VC32 contained pesticide TEC exceedances down to 3 to 5 feet, with a maximum exceedance ratio of 3 in sample T4-VC32-1-3.

PCBs

The concentrations of total PCBs in subsurface sediment samples from locations T4-VC22, T4-VC23, T4-VC24, T4-VC25, T4-VC27, T4-VC28, and T4-VC33 were below the PEC or TEC. The concentration of total PCBs was above the PEC in sample T4-VC29-1-3, with an exceedance ratio of less than 2. T4-VC26-3-5

contained total PCBs above the TEC with an exceedance ratio of 3. T4-VC29-1-3 contained total PCBs above the TEC with an exceedance ratio of 16. T4-VC32-1-3 contained total PCBs above the TEC with an exceedance ratio of less than 2.

5.3.3.5 North of Berth 414

North of Berth 414 subsurface sediment data are compared to SQGs in Table 5-6. Figure 5-29 presents the geologic cross section for north of Berth 414. Figure 5-41 shows chemistry results for lead, zinc, total PAHs, total PCBs, and Σ DDTs posted on the geologic cross section. Sediments at north of Berth 414 generally consist of silt underlain by sand. The layer of silt ranges from approximately 8 to 9 feet in thickness.

Metals

All metals results were below the PEC in north of Berth 414 subsurface sediment samples. Concentrations of cadmium, copper, lead, mercury, and zinc were above the TEC in north of Berth 414 subsurface sediment samples. Metals TEC exceedances extended to 7 to 9 feet below mudline at location T4-VC30 and to 20.5 to 22.5 feet below mudline at location T4-VC31 (the bottom sample in the core). The concentrations of cadmium and copper are less than two times the TEC. The maximum lead and zinc exceedance ratios are 3 and 2, respectively, in sample T4-VC30-5-7. The maximum mercury exceedance is 4 in sample T4-VC31-7-9.

SVOCs

All PAH concentrations were below the PEC in north of Berth 414 subsurface sediment samples. PAH TEC exceedances extend to 7 to 9 feet below mudline at location T4-VC30 and 9 to 11 feet below mudline at location T4-VC31. The maximum total PAH TEC exceedance ratio is 3 in sample T4-VC31-7-9.

Butylbenzyl phthalate was detected in three north of Berth 414 subsurface sediment samples, with maximum concentrations of 7.5 µg/kg in T4-VC30-5-7 and T4-VC31-3-5. Bis(2-ethylhexyl)phthalate was detected in five north of Berth 414 subsurface sediment samples, with a maximum concentration of 72 µg/kg in T4-VC31-1-3.

Pesticides

All pesticide concentrations were below the PEC in north of Berth 414 surface sediment samples. Total DDD, total DDE, total DDT, and Σ DDT concentrations above the TEC extend to 7 to 9 feet below mudline at location T4-VC30 and 15 to 17 feet below mudline at location T4-VC31. The maximum exceedance ratio for Σ DDTs was 7 in sample T4-VC30-7-9.

PCBs

All total PCB concentrations in north of Berth 414 surface sediment samples were below the PEC. Total PCB TEC exceedances extended to 7 to 9 feet below mudline at location T4-VC30 and to 3 to 5 feet below mudline at location T4-VC31. The maximum total PCB TEC exceedance ratio was 2 in sample T4-VC30-3-5.

5.4 Dredged Sediment Quality Characteristics

This section presents a limited evaluation of the dredged sediment quality characteristics, including the evaluation of:

- water quality impacts during dredging;
- sediment quality characteristics impacting onsite disposal; and
- sediment quality characteristics impacting offsite disposal in a Subtitle D landfill.

A number of complex congener families were evaluated using summations of certain analytes within the family. Section 4.3 describes how the summations were calculated. A more complete analysis of dredged sediment quality will be presented in the EE/CA.

5.4.1 Potential Water Quality Impacts During Dredging

Two DRETs were performed, one on a composite sediment sample from Berth 401 and Slip 1 (T4-CM1-DRET) using surface water from Slip 1 (T4-CM1), the other on a composite sediment sample from Wheeler Bay, Slip 3, and north of Berth 414 (T4-CM2-DRET) using surface water from Slip 3 (T4-CM2). The DRET chemistry results are discussed in Section 4.4.2. During the EE/CA, DRET results will be compared to relevant surface water quality criteria to evaluate potential impacts to surface water during dredging.

5.4.2 Sediment Quality Characteristics Impacting Onsite Disposal

One CST and one MET were performed on a composite sediment sample from Wheeler Bay, Slip 3, and north of Berth 414 (T4-CM2-DRET) using surface water from Slip 3 (T4-CM2). The CST and MET results are discussed in Section 4.4.3. During the EE/CA, CST and MET results will be evaluated to determine design characteristics for the CDF, particularly aspects of the CDF that impact dredged material settling characteristics/velocity (the CST) and short-term water quality impacts from effluent from the CDF (the MET).

5.4.3 Sediment Quality Characteristics Impacting Offsite Disposal in a Subtitle D Landfill

Data were collected to evaluate sediment quality characteristics impacting offsite disposal in a subtitle D landfill, including:

- hazardous waste characteristics, including ignitability, corrosivity, reactivity, and TCLP;
- a TSCA determination;
- data on the generation and loss of free liquid (paint filter test); and
- landfill-specific acceptance criteria.

Two composite sediment samples were analyzed for hazardous waste characteristics and generation and loss of free liquid. One composite sediment sample (T4-CM1) consisted of the cores collected from Berth 401 and Slip 1. The other sample (T4-CM2) consisted of cores from Wheeler Bay, Slip 3, and north of Berth 414. Discrete surface, under-pier, and subsurface sediment samples were analyzed for PCBs and TPH. These data will be used in the TSCA determination and landfill-specific acceptance determination. Results of these analyses are presented in Sections 4.3 and 4.4.

The two composite sediment samples did not display hazardous waste characteristics. Ignitability, corrosivity, and reactivity results did not display hazardous waste characteristics. TCLP results were less than the maximum concentrations of contaminants for the toxicity characteristic (CFR 40.261.23), as presented in Table 5-10. The two composite sediment samples passed the paint filter test, indicating the dredged material would likely be acceptable for transport from Terminal 4, because free liquid was not generated during the paint filter test.

PCB and TPH results will be compared to the waste acceptance criteria of landfills considered as upland disposal sites for dredged sediment, if such an alternative is considered during the EE/CA.

5.5 Hydraulics and Sedimentation Characteristics

This section presents a general characterization of hydraulics and sedimentation in the Removal Action Area based on previously existing information summarized in the EE/CA work plan (BBL, 2004a) and the additional data collected in April and May 2004. The methods used to collect supplemental data during the field program are presented in Section 3.5. The results of the field program are presented in Section 4.5, which describes the temporal variation in near-bottom velocity and turbidity, the spatial variation in river-induced currents in the slips, and the sediment depositional flux and associated contaminants at the various measurement locations during relatively low-flow, low-rainfall conditions. The water level data collected using one downstream tide gage and two pressure transducers/data loggers in Slip 3 provide needed information to develop a hydrodynamic/sediment transport model of the Lower Willamette River in the vicinity of the Removal Action Area. Information on hydraulics and sedimentation characteristics will be further developed to assess the long-term effectiveness of various Removal Action alternatives through an evaluation of recontamination potential during and after implementation of the Removal Action.

Hydraulics within Slips 1 and 3 of the Removal Action Area are affected by variations in river flow, river stage, ship-induced currents, and, to a lesser extent, localized currents from stormwater discharges.

During the relatively low-flow, low-rainfall conditions encountered during the field program, measured current velocities were low within the slips, and measurements were often comparable to the measurement accuracy (referred to as “noise”) of the ADCP and ADCM equipment, with the notable exceptions of velocity spikes detected when ships were entering or leaving Slip 3. The ADCP data indicate the presence of a clockwise eddy caused by the river near the mouth of Slip 3. In general, given the orientation of the slips relative to the river, river-induced currents in the slips will always be relatively low in velocity compared to the river velocity and will manifest as relatively weak eddy currents. Given the limited period of measurement under relatively low-flow conditions, available data may be insufficient to assess whether river-induced currents can cause resuspension of sediments within the slips. The ADCP data indicate that secondary eddy currents caused by the

river may induce upstream flow in Wheeler Bay. Intuitively, the ADCP data also show that the highest velocity river-induced currents occur along the front of the Removal Action Area bordering the main river.

While river-induced currents have an influence on hydraulics of the Removal Action Area, the ADCM data indicate that current velocities are dominated by propeller-induced currents, even in areas outside of the paths that ships take to and from Terminal 4 berths. The data indicate that a deep-draft vessel moving under its own power (or even with tug assistance) can generate very high near-bottom current velocities when the propeller is only a few feet from the bottom of the slip. Although tugs have shallower drafts, tug propellers generate high current velocities, which may also have important impacts on near-bottom velocities and sediment transport.

Comparison of the ADCM data and ship arrival/departure logs indicates that propeller-induced currents cause circulation and increased velocities and turbidity levels far from the paths that ships take in Slip 3. Additionally, sediment trap samples contained interbedded sand and silt layers, possibly reflecting redistribution and transport of sand particles caused by ship scour. Although there may be additional causes of sedimentation, it can reasonably be concluded that sediment redistribution and transport by propeller-induced currents have important effects on overall hydrodynamics and sediment transport in the Removal Action Area.

Data collected during the recent field program indicate that propeller-induced currents are a dominant process affecting hydraulics and sediment redistribution within the Removal Action Area. Ship-induced currents scour and redistribute bottom sediments along the ship paths to other lower-energy areas not directly affected by periodic propeller scour.

The recent sediment trap data also indicate that ongoing river-induced sedimentation of suspended sediments occurs nearly continuously throughout the Removal Action Area. The periodic redistribution of this material affects long-term sediment accumulation patterns within the slips. Port bathymetric and dredging records indicate a “trench” scoured into the bottom of Slip 3 angling back toward the northeast berthing area. Detailed bathymetry maps reveal what appears to be a corresponding “berm” of mounded sediment alongside a section of this trench that may be caused by the relocation of sediments via propeller scour. Finer sediments are subject to broader redistribution than are sandy sediments resuspended by propeller scour and are carried by the ship-induced currents to other areas of Terminal 4.

Data gathered during the field program are not representative of high-flow, high-rainfall periods, so characterization of hydraulics and sedimentation in the slips under such conditions is not supported by these data. Additionally, although propeller-induced currents appear to be a more significant factor in sediment transport within the slips than are river-induced currents, the data are not sufficient for modeling potential sediment redistribution for the purposes of the recontamination assessment. Characterization of hydraulics and sedimentation under high-flow conditions and ship-induced currents will be further examined during the recontamination assessment being conducted for the EE/CA. Sediment supply and deposition from stormwater runoff sources will also be considered for further assessment during the analysis of recontamination potential.

Table 5-1 Vertical Groundwater Hydraulic Gradient and Gradient Direction

	Screen Midpoint Elevation Difference (ft)	Date										
		4/6/04	4/21/04	4/29/04	5/5/04	5/13/04	5/20/04	5/25/04	6/3/04	Minimum	Maximum	Mean
Monitoring Well Cluster T4-MW01												
Groundwater Elevation (ft CRD)												
T4-MW01S			5.80	3.61	4.62	5.56	5.58	5.73	7.91	3.61	7.91	5.54
T4-MW01I			6.06	3.59	4.66	5.59	5.52	5.68	8.32	3.59	8.32	5.63
T4-MW01D			6.11	3.73	4.73	5.66	5.62	5.75	8.31	3.73	8.31	5.70
Groundwater Elevation Difference (ft)												
T4-MW01S - T4-MW01I			-0.26	0.02	-0.04	-0.03	0.06	0.05	-0.41	-0.41	0.06	-0.09
T4-MW01I - T4-MW01D			-0.05	-0.14	-0.07	-0.07	-0.10	-0.07	0.01	-0.14	0.01	-0.07
Vertical Hydraulic Gradient (ft/ft)												
T4-MW01S - T4-MW01I	34.34		-0.0076	0.0006	-0.0012	-0.0009	0.0017	0.0015	-0.012	-0.012	0.0017	-0.0025
T4-MW01I - T4-MW01D	134.90		-0.00037	-0.00104	-0.00052	-0.00052	-0.00074	-0.00052	0.000074	-0.0010	0.000074	-0.00052
Vertical Hydraulic Gradient Direction												
T4-MW01S - T4-MW01I			Upward	Downward	Upward	Upward	Downward	Downward	Upward	Downward	Upward	Downward
T4-MW01I - T4-MW01D			Upward	Upward	Upward	Upward	Upward	Upward	Downward	Downward	Upward	Downward
Monitoring Well Cluster T4-MW02												
Groundwater Elevation (ft CRD)												
T4-MW02S			16.23	13.95	15.89	15.76	15.65	15.62	15.51	13.95	16.23	15.52
T4-MW02I			16.44	16.47	16.35	16.27	16.14	16.12	16.02	16.02	16.47	16.26
T4-MW02D			6.28	4.17	4.70	5.95	5.58	5.93	8.16	4.17	8.16	5.82
Groundwater Elevation Difference (ft)												
T4-MW02S - T4-MW02I			-0.21	-2.52	-0.46	-0.51	-0.49	-0.50	-0.51	-2.52	-0.21	-0.74
T4-MW02I - T4-MW02D			10.16	12.30	11.65	10.32	10.56	10.19	7.86	7.86	12.30	10.43
Vertical Hydraulic Gradient (ft/ft)												
T4-MW02S - T4-MW02I	14.86		-0.014	-0.170	-0.031	-0.034	-0.033	-0.034	-0.034	-0.17	-0.01	-0.050
T4-MW02I - T4-MW02D	119.50		0.085	0.10	0.097	0.086	0.088	0.085	0.066	0.066	0.10	0.087
Vertical Hydraulic Gradient Direction												
T4-MW02S - T4-MW02I			Upward	Upward	Upward	Upward	Upward	Upward	Upward	Upward	Upward	Upward
T4-MW02I - T4-MW02D			Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
Monitoring Well Cluster T4-MW03												
Groundwater Elevation (ft CRD)												
T4-MW03S			11.25	12.14	12.12	12.06	11.99	11.99	12.01	11.25	12.14	11.94
T4-MW03I/D			6.29	4.07	4.61	5.99	6.35	5.89	8.11	4.07	8.11	5.90
Groundwater Elevation Difference (ft)												
T4-MW03S - T4-MW03I/D			4.96	8.07	7.51	6.07	5.64	6.10	3.90	3.90	8.07	6.04
Vertical Hydraulic Gradient (ft/ft)												
T4-MW03S - T4-MW03I/D	159.30		0.031	0.051	0.047	0.038	0.035	0.038	0.024	0.024	0.051	0.038
Vertical Hydraulic Gradient Direction												
T4-MW03S - T4-MW03I/D			Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward

Table 5-1 Vertical Groundwater Hydraulic Gradient and Gradient Direction

	Screen Midpoint Elevation Difference (ft)	Date										
		4/6/04	4/21/04	4/29/04	5/5/04	5/13/04	5/20/04	5/25/04	6/3/04	Minimum	Maximum	Mean
Monitoring Well Cluster T4-MW04												
Groundwater Elevation (ft CRD)												
T4-MW04S			6.29	3.85	6.68	6.08	5.43	5.85	8.07	3.85	8.07	6.04
T4-MW04I			6.26	2.93	6.64	6.06	5.37	5.85	8.04	2.93	8.04	5.88
Groundwater Elevation Difference (ft)												
T4-MW04S - T4-MW04I			0.03	0.9	0.04	0.02	0.06	0.00	0.03	0.00	0.92	0.16
Vertical Hydraulic Gradient (ft/ft)												
T4-MW04S - T4-MW04I	16.61		0.0018	0.055	0.0024	0.0012	0.0036	0.00	0.0018	0.00	0.055	0.0095
Vertical Hydraulic Gradient Direction												
T4-MW04S - T4-MW04I			Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
Monitoring Well Cluster T4-MW05												
Groundwater Elevation (ft CRD)												
T4-MW05S		16.33	16.10	16.02	15.93	15.80	15.69	15.63	15.52	15.52	16.10	15.81
T4-MW05I		6.68	6.67	6.61	6.52	6.73	6.69	6.73	6.94	6.52	6.94	6.70
Groundwater Elevation Difference (ft)												
T4-MW05S - T4-MW05I		9.65	9.43	9.41	9.41	9.07	9.00	8.90	8.58	8.58	9.43	9.11
Vertical Hydraulic Gradient (ft/ft)												
T4-MW05S - T4-MW05I	44.30	0.22	0.21	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.21	0.21
Vertical Hydraulic Gradient Direction												
T4-MW05S - T4-MW05I		Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
Monitoring Well Cluster T4-MW06												
Groundwater Elevation (ft CRD)												
T4-MW06S		4.13		3.55	5.84	5.84	6.05	5.78	8.11	3.55	8.11	5.86
T4-MW06I		3.42		3.67	6.45	6.06	6.51	5.21	7.85	3.42	7.85	5.96
T4-MW06D		3.40		3.35	6.25	5.95	6.49	5.59	7.75	3.35	7.75	5.90
Groundwater Elevation Difference (ft)												
T4-MW06S - T4-MW06I		0.71		-0.12	-0.61	-0.22	-0.46	0.57	0.26	-0.61	0.57	-0.10
T4-MW06I - T4-MW06D		0.02		0.32	0.20	0.11	0.02	-0.38	0.10	-0.38	0.32	0.06
Vertical Hydraulic Gradient (ft/ft)												
T4-MW06S - T4-MW06I	33.95	0.021		-0.0035	-0.018	-0.0065	-0.014	0.017	0.0077	-0.018	0.017	-0.0028
T4-MW06I - T4-MW06D	144.95	0.00014		0.0022	0.0014	0.00076	0.00014	-0.0026	0.00069	-0.0026	0.0022	0.00043
Vertical Hydraulic Gradient Direction												
T4-MW06S - T4-MW06I		Downward		Upward	Upward	Upward	Upward	Downward	Downward	Upward	Downward	Upward
T4-MW06I - T4-MW06D		Downward		Downward	Downward	Downward	Downward	Upward	Downward	Upward	Downward	Downward

Notes:
Negative groundwater elevation differences indicate that groundwater in the upper aquifer is lower in elevation than groundwater in the lower aquifer.
Negative vertical gradients indicate an upward gradient.
ft - feet
ft CRD - feet Columbia River Datum
ft/ft - feet/feet

Table 5-2
Selected Berth 401 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC01-0-1 K2401958-011 03/16/2004	T4-VC01-1-3 K2401958-012 03/16/2004	T4-VC01-3-5 K2401958-013 03/16/2004	T4-VC02-0-1 K2402051-001 03/18/2004	T4-VC02-1-3 K2402051-002 03/18/2004	T4-VC02-3-5 K2402051-003 03/18/2004	T4-VC02-5-7 K2402051-005 03/18/2004	T4-VC02-7-9 K2402051-006 03/18/2004
Metals (mg/kg)										
Arsenic	9.79	33	3.8	3.5	3.6	3.4	3.4	2.9	2.5	2.9
Cadmium	0.99	4.98	0.46	0.54	0.1	0.228	0.191	0.049 B	0.058	0.066
Chromium	43.4	111	30.4 J	17.5 J	14 J	20.3 J	10.8 J	10 J	10 J	11.7 J
Copper	31.6	149	44.3 J	28.3 J	16.5 J	28.1 J	18.2 J	12.6 J	12.4 J	13.5 J
Lead	35.8	128	22.5	31.9	6.4	15.8	13.6	4.32	2.39	2.56
Mercury	0.18	1.06	0.094	0.118	0.015 B	0.05	0.541	0.008 B	0.011 B	0.019 U
Nickel	22.7	48.6	24.8 J	21.2 J	19.4 J	19.5 J	14.6 J	14.4 J	14.2 J	16.3 J
Selenium	NS	NS	0.17 J	0.12 J	0.1 UJ	0.07 J	0.12 UJ	0.11 UJ	0.11 UJ	0.11 J
Silver	NS	NS	0.26	0.09	0.03	0.31	0.11	0.02 U	0.02 U	0.02 U
Zinc	121	459	111 J	151 J	48 J	79.9 J	566 J	39.4 J	50.1 J	45.2 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	22	90	17	14	140	1.3 J	5.0 U	5.0 U
2-Methylnaphthalene	NS	NS	8.8	68	4.0 J	4.8 J	95	1.0 J	5.0 U	5.0 U
1-Methylnaphthalene	NS	NS	5.2	36	2.5 J	3.2 J	42	0.78 J	5.0 U	5.0 U
Biphenyl	NS	NS	4.8 J	15	2.2 J	5.1 U	24	5.0 U	5.0 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	7.7	74	3.9 J	3.3 J	62	0.46 J	5.0 U	5.0 U
Acenaphthylene	NS	NS	8.0	28	4.9 J	6.7	24	0.78 J	5.0 U	5.0 U
Acenaphthene	NS	NS	26	69	6.2	14	76	0.93 J	5.0 U	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	11	98	3.6 J	3.5 J	24	5.0 U	5.0 U	5.0 U
Fluorene	77.4	536	22	77	4.5 J	11	70	0.91 J	5.0 U	5.0 U
Phenanthrene	204	1,170	170	690	86	65	440	3.1 J	5.0 U	5.0 U
Anthracene	57.2	845	35	130	9.0	18	130	1.0 J	5.0 U	5.0 U
1-Methylphenanthrene	NS	NS	22	82	5.7	6.0	44	0.28 J	5.0 U	5.0 U
Fluoranthene	423	2,230	340	900	39	130	440	3.6 J	5.0 U	5.0 U
Pyrene	195	1,520	410	1,300	80	150	640	6.3	5.0 U	5.0 U
Benz(a)anthracene	108	1,050	180	320	12	69	190	3.3 J	5.0 U	5.0 U
Chrysene	166	1,290	240	450	17	99	240	4.8 J	5.0 U	5.0 U
Benzo(b)fluoranthene	NS	NS	230	310	11	90	200	5.0 J	5.0 U	5.0 U
Benzo(k)fluoranthene	NS	NS	190	290	12	75	190	5.3	5.0 U	5.0 U
Benzo(e)pyrene	NS	NS	190	300	13	82	180	5.8	5.0 U	5.0 U

Table 5-2
Selected Berth 401 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC01-0-1 K2401958-011 03/16/2004	T4-VC01-1-3 K2401958-012 03/16/2004	T4-VC01-3-5 K2401958-013 03/16/2004	T4-VC02-0-1 K2402051-001 03/18/2004	T4-VC02-1-3 K2402051-002 03/18/2004	T4-VC02-3-5 K2402051-003 03/18/2004	T4-VC02-5-7 K2402051-005 03/18/2004	T4-VC02-7-9 K2402051-006 03/18/2004
Benzo(a)pyrene	150	1,450	230	400	15	98	250	6.9 J	5.0 U	5.0 U
Perylene	NS	NS	190	130	19	47	92	3.0 J	2.8 J	0.50 J
Indeno(1,2,3-cd)pyrene	NS	NS	200	340	13	83	190	4.6 J	5.0 U	5.0 U
Dibenz(a,h)anthracene	33	NS	32	38	1.2 J	13	29	0.51 J	5.0 U	5.0 U
Benzo(g,h,i)perylene	NS	NS	190	380	18	85	200	6.5	5.0 U	5.0 U
Dimethyl phthalate	NS	NS	19 J	40 U	20 U	21 U	20 U	20 U	20 U	20 U
Diethyl phthalate	NS	NS	40 U	40 U	20 U	21 U	20 U	20 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	40 U	40 U	20 U	61 U	20 U	20 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	93	170	20 U	21 U	17 J	20 U	20 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	1400	350	20 U	490	76 U	20 U	20 U	20 U
Di-n-octyl phthalate	NS	NS	29 J	40 U	20 U	21 U	20 U	20 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	2,103	5,054	314	840	3,030	43	5.0 U	5.0 U
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	7.0 J	0.44 U	0.42 U	3.8 J	4.0 U	0.40 U	0.40 U	0.40 U
4,4'-DDD	NS	NS	4.7	1.0	0.42 U	4.5	2.6 J	0.40 U	0.40 U	0.40 U
4,4'-DDT	NS	NS	12 J	4.3 U	0.42 U	3.1 J	9.9	0.099 J	0.40 U	0.40 U
2,4'-DDE	NS	NS	0.15 J	0.43 U	0.42 U	4.1 U	4.0 U	0.40 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	2.1 U	5.2	0.42 U	4.1 U	4.0 U	0.40 U	0.40 U	0.40 U
2,4'-DDT	NS	NS	5.1	3.7 J	0.42 U	4.1 U	8.8 J	0.40 U	0.40 U	0.40 U
Total DDD (c,e)	4.88	28	4.7	6.2	0.42 U	4.5	2.6 J	0.40 U	0.40 U	0.40 U
Total DDE (c,f)	3.16	31.3	7.2 J	0.44 U	0.42 U	3.8 J	4.0 U	0.40 U	0.40 U	0.40 U
Total DDT (c,g)	4.16	62.9	17	3.7 J	0.42 U	3.1 J	19	0.099 J	0.40 U	0.40 U
ΣDDTs (c,h)	5.28	572	29	9.9	0.42 U	11	21	0.099 J	0.40 U	0.40 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	6.7 U	5.3 U	5.3 U	5.1 U	25 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	14 U	11 U	11 U	11 U	50 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	6.7 U	5.3 U	5.3 U	5.1 U	25 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	120	69	5.3 U	5.1 U	25 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	6.7 U	5.3 U	5.3 U	6.1	25 U	5.0 U	5.0 U	5.0 U
Aroclor 1254	NS	NS	130	82	5.3 U	11 U	140	5.0 U	5.0 U	5.0 U

Table 5-2
Selected Berth 401 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC01-0-1 K2401958-011 03/16/2004	T4-VC01-1-3 K2401958-012 03/16/2004	T4-VC01-3-5 K2401958-013 03/16/2004	T4-VC02-0-1 K2402051-001 03/18/2004	T4-VC02-1-3 K2402051-002 03/18/2004	T4-VC02-3-5 K2402051-003 03/18/2004	T4-VC02-5-7 K2402051-005 03/18/2004	T4-VC02-7-9 K2402051-006 03/18/2004
Aroclor 1260	NS	NS	6.7 U	5.3 U	5.3 U	8.7	25 U	5.0 U	5.0 U	5.0 U
Aroclor 1262	NS	NS	6.7 U	5.3 U	5.3 U	5.1 U	25 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	6.7 U	5.3 U	5.3 U	5.1 U	25 U	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	250	151	11 U	15	140	10 U	10 U	10 U
Conventionals (percent)										
Total organic carbon	NS	NS	1.83	1.15	0.18 U	1.43	0.82	0.04 J	0.25	0.03 J
Total solids	NS	NS	57.4	78.8	79.9	66.2	83.6	79.1	74.7	75.8

Table 5-2
Selected Berth 401 Surface and Subsurface Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC03-0-1 K2401908-001 03/16/2004	T4-VC03-1-3 K2401908-002 03/16/2004	T4-VC03-3-5 K2401908-003 03/16/2004	T4-VC03-5-7 K2401908-004 03/16/2004	T4-PS03-11-13 K2402526-024 04/02/2004	T4-PS03-15-17 K2402526-025 04/02/2004	T4-VC04-0-1 K2401908-005 03/16/2004	T4-VC04-1-3 K2401908-006 03/16/2004
Metals (mg/kg)										
Arsenic	9.79	33	3.4	3.3	2.4	2.6	3.4	2.2	3.7	4.5
Cadmium	0.99	4.98	0.25	0.12	0.09	0.12	0.12	0.11	0.31	0.36
Chromium	43.4	111	21.2 J	13 J	10.9 J	9.66 J	11.4	10.5	24.3 J	28.4 J
Copper	31.6	149	31.7 J	16.3 J	14.7 J	14.8 J	30.4	26.1	35.8 J	40.7 J
Lead	35.8	128	13	6.33	2.48	2.5	5.13	3.75	21.7	20.5
Mercury	0.18	1.06	0.048 J	0.021 J	0.012 J	0.026 J	0.01 B	0.02 U	0.096 J	0.067 J
Nickel	22.7	48.6	20.4 J	17.9 J	16.1 J	14.4 J	15.7 J	14.7 J	21.4 J	25.1 J
Selenium	NS	NS	0.09 J	0.03 J	0.11 UJ	0.12 UJ	0.1 UJ	0.11 UJ	0.15 J	0.17 J
Silver	NS	NS	0.12	0.03	0.02	0.03	0.06	0.03	0.19	0.2
Zinc	121	459	77.7 J	54.7 J	41.7 J	35.9 J	43 J	40.3 J	86.4 J	106 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	11	32	0.27 J	0.52 J	8.9	0.56 J	19	25
2-Methylnaphthalene	NS	NS	3.3 J	12	5.0 U	4.9 U	2.1 J	5.0 U	9.3	8.9
1-Methylnaphthalene	NS	NS	2.4 J	9.7	5.0 U	4.9 U	1.2 J	5.0 U	6.8	4.5 J
Biphenyl	NS	NS	2.3 J	4.1 J	5.0 U	4.9 U	5.1 U	5.0 U	4.0 J	3.2 J
2,6-Dimethylnaphthalene	NS	NS	3.0 J	9.3	5.0 U	4.9 U	1.3 J	5.0 U	6.1	5.2
Acenaphthylene	NS	NS	4.4 J	5.9	5.0 U	0.32 J	1.5 J	5.0 U	9.9	5.4
Acenaphthene	NS	NS	16	15	0.51 J	72	11	1.3 J	29	32
2,3,5-Trimethylnaphthalene	NS	NS	3.1 J	6.0	5.0 U	4.9 U	0.97 J	5.0 U	5.5	3.7 J
Fluorene	77.4	536	11	14	5.0 U	4.9 U	1.9 J	0.28 J	32	20
Phenanthrene	204	1,170	60	78	5.0 U	4.9 U	18	2.0 J	210	120
Anthracene	57.2	845	14	17	5.0 U	4.9 U	3.0 J	0.34 J	34	25
1-Methylphenanthrene	NS	NS	5.3	8.4	5.0 U	0.17 J	1.5 J	0.21 J	18	8.7
Fluoranthene	423	2,230	98	130	5.0 U	4.9 U	18	3.2 J	380	210
Pyrene	195	1,520	130	220	5.0 U	4.9 U	25	3.4 J	440	260
Benz(a)anthracene	108	1,050	43	61	0.17 J	0.24 J	7.2	1.5 J	170	130
Chrysene	166	1,290	64	66	0.27 J	0.43 J	10	2.3 J	240	170
Benzo(b)fluoranthene	NS	NS	53	40	0.34 J	0.24 J	7.1	2.0 J	230	180
Benzo(k)fluoranthene	NS	NS	52	44	0.21 J	0.22 J	6.7	1.4 J	180	160
Benzo(e)pyrene	NS	NS	48	41	0.21 J	0.23 J	7.0	1.7 J	180	140

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC03-0-1	T4-VC03-1-3	T4-VC03-3-5	T4-VC03-5-7	T4-PS03-11-13	T4-PS03-15-17	T4-VC04-0-1	T4-VC04-1-3
Lab ID:			K2401908-001	K2401908-002	K2401908-003	K2401908-004	K2402526-024	K2402526-025	K2401908-005	K2401908-006
Date Sampled:	TEC (a)	PEC (b)	03/16/2004	03/16/2004	03/16/2004	03/16/2004	04/02/2004	04/02/2004	03/16/2004	03/16/2004
Benzo(a)pyrene	150	1,450	59	53	0.16 J	4.9 U	9.5	1.6 J	220	180
Perylene	NS	NS	54	29	0.48 J	5.9	10	1.1 J	130	89
Indeno(1,2,3-cd)pyrene	NS	NS	49	34	0.22 J	4.9 U	9.0 J	5.0 UJ	180	150
Dibenz(a,h)anthracene	33	NS	6.7	4.2 J	5.0 U	4.9 U	1.5 J	5.0 UJ	28	24
Benzo(g,h,i)perylene	NS	NS	55	42	0.27 J	0.28 J	10	5.0 U	180	150
Dimethyl phthalate	NS	NS	20 UJ	20 U	20 U	20 U	11 U	10 U	18 U	20 U
Diethyl phthalate	NS	NS	20 UJ	20 U	20 U	20 U	11 U	10 U	18 U	20 U
Di-n-butyl phthalate	NS	NS	20 UJ	20 U	20 U	20 U	11 U	10 U	18 U	20 U
Butylbenzyl phthalate	NS	NS	12 J	20 U	20 U	20 U	11 U	10 U	13 J	14 J
Bis(2-ethylhexyl) phthalate	NS	NS	39 J	20 U	20 U	20 U	85	95	56	54
Di-n-octyl phthalate	NS	NS	20 UJ	20 U	20 U	20 U	23	10 U	18 U	20 U
Total PAHs (c,d)	1,610	22,800	615	776	1.9 J	74	128	20 J	2,194	1,517
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	2.7	0.40 U	0.40 U	0.40 U	0.43 U	0.43 U	2.7	4.1
4,4'-DDD	NS	NS	1.8	0.40 U	0.40 U	0.40 U	0.43 U	0.43 U	1.6	2.9
4,4'-DDT	NS	NS	0.40 U	0.12 J	0.40 U	0.40 U	0.43 U	0.43 U	0.4 U	13
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.43 U	0.4 U	0.4 U
2,4'-DDD	NS	NS	1.1 J	0.40 U	0.40 U	0.40 U	0.43 U	0.43 U	1.4 J	1.4 J
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.43 U	0.43	0.4 U
Total DDD (c,e)	4.88	28	2.9	0.40 U	0.40 U	0.40 U	0.43 U	0.43 U	3.0	4.3
Total DDE (c,f)	3.16	31.3	2.7	0.40 U	0.40 U	0.40 U	0.43 U	0.43 U	2.7	4.1
Total DDT (c,g)	4.16	62.9	0.40 U	0.12 J	0.40 U	0.40 U	0.43 U	0.43 U	0.43	13
ΣDDTs (c,h)	5.28	572	5.6	0.12 J	0.40 U	0.40 U	0.43 U	0.43 U	6.1	21
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	11 U	11 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	4.1 J	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	5.0 U	5.9
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	5.0 U	18 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC03-0-1 K2401908-001 03/16/2004	T4-VC03-1-3 K2401908-002 03/16/2004	T4-VC03-3-5 K2401908-003 03/16/2004	T4-VC03-5-7 K2401908-004 03/16/2004	T4-PS03-11-13 K2402526-024 04/02/2004	T4-PS03-15-17 K2402526-025 04/02/2004	T4-VC04-0-1 K2401908-005 03/16/2004	T4-VC04-1-3 K2401908-006 03/16/2004
Aroclor 1260	NS	NS	8.0	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	8.9	12
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.3 U	5.4 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	12	10 U	10 U	10 U	11 U	11 U	8.9	17.9
Conventionals (percent)										
Total organic carbon	NS	NS	1.31	0.2	0.09 U	1.85	0.25	0.02 J	1.92	2.03
Total solids	NS	NS	61	76.2	89.1	70.6	76.8	75.3	58.4	57.4

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC04-3-5	T4-VC04-5-7	T4-VC04-7-9	T4-PS04-10-12	T4-PS04-15-17	T4-VC05-0-1	T4-VC05-1-3	T4-VC05-3-5
Lab ID:			K2401908-007	K2401908-009	K2401908-010	K2402526-008	K2402526-009	K2401958-014	K2401958-015	K2401958-016
Date Sampled:	TEC (a)	PEC (b)	03/16/2004	03/16/2004	03/16/2004	04/05/2004	04/05/2004	03/16/2004	03/16/2004	03/16/2004
Metals (mg/kg)										
Arsenic	9.79	33	2.9	2.9	4.2	3.1	2.4	3.4	3.1	2.1
Cadmium	0.99	4.98	0.11	0.09	0.12	0.14	0.12	0.33	0.4	0.16
Chromium	43.4	111	12.9 J	9.52 J	13.3 J	11.4	9.88	24.7 J	16.8 J	11.1 J
Copper	31.6	149	15.7 J	13.1 J	16.9 J	21.3	29.1	39.9 J	21.7 J	16.4 J
Lead	35.8	128	4.11	4.29	5.67	9.95	4.09	20.5	19.1	8.06
Mercury	0.18	1.06	0.014 J	0.011 J	0.009 J	0.03	0.02 U	0.104	0.037	0.042
Nickel	22.7	48.6	17 J	15.2 J	18.3 J	15.2 J	14.6 J	22.2 J	19.5 J	17.2 J
Selenium	NS	NS	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.1 UJ	0.14 J	0.1 UJ	0.11 UJ
Silver	NS	NS	0.03	0.04	0.03	0.04	0.02	0.24	0.09	0.08
Zinc	121	459	49.7 J	46.1 J	58.4 J	43.3 J	36 J	87.8 J	125 J	58.7 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	12 J	0.98 J	2.7 J	53	0.48 J	33	54	25
2-Methylnaphthalene	NS	NS	4.3 J	5.0 U	1.1 J	12	5.0 U	16	20	14
1-Methylnaphthalene	NS	NS	2.0 J	5.0 U	0.66 J	6.5	5.0 U	10	8.6	8.6
Biphenyl	NS	NS	2.0 J	5.0 U	5.0 U	4.2 J	5.0 U	5.0	5.3	2.8 J
2,6-Dimethylnaphthalene	NS	NS	1.8 J	5.0 U	0.38 J	6.9	5.0 U	9.0	9.9	9.7
Acenaphthylene	NS	NS	2.7 J	0.43 J	0.62 J	22	5.0 U	8.1	31	2.7 J
Acenaphthene	NS	NS	14	0.35 J	5.4	20	0.35 J	75	38	10
2,3,5-Trimethylnaphthalene	NS	NS	1.5 J	5.0 U	0.55 J	10	5.0 U	9.6	7.7	4.9 J
Fluorene	77.4	536	7.6	5.0 U	2.2 J	13	5.0 U	51	17	11
Phenanthrene	204	1,170	82 J	5.0 U	16	160	1.3 J	370	130	77
Anthracene	57.2	845	13 J	5.0 U	5.0 U	53	0.30 J	60	34	12
1-Methylphenanthrene	NS	NS	5.6	0.29 J	2.7 J	25	0.20 J	22	25	11
Fluoranthene	423	2,230	120 J	3.0 J	31	230	3.9 J	690	200	54
Pyrene	195	1,520	150 J	8.1	45	250	4.3 J	750	420	130
Benz(a)anthracene	108	1,050	61 J	3.1 J	16	100	3.1 J	400	200	21
Chrysene	166	1,290	74 J	4.3 J	24	150	3.0 J	510	250	31
Benzo(b)fluoranthene	NS	NS	62 J	3.4 J	25	83	3.5 J	610	190	16
Benzo(k)fluoranthene	NS	NS	53 J	2.9 J	19	78	3.0 J	420	190	17
Benzo(e)pyrene	NS	NS	51 J	3.0 J	20	86	2.7 J	430	200	17

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC04-3-5 K2401908-007 03/16/2004	T4-VC04-5-7 K2401908-009 03/16/2004	T4-VC04-7-9 K2401908-010 03/16/2004	T4-PS04-10-12 K2402526-008 04/05/2004	T4-PS04-15-17 K2402526-009 04/05/2004	T4-VC05-0-1 K2401958-014 03/16/2004	T4-VC05-1-3 K2401958-015 03/16/2004	T4-VC05-3-5 K2401958-016 03/16/2004
Benzo(a)pyrene	150	1,450	68 J	2.8 J	22	110	2.0 J	560	280	20
Perylene	NS	NS	28	7.7	14	48	1.5 J	340	120	18
Indeno(1,2,3-cd)pyrene	NS	NS	52 J	1.7 J	17	82 J	5.0 UJ	510	200	15
Dibenz(a,h)anthracene	33	NS	7.2	5.0 U	3.2 J	19 J	5.0 UJ	100	32	1.7 J
Benzo(g,h,i)perylene	NS	NS	56 J	2.3 J	19	87	5.0 U	460	210	19
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	50 U	10 U	40 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	50 U	10 U	40 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	50 U	10 U	40 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	50 U	10 U	13 J	20 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	470 J	20 U	20 U	80	44	72	34	20 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	50 U	10 U	40 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	719	29	209	1,322	25 J	4,537	2,034	427
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.35 J	0.40 U	0.41 U	0.50 J	0.42 U	4.6	2.6 J	1.1 J
4,4'-DDD	NS	NS	0.34 J	0.40 U	0.41 U	2.1	0.42 U	3.4	3.2	0.99
4,4'-DDT	NS	NS	0.53 J	0.40 U	0.087 J	0.52 U	0.42 U	2.5	2.1	0.77
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.41 U	0.5 U	0.42 U	0.21 J	0.43 U	0.41 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.41 U	0.83 U	0.42 U	1.8 J	3.1 J	0.92 J
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.41 U	1.2 U	0.42 U	0.88 U	1.5 U	0.39 J
Total DDD (c,e)	4.88	28	0.34 J	0.40 U	0.41 U	2.1	0.42 U	5.2	6.3	1.9
Total DDE (c,f)	3.16	31.3	0.35 J	0.40 U	0.41 U	0.5 J	0.42 U	4.8	2.6 J	1.1 J
Total DDT (c,g)	4.16	62.9	0.53 J	0.40 U	0.087 J	1.2 U	0.42 U	2.5	2.1	1.2
ΣDDTs (c,h)	5.28	572	1.2 J	0.40 U	0.087 J	2.6	0.42 U	13	11	4.2
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.1 U	5.5 U	5.3 U	6.7 U	5.2 U	5.1 U
Aroclor 1221	NS	NS	10 U	10 U	11 U	11 U	11 U	14 U	11 U	11 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.1 U	5.5 U	5.3 U	6.7 U	5.2 U	5.1 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.1 U	5.5 U	5.3 U	6.7 U	5.2 U	5.1 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.1 U	5.5 U	5.3 U	7.4	34 J	4.1 J
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.1 U	5.5 U	5.3 U	6.7 U	37 U	12 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC04-3-5 K2401908-007 03/16/2004	T4-VC04-5-7 K2401908-009 03/16/2004	T4-VC04-7-9 K2401908-010 03/16/2004	T4-PS04-10-12 K2402526-008 04/05/2004	T4-PS04-15-17 K2402526-009 04/05/2004	T4-VC05-0-1 K2401958-014 03/16/2004	T4-VC05-1-3 K2401958-015 03/16/2004	T4-VC05-3-5 K2401958-016 03/16/2004
Aroclor 1260	NS	NS	3.7 J	5.0 U	5.1 U	3.9 J	5.3 U	25	25	8.7
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.1 U	5.5 U	5.3 U	6.7 U	5.2 U	5.1 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.1 U	5.5 U	5.3 U	6.7 U	5.2 U	5.1 U
Total PCBs (c,i)	59.8	676	3.7 J	10 U	11 U	3.9 J	11 U	32	59	13
Conventionals (percent)										
Total organic carbon	NS	NS	1.05 J	0.15 U	0.22	0.55	0.05	1.78	0.63	0.46
Total solids	NS	NS	74.8	75.8	77.6	70.7	77.6	53.9	79.8	78.9

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC05-5-7 K2401958-017 03/16/2004	T4-VC05-7-9 K2401958-018 03/16/2004	T4-VC06-0-1 K2401949-001 03/16/2004	T4-VC06-1-3 K2401949-002 03/16/2004	T4-VC06-3-5 K2401949-003 03/16/2004	T4-VC06-5-7 K2401949-004 03/16/2004	T4-VC06-7-9 K2401949-005 03/16/2004	T4-VC07-0-1 K2401958-008 03/17/2004
Metals (mg/kg)										
Arsenic	9.79	33	3	1.8	4.2	1.6	1.5	1.2	1.4	5.3
Cadmium	0.99	4.98	0.13	0.1	0.63	0.22	0.12	0.09	0.09	0.71
Chromium	43.4	111	14.7 J	11.8 J	25.1 J	11.6 J	13 J	11.2 J	10.2 J	29.7 J
Copper	31.6	149	18.6 J	16.1 J	40.2 J	15.9 J	17.2 J	15 J	14.6 J	45.9 J
Lead	35.8	128	3.07	2.74	39	11.4	3.12	2.49	2.54	50.3
Mercury	0.18	1.06	0.019 U	0.011 B	0.075	0.032	0.019 U	0.014 B	0.025	0.096
Nickel	22.7	48.6	19.2 J	17.4 J	21.6 J	15.4 J	19.1 J	17.5 J	16.5 J	24.3 J
Selenium	NS	NS	0.12 UJ	0.11 UJ	0.16 J	0.04 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.17 J
Silver	NS	NS	0.03	0.03	0.29	0.09	0.04	0.02	0.02 U	0.37
Zinc	121	459	50.9 J	44.8 J	145 J	67.6 J	46.5 J	39.5 J	38.2 J	173 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	0.28 J	5.0 U	44	70	5.0 U	0.30 J	5.0 U	91
2-Methylnaphthalene	NS	NS	5.0 U	5.0 U	20	33	5.0 U	5.0 U	5.0 U	33
1-Methylnaphthalene	NS	NS	5.0 U	5.0 U	11	15	5.0 U	5.0 U	5.0 U	19
Biphenyl	NS	NS	5.0 U	5.0 U	5.5	8.3	5.0 U	5.0 U	5.0 U	11
2,6-Dimethylnaphthalene	NS	NS	5.0 U	5.0 U	10	25	5.0 U	5.0 U	5.0 U	18
Acenaphthylene	NS	NS	5.0 U	5.0 U	12	12	5.0 U	5.0 U	5.0 U	22
Acenaphthene	NS	NS	5.0 U	5.0 U	150	44	5.0 U	5.0 U	5.0 U	280
2,3,5-Trimethylnaphthalene	NS	NS	5.0 U	5.0 U	12	51	5.0 U	5.0 U	0.34 J	17
Fluorene	77.4	536	5.0 U	5.0 U	62	24	0.23 J	5.0 U	5.0 U	130
Phenanthrene	204	1,170	5.0 U	5.0 U	590	290	5.0 U	5.0 U	5.0 U	1,300
Anthracene	57.2	845	5.0 U	5.0 U	130	41	0.29 J	0.32 J	0.32 J	280
1-Methylphenanthrene	NS	NS	5.0 U	5.0 U	41	40	5.0 U	5.0 U	0.83 J	95
Fluoranthene	423	2,230	5.0 U	5.0 U	1,200	240	5.0 U	5.0 U	2.1 J	2,600
Pyrene	195	1,520	5.0 U	5.0 U	1,400	420	5.0 U	5.0 U	5.0 U	2,800
Benz(a)anthracene	108	1,050	5.0 U	5.0 U	810	100	5.0 U	5.0 U	0.28 J	1,600
Chrysene	166	1,290	0.21 J	5.0 U	950	140	5.0 U	0.17 J	0.34 J	1,900
Benzo(b)fluoranthene	NS	NS	5.0 U	5.0 U	1000	89	5.0 U	5.0 U	5.0 U	2,100
Benzo(k)fluoranthene	NS	NS	5.0 U	5.0 U	920	88	5.0 U	5.0 U	0.43 J	1,900
Benzo(e)pyrene	NS	NS	5.0 U	5.0 U	840	90	5.0 U	5.0 U	0.19 J	1,700

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC05-5-7 K2401958-017 03/16/2004	T4-VC05-7-9 K2401958-018 03/16/2004	T4-VC06-0-1 K2401949-001 03/16/2004	T4-VC06-1-3 K2401949-002 03/16/2004	T4-VC06-3-5 K2401949-003 03/16/2004	T4-VC06-5-7 K2401949-004 03/16/2004	T4-VC06-7-9 K2401949-005 03/16/2004	T4-VC07-0-1 K2401958-008 03/17/2004
Benzo(a)pyrene	150	1,450	5.0 U	5.0 U	1,100	110	5.0 U	5.0 U	0.23 J	2,300
Perylene	NS	NS	0.56 J	5.0 U	390	120	0.45 J	0.32 J	5.0 U	800
Indeno(1,2,3-cd)pyrene	NS	NS	5.0 U	5.0 U	860	92	5.0 U	5.0 U	0.24 J	1,800
Dibenz(a,h)anthracene	33	NS	5.0 U	5.0 U	210	12	5.0 U	5.0 U	5.0 U	340
Benzo(g,h,i)perylene	NS	NS	5.0 U	5.0 U	880	110	5.0 U	5.0 U	0.29 J	1,700
Dimethyl phthalate	NS	NS	20 U	20 U	39 U	20 U	20 U	20 U	20 U	80 U
Diethyl phthalate	NS	NS	20 U	20 U	39 U	20 U	20 U	20 U	20 U	80 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	39 U	20 U	20 U	20 U	20 U	80 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	22 J	20 U	20 U	20 U	20 U	39 J
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	20 U	230	32 U	22 U	50 U	37 U	330
Di-n-octyl phthalate	NS	NS	20 U	20 U	39 U	20 U	20 U	20 U	20 U	80 U
Total PAHs (c,d)	1,610	22,800	0.49 J	5.0 U	8,368	1,668	0.52 J	0.79 J	3.7 J	17,303
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.42 U	0.42 U	3.1	1.5 J	0.40 U	0.40 U	0.40 U	2.3
4,4'-DDD	NS	NS	0.42 U	0.42 U	2.9	1.0	0.40 U	0.40 U	0.40 U	2.1
4,4'-DDT	NS	NS	0.42 U	0.42 U	5.8	1.1	0.40 U	0.40 U	0.40 U	2.8 J
2,4'-DDE	NS	NS	0.42 U	0.42 U	0.4 U	0.4 U	0.40 U	0.40 U	0.40 U	0.53 U
2,4'-DDD	NS	NS	0.42 U	0.42 U	2.7 J	1.1 J	0.40 U	0.40 U	0.40 U	2.4 J
2,4'-DDT	NS	NS	0.42 U	0.42 U	2.1 U	0.49 J	0.40 U	0.40 U	0.40 U	0.69 J
Total DDD (c,e)	4.88	28	0.42 U	0.42 U	5.6	2.1	0.40 U	0.40 U	0.40 U	4.5
Total DDE (c,f)	3.16	31.3	0.42 U	0.42 U	3.1	1.5 J	0.40 U	0.40 U	0.40 U	2.3
Total DDT (c,g)	4.16	62.9	0.42 U	0.42 U	5.8	1.6	0.40 U	0.40 U	0.40 U	3.5 J
ΣDDTs (c,h)	5.28	572	0.42 U	0.42 U	15	5.2	0.40 U	0.40 U	0.40 U	10
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.2 U	5.2 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.6 U
Aroclor 1221	NS	NS	11 U	11 U	10 U	10 U	10 U	10 U	10 U	14 U
Aroclor 1232	NS	NS	5.2 U	5.2 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.6 U
Aroclor 1242	NS	NS	5.2 U	5.2 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.6 U
Aroclor 1248	NS	NS	5.2 U	5.2 U	13	7.6	5.0 U	5.0 U	5.0 U	12
Aroclor 1254	NS	NS	5.2 U	5.2 U	33 U	20 U	5.0 U	5.0 U	5.0 U	31 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC05-5-7 K2401958-017 03/16/2004	T4-VC05-7-9 K2401958-018 03/16/2004	T4-VC06-0-1 K2401949-001 03/16/2004	T4-VC06-1-3 K2401949-002 03/16/2004	T4-VC06-3-5 K2401949-003 03/16/2004	T4-VC06-5-7 K2401949-004 03/16/2004	T4-VC06-7-9 K2401949-005 03/16/2004	T4-VC07-0-1 K2401958-008 03/17/2004
Aroclor 1260	NS	NS	5.2 U	5.2 U	23	15	5.0 U	5.0 U	5.0 U	27
Aroclor 1262	NS	NS	5.2 U	5.2 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.6 U
Aroclor 1268	NS	NS	5.2 U	5.2 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.6 U
Total PCBs (c,i)	59.8	676	11 U	11 U	36	23	10 U	10 U	10 U	39
Conventionals (percent)										
Total organic carbon	NS	NS	0.18	0.09 U	1.43	0.46	0.14 U	0.15 U	0.12 U	1.7
Total solids	NS	NS	80.7	77.2	62.2	82.6	77.5	92.5	78.5	51.1

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC07-1-3 K2401958-009 03/17/2004	T4-VC07-3-5 K2401958-010 03/17/2004	T4-VC07-5-7 K2401949-013 03/17/2004	T4-VC07-7-9 K2401949-014 03/17/2004	T4-VC08-0-1 K2401949-015 03/17/2004	T4-VC08-1-3 K2401949-016 03/17/2004	T4-VC08-3-5 K2401949-017 03/17/2004	T4-VC08-5-7 K2401949-018 03/17/2004
Metals (mg/kg)										
Arsenic	9.79	33	5.6	3.2	2.1	2.1	3.6	2.4	1.9	1.6
Cadmium	0.99	4.98	1.14	0.38	0.12	0.1	0.94	0.19	0.15	0.12
Chromium	43.4	111	31 J	20.2 J	14.1 J	13 J	20.8 J	22.7 J	17.7 J	16.9 J
Copper	31.6	149	51 J	25.4 J	16.1 J	17 J	33.3 J	26.1 J	21.7 J	18.9 J
Lead	35.8	128	102	28.1	5.4	2.83	66.4	5.79	3.85	3.1
Mercury	0.18	1.06	0.17	0.055	0.017 B	0.029	0.077	0.022	0.023	0.01 B
Nickel	22.7	48.6	24.7 J	20.3 J	18.7 J	18 J	22.1 J	26.5 J	22.5 J	22.2 J
Selenium	NS	NS	0.17 J	0.06 J	0.11 UJ	0.12 UJ	0.07 UJ	0.04 UJ	0.11 J	0.11 UJ
Silver	NS	NS	0.69	0.16	0.04	0.03	0.28	0.05	0.04	0.03
Zinc	121	459	250 J	108 J	49.7 J	44.2 J	191 J	59.1 J	47.9 J	48.3 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	130	52	6.2	5.0 U	56	2.9 J	4.9 U	5.0 U
2-Methylnaphthalene	NS	NS	81	25	1.2 J	5.0 U	26	1.4 J	4.9 U	5.0 U
1-Methylnaphthalene	NS	NS	30	10	0.68 J	5.0 U	13	0.67 J	4.9 U	5.0 U
Biphenyl	NS	NS	24	6.2	5.0 U	5.0 U	6.0	4.9 U	4.9 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	57	15	0.89 J	5.0 U	15	0.91 J	4.9 U	5.0 U
Acenaphthylene	NS	NS	36	8.3	1.7 J	5.0 U	10	0.43 J	4.9 U	5.0 U
Acenaphthene	NS	NS	210	36	7.7	0.30 J	160	4.1 J	4.9 U	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	58	13	1.9 J	5.0 U	15	0.99 J	4.9 U	5.0 U
Fluorene	77.4	536	370	34	2.6 J	5.0 U	78	1.4 J	4.9 U	5.0 U
Phenanthrene	204	1,170	1,500	160	37	1.4 J	600	14	4.9 U	5.0 U
Anthracene	57.2	845	380	36	5.5	0.27 J	140	3.1 J	0.28 J	5.0 U
1-Methylphenanthrene	NS	NS	140	17	4.5 J	0.17 J	45	1.3 J	4.9 U	5.0 U
Fluoranthene	423	2,230	1,400	240	29	5.0 U	1,200	24	4.9 U	5.0 U
Pyrene	195	1,520	1,600	310	52	1.6 J	1,400	30	4.9 U	5.0 U
Benz(a)anthracene	108	1,050	520	110	17	0.33 J	830	14	0.63 J	5.0 U
Chrysene	166	1,290	730	160	22	0.47 J	950	17	0.36 J	5.0 U
Benzo(b)fluoranthene	NS	NS	570	140	12	0.28 J	980	16	0.19 J	0.23 J
Benzo(k)fluoranthene	NS	NS	420	120	15	0.24 J	950	17	0.37 J	5.0 U
Benzo(e)pyrene	NS	NS	440	120	12	0.25 J	830	14	0.27 J	5.0 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC07-1-3 K2401958-009 03/17/2004	T4-VC07-3-5 K2401958-010 03/17/2004	T4-VC07-5-7 K2401949-013 03/17/2004	T4-VC07-7-9 K2401949-014 03/17/2004	T4-VC08-0-1 K2401949-015 03/17/2004	T4-VC08-1-3 K2401949-016 03/17/2004	T4-VC08-3-5 K2401949-017 03/17/2004	T4-VC08-5-7 K2401949-018 03/17/2004
Benzo(a)pyrene	150	1,450	520	140	15	0.2 J	1,100	17	4.9 U	5.0 U
Perylene	NS	NS	300	120	20	1.8 J	380	220	94	11
Indeno(1,2,3-cd)pyrene	NS	NS	410	120	8.7	5.0 U	990	12	4.9 U	5.0 U
Dibenz(a,h)anthracene	33	NS	85	22	1.4 J	5.0 U	200	1.8 J	4.9 U	5.0 U
Benzo(g,h,i)perylene	NS	NS	400	120	11	0.16 J	870	14	4.9 U	5.0 U
Dimethyl phthalate	NS	NS	80 U	20 U	20 U	20 U	37 U	22 U	20 U	20 U
Diethyl phthalate	NS	NS	80 U	20 U	20 U	20 U	37 U	22 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	80 U	20 U	20 U	20 U	37 U	22 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	80 U	20 U	2.5 J	20 U	15 J	22 U	20 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	280	58	59 U	51 U	170 U	25 U	20 U	22 U
Di-n-octyl phthalate	NS	NS	80 U	20 U	20 U	20 U	37 U	22 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	8,386	1,546	223	5.1 J	8,454	161	1.8 J	0.23 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	11 J	2.7 J	0.22 J	0.40 U	2.4	0.40 U	0.40 U	0.40 U
4,4'-DDD	NS	NS	5.2	1.2	0.36 J	0.40 U	1.8	0.40 U	0.40 U	0.40 U
4,4'-DDT	NS	NS	9.5	3.6 J	0.31 J	0.11 J	2.7	0.19 J	0.40 U	0.40 U
2,4'-DDE	NS	NS	1.3	0.38 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	3.0 U	3.0 J	0.27 J	0.40 U	2.5 J	0.40 U	0.40 U	0.40 U
2,4'-DDT	NS	NS	6.7	1.9	0.13 J	0.40 U	1.5 J	0.40 U	0.40 U	0.40 U
Total DDD (c,e)	4.88	28	5.2	4.2	0.63 J	0.40 U	4.3	0.40 U	0.40 U	0.40 U
Total DDE (c,f)	3.16	31.3	12	2.7 J	0.22 J	0.40 U	2.4	0.40 U	0.40 U	0.40 U
Total DDT (c,g)	4.16	62.9	16	5.5	0.44 J	0.11 J	4.2	0.19 J	0.40 U	0.40 U
ΣDDTs (c,h)	5.28	572	34	12	1.3 J	0.11 J	11	0.19 J	0.40 U	0.40 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	7.0 U	4.8 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	14 U	9.5 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	7.0 U	4.8 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	7.0 U	4.8 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	56	20	5.0 U	5.0 U	16	5.0 U	5.0 U	5.0 U
Aroclor 1254	NS	NS	150 U	52 U	5.0 U	5.0 U	37 U	5.0 U	5.0 U	5.0 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC07-1-3 K2401958-009 03/17/2004	T4-VC07-3-5 K2401958-010 03/17/2004	T4-VC07-5-7 K2401949-013 03/17/2004	T4-VC07-7-9 K2401949-014 03/17/2004	T4-VC08-0-1 K2401949-015 03/17/2004	T4-VC08-1-3 K2401949-016 03/17/2004	T4-VC08-3-5 K2401949-017 03/17/2004	T4-VC08-5-7 K2401949-018 03/17/2004
Aroclor 1260	NS	NS	130	47	3.3 J	5.0 U	30	5.0 U	5.0 U	5.0 U
Aroclor 1262	NS	NS	7.0 U	4.8 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	7.0 U	4.8 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	186	67	3.3 J	10 U	46	10 U	10 U	10 U
Conventionals (percent)										
Total organic carbon	NS	NS	2.1	0.8	0.17	0.2	0.86	0.38	0.32	0.15 U
Total solids	NS	NS	55.1	70.7	90	83.2	62.2	71.7	74.6	77

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC08-7-9	T4-VC08-9-11	T4-VC09-0-1	T4-VC09-1-3	T4-VC09-3-5	T4-VC09-5-7	T4-VC09-7-9	T4-VC09-9-11
Lab ID:			K2402012-001	K2402012-002	K2402012-004	K2402012-005	K2402008-010	K2402008-011	K2402008-012	K2402008-013
Date Sampled:	TEC (a)	PEC (b)	03/17/2004	03/17/2004	03/17/2004	03/17/2004	03/17/2004	03/17/2004	03/17/2004	03/17/2004
Metals (mg/kg)										
Arsenic	9.79	33	1.6	4	5.3	3.9	4.8 J	2.4 J	3 J	2.5 J
Cadmium	0.99	4.98	0.13	0.13	0.53	1	1.12	0.17	0.23	0.24
Chromium	43.4	111	22.2 J	19.9 J	32 J	23.7 J	24.1 J	29.6 J	24.2 J	25.4 J
Copper	31.6	149	27.7 J	26.6 J	44.3 J	38.2 J	54.3 J	35.1 J	31.4 J	34.5 J
Lead	35.8	128	4.76	4.58	47.4	72.2	88 J	7.13 J	5.36 J	5.45 J
Mercury	0.18	1.06	0.021	0.061	0.088	0.085	0.126	0.075	0.028	0.033
Nickel	22.7	48.6	25.8	30.1	23.6	21	23.8 J	27.7 J	22.4 J	27.9 J
Selenium	NS	NS	0.1 UJ	0.1 UJ	0.08 UJ	0.09 UJ	0.12 UJ	0.04 J	0.11 UJ	0.1 UJ
Silver	NS	NS	0.04	0.05	0.27	0.3	0.31	0.06	0.07	0.06 J
Zinc	121	459	55.6 J	53.9 J	133 J	202 J	253 J	70.4 J	64.4 J	63.6 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	5.0 U	5.0 U	56	87	46	4.9 U	5.0 U	5.0 U
2-Methylnaphthalene	NS	NS	5.0 U	5.0 U	29	39	24	4.9 U	5.0 U	5.0 U
1-Methylnaphthalene	NS	NS	5.0 U	5.0 U	17	19	12	4.9 U	5.0 U	5.0 U
Biphenyl	NS	NS	5.0 U	5.0 U	8.3	9.1	6.8	4.9 U	5.0 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	5.0 U	5.0 U	17	21	17	4.9 U	5.0 U	5.0 U
Acenaphthylene	NS	NS	5.0 U	5.0 U	18	21	14	4.9 U	5.0 U	5.0 U
Acenaphthene	NS	NS	5.0 U	5.0 U	360	340	85	0.84 J	5.0 U	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	5.0 U	5.0 U	12	15	29	4.9 U	5.0 U	5.0 U
Fluorene	77.4	536	5.0 U	5.0 U	200	150	82	4.9 U	5.0 U	5.0 U
Phenanthrene	204	1,170	5.0 U	5.0 U	1,900	1,300	470	4.9 U	5.0 U	5.0 U
Anthracene	57.2	845	5.0 U	5.0 U	450	330	81	4.9 U	5.0 U	5.0 U
1-Methylphenanthrene	NS	NS	5.0 U	5.0 U	120	91	49	4.9 U	5.0 U	5.0 U
Fluoranthene	423	2,230	5.0 U	5.0 U	4,100	2,500	720	4.9 U	5.0 U	5.0 U
Pyrene	195	1,520	5.0 U	5.0 U	4,400	2,800	760	4.9 U	5.0 U	5.0 U
Benz(a)anthracene	108	1,050	5.0 U	0.33 J	2,900	1,800	310	4.9 U	0.27 J	5.0 U
Chrysene	166	1,290	5.0 U	5.0 U	3,400	2,000	430	0.29 J	0.50 J	5.0 U
Benzo(b)fluoranthene	NS	NS	0.29 J	5.0 U	4,100	2,300	360	0.36 J	0.53 J	0.51 J
Benzo(k)fluoranthene	NS	NS	5.0 U	5.0 U	3,300	1,900	300	0.26 J	5.0 U	5.0 U
Benzo(e)pyrene	NS	NS	5.0 U	5.0 U	3,100	1,700	280	0.3 J	0.36 J	0.25 J

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC08-7-9 K2402012-001 03/17/2004	T4-VC08-9-11 K2402012-002 03/17/2004	T4-VC09-0-1 K2402012-004 03/17/2004	T4-VC09-1-3 K2402012-005 03/17/2004	T4-VC09-3-5 K2402008-010 03/17/2004	T4-VC09-5-7 K2402008-011 03/17/2004	T4-VC09-7-9 K2402008-012 03/17/2004	T4-VC09-9-11 K2402008-013 03/17/2004
Benzo(a)pyrene	150	1,450	5.0 U	5.0 U	4,200	2,400	330	4.9 U	5.0 U	5.0 U
Perylene	NS	NS	64	68	1,300	780	200	210	210	130
Indeno(1,2,3-cd)pyrene	NS	NS	5.0 U	5.0 U	3,400	1,900	270	4.9 U	5.0 U	5.0 U
Dibenz(a,h)anthracene	33	NS	5.0 U	5.0 U	650	480	43	4.9 U	5.0 U	5.0 U
Benzo(g,h,i)perylene	NS	NS	5.0 U	5.0 U	3,100	1,700	260	0.21 J	0.20 J	5.0 U
Dimethyl phthalate	NS	NS	20 U	20 U	23 U	20 U	19 U	20 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	23 U	20 U	19 U	20 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	23 U	20 U	19 U	20 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	36	22	22	20 U	20 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	20 U	370	190	110	20 U	20 U	20 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	23 U	20 U	19 U	20 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	0.29 J	0.33 J	29,384	17,928	3,988	1.8 J	1.3 J	0.51 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.39 U	0.43 U	4.8	3.0 J	5.6 J	0.39 U	0.40 U	0.40 U
4,4'-DDD	NS	NS	0.39 U	0.43 U	4.1	2.4	4.6	0.39 U	0.40 U	0.40 U
4,4'-DDT	NS	NS	0.39 U	0.43 U	5.6	3.9	14	0.39 U	0.40 U	0.40 U
2,4'-DDE	NS	NS	0.39 U	0.43 U	0.64 U	0.48 U	2.3 U	0.39 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	0.39 U	0.43 U	3.6 J	3.9 J	3.6 U	0.39 U	0.40 U	0.40 U
2,4'-DDT	NS	NS	0.39 U	0.43 U	2.1 U	2.2	7.8	0.39 U	0.40 U	0.40 U
Total DDD (c,e)	4.88	28	0.39 U	0.43 U	7.7	6.3	4.6	0.39 U	0.40 U	0.40 U
Total DDE (c,f)	3.16	31.3	0.39 U	0.43 U	4.8	3.0 J	5.6 J	0.39 U	0.40 U	0.40 U
Total DDT (c,g)	4.16	62.9	0.39 U	0.43 U	5.6	6.1	22	0.39 U	0.40 U	0.40 U
ΣDDTs (c,h)	5.28	572	0.39 U	0.43 U	18	15	32	0.39 U	0.40 U	0.40 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	4.8 U	5.4 U	8.0 U	6.0 U	4.6 U	4.8 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	9.6 U	11 U	16 U	12 U	9.1 U	9.6 U	9.9 U	10 U
Aroclor 1232	NS	NS	4.8 U	5.4 U	8.0 U	6.0 U	4.6 U	4.8 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	4.8 U	5.4 U	8.0 U	6.0 U	4.6 U	4.8 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	4.8 U	5.4 U	31 J	43 J	72 J	4.8 U	5.0 U	5.0 U
Aroclor 1254	NS	NS	4.8 U	5.4 U	54 U	61 U	150 U	4.8 U	5.0 U	5.0 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC08-7-9 K2402012-001 03/17/2004	T4-VC08-9-11 K2402012-002 03/17/2004	T4-VC09-0-1 K2402012-004 03/17/2004	T4-VC09-1-3 K2402012-005 03/17/2004	T4-VC09-3-5 K2402008-010 03/17/2004	T4-VC09-5-7 K2402008-011 03/17/2004	T4-VC09-7-9 K2402008-012 03/17/2004	T4-VC09-9-11 K2402008-013 03/17/2004
Aroclor 1260	NS	NS	4.8 U	5.4 U	60	56	160	4.8 U	5.0 U	5.0 U
Aroclor 1262	NS	NS	4.8 U	5.4 U	8.0 U	6.0 U	4.6 U	4.8 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	4.8 U	5.4 U	8.0 U	6.0 U	4.6 U	4.8 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	9.6 U	11 U	91	99	232	9.6 U	9.9 U	10 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.13	0.16	1.96	1.31	0.87	1.09	1.51	0.56
Total solids	NS	NS	69.9	69.2	45	59.3	70.4	64.4	64.1	67.4

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC10-0-1 K2402008-017 03/18/2004	T4-VC10-1-3 K2402008-018 03/18/2004	T4-VC10-3-5 K2402008-019 03/18/2004	T4-VC10-5-7 K2402008-020 03/18/2004	T4-VC10-7-9 K2402012-006 03/18/2004	T4-VC10-9-11 K2402008-002 03/18/2004	T4-VC10-11-13 K2402008-003 03/18/2004	T4-VC11-0-1 K2402051-007 03/18/2004
Metals (mg/kg)										
Arsenic	9.79	33	3.4 J	3.2 J	3.1 J	4.2 J	2.8	3.1 J	3.3 J	4.5
Cadmium	0.99	4.98	0.13	0.15	0.19	0.25	0.17	0.19	0.18	0.237
Chromium	43.4	111	12.6 J	14.7 J	25.2 J	26.1 J	25.4 J	21.7 J	22.7 J	23.7 J
Copper	31.6	149	15 J	19.2 J	30.1 J	32.7 J	30 J	30.8 J	29 J	32 J
Lead	35.8	128	8.68 J	6.9 J	5.68 J	6.56 J	5.77	5.9 J	5.44 J	16.7
Mercury	0.18	1.06	0.011 B	0.016 B	0.065	0.211	0.079	0.148	0.047	0.062
Nickel	22.7	48.6	16.3 J	17.5 J	22.2 J	25.2 J	22.5	21.1 J	22.6 J	19.7 J
Selenium	NS	NS	0.11 UJ	0.11 UJ	0.11 UJ	0.04 J	0.1 UJ	0.05 J	0.03 J	0.08 J
Silver	NS	NS	0.02	0.03	0.07	0.07	0.06	0.07	0.06	0.22
Zinc	121	459	51 J	51.3 J	59.6 J	63.1 J	58.1 J	58.1 J	56.6 J	77.6 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	0.45 J	0.70 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	14
2-Methylnaphthalene	NS	NS	5.0 U	0.30 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	6.1
1-Methylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	3.6 J
Biphenyl	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	5.0 U	0.21 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	3.3 J
Acenaphthylene	NS	NS	0.76 J	0.67 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	5.6
Acenaphthene	NS	NS	0.59 J	0.4 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	24
2,3,5-Trimethylnaphthalene	NS	NS	5.0 U	0.25 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	3.6 J
Fluorene	77.4	536	0.50 J	0.42 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	20
Phenanthrene	204	1,170	3.1 J	2.8 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	170
Anthracene	57.2	845	2.1 J	1.4 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	38
1-Methylphenanthrene	NS	NS	0.40 J	1.1 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	11
Fluoranthene	423	2,230	8.6	16	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	350
Pyrene	195	1,520	10	23	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	390
Benz(a)anthracene	108	1,050	4.5 J	9.4	5.0 U	4.9 U	5.0 U	0.22 J	0.94 J	190
Chrysene	166	1,290	6.4	11	0.29 J	0.36 J	5.0 U	0.41 J	1.1 J	240
Benzo(b)fluoranthene	NS	NS	5.3	7.6	0.29 J	0.63 J	0.78 J	0.45 J	1.3 J	280
Benzo(k)fluoranthene	NS	NS	6.4	10	5.0 U	4.9 U	5.0 U	0.33 J	0.70 J	210
Benzo(e)pyrene	NS	NS	5.4	8.0	0.20 J	0.28 J	5.0 U	0.33 J	0.86 J	210

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC10-0-1 K2402008-017 03/18/2004	T4-VC10-1-3 K2402008-018 03/18/2004	T4-VC10-3-5 K2402008-019 03/18/2004	T4-VC10-5-7 K2402008-020 03/18/2004	T4-VC10-7-9 K2402012-006 03/18/2004	T4-VC10-9-11 K2402008-002 03/18/2004	T4-VC10-11-13 K2402008-003 03/18/2004	T4-VC11-0-1 K2402051-007 03/18/2004
Benzo(a)pyrene	150	1,450	4.6 J	8.1	5.0 U	4.9 U	5.0 U	5.0 U	0.80 J	260
Perylene	NS	NS	1.7 J	74	140	240	410	260	310	120
Indeno(1,2,3-cd)pyrene	NS	NS	3.1 J	4.5 J	5.0 U	4.9 U	5.0 U	5.0 U	0.76 J	220
Dibenz(a,h)anthracene	33	NS	0.51 J	0.52 J	5.0 U	4.9 U	5.0 U	5.0 U	4.9 U	38
Benzo(g,h,i)perylene	NS	NS	4.1 J	5.7	5.0 U	0.19 J	5.0 U	0.23 J	0.82 J	210
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	20 U	6.1 J
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	20 U	90 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	53	91	0.58 J	0.99 J	0.78 J	1.4 J	4.8 J	2,192
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.39 U	3.0
4,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.39 U	2.1
4,4'-DDT	NS	NS	0.40 U	0.52	0.40 U	0.40 U	0.40 U	0.40 U	0.39 U	0.40 U
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.39 U	0.40 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	0.52 U	0.40 U	0.40 U	0.40 U	1.6 J
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.39 U	0.28 J
Total DDD (c,e)	4.88	28	0.40 U	0.40 U	0.40 U	0.52 U	0.40 U	0.40 U	0.40 U	3.7
Total DDE (c,f)	3.16	31.3	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.39 U	3.0
Total DDT (c,g)	4.16	62.9	0.40 U	0.52	0.40 U	0.40 U	0.40 U	0.40 U	0.39 U	0.28 J
ΣDDTs (c,h)	5.28	572	0.40 U	0.52	0.40 U	0.52 U	0.40 U	0.40 U	0.40 U	7.0
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	9.8 U	10 U	10 U	10 U	9.8 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	6.4
Aroclor 1254	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	14 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC10-0-1 K2402008-017 03/18/2004	T4-VC10-1-3 K2402008-018 03/18/2004	T4-VC10-3-5 K2402008-019 03/18/2004	T4-VC10-5-7 K2402008-020 03/18/2004	T4-VC10-7-9 K2402012-006 03/18/2004	T4-VC10-9-11 K2402008-002 03/18/2004	T4-VC10-11-13 K2402008-003 03/18/2004	T4-VC11-0-1 K2402051-007 03/18/2004
Aroclor 1260	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	15
Aroclor 1262	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 U
Total PCBs (c,i)	59.8	676	10 U	10 U	9.8 U	10 U	10 U	10 U	9.8 U	21
Conventionals (percent)										
Total organic carbon	NS	NS	0.11	0.54	1.26	1.83	0.74	1.22	1.07	1.85
Total solids	NS	NS	76.9	74.8	66.3	59.7	67.8	65.6	68.5	55.1

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC11-1-3	T4-VC11-3-5	T4-VC11-5-7	T4-VC11-7-9	T4-VC11-9-11	T4-VC12-0-1	T4-VC12-1-3	T4-VC12-3-5
Lab ID:			K2402051-008	K2402051-009	K2402051-010	K2402051-011	K2402051-012	K2402051-013	K2402051-014	K2402051-015
Date Sampled:	TEC (a)	PEC (b)	03/18/2004	03/18/2004	03/18/2004	03/18/2004	03/18/2004	03/19/2004	03/19/2004	03/19/2004
Metals (mg/kg)										
Arsenic	9.79	33	5	2.3	2.6	2.5	2	3.7	4.9	4.9
Cadmium	0.99	4.98	0.391	0.08	0.051 B	0.047 B	0.037 B	0.284	0.713	0.325
Chromium	43.4	111	22.9 J	7.95 J	8.59 J	8.57 J	6.41 J	18.5 J	21.1 J	13.9 J
Copper	31.6	149	37.7 J	11.9 J	11.5 J	11.7 J	9.42 J	31.7 J	36 J	21.2 J
Lead	35.8	128	22	5.14	2.44	2.28	1.95	19.8	53.3	31.9
Mercury	0.18	1.06	0.078	0.022	0.009 B	0.015 B	0.018 U	0.074	0.139	0.273
Nickel	22.7	48.6	20.3 J	14.2 J	13.8 J	14 J	12.2 J	17.3 J	20.2 J	17.7 J
Selenium	NS	NS	0.08 J	0.11 UJ	0.11 UJ	0.12 UJ	0.12 UJ	0.05 J	0.04 J	0.12 UJ
Silver	NS	NS	0.28	0.04	0.02 U	0.02 U	0.02 U	0.5	0.31	0.19
Zinc	121	459	102 J	43.9 J	33.6 J	34.2 J	27.3 J	79.2 J	172 J	93.5 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	15	17	2.0 J	5.0 U	5.0 U	360	120	110
2-Methylnaphthalene	NS	NS	7.0	5.4	0.88 J	5.0 U	5.0 U	330	66	53
1-Methylnaphthalene	NS	NS	4.1 J	2.3 J	0.39 J	5.0 U	5.0 U	190	27	22
Biphenyl	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	42	13	12
2,6-Dimethylnaphthalene	NS	NS	4.0 J	2.9 J	0.39 J	5.0 U	5.0 U	110	40	69
Acenaphthylene	NS	NS	7.9	3.1 J	0.3 J	5.0 U	5.0 U	22 J	18	21
Acenaphthene	NS	NS	44	16	1.9 J	5.0 U	5.0 U	1,200	160	180
2,3,5-Trimethylnaphthalene	NS	NS	3.2 J	5.1	0.31 J	5.0 U	5.0 U	38	53	100
Fluorene	77.4	536	22	4.7 J	0.47 J	5.0 U	5.0 U	1,000	130	170
Phenanthrene	204	1,170	170	60	6.6	5.0 U	5.0 U	4,900	550	890
Anthracene	57.2	845	44	9.3	0.87 J	5.0 U	5.0 U	640	72	100
1-Methylphenanthrene	NS	NS	9.4	6.9	0.88 J	5.0 U	5.0 U	190	46	63
Fluoranthene	423	2,230	370	75	6.4	5.0 U	5.0 U	9,700	500	490
Pyrene	195	1,520	430	100	12	5.0 U	5.0 U	7,200	610	620
Benz(a)anthracene	108	1,050	260	28	2.3 J	5.0 U	5.0 U	4,000	210	160
Chrysene	166	1,290	300	38	3.4 J	5.0 U	5.0 U	4,900	260	210
Benzo(b)fluoranthene	NS	NS	340	27	1.7 J	5.0 U	5.0 U	6,200	230	150
Benzo(k)fluoranthene	NS	NS	270	22	1.7 J	5.0 U	5.0 U	4,000	200	120
Benzo(e)pyrene	NS	NS	260	24	1.8 J	5.0 U	5.0 U	4,100	190	140

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC11-1-3 K2402051-008 03/18/2004	T4-VC11-3-5 K2402051-009 03/18/2004	T4-VC11-5-7 K2402051-010 03/18/2004	T4-VC11-7-9 K2402051-011 03/18/2004	T4-VC11-9-11 K2402051-012 03/18/2004	T4-VC12-0-1 K2402051-013 03/19/2004	T4-VC12-1-3 K2402051-014 03/19/2004	T4-VC12-3-5 K2402051-015 03/19/2004
Benzo(a)pyrene	150	1,450	350	28	1.6 J	5.0 UJ	5.0 UJ	6,300 J	240	180
Perylene	NS	NS	130	28	2.6 J	5.0 U	5.0 U	1,700	180	87
Indeno(1,2,3-cd)pyrene	NS	NS	280	21	5.0 U	5.0 UJ	5.0 UJ	4,700	200	150
Dibenz(a,h)anthracene	33	NS	54	3.0 J	0.22 J	5.0 UJ	5.0 UJ	1,100	32	19
Benzo(g,h,i)perylene	NS	NS	260	24	1.5 J	5.0 U	5.0 U	4,100	210	180
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	41 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	41 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	41 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	6.5 J	20 U	20 U	20 U	20 U	11 J	8.6 J	14 J
Bis(2-ethylhexyl) phthalate	NS	NS	66 U	20 U	20 U	20 U	20 U	95 U	40 U	28 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	41 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	2,623	428	41	5.0 U	5.0 U	50,422	3,300	3,401
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	3.9	0.89	0.40 U	0.40 U	0.40 U	2.8	7.3	15 J
4,4'-DDD	NS	NS	3.0	1.4	0.40 U	0.40 U	0.40 U	1.7	5	9.5
4,4'-DDT	NS	NS	2.0 J	2.9	0.07 J	0.40 U	0.40 U	0.54 U	3.3	7.1 J
2,4'-DDE	NS	NS	0.75 U	0.40 U	0.40 U	0.40 U	0.40 U	0.53 U	0.49 U	3
2,4'-DDD	NS	NS	2.2 J	1.3	0.40 U	0.40 U	0.40 U	2.3 U	5.3 J	5.6 J
2,4'-DDT	NS	NS	1.1 U	0.98 U	0.40 U	0.40 U	0.40 U	0.53 J	1.5 J	4.9
Total DDD (c,e)	4.88	28	5.2	2.7	0.40 U	0.40 U	0.40 U	1.7	10	15
Total DDE (c,f)	3.16	31.3	3.9	0.89	0.40 U	0.40 U	0.40 U	2.8	7.3	18
Total DDT (c,g)	4.16	62.9	2 J	2.9	0.07 J	0.40 U	0.40 U	0.53 J	4.8	12
ΣDDTs (c,h)	5.28	572	11	6.5	0.07 J	0.40 U	0.40 U	5.0	22	45
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	10	10	5.0 U	5.0 U	5.0 U	9.7 J	47 J	13
Aroclor 1254	NS	NS	20 U	20 U	5.0 U	5.0 U	5.0 U	16 U	83 U	51 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC11-1-3 K2402051-008 03/18/2004	T4-VC11-3-5 K2402051-009 03/18/2004	T4-VC11-5-7 K2402051-010 03/18/2004	T4-VC11-7-9 K2402051-011 03/18/2004	T4-VC11-9-11 K2402051-012 03/18/2004	T4-VC12-0-1 K2402051-013 03/19/2004	T4-VC12-1-3 K2402051-014 03/19/2004	T4-VC12-3-5 K2402051-015 03/19/2004
Aroclor 1260	NS	NS	16	64	5.0 U	5.0 U	5.0 U	15	48	83
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	26	74	10 U	10 U	10 U	25	95	96
Conventionals (percent)										
Total organic carbon	NS	NS	1.97	0.46	0.03 J	0.02 J	0.02 J	1.86	1.55	0.97
Total solids	NS	NS	56.8	78.6	93	81.8	85	49.8	60.5	71.3

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC12-5-7 K2402051-016 03/19/2004	T4-VC12-7-9 K2402051-018 03/19/2004	T4-PS12-10-12 K2402526-003 04/05/2004	T4-PS12-15-17 K2402526-004 04/05/2004	T4-VC13-0-1 K2402051-019 03/19/2004	T4-VC13-1-3 K2402051-020 03/19/2004	T4-VC13-3-5 K2402055-001 03/19/2004	T4-VC13-5-7 K2402055-002 03/19/2004
Metals (mg/kg)										
Arsenic	9.79	33	2.8	3.9	2.1	1.9	4.7	3.1	3.6	2
Cadmium	0.99	4.98	0.047 B	0.046 B	0.11	0.08	0.117	0.074	0.09	0.09
Chromium	43.4	111	7.11 J	9.59 J	9.38	9.61	10 J	10.2 J	14.4 J	13.2 J
Copper	31.6	149	10.7 J	12.5 J	23.4	27.8	14.1 J	13.1 J	16.2 J	15.5 J
Lead	35.8	128	2.25	2.38	3.43	3.46	7.5	6.29	2.87	2.65
Mercury	0.18	1.06	0.016 U	0.018 U	0.02 U	0.02 U	0.014 B	0.01 B	0.011 B	0.02 U
Nickel	22.7	48.6	12.9 J	15.7 J	13.3 J	14 J	14.2 J	13.7 J	18.1	17.1
Selenium	NS	NS	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.12 UJ	0.11 UJ
Silver	NS	NS	0.02 U	0.02 U	0.02	0.02	0.03	0.04	0.02	0.02
Zinc	121	459	30.4 J	37.2 J	34.2 J	32.2 J	67.5 J	43.6 J	47.1 J	44.6 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	5.0 U	5.0 U	0.63 J	5.1 U	3.8 J	1.6 J	2.6 J	1.7 J
2-Methylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	22	1.1 J	0.43 J	0.36 J
1-Methylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	23	0.61 J	0.31 J	4.9 U
Biphenyl	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	3.1 J	5.0 U	5.0 U	4.9 U
2,6-Dimethylnaphthalene	NS	NS	5.0 U	5.0 U	0.37 J	5.1 U	49	0.53 J	0.18 J	4.9 U
Acenaphthylene	NS	NS	5.0 U	5.0 U	1.2 J	5.1 U	5.4	0.32 J	0.30 J	0.28 J
Acenaphthene	NS	NS	5.0 U	5.0 U	0.89 J	5.1 U	170	6.7	0.35 J	4.9 U
2,3,5-Trimethylnaphthalene	NS	NS	5.0 U	5.0 U	0.50 J	5.1 U	54	0.29 J	5.0 U	4.9 U
Fluorene	77.4	536	5.0 U	5.0 U	0.93 J	5.1 U	270	7.2	0.57 J	0.35 J
Phenanthrene	204	1,170	5.0 U	5.0 U	12	5.1 U	1,500	42	5.0 U	4.9 U
Anthracene	57.2	845	0.22 J	5.0 U	5.3	5.1 U	280	5.8	0.41 J	0.41 J
1-Methylphenanthrene	NS	NS	0.20 J	5.0 U	3.6 J	5.1 U	76	1.2 J	0.19 J	4.9 U
Fluoranthene	423	2,230	5.0 U	5.0 U	19	5.1 U	1,400	84	5.0 U	4.9 U
Pyrene	195	1,520	5.0 U	5.0 U	25	1.7 J	950	82	2.4 J	3.2 J
Benz(a)anthracene	108	1,050	0.70 J	5.0 U	11	0.74 J	130	34	0.89 J	1.1 J
Chrysene	166	1,290	0.56 J	5.0 U	12	0.88 J	190	42	5.0 U	1.1 J
Benzo(b)fluoranthene	NS	NS	0.95 J	5.0 U	5.1	0.27 J	94	39	0.95 J	0.59 J
Benzo(k)fluoranthene	NS	NS	0.64 J	5.0 U	7.9	0.22 J	71	33	5.0 U	0.90 J
Benzo(e)pyrene	NS	NS	1.0 J	5.0 U	5.8	0.28 J	88	30	0.90 J	0.70 J

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC12-5-7 K2402051-016 03/19/2004	T4-VC12-7-9 K2402051-018 03/19/2004	T4-PS12-10-12 K2402526-003 04/05/2004	T4-PS12-15-17 K2402526-004 04/05/2004	T4-VC13-0-1 K2402051-019 03/19/2004	T4-VC13-1-3 K2402051-020 03/19/2004	T4-VC13-3-5 K2402055-001 03/19/2004	T4-VC13-5-7 K2402055-002 03/19/2004
Benzo(a)pyrene	150	1,450	0.33 J	5.0 U	8.9	5.1 U	78	35	0.73 J	0.83 J
Perylene	NS	NS	0.31 J	0.33 J	2.7 J	0.57 J	33	16	5.0 J	2.9 J
Indeno(1,2,3-cd)pyrene	NS	NS	5.0 U	5.0 U	4.9 J	5.1 UJ	51	28	0.45 J	0.36 J
Dibenz(a,h)anthracene	33	NS	0.34 J	5.0 U	5.0 UJ	5.1 UJ	13	5.8	5.0 U	4.9 U
Benzo(g,h,i)perylene	NS	NS	1.1 J	5.0 U	4.7 J	5.1 U	54	30	0.79 J	0.58 J
Dimethyl phthalate	NS	NS	20 U	20 U	10 U	11 U	20 U	20 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	10 U	11 U	20 U	20 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	10 U	11 U	20 U	20 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	10 U	11 U	11 J	20 U	20 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	20 U	120	32	21 U	20 U	20 U	20 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	10 U	11 U	20 U	20 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	3.4 J	5.0 U	110	3.8 J	5,142	413	9.2 J	10 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.40 U	0.43 U	0.43 U	0.40 U	0.40 U	0.40 U	0.43 U
4,4'-DDD	NS	NS	0.40 U	0.40 U	0.43 U	0.43 U	0.40 U	0.40 U	0.40 U	0.43 U
4,4'-DDT	NS	NS	0.40 U	0.40 U	0.43 U	0.43 U	65	1.7	0.40 U	0.43 U
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.43 U	0.43 U	0.40 U	0.40 U	0.40 U	0.43 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.43 U	0.43 U	9.5	2.3 J	0.40 U	0.43 U
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.43 U	0.43 U	7.1 U	0.45 U	0.40 U	0.43 U
Total DDD (c,e)	4.88	28	0.40 U	0.40 U	0.43 U	0.43 U	9.5	2.3 J	0.40 U	0.43 U
Total DDE (c,f)	3.16	31.3	0.40 U	0.40 U	0.43 U	0.43 U	0.40 U	0.40 U	0.40 U	0.43 U
Total DDT (c,g)	4.16	62.9	0.40 U	0.40 U	0.43 U	0.43 U	65	1.7	0.40 U	0.43 U
ΣDDTs (c,h)	5.28	572	0.40 U	0.40 U	0.43 U	0.43 U	75	4.0	0.40 U	0.43 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	50 U	5.0 U	5.0 U	5.4 U
Aroclor 1221	NS	NS	10 U	10 U	11 U	11 U	100 U	10 U	10 U	11 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	50 U	5.0 U	5.0 U	5.4 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	50 U	5.0 U	5.0 U	5.4 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	50 U	5.0 U	5.0 U	5.4 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	50 U	37	5.0 U	5.4 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC12-5-7 K2402051-016 03/19/2004	T4-VC12-7-9 K2402051-018 03/19/2004	T4-PS12-10-12 K2402526-003 04/05/2004	T4-PS12-15-17 K2402526-004 04/05/2004	T4-VC13-0-1 K2402051-019 03/19/2004	T4-VC13-1-3 K2402051-020 03/19/2004	T4-VC13-3-5 K2402055-001 03/19/2004	T4-VC13-5-7 K2402055-002 03/19/2004
Aroclor 1260	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	820	5.0 U	5.0 U	5.4 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	50 U	5.0 U	5.0 U	5.4 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.3 U	5.4 U	50 U	5.0 U	5.0 U	5.4 U
Total PCBs (c,i)	59.8	676	10 U	10 U	11 U	11 U	820	37	10 U	11 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.09	0.12	0.05	0.05 U	0.65	0.11	0.11	0.05
Total solids	NS	NS	88.9	77.1	77.5	74.5	88.1	91.2	83.2	77.7

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC13-7-9 K2402055-003 03/19/2004	T4-VC14-0-1 K2402008-004 03/18/2004	T4-VC14-1-3 K2402008-005 03/18/2004	T4-VC14-3-5 K2402008-007 03/18/2004	T4-VC14-5-7 K2402008-008 03/18/2004	T4-VC14-7-9 K2402008-009 03/18/2004	T4-VC15-0-1 K2401958-020 03/16/2004	T4-VC15-1-3 K2401949-007 03/16/2004
Metals (mg/kg)										
Arsenic	9.79	33	2.9	2.9 J	2.7 J	2.9 J	3.1 J	1.4 J	6.1	6.8
Cadmium	0.99	4.98	0.13	0.2	0.19	0.2	0.39	0.07	1.5	3.4
Chromium	43.4	111	17.4 J	11.1 J	9.96 J	13 J	15.9 J	9.3 J	32.3 J	33.2 J
Copper	31.6	149	20.9 J	14 J	13.4 J	16 J	21.8 J	13.3 J	54.1 J	54.9 J
Lead	35.8	128	7.28	9.75 J	9.59 J	9.42 J	28.4 J	2.19 J	124	242
Mercury	0.18	1.06	0.04	0.009 B	0.019 U	0.019 B	0.075	0.016 B	0.131	0.251
Nickel	22.7	48.6	19.9	15 J	14.9 J	15.4 J	18.3 J	15.9 J	24.7 J	26.4 J
Selenium	NS	NS	0.11 UJ	0.12 UJ	0.1 UJ	0.11 UJ	0.12 UJ	0.1 UJ	0.22	0.23
Silver	NS	NS	0.06	0.03	0.03	0.05	0.13	0.02 U	0.79	1.43
Zinc	121	459	54.6 J	56.9 J	54.9 J	59.4 J	110 J	35.6 J	271 J	654 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	16	0.63 J	5.0 U	3.4 J	61	4.8 U	70	100
2-Methylnaphthalene	NS	NS	2.5 J	0.37 J	5.0 U	1.6 J	22	4.8 U	35	63
1-Methylnaphthalene	NS	NS	1.5 J	5.0 U	5.0 U	0.9 J	11	4.8 U	18	28
Biphenyl	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	6.0	4.8 U	9.0	14
2,6-Dimethylnaphthalene	NS	NS	1.6 J	0.27 J	5.0 U	1.2 J	9.8	4.8 U	24	65
Acenaphthylene	NS	NS	4.2 J	0.34 J	0.37 J	0.99 J	7.9	4.8 U	20	24
Acenaphthene	NS	NS	1.7 J	0.36 J	5.0 U	9.0	62	4.8 U	290	140
2,3,5-Trimethylnaphthalene	NS	NS	1.4 J	0.24 J	0.31 J	1.6 J	9.7	4.8 U	18	150
Fluorene	77.4	536	3.3 J	0.37 J	0.22 J	6.1	42	4.8 U	160	140
Phenanthrene	204	1,170	22	3.0 J	5.0 U	41	360	4.8 U	1,200	750
Anthracene	57.2	845	5.1	0.93 J	0.88 J	10	81	4.8 U	270	110
1-Methylphenanthrene	NS	NS	3.2 J	0.38 J	0.23 J	3.2 J	31	4.8 U	92	110
Fluoranthene	423	2,230	24	5.8	4.2 J	84	410	4.8 U	2,500	920
Pyrene	195	1,520	53	13	11	110	510	4.8 U	2,700	1,200
Benz(a)anthracene	108	1,050	11	3.3 J	3.0 J	51	250	4.8 U	1,600	410
Chrysene	166	1,290	16	5.4	4.2 J	64	300	4.8 U	2,000	550
Benzo(b)fluoranthene	NS	NS	8.5	4.1 J	5.0 J	69	290	4.8 U	2,000	470
Benzo(k)fluoranthene	NS	NS	14	5.6	4.5 J	61	250	4.8 U	2,000	370
Benzo(e)pyrene	NS	NS	12	4.8 J	4.4 J	57	220	4.8 U	1,700	370

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC13-7-9 K2402055-003 03/19/2004	T4-VC14-0-1 K2402008-004 03/18/2004	T4-VC14-1-3 K2402008-005 03/18/2004	T4-VC14-3-5 K2402008-007 03/18/2004	T4-VC14-5-7 K2402008-008 03/18/2004	T4-VC14-7-9 K2402008-009 03/18/2004	T4-VC15-0-1 K2401958-020 03/16/2004	T4-VC15-1-3 K2401949-007 03/16/2004
Benzo(a)pyrene	150	1,450	12	3.0 J	3.7 J	71	300	0.20 J	2,300	450
Perylene	NS	NS	62	1.9 J	1.7 J	34	120	4.8 U	800	300
Indeno(1,2,3-cd)pyrene	NS	NS	8	2.4 J	3.5 J	57	220	4.8 U	1,800	370
Dibenz(a,h)anthracene	33	NS	0.74 J	0.5 J	0.66 J	9.2	39	4.8 U	360	76
Benzo(g,h,i)perylene	NS	NS	15	3.8 J	3.8 J	56	210	4.8 U	1,700	370
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	44 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	11 J	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	44 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	2.7 J	13 J	20 U	33 J	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	20 U	20 U	20 U	42 U	20 U	280	150 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	44 U	20 U
Total PAHs (c,d)	1,610	22,800	191	46	37	580	2,924	0.20 J	17,110	5,634
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.42 U	0.40 U	0.40 U	0.88	2.7 J	0.40 U	4.7	9.5 J
4,4'-DDD	NS	NS	0.42 U	0.33 J	0.34 J	0.88	1.6	0.40 U	3.1	4.8
4,4'-DDT	NS	NS	0.42 U	0.83	0.91	1	3.3	0.40 U	5.7	13
2,4'-DDE	NS	NS	0.42 U	0.095 J	0.40 U	0.39 U	0.64 J	0.40 U	0.59 U	2.3 U
2,4'-DDD	NS	NS	0.42 U	0.40 U	0.40 U	0.7 J	3.4 J	0.40 U	4.4 J	11 J
2,4'-DDT	NS	NS	0.42 U	0.40 U	0.40 U	0.39 U	1.9	0.40 U	2.5 J	6.6
Total DDD (c,e)	4.88	28	0.42 U	0.33 J	0.34 J	1.6	5.0	0.40 U	7.5	16
Total DDE (c,f)	3.16	31.3	0.42 U	0.095 J	0.40 U	0.88	3.3 J	0.40 U	4.7	9.5 J
Total DDT (c,g)	4.16	62.9	0.42 U	0.83	0.91	1.0	5.2	0.40 U	8.2	20
ΣDDTs (c,h)	5.28	572	0.42 U	1.3	1.3	3.5	14	0.40 U	20	45
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.2 U	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	7.4 U	5.0 U
Aroclor 1221	NS	NS	11 U	10 U	10 U	9.7 U	10 U	10 U	15 U	10 U
Aroclor 1232	NS	NS	5.2 U	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	7.4 U	5.0 U
Aroclor 1242	NS	NS	5.2 U	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	7.4 U	5.0 U
Aroclor 1248	NS	NS	5.2 U	5.0 U	5.0 U	3.1 J	14	5.0 U	28	72
Aroclor 1254	NS	NS	5.2 U	5.0 U	5.0 U	6.1 U	38 U	5.0 U	61 U	180 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC13-7-9 K2402055-003 03/19/2004	T4-VC14-0-1 K2402008-004 03/18/2004	T4-VC14-1-3 K2402008-005 03/18/2004	T4-VC14-3-5 K2402008-007 03/18/2004	T4-VC14-5-7 K2402008-008 03/18/2004	T4-VC14-7-9 K2402008-009 03/18/2004	T4-VC15-0-1 K2401958-020 03/16/2004	T4-VC15-1-3 K2401949-007 03/16/2004
Aroclor 1260	NS	NS	5.2 U	5.3	5.4	6.1	35	5.0 U	52	160
Aroclor 1262	NS	NS	5.2 U	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	7.4 U	5.0 U
Aroclor 1268	NS	NS	5.2 U	5.0 U	5.0 U	4.9 U	5.0 U	5.0 U	7.4 U	5.0 U
Total PCBs (c,i)	59.8	676	11 U	5.3	5.4	9.2	49	10 U	80	232
Conventionals (percent)										
Total organic carbon	NS	NS	0.29	0.05	0.04 J	0.2	0.51	0.05	2.04	1.69
Total solids	NS	NS	74.4	83.6	78.1	77.5	81.7	77.9	45.3	56.9

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC15-3-5	T4-VC15-5-7	T4-VC15-7-9	T4-VC15-9-11	T4-VC16-0-1	T4-VC16-1-3	T4-VC16-3-5	T4-VC16-5-7
Lab ID:			K2401949-008	K2401949-009	K2401949-010	K2401949-011	K2401958-001	K2401958-002	K2401958-003	K2401958-004
Date Sampled:	TEC (a)	PEC (b)	03/16/2004	03/16/2004	03/16/2004	03/16/2004	03/17/2004	03/17/2004	03/17/2004	03/17/2004
Metals (mg/kg)										
Arsenic	9.79	33	3.8	2	2.8	2.3	4.9	2.9	2.5	2.7
Cadmium	0.99	4.98	0.35	0.17	0.23	0.19	1.52	0.42	0.18	0.27
Chromium	43.4	111	29.9 J	25.9 J	30.2 J	29.7 J	23.2 J	17.4 J	21.1 J	27 J
Copper	31.6	149	35.3 J	35.7 J	35.3 J	31.5 J	37.5 J	24.1 J	24.4 J	43.8 J
Lead	35.8	128	14.4	6.85	6.7	5.46	126	54.4	4.5	6.88
Mercury	0.18	1.06	0.097	0.068	0.05	0.037	0.097	0.132	0.053	0.038
Nickel	22.7	48.6	29.9 J	20 J	25.3 J	26.5 J	17.4 J	21.1 J	30.4 J	26.2 J
Selenium	NS	NS	0.13 UJ	0.1 UJ	0.1 UJ	0.09 UJ	0.13 J	0.11 UJ	0.07 J	0.14 J
Silver	NS	NS	0.18	0.07	0.08	0.08	0.44	0.09	0.05	0.07
Zinc	121	459	82.1 J	67.2 J	62 J	59.6 J	287 J	98.7 J	52.6 J	70.1 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	21	4.9 U	5.0 U	4.9 U	120	300	5.0 U	5.0 U
2-Methylnaphthalene	NS	NS	8.4	4.9 U	5.0 U	4.9 U	63	85	5.0 U	5.0 U
1-Methylnaphthalene	NS	NS	3.7 J	4.9 U	5.0 U	4.9 U	34	23	5.0 U	5.0 U
Biphenyl	NS	NS	4.0 J	4.9 U	5.0 U	4.9 U	14	6.0	5.0 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	5.6	4.9 U	5.0 U	4.9 U	39	21	5.0 U	5.0 U
Acenaphthylene	NS	NS	6.3	4.9 U	5.0 U	4.9 U	30	4.9 J	5.0 U	5.0 U
Acenaphthene	NS	NS	20	4.9 U	5.0 U	4.9 U	740	96	5.0 U	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	28	4.9 U	5.0 U	4.9 U	40	17	5.0 U	5.0 U
Fluorene	77.4	536	22	4.9 U	5.0 U	4.9 U	600	62	5.0 U	5.0 U
Phenanthrene	204	1,170	180	4.9 U	5.0 U	4.9 U	4,000	280	5.0 U	5.0 U
Anthracene	57.2	845	29	4.9 U	5.0 U	4.9 U	630	43	5.0 U	5.0 U
1-Methylphenanthrene	NS	NS	30	4.9 U	5.0 U	4.9 U	220	27	5.0 U	5.0 U
Fluoranthene	423	2,230	250	4.9 U	5.0 U	4.9 U	6,600	330	5.0 U	5.0 U
Pyrene	195	1,520	370	4.9 U	2.2 J	4.9 U	7,100	420	5.0 U	5.0 U
Benz(a)anthracene	108	1,050	110	0.35 J	1.1 J	0.27 J	4,300	170	0.23 J	0.48 J
Chrysene	166	1,290	150	0.82 J	1.6 J	0.56 J	5,100	210	0.36 J	0.52 J
Benzo(b)fluoranthene	NS	NS	90	0.75 J	1.6 J	0.78 J	5,500	200	0.47 J	0.48 J
Benzo(k)fluoranthene	NS	NS	92	0.38 J	1.2 J	0.53 J	4,900	190	0.35 J	0.34 J
Benzo(e)pyrene	NS	NS	96	0.49 J	1.2 J	0.60 J	4,300	170	0.46 J	0.42 J

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC15-3-5 K2401949-008 03/16/2004	T4-VC15-5-7 K2401949-009 03/16/2004	T4-VC15-7-9 K2401949-010 03/16/2004	T4-VC15-9-11 K2401949-011 03/16/2004	T4-VC16-0-1 K2401958-001 03/17/2004	T4-VC16-1-3 K2401958-002 03/17/2004	T4-VC16-3-5 K2401958-003 03/17/2004	T4-VC16-5-7 K2401958-004 03/17/2004
Benzo(a)pyrene	150	1,450	130	4.9 U	0.8 J	4.9 U	5,900	210	0.23 J	0.24 J
Perylene	NS	NS	310	510	280	310	1,800	150	97	290
Indeno(1,2,3-cd)pyrene	NS	NS	96	4.9 U	0.56 J	4.9 U	4,800	170	0.24 J	0.28 J
Dibenz(a,h)anthracene	33	NS	11	4.9 U	5.0 U	4.9 U	960	21	5.0 U	5.0 U
Benzo(g,h,i)perylene	NS	NS	120	0.27 J	0.91 J	0.33 J	4,300	180	0.27 J	0.35 J
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	100 U	20 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	100 U	20 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	20 U	100 U	20 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	20 U	110	20 U	20 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	43 U	20 U	31 U	27 U	580	27 U	20 U	20 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	20 U	100 U	20 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	1,470	2.3 J	8.5 J	2.1 J	45,520	2,516	1.6 J	2.1 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.82 J	0.40 U	0.40 U	0.40 U	3.1	1.4 J	0.48 U	0.50 U
4,4'-DDD	NS	NS	0.49	0.40 U	0.40 U	0.40 U	2.8	1.6	0.48 U	0.50 U
4,4'-DDT	NS	NS	0.81	0.40 U	0.40 U	0.40 U	9.1 J	3.3 J	0.48 UJ	0.50 U
2,4'-DDE	NS	NS	0.4 U	0.40 U	0.40 U	0.40 U	0.41 U	0.44 U	0.48 U	0.50 U
2,4'-DDD	NS	NS	0.91	0.40 U	0.40 U	0.40 U	4.2 J	1.7 J	0.48 U	0.50 U
2,4'-DDT	NS	NS	0.34 J	0.40 U	0.40 U	0.40 U	2.1 J	0.96	0.48 U	0.50 U
Total DDD (c,e)	4.88	28	1.4	0.40 U	0.40 U	0.40 U	7.0	3.3	0.48 U	0.50 U
Total DDE (c,f)	3.16	31.3	0.82 J	0.40 U	0.40 U	0.40 U	3.1	1.4 J	0.48 U	0.50 U
Total DDT (c,g)	4.16	62.9	1.2	0.40 U	0.40 U	0.40 U	11 J	4.3	0.48 U	0.50 U
ΣDDTs (c,h)	5.28	572	3.4	0.40 U	0.40 U	0.40 U	21	9.0	0.48 U	0.50 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.5 U	6.0 U	6.3 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	11 U	11 U	12 U	13 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.5 U	6.0 U	6.3 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.5 U	6.0 U	6.3 U
Aroclor 1248	NS	NS	9.1	5.0 U	5.0 U	5.0 U	34	17 J	6.0 U	6.3 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	64 U	25 U	6.0 U	6.3 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC15-3-5 K2401949-008 03/16/2004	T4-VC15-5-7 K2401949-009 03/16/2004	T4-VC15-7-9 K2401949-010 03/16/2004	T4-VC15-9-11 K2401949-011 03/16/2004	T4-VC16-0-1 K2401958-001 03/17/2004	T4-VC16-1-3 K2401958-002 03/17/2004	T4-VC16-3-5 K2401958-003 03/17/2004	T4-VC16-5-7 K2401958-004 03/17/2004
Aroclor 1260	NS	NS	14	5.0 U	5.0 U	5.0 U	62	19	6.0 U	6.3 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.5 U	6.0 U	6.3 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.5 U	6.0 U	6.3 U
Total PCBs (c,i)	59.8	676	23.1	10 U	10 U	10 U	96	36	12 U	13 U
Conventionals (percent)										
Total organic carbon	NS	NS	1.23	1.23	1.11	0.49	2.13	0.53	0.72	1.1
Total solids	NS	NS	62.3	63.2	61	65.9	65.5	72.8	69.7	66.4

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC16-7-9	T4-VC16-9-11	T4-VC17-0-1	T4-VC17-1-3	T4-VC17-3-5	T4-VC17-5-7	T4-PS17-10-12	T4-PS17-15-17
Lab ID:			K2401958-005	K2401958-006	K2401908-014	K2401908-015	K2401908-016	K2401908-017	K2402526-012	K2402526-013
Date Sampled:	TEC (a)	PEC (b)	03/17/2004	03/17/2004	03/15/2004	03/15/2004	03/15/2004	03/15/2004	04/02/2004	04/02/2004
Metals (mg/kg)										
Arsenic	9.79	33	2.1	2.8	3.6	3.9	4.1	3.2	3.3	2.5
Cadmium	0.99	4.98	0.19	0.16	0.31	0.41	0.62	0.24	0.12	0.09
Chromium	43.4	111	24.5 J	25.7 J	25.3 J	26.4 J	29.7 J	16.9 J	11.7	9.56
Copper	31.6	149	31.4 J	30.2 J	34.6 J	38.6 J	39.9 J	20.5 J	30	30
Lead	35.8	128	5.18	4.84	16.6	26.4	33.1	11.6	5.54	4.39
Mercury	0.18	1.06	0.184	0.025	0.089 J	0.097 J	0.376 J	0.105 J	0.02	0.01 B
Nickel	22.7	48.6	27.2 J	25.4 J	22.3 J	23.3 J	25.2 J	19.6 J	16.6 J	14.2 J
Selenium	NS	NS	0.1 UJ	0.06 J	0.15 J	0.17 J	0.15 J	0.07 J	0.11 UJ	0.11 UJ
Silver	NS	NS	0.06	0.05	0.16	0.22	0.44	0.13	0.03	0.03
Zinc	121	459	58.1 J	54.7 J	81.9 J	119 J	127 J	77.2 J	40.9 J	38.7 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	4.7 U	5.0 U	14	130	580	350	24	2.1 J
2-Methylnaphthalene	NS	NS	4.7 U	5.0 U	7.2	71	160	62	4.5 J	0.59 J
1-Methylnaphthalene	NS	NS	4.7 U	5.0 U	5.7	26	83	36	2.4 J	0.33 J
Biphenyl	NS	NS	4.7 U	5.0 U	2.9 J	16	63	27	4.9 U	4.9 U
2,6-Dimethylnaphthalene	NS	NS	4.7 U	5.0 U	6.6	30	130	52	3.6 J	0.53 J
Acenaphthylene	NS	NS	4.7 U	5.0 U	5.3	28	96	64	6.0	0.44 J
Acenaphthene	NS	NS	4.7 U	5.0 U	34	69	210	41	5.7	0.79 J
2,3,5-Trimethylnaphthalene	NS	NS	4.7 U	5.0 U	5.8	20	160	49	3.9 J	0.45 J
Fluorene	77.4	536	4.7 U	5.0 U	38	63	180	65	5.4	0.83 J
Phenanthrene	204	1,170	4.7 U	5.0 U	200	340	1,600	560	52	6.0
Anthracene	57.2	845	4.7 U	5.0 U	24	69	280	110	12	0.98 J
1-Methylphenanthrene	NS	NS	4.7 U	5.0 U	9.0	36	160	50	5.9	0.8 J
Fluoranthene	423	2,230	4.7 U	5.0 U	190	520	2,100	650	77	9.5
Pyrene	195	1,520	4.7 U	5.0 U	220	690	3,300	980	98	12
Benz(a)anthracene	108	1,050	4.7 U	5.0 U	89	270	730	210	27	3.5 J
Chrysene	166	1,290	4.7 U	5.0 U	130	360	970	300	38	4.8 J
Benzo(b)fluoranthene	NS	NS	0.21 J	0.21 J	120	330	650	200	22	3.2 J
Benzo(k)fluoranthene	NS	NS	4.7 U	5.0 U	110	290	680	200	25	3.3 J
Benzo(e)pyrene	NS	NS	0.18 J	0.21 J	110	300	720	220	24	3.5 J

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC16-7-9 K2401958-005 03/17/2004	T4-VC16-9-11 K2401958-006 03/17/2004	T4-VC17-0-1 K2401908-014 03/15/2004	T4-VC17-1-3 K2401908-015 03/15/2004	T4-VC17-3-5 K2401908-016 03/15/2004	T4-VC17-5-7 K2401908-017 03/15/2004	T4-PS17-10-12 K2402526-012 04/02/2004	T4-PS17-15-17 K2402526-013 04/02/2004
Benzo(a)pyrene	150	1,450	4.7 U	5.0 U	120	410	1,000	300	34	3.9 J
Perylene	NS	NS	180	160	61	160	330	150	27	4.5 J
Indeno(1,2,3-cd)pyrene	NS	NS	4.7 U	5.0 U	100	360	800	230	30 J	4.9 UJ
Dibenz(a,h)anthracene	33	NS	4.7 U	5.0 U	16	46	78	21	3.8 J	4.9 UJ
Benzo(g,h,i)perylene	NS	NS	4.7 U	0.15 J	110	380	1,000	290	36	4.6 J
Dimethyl phthalate	NS	NS	19 U	20 U	20 U	20 U	39 U	23 U	9.8 U	9.8 U
Diethyl phthalate	NS	NS	19 U	20 U	20 U	20 U	39 U	23 U	9.8 U	9.8 U
Di-n-butyl phthalate	NS	NS	19 U	20 U	20 U	20 U	39 U	23 U	20 U	9.8 U
Butylbenzyl phthalate	NS	NS	19 U	20 U	7.6 J	9.7 J	39 U	23 U	9.8 U	9.8 U
Bis(2-ethylhexyl) phthalate	NS	NS	19 U	20 U	54	100	39 U	23 U	60	63
Di-n-octyl phthalate	NS	NS	19 U	20 U	20 U	20 U	39 U	23 U	9.8 U	9.8 U
Total PAHs (c,d)	1,610	22,800	0.21 J	0.21 J	1,294	3,569	12,376	4,030	426	51
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.39 U	3.1	5.6 J	25 J	0.41 U	0.45 J	0.43 U
4,4'-DDD	NS	NS	0.40 U	0.39 U	2.0	4.5	43	0.41 U	0.94	0.43 U
4,4'-DDT	NS	NS	0.40 UJ	0.39 UJ	0.45 U	3.3	8.2 J	0.62	2.8	0.43 U
2,4'-DDE	NS	NS	0.40 U	0.39 U	0.4 U	0.86 U	1.9 U	0.41 U	0.44 U	0.43 U
2,4'-DDD	NS	NS	0.40 U	0.39 U	1.2	3.7 J	30	0.41 U	0.73	0.43 U
2,4'-DDT	NS	NS	0.40 U	0.39 U	0.44	2.2 J	13 U	0.41 U	0.44 U	0.43 U
Total DDD (c,e)	4.88	28	0.40 U	0.39 U	3.2	8.2	73	0.41 U	1.7	0.43 U
Total DDE (c,f)	3.16	31.3	0.40 U	0.39 U	3.1	5.6 J	25 J	0.41 U	0.45 J	0.43 U
Total DDT (c,g)	4.16	62.9	0.40 U	0.39 U	0.44	5.5	8.2 J	0.62	2.8	0.43 U
ΣDDTs (c,h)	5.28	572	0.40 U	0.39 U	6.7	19	106	0.62	4.9	0.43 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	4.9 U	5.0 U	5.1 U	5.0 U	5.1 U	5.5 U	5.4 U
Aroclor 1221	NS	NS	9.9 U	9.7 U	10 U	11 U	10 U	11 U	11 U	11 U
Aroclor 1232	NS	NS	5.0 U	4.9 U	5.0 U	5.1 U	5.0 U	5.1 U	5.5 U	5.4 U
Aroclor 1242	NS	NS	5.0 U	4.9 U	5.0 U	5.1 U	5.0 U	5.1 U	5.5 U	5.4 U
Aroclor 1248	NS	NS	5.0 U	4.9 U	4.7 J	20	13 J	5.1 U	5.5 U	5.4 U
Aroclor 1254	NS	NS	5.0 U	4.9 U	5.0 U	71 U	270 U	5.1 U	5.5 U	5.4 U

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC16-7-9 K2401958-005 03/17/2004	T4-VC16-9-11 K2401958-006 03/17/2004	T4-VC17-0-1 K2401908-014 03/15/2004	T4-VC17-1-3 K2401908-015 03/15/2004	T4-VC17-3-5 K2401908-016 03/15/2004	T4-VC17-5-7 K2401908-017 03/15/2004	T4-PS17-10-12 K2402526-012 04/02/2004	T4-PS17-15-17 K2402526-013 04/02/2004
Aroclor 1260	NS	NS	5.0 U	4.9 U	10	54	180 J	15	5.5 U	5.4 U
Aroclor 1262	NS	NS	5.0 U	4.9 U	5.0 U	5.1 U	5.0 U	5.1 U	5.5 U	5.4 U
Aroclor 1268	NS	NS	5.0 U	4.9 U	5.0 U	5.1 U	51 J	15	5.5 U	5.4 U
Total PCBs (c,i)	59.8	676	9.9 U	9.7 U	15	74	244 J	30	11 U	11 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.28	0.3	1.69	2.25	2.3	0.84	0.13	0.06
Total solids	NS	NS	67.4	68.9	54.8	54.2	60	71.7	72.5	73.3

Table 5-3
Selected Slip 1 Surface and Subsurface Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC18-0-1 K2401792-005 03/11/2004	T4-VC18-1-3 K2401792-006 03/11/2004	T4-VC18-3-5 K2401792-007 03/11/2004	T4-VC18-5-7 K2401792-008 03/11/2004	T4-VC18-7-9 K2401792-009 03/11/2004	T4-VC19-0-1 K2401768-008 03/10/2004	T4-VC19-1-3 K2401768-009 03/10/2004	T4-VC19-3-5 K2401768-010 03/10/2004
Metals (mg/kg)										
Arsenic	9.79	33	3.4	2.8	2.8	2.3	2.3	2.9	3.3	2.9
Cadmium	0.99	4.98	1.03	0.48	0.34	0.11	0.08	0.5	0.52	0.47
Chromium	43.4	111	24.3 J	19.1 J	25.5 J	11 J	10.9 J	22.7 J	21.6 J	22.7 J
Copper	31.6	149	32.1 J	27.3 J	31.8 J	14.2 J	13.4 J	31.9 J	36.9 J	29.5 J
Lead	35.8	128	131	33.6	22.1	5.17	2.62	43.2	38.6	34.1
Mercury	0.18	1.06	0.079	0.078	0.163	0.088	0.009 J	0.071	0.076	0.093
Nickel	22.7	48.6	20.7 J	18.1 J	21.4 J	14.8 J	15.4 J	18.7 J	18.2 J	20.9 J
Selenium	NS	NS	0.22	0.19	0.22	0.11 U	0.11 U	0.23	0.22	0.2
Silver	NS	NS	0.49	0.2	0.22	0.05	0.02 U	0.23	0.33	0.19
Zinc	121	459	144 J	111 J	88.1 J	46.4 J	40.7 J	91.7 J	106 J	97.2 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	36	170	200	98	24 J	69	330	100
2-Methylnaphthalene	NS	NS	26	100	130	52	3.9 J	51	160	69
1-Methylnaphthalene	NS	NS	21	45	62	20	1.4 J	34	84	33
Biphenyl	NS	NS	7.7	19	19	12	3 J	11	26	12
2,6-Dimethylnaphthalene	NS	NS	18	61	62	28	1.6 J	21	51	38
Acenaphthylene	NS	NS	11	17	14	27	8	12	14	25
Acenaphthene	NS	NS	52	250	300	180	4.1 J	350	1,700	190
2,3,5-Trimethylnaphthalene	NS	NS	73	97	41	38	0.77 J	31	44	52
Fluorene	77.4	536	39	180	160	110	2.1 J	220	790	120
Phenanthrene	204	1,170	160	710	410	710	44 J	1,900	7,300	600
Anthracene	57.2	845	33	91	49	54	8.4	370	1,700	95
1-Methylphenanthrene	NS	NS	16	70	24	79	7.4 J	110	380	54
Fluoranthene	423	2,230	300	690	250	530	38 J	4,400	14,000	970
Pyrene	195	1,520	390	770	280	700	170	4,300	16,000	1,200
Benz(a)anthracene	108	1,050	160	220	84	230	120 J	2,900	9,600	630
Chrysene	166	1,290	220	310	100	290	160 J	3,500	11,000	820
Benzo(b)fluoranthene	NS	NS	220	190	82	150	130 J	4,000	11,000	870
Benzo(k)fluoranthene	NS	NS	190	170	74	160	140 J	3,100	11,000	560
Benzo(e)pyrene	NS	NS	190	160	79	170	140 J	2,900	9,000	610

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC18-0-1 K2401792-005 03/11/2004	T4-VC18-1-3 K2401792-006 03/11/2004	T4-VC18-3-5 K2401792-007 03/11/2004	T4-VC18-5-7 K2401792-008 03/11/2004	T4-VC18-7-9 K2401792-009 03/11/2004	T4-VC19-0-1 K2401768-008 03/10/2004	T4-VC19-1-3 K2401768-009 03/10/2004	T4-VC19-3-5 K2401768-010 03/10/2004
Benzo(a)pyrene	150	1,450	250	210	110	250	220 J	3,800	13,000	810
Perylene	NS	NS	100	110	110	76	59 J	1,200	3,800	350
Indeno(1,2,3-cd)pyrene	NS	NS	220	160	91	170	170 J	3,100	10,000	690
Dibenz(a,h)anthracene	33	NS	36	28	12	24	22 J	800	2,000	150
Benzo(g,h,i)perylene	NS	NS	220	170	100	190	170 J	2,700	9,000	630
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	100 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	7.5 J	20 U	20 U	7.4 J	100 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	180 U	20 U	20 U	20 U	20 U	100 U	20 U
Butylbenzyl phthalate	NS	NS	9.5 J	20 U	20 U	20 U	20 U	17 J	100 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	57 U	72	24 U	20 U	30 U	73	130	55 U
Di-n-octyl phthalate	NS	NS	20 UJ	20 UJ	20 UJ	20 UJ	20 UJ	20 UJ	100 UJ	20 UJ
Total PAHs (c,d)	1,610	22,800	2,061	3,978	2,113	3,489	1,069	28,921	97,434	6,990
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	4.9	3.8	9.3	1.7	1.1	2.9	4.3 J	8.5
4,4'-DDD	NS	NS	3.3	4.4	7.5	2.2	12 J	2	2.5 J	4.1
4,4'-DDT	NS	NS	4.7 J	1.9 J	1.5 U	5.7	0.75 J	0.88 U	3 J	3.3
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.87 U	0.37 J	0.40 U	0.73 U	0.56 UJ	0.64 U
2,4'-DDD	NS	NS	1.8 J	2.9	3.7	1.2	4.4 J	1.6 J	2.4 J	3 J
2,4'-DDT	NS	NS	1.2 U	1	1.5 U	0.63 J	0.40 U	0.39 U	1.4 UJ	1.5 U
Total DDD (c,e)	4.88	28	5.1	7.3	11	3.4	16	3.6	4.9 J	7.1
Total DDE (c,f)	3.16	31.3	4.9	3.8	9.3	2.1	1.1	2.9	4.3 J	8.5
Total DDT (c,g)	4.16	62.9	4.7	2.9	1.5 U	6.3	0.75 J	0.88 U	3 J	3.3
ΣDDTs (c,h)	5.28	572	15	14	21	12	18.3	6.5	12 J	19
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 UJ	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	10 U	9.7 U	10 UJ	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 UJ	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 UJ	5.0 U
Aroclor 1248	NS	NS	11	19	28	8.7 J	5.0 U	13 J	17 J	22
Aroclor 1254	NS	NS	24 U	35 U	37 U	16 U	5.0 U	21 U	30 UJ	36 U

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC18-0-1 K2401792-005 03/11/2004	T4-VC18-1-3 K2401792-006 03/11/2004	T4-VC18-3-5 K2401792-007 03/11/2004	T4-VC18-5-7 K2401792-008 03/11/2004	T4-VC18-7-9 K2401792-009 03/11/2004	T4-VC19-0-1 K2401768-008 03/10/2004	T4-VC19-1-3 K2401768-009 03/10/2004	T4-VC19-3-5 K2401768-010 03/10/2004
Aroclor 1260	NS	NS	28	25	42	7.9	5.0 U	26	25 J	48
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 UJ	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.9 U	5.0 UJ	5.0 U
Total PCBs (c,i)	59.8	676	39	44	70	17	10 U	39	42 J	70
Conventionals (percent)										
Total organic carbon	NS	NS	1.78	1.33	1.86	0.48	0.09 U	1.78	2.29	1.6
Total solids	NS	NS	57.2	61.9	58.3	75.5	77	53.8	51.8	63.7

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC19-5-7 K2401792-001 03/10/2004	T4-VC19-7-9 K2401792-003 03/10/2004	T4-VC19-9-11 K2401792-004 03/10/2004	T4-VC20-0-1 K2401768-001 03/09/2004	T4-VC20-1-3 K2401768-002 03/09/2004	T4-VC20-3-5 K2401768-003 03/09/2004	T4-VC20-5-7 K2401768-004 03/09/2004	T4-VC20-7-9 K2401768-005 03/09/2004
Metals (mg/kg)										
Arsenic	9.79	33	1.8	2.5	2	2.8	2.6	3.2	3.2	3.6
Cadmium	0.99	4.98	0.21	0.34	0.13	0.26	0.26	0.39	0.44	0.72
Chromium	43.4	111	20.6 J	19.5 J	11.4 J	22.7 J	20 J	24.5 J	24.4 J	24.1 J
Copper	31.6	149	19.1 J	22.7 J	16.9 J	29.8 J	29.6 J	38.8 J	36.1 J	37 J
Lead	35.8	128	11.1 J	20.6	7.24	15.1	13.8	25.2	38.3	62.5
Mercury	0.18	1.06	0.096	0.113	0.021	0.06	0.069	0.085	0.117	0.17
Nickel	22.7	48.6	22.1 J	19.1 J	16.8 J	18.9 J	18.3 J	20.1 J	20.3 J	20.2 J
Selenium	NS	NS	0.18	0.11	0.12 U	0.26	0.25	0.28	0.25	0.23
Silver	NS	NS	0.12	0.17	0.03	0.17	0.17	0.29	0.32	0.41
Zinc	121	459	59.6 J	85.1 J	39.8 J	67.3 J	65.7 J	94 J	122 J	271 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	120	190	87	14	12	40	74	350
2-Methylnaphthalene	NS	NS	54	51	14	6	4.7 J	19	35	180
1-Methylnaphthalene	NS	NS	23	27	13	3.9 J	3.7 J	11	14	150
Biphenyl	NS	NS	13	16	5.1	2.4 J	1.9 J	4.7 J	8.8	31
2,6-Dimethylnaphthalene	NS	NS	66	41	20	3.4 J	3.5 J	8.5	21	78
Acenaphthylene	NS	NS	33 J	30	14	5.8	3.3 J	8.7	15	24
Acenaphthene	NS	NS	170	92	22	17	18	120	56	240
2,3,5-Trimethylnaphthalene	NS	NS	120	50	19	3.4 J	3.1 J	5.7	18	44
Fluorene	77.4	536	100	59	12	14	11	54	50	140
Phenanthrene	204	1,170	690	510	95	110	84	420	200	450
Anthracene	57.2	845	65 J	62	20	29	20	110	54	77
1-Methylphenanthrene	NS	NS	110	62	18	8.9	7.2	30	22	43
Fluoranthene	423	2,230	810 J	480	99	230	160	850	300	380
Pyrene	195	1,520	1,200 J	720	230	280	180	920	370	450
Benz(a)anthracene	108	1,050	270 J	220	70	120	96	620	130	180
Chrysene	166	1,290	340 J	290	96	160	130	710	190	230
Benzo(b)fluoranthene	NS	NS	200 J	190	64	160	130	810	160	180
Benzo(k)fluoranthene	NS	NS	180 J	200	66	140	110	650	140	190
Benzo(e)pyrene	NS	NS	200 J	210	72	130	100	610	140	190

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC19-5-7 K2401792-001 03/10/2004	T4-VC19-7-9 K2401792-003 03/10/2004	T4-VC19-9-11 K2401792-004 03/10/2004	T4-VC20-0-1 K2401768-001 03/09/2004	T4-VC20-1-3 K2401768-002 03/09/2004	T4-VC20-3-5 K2401768-003 03/09/2004	T4-VC20-5-7 K2401768-004 03/09/2004	T4-VC20-7-9 K2401768-005 03/09/2004
Benzo(a)pyrene	150	1,450	280 J	320	100	170	130	870	170	280
Perylene	NS	NS	270	120	48	81	56	280	130	84
Indeno(1,2,3-cd)pyrene	NS	NS	210 J	240	81	140	100	710	140	210
Dibenz(a,h)anthracene	33	NS	32 J	30	10	26	20	150	26	28
Benzo(g,h,i)perylene	NS	NS	230 J	260	95	150	100	630	150	240
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	8.8 J	20 U	20 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	15 J	8.7 J	20 U	7.9 J	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	52 U	20 U	21 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	22	6.4 J	19 J	20 U	14 J	17 J	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	280 J	20 U	20 U	90	69	150	3000	57 U
Di-n-octyl phthalate	NS	NS	20 UJ	20 UJ	20 UJ	16 J	20 UJ	20 UJ	20 UJ	20 UJ
Total PAHs (c,d)	1,610	22,800	4,458	3,363	975	1,450	1,084	6,183	1,909	3,171
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	3.8	1.6 J	0.40 U	2.6	3.7	3.3	6.8 J	11 J
4,4'-DDD	NS	NS	3.4	3.8	1.3	2.2	2.6	2.9	4.3	7.6
4,4'-DDT	NS	NS	1.6	0.87 J	0.25 J	4.9	0.40 U	1.8 J	4.8	16
2,4'-DDE	NS	NS	0.53 U	0.56	0.40 U	0.41 U	0.40 U	0.48 U	0.87 U	2.0 U
2,4'-DDD	NS	NS	2.4 J	2.9	0.72	0.64 U	1.5 J	1.8 J	4.9 J	8.3 J
2,4'-DDT	NS	NS	1.2	0.40 U	0.40 U	0.41 U	0.49 U	0.67 U	3	4.8
Total DDD (c,e)	4.88	28	5.8	6.7	2.0	2.2	4.1	4.7	9.2	16
Total DDE (c,f)	3.16	31.3	3.8	2.2	0.40 U	2.6	3.7	3.3	6.8	11
Total DDT (c,g)	4.16	62.9	2.8	0.87	0.25 J	4.9	0.49 U	1.8 J	7.8	21
ΣDDTs (c,h)	5.28	572	12	9.7	2.3	9.7	7.8	9.8	24	48
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	22 J	5.0 U	5.0 U	5.5	9.8 J	13 J	41	78
Aroclor 1254	NS	NS	30 U	5.0 U	5.0 U	7.4 U	14 U	22 U	75 U	160 U

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC19-5-7	T4-VC19-7-9	T4-VC19-9-11	T4-VC20-0-1	T4-VC20-1-3	T4-VC20-3-5	T4-VC20-5-7	T4-VC20-7-9
Lab ID:			K2401792-001	K2401792-003	K2401792-004	K2401768-001	K2401768-002	K2401768-003	K2401768-004	K2401768-005
Date Sampled:	TEC (a)	PEC (b)	03/10/2004	03/10/2004	03/10/2004	03/09/2004	03/09/2004	03/09/2004	03/09/2004	03/09/2004
Aroclor 1260	NS	NS	20	5.0 U	5.0 U	11	12	16	69	170
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	42	10 U	10 U	17	22	29	110	248
Conventionals (percent)										
Total organic carbon	NS	NS	0.86	0.67	0.53	1.8	1.86	2.36	1.99	2.12
Total solids	NS	NS	68.8	69.5	70.9	49.4	54.4	52.6	55.8	55.3

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC20-9-11 K2401768-006 03/09/2004	T4-VC20-11-13 K2401768-007 03/09/2004	T4-PS20-15-17 K2402764-011 04/13/2004	T4-PS20-20-22 K2402764-012 04/13/2004	T4-VC21-0-1 K2401844-001 03/11/2004	T4-VC21-1-3 K2401844-002 03/11/2004	T4-VC21-3-5 K2401844-003 03/11/2004	T4-VC21-5-7 K2401844-004 03/11/2004
Metals (mg/kg)										
Arsenic	9.79	33	4.6	2.9	4.4	3.3	4.3	3.2	4.7	5.1
Cadmium	0.99	4.98	0.84	0.44	0.66	0.2	0.35	0.26	0.52	0.73
Chromium	43.4	111	27.2 J	23.2 J	23.9 J	13.6 J	27.2 J	22.6 J	29.4 J	26.5 J
Copper	31.6	149	39.7 J	29.7 J	35.7 J	32.7 J	39.4 J	35.2 J	51.5 J	43.7 J
Lead	35.8	128	61.7	20.5	28.7 J	9.71 J	21.2	14.6	36.2	64.3
Mercury	0.18	1.06	0.187	0.316	0.238	0.031	0.065	0.068	0.09	0.131
Nickel	22.7	48.6	20.6 J	19.2 J	21.1 J	16.2 J	22.8 J	20.5 J	27.9 J	22.8 J
Selenium	NS	NS	0.28	0.19	0.142 U	0.074 U	0.17 J	0.1 J	0.17 J	0.12 J
Silver	NS	NS	0.45	0.34	0.31	0.09	0.21	0.16	0.39	0.32
Zinc	121	459	235 J	98.1 J	133 J	60.6 J	96.9 J	73.9 J	132 J	224 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	190	420	450	75	15	14	38	170
2-Methylnaphthalene	NS	NS	290	160	350	89	5.9	7.7	16	100
1-Methylnaphthalene	NS	NS	480	120	870	120	3.9 J	6	8.8	62
Biphenyl	NS	NS	30	39	44	9.4	2.7 J	2.5 J	5 J	17
2,6-Dimethylnaphthalene	NS	NS	180	130	510	71	3.6 J	4.7 J	8.7	65
Acenaphthylene	NS	NS	20	62	82	9.9	7.6	6.3	8.8	16
Acenaphthene	NS	NS	560	240	1300	190	35	21	100	210
2,3,5-Trimethylnaphthalene	NS	NS	82	130	260	34	3.7 J	3.5 J	7.2	63
Fluorene	77.4	536	340	180	890	160	28	14	52	150
Phenanthrene	204	1,170	790	960	2,900	500	130	79	410	510
Anthracene	57.2	845	140	190	520	81	37	16	96	81
1-Methylphenanthrene	NS	NS	67	120	220	35	11	7.9	30	45
Fluoranthene	423	2,230	560	1,300	1,900	330	340	150	810	430
Pyrene	195	1,520	600	2,000	1,700	270	400	190	870	480
Benz(a)anthracene	108	1,050	160	440	500	74	190	90	550	130
Chrysene	166	1,290	190	600	640	95	240	110	630	160
Benzo(b)fluoranthene	NS	NS	120	460	360	47	250	110	690	120
Benzo(k)fluoranthene	NS	NS	100	410	330	46	210	89	590	110
Benzo(e)pyrene	NS	NS	110	460	330	44	200	90	540	110

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC20-9-11 K2401768-006 03/09/2004	T4-VC20-11-13 K2401768-007 03/09/2004	T4-PS20-15-17 K2402764-011 04/13/2004	T4-PS20-20-22 K2402764-012 04/13/2004	T4-VC21-0-1 K2401844-001 03/11/2004	T4-VC21-1-3 K2401844-002 03/11/2004	T4-VC21-3-5 K2401844-003 03/11/2004	T4-VC21-5-7 K2401844-004 03/11/2004
Benzo(a)pyrene	150	1,450	150	660	530	59	270	120	770	140
Perylene	NS	NS	60	250	190	23	87	68	270	82
Indeno(1,2,3-cd)pyrene	NS	NS	120	580	430 J	47 J	230	100	650	120
Dibenz(a,h)anthracene	33	NS	17	65	80 J	7.6 J	42	19	140	17
Benzo(g,h,i)perylene	NS	NS	130	650	470	54	220	100	570	130
Dimethyl phthalate	NS	NS	20 U	98 U	10 UJ	10 U	21 U	20 U	20 U	99 U
Diethyl phthalate	NS	NS	20 U	98 U	10 UJ	10 U	21 U	20 U	20 U	99 U
Di-n-butyl phthalate	NS	NS	20 U	98 U	10 UJ	10 U	21 U	20 U	26 U	99 U
Butylbenzyl phthalate	NS	NS	20 U	98 U	10 UJ	10 U	21 U	20 U	20 U	99 U
Bis(2-ethylhexyl) phthalate	NS	NS	45 U	98 U	77 J	140	120 U	41 U	140 U	99 U
Di-n-octyl phthalate	NS	NS	20 UJ	98 UJ	10 UJ	10 U	21 U	20 U	20 U	99 U
Total PAHs (c,d)	1,610	22,800	3,920	7,922	12,102	1,937	2,153	1,009	5,615	2,707
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	14 J	6.3 J	11 J	1.7 J	2.5	4.1	3.8	9.5 J
4,4'-DDD	NS	NS	8.4	8.4	7.6	0.83	2.4	3.8	1.8	5.7
4,4'-DDT	NS	NS	12	2.8	2.3 J	2.4	31	0.40 U	2.7	5.5
2,4'-DDE	NS	NS	1.7 U	1.6	1.6 U	0.40 U	0.42 U	0.40 U	0.40 U	0.63 U
2,4'-DDD	NS	NS	3.9 U	5.2	3.7	0.8	0.61 J	1.3	2 J	5.9 J
2,4'-DDT	NS	NS	8.2	2.5 U	2.9 U	1.9	0.86 U	0.40 U	1.2	3.3
Total DDD (c,e)	4.88	28	8.4	14	11	1.6	3.0	5.1	3.8	12
Total DDE (c,f)	3.16	31.3	14 J	7.9	11 J	1.7 J	2.5	4.1	3.8	9.5
Total DDT (c,g)	4.16	62.9	20	2.8	2.3 J	4.3	31	0.40 U	3.9	8.8
ΣDDTs (c,h)	5.28	572	43	24	25	7.6	37	9.2	12	30
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	11 U	5.0 U	5.0 U	5.3 U	5.0 U	5.0 U	5.1 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	11 U	10 U	10 U	11 U
Aroclor 1232	NS	NS	5.0 U	17 U	5.0 U	5.0 U	5.3 U	5.0 U	5.0 U	5.1 U
Aroclor 1242	NS	NS	5.0 U	14 U	27 J	5.0 U	5.3 U	5.0 U	5.0 U	5.1 U
Aroclor 1248	NS	NS	110	7.8 U	5.0 U	5.0 U	6.7	6.3	18	63
Aroclor 1254	NS	NS	240 U	54 U	52 J	17 J	17 U	13 U	32 U	83 U

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC20-9-11 K2401768-006 03/09/2004	T4-VC20-11-13 K2401768-007 03/09/2004	T4-PS20-15-17 K2402764-011 04/13/2004	T4-PS20-20-22 K2402764-012 04/13/2004	T4-VC21-0-1 K2401844-001 03/11/2004	T4-VC21-1-3 K2401844-002 03/11/2004	T4-VC21-3-5 K2401844-003 03/11/2004	T4-VC21-5-7 K2401844-004 03/11/2004
Aroclor 1260	NS	NS	160	41	47 J	7 J	16	10	33	87
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.3 U	5.0 U	5.0 U	5.1 U
Aroclor 1268	NS	NS	5.0 U	53	20 J	5.0 U	5.3 U	5.0 U	5.0 U	5.1 U
Total PCBs (c,i)	59.8	676	270	94	146 J	24 J	23	16	51	150
Conventionals (percent)										
Total organic carbon	NS	NS	2.62	1.81	1.26	0.37	2	1.9	2.23	4.25
Total solids	NS	NS	54.5	63.6	64.4	72.8	47.6	56.1	53.9	58.7

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC21-7-9 K2401844-005 03/11/2004	T4-VC21-9-11 K2401844-006 03/11/2004	T4-VC21-11-13 K2401844-007 03/11/2004	T4-PS21-15-17 K2402764-018 04/13/2004	T4-PS21-20-22 K2402764-019 04/13/2004
Metals (mg/kg)							
Arsenic	9.79	33	4.7	4.1	5.9	7.6	4.8
Cadmium	0.99	4.98	0.78	0.54	0.94	0.86	0.39
Chromium	43.4	111	25.2 J	31.3 J	35.3 J	29.7 J	29.2 J
Copper	31.6	149	41.7 J	38.4 J	48 J	98.5 J	37.4 J
Lead	35.8	128	62	29.7	40.5	3,130 J	21.8 J
Mercury	0.18	1.06	0.155	0.301	0.517	1.66	0.235
Nickel	22.7	48.6	22.4 J	24.5 J	24.9 J	23.3 J	24.3 J
Selenium	NS	NS	0.19	0.18 J	0.21	0.217 U	0.174 U
Silver	NS	NS	0.22	0.32	0.53	0.49	0.28
Zinc	121	459	214 J	139 J	154 J	181 J	85 J
Semivolatile Organics (ug/kg)							
Naphthalene	176	561	660	200	140	220	120
2-Methylnaphthalene	NS	NS	390	87	36	71	25
1-Methylnaphthalene	NS	NS	400	74	19	39	13
Biphenyl	NS	NS	59	19	16	27	14
2,6-Dimethylnaphthalene	NS	NS	220	120	32	80	21
Acenaphthylene	NS	NS	20	48	49	98	46
Acenaphthene	NS	NS	650	350	29	140	28
2,3,5-Trimethylnaphthalene	NS	NS	140	130	34	130	22
Fluorene	77.4	536	420	320	41	140	31
Phenanthrene	204	1,170	1,200	1,600	390	1,100	290
Anthracene	57.2	845	180	280	90	240	68
1-Methylphenanthrene	NS	NS	88	160	50	200	39
Fluoranthene	423	2,230	810	980	620	1,900	660
Pyrene	195	1,520	810	1,200	940	1,800	720
Benz(a)anthracene	108	1,050	210	260	220	670	200
Chrysene	166	1,290	240	330	320	870	290
Benzo(b)fluoranthene	NS	NS	120	220	280	790	230
Benzo(k)fluoranthene	NS	NS	130	200	220	530	210
Benzo(e)pyrene	NS	NS	100	220	280	650	240

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC21-7-9	T4-VC21-9-11	T4-VC21-11-13	T4-PS21-15-17	T4-PS21-20-22
Lab ID:			K2401844-005	K2401844-006	K2401844-007	K2402764-018	K2402764-019
Date Sampled:	TEC (a)	PEC (b)	03/11/2004	03/11/2004	03/11/2004	04/13/2004	04/13/2004
Benzo(a)pyrene	150	1,450	140	320	380	990	380
Perylene	NS	NS	84	140	220	590	380
Indeno(1,2,3-cd)pyrene	NS	NS	89	280	380	930 J	390 J
Dibenz(a,h)anthracene	33	NS	16	37	39	190 J	46 J
Benzo(g,h,i)perylene	NS	NS	98	310	450	980	490
Dimethyl phthalate	NS	NS	100 U	100 U	99 U	100 U	10 U
Diethyl phthalate	NS	NS	100 U	100 U	99 U	100 U	10 U
Di-n-butyl phthalate	NS	NS	100 U	100 U	99 U	100 U	10 U
Butylbenzyl phthalate	NS	NS	100 U	100 U	99 U	110	10 U
Bis(2-ethylhexyl) phthalate	NS	NS	100 U	100 U	99 U	240 U	200
Di-n-octyl phthalate	NS	NS	100 U	100 U	99 U	100 U	10 U
Total PAHs (c,d)	1,610	22,800	5,590	6,308	3,719	9,488	3,273
Pesticides (ug/kg)							
4,4'-DDE	NS	NS	10	6.7 J	0.40 U	0.41 U	0.40 U
4,4'-DDD	NS	NS	7.5	7.7	0.40 U	0.93	0.40 U
4,4'-DDT	NS	NS	3.1	2.6	0.40 U	0.43 U	0.40 U
2,4'-DDE	NS	NS	1.3 U	1.3 U	0.40 U	0.41 U	0.40 U
2,4'-DDD	NS	NS	4.1	3.7	0.40 U	0.41 U	0.40 U
2,4'-DDT	NS	NS	1.8 J	1.8 U	0.25 J	0.41 U	0.40 U
Total DDD (c,e)	4.88	28	12	11	0.40 U	0.93	0.40 U
Total DDE (c,f)	3.16	31.3	10	6.7 J	0.40 U	0.41 U	0.40 U
Total DDT (c,g)	4.16	62.9	4.9	2.6	0.25 J	0.43 U	0.40 U
ΣDDTs (c,h)	5.28	572	27	21	0.25 J	0.93	0.40 U
PCBs (ug/kg)							
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	11 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U
Aroclor 1248	NS	NS	36	26	5.0 U	5.1 U	5.0 U
Aroclor 1254	NS	NS	55 U	51 U	5.0 U	12 J	5.0 U

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC21-7-9 K2401844-005 03/11/2004	T4-VC21-9-11 K2401844-006 03/11/2004	T4-VC21-11-13 K2401844-007 03/11/2004	T4-PS21-15-17 K2402764-018 04/13/2004	T4-PS21-20-22 K2402764-019 04/13/2004
Aroclor 1260	NS	NS	53	43	7.4 U	7.5 J	5.0 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	9.0 U	5.1 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	77 J	5.1 U	5.0 U
Total PCBs (c,i)	59.8	676	89	69	77 J	20 J	10 U
Conventionals (percent)							
Total organic carbon	NS	NS	2.45	1.66	2.2	2.78	1.81
Total solids	NS	NS	58.8	63.8	59.5	59.1	58.9

Table 5-4
Selected Wheeler Bay Surface and Subsurface Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC22-0-1 K2401844-008 03/11/2004	T4-VC22-1-3 K2401844-009 03/11/2004	T4-VC22-3-5 K2401844-010 03/11/2004	T4-VC22-5-7 K2401844-011 03/11/2004	T4-VC22-7-9 K2401844-012 03/11/2004	T4-VC22-9-11 K2401844-014 03/11/2004	T4-PS22-15-17 K2402764-025 04/13/2004	T4-PS22-20-22 K2402764-026 04/13/2004
Metals (mg/kg)										
Arsenic	9.79	33	1.2	0.9	2.1	1.4	1.5	1.3	1.7	1.6
Cadmium	0.99	4.98	0.09	0.07	0.09	0.09	0.08	0.08	0.14	0.14
Chromium	43.4	111	9.63 J	8.34 J	12.4 J	13.1 J	11.9 J	8.97 J	12.5 J	12.1 J
Copper	31.6	149	13.3 J	12.3 J	16.3 J	16.3 J	14.6 J	13.5 J	39.8 J	42.6 J
Lead	35.8	128	2.72	2.08	2.65	2.67	2.3	2.27	5.35 J	5.55 J
Mercury	0.18	1.06	0.009 B	0.019 U	0.013 B	0.041 J	0.011 B	2.15	0.041	0.014 B
Nickel	22.7	48.6	14.4 J	14.6 J	18.3 J	18.1 J	20 J	15.9 J	17.4 J	18.2 J
Selenium	NS	NS	0.11 UJ	0.11 UJ	0.12 UJ	0.12 UJ	0.11 UJ	0.11 UJ	0.063 U	0.067 U
Silver	NS	NS	0.03	0.02	0.02 U	0.02	0.02	0.02	0.06	0.05
Zinc	121	459	38.6 J	34.3 J	52.7 J	46.8 J	40.8 J	35.2 J	43.4 J	44 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	1.5 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.36 J	0.46 J
2-Methylnaphthalene	NS	NS	0.61 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
1-Methylnaphthalene	NS	NS	0.24 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Biphenyl	NS	NS	0.68 J	0.46 J	0.37 J	0.35 J	0.33 J	0.29 J	5.0 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	0.2 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.19 J
Acenaphthylene	NS	NS	0.73 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acenaphthene	NS	NS	2.6 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.34 J
2,3,5-Trimethylnaphthalene	NS	NS	5 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Fluorene	77.4	536	1.1 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.29 J	0.36 J
Phenanthrene	204	1,170	11	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.5 J	2.0 J
Anthracene	57.2	845	3.2 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.3 J	0.36 J
1-Methylphenanthrene	NS	NS	0.93 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.21 J	0.21 J
Fluoranthene	423	2,230	30	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	2.3 J	3.5 J
Pyrene	195	1,520	44	0.16 J	5.0 U	0.20 J	5.0 U	5.0 U	2.4 J	3.6 J
Benz(a)anthracene	108	1,050	18	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 J	1.3 J
Chrysene	166	1,290	22	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.4 J	2.0 J
Benzo(b)fluoranthene	NS	NS	19	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzo(k)fluoranthene	NS	NS	22	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzo(e)pyrene	NS	NS	19	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC22-0-1 K2401844-008 03/11/2004	T4-VC22-1-3 K2401844-009 03/11/2004	T4-VC22-3-5 K2401844-010 03/11/2004	T4-VC22-5-7 K2401844-011 03/11/2004	T4-VC22-7-9 K2401844-012 03/11/2004	T4-VC22-9-11 K2401844-014 03/11/2004	T4-PS22-15-17 K2402764-025 04/13/2004	T4-PS22-20-22 K2402764-026 04/13/2004
Benzo(a)pyrene	150	1,450	25	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	0.96 J	1.4 J
Perylene	NS	NS	7.9	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.3 J
Indeno(1,2,3-cd)pyrene	NS	NS	18	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ
Dibenz(a,h)anthracene	33	NS	2.6 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	5.0 UJ
Benzo(g,h,i)perylene	NS	NS	21	5.0 U	5.0 U	0.15 J	5.0 U	5.0 U	5.0 U	5.0 U
Dimethyl phthalate	NS	NS	20 U	20 U	2.9 J	20 U	20 U	20 U	10 UJ	10 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	10 UJ	10 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	4.4 UJ	10 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	10 UJ	10 U
Bis(2-ethylhexyl) phthalate	NS	NS	22 U	27 U	53 U	22 U	20 U	39 U	53 J	110
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	10 UJ	10 U
Total PAHs (c,d)	1,610	22,800	200	0.16 J	5.0 U	0.20 J	5.0 U	5.0 U	11 J	15 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
4,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
4,4'-DDT	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
Total DDD (c,e)	4.88	28	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
Total DDE (c,f)	3.16	31.3	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
Total DDT (c,g)	4.16	62.9	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
ΣDDTs (c,h)	5.28	572	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC22-0-1 K2401844-008 03/11/2004	T4-VC22-1-3 K2401844-009 03/11/2004	T4-VC22-3-5 K2401844-010 03/11/2004	T4-VC22-5-7 K2401844-011 03/11/2004	T4-VC22-7-9 K2401844-012 03/11/2004	T4-VC22-9-11 K2401844-014 03/11/2004	T4-PS22-15-17 K2402764-025 04/13/2004	T4-PS22-20-22 K2402764-026 04/13/2004
Aroclor 1260	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.08 U	0.06 U	0.06 U	0.06 U	0.06 U	0.05 U	0.03 J	0.04 J
Total solids	NS	NS	91.4	92.2	80.9	84	77.6	76.2	77	76.3

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC23-0-1 K2401559-001 03/03/2004	T4-VC23-1-3 K2401559-002 03/03/2004	T4-VC23-3-5 K2401559-003 03/03/2004	T4-VC23-5-7 K2401559-004 03/03/2004	T4-VC23-7-9 K2401559-005 03/03/2004	T4-VC23-9-11 K2402524-001 03/03/2004	T4-VC24-0-1 K2401559-007 03/03/2004	T4-VC24-1-3 K2401559-008 03/03/2004
Metals (mg/kg)										
Arsenic	9.79	33	4.2	2.1	1.8	1.8	1.7	4.2	15.1	5.5
Cadmium	0.99	4.98	0.61	0.1	0.1	0.11	0.12	0.176	4.44	0.92
Chromium	43.4	111	13.9 J	10.1 J	9.91 J	9.21 J	9.37 J	12.6	25.4 J	22.8 J
Copper	31.6	149	29 J	20.6 J	13.9 J	13.8 J	13.5 J	16.6	72.4 J	41 J
Lead	35.8	128	69.2	3.22	2.4	2.77	2.39	2.54	681	153
Mercury	0.18	1.06	0.033 J	0.019 UJ	0.014 J	0.014 J	0.012 J	0.02 B	0.129	0.034 J
Nickel	22.7	48.6	19.3 J	15.5 J	16.6 J	15.5 J	14.9 J	19 J	21 J	23.3 J
Selenium	NS	NS	0.25	0.11	0.24 J	0.12	0.27	0.1 J	0.24	0.28
Silver	NS	NS	0.23	0.05	0.04	0.04	0.04	0.03	1.46	0.15
Zinc	121	459	115 J	38.2 J	37.6 J	35.8 J	37.1 J	37.6 J	768 J	151 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	39	0.42 J	0.32 J	0.32 J	0.33 J	0.73 J	11,000	140
2-Methylnaphthalene	NS	NS	19	5.0 U	5.0 U	5.1 U	5.0 U	0.88 J	2,900	76
1-Methylnaphthalene	NS	NS	12	5.0 U	5.0 U	5.1 U	5.0 U	1.6 J	1,500	43
Biphenyl	NS	NS	5.4	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	670	14 J
2,6-Dimethylnaphthalene	NS	NS	8.4	5.0 U	5.0 U	5.1 U	5.0 U	0.76 J	660	28
Acenaphthylene	NS	NS	6.1	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	53 J	7.4 J
Acenaphthene	NS	NS	200	1.3 J	5.0 U	5.1 U	5.0 U	0.46 J	16,000	960
2,3,5-Trimethylnaphthalene	NS	NS	9.4	5.0 U	5.0 U	5.1 U	5.0 U	2.3 J	170 J	20 J
Fluorene	77.4	536	93	0.79 J	5.0 U	5.1 U	5.0 U	0.46 J	9,900	390
Phenanthrene	204	1,170	820	9.6	5.0 U	5.1 U	5.0 U	5.4	66,000	3,500
Anthracene	57.2	845	210	2.4 J	5.0 U	5.1 U	5.0 U	0.69 J	15,000	930
1-Methylphenanthrene	NS	NS	54	0.68 J	5.0 U	5.1 U	5.0 U	41	2,300	210
Fluoranthene	423	2,230	1,600	21	5.0 U	5.1 U	5.0 U	5.0 U	110,000	6,600
Pyrene	195	1,520	1,800	24	0.19 J	0.26 J	0.22 J	3.1 J	100,000	7,600
Benz(a)anthracene	108	1,050	1,100	14	5.0 U	5.1 U	5.0 U	4.3 J	56,000	4,500
Chrysene	166	1,290	1,300	17	5.0 U	5.1 U	5.0 U	2.9 J	56,000	5,100
Benzo(b)fluoranthene	NS	NS	1,500	17	5.0 U	5.1 U	5.0 U	0.76 J	55,000	5,500
Benzo(k)fluoranthene	NS	NS	1,300	16	5.0 U	5.1 U	5.0 U	4.2 J	53,000	5,300
Benzo(e)pyrene	NS	NS	1,100	15	5.0 U	5.1 U	5.0 U	1.3 J	36,000	4,500

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC23-0-1 K2401559-001 03/03/2004	T4-VC23-1-3 K2401559-002 03/03/2004	T4-VC23-3-5 K2401559-003 03/03/2004	T4-VC23-5-7 K2401559-004 03/03/2004	T4-VC23-7-9 K2401559-005 03/03/2004	T4-VC23-9-11 K2402524-001 03/03/2004	T4-VC24-0-1 K2401559-007 03/03/2004	T4-VC24-1-3 K2401559-008 03/03/2004
Benzo(a)pyrene	150	1,450	1,600	18	5.0 U	5.1 U	5.0 U	1.9 J	55,000	6,500
Perylene	NS	NS	470	5.9	5.0 U	0.26 J	5.0 U	17	14,000	1,900
Indeno(1,2,3-cd)pyrene	NS	NS	1,300	13	5.0 U	5.1 U	5.0 U	5.0 UJ	36,000	5,000
Dibenz(a,h)anthracene	33	NS	270	2.2 J	5.0 U	5.1 U	5.0 U	5.0 UJ	8,400	970
Benzo(g,h,i)perylene	NS	NS	1,200	14	5.0 U	5.1 U	5.0 U	5.0 U	26,000	4,600
Dimethyl phthalate	NS	NS	20 U	10 U	10 U	11 U	10 U	50 U	200 U	20 U
Diethyl phthalate	NS	NS	20 U	10 U	10 U	11 U	10 U	50 U	200 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	10 U	10 U	11 U	20 U	50 U	200 U	28
Butylbenzyl phthalate	NS	NS	20 U	10 U	10 U	11 U	10 U	50 U	180 J	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	68	10 U	10 U	11 U	10 U	50 U	200 U	58
Di-n-octyl phthalate	NS	NS	20 UJ	10 UJ	10 UJ	11 UJ	10 UJ	50 U	200 UJ	20 UJ
Total PAHs (c,d)	1,610	22,800	11,568	142	0.51 J	0.58 J	0.55 J	25	602,953	47,027
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	2.1	0.40 U	0.40 U	0.40 U	0.40 U	0.48 U	6.0	1.2
4,4'-DDD	NS	NS	2.0	0.40 U	0.40 U	0.40 U	0.55 U	0.48 U	5.6	1.5
4,4'-DDT	NS	NS	1.8 J	0.40 U	0.40 U	0.40 U	0.40 U	0.24 J	6.5	0.40 U
2,4'-DDE	NS	NS	0.44 U	0.40 U	0.40 U	0.40 U	0.40 U	0.48 U	0.72 U	0.40 U
2,4'-DDD	NS	NS	1.1	0.40 U	0.40 U	0.40 U	0.40 U	0.48 U	3.0	1.0
2,4'-DDT	NS	NS	1.1 J	0.40 U	0.40 U	0.40 U	0.40 U	0.63 U	0.84 U	0.61 J
Total DDD (c,e)	4.88	28	3.1	0.40 U	0.40 U	0.40 U	0.55 U	0.48 U	8.6	2.5
Total DDE (c,f)	3.16	31.3	2.1	0.40 U	0.40 U	0.40 U	0.40 U	0.48 U	6	1.2
Total DDT (c,g)	4.16	62.9	2.9 J	0.40 U	0.40 U	0.40 U	0.40 U	0.24 J	6.5	0.61 J
ΣDDTs (c,h)	5.28	572	8.1	0.40 U	0.40 U	0.40 U	0.55 U	0.24 J	21.1	4.3
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	5.1 U	5.0 U
Aroclor 1221	NS	NS	9.9 U	10 U	10 U	10 U	10 U	12 U	11 U	9.9 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	5.1 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	5.1 U	5.0 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	5.1 U	5.0 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	5.1 U	11

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC23-0-1 K2401559-001 03/03/2004	T4-VC23-1-3 K2401559-002 03/03/2004	T4-VC23-3-5 K2401559-003 03/03/2004	T4-VC23-5-7 K2401559-004 03/03/2004	T4-VC23-7-9 K2401559-005 03/03/2004	T4-VC23-9-11 K2402524-001 03/03/2004	T4-VC24-0-1 K2401559-007 03/03/2004	T4-VC24-1-3 K2401559-008 03/03/2004
Aroclor 1260	NS	NS	12	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	53	10 J
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	5.1 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0 U	5.1 U	5.0 U
Total PCBs (c,i)	59.8	676	12	10 U	10 U	10 U	10 U	12 U	53	21
Conventionals (percent)										
Total organic carbon	NS	NS	0.7	0.05	0.05	0.27	0.08	5.71	2.28	0.86
Total solids	NS	NS	70.9	79	78.1	76.1	75.9	59.4	48.9	67.6

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC24-3-5 K2401559-009 03/03/2004	T4-VC24-5-7 K2401615-001 03/03/2004	T4-VC24-7-9 K2401615-002 03/03/2004	T4-VC24-9-11 K2401615-003 03/03/2004	T4-VC24-11-13 K2402524-002 03/03/2004	T4-VC25-0-1 K2401844-015 03/11/2004	T4-VC25-1-3 K2401844-016 03/11/2004	T4-VC25-3-5 K2401844-017 03/11/2004
Metals (mg/kg)										
Arsenic	9.79	33	2.3	2.4	1.8	2.8	2.1	2.8	2.2	2.4
Cadmium	0.99	4.98	0.2	0.2	0.21	0.23	0.163	0.09	0.09	0.11
Chromium	43.4	111	19.4 J	21 J	20.1 J	20.5 J	20.2	12.4 J	9.71 J	12.2 J
Copper	31.6	149	27.7 J	26.3 J	28.3 J	26.3 J	25.8	16.3 J	14.4 J	16 J
Lead	35.8	128	4.93	4.6	4.77	4.71	4.22	2.64	2.58	2.52
Mercury	0.18	1.06	0.035 J	0.023	0.083	0.027	0.08	0.023	0.013 B	0.02 U
Nickel	22.7	48.6	22.5 J	23.9 J	23.1 J	22.7 J	22.4 J	16.9 J	16.2 J	16.6 J
Selenium	NS	NS	0.2	0.16	0.25	0.29	0.05 J	0.11 UJ	2.58	0.11 UJ
Silver	NS	NS	0.09	0.07	0.07	0.07	0.04	0.03	0.03	0.03
Zinc	121	459	50.6 J	53.6 J	52.9 J	51.2 J	48.2 J	45.8 J	40.5 J	47.1 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	0.37 J	5.0 U	5.0 U	5.0 U	5.1 U	0.27 J	0.53 J	5.0 U
2-Methylnaphthalene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	0.56 J	5.0 U
1-Methylnaphthalene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	0.41 J	5.0 U
Biphenyl	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	0.44 J	0.5 J	0.30 J
2,6-Dimethylnaphthalene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	0.15 J	5.0 U
Acenaphthylene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U
Acenaphthene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	0.33 J	5.0 U	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U
Fluorene	77.4	536	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U
Phenanthrene	204	1,170	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	0.75 J	0.24 J	5.0 U
Anthracene	57.2	845	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U
1-Methylphenanthrene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U
Fluoranthene	423	2,230	4.9 U	0.47 J	5.0 U	5.0 U	5.1 U	2.1 J	0.24 J	0.28 J
Pyrene	195	1,520	0.29 J	0.45 J	5.0 U	0.31 J	5.1 U	2.8 J	0.16 J	0.20 J
Benz(a)anthracene	108	1,050	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	1.6 J	0.33 J	5.0 U
Chrysene	166	1,290	4.9 U	0.31 J	5.0 U	5.0 U	5.1 U	2.1 J	0.27 J	0.21 J
Benzo(b)fluoranthene	NS	NS	4.9 U	0.22 J	0.22 J	5.0 U	5.1 U	2.2 J	0.22 J	0.24 J
Benzo(k)fluoranthene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	1.6 J	0.23 J	5.0 U
Benzo(e)pyrene	NS	NS	0.19 J	0.19 J	5.0 U	5.0 U	5.1 U	1.6 J	5.0 U	0.20 J

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC24-3-5 K2401559-009 03/03/2004	T4-VC24-5-7 K2401615-001 03/03/2004	T4-VC24-7-9 K2401615-002 03/03/2004	T4-VC24-9-11 K2401615-003 03/03/2004	T4-VC24-11-13 K2402524-002 03/03/2004	T4-VC25-0-1 K2401844-015 03/11/2004	T4-VC25-1-3 K2401844-016 03/11/2004	T4-VC25-3-5 K2401844-017 03/11/2004
Benzo(a)pyrene	150	1,450	4.9 U	5.0 U	5.0 U	5.0 U	5.1 U	1.6 J	0.18 J	5.0 U
Perylene	NS	NS	68	76	64	120	150	0.95 J	0.85 J	5.0 U
Indeno(1,2,3-cd)pyrene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	0.35 J	0.90 J	5.0 U	5.0 U
Dibenz(a,h)anthracene	33	NS	4.9 U	5.0 U	5.0 U	5.0 U	5.1 UJ	0.22 J	5.0 U	5.0 U
Benzo(g,h,i)perylene	NS	NS	4.9 U	5.0 U	5.0 U	5.0 U	0.26 J	1.3 J	0.2 J	0.15 J
Dimethyl phthalate	NS	NS	9.8 U	20 U	20 U	20 U	11 U	20 U	20 U	20 U
Diethyl phthalate	NS	NS	9.8 U	20 U	20 U	20 U	11 U	20 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	76	20	4.7 J	6.9 J	11 U	20 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	9.8 U	20 U	20 U	20 U	11 U	20 U	20 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	9.8 U	20 U	20 U	20 U	11 U	26 U	20 U	20 U
Di-n-octyl phthalate	NS	NS	9.8 UJ	20 UJ	20 UJ	20 UJ	11 U	20 U	20 U	20 U
Total PAHs (c,d)	1,610	22,800	0.66 J	1.5 J	0.22 J	0.31 J	5.1 U	15 J	2.4 J	0.93 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
4,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
4,4'-DDT	NS	NS	0.40 U	0.40 U	0.12 J	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
Total DDD (c,e)	4.88	28	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
Total DDE (c,f)	3.16	31.3	0.40 U	0.40 U	0.40 U	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
Total DDT (c,g)	4.16	62.9	0.40 U	0.40 U	0.12 J	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
ΣDDTs (c,h)	5.28	572	0.40 U	0.40 U	0.12 J	0.40 U	0.43 U	0.40 U	0.40 U	0.40 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	9.9 U	9.9 U	9.9 U	10 U	11 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC24-3-5 K2401559-009 03/03/2004	T4-VC24-5-7 K2401615-001 03/03/2004	T4-VC24-7-9 K2401615-002 03/03/2004	T4-VC24-9-11 K2401615-003 03/03/2004	T4-VC24-11-13 K2402524-002 03/03/2004	T4-VC25-0-1 K2401844-015 03/11/2004	T4-VC25-1-3 K2401844-016 03/11/2004	T4-VC25-3-5 K2401844-017 03/11/2004
Aroclor 1260	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.4 U	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	9.9 U	9.9 U	9.9 U	10 U	11 U	10 U	10 U	10 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.75	0.83	0.56	1.32	0.49	0.19	0.08 U	0.07 U
Total solids	NS	NS	66.3	68.1	68.4	69.1	72	91.5	92	77

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC25-5-7 K2401844-018 03/11/2004	T4-VC25-7-9 K2401844-019 03/11/2004	T4-VC25-9-11 K2401844-020 03/11/2004	T4-V26-0-1 K2401654-007 03/04/2004	T4-V26-1-3 K2401654-008 03/04/2004	T4-VC26-3-5 K2401654-009 03/05/2004	T4-VC26-5-7 K2401654-010 03/05/2004	T4-VC26-7-9 K2401677-001 03/05/2004
Metals (mg/kg)										
Arsenic	9.79	33	2.4	2.7	2.5	3.2	4.8	3.9	2.5	2.1
Cadmium	0.99	4.98	0.1	0.11	0.09	0.49	0.8	0.8	0.17	0.12
Chromium	43.4	111	11.1 J	13 J	11.3 J	25.2	25	23.6	12.1	11.7
Copper	31.6	149	15.6 J	17.3 J	16.1 J	33.4 J	43.1 J	35.6 J	16.5 J	14.6 J
Lead	35.8	128	2.58	2.72	2.65	31.4	109	71.5	13.6	2.77
Mercury	0.18	1.06	0.037	0.025	0.011 B	0.074	0.088	0.102	0.017 B	0.02
Nickel	22.7	48.6	17 J	16.7 J	16.3 J	20.5 J	20.4 J	20.8 J	16 J	15.4 J
Selenium	NS	NS	0.12 UJ	0.13 UJ	0.11 UJ	0.24 U	0.24 U	0.18 U	0.04 U	0.03 U
Silver	NS	NS	0.03	0.02 U	0.02	0.21	0.46	0.37	0.04	0.03
Zinc	121	459	44.8 J	47.8 J	46.3 J	97.8 J	150 J	152 J	57.9 J	42.6 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	5.0 U	5.0 U	5.0 U	48	49	37	20	0.27 J
2-Methylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	19	24	22	7.5	5.0 U
1-Methylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	12	14	12	3.1 J	5.0 U
Biphenyl	NS	NS	0.33 J	0.38 J	0.34 J	7.9	6.3	5.5	2.4 J	5.0 U
2,6-Dimethylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	8.2	9.9	10	4.2 J	5.0 U
Acenaphthylene	NS	NS	5.0 U	5.0 U	5.0 U	20	8.3	7.4	2.2 J	5.0 U
Acenaphthene	NS	NS	5.0 U	5.0 U	5.0 U	98	270	74	14	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	10	8.7	10	4.7 J	5.0 U
Fluorene	77.4	536	5.0 U	5.0 U	5.0 U	64	120	46	5.7	5.0 U
Phenanthrene	204	1,170	5.0 U	5.0 U	5.0 U	600	1,100	340	50	1.4 J
Anthracene	57.2	845	5.0 U	5.0 U	5.0 U	140	280	59	7.2	5.0 U
1-Methylphenanthrene	NS	NS	5.0 U	5.0 U	5.0 U	42	69	23	6.4	0.15 J
Fluoranthene	423	2,230	5.0 U	5.0 U	5.0 U	1,300	2,400	680	47	2.0 J
Pyrene	195	1,520	5.0 U	5.0 U	0.23 J	1,600	2,700	730	69	2.5 J
Benz(a)anthracene	108	1,050	5.0 U	5.0 U	5.0 U	750	1,800	410	18	1.1 J
Chrysene	166	1,290	5.0 U	5.0 U	5.0 U	930	2,000	530	27	1.5 J
Benzo(b)fluoranthene	NS	NS	5.0 U	5.0 U	0.23 J	1000	2,400	580	17	1.2 J
Benzo(k)fluoranthene	NS	NS	5.0 U	5.0 U	0.23 J	870	1,900	450	18	1.2 J
Benzo(e)pyrene	NS	NS	5.0 U	5.0 U	0.21 J	820	1,800	430	18	1.2 J

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC25-5-7 K2401844-018 03/11/2004	T4-VC25-7-9 K2401844-019 03/11/2004	T4-VC25-9-11 K2401844-020 03/11/2004	T4-V26-0-1 K2401654-007 03/04/2004	T4-V26-1-3 K2401654-008 03/04/2004	T4-VC26-3-5 K2401654-009 03/05/2004	T4-VC26-5-7 K2401654-010 03/05/2004	T4-VC26-7-9 K2401677-001 03/05/2004
Benzo(a)pyrene	150	1,450	5.0 U	5.0 U	5.0 U	1,100	2,600	570	21	1.0 J
Perylene	NS	NS	5.0 U	5.0 U	0.28 J	330	760	200	18	0.62 J
Indeno(1,2,3-cd)pyrene	NS	NS	5.0 U	5.0 U	5.0 U	900	2,100	500	16	0.48 J
Dibenz(a,h)anthracene	33	NS	5.0 U	5.0 U	5.0 U	160	430	110	2.2 J	5.0 U
Benzo(g,h,i)perylene	NS	NS	5.0 U	5.0 U	0.21 J	870	1,900	460	20	0.85 J
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	10 U	10 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	20 U	10 U	10 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	7.8 J	5.3 J	13 J	10 U	3.5 J
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	4.4 J	13 J	7.5 J	10 U	10 U
Bis(2-ethylhexyl) phthalate	NS	NS	35 U	20 U	21 U	40	58	86	10 U	10 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	20 UJ	20 UJ	20 UJ	10 UJ	10 UJ
Total PAHs (c,d)	1,610	22,800	5.0 U	5.0 U	0.69 J	8,520	17,627	4,513	316	12 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	3.5	3.7	4.7 J	2.2 J	0.41 U
4,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	2.5	3.1	3.3	1.8	0.41 U
4,4'-DDT	NS	NS	0.40 U	0.40 U	0.40 U	2.0 J	1.7	13	1.5	0.41 U
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.40 U	0.40 U	0.62 U	0.40 U	0.41 U	0.41 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	1.2	2.1	4.2 J	2.1 J	0.41 U
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.40 U	0.74	0.93 J	3.1 J	1	0.41 U
Total DDD (c,e)	4.88	28	0.40 U	0.40 U	0.40 U	3.7	5.2	7.5	3.9	0.41 U
Total DDE (c,f)	3.16	31.3	0.40 U	0.40 U	0.40 U	3.5	3.7	4.7 J	2.2	0.41 U
Total DDT (c,g)	4.16	62.9	0.40 U	0.40 U	0.40 U	2.7	2.6	16	2.5	0.41 U
ΣDDTs (c,h)	5.28	572	0.40 U	0.40 U	0.40 U	9.9	12	28	8.6	0.41 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.1 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	11 U	10 U	11 U	11 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.1 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.1 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.0 U	6.0	13	53	18	5.1 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	15 U	29 U	88 U	33 U	5.1 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC25-5-7 K2401844-018 03/11/2004	T4-VC25-7-9 K2401844-019 03/11/2004	T4-VC25-9-11 K2401844-020 03/11/2004	T4-V26-0-1 K2401654-007 03/04/2004	T4-V26-1-3 K2401654-008 03/04/2004	T4-VC26-3-5 K2401654-009 03/05/2004	T4-VC26-5-7 K2401654-010 03/05/2004	T4-VC26-7-9 K2401677-001 03/05/2004
Aroclor 1260	NS	NS	5.0 U	5.0 U	5.0 U	16	28	130	26	5.1 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.1 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.1 U
Total PCBs (c,i)	59.8	676	10 U	10 U	10 U	22	41	183	44	11 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.06 U	0.08 U	0.12	1.71	2.05	3.71	0.73	0.09 U
Total solids	NS	NS	81.4	80.3	77	51.5	51.7	59.6	77.9	79.2

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC27-0-1	T4-VC27-1-3	T4-VC27-3-5	T4-VC27-5-7	T4-VC27-7-9	T4-VC28-0-1	T4-VC28-1-3	T4-VC28-3-5
Lab ID:			K2401716-004	K2401716-005	K2401716-006	K2401716-007	K2401716-008	K2401615-006	K2401615-007	K2401615-009
Date Sampled:	TEC (a)	PEC (b)	03/09/2004	03/09/2004	03/09/2004	03/09/2004	03/09/2004	03/04/2004	03/04/2004	03/04/2004
Metals (mg/kg)										
Arsenic	9.79	33	1.8	1.6	1.9	1.6	1.4	2.8	2.2	2.1
Cadmium	0.99	4.98	0.1	0.08	0.08	0.08	0.08	0.18	0.24	0.14
Chromium	43.4	111	9.22 J	9.11 J	11 J	11.6 J	10.4 J	11.9 J	12.2 J	11.2 J
Copper	31.6	149	13.1 J	12 J	13.6 J	13.8 J	13.3 J	15.5 J	15.5 J	14.8 J
Lead	35.8	128	4	2.46	2.39	2.26	2.46	3.24	2.6	2.46
Mercury	0.18	1.06	0.019	0.01 B	0.014 B	0.016 U	0.014 B	0.011 B	0.018 U	0.02 U
Nickel	22.7	48.6	14.1 J	13.6 J	15 J	15.2 J	14.8 J	16.8 J	18 J	16.7 J
Selenium	NS	NS	0.12 U	0.11 U	0.12 U	0.11 U	0.11 U	0.11	0.11	0.25
Silver	NS	NS	0.03	0.02 U	0.03	0.02	0.02 U	0.05	0.03	0.03
Zinc	121	459	39.2	37	40.6	39.1	36.9	41.3 J	43.1 J	39.6 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	95	3.7 J	0.32 J	5.0 U	5.0 U	60	0.29 J	5.0 U
2-Methylnaphthalene	NS	NS	45	0.65 J	5.0 U	5.0 U	5.0 U	17	5.0 U	5.0 U
1-Methylnaphthalene	NS	NS	21	0.53 J	5.0 U	5.0 U	5.0 U	9.7	5.0 U	5.0 U
Biphenyl	NS	NS	11	5.0 U	5.0 U	5.0 U	5.0 U	14	5.0 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	22	0.74 J	5.0 U	5.0 U	5.0 U	7.7	5.0 U	5.0 U
Acenaphthylene	NS	NS	13	0.34 J	5.0 U	5.0 U	5.0 U	25	5.0 U	5.0 U
Acenaphthene	NS	NS	27	1.2 J	5.0 U	5.0 U	5.0 U	47	5.0 U	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	32	1.4 J	5.0 U	5.0 U	5.0 U	12	5.0 U	5.0 U
Fluorene	77.4	536	29	1.3 J	5.0 U	5.0 U	5.0 U	44	5.0 U	5.0 U
Phenanthrene	204	1,170	160	7.2	5.0 U	0.30 J	5.0 U	290	5.0 U	5.0 U
Anthracene	57.2	845	47	2.1 J	5.0 U	5.0 U	5.0 U	140	5.0 U	5.0 U
1-Methylphenanthrene	NS	NS	26	1.2 J	5.0 U	5.0 U	5.0 U	25	5.0 U	5.0 U
Fluoranthene	423	2,230	430	12	5.0 U	0.47 J	0.26 J	560	0.54 J	5.0 U
Pyrene	195	1,520	800	45	0.16 J	0.62 J	0.24 J	830	0.63 J	5.0 U
Benz(a)anthracene	108	1,050	220	9.8	5.0 U	0.22 J	5.0 U	240	5.0 U	5.0 U
Chrysene	166	1,290	310	14	5.0 U	0.36 J	5.0 U	290	0.22 J	5.0 U
Benzo(b)fluoranthene	NS	NS	200	6.1	5.0 U	0.26 J	5.0 U	180	5.0 U	5.0 U
Benzo(k)fluoranthene	NS	NS	170	8.8	5.0 U	0.19 J	5.0 U	210	5.0 U	5.0 U
Benzo(e)pyrene	NS	NS	200	8.6	5.0 U	0.25 J	5.0 U	190	5.0 U	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC27-0-1 K2401716-004 03/09/2004	T4-VC27-1-3 K2401716-005 03/09/2004	T4-VC27-3-5 K2401716-006 03/09/2004	T4-VC27-5-7 K2401716-007 03/09/2004	T4-VC27-7-9 K2401716-008 03/09/2004	T4-VC28-0-1 K2401615-006 03/04/2004	T4-VC28-1-3 K2401615-007 03/04/2004	T4-VC28-3-5 K2401615-009 03/04/2004
Benzo(a)pyrene	150	1,450	280	9.8	5 U	0.24 J	5.0 U	320	5.0 U	5.0 U
Perylene	NS	NS	100	5.5	0.32 J	0.32 J	5.0 U	78	5.0 U	0.30 J
Indeno(1,2,3-cd)pyrene	NS	NS	230	6.8	5.0 U	0.18 J	5.0 U	220	5.0 U	5.0 U
Dibenz(a,h)anthracene	33	NS	29	0.65 J	5.0 U	5.0 U	5.0 U	28	5.0 U	5.0 U
Benzo(g,h,i)perylene	NS	NS	250	9.0	5.0 U	0.26 J	5.0 U	230	5.0 U	5.0 U
Dimethyl phthalate	NS	NS	20 U	10 U	10 U	10 U	5.0 J	20 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	10 U	10 U	10 U	8.2 J	20 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	10 U	10 U	10 U	11 U	9.4 J	3.4 J	4.3 J
Butylbenzyl phthalate	NS	NS	20 U	10 U	10 U	10 U	6.3 J	20 U	20 U	3.4 J
Bis(2-ethylhexyl) phthalate	NS	NS	520	10 U	10 U	10 U	12 U	20 U	20 U	20 U
Di-n-octyl phthalate	NS	NS	20 UJ	10 UJ	10 UJ	10 UJ	8.0 J	20 UJ	20 UJ	20 UJ
Total PAHs (c,d)	1,610	22,800	2,781	121	0.48 J	2.7 J	0.5 J	3,236	1.7 J	5.0 U
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.64 J	0.40 U	0.40 U	0.41 U	0.40 U	0.26 J	0.40 U	0.40 U
4,4'-DDD	NS	NS	2 J	0.40 U	0.40 U	0.41 U	0.40 U	0.40 U	0.40 U	0.40 U
4,4'-DDT	NS	NS	0.63	0.40 U	0.40 U	0.41 U	0.40 U	0.40 U	0.40 U	0.40 U
2,4'-DDE	NS	NS	0.3 J	0.40 U	0.40 U	0.41 U	0.40 U	0.40 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	1.2	0.40 U	0.40 U	0.41 U	0.40 U	0.31 J	0.40 U	0.40 U
2,4'-DDT	NS	NS	0.49 U	0.40 U	0.40 U	0.41 U	0.40 U	0.40 U	0.40 U	0.40 U
Total DDD (c,e)	4.88	28	3.2	0.40 U	0.40 U	0.41 U	0.40 U	0.31 J	0.40 U	0.40 U
Total DDE (c,f)	3.16	31.3	0.94 J	0.40 U	0.40 U	0.41 U	0.40 U	0.26 J	0.40 U	0.40 U
Total DDT (c,g)	4.16	62.9	0.63	0.40 U	0.40 U	0.41 U	0.40 U	0.40 U	0.40 U	0.40 U
ΣDDTs (c,h)	5.28	572	4.8	0.40 U	0.40 U	0.41 U	0.40 U	0.57 J	0.40 U	0.40 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	11 U	10 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC27-0-1 K2401716-004 03/09/2004	T4-VC27-1-3 K2401716-005 03/09/2004	T4-VC27-3-5 K2401716-006 03/09/2004	T4-VC27-5-7 K2401716-007 03/09/2004	T4-VC27-7-9 K2401716-008 03/09/2004	T4-VC28-0-1 K2401615-006 03/04/2004	T4-VC28-1-3 K2401615-007 03/04/2004	T4-VC28-3-5 K2401615-009 03/04/2004
Aroclor 1260	NS	NS	6.8	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	6.8	10 U	10 U	11 U	10 U	10 U	10 U	10 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.15	0.07 U	0.04 U	0.04 U	0.05 U	0.19	0.09	0.45
Total solids	NS	NS	86.9	89.7	83.1	90.2	78.5	78.7	78.9	79.7

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC28-5-7 K2401615-010 03/04/2004	T4-VC28-7-9 K2401654-001 03/04/2004	T4-PS28-10-12 K2402526-020 04/02/2004	T4-PS28-15-17 K2402526-021 04/02/2004	T4-VC29-0-1 K2401677-002 03/05/2004	T4-VC29-1-3 K2401677-003 03/05/2004	T4-VC29-3-5 K2401677-004 03/05/2004	T4-VC29-5-7 K2401677-005 03/05/2004
Metals (mg/kg)										
Arsenic	9.79	33	1.7	1.4	1.6	1.8	6.4	5.4	3.8	1.4
Cadmium	0.99	4.98	0.13	0.12	0.08	0.1	1.9	1.81	0.88	0.09
Chromium	43.4	111	11.5 J	9.47	10.4	10	21.9	28	15.7	13.9
Copper	31.6	149	14.9 J	14.3 J	49.5	34	44.9 J	43.9 J	28.6 J	15 J
Lead	35.8	128	2.64	2.35	7.33	5.01	338	240	129	2.74
Mercury	0.18	1.06	0.02	0.011 B	0.01 B	0.01 B	0.088	0.078	0.053	0.014 B
Nickel	22.7	48.6	16.6 J	15.6 J	16 J	15.4 J	19 J	21.7 J	18.7 J	17.2 J
Selenium	NS	NS	0.2	0.05 J	0.11 UJ	0.11 UJ	0.19 U	0.21 U	0.13 U	0.11 U
Silver	NS	NS	0.03	0.03 U	0.03	0.03	0.7	0.54	0.28	0.02
Zinc	121	459	43.1 J	37.2 J	38.4 J	39.9 J	281 J	263 J	155 J	43.5 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	5.0 U	5.0 U	0.60 J	0.34 J	190	360	120	5.0 U
2-Methylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	82	140	48	5.0 U
1-Methylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	48	95	32	5.0 U
Biphenyl	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	26	67	15	5.0 U
2,6-Dimethylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	27	64	27	5.0 U
Acenaphthylene	NS	NS	5.0 U	5.0 U	0.25 J	4.9 U	57	150	27	5.0 U
Acenaphthene	NS	NS	5.0 U	5.0 U	0.28 J	4.9 U	600	840	400	0.46 J
2,3,5-Trimethylnaphthalene	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	22	120	45	5.0 U
Fluorene	77.4	536	5.0 U	5.0 U	0.53 J	0.28 J	310	510	190	5.0 U
Phenanthrene	204	1,170	5.0 U	5.0 U	3.1 J	1.8 J	2,700	4,500	1,700	1.3 J
Anthracene	57.2	845	5.0 U	5.0 U	0.71 J	0.42 J	720	1,200	370	5.0 U
1-Methylphenanthrene	NS	NS	5.0 U	5.0 U	0.29 J	4.9 U	170	340	100	5.0 U
Fluoranthene	423	2,230	5.0 U	5.0 U	8.6	5.6	6,000	9,600	4,000	0.74 J
Pyrene	195	1,520	5.0 U	0.15 J	10	6.9	7,000	13,000	4,400	0.70 J
Benz(a)anthracene	108	1,050	5.0 U	5.0 U	2.5 J	1.7 J	3,800	6,600	2,600	5.0 U
Chrysene	166	1,290	5.0 U	5.0 U	3.8 J	2.5 J	4,300	7,400	3,000	5.0 U
Benzo(b)fluoranthene	NS	NS	5.0 U	5.0 U	2.0 J	1.7 J	4,900	8,600	3,200	5.0 U
Benzo(k)fluoranthene	NS	NS	5.0 U	5.0 U	2.6 J	1.7 J	4,100	6,600	2,900	5.0 U
Benzo(e)pyrene	NS	NS	5.0 U	5.0 U	2.6 J	1.8 J	3,800	6,500	2,500	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC28-5-7 K2401615-010 03/04/2004	T4-VC28-7-9 K2401654-001 03/04/2004	T4-PS28-10-12 K2402526-020 04/02/2004	T4-PS28-15-17 K2402526-021 04/02/2004	T4-VC29-0-1 K2401677-002 03/05/2004	T4-VC29-1-3 K2401677-003 03/05/2004	T4-VC29-3-5 K2401677-004 03/05/2004	T4-VC29-5-7 K2401677-005 03/05/2004
Benzo(a)pyrene	150	1,450	5.0 U	5.0 U	2.5 J	1.6 J	5,600	9,500	3,600	5.0 U
Perylene	NS	NS	0.36 J	5.0 U	1.2 J	1.0 J	1,600	2,700	1,000	5.5
Indeno(1,2,3-cd)pyrene	NS	NS	5.0 U	5.0 U	5.0 UJ	4.9 UJ	4,600	7,900	2,800	5.0 U
Dibenz(a,h)anthracene	33	NS	5.0 U	5.0 U	5.0 UJ	4.9 UJ	880	1,400	550	5.0 U
Benzo(g,h,i)perylene	NS	NS	5.0 U	5.0 U	5.0 U	4.9 U	4,100	7,100	2,600	5.0 U
Dimethyl phthalate	NS	NS	20 U	10 U	10 U	9.8 U	20 U	100 U	100 U	10 U
Diethyl phthalate	NS	NS	20 U	10 U	10 U	9.8 U	20 U	100 U	100 U	10 U
Di-n-butyl phthalate	NS	NS	3.6 J	10 U	10 U	9.8 U	10 J	100 U	100 U	21 J
Butylbenzyl phthalate	NS	NS	20 U	10 U	10 U	9.8 U	19 J	100 U	100 U	10 U
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	10 U	60	94	70	130	64 J	10 U
Di-n-octyl phthalate	NS	NS	20 UJ	10 UJ	10 U	9.8 U	20 UJ	100 UJ	100 UJ	10 UJ
Total PAHs (c,d)	1,610	22,800	5.0 U	0.15 J	37	25	40,277	68,860	26,507	3.2 J
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.40 U	0.43 U	0.42 U	2.2	4.1	1.8	0.40 U
4,4'-DDD	NS	NS	0.40 U	0.40 U	0.43 U	0.42 U	3.4	64 J	2.5	0.40 U
4,4'-DDT	NS	NS	0.40 U	0.40 U	0.43 U	0.42 U	2.8 J	90	1.6	0.40 U
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.43 U	0.42 U	0.75	0.67 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.43 U	0.42 U	2.4	16	1.8 J	0.40 U
2,4'-DDT	NS	NS	0.40 U	0.40 U	0.43 U	0.42 U	0.63 U	24 U	0.40 U	0.40 U
Total DDD (c,e)	4.88	28	0.40 U	0.40 U	0.43 U	0.42 U	5.8	80	4.3	0.40 U
Total DDE (c,f)	3.16	31.3	0.40 U	0.40 U	0.43 U	0.42 U	3.0	4.1	1.8	0.40 U
Total DDT (c,g)	4.16	62.9	0.40 U	0.40 U	0.43 U	0.42 U	2.8	90	1.6	0.40 U
ΣDDTs (c,h)	5.28	572	0.40 U	0.40 U	0.43 U	0.42 U	12	174	7.7	0.40 U
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	5.2 U	50 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	11 U	11 U	11 U	100 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	5.2 U	50 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	5.2 U	50 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	11	50 U	6.7	5.0 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	19 U	240 U	22 U	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC28-5-7 K2401615-010 03/04/2004	T4-VC28-7-9 K2401654-001 03/04/2004	T4-PS28-10-12 K2402526-020 04/02/2004	T4-PS28-15-17 K2402526-021 04/02/2004	T4-VC29-0-1 K2401677-002 03/05/2004	T4-VC29-1-3 K2401677-003 03/05/2004	T4-VC29-3-5 K2401677-004 03/05/2004	T4-VC29-5-7 K2401677-005 03/05/2004
Aroclor 1260	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	31	1000	17	5.0 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	5.2 U	50 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.3 U	5.3 U	5.2 U	50 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	10 U	10 U	11 U	11 U	42	1000	24	10 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.09	0.03 J	0.05 U	0.04 J	1.89	2.06	0.86	0.15 U
Total solids	NS	NS	78.4	80.1	76.6	77.9	48.7	54.2	68.5	76.9

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC29-7-9 K2401677-007 03/05/2004	T4-VC29-9-11 K2401677-008 03/05/2004	T4-VC32-0-1 K2401654-002 03/04/2004	T4-VC32-1-3 K2401654-003 03/04/2004	T4-VC32-3-5 K2401654-004 03/04/2004	T4-VC32-5-7 K2401654-005 03/04/2004	T4-VC32-7-9 K2402524-003 03/03/2004	T4-PS32-10-12 K2402526-016 04/02/2004
Metals (mg/kg)										
Arsenic	9.79	33	2	1.7	5.1	5.2	4.6	2.3	23.3	2.3
Cadmium	0.99	4.98	0.18	0.15	1.69	1.19	1.23	0.1	0.136	0.12
Chromium	43.4	111	24.8	21.5	23	26.4	19.6	9.59	12	11.5
Copper	31.6	149	26 J	25.1 J	44 J	53.7 J	49.7 J	13.9 J	16.3	41.5
Lead	35.8	128	5.45	4.73	176	151	161	2.69	2.59	7.74
Mercury	0.18	1.06	0.031	0.023	0.083	0.11	0.086	0.012 B	0.02	0.03
Nickel	22.7	48.6	23.8 J	20.8 J	22.8 J	23.7 J	20.5 J	14.8 J	23.9 J	17.7 J
Selenium	NS	NS	0.08 U	0.08 U	0.17 J	0.2 J	0.35 J	0.12 U	0.04 J	0.1 UJ
Silver	NS	NS	0.05	0.04	0.57	0.48	0.77	0.02 U	0.03	0.04
Zinc	121	459	54.4 J	46 J	253 J	188 J	207 J	38 J	40.9 J	46.1 J
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	4.9 U	5.0 U	290	170	170	0.37 J	5.3 U	8.4
2-Methylnaphthalene	NS	NS	4.9 U	5.0 U	84	74	82	5.0 U	5.3 U	3.3 J
1-Methylnaphthalene	NS	NS	4.9 U	5.0 U	63	47	45	5.0 U	5.3 U	1.8 J
Biphenyl	NS	NS	4.9 U	5.0 U	58	27	17 J	5.0 U	5.3 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	4.9 U	5.0 U	58	43	30	5.0 U	5.3 U	2.4 J
Acenaphthylene	NS	NS	4.9 U	5.0 U	130	54	23 J	5.0 U	5.3 U	1.6 J
Acenaphthene	NS	NS	4.9 U	5.0 U	340	390	1,000	0.40 J	0.83 J	10
2,3,5-Trimethylnaphthalene	NS	NS	4.9 U	5.0 U	120	63	26	5.0 U	5.3 U	6.0
Fluorene	77.4	536	4.9 U	5.0 U	330	260	400	0.24 J	5.3 U	5.9
Phenanthrene	204	1,170	4.9 U	5.0 U	2,600	1,900	3,700	1.9 J	5.3 U	47
Anthracene	57.2	845	4.9 U	5.0 U	660	410	1,000	0.45 J	5.3 U	10
1-Methylphenanthrene	NS	NS	4.9 U	5.0 U	170	150	260	0.15 J	5.3 U	5.6
Fluoranthene	423	2,230	4.9 U	5.0 U	5,100	4,300	7,900	4.0 J	5.3 U	88
Pyrene	195	1,520	4.9 U	5.0 U	7,600	4,800	9,200	5.2	5.3 U	97
Benz(a)anthracene	108	1,050	4.9 U	5.0 U	2,500	2,800	5,600	1.9 J	5.3 U	42
Chrysene	166	1,290	4.9 U	5.0 U	3,400	3,400	6,200	2.5 J	5.3 U	55
Benzo(b)fluoranthene	NS	NS	4.9 U	0.23 J	3,000	3,700	6,900	2.2 J	1.6 J	49
Benzo(k)fluoranthene	NS	NS	4.9 U	5.0 U	3,000	2,500	6,200	2.0 J	5.3 U	47
Benzo(e)pyrene	NS	NS	4.9 U	5.0 U	2,900	2,800	5,500	2.0 J	5.3 U	43

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC29-7-9 K2401677-007 03/05/2004	T4-VC29-9-11 K2401677-008 03/05/2004	T4-VC32-0-1 K2401654-002 03/04/2004	T4-VC32-1-3 K2401654-003 03/04/2004	T4-VC32-3-5 K2401654-004 03/04/2004	T4-VC32-5-7 K2401654-005 03/04/2004	T4-VC32-7-9 K2402524-003 03/03/2004	T4-PS32-10-12 K2402526-016 04/02/2004
Benzo(a)pyrene	150	1,450	4.9 U	5.0 U	3,500	3,900	8,000	1.8 J	5.3 U	58
Perylene	NS	NS	140	160	1,100	1,100	2,300	0.91 J	3.4 J	21
Indeno(1,2,3-cd)pyrene	NS	NS	4.9 U	5.0 U	2,400	3,300	6,600	0.81 J	5.3 UJ	54 J
Dibenz(a,h)anthracene	33	NS	4.9 U	5.0 U	630	690	1,400	5.0 U	5.3 UJ	6.7 J
Benzo(g,h,i)perylene	NS	NS	4.9 U	5.0 U	3,100	3,000	5,900	1.5 J	5.3 U	53
Dimethyl phthalate	NS	NS	9.8 U	10 U	20 U	20 U	20 U	9.9 U	11 U	9.9 U
Diethyl phthalate	NS	NS	9.8 U	10 U	20 U	20 U	20 U	9.9 U	11 U	9.9 U
Di-n-butyl phthalate	NS	NS	9.8 U	10 U	32	14 J	13 J	9.9 U	11 U	9.9 U
Butylbenzyl phthalate	NS	NS	9.8 U	10 U	9.5 J	20 U	20 U	9.9 U	11 U	9.9 U
Bis(2-ethylhexyl) phthalate	NS	NS	13 U	37 U	79	130	180	9.9 U	11 U	110
Di-n-octyl phthalate	NS	NS	9.8 UJ	10 UJ	20 UJ	20 UJ	20 UJ	9.9 UJ	11 U	9.9 U
Total PAHs (c,d)	1,610	22,800	4.9 U	0.23 J	32,450	28,584	56,293	23	2.4 J	519
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	0.40 U	0.40 U	2.9	4.9	3.6	0.41 U	0.46 U	0.36 J
4,4'-DDD	NS	NS	0.40 U	0.40 U	5.4	4.5	3.7	0.41 U	0.46 U	0.32 J
4,4'-DDT	NS	NS	0.40 U	0.40 U	9.8	4	2.8	0.41 U	0.46 U	0.43 J
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.93 U	0.79 U	0.69 U	0.41 U	0.46 U	0.43 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	2.8	3	2.5	0.41 U	0.46 U	0.43 U
2,4'-DDT	NS	NS	0.40 U	0.40 U	1.4 J	1.3 J	0.66 U	0.41 U	0.46 U	0.43 U
Total DDD (c,e)	4.88	28	0.40 U	0.40 U	8.2	7.5	6.2	0.41 U	0.46 U	0.32 J
Total DDE (c,f)	3.16	31.3	0.40 U	0.40 U	2.9	4.9	3.6	0.41 U	0.46 U	0.36 J
Total DDT (c,g)	4.16	62.9	0.40 U	0.40 U	11	5.3	2.8	0.41 U	0.46 U	0.43 J
ΣDDTs (c,h)	5.28	572	0.40 U	0.40 U	22	18	13	0.41 U	0.46 U	1.1 J
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.7 U	5.3 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	11 U	10 U	11 U	12 U	11 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.7 U	5.3 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.7 U	5.3 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	11 J	24	22	5.1 U	5.7 U	5.3 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	28 U	45 U	33 U	5.1 U	5.7 U	5.3 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC29-7-9 K2401677-007 03/05/2004	T4-VC29-9-11 K2401677-008 03/05/2004	T4-VC32-0-1 K2401654-002 03/04/2004	T4-VC32-1-3 K2401654-003 03/04/2004	T4-VC32-3-5 K2401654-004 03/04/2004	T4-VC32-5-7 K2401654-005 03/04/2004	T4-VC32-7-9 K2402524-003 03/03/2004	T4-PS32-10-12 K2402526-016 04/02/2004
Aroclor 1260	NS	NS	5.0 U	5.0 U	46	64	29	5.1 U	5.7 U	5.3 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.7 U	5.3 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.1 U	5.0 U	5.1 U	5.7 U	5.3 U
Total PCBs (c,i)	59.8	676	10 U	10 U	57	88	51	11 U	12 U	11 U
Conventionals (percent)										
Total organic carbon	NS	NS	0.65	0.35	2.73	2.25	1.68	0.05	4.55	0.19
Total solids	NS	NS	70.4	67.5	51	53.7	59.3	80.7	76.7	77.1

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-PS32-15-17 K2402526-017 04/02/2004	T4-VC33-5-7 K2402350-002 03/26/2004	T4-VC33-9-11 K2402350-003 03/26/2004	T4-VC33-11-13 K2402350-004 03/26/2004
Metals (mg/kg)						
Arsenic	9.79	33	4.8	1.7	3.9	2.7
Cadmium	0.99	4.98	0.3	0.12	0.25	0.21
Chromium	43.4	111	14.3	9.3	24.4	19.7
Copper	31.6	149	31	35.1	32.2	27.2
Lead	35.8	128	6.46	5.44	5.32	4.03
Mercury	0.18	1.06	0.02	0.01 J	0.02 J	0.03 J
Nickel	22.7	48.6	22.7 J	14.7 J	32.9 J	21.8 J
Selenium	NS	NS	0.9	0.11 UJ	0.11 J	0.07 J
Silver	NS	NS	0.03	0.03	0.05	0.04
Zinc	121	459	47.1 J	34	51	44.4
Semivolatile Organics (ug/kg)						
Naphthalene	176	561	12	9.0	5.1 U	5.0 U
2-Methylnaphthalene	NS	NS	3.7 J	5.6	5.1 U	5.0 U
1-Methylnaphthalene	NS	NS	1.9 J	3.3 J	5.1 U	5.0 U
Biphenyl	NS	NS	4.9 U	5.1 U	5.1 U	5.0 U
2,6-Dimethylnaphthalene	NS	NS	1.9 J	1.2 J	5.1 U	5.0 U
Acenaphthylene	NS	NS	3.5 J	5.1 U	5.1 U	5.0 U
Acenaphthene	NS	NS	7.9	22	0.51 J	5.0 U
2,3,5-Trimethylnaphthalene	NS	NS	2.1 J	0.3 J	5.1 U	5.0 U
Fluorene	77.4	536	7.9	9.9	5.1 U	5.0 U
Phenanthrene	204	1,170	140	89	2.0 J	5.0 U
Anthracene	57.2	845	39	14	0.42 J	5.0 U
1-Methylphenanthrene	NS	NS	15	4.7 J	5.1 U	5.0 U
Fluoranthene	423	2,230	350	220	4.7 J	5.0 U
Pyrene	195	1,520	400	170	4.5 J	5.0 U
Benz(a)anthracene	108	1,050	130	94	2.7 J	5.0 U
Chrysene	166	1,290	170	140	3.8 J	5.0 U
Benzo(b)fluoranthene	NS	NS	120	150	3.7 J	5.0 U
Benzo(k)fluoranthene	NS	NS	120	110	3.1 J	5.0 U
Benzo(e)pyrene	NS	NS	120	110	3.1 J	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-PS32-15-17 K2402526-017 04/02/2004	T4-VC33-5-7 K2402350-002 03/26/2004	T4-VC33-9-11 K2402350-003 03/26/2004	T4-VC33-11-13 K2402350-004 03/26/2004
Benzo(a)pyrene	150	1,450	180	130	3.3 J	5.0 U
Perylene	NS	NS	45	37	100	36
Indeno(1,2,3-cd)pyrene	NS	NS	150 J	110 J	5.1 UJ	5.0 UJ
Dibenz(a,h)anthracene	33	NS	23 J	31 J	5.1 UJ	5.0 UJ
Benzo(g,h,i)perylene	NS	NS	160	110	5.1 U	5.0 U
Dimethyl phthalate	NS	NS	9.8 U	11 U	11 U	10 U
Diethyl phthalate	NS	NS	9.8 U	11 U	11 U	10 U
Di-n-butyl phthalate	NS	NS	9.8 U	11 U	11 U	10 U
Butylbenzyl phthalate	NS	NS	9.8 U	11 U	11 U	10 U
Bis(2-ethylhexyl) phthalate	NS	NS	80	47	71 U	10 U
Di-n-octyl phthalate	NS	NS	9.8 U	11 U	11 U	10 U
Total PAHs (c,d)	1,610	22,800	1,680	1,158	28.73 J	5.0 U
Pesticides (ug/kg)						
4,4'-DDE	NS	NS	0.43 U	0.41 U	0.41 U	0.40 U
4,4'-DDD	NS	NS	0.43 U	0.41 U	0.48 U	0.87 U
4,4'-DDT	NS	NS	0.29 J	0.41 U	0.41 U	0.40 U
2,4'-DDE	NS	NS	0.43 U	0.41 U	0.41 U	0.40 U
2,4'-DDD	NS	NS	0.43 U	0.41 U	0.41 U	0.40 U
2,4'-DDT	NS	NS	0.43 U	0.41 U	0.41 U	0.40 U
Total DDD (c,e)	4.88	28	0.43 U	0.41 U	0.48 U	0.87 U
Total DDE (c,f)	3.16	31.3	0.43 U	0.41 U	0.41 U	0.40 U
Total DDT (c,g)	4.16	62.9	0.29 J	0.41 U	0.41 U	0.40 U
ΣDDTs (c,h)	5.28	572	0.29 J	0.41 U	0.48 U	0.87 U
PCBs (ug/kg)						
Aroclor 1016	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U
Aroclor 1221	NS	NS	11 U	11 U	11 U	10 U
Aroclor 1232	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U
Aroclor 1242	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U
Aroclor 1248	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U
Aroclor 1254	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-PS32-15-17 K2402526-017 04/02/2004	T4-VC33-5-7 K2402350-002 03/26/2004	T4-VC33-9-11 K2402350-003 03/26/2004	T4-VC33-11-13 K2402350-004 03/26/2004
Aroclor 1260	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U
Aroclor 1262	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U
Aroclor 1268	NS	NS	5.4 U	5.1 U	5.1 U	5.0 U
Total PCBs (c,i)	59.8	676	11 U	11 U	11 U	10 U
Conventionals (percent)						
Total organic carbon	NS	NS	0.54	0.07	1.2	0.58
Total solids	NS	NS	74.8	73.2	64.2	71.2

Table 5-5
Selected Slip 3 Surface and Subsurface Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-6
Selected North of Berth 414 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC30-0-1 K2401716-016 03/08/2004	T4-VC30-1-3 K2401716-017 03/08/2004	T4-VC30-3-5 K2401716-018 03/08/2004	T4-VC30-5-7 K2401716-001 03/08/2004	T4-VC30-7-9 K2401716-002 03/08/2004	T4-VC30-9-11 K2401716-003 03/08/2004	T4-VC31-0-1 K2401716-010 03/08/2004	T4-VC31-1-3 K2401716-011 03/08/2004
Metals (mg/kg)										
Arsenic	9.79	33	2.6	3.1	3.6	4.3	2.5	1.9	2.9	2.9
Cadmium	0.99	4.98	0.26	0.45	0.85	1.61	0.51	0.07	0.28	0.33
Chromium	43.4	111	19.6 J	27.1 J	24.4 J	21.7 J	18.6 J	10.1 J	24.4 J	25.1 J
Copper	31.6	149	28.6 J	35.8 J	34.1 J	36.2 J	29.9 J	12.9 J	30.1 J	31.7 J
Lead	35.8	128	15.2	32.2	82	125	34.5	2.22	17.7	24.1
Mercury	0.18	1.06	0.069	0.093	0.141	0.148	0.282	0.038	0.073	0.082
Nickel	22.7	48.6	16.9 J	20 J	21.1 J	20.9 J	17.3 J	14 J	19.5 J	19.4 J
Selenium	NS	NS	0.15 U	0.16 U	0.16 U	0.23	0.2	0.11 U	0.16	0.18
Silver	NS	NS	0.15	0.31	0.36	0.44	0.36	0.03	0.16	0.2
Zinc	121	459	64.7	95.3	295	326	107	35	72.2	78.3
Semivolatile Organics (ug/kg)										
Naphthalene	176	561	9.6	12	81	220	180	5.0 U	11	16
2-Methylnaphthalene	NS	NS	3.6 J	5.9	39	150	120	5.0 U	17	10
1-Methylnaphthalene	NS	NS	2.5 J	3.4 J	18	120	170	5.0 U	11	6.2
Biphenyl	NS	NS	1.4 J	2.5 J	9.6	25	19	5.0 U	3.1 J	3.5 J
2,6-Dimethylnaphthalene	NS	NS	1.9 J	2.8 J	23	80	90	5.0 U	6.1	3.8 J
Acenaphthylene	NS	NS	2.4 J	5.4	25	24	30	5.0 U	1.5 J	11
Acenaphthene	NS	NS	15	25	68	190	320	5.0 U	87	48
2,3,5-Trimethylnaphthalene	NS	NS	2.0 J	3.0 J	23	45	67	5.0 U	2.2 J	2.7 J
Fluorene	77.4	536	9.3	16	65	130	180	5.0 U	59	34
Phenanthrene	204	1,170	76	130	290	380	610	0.42 J	540	280
Anthracene	57.2	845	16	26	65	81	120	5.0 U	88	52
1-Methylphenanthrene	NS	NS	4.2 J	9.4	33	35	59	5.0 U	22	13
Fluoranthene	423	2,230	150	300	550	390	560	0.52 J	940	550
Pyrene	195	1,520	160	330	750	550	710	0.66 J	890	600
Benz(a)anthracene	108	1,050	87	170	310	180	220	5.0 U	570	320
Chrysene	166	1,290	110	220	400	230	280	0.25 J	740	440
Benzo(b)fluoranthene	NS	NS	120	230	320	180	230	0.25 J	900	510
Benzo(k)fluoranthene	NS	NS	96	190	280	190	200	5.0 U	550	390
Benzo(e)pyrene	NS	NS	95	180	300	190	230	0.21 J	590	440

Table 5-6
Selected North of Berth 414 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC30-0-1 K2401716-016 03/08/2004	T4-VC30-1-3 K2401716-017 03/08/2004	T4-VC30-3-5 K2401716-018 03/08/2004	T4-VC30-5-7 K2401716-001 03/08/2004	T4-VC30-7-9 K2401716-002 03/08/2004	T4-VC30-9-11 K2401716-003 03/08/2004	T4-VC31-0-1 K2401716-010 03/08/2004	T4-VC31-1-3 K2401716-011 03/08/2004
Benzo(a)pyrene	150	1,450	120	240	460	280	340	0.21 J	740	550
Perylene	NS	NS	46	84	130	84	96	5.0 U	240	190
Indeno(1,2,3-cd)pyrene	NS	NS	100	200	350	240	300	5.0 U	640	580
Dibenz(a,h)anthracene	33	NS	22	40	47	29	38	5.0 U	150	94
Benzo(g,h,i)perylene	NS	NS	98	190	370	260	320	0.22 J	550	630
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	4.9 J	20 U	10 U	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	7.5 J	20 U	10 U	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	20 U	20 U	10 U	20 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	7.5 J	20 U	10 U	6.7 J	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	33 U	48	20 U	20 U	10 U	20 U	72
Di-n-octyl phthalate	NS	NS	20 UJ	20 UJ	20 UJ	20 UJ	20 UJ	10 UJ	20 UJ	20 UJ
Total PAHs (c,d)	1,610	22,800	971	1,894	3,664	3,025	3,980	2.3 J	6,117	3,801
Pesticides (ug/kg)										
4,4'-DDE	NS	NS	3.8	4.3	10	8.9	15 J	0.40 U	3.7	3.3
4,4'-DDD	NS	NS	2.8	2.4	10	10	12	0.40 U	3.1	2
4,4'-DDT	NS	NS	1.4 J	3	6.8	4.2	5.2	0.40 U	2.1 J	2.1
2,4'-DDE	NS	NS	0.4 U	0.40 U	1.6 U	1.4 U	2.2 U	0.40 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	1.5	2.5 J	7.7 J	5	6.1 J	0.40 U	1.8	1.7
2,4'-DDT	NS	NS	0.36 J	1.4 J	3.7 J	2.2	2.2 J	0.40 U	0.61 J	0.71 U
Total DDD (c,e)	4.88	28	4.3	4.9	18	15	18	0.40 U	4.9	3.7
Total DDE (c,f)	3.16	31.3	3.8	4.3	10	8.9	15 J	0.40 U	3.7	3.3
Total DDT (c,g)	4.16	62.9	1.8 J	4.4	11	6.4	7.4	0.40 U	2.7 J	2.1
ΣDDTs (c,h)	5.28	572	9.9	14	38	30	41	0.40 U	11	9.1
PCBs (ug/kg)										
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	6.9	19	73	37	50	5.0 U	9.2	9.0
Aroclor 1254	NS	NS	14 U	43 U	130 U	71 U	110 U	5.0 U	18 U	18 U

Table 5-6
Selected North of Berth 414 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC30-0-1	T4-VC30-1-3	T4-VC30-3-5	T4-VC30-5-7	T4-VC30-7-9	T4-VC30-9-11	T4-VC31-0-1	T4-VC31-1-3
Lab ID:			K2401716-016	K2401716-017	K2401716-018	K2401716-001	K2401716-002	K2401716-003	K2401716-010	K2401716-011
Date Sampled:	TEC (a)	PEC (b)	03/08/2004	03/08/2004	03/08/2004	03/08/2004	03/08/2004	03/08/2004	03/08/2004	03/08/2004
Aroclor 1260	NS	NS	13 J	50	96	57	83	5.0 U	13	22
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	20	69	169	94	133	10 U	22	31
Conventionals (percent)										
Total organic carbon	NS	NS	1.87	2.05	1.83	2.07	1.89	0.06 U	1.79	1.98
Total solids	NS	NS	50.7	51.8	55.9	60.9	60.8	76.2	51.2	52.8

Table 5-6
Selected North of Berth 414 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC31-3-5 K2401716-012 03/08/2004	T4-VC31-5-7 K2401716-013 03/08/2004	T4-VC31-7-9 K2401716-014 03/08/2004	T4-VC31-9-11 K2401716-015 03/08/2004	T4-PS31-15-17 K2402764-004 04/14/2004	T4-PS31-20.5-22.5 K2402764-005 04/14/2004
Metals (mg/kg)								
Arsenic	9.79	33	2.8	2.9	3.9	3.8	2.1	2
Cadmium	0.99	4.98	0.38	0.37	0.99	0.99	0.32	0.12
Chromium	43.4	111	21.1 J	27.6 J	29.4 J	20.5 J	10 J	8.52 J
Copper	31.6	149	28.4 J	30.8 J	36.4 J	24.5 J	20 J	35.3 J
Lead	35.8	128	31.3	38.4	41.4	27.8	6.8 J	5.52 J
Mercury	0.18	1.06	0.149	0.313	0.714	0.228	0.045	0.015 B
Nickel	22.7	48.6	18 J	18.9 J	18.7 J	17.6 J	14.1 J	13.8 J
Selenium	NS	NS	0.13 U	0.13 U	0.14 U	0.05 U	0.052 U	0.088 U
Silver	NS	NS	0.24	0.55	0.59	0.2	0.07	0.05
Zinc	121	459	112	106	173	175	73.8 J	42.6 J
Semivolatile Organics (ug/kg)								
Naphthalene	176	561	38	120	250	120	24	11
2-Methylnaphthalene	NS	NS	23	60	150	51	13	2.9 J
1-Methylnaphthalene	NS	NS	11	45	100	30	9.0	1.6 J
Biphenyl	NS	NS	5.1	12	26	13	4.0 J	5.0 U
2,6-Dimethylnaphthalene	NS	NS	16	36	210	65	8.8	2.0 J
Acenaphthylene	NS	NS	7.5	19	70	41	3.5 J	0.68 J
Acenaphthene	NS	NS	39	90	76	46	18	2.6 J
2,3,5-Trimethylnaphthalene	NS	NS	18	26	240	74	9.2	1.5 J
Fluorene	77.4	536	29	49	82	42	10	2.5 J
Phenanthrene	204	1,170	120	170	690	390	100	16
Anthracene	57.2	845	19	31	130	76	21	3.1 J
1-Methylphenanthrene	NS	NS	13	22	180	73	11	1.8 J
Fluoranthene	423	2,230	150	180	800	490	140	17
Pyrene	195	1,520	200	250	1,400	720	170	23
Benz(a)anthracene	108	1,050	74	90	290	180	36	5.6
Chrysene	166	1,290	97	120	460	250	56	8.9
Benzo(b)fluoranthene	NS	NS	85	99	330	180	32	5.4
Benzo(k)fluoranthene	NS	NS	79	110	240	180	33	6.3
Benzo(e)pyrene	NS	NS	77	110	330	200	35	6.4

Table 5-6
Selected North of Berth 414 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID:			T4-VC31-3-5	T4-VC31-5-7	T4-VC31-7-9	T4-VC31-9-11	T4-PS31-15-17	T4-PS31-20.5-22.5
Lab ID:			K2401716-012	K2401716-013	K2401716-014	K2401716-015	K2402764-004	K2402764-005
Date Sampled:	TEC (a)	PEC (b)	03/08/2004	03/08/2004	03/08/2004	03/08/2004	04/14/2004	04/14/2004
Benzo(a)pyrene	150	1,450	100	160	440	290	50	7.6
Perylene	NS	NS	45	62	210	120	17	3.3 J
Indeno(1,2,3-cd)pyrene	NS	NS	87	130	390	270	46 J	7.7 J
Dibenz(a,h)anthracene	33	NS	15	17	42	28	5.3 J	5 UJ
Benzo(g,h,i)perylene	NS	NS	92	150	450	300	57	10
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	11 U	10 UJ
Diethyl phthalate	NS	NS	20 U	20 U	20 U	20 U	11 U	10 UJ
Di-n-butyl phthalate	NS	NS	23 U	22 U	20 U	29 U	11 U	10 UJ
Butylbenzyl phthalate	NS	NS	7.5 J	20 U	20 U	20 U	11 U	10 UJ
Bis(2-ethylhexyl) phthalate	NS	NS	37	20 U	20 U	20 U	65	60 J
Di-n-octyl phthalate	NS	NS	20 UJ	20 UJ	20 UJ	20 UJ	11 U	10 UJ
Total PAHs (c,d)	1,610	22,800	1,038	1,488	5,258	3,005	694	110
Pesticides (ug/kg)								
4,4'-DDE	NS	NS	5.3	5.3	0.40 U	0.22 J	0.78 J	0.40 U
4,4'-DDD	NS	NS	4.4	12	0.40 U	0.40 U	3.1	0.43
4,4'-DDT	NS	NS	4.3	1.6	0.40 U	0.40 U	5.1	0.40 U
2,4'-DDE	NS	NS	0.63 U	1.2 J	0.40 U	0.40 U	0.40 U	0.40 U
2,4'-DDD	NS	NS	3.8 J	10	0.40 U	0.40 U	2.1	0.28 J
2,4'-DDT	NS	NS	2.1	1.3 J	0.25 J	0.40 U	0.5	0.40 U
Total DDD (c,e)	4.88	28	8.2	22	0.40 U	0.40 U	5.2	0.71
Total DDE (c,f)	3.16	31.3	5.3	6.5	0.40 U	0.22 J	0.78 J	0.40 U
Total DDT (c,g)	4.16	62.9	6.4	2.9	0.25 J	0.40 U	5.6	0.40 U
ΣDDTs (c,h)	5.28	572	20	31	0.25 J	0.22 J	12	0.71
PCBs (ug/kg)								
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1221	NS	NS	10 U	10 U	10 U	10 U	10 U	10 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1248	NS	NS	38	12 J	5.0 U	5.0 U	5.0 U	5.0 U
Aroclor 1254	NS	NS	66 U	42 U	5.0 U	5.0 U	5.0 U	5.0 U

Table 5-6
Selected North of Berth 414 Surface and Subsurface Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-VC31-3-5 K2401716-012 03/08/2004	T4-VC31-5-7 K2401716-013 03/08/2004	T4-VC31-7-9 K2401716-014 03/08/2004	T4-VC31-9-11 K2401716-015 03/08/2004	T4-PS31-15-17 K2402764-004 04/14/2004	T4-PS31-20.5-22.5 K2402764-005 04/14/2004
Aroclor 1260	NS	NS	58	25 J	14 U	5.0 U	5.0 U	5.0 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	13 U	5.0 U	5.0 U	5.0 U
Aroclor 1268	NS	NS	5.0 U	20 J	49 J	5.0 U	5.0 U	5.0 U
Total PCBs (c,i)	59.8	676	96	57 J	49 J	10 U	10 U	10 U
Conventionals (percent)								
Total organic carbon	NS	NS	1.58	2.22	2.77	1.13	0.21	0.07
Total solids	NS	NS	59.8	58.5	62.7	72.2	78.3	75.5

Table 5-6
Selected North of Berth 414 Surface and Subsurface Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-7
Selected Berth 401 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP01-0-1 K2401845-001 03/12/2004	T4-UP02-0-1 K2401845-002 03/12/2004
Metals (mg/kg)				
Arsenic	9.79	33	3.8	1.9
Cadmium	0.99	4.98	0.34	0.15
Chromium	43.4	111	17.8	7.17
Copper	31.6	149	24.2 J	9.3 J
Lead	35.8	128	33.7	7.6
Mercury	0.18	1.06	0.127	0.017 B
Nickel	22.7	48.6	18.2 J	9.21 J
Selenium	NS	NS	0.09 U	0.11 U
Silver	NS	NS	0.2	0.04
Zinc	121	459	94.6 J	48.8 J
Semivolatile Organics (ug/kg)				
Naphthalene	176	561	82	1.8 J
2-Methylnaphthalene	NS	NS	25	0.70 J
1-Methylnaphthalene	NS	NS	11	0.44 J
Biphenyl	NS	NS	14	5.0 U
2,6-Dimethylnaphthalene	NS	NS	21	0.41 J
Acenaphthylene	NS	NS	18	1.7 J
Acenaphthene	NS	NS	85	1.6 J
2,3,5-Trimethylnaphthalene	NS	NS	46	0.52 J
Fluorene	77.4	536	48	1.1 J
Phenanthrene	204	1,170	630	9.8
Anthracene	57.2	845	71	5.5
1-Methylphenanthrene	NS	NS	66	1.5 J
Fluoranthene	423	2,230	730	23
Pyrene	195	1,520	1,200	33
Benz(a)anthracene	108	1,050	240	10
Chrysene	166	1,290	320	16
Benzo(b)fluoranthene	NS	NS	220	13
Benzo(k)fluoranthene	NS	NS	240	14
Benzo(e)pyrene	NS	NS	240	17

Table 5-7
Selected Berth 401 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP01-0-1 K2401845-001 03/12/2004	T4-UP02-0-1 K2401845-002 03/12/2004
Benzo(a)pyrene	150	1,450	350	13
Perylene	NS	NS	110	7.3
Indeno(1,2,3-cd)pyrene	NS	NS	310	12
Dibenz(a,h)anthracene	33	NS	31	1.8 J
Benzo(g,h,i)perylene	NS	NS	360	15
Dimethyl phthalate	NS	NS	20 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U
Butylbenzyl phthalate	NS	NS	13 J	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	62	33
Di-n-octyl phthalate	NS	NS	20 U	20 U
Total PAHs (c,d)	1,610	22,800	4,234	144
Pesticides (ug/kg)				
4,4'-DDE	NS	NS	3.2 U	0.21 J
4,4'-DDD	NS	NS	8.8	0.42 U
4,4'-DDT	NS	NS	4.2	0.84
2,4'-DDE	NS	NS	0.95 U	0.42 U
2,4'-DDD	NS	NS	5.7	0.42 U
2,4'-DDT	NS	NS	1.2 U	0.42 U
Total DDD (c,e)	4.88	28	15	0.42 U
Total DDE (c,f)	3.16	31.3	3.2 U	0.21 J
Total DDT (c,g)	4.16	62.9	4.2	0.84
ΣDDTs (c,h)	5.28	572	19	1.1
PCBs (ug/kg)				
Aroclor 1016	NS	NS	5.4 U	5.2 U
Aroclor 1221	NS	NS	11 U	11 U
Aroclor 1232	NS	NS	5.4 U	5.2 U
Aroclor 1242	NS	NS	5.4 U	5.2 U
Aroclor 1248	NS	NS	22 J	2.9 J
Aroclor 1254	NS	NS	19 U	5.2 U

Table 5-7
Selected Berth 401 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP01-0-1 K2401845-001 03/12/2004	T4-UP02-0-1 K2401845-002 03/12/2004
Aroclor 1260	NS	NS	29 J	5.2 U
Aroclor 1262	NS	NS	5.4 U	5.2 U
Aroclor 1268	NS	NS	5.4 U	5.2 U
Total PCBs (c,i)	59.8	676	51 J	2.9 J
Conventionals (percent)				
Total organic carbon	NS	NS	1.24	0.28
Total solids	NS	NS	62.5	77.3

Table 5-7
Selected Berth 401 Under-pier Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-8
Selected Slip 1 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP03 K2402940-001 04/21/2004	T4-UP04 K2402940-003 04/21/2004	T4-UP05 K2402940-004 04/21/2004	T4-UP06-0-1 K2401845-003 03/12/2004	T4-UP07-0-1 K2401845-004 03/12/2004	T4-UP08-0-1 K2401845-005 03/12/2004
Metals (mg/kg)								
Arsenic	9.79	33	2.3	3.3	2.8	5.7	7	2.4
Cadmium	0.99	4.98	0.17	0.17	0.17	1.02	5.79	0.5
Chromium	43.4	111	12.9	12.4	10.4	24.4	23.8	18
Copper	31.6	149	16.4 J	13.9 J	13.4 J	37.3 J	49.8 J	18.9 J
Lead	35.8	128	17.3	11.2	11.9	49.4	1950	40.8
Mercury	0.18	1.06	0.026	0.013 B	0.036	0.123	0.067	0.021
Nickel	22.7	48.6	15.3 J	14.8 J	14.2 J	18.9 J	18.8 J	19.9 J
Selenium	NS	NS	0.03 J	0.08 UJ	0.08 UJ	0.21 U	0.27 U	0.08 U
Silver	NS	NS	0.07	0.06	0.04	0.25	0.75	0.06
Zinc	121	459	65.5 J	52.4 J	51.6 J	178 J	1000 J	114 J
Semivolatile Organics (ug/kg)								
Naphthalene	176	561	6.9	1.3 J	1.8 J	15	28	2.9 J
2-Methylnaphthalene	NS	NS	0.74 J	0.85 J	1.0 J	8.6	21	0.99 J
1-Methylnaphthalene	NS	NS	0.51 J	0.46 J	0.5 J	4.6 J	13	0.6 J
Biphenyl	NS	NS	5.0 U	5.0 U	5.0 U	3.5 J	5.0 J	4.9 U
2,6-Dimethylnaphthalene	NS	NS	0.3 J	1.1 J	0.58 J	12	36	0.56 J
Acenaphthylene	NS	NS	2.0 J	1.0 J	3.0 J	38	46	1.4 J
Acenaphthene	NS	NS	2.1 J	3.8 J	1.7 J	39	130	4.9 J
2,3,5-Trimethylnaphthalene	NS	NS	0.82 J	0.88 J	0.5 J	12	32	0.75 J
Fluorene	77.4	536	1.6 J	2.6 J	1.7 J	82	210	4.4 J
Phenanthrene	204	1,170	15	18	12	410	960	19
Anthracene	57.2	845	2.5 J	5.2	7.7	320	2,500	6.8
1-Methylphenanthrene	NS	NS	1.1 J	1.8 J	1.3 J	52	140	1.7 J
Fluoranthene	423	2,230	32	47	57	850	2,800	150
Pyrene	195	1,520	29	46	45	910	2,700	230
Benz(a)anthracene	108	1,050	13	26	21	880	1,700	46
Chrysene	166	1,290	21	37	28	1,400	2,500	68
Benzo(b)fluoranthene	NS	NS	16	34	27	820	1,200	55
Benzo(k)fluoranthene	NS	NS	19	33	29	690	1,200	40
Benzo(e)pyrene	NS	NS	14	34	25	660	920	47

Table 5-8
Selected Slip 1 Under-pier Sediment Data Compared to SQGs

Sample ID:			T4-UP03	T4-UP04	T4-UP05	T4-UP06-0-1	T4-UP07-0-1	T4-UP08-0-1
Lab ID:			K2402940-001	K2402940-003	K2402940-004	K2401845-003	K2401845-004	K2401845-005
Date Sampled:	TEC (a)	PEC (b)	04/21/2004	04/21/2004	04/21/2004	03/12/2004	03/12/2004	03/12/2004
Benzo(a)pyrene	150	1,450	16	38	25	710	1,000	41
Perylene	NS	NS	15	26	7.7	220	390	96
Indeno(1,2,3-cd)pyrene	NS	NS	14	31	18	500	800	26
Dibenz(a,h)anthracene	33	NS	2.0 J	5.0	2.8 J	120	200	5.0
Benzo(g,h,i)perylene	NS	NS	15	37	23	410	590	27
Dimethyl phthalate	NS	NS	20 U	20 U	20 U	140 U	99 U	20 U
Diethyl phthalate	NS	NS	20 U	20 U	20 U	140 U	99 U	20 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	20 U	140 U	99 U	20 U
Butylbenzyl phthalate	NS	NS	20 U	20 U	20 U	51 J	99 U	20 U
Bis(2-ethylhexyl) phthalate	NS	NS	20 U	23 U	20 U	620	250	20 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	20 U	140 U	99 U	20 U
Total PAHs (c,d)	1,610	22,800	176	293	260	7,164	16,974	669
Pesticides (ug/kg)								
4,4'-DDE	NS	NS	0.40 U	0.32 J	0.40 U	3.3	2.7	0.43 U
4,4'-DDD	NS	NS	0.40 U	0.39 J	0.55	2.4 J	3.8	0.43 U
4,4'-DDT	NS	NS	0.39 J	1.4	1.6	6.6 J	3.3 J	0.37 J
2,4'-DDE	NS	NS	0.40 U	0.40 U	0.15 J	1.1 U	0.54 U	0.43 U
2,4'-DDD	NS	NS	0.40 U	0.40 U	0.40 U	1.8 J	3.4 J	0.43 U
2,4'-DDT	NS	NS	0.40 U	0.58 J	0.22 J	0.73 U	0.91 U	0.2 J
Total DDD (c,e)	4.88	28	0.40 U	0.39 J	0.55	4.2 J	7.2	0.43 U
Total DDE (c,f)	3.16	31.3	0.40 U	0.32 J	0.15 J	3.3	2.7	0.43 U
Total DDT (c,g)	4.16	62.9	0.39 J	2.0	1.8	6.6 J	3.3 J	0.57 J
ΣDDTs (c,h)	5.28	572	0.39 J	2.7	2.5	14	13	0.57 J
PCBs (ug/kg)								
Aroclor 1016	NS	NS	5.0 U	5.0 U	5.0 U	9.1 U	6.8 U	5.3 U
Aroclor 1221	NS	NS	9.9 U	10 U	10 U	19 U	14 U	11 U
Aroclor 1232	NS	NS	5.0 U	5.0 U	5.0 U	9.1 U	6.8 U	5.3 U
Aroclor 1242	NS	NS	5.0 U	5.0 U	5.0 U	9.1 U	6.8 U	5.3 U
Aroclor 1248	NS	NS	5.0 U	5.0 U	5.0 U	25	10 J	5.3 U
Aroclor 1254	NS	NS	5.0 U	5.0 U	5.0 U	40 U	40 U	7.4

Table 5-8
Selected Slip 1 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP03 K2402940-001 04/21/2004	T4-UP04 K2402940-003 04/21/2004	T4-UP05 K2402940-004 04/21/2004	T4-UP06-0-1 K2401845-003 03/12/2004	T4-UP07-0-1 K2401845-004 03/12/2004	T4-UP08-0-1 K2401845-005 03/12/2004
Aroclor 1260	NS	NS	5.0 U	6.6	5.0 U	63	34	5.3 U
Aroclor 1262	NS	NS	5.0 U	5.0 U	5.0 U	9.1 U	6.8 U	5.3 U
Aroclor 1268	NS	NS	5.0 U	5.0 U	5.0 U	9.1 U	6.8 U	5.3 U
Total PCBs (c,i)	59.8	676	9.9 U	6.6	10 U	88	44	7.4
Conventionals (percent)								
Total organic carbon	NS	NS	0.4	0.42	0.09	3.81	1.7	0.29
Total solids	NS	NS	70.7	72.4	71.8	36.7	53.1	75.4

Table 5-8
Selected Slip 1 Under-pier Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus-based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. Σ DDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-9
Selected Slip 3 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP09-0-2 K2401908-012 03/15/2004	T4-UP10-0-1 K2401845-006 03/12/2004	T4-UP10-0-2 K2401908-011 03/15/2004	T4-UP12-0-1 K2401949-006 03/12/2004	T4-UP13-0-1 K2402008-001 03/18/2004	T4-UP14 K2402940-002 04/21/2004
Metals (mg/kg)								
Arsenic	9.79	33	3.6	3.3	3.6	6.2	12.3 J	6.4
Cadmium	0.99	4.98	0.3	0.34	0.35	6.99	10.1	2.99
Chromium	43.4	111	24.5 J	20.6	24.3 J	12.5 J	15.7 J	21.9
Copper	31.6	149	35.8 J	38.5 J	35 J	43.2 J	55.5 J	37.7 J
Lead	35.8	128	17.3	27.4	23.1	924	1,670 J	198
Mercury	0.18	1.06	0.06 J	0.085	0.061 J	0.043	0.09	0.119
Nickel	22.7	48.6	22.5 J	21.8 J	22.2 J	15 J	18.5 J	20.1 J
Selenium	NS	NS	0.17 J	0.08 U	0.15 J	0.07 UJ	0.06 J	0.04 J
Silver	NS	NS	0.17	0.13	0.14	2.43	3.53	0.39
Zinc	121	459	91.2 J	96.3 J	94.7 J	1130 J	2,050 J	458 J
Semivolatile Organics (ug/kg)								
Naphthalene	176	561	43	58	69 J	130	1,700	320
2-Methylnaphthalene	NS	NS	29	29	42 J	87	940	120
1-Methylnaphthalene	NS	NS	30	18	42 J	46 J	490	60
Biphenyl	NS	NS	8.4	8.3	12	15 J	120	53
2,6-Dimethylnaphthalene	NS	NS	34	18	40 J	25 J	250	80
Acenaphthylene	NS	NS	12	20	29 J	12 J	25	120
Acenaphthene	NS	NS	150	86	180 J	2,500	11,000	220
2,3,5-Trimethylnaphthalene	NS	NS	29	15	33 J	20 J	98	220
Fluorene	77.4	536	150	74	170 J	730	3,400	210
Phenanthrene	204	1,170	630	420	820 J	7,600	32,000	1,900
Anthracene	57.2	845	110	110	180 J	2,300	8,700	410
1-Methylphenanthrene	NS	NS	50	35	64 J	610	1,800	170
Fluoranthene	423	2,230	680	770	1,300 J	17,000	64,000	4,900
Pyrene	195	1,520	710	910	1,400 J	15,000	74,000	4,900
Benz(a)anthracene	108	1,050	240	510	640 J	13,000	41,000	2,400
Chrysene	166	1,290	280	600	780 J	11,000	44,000	3,000
Benzo(b)fluoranthene	NS	NS	240	680	840 J	13,000	44,000	2,200
Benzo(k)fluoranthene	NS	NS	210	560	700 J	11,000	42,000	2,500
Benzo(e)pyrene	NS	NS	200	560	690 J	9,600	32,000	2,100

Table 5-9
Selected Slip 3 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP09-0-2 K2401908-012 03/15/2004	T4-UP10-0-1 K2401845-006 03/12/2004	T4-UP10-0-2 K2401908-011 03/15/2004	T4-UP12-0-1 K2401949-006 03/12/2004	T4-UP13-0-1 K2402008-001 03/18/2004	T4-UP14 K2402940-002 04/21/2004
Benzo(a)pyrene	150	1,450	250	720	880 J	18,000 J	48,000	3,300
Perylene	NS	NS	120	220	310 J	4,300	13,000	840
Indeno(1,2,3-cd)pyrene	NS	NS	200	650	780 J	14,000 J	31,000	2,700
Dibenz(a,h)anthracene	33	NS	30	120	150 J	2,400	6,500	430
Benzo(g,h,i)perylene	NS	NS	200	600	720 J	9,700	25,000	2,700
Dimethyl phthalate	NS	NS	20 U	20 U	39 U	38 UJ	200 U	100 U
Diethyl phthalate	NS	NS	20 U	20 U	39 U	38 UJ	200 U	100 U
Di-n-butyl phthalate	NS	NS	20 U	20 U	39 U	38 UJ	200 U	100 U
Butylbenzyl phthalate	NS	NS	8.8 J	27	17 J	38 UJ	200 U	100 U
Bis(2-ethylhexyl) phthalate	NS	NS	61	140	130	59 UJ	200 U	100 U
Di-n-octyl phthalate	NS	NS	20 U	20 U	39 U	38 UJ	200 U	100 U
Total PAHs (c,d)	1,610	22,800	3,705	5,518	7,988 J	111,272	413,825	26,380
Pesticides (ug/kg)								
4,4'-DDE	NS	NS	3.1	1.4	2.5	0.27 J	4.0 U	3.4 J
4,4'-DDD	NS	NS	2	2	2.3	0.65	4.0 U	13
4,4'-DDT	NS	NS	0.40 U	0.47 U	0.40 U	0.40 U	4.4	14
2,4'-DDE	NS	NS	0.40 U	0.47 U	0.40 U	0.40 U	4.0 U	4.0 U
2,4'-DDD	NS	NS	1.2 J	1.3	1.4	0.55 U	4.5 U	4.7
2,4'-DDT	NS	NS	0.40 U	0.47 U	0.40 U	0.40 U	4.0 U	4.0 U
Total DDD (c,e)	4.88	28	3.2	3.3	3.7	0.65	4.5 U	18
Total DDE (c,f)	3.16	31.3	3.1	1.4	2.5	0.27 J	4.0 U	3.4 J
Total DDT (c,g)	4.16	62.9	0.40 U	0.47 U	0.40 U	0.40 U	4.4	14
ΣDDTs (c,h)	5.28	572	6.3	4.7	6.2	0.92	4.4	35
PCBs (ug/kg)								
Aroclor 1016	NS	NS	5.0 U	5.9 U	5.0 U	5.0 U	5.0 U	50 U
Aroclor 1221	NS	NS	10 U	12 U	10 U	10 U	10 U	100 U
Aroclor 1232	NS	NS	5.0 U	5.9 U	5.0 U	5.0 U	5.0 U	50 U
Aroclor 1242	NS	NS	5.0 U	5.9 U	5.0 U	5.0 U	5.0 U	50 U
Aroclor 1248	NS	NS	5.1	5.7 J	8.0	6.0	5.0 U	50 U
Aroclor 1254	NS	NS	5.0 U	10 U	5.0 U	7.5 U	5.0 U	50 U

Table 5-9
Selected Slip 3 Under-pier Sediment Data Compared to SQGs

Sample ID: Lab ID: Date Sampled:	TEC (a)	PEC (b)	T4-UP09-0-2 K2401908-012 03/15/2004	T4-UP10-0-1 K2401845-006 03/12/2004	T4-UP10-0-2 K2401908-011 03/15/2004	T4-UP12-0-1 K2401949-006 03/12/2004	T4-UP13-0-1 K2402008-001 03/18/2004	T4-UP14 K2402940-002 04/21/2004
Aroclor 1260	NS	NS	9.1	8.6	12	5.6	33	50 U
Aroclor 1262	NS	NS	5.0 U	5.9 U	5.0 U	5.0 U	5.0 U	50 U
Aroclor 1268	NS	NS	5.0 U	5.9 U	5.0 U	5.0 U	5.0 U	50 U
Total PCBs (c,i)	59.8	676	14	14	20	12	33	100 U
Conventionals (percent)								
Total organic carbon	NS	NS	1.82	1.08	1.53	0.24	2.83	1.53
Total solids	NS	NS	54.2	60.4	59.3	80.7	81.4	62.2

Table 5-9
Selected Slip 3 Under-pier Sediment Data Compared to SQGs

TPH and grain size data are not presented in this table. These data are presented in Appendix E.

NS = No screening level.
NA = Not analyzed because of insufficient sample volume.
U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method report limit but greater than the method detection limit.

Boxed values indicate concentration is greater than TEC.
Shaded values indicate concentration is greater than PEC.

a. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus based threshold effect concentrations (TEC). Represents concentration below which toxicity is unlikely to be observed.
b. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Receptors (MacDonald et al., 2000a). Consensus based probable effect concentrations (PEC). Represents concentration above which toxicity is likely to be observed.
c. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
d. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
e. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
f. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
g. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
h. ΣDDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes e, f, and g for the definitions of total DDD, total DDE, and total DDT, respectively.
i. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table 5-10
TCLP Results Compared to Hazardous Waste Criteria

Sample ID: Lab ID: Date Sampled:	TCLP Criteria (a)	T4-CM1 K2402055-004 03/23/2004	T4-CM2 K2401845-007 03/11/2004
Metals (mg/L)			
Arsenic	5	0.1 U	0.1 U
Barium	100	0.5 B	1
Cadmium	1	0.01 U	0.01 U
Chromium	5	0.004 B	0.01 U
Lead	5	0.05 U	0.05 U
Selenium	1	0.1 U	0.1 U
Silver	5	0.01 J	0.01 U
Mercury	0.2	0.001 U	0.001 UJ
Pesticides (mg/L)			
gamma-BHC (Lindane)	0.4	0.0005 U	0.0005 U
Heptachlor	0.008	0.0005 U	0.0005 U
Heptachlor Epoxide	0.008	0.0005 U	0.0005 U
Endrin	0.02	0.0005 U	0.0005 U
Methoxychlor	10	0.001 U	0.001 U
Chlordane	0.03	0.005 U	0.005 U
Toxaphene	0.5	0.01 U	0.01 U
Herbicides (ug/L)			
2,4-D	10000	100 U	100 U
2,4,5-TP (Silvex)	1000	20 U	20 U
Volatile Organics (mg/L)			
Vinyl Chloride	0.2	0.08 U	0.08 U
1,1-Dichloroethene (1,1-DCE)	0.7	0.2 U	0.2 U
2-Butanone (MEK)	200	8 U	8 U
Chloroform	6	0.2 U	0.2 U
Carbon Tetrachloride	0.5	0.2 U	0.2 U
1,2-Dichloroethane (EDC)	0.5	0.2 U	0.2 U
Benzene	0.5	0.2 U	0.2 U
Trichloroethene (TCE)	0.5	0.2 U	0.2 U
Tetrachloroethene (PCE)	0.7	0.2 U	0.2 U
Chlorobenzene	100	0.2 U	0.2 U
1,4-Dichlorobenzene	7.5	0.2 U	0.2 U
Semivolatile Organics (mg/L)			
Pyridine	5	0.5 UJ	0.5 UJ
2-Methylphenol	200	0.1 U	0.1 U
Hexachloroethane	3	0.1 UJ	0.1 U
4-Methylphenol	200	0.1 U	0.1 U
Nitrobenzene	2	0.1 U	0.1 U
Hexachlorobutadiene	0.5	0.1 UJ	0.1 U
2,4,6-Trichlorophenol	2	0.1 U	0.1 U
2,4,5-Trichlorophenol	400	0.1 U	0.1 U
2,4-Dinitrotoluene	0.13	0.1 U	0.1 U
Hexachlorobenzene	0.13	0.1 UJ	0.1 UJ
Pentachlorophenol (PCP)	100	0.25 U	0.25 U

U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method reporting limit but greater than the method detection limit.

a. Hazardous waste criteria from CFR 40.261.23.

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