Lower Duwamish Waterway Superfund Site

Terminal 117 Early Action Area

T-117 Sediment, Soil, and Water Field Sampling, Cruise and Data Report Final

For submittal to:

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March 4, 2005

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Acronyms

Acronym	definition
AET	apparent effects threshold
ARI	Analytical Resources, Inc.
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
City	City of Seattle
COC	chain of custody
CSL	cleanup screening level

Acronym	definition
DO	dissolved oxygen
DOF	Dalton, Olmsted and Fuglevand, Inc.
dw	dry weight
EAA	early action area
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EF	exceedance factor
EPA	US Environmental Protection Agency
FC	field coordinator
FS	feasibility study
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
MLLW	mean lower low water
NAPL	non-aqueous-phase liquid
NTU	nephelometric turbidity unit
OC	organic carbon normalized
Onsite	Onsite Enterprises, Inc.
ORP	oxygen-redox potential
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
Port	Port of Seattle
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RI	remedial investigation
RM	river mile
SMS	Washington State Sediment Management Standards
Spc	specific conductance
SQS	Sediment Quality Standard
SVOC	semivolatile organic compound
T-117	Terminal 117
TBT	tributyltin
TOC	total organic carbon
VOC	volatile organic compound
Windward	Windward Environmental LLC

1.0 Introduction

This data report presents the results of the sediment, soil and water investigations conducted in the Terminal 117 (T-117) Early Action Area (EAA) of the Lower Duwamish Waterway (LDW) Superfund Site. The T-117 site has been identified as an early action area of the LDW Superfund site. The LDW site was added to the EPA's National Priorities List (the national list of sites for the Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA, also known as Superfund) on September 13, 2001. The Phase 1 remedial investigation (RI) for the LDW (Windward 2003a) was a summary and evaluation (including a risk assessment) of existing LDW data from previous studies. One of the primary objectives of the Phase 1 RI was to identify areas within the LDW site that might be candidates for early cleanup action because of their potential for higher levels of risks. Windward (2003b) prepared a technical memorandum that recommended seven areas to EPA and Ecology for early action. The T-117 EAA, located at approximately River Mile (RM) 3.6 on the west side of the waterway, was designated as "Area 5" in that technical memorandum.

Investigation of the T-117 EAA is being conducted under the existing Administrative Order on Consent (Cohen 2003) signed by the City of Seattle (City), King County, the Port of Seattle (Port), and The Boeing Company—working together in the LDW as the Lower Duwamish Waterway Group (LDWG. Work at the T-117 EAA is sponsored by two of the four LDWG members: the Port and the City.

The T-117 work plan (Windward et al. 2003c) requires the following tasks to be completed:

- Summary of existing information and data gaps analysis report and quality Assurance project plan (QAPP) (Task 1)
- Cruise and data report (Task 2)
- Technical memorandum on preliminary boundaries of the removal action (Task 3)
- Community involvement (Task 10)

This data report fulfills Task 2 of the work plan. This document describes the sediment, soil and water results for the T-117 EAA. PCBs were identified as the primary risk driver for the removal action at the T-117 shoreline (Windward 2003b; Windward et al. 2003b). This investigation characterized the nature and extent of PCBs in the T-117 EAA to determine the removal boundary needed to reduce the risks associated with PCBs at T-117. Full-suite Washington State Sediment Management Standards (SMS) source evaluation sampling was also conducted to determine the potential for sediment recontamination. Multiple field sampling investigations were conducted to fill identified data gaps (Windward et al. 2003b). Data were collected primarily to determine the nature and extent of PCB contamination, assist engineering remediation design, and identify potential sources of contamination to the sediment.

1.1 SITE DESCRIPTION

1.1.1 T-117 EAA

T-117 EAA is located on the west side of the LDW from approximately RM 3.5-3.7, as measured from the southern tip of Harbor Island. The area generally consists of the intertidal zone extending from the top of the shoreline bank (~ +13 ft mean lower low water [MLLW]) to the slope of the navigation channel (~ -9 ft MLLW) and is bordered by South Park Marina to the north and the Boeing South Park facility to the south.

1.1.2 T-117 adjacent upland property

The adjacent upland portion of the west shore of the T-117 EAA includes the Port's T-117 property. This property, the former Malarkey Asphalt Company site, is located at 8700 Dallas Avenue South in Seattle, Washington. The upland T-117 property covers approximately 5.5 ac including a 50-60-ft (15-18-m)-wide section of land adjacent to the shoreline owned by the Port as successor in interest to the Duwamish Commercial Waterway District No. 1. In 1999, the Port acquired the additional inland parcels that made up the former Malarkey property between the shoreline parcel and Dallas Avenue South. These properties were consolidated to form the present-day T-117. Adjacent properties include Basin Oil Company on the west side of Dallas Avenue, Boeing Company to the south, and South Park Marina to the north/northwest.

1.2 SAMPLE DESIGN

The purpose of the field investigation is to fill data gaps identified after reviewing historic data (Windward et al. 2003b) to help define a removal action boundary and to evaluate potential upland source contributions to the T-117 EAA during and after removal. This field investigation was conducted by completing iterative field efforts; each additional field effort based on the results of the preceding effort, ultimately providing the data to further support the removal boundary. The following presents the sequence of data collection events to complete this investigation. Sampling locations are shown on Figure 1-1.

Initially, surface and subsurface sediment chemical data were generated to: determine the horizontal and vertical nature and extent of sediment contamination by PCBs within the T-117 EAA, determine an EAA removal boundary, determine release of chemicals listed in the (SMS) from potential upland sources to sediment, and establish the general engineering characteristics of the shoreline sediment for constructability of potential removal actions.

Soil borings were advanced along the shoreline to: generate chemical and geotechnical data to determine the vertical extent of soil impacted by PCBs along the shoreline for source control evaluation during and after removal, to determine whether polycyclic aromatic hydrocarbons (PAHs) were present in the bank, to assess the potential for contamination to the sediment, and to establish the general engineering characteristics of the shoreline soil to assess constructability of potential removal actions.

As part of the source control evaluation, soil samples from the southern drainage ditch and catch basins, water samples from intertidal seeps, and groundwater samples from shoreline monitoring wells were collected to evaluate whether contaminants are being transported to the shoreline sediment.

Additionally, large asphalt deposits and major debris were located in the shoreline bank and south ditch were identified, described, and mapped.

A 24-hour tidal study was conducted to characterize the groundwater gradient beneath the adjacent T-117 nearshore upland area, characterize the influence of tides in the LDW on water levels in the wells, establish appropriate tide ranges for monitoring well sampling, and check for the occurrence of non-aqueous phase liquid (NAPL) in wells.

To accomplish the objectives described above, the following data were collected:

- In December 2003, surface sediment grab samples, a composite surface sediment sample (consisting of sediment from 4 sampling locations), and subsurface sediment cores were collected from the T-117 EAA and analyzed primarily for PCBs, surface sediment samples near potential source discharge areas were also analyzed for all SMS chemicals, and sediment sample near the South Park Marina was analyzed for tributyltin (TBT).
- Soil catch basin, drainage ditch, and shoreline bank samples were also collected from T-117 in early December 2003.
- Seep water and groundwater samples were collected from T-117 in late December 2003 and early January 2004: one each from four shoreline bank monitoring wells and three seep locations along the toe of the bank.
- A follow-up well check for the presence of NAPL was conducted in August 2004.
- The locations of large concentrated roofing/shingle asphalt outcrops and debris in the shoreline bank and south ditch were mapped in late March 2004.

Following the initial sample collection effort, the areal extent of PCB contamination at northern portion of T-117 was still unbounded. To better define the removal boundary, additional subsurface and surface sediment samples were collected from the T-117 the northern portion of the EAA and shallow soil borings were collected from the northern upland bank during March 2004. All these samples were analyzed for PCBs and compared to SMS.

Additional soil sampling was also conducted to estimate the concentrations of PCBs in the roadway along the entrance area of the T-117 property and evaluate if these materials are the likely source of elevated PCBs in and around catch basin 5. Roadway soil samples and additional catch basin samples were analyzed for PCBs in March 2004.

These results were summarized and interpreted in the T-117 preliminary boundary technical memorandum (Windward et al. 2004a) and used to delineate the preliminary removal boundary.

Following the preliminary removal boundary delineation, there was still some uncertainty about the nature and extent of PCB contamination. Additional surface sediment samples were collected to determine the nature and extent of PCB sediment contamination outside the offshore northern portion of the preliminary removal boundary to better define the boundary. Archived samples collected in December 2003 that were either outside of the removal boundary or below the vertical extent of PCB contamination were analyzed for additional chemicals to assist in cleanup decisions.

Another sampling effort was conducted in September 2004 to further delineate the extent of PCB contamination in the northern portion of the site that extends into South Park Marina. This sampling event was conducted to satisfy both the EPA EAA boundary definition and the Dredge Material Management Program (DMMP) for the South Park Marina. Surface sediment and subsurface samples were collected to determine the nature and extent of PCB sediment within the southern portion of the marina to better define the removal boundary. Subsurface samples were also collected to characterize the South Park Marina's dredge material management unit in compliance with Puget Sound Dredge Disposal Agency (PSDDA) sediment characterization requirements and chemical guidelines. These results are presented in a separate data report (Windward et al. 2005a).

Based on the results of the iterative sampling and analysis program, a proposed removal boundary was delineated [see Appendix A, T-117 boundary technical memorandum of the EE/CA (Windward et al. 2005b)]. The data to support the rational for the boundary definition is summarized in Section 2.4 of the EE/CA. This document presents the data collected as a result of all the iterative sampling and analysis activities discussed above.

1.3 REPORT ORGANIZATION

This report is organized into sections addressing field methods, laboratory methods, results, and references. The following Appendices support the text:

- Appendix A – chain of custody forms
- Appendix B – field form, logs and notes
- Appendix C – data validation
- Appendix D – results tables
- Appendix E – analytical lab data

- Appendix F – NAPL investigation well levels
- Appendix G – tidal study well levels
- Appendix H – data management

2.0 Field Methods

2.1 SAMPLE COLLECTION

All field activities were performed under the direction of the field coordinator (FC) or other oversight personnel, with EPA oversight as appropriate. Sampling was accomplished by a joint operation of Windward Environmental LLC (Windward), Onsite Enterprises, Inc. (Onsite), and Dalton, Olmsted and Fuglevand, Inc. (DOF). Sediment sampling was conducted under the direction of Windward with assistance from Marine Sampling Systems or Mullins Guide Service. Soil borings and monitoring well construction were accomplished under the direction of DOF with assistance from a Holt Drilling. Catch basin grabs, drainage ditch sampling, groundwater monitoring, seep sampling, shoreline asphalt mapping, roadway and shallow soil borings were conducted under direction of Onsite. The various sampling methods are discussed below.

2.1.1 Sediment collection

The field procedures used to collect the sediment samples are described in greater detail in Section 3.1.4 of the QAPP (Windward et al. 2003a) and QAPP addenda (Windward et al. 2004c, d, e). Four field events were undertaken including the initial field event and the three supplemental events as described above. The following methods were used:

- Initial event: Surface samples (to 10 cm) using hydraulic grab sampler; subsurface samples (to 10 ft or refusal) using a vibracorer.
- Supplemental Event 1: Surface samples (to 10 cm) using an Eckman grab; subsurface samples (to about 2.5 ft or refusal) using a hand-held gravity coring device or clam gun
- Supplemental Event 2: Surface samples (to 10 cm) using a van Veen grab.
- Supplemental Event 3: Surface samples (to 10 cm) using hydraulic grab sampler; subsurface samples (to 10 ft or refusal) using a vibracorer.

2.1.2 Soil boring collection and monitoring well construction

During the initial field effort, soil borings and monitoring well installations were conducted using a hollow-stem auger drill, penetrating 15 to 20 ft, deployed from a drill rig. For the supplemental sampling, eight shallow soil borings were completed along the northern bank of the T-117 property. The soil borings were advanced using a hollow-stem handheld auger which has a practical depth limit of approximately 1.5 to

2 ft. Detailed descriptions of soil boring sampling and well installation methods are found in Section 3.2.2.4 of the QAPP (Windward et al. 2003a) and descriptions of the supplemental soil boring sampling methods are in the QAPP addendum (Windward et al. 2004c).

2.1.3 Catch basin, drainage ditch, and roadway soil sample collection

Drainage ditch, roadway and soil samples collected from the sump of catch basins 1, 4 and 6 were collected by hand with a stainless steel spoon. Since water was present in the sump of catch basin 5, a gravity core sampler was used to obtain the soil sample. An additional soil sample (not specified in the QAPP) was also taken from material around the outside of catch basin 5, which was collected by hand with a stainless steel spoon. No filter fabric was present at catch basin 1 and the sediment within filter fabric at catch basin 5 could not be retrieved since the fine sediments were too embedded within the filter. Detailed descriptions of catch basin, drainage ditch soil and roadway sampling methods are found in Sections 3.2.2.2 and 3.2.2.7 of the QAPP (Windward et al. 2003a), and the roadway work plan (Onsite 2004).

2.1.4 Monitoring well tidal study and sample collection

The 24-hour tidal levels in each well were monitored using Instrumentation Northwest AquiStar® PT2X submersible pressure transmitters and data loggers to evaluate response to tidal influences in the adjacent LDW. An additional sensor was installed in a stilling well located at the south end of the South Park Marina dock (adjacent to the boathouse). All pressure sensors were calibrated at the Instrumentation Northwest facility in Kirkland, Washington immediately prior to deployment into the field. The study was initiated on December 8, 2003 and concluded the following day during tidal extremes in the LDW of approximately +7.0 ft to -1.0 ft MLLW. Visual observations during probe placement and retrieval in the wells did not indicate the presence of NAPL. An additional product investigation in the shoreline wells (MW-2, MW-4, MW-5, MW-6) was conducted on August 15, 2004 (see Appendix F for additional details).

Two newly constructed wells (MW-5 and MW-6) were developed after installation using surge and bail techniques after well construction. Subsequent observation of monitoring well water quality indicated high levels of turbidity in all the shoreline wells (MW-2, MW-4, MW-5 and MW-6) and the wells were therefore redeveloped by alternately surging and pumping using a dedicated submersible down-hole pump, four days prior to sampling. Procedures generally described in EPA guidance (Izraell et al. 1992) were followed, using turbidity as an indicator of development progress, with the objective of developing until the turbidity levels in the wells were stabilized. In some wells, however, the observed turbidity levels remained relatively high, even after the removal of multiple well casing volumes; emphasizing the need for low-flow well purging and sampling techniques.

Newly constructed wells MW-5 and MW-6 and existing shoreline wells MW-2 and MW-4 were sampled using low-flow techniques. Detailed descriptions of the sample collection methods are found in Section 3.2.2.8 of the QAPP(Windward et al. 2003a). Well sampling times were selected to coincide with a falling tide to help ensure the collection of water representative of the site. All wells were purged prior to sampling. Water levels in the wells responded to tidal fluctuations and were observed to recharge after purging, indicating good communication with the surrounding groundwater.

2.1.5 Seep sample collection

Three seeps were selected for sampling, one major seep which was already identified and two minor seeps that were selected prior to seep sampling during a reconnaissance survey conducted with EPA oversight. Methods were discussed with EPA prior to sampling, and an EPA representative was present to oversee sampling to ensure that the most appropriate method was used. For the major seep and two minor seeps, it was possible to place a piece of tubing, such as that used for sampling monitoring wells, directly into the flow and flush the water directly into glass sample containers. No filtering or fixing of the samples for metals analysis was done in the field; this was anticipated to be done by the lab within 24hrs of receipt of the samples.

The flow rates of all three seeps were quantitatively measured as described in Section 3.2.2.3 of the QAPP (Windward et al. 2003a). Flow rate was calculated by using a stopwatch to measure the rate at which seep water filled a graduated cylinder. Water quality parameters dissolved oxygen (DO), temperature, pH, turbidity, specific conductance (Spc), and oxidation-reduction potential (ORP), were measured using a Hydrolab and turbidity was measured with a turbidity meter.

2.2 SHORELINE ASPHALT MAPPING

Large asphalt masses in the shoreline bank and south ditch were identified and mapped. Long stakes marked with ribbon were used to measure their locations relative to the soil boring/transect locations from the shoreline. The location along the shoreline, relative to the soil boreholes/transect locations was estimated using a 100-ft tape measure. A handheld Wide Area Augmentation System enabled Magellan SporTrak global positioning system unit was used to record the position of the asphalt masses. For individual asphalt masses, the span along the shoreline was measured and the elevation from the mudline was estimated. Each mass was sequentially assigned an identification number, digitally photographed, and briefly described in the field logbook.

2.3 SAMPLE PROCESSING

Acceptable sediment core samples from the initial field effort were transported to Analytical Resources, Inc. (ARI) for processing prior to chemical analysis. The core sections were extracted with a vibrating extruder table and placed on an aluminum foil covered tray. One-foot core segments for the first two feet of the core and two-foot segments for the remaining core sample were placed into stainless steel mixing bowls. When stratified sediment conditions were encountered in the cores, care was taken to include only one material type in each sample. This occurred in the first foot of core T-117-SE-43-SC which was divided into subsamples identified as T-117-SE-43-SC-0-0.3 and T-117-SE-43-SC-0.3-1, and also in the first two feet of T-117-SE-16-SC which was divided into subsamples identified as T-117-SE-16-SC-0-0.9, T-117-SE-16-SC-0.9-1.3, and T-117-SE-16-SC-1.3-2.

The supplemental sampling processing occurred at upland T-117property. Subsurface sediment cores were extracted by placing the core over the processing table at a 45 degree angle and tapping on the outside of the tube. One-foot core segments were visually classified and homogenized prior to chemical analysis. Care was taken to not include any material that had been in contact with any interior sampler surface. When stratified sediment conditions were encountered in the cores, care was taken to include only one material type in each sample. This occurred in the first foot of core T-117-SE-70-SC which was divided into subsamples identified as T-117-SE-43-SC-0-0.5 and T-117-SE-43-SC-0.5-1.

For all surface sediment, the upper 10 cm was collected from acceptable grab samples and placed into a stainless steel mixing bowl and homogenized. For all soil samples, material was collected from the appropriate depth and placed into a stainless steel mixing bowl and homogenized.

Soil or sediment for VOC analysis was collected prior to homogenization and placed into an appropriate size glass-vial with a septa cap. After homogenization, soil and sediment samples were placed in appropriate-sized, certified-clean, wide-mouth glass jars capped with Teflon®-lined lids (QAPP Table 3-7). All seep and groundwater samples were placed in appropriately-sized, certified glass or high density polyethylene bottles capped with Teflon®-lined lids (QAPP Table 3-8). Each container was sealed, labeled, and stored under conditions specified in Table 2-1 of the QAPP. Visible organisms and debris were removed prior to distribution to sample containers; removed materials were noted in the field logbooks.

2.4 FIELD EQUIPMENT DECONTAMINATION

To prevent cross-contamination of samples, all sampling equipment that came in contact with the sediment underwent the following decontamination procedures prior to collection activities at each station:

- Rinse with site water or tap water and wash with scrub brush until free of sediment
- Wash with phosphate-free detergent and site or tap water
- Rinse with site or tap water
- Rinse with distilled water

There were no cases in which samples were suspected of having higher levels of contaminants, so no extra decontamination steps were conducted.

Sampling equipment used for collecting water samples was pre-cleaned and used only once per sample, so decontamination between samples was not necessary.

2.5 Field Quality Assurance and Quality Control

Field duplicate samples were collected to evaluate the effectiveness of field decontamination and homogenization procedures. Sediment duplicates were prepared from the same batch of homogenized sediment. Water duplicates were prepared by filling sample and sample duplicate bottles on an analyte-by-analyte basis. All samples collected were documented in the site logbook. Table 2-1 lists the field duplicate sample IDs and the corresponding sample IDs collected from the same location.

Table 2-1. Duplicate sample IDs

Sample ID	Duplicate sample ID
T-117-SE-29-SG	T-117-SE-52-SG
T-117-SE-33-SG	T-117-SE-60-SG
T-117-SE-45-SG	T-117-SE-53-SG
T-117-SE-15-SC-24	T-117-SE-49-SC-24
T-117-SE-17-SC-68	T-117-SE-47-SC-68
T-117-SE-31-SC-810	T-117-SE-48-SC-810
T-117-SE-35-SC-24	T-117-SE-50-SC-24
T-117-SE-42-SC-68	T-117-SE-51-SC-68
T-117-SE-78 -SG	T-117-SE-83 -SG
T-117-CB-1-SU	T-117-CB-1-SU-D
T-117-DS-1	T-117-DS-1-D
T-117-MW-6	T-117-MW-6-DUP
T-117-SW-2	T-117-SW-4
T-117-SB-8-01	T-117-SB-15-01
T-117-SE-73-SG	T-117-SE-75-SG
T-117-CB-04-SU-1	T-117-CB-04-SU-2
T-117-RW-02-01	T-117-RW-02-02
T-117-SE-89-SG	T-117-SE-95-SG

Fourteen rinsate blanks were collected after processing samples T-117-SE-15-SC, T-117-SE-17-SC, T-117-SE-25-SC, T-117-SE-35-SC, T-117-SE-42-SC, T-117-SE-29-SG, T-117-SE-39-SG, T-117-SE-45-SG, T-117-SE-79-SG, T-117-SB-7, T-117-SE-71-SC, T-117-CB-1, T-117-DS-1, and T-117-SE-89-SG. Rinsate blanks were collected by running deionized water over decontaminated sample processing equipment and collecting the water in clean sample jars.

2.6 DISPOSAL OF UNUSED SAMPLE MATERIAL

All sediment remaining in the sampling gear and on the deck of the sampling vessel after sampling was washed overboard at the collection site prior to moving to the next sampling station. All unused sediment from the processing facility was placed into buckets and disposed by the analytical laboratory.

All soil remaining in the sampling gear after sampling was washed off at the collection site prior to moving to the next sampling station. Unused soil and contaminated water from the soil borings were collected in drums and stored on the property until transferred to an incineration facility. All other unused soil or water samples were returned to the collection site

All disposable sampling materials and personnel protective equipment used in sample processing, such as disposable gloves and paper towels, were placed in heavyweight garbage bags, removed from the site by sampling personnel, and placed in a normal refuse container for disposal.

2.7 SAMPLE IDENTIFICATION SCHEME

The location ID naming convention is described below. The first four characters are T-117, to designate the T-117 area. The next two characters identify the type of location, based on the medium sampled, followed by consecutive numbers to identify the specific location within the T-117 area:

- CB – catch basin soil location, followed by 1, 4, 5, or 6 which corresponds to the catch basin's number
- DS – drainage ditch soil location, followed by numbers 1 or 2
- MW – monitoring well location, followed by monitoring well number 2 to 6
- RW – roadway location, followed by consecutive numbers 1 to 6
- SB – soil boring location, followed by consecutive numbers 1 to 14
- SE – sediment location, followed by a number 7-46, 71-82, or 84-93, and then followed by an "G" to indicate a surface grab location or an "SC" to indicate a subsurface core location
- SW – seep water location, followed by consecutive numbers 1 to 3

Sample IDs are the same as location IDs, except for some that contain additional information, as follows:

- CB followed by SU for samples collected from the sump, or OUT for soil collected around the catch basin opening
- SB followed by two characters identifying the depth interval of soil collected, e.g., for SB-1 through SB-6, 01 = 0 to 1.5 ft, 02= 2.5 to 4 ft, 03 = 5 to 6.5 ft, 04 = 7.5 to 9 ft, 05 = 10 to 12.5 ft, 06= 17.5 to 19 ft; for SB 7 through SB-14, 01 = 0 to 1.5 ft

- Rinsate blanks were assigned the same characters as the station identifier, followed by the identifier "RB"

Sample IDs for sediment are also similar to location IDs. For example, the surface sediment sample collected at location T-117-SE-07G was designated T-117-SE07-SG. The sample IDs for the subsurface samples also include the depth interval included in the sample. For example, the subsample collected from the 0-to-1 ft interval at location T-117-SE-15-SC was designated as T-117-SE-15-SC-01. The composite sample was identified as T-117-SE-SGcomp1.

2.8 SAMPLE DOCUMENTATION PROCEDURES

A field data log was used to note the date, time, and location of sampling stations, as well as additional parameters recorded in the field (see Appendix B). The following data were included in the field data log:

- Names of field coordinators and person(s) collecting and logging the cores
- Unique station identifier
- Station coordinates
- Date and time of collection
- Collection method
- Observations made during sample collection, including weather conditions, complications, and other details associated with sampling equipment or procedures

Sediment samples contained the following additional information that was recorded on either the sediment/soil or sediment core collection form:

- Recovered core length, depth of penetration, and percent recovery
- Uncorrected water depth at each station, tide elevation, and mudline elevation (i.e., tide-corrected water depth of each station relative to MLLW)
- Qualitative notation of apparent resistance of sediment column to coring (time required for penetration)
- Lithology observations

Drainage ditch and catch basin soil samples contained the following additional information that was be recorded on the sediment/soil collection form:

- Physical observations of soil, including the presence of foreign objects, color, presence of sheens, apparent grain size, moisture (soil only), and odor
- Penetration depth of the sampler

After seep water collection, the following additional information was recorded on the collection form:

- Description of the substrate through or over which the seep flows
- Quantitative flow rate
- Seep observations (e.g., bacterial slime, oily sheen, staining, obvious odor)
- Description of embankment substrate including presence of fill or waste material
- Seep location relative to the shoreline bank
- Recency of rainfall events
- Tidal stage

After groundwater collection, the following additional information was recorded on the collection form:

- Depth to bottom of monitoring well
- Depth to groundwater
- Tide elevation relative to MLLW
- Well volume
- Purge flow rate
- Purge time
- Purge volume
- Purge parameters: DO, temperature, pH, turbidity, Spc, ORP
- Groundwater observations, including the presence of product sheen or layer

Soil borings contained the following additional information that was recorded on the soil core log:

- Physical observations of soil, including the presence of foreign objects, color, presence of sheens, apparent grain size, moisture, and odor
- Borings were logged to record geologic stratigraphy and the presence of any water-bearing layers
- Penetration depth of the sampler
- Standard penetration test results

Soil borings in which monitoring wells were installed contain additional information that was recorded on the boring and well log.

During shoreline asphalt mapping, the following additional information was recorded in the field logbook:

- Relative distance of asphalt mass from soil boring station/transect
- Span of asphalt mass along the shoreline

- Elevation range of asphalt mass relative to the mudline
- Other observations that made the asphalt mass distinguishable

2.9 Chain of Custody and Sample Transport Procedures

Chain-of-custody (COC) forms were used to track sample custody (see Appendix A). Samples collected in the field were placed in a cooler with ice. All sediment, soil and water samples were hand-delivered to ARI in Tukwila, WA. Cores were cut into 4 ft sections and placed in an icebox on the sampling vessel until transport to ARI where they were placed in a walk-in cooler and processed the following day at ARI.

2.10 Field Deviations from the QAPP

Field deviations from the QAPP and QAPP addenda included modifications to the sample identification scheme for one seep water sample and several QA/QC duplicate samples, and modifications to samples taken at catch basin 5 and soil boring locations 2 and 6. These field deviations did not affect data quality, are documented in the Form 7s (Appendix B), and are discussed in detail below.

- Table 3-2 in Section 3.1.2 of the QAPP indicated that the location of the major seep was to be identified as T-117-SW-1. In the field, that seep location was identified as T-117-SW-2 instead because of its relative position between the two minor seeps and their sampling order.
- Some field duplicates for QA/QC were not identified with the next available number from the sequence as specified in Section 3.2.1 of the QAPP. The sample and field duplicate taken from the sump of catch basin 1 were identified as T-117-CB-1-SU and T-117-CB-1-SU-D, respectively, instead of T-117-CB-1-SP and T-117-CB-6-SP, respectively. The QAPP indicated that sump samples were to be identified with "SP," not "SU." Also, field duplicates from samples T-117-DS-1 and T-117-MW-6 were identified as T-117-DS-1-D and T-117-MW-6-DUP, respectively, instead of T-117-DS-4 and T-117-MW-7, respectively. The alternative sample identification scheme used still distinguished field duplicates from their respective parent samples, and was thus considered acceptable.
- Accumulated soil in the filter fabric at catch basin 5 was not sampled, as directed in Section 3.1.1 of the QAPP, because it was limited in volume and most of it was embedded within the fabric such that collection was not possible.
- An additional soil sample, identified as T-117-CB-5-OUT, directly surrounding catch basin 5, was taken at the request of Port of Seattle Project Manager Doug Hotchkiss, because there was a concern that it was a potential source of recontamination.
- Not all interval soil samples were collected as described in the QAPP (Section 3.1.3) at T-117-SB-2 and T-117-SB-6. There were no soil samples taken

from the fourth and fifth boring intervals at soil boring location T-117-SB-2, or from the fourth boring interval at soil boring location T-117-SB-6, because there was no recovery at these intervals. Both the fourth and fifth soil intervals at T-117-SB-2 consisted of a slough of the same materials as above them, and the fourth soil interval at T-117-SB-2 consisted of a layer of brick, preventing any soil collection.

- The interface probe was not used in the initial groundwater investigation to check for the presence of NAPL in the monitoring wells immediately prior to sampling as directed in the QAPP. Monitoring wells were checked for floating NAPL during prior observations (i.e. during the tidal study and/or during development) and none was detected. The samplers believed it prudent not to introduce the interface probe into the wells immediately prior to sampling for chemical analyses, to minimize disturbance of the water column and the potential for cross-contamination. Another investigation of NAPL was conducted in August, 2004 to correct this QAPP deviation.
- Continuous monitoring of NAPL thickness in the monitoring wells included in the tidal study could not be performed during the study due to the potential for disturbing the sensitive down-hole pressure sensors. Observations of well water prior to and following the tidal study did not indicate the presence of NAPL. Additional product measurements were conducted in August 2004.
- The sediment core from sample station T-117-SE-70-SC was subdivided into 0-0.5 ft, 0.5-1 ft, and 1-2 ft intervals instead of one-foot intervals for the upper two layers and the remainder for the bottom layer because total core recovery was only two feet. The upper one-foot layer was subdivided into two subsections because it visually appeared to contain different layers.
- During the supplemental sampling, color photos focusing on changes in stratigraphy and visible contamination were not taken of the cores prior to sample processing. Because sampling occurred during low tide in the evening, there was not enough ambient light for clear photos and flash photography washed out the sample due to the aluminum foil background.

3.0 Laboratory Methods

ARI conducted chemical and physical testing for each sample. All subsurface and surface sediment samples were analyzed for total PCBs, total solids and total organic carbon (TOC). Seven surface sediment samples were also analyzed for metals[2], semivolatile organic compounds (SVOCs), and VOCs. One surface sediment sample was also analyzed for TBT. Soil boring samples 1 through 6 were analyzed for total PCBs, PAHs, total solids and TOC. Catch basin 1 and 5, drainage ditch soil, and seep water samples were analyzed for total PCBs, SMS metals,[1] SVOCs, VOCs, total solids and TOC. Some soil and sediment samples were also analyzed for grain size and geotechnical parameters see Section 4.2.2 for additional details. Seep water samples for metals analysis were filtered and fixed at the laboratory prior to analysis. Groundwater samples were analyzed for total PCBs, PAHs, VOCs and TOC and total suspended solids. Roadway and catch basin 4 and 6 soil samples were analyzed for PCBs and total solids. Supplemental sediment and soil samples were analyzed for PCBs and TOC. Sediment samples from the initial effort that were only analyzed for PCBs and soil boring samples from SB-1 through SB-6 were also archived for potential analysis of additional chemicals.

3.1 Analytical Methods

The chemical and physical testing adhered to the most recent Puget Sound Estuary Program (PSEP) QA/QC procedures (PSEP 1997), PSEP analysis protocols and EPA analysis protocols. Grain-size analysis was conducted following PSEP (1986) protocols for subsurface sediment samples and American Society for Testing and Materials (ASTM, D2217/D422) for surface sediment samples. Table 3-1 summarizes specific methods used to analyze the samples.

[1] Arsenic, cadmium, chromium, copper, lead, silver, and zinc

Table 3-1. Summary of analytical methods

CHEMICAL	UNITS	RDL	METHOD	REFERENCE
Sediment/Soil				
Volatile organic compounds (VOCs)	µg/kg dw	0.9	GC/MS	EPA 8260/8270
Semivolatile organic compounds (SVOCs)	µg/kg dw	20	GC/MS	EPA 8270/8081
Polychlorinated biphenyls (PCBs)	µg/kg dw	19	GC/ECD	EPA 8082
Mercury	mg/kg dw	0.07	CVAA	EPA 7471A
Other metals	mg/kg dw	0.3	ICP	EPA 6010B
Tributyltin (TBT)	µg/kg dw	5.0	GC/MS	Krone et al., 1989
TOC	% dw	0.02	combustion	Plumb, 1981
Total solids	% ww	0.01	oven-dried	SM254-G
Moisture content	% ww	0.01	oven-dried	ASTM D2216
Grain size	% dw	0.1	sieve	PSEP 1986/ASTMD422/D2217
Water				
VOCs	µg/kg dw	0.9	GC/MS	EPA 8260/8270
SVOCs	µg/kg dw	20	GC/MS	EPA 8270
PCBs	µg/kg dw	19	GC/ECD	EPA 8082
Mercury (total)	mg/kg dw	0.07	CVAA	EPA 7471A
Other metals (total)	mg/kg dw	0.3	ICP	EPA 6010B
TOC	% dw	0.02	combustion	EPA 415.1
Total suspended solids (TSS)	% ww	0.01	oven-dried	EPA 160.2

ASTM – American Society for Testing and Materials
CVAA – cold vapor atomic absorption
ICP – inductively coupled plasma-atomic emission spectrometry
dw – dry weight basis
ECD – electron capture detection
GC – gas chromatography
MS – mass spectrometry
PSEP – Puget Sound Estuary Program
RDL – reporting detection limit
ww – wet weight basis

3.2 QA/QC FOR CHEMICAL/PHYSICAL TESTING

Data quality objectives and laboratory quality control procedures are discussed in Section 2.4 of the QAPP. Analytical results were validated by Sayler Data Solutions or Ecochem. The results of the validations are presented in Appendix C.

3.3 LABORATORY DEVIATIONS FROM THE QAPP

Laboratory deviations from the QAPP are documented in the Form 7s (Appendix B), and are discussed in detail below.

- The QAPP specified that the PSEP analysis method for grain size was to be employed for all sediment samples. The laboratory analyzed the surface sediment samples by ASTM method D-2217/D-422. This method is comparable to the PSEP method except that a #230 (62.5 µm) sieve is not used. This sieve size has historically been used in Puget Sound to differentiate the boundary between sand and silt. The laboratory used the raw data from the ASTM method to estimate the sediment finer than 62.5 µm.

- The QAPP specified that seep samples would be centrifuged prior to analysis to ensure that no sediment was in the water sample. The water samples had no visible particulates; therefore, centrifuging was not conducted. This deviation was corrected by taking a follow-up sample, centrifuging, and completing the required analysis. Both PCB results are presented in Table 4-16.
- The QAPP stated the metals in water would be analyzed as dissolved. The samples were submitted to the lab unfiltered and unfixed. The laboratory planned on fixing and filtering the samples within 24 hours of receipt. However, the samples were mistakenly fixed and analyzed prior to filtering; the results were thus for total metals instead of dissolved. This deviation was not discovered until three weeks after it occurred. The lab then used some unused sample from PCB analysis and reanalyzed it for metals after filtering and fixing, resulting in dissolved metal results. Due to volume constraints mercury could not be re-analyzed as dissolved, since total mercury was undetected it likely that dissolved results would also have been undetected. Because the samples were not filtered immediately, results for dissolved metals were rejected.

4.0 Results

Results of the sediment, soil, and water chemistry analyses are summarized below. These results have undergone data validation, as described in detail in Appendix C. The results presented in this report are of good quality and should be considered acceptable for all project uses. All chemistry results compared to SMS are presented in Appendix D and raw laboratory data can be found in Appendix E.

When laboratory duplicates were analyzed, the average concentration for the duplicates was calculated and used as the sample concentration. In the tables below and Appendix D, field duplicate results are presented independently from the sample from which the field duplicate came. For mapping purposes, however, field duplicate results were averaged. Significant figure rules were applied when summing and during carbon normalizing. For carbon normalized averages, results from the two samples were averaged before normalizing (average value dw/average TOC value). A detailed discussion of the hierarchical approach used in averaging laboratory replicates and field duplicates, calculating totals, carbon normalization and application of significant figures is presented in Appendix H.

4.1 Sampling Locations and Sample Characteristics

The sample locations and descriptions are presented in Table 4-1 (surface sediment samples), Table 4-2 (subsurface sediment samples), Table 4-3 (soil samples from the drainage ditch, catch basins, and soil borings collected along the T-117 shoreline), and Table 4-4 (seeps and monitoring wells). All coordinates are reported in Washington State Plane North (NAD 83, US survey feet).

Table 4-1. Surface sediment location descriptions

Location	Date	Time	Northing	Easting	Penetration Depth (cm)	Sediment Characteristics
Initial Sampling December 2003						
T-117-SE-07-G	12.8.03	1609	195833	1275232	24	fine sand and silt, gray-black, slight H_2S odor, wood and leafy debris
T-117-SE-08-G	12.8.03	1231	195795	1275145	18	coarse to-medium sand, gray, slight H_2S odor
T-117-SE-09-G [a]	12.8.03	1340	195768	1275185	19	coarse-medium sand, drab olive, wood and leaf debris, shell fragments
T-117-SE-10-G	12.8.03	1553	195778	1275215	22	medium-fine sand, gray, wood debris, shell fragments
T-117-SE-11-G [a]	12.8.03	1401	195768	1275219	22	coarse-medium sand, drab olive, moderate H_2S, rust, wood debris
T-117-SE-12-G [a]	12.8.03	1459	195764	1275272	16	coarse-medium sand, gravel, drab olive, wood debris, shell fragments
T-117-SE-13-G	12.8.03	1535	195747	1275315	30	silt, brown surface, moderate H_2S, wood, leaves, worms
T-117-SE-14-G [a]	12.8.03	1515	195717	1275336	30	silt, brown surface, moderate H_2S, wood and leafy debris, worms
T-117-SE-15-G	12.5.03	1022	195741	1275422	30	silt, black, leaves, oil sheen
T-117-SE-16-G	12.5.03	1003	195714	1275404	25	silt, black, debris
T-117-SE-17G	12.5.03	0935	195689	1275384	21	coarse-medium sand, silt, black, slight h_2s, large rocks, wood debris
T-117-SE-18-G	12.5.03	1035	195669	1275428	21	medium sand, silt, black, wood, shell fragments
T-117-SE-19-G	12.5.03	1112	195677	1275494	15	fine sand, silt, black, moderate H_2S
T-117-SE-20-G	12.5.03	1042	195655	1275471	26	fine sand, silt, brown
T-117-SE-21-G	12.8.03	1039	195635	1275433	16	cobble, gravel, coarse-medium sand, gray, asphalt, wood, leaves
T-117-SE-22-G	12.5.03	1128	195604	1275470	24	gravel, fine sand, silt, dark brown, black streaks, asphalt
T-117-SE-23-G	12.5.03	1142	195603	1275569	24	fine sand, silt, gray, wood, worms, oil sheen
T-117-SE-24-G	12.5.03	1158	195584	1275521	24	fine sand, silt, gray, black streaks, wood, shell fragments, oil sheen
T-117-SE-25-G (co-located with seep 2)	12.5.03	1020	195559	1275471	17	cobble, gravel, coarse-medium sand, gray, large rocks, asphalt, wood, leaves
T-117-SE-26-G	12.5.03	1339	195543	1275501	19	cobble, medium-fine sand, silt, gray, large rocks, asphalt
T-117-SE-27-G	12.5.03	1351	195558	1275586	26	silt, dark gray, wood, worms, oil sheen
T-117-SE-28-G	12.5.03	1404	195507	1275546	22	fine sand, silt, gray
T-117-SE-29-G	12.5.03	1423	195508	1275625	25	silt, clay, gray, oil sheen
T-117-SE-30-G	12.5.03	1438	195474	1275579	25	fine sand, silt, gray
T-117-SE-31-G	12.5.03	1508	195451	1275544	15	cobble, medium-fine sand, gray, asphalt, rusted pipe
T-117-SE-32-G	12.5.03	1531	195444	1275604	25	silt, black

LOCATION	DATE	TIME	NORTHING	EASTING	PENETRATION DEPTH (cm)	SEDIMENT CHARACTERISTICS
T-117-SE-33-G (co-located with seep 3)	12.23.03	2330	195728	1275344	12	cobble, gravel, coarse-medium sand, gray, slight H_2S, large rocks, asphalt, oil sheen
T-117-SE-34-G	12.5.03	1546	195394	1275578	25	coarse-medium-fine sand, silt, gray-black, plants
T-117-SE-35-G	12.9.03	1015	195438	1275663	26	fine sand, silt, gray-black, wood, leaves, oil sheen
T-117-SE-36-G	12.9.03	0959	195406	1275613	27	silt, black, wood, shell fragments
T-117-SE-37-G	12.8.03	1116	195380	1275563	12	cobble, gravel, coarse-medium sand, gray-black, large rocks, asphalt, oil sheen
T-117-SE-38-G	12.9.03	0944	195370	1275690	26	silt, gray-black, wood, leaves, shell fragments, worms, oil sheen
T-117-SE-39-G (co-located with seep 1)	12.23.03	2137	195457	1275512	14	cobble, coarse-medium-fine sand, silt, gray, plants, leaves, asphalt
T-117-SE-40-G	12.8.03	0954	195281	1275612	20	cobble, coarse-medium sand, gray, wood, leaves, asphalt, brick, rust, black streaks, oil sheen
T-117-SE-41-G	12.9.03	0929	195307	1275709	25	silt, gray-black, wood, leaves, oil sheen
T-117-SE-42-G	12.9.03	0912	195278	1275668	21	fine sand, silt, black, very slight h_2s, wood, plants, shell fragments, brick, rust
T-117-SE-43-G	12.8.03	0908	195247	1275616	15	cobble, coarse-medium-fine sand, silt, gray-brown, plants, rust
T-117-SE-44-G	12.9.03	0901	195221	1275668	23	medium-fine sand, silt, gray, wood, plants, shell fragments
T-117-SE-45-G	12.8.03	1200	195180	1275634	18	cobble, gravel, coarse-medium sand, gray, worms, shell fragments
T-117-SE-46-G	12.9.03	0842	195148	1275660	15	cobble, gravel, coarse-medium-fine sand, gray
T-117-SE-47-G [b]	12.9.03	--	195754	1275253	--	--
Supplemental Sampling						
March 2003						
T-117-SE-73-G	3.16.04	1220	195835	1275111	11	brown surface layer, black, brown, silt, organic matter
T-117-SE-74-G	3.16.04	1250	195885	1275033	10.5	brown surface layer, gray, silt, medium and coarse sand, organic matter
June 2003						
T-117-SE-76-G	6.4.04	0935	195801	1275198	22	brown surface layer, dark gray mostly silt with some fine to medium sand, filamentous algae on surface and woody debris throughout
T-117-SE-77-G	6.4.04	1015	195783	1275255	21	brown surface layer, dark gray half silt half fine to medium sand, filamentous algae and leaves on surface
T-117-SE-78-G	6.4.04	1035	195768	1275297	22	brown surface layer, dark gray mostly silt with trace fine to medium sand, filamentous algae on surface and leaf and plant debris throughout
T-117-SE-79-G	6.4.04	1055	195747	1275375	22	brown surface layer, dark gray half silt half fine to medium sand, filamentous algae and leaves on surface

LOCATION	DATE	TIME	NORTHING	EASTING	PENETRATION DEPTH (cm)	SEDIMENT CHARACTERISTICS
T-117-SE-80-G	6.4.04	1125	195730	1275411	22	brown surface layer, dark gray half silt half fine to medium sand, filamentous algae and leaves on surface
T-117-SE-81-G	6.4.04	1145	195672	1275476	17	brown surface layer, dark gray half silt half fine to medium sand, filamentous algae and leaves on surface
T-117-SE-82-G	6.4.04	1200	195593	1275550	20	brown surface layer, dark gray half silt half fine to medium sand, filamentous algae and leaves on surface
September 2003						
T-117-SE-84-G	9.14.04	1411	195810	1275123	15	fine sand, silt clay, black, brown loose surface with silty sand underneath, larger grain size, trace organics on the surface, petroleum sheen
T-117-SE-85-G	9.14.04	1239	195833	1275201	23	silt, clay, brown loose surface sediment, dark gray-black cohesive silt beneath, more cohesive with depth, trace organics
T-117-SE-86-G	9.14.04	1158	195801	1275271	16	silt, clay, brown loose surface sediment, dark gray-black cohesive silt beneath with organic matter, woody and leafy debris, twigs, worm tubes, shell fragments, more cohesive with depth
T-117-SE-89-G	9.14.04	1309	195815	1275172	15	medium-fine sand, silt clay, gray with red flecks, brown loose surface with silty sand underneath, larger grain size, some worm tubes on surface but only sand with depth
T-117-SE-91-G	9.14.04	1217	195814	1275226	22	silt, clay, brown loose surface sediment, dark gray-black cohesive silt beneath, more cohesive with depth
T-117-SE-93-G	9.14.04	1133	195783	1275299	20	silt, clay, sandy brown loose, fluffy light surface sediment, dark gray-black cohesive silt beneath with organic matter, clam shell, more cohesive with depth

[a] Sediment from these locations were composited to make sample T-117-SE-SGcomp1

[b] Coordinates shown are the centroid of the four locations from which sediments were collected for compositing

Table 4-2. Subsurface sediment location descriptions

LOCATION	DATE	TIME	NORTHING	EASTING	DEPTH TO MUD (ft)	DRIVE LENGTH (ft)	CORE RECOVERY (ft)	OVERALL RECOVERY (%)[a]
Initial Sampling December 2003								
T-117-SE-15-SC	12.3.03	0925	195740	1275420	15.5	12.5	12.5	100
T-117-SE-16-SC	12.3.03	1021	195716	1275405	13.0	13.0	11.75	90
T-117-SE-17-SC	12.3.03	1059	195692	1275384	10.25	12.0	10.84	90
T-117-SE-20-SC	12.4.03	0852	195650	1275468	10.1	12.5	12.1	97
T-117-SE-21-SC	12.3.03	1150	195633	1275433	9.16	12.5	12.25	98
T-117-SE-23-SC	12.4.03	1253	195604	1275568	25.2	11.5	9.75	85
T-117-SE-24-SC	12.4.03	0937	195582	1275518	10.7	12.5	11.4	9
T-117-SE-25-SC	12.3.03	1320	195553	1275472	7.75	12.0	9.67	81
T-117-SE-30-SC	12.4.03	1016	195473	1275579	11.9	12.0	11.1	93

Location	Date	Time	Northing	Easting	Depth to Mud (ft)	Drive Length (ft)	Core Recovery (ft)	Overall Recovery (%)[a]
T-117-SE-31-SC	12.3.03	1410	195445	1275534	7.5	12.5	10.6	85
T-117-SE-35-SC	12.4.03	1332	195438	1275664	26.3	12.0	10.7	89
T-117-SE-36-SC	12.4.03	1056	195405	1275612	13.7	13.0	13.0	100
T-117-SE-37-SC	12.3.03	1450	195377	1275565	7.58	11.2	11.5	103
T-117-SE-42-SC	12.4.03	1142	195279	1275667	15.3	12.5	11.5	92
T-117-SE-43-SC	12.4.03	1540	195244	1275617	6.1	12.5	12.34	99
Supplemental Sampling								
March 2003								
T-117-SE-70-SC	3.16.04	1845	195734	1275306	0	2.0	2.0	100
T-117-SE-71-SC	3.15.04	1725	195778	1275217	0	3.0	2.7	90
T-117-SE-72-SC	3.16.04	1922	195780	1275143	0	2.4	2.4	100
September 2003								
T-117-SE-89-SC	9.15.04	0949	195815	1275180	5.0	8	6	75
T-117-SE-91-SC	9.15.04	1222	195820	1275230	6.4	10.5	8.2	78
T-117-SE-93-SC	9.15.04	1202	195783	1275303	5.5	11	10	91

[a] Overall recovery = (core recovery/drive length) x 100

Table 4-3. Soil sample locations

Location	Sample ID	Date	Time	Northing	Easting	Depth Interval (ft)	Recovery length (in.)	Overall Recovery (%)[a]
Initial Sampling December 2003								
T-117-CB-1	T-117-CB1-SU	12.8.03	1354	195595	1275364	na	na	na
T-117-CB-5	T-117-CB5	12.9.03	1220	195336	1275526	na	na	na
	T-117-CB5-OUT	12.12.03	1234	195336	1275526	na	na	na
T-117-DS-1	T-117-DS1	12.8.03	1513	195174	1275595	na	na	na
T-117-DS-2	T-117-DS2	12.8.03	1540	195173	1275553	na	na	na
T-117-SB-1	T-117-SB1-01	12.5.03	1045	195648	1275362	0-1.5	18	100
	T-117-SB1-02	12.5.03	1050	195648	1275362	2.5-4	12	67
	T-117-SB1-03	12.5.03	1055	195648	1275362	5-6.5	18	100
	T-117-SB1-04	12.5.03	1100	195648	1275362	7.5-9	12	67
	T-117-SB1-05	12.5.03	1110	195648	1275362	12.5-14	12	67
	T-117-SB1-06	12.5.03	1120	195648	1275362	17.5-19	18	100
T-117-SB-2	T-117-SB2-01	12.5.03	0925	195610	1275398	0-1.5	6	33
	T-117-SB2-02	12.5.03	0930	195610	1275398	2.5-4	12	67
	T-117-SB2-03	12.5.03	0940	195610	1275398	5-6.5	6	33
	T-117-SB2-06	12.5.03	1000	195610	1275398	17.5-19	18	100

Location	Sample ID	Date	Time	Northing	Easting	Depth Interval (ft)	Recovery length (in.)	Overall Recovery (%)[a]
T-117-SB-3	T-117-SB3-01	12.4.03	0935	195548	1275432	0-1.5	18	100
	T-117-SB3-02	12.4.03	0940	195548	1275432	2.5-4	18	100
	T-117-SB3-03	12.4.03	0945	195548	1275432	5-6.5	8	44
	T-117-SB3-04	12.4.03	0950	195548	1275432	7.5-9	12	67
	T-117-SB3-05	12.4.03	1000	195548	1275432	12.5-14	18	100
	T-117-SB3-06	12.4.03	1010	195548	1275432	17.5-19	18	100
T-117-SB-4	T-117-SB4-01	12.4.03	1140	195427	1275503	0-1.5	12	67
	T-117-SB4-02	12.4.03	1155	195427	1275503	2.5-4	6	33
	T-117-SB4-03	12.4.03	1200	195427	1275503	5-6.5	12	67
	T-117-SB4-04	12.4.03	1210	195427	1275503	7.5-9	18	100
	T-117-SB4-05	12.4.03	1220	195427	1275503	12.5-14	18	100
	T-117-SB4-06	12.4.03	1230	195427	1275503	17.5-19	18	100
T-117-SB-5	T-117-SB5-01	12.5.03	0808	195346	1275528	0-1.5	12	67
	T-117-SB5-02	12.5.03	0810	195346	1275528	2.5-4	6	33
	T-117-SB5-03	12.5.03	0815	195346	1275528	5-6.5	18	100
	T-117-SB5-04	12.5.03	0820	195346	1275528	7.5-9	18	100
	T-117-SB5-05	12.5.03	0825	195346	1275528	12.5-14	12	67
	T-117-SB5-06	12.5.03	0830	195346	1275528	17.5-19	18	100
T-117-SB-6	T-117-SB6-01	12.4.03	1405	195223	1275578	0-1.5	10	56
	T-117-SB6-02	12.4.03	1410	195223	1275578	2.5-4	12	67
	T-117-SB6-03	12.4.03	1415	195223	1275578	5-6.5	18	100
	T-117-SB6-05	12.4.03	1430	195223	1275578	12.5-14	18	100
	T-117-SB6-06	12.4.03	1440	195223	1275578	17.5-19	18	100
Roadway Sampling March 2003								
T-117-CB-4	T-117-CB4-SU-1	3.4.04	1505	195409	1275471	na	na	na
T-117-CB-6	T-117-CB6-SU	3.2.04	1445	195254	1275368	na	na	na
T-117-RW-1	T-117-RW1	3.2.04	1330	195277	1275368	na	na	na
T-117-RW-2	T-117-RW2	3.2.04	1340	195289	1275360	na	na	na
T-117-RW-3	T-117-RW3	3.2.04	1355	195259	1275347	na	na	na
T-117-RW-4	T-117-RW4	3.2.04	1410	195277	1275347	na	na	na
T-117-RW-5	T-117-RW5	3.2.04	1420	195301	1275343	na	na	na
T-117-RW-6	T-117-RW6	3.2.04	1430	195283	1275339	na	na	na
Supplemental Sampling March 2003								
T-117-SB-7	T-117-SB7-01	3.15.04	1005	195667	1275338	0-1.5	18	100
T-117-SB-8	T-117-SB8-01	3.15.04	1050	195681	1275348	0-1.5	18	100
T-117-SB-9	T-117-SB9-01	3.15.04	1120	195701	1275304	0-1.5	18	100
T-117-SB-10	T-117-SB10-01	3.15.04	1135	195732	1275267	0-1.5	18	100
T-117-SB-11	T-117-SB11-01	3.15.04	1205	195741	1275206	0-1.5	18	100
T-117-SB-12	T-117-SB12-01	3.15.04	1220	195729	1275167	0-1.5	18	100
T-117-SB-13	T-117-SB13-01	3.15.04	1240	195751	1275112	0-1.5	18	100

LOCATION	SAMPLE ID	DATE	TIME	NORTHING	EASTING	DEPTH INTERVAL (ft)	RECOVERY LENGTH (in.)	OVERALL RECOVERY (%)[a]
T-117-SB-14	T-117-SB14-01	3.15.04	1300	195773	1275132	0-1.5	18	100

[b] Overall recovery = (Core recovery/Drive length) x 100

na – not applicable for catch basin and drainage ditch soil samples

Table 4-4. Groundwater sample locations and *in situ* measurements

LOCATION	DATE	TIME	NORTHING	EASTING	FLOW RATE	TEMP (ºC)	DO	PH	ORP	SPC	TURBIDITY (NTU)
T-117-SW-1 (minor seep)	12.23.03	2137	195457	1275512	31 mL/sec[a]	7.58	10.0	6.85	474	5,285	1.05
T-117-SW-2 (major seep)	12.23.03	2220	195563	1275547	780 mL/sec[b]	7.47	10.35	6.50	478	13,479	0.45
T-117-SW-3 (minor seep)	12.23.03	2311	195728	1275344	97 mL/sec[c]	9.28	10.7	6.73	437	18,568	4.50
T-117-MW-2	1.13.04	1350	195352	1275519	400 mL/min	10.67	0.38 [d]	6.66	80 [d]	601 [d]	9.84
T-117-MW-4	1.14.04	1520	195594	1275393	450 mL/min	7.78	9.90	6.52	387	16,864	0.58
T-117-MW-5	1.14.04	1443	195548	1275432	400 mL/min	7.56	9.22	7.38	368	21,045	2.52
T-117-MW-6	1.14.04	1402	195427	1275503	400 mL/min	10.18	8.43	6.47	374	1,630	39.2

[a] 1 L/31.85 sec field observation

[b] 7 L/9.01 sec field observation

[c] 1 L/10.26 sec field observation

[d] Values are uncertain since probe batteries were low

DO—dissolved oxygen

ORP—oxygen-redox potential

Spc—specific conductance

NTU – nephelometric turbidity unit

4.2 PHYSICAL CHARACTERISTICS

4.2.1 General physical characteristics

The physical characteristics of each sediment core and soil sample were recorded on the collection forms (Appendix B) and are presented in Tables 4-5 and 4-6.

Table 4-5. Physical characteristics of each subsurface sediment sample

STATION	CORE INTERVAL (ft)	SEDIMENT CHARACTERISTICS [a]
Initial Sampling December 2003		
T-117-SE-15-SC	0-2	black, soft silt with organics
	2-4	dark gray soft silt, firmer with depth
	4-10	medium-firm silt
T-117-SE-16-SC	0-0.9	very fibrous black silt
	0.9-1.3	black soft silt
	1.3-2.0	dark gray sandy silt
	2-4	dark gray to black silt with some wood debris
	4-10	dark gray silt

Station	Core Interval (ft)	Sediment Characteristics [a]
T-117-SE-17-SC	0-1	fibrous silt, H_2S odor, black
	1-2	soft sandy silt, dark gray
	2-4	soft to medium-firm silt, dark gray with organics
	4-6	medium-firm silt, dark gray
	6-7	firm sandy silt, dark gray
	7-8	gray silty firm sand
	8-9.9	gray firm sand
	9.9-10	gray firm sandy silt
T-117-SE-20-SC	0-1	very soft black silt with minor wood debris
	1-2	soft black to dark gray silt
	2-4	soft dark gray silt becoming medium-firm
	4-6	medium-firm dark gray silt
T-117-SE-21-SC	0-1	black gravelly silty sand
	1-5	dark gray firm silt
	5-6.5	medium sand
	6.5-10	gray firm silt
T-117-SE-23-SC	0-2	black very soft silt, with fiber layer @ 0.75-1 ft
	2-4	black soft silt
	6-9	black medium-firm silt
	9-9.25	firm sand
T-117-SE-24-SC	0-2	dark gray soft silt
	2-3	dark gray soft to medium-firm silt
	3-4	gray silty fine sand
	4-6	dark gray medium-firm silt
	6-6.5	firm silt
	6.5-7	silty sand
	7-9	dark gray silt
	9-10	very silty firm sand
T-117-SE-25-SC	0-1.3	gray gravelly silty sand, slight h_2s odor
	1.3-2	dark dray soft to medium-firm silt
	2-3	dark gray soft to medium-firm silt with occasional woody debris
	3-4	gravelly sand
	4-7	dark gray firm silt
	7-8	very firm gray silt
	8-9.2	medium sand
T-117-SE-30-SC	0-1	gray very soft silt
	1-2	dark gray soft silt
	2-2.25	dark grey medium silt
	2.25-4.75	medium sand
	4.75-6	black to dark gray silt
	6-6.25	silt
	6.25-10	gray, very silty fine sand with (2-in.) organic layer at 9 ft

STATION	CORE INTERVAL (ft)	SEDIMENT CHARACTERISTICS [a]
T-117-SE-31-SC	0-1	black gravelly sandy silt with woody debris
	1-2	dark gray sandy silt
	2-4	medium-firm dark gray sandy silt
	4-7.5	firm gray silt
	7.5-9.5	increased firmness, gray silt
	9.5-10	medium sand
T-117-SE-35-SC	0-1	very soft black silt
	1-2	soft dark gray silt
	2-6	dark gray to gray silt with occasional organics
	6-9	gray silt
	9-10	medium sand
T-117-SE-36-SC	0-1.25	dark gray medium-firm silt
	1.25-3	medium sand
	3-4	dark gray medium-firm silt
	4-6	gray sandy silt
	6-7	gray silty fine sand
	7-10	gray slightly silty fine sand
T-117-SE-37-SC	0-0.7	sandy gravel
	0.7-1.9	firm gray silt
	1.9-5.5	firm sand
	5.5-10	medium sand
T-117-SE-42-SC	0-2	very soft black silt, to soft at 1 ft
	2-3	black soft silt
	3-3.5	medium sand
	3.5-4	dark gray silt
	4-4.5	silty fine sand
	4.5-6	gray silt
	6-10	gray fine sandy silt to silty fine sand
T-117-SE-43-SC	0-0.3	gray, wet silty sand
	0.3-10	gray firm silt
Supplemental Sampling		
March 2003		
T-117-SE-70-SC	0-0.5	brown surface layer, gray, black, silt, gravel, organic matter
	0.5-1	slight petroleum odor, gray, fine, medium and coarse sand, gravel
	1-2	slight petroleum odor, gray, silt, fine sand, gravel, organic matter
T-117-SE-71-SC	0-1	slight petroleum odor, brown surface, brown, gray, silt, fine and coarse sand
	1-2	brown, coarse sand
	2-2.7	brown, coarse sand
T-117-SE-72-SC	0-1	brown surface, brown, gray, fine and medium sand, organic matter
	1-2	brown, gray, medium and coarse sand, organic matter
	2-2.4	brown, gray, medium and coarse sand, organic matter
September 2003		

STATION	CORE INTERVAL (ft)	SEDIMENT CHARACTERISTICS [a]
T-117-SE-89-SC	0-2	slight petroleum odor, organic matter, hair, 3-in band of medium-fine sand at 11 in.,50/50 black clay silt, wood debris in bottom foot or section
T-117-SE-91-SC	0-2	lighter brown surface, organic matter, roots, cohesive silt at first few inches, soft silt at first six inches, no sand, 2nd foot is solid, cohesive, black, clay
T-117-SE-93-SC	0-2	trace amounts of fine sand, organic matter in top 1ft, roots, leafy debris, hair

[a] Laboratory sample descriptions

Table 4-6. Physical characteristics of each soil sample

LOCATION	CORE INTERVAL (ft)	SOIL CHARACTERISTICS
Initial Sampling December 2003		
T-117-CB-1	na	coarse sand; gray; no odor
T-117-CB-5	na	gravel, coarse and medium sand, silt; gray; strong petroleum odor
T-117-CB-5-OUT	na	fine sand, silt, organic matter; drab olive, brown; no odor
T-117-DS-1	na	organic matter; brown; humic odor
T-117-DS-2	na	organic matter; brown; humic odor
T-117-SB-1	0-1.5	damp, mottled brown, gravel, sand, silt
	2.5-4	moist, mottled brown, gravel, sand, silt
	5-6.5	moist, mottled brown, gravel, sand, silt, 3in dark brown staining at 6ft
	7.5-9	wet, brown, gravel, sand, silt
	12.5-14	saturated, brown, sand, gravel
	17.5-19	saturated, dark gray, fine to medium sand
T-117-SB-2	0-1.5	wet, mottled brown, gravel, silt, sand, roots, coal fragments
	2.5-4	moist, mottled brown, gravel, silt, sand, roots
	5-6.5	damp, mottled brown, gravel, silt, sand
	7.5-9	slough in spoon, as above
	12.5-14	slough in spoon, as above
	17.5-19	6in of gray silt, grading to saturated dark gray fine to medium sand
T-117-SB-3	0-1.5	damp, brown, gravel, sand, silt, brick fragments
	2.5-4	upper 12in as above, lower 6in dark gray, fine to medium sand
	5-6.5	moist, gray, gravel, sand, trace of silt, asphalt fragments
	7.5-9	moist, brown, gravel, silt, sand, crushed rock
	12.5-14	wet, dark gray, silt, fine sand
	17.5-19	saturated, dark dray, silt, fine sand
T-117-SB-4	0-1.5	damp, gray, gravel, sand, trace of silt
	2.5-4	crushed rock, shattered gravel
	5-6.5	moist, mottled brown, silt, sand, peat, roofing felt
	7.5-9	wet, dark gray, fine sand, silt, oil in root casts
	12.5-14	saturated, dark gray, fine to medium sand, silt
	17.5-19	saturated, dark gray, fine to medium sand

LOCATION	CORE INTERVAL (ft)	SOIL CHARACTERISTICS
T-117-SB-5	0-1.5	moist, brown, silt, sand, organic matter, roots
	2.5-4	moist, brown, gravel, silt, sand, organic matter
	5-6.5	wet, gray, fine sand, silt
	7.5-9	wet, gray, silt, fine sand
	12.5-14	saturated, gray, silt, fine sand
	17.5-19	saturated, gray, fine sand
T-117-SB-6	0-1.5	hard tar and organic matter at surface, brown, gravel, silt, sand
	2.5-4	damp, mottled brown, gravel, silt, sand
	5-6.5	moist, mottled brown, gravel, silt, sand, brick fragments
	7.5-9	brick fragments
	12.5-14	saturated, gray, fine sand, silt
	17.5-19	saturated, gray, silt, fine sand, organic matter
Supplemental Sampling March 2003		
T-117-SB-7	0-1.5	brown, silt, medium and coarse sand, organic matter (roots and twigs) brick and asphalt pieces
T-117-SB-8	0-1.5	brown, silt, medium and coarse sand, gravel, organic matter, asphalt pieces
T-117-SB-9	0-1.5	brown, silt, medium and coarse sand, gravel, organic matter, asphalt pieces
T-117-SB-10	0-1.5	brown, silt, coarse sand, organic matter, asphalt pieces
T-117-SB-11	0-1.5	brown, silt, medium and coarse sand, organic matter
T-117-SB-12	0-1.5	brown, silt, medium and coarse sand, gravel, organic matter
T-117-SB-13	0-1.5	brown, gray, silt, coarse sand, gravel, organic matter
T-117-SB-14	0-1.5	brown, silt, coarse sand, gravel, organic matter

na — not applicable

4.2.2 Physical analysis results

Table 4-7 presents grain size and percent moisture analyses for sediment and soil samples. Specific gravity analysis results are also presented for sediment core samples. The results confirm the observations recorded in Tables 4-5 and 4-6. All sediment and soil samples, except for the roadway and catch basin 4 and 6 were analyzed for percent solids and TOC. These results can be found in Appendix D. The raw laboratory results for grain size and geotechnical data are presented in Appendix E.

Table 4-7. Sediment grain size results

SAMPLE NUMBER	% GRAVEL	% SAND	% SILT	% CLAY	% FINES[a]	SPECIFIC GRAVITY	% MOISTURE CONTENT
Surface sediment[b]							
T-117-SE08-SG	< 0.1	75.3	19.4	5.3	24.7	no data	48.8
T-117-SE21-SG	25.6	51.8	19.6	3.0	22.6	no data	37.6
T-117-SE25-SG	9.5	75.9	11.2	3.5	14.7	no data	35.3
T-117-SE37-SG	13.3	67.8	15.9	3.0	18.9	no data	34.4
T-117-SE45-SG	5.7	66.1	22.1	6.1	28.2	no data	41.2
T-117-SE84-SG	0.6	85.1	10.7	3.5	14.2	no data	no data
T-117-SE85-SG	0.3	17.1	64.5	18.1	82.6	no data	no data

Sample Number	% Gravel	% Sand	% Silt	% Clay	% Fines[a]	Specific Gravity	% Moisture Content
T-117-SE86-SG	5.2	15.3	60.5	18.8	79.3	no data	no data
T-117-SE89-SG	0.2	91.3	5.6	2.8	8.4	no data	no data
T-117-SE91-SG	0.2	16.2	65.6	18.1	83.7	no data	no data
T-117-SE93-SG	0.6	22.0	61.6	16.0	77.6	no data	no data
T-117-SE95-SG[e]	0.2	90.9	5.9	2.9	8.8	no data	no data
Subsurface sediment[c]							
T-117-SE15-SC-12	1.7	32.5	53.4	12.3	65.7	no data	81.6
T-117-SE15-SC-12[d]	1.9	33.1	52.6	12.3	64.9	no data	no data
T-117-SE15-SC-12[d]	2.6	32.4	52.2	12.8	65.0	no data	no data
T-117-SE15-SC-68	< 0.1	51.4	40.8	7.9	48.7	no data	54.8
T-117-SE16-SC-68	< 0.1	39.6	50.1	10.3	60.4	no data	55.3
T-117-SE30-SC-24	0.1	99.3	0.1	0.4	0.5	2.69	25.7
T-117-SE30-SC-68	< 0.1	72.5	24.3	3.3	27.6	no data	41.1
T-117-SE31-SC-24	0.5	36.6	54.6	8.3	62.9	2.64	59.3
T-117-SE31-SC-68	< 0.1	8.1	61.9	29.8	91.7	2.63	50.1
T-117-SE35-SC-46	0.1	51.7	38.6	9.5	48.1	no data	60.0
T-117-SE36-SC-68	0.1	73.4	22.8	3.7	26.5	no data	36.3
T-117-SE37-SC-24	< 0.1	94.2	4.7	1.0	5.7	no data	32.8
T-117-SE37-SC-68	< 0.1	96.6	2.5	1.0	3.5	no data	29.1
T-117-SE89-SC-02	0.5	42.9	45.5	11.0	56.5	no data	no data
T-117-SE89-SC-02[d]	1.0	42.6	45.5	10.9	56.4	no data	no data
T-117-SE89-SC-02[d]	1.5	41.9	45.6	11.1	56.7	no data	no data
T-117-SE91-SC-02	0	14.6	71.3	14.3	85.6	no data	no data
T-117-SE93-SC-02	0	23.4	63.1	13.4	76.5	no data	no data
Soil[c]							
T-117-CB1-SU	0.1U	72.9	24.6	2.5	27.1	no data	37.4
T-117-CB1-SU-D[e]	0.1U	70.5	26.9	2.6	29.5	no data	35.2
T-117-CB5	12.5	67.9	12.7	6.9	19.6	no data	38.5
T-117-DS1	4.0	74.4	16.2	5.4	21.6	no data	166
T-117-DS2	0.8	75.7	20.0	3.5	23.5	no data	117
T-117-SB1-01	17.3	75.7	0.1U	0.1U	0.1U	no data	13.3
T-117-SB1-03	25.8	68.3	0.1U	0.1U	0.1U	no data	10.1
T-117-SB3-01	18.6	74.8	0.1U	0.1U	0.1U	no data	9.6
T-117-SB4-04	0.1U	1.1	64.5	34.4	98.9	no data	39.3
T-117-SB6-03	14.4	56.9	0.1U	0.1U	0.1U	no data	13.3
T-117-SB6-05	0.1U	2.6	54.5	42.9	97.4	no data	52.3

[a] percent fines is calculated as the sum of percent silt and percent clay

[b] analyzed by ASTM method D-2217/D-422

[c] analyzed by PSEP method

[d] lab duplicate and/or triplicate

[e] field duplicate

U – undetected value

4.3 Sediment Chemistry Results

4.3.1 Surface sediment

4.3.1.1 PCBs

Table 4-8 presents the total PCB results compared to SMS for the individual surface sediment grab samples, the composite sample and the field duplicates. The PCB concentrations for the initial surface grab samples are shown on Figure 4-1 and the supplemental grab samples are on Figure 4-2.

Table 4-8. Total PCB surface sediment results compared to SMS

Location	Sample ID	Total PCBs (µg/kg dw)	Total PCBs (mg/kg-OC)	Q	SQS EF	CSL EF
Initial Sampling December 2003						
T-117-SE-07-G	T-117-SE07-SG	87	2.7		0.23	0.042
T-117-SE-08-G	T-117-SE08-SG	1,000	**45**		3.8	0.70
T-117-SE-10-G	T-117-SE10-SG	1,200	**60**		5.0	0.92
T-117-SE-13-G	T-117-SE13-SG	870	**31**		2.6	0.48
T-117-SE-15-G	T-117-SE15-SG	132	5.7		0.48	0.088
T-117-SE-16-G	T-117-SE16-SG	2,800	***160***		13	2.4
T-117-SE-17-G	T-117-SE17-SG	12,000	***550***		45	8.4
T-117-SE-18-G	T-117-SE18-SG	5,900	***350***		29	5.3
T-117-SE-19-G	T-117-SE19-SG	270	**23**	J	1.9	0.35
T-117-SE-20-G	T-117-SE20-SG	1,300	***100***		8.3	1.5
T-117-SE-21-G	T-117-SE21-SG	38,000	***2,200***		186	34
T-117-SE-22-G	T-117-SE22-SG	16,000	***890***		74	14
T-117-SE-23-G	T-117-SE23-SG	80	4.7		0.39	0.072
T-117-SE-24-G	T-117-SE24-SG	3,500	***230***		19	3.6
T-117-SE-25-G	T-117-SE25-SG	4,000	***290***		24	4.4
T-117-SE-26-G	T-117-SE26-SG	1,900	***110***		9.3	1.7
T-117-SE-27-G	T-117-SE27-SG	83	4.6		0.38	0.071
T-117-SE-28-G	T-117-SE28-SG	910	***76***		6.3	1.2
T-117-SE-29-G	T-117-SE29-SG	170	6.5		0.54	0.10
	T-117-SE52-SG[a]	102	4.3		0.36	0.066
T-117-SE-30-G	T-117-SE30-SG	320	**19**		1.6	0.29
T-117-SE-31-G	T-117-SE31-SG	3,400	***150***		12	2.3
T-117-SE-32-G	T-117-SE32-SG	250	11		0.95	0.17
T-117-SE-33-G	T-117-SE33-SG	9,400	***310***	J	26	4.8
	T-117-SE60-SG[a]	1,300	***130***		11	2.0
T-117-SE-34-G	T-117-SE34-SG	4,900	***330***		27	5.0
T-117-SE-35-G	T-117-SE35-SG	47	2.1	J	0.18	0.033
T-117-SE-36-G	T-117-SE36-SG	230	10		0.87	0.16
T-117-SE-37-G	T-117-SE37-SG	4,300	***230***		19	3.5
T-117-SE-38-G	T-117-SE38-SG	86	4.8		0.40	0.074

LOCATION	SAMPLE ID	TOTAL PCBS (µg/kg dw)	TOTAL PCBS (mg/kg-OC)	Q	SQS EF	CSL EF
T-117-SE-39-G	T-117-SE39-SG	11,000	***420***		35	6.5
T-117-SE-40-G	T-117-SE40-SG	3,200	***200***		17	3.1
T-117-SE-41-G	T-117-SE41-SG	127	4.5		0.38	0.070
T-117-SE-42-G	T-117-SE42-SG	136	5.9		0.49	0.091
T-117-SE-43-G	T-117-SE43-SG	540	**55**	J	4.6	0.85
T-117-SE-44-G	T-117-SE44-SG	320	**21**		1.8	0.33
T-117-SE-45-G	T-117-SE45-SG	520	**43**	J	3.6	0.66
	T-117-SE53-SG[a]	910	***83***	J	6.9	1.3
T-117-SE-46-G	T-117-SE46-SG	210	**13**		1.1	0.20
T-117-SE-47-G	T-117-SESGComp1	4,000	***170***		14	2.7
Supplemental Sampling						
March 2003						
T-117-SE-73-G	T-117-SE73-SG	263	8.0	J	0.66	0.12
	T-117-SE75-SG[a]	223	7.0		0.58	0.11
T-117-SE-74-G	T-117-SE74-SG	123	4.6		0.38	0.070
June 2003						
T-117-SE-76-G	T-117-SE76-SG	1,400	***77***		6.4	1.2
T-117-SE-77-G	T-117-SE77-SG	1,100	**33**		2.8	0.51
T-117-SE-78-G	T-117-SE78-SG	508	**39**		3.3	0.61
	T-117-SE83-SG[a]	310	9.2	J	0.77	0.14
T-117-SE-79-G	T-117-SE79-SG	150	8.8		0.74	0.14
T-117-SE-80-G	T-117-SE80-SG	143	6.6		0.55	0.10
T-117-SE-81-G	T-117-SE81-SG	400	34		2.8	0.53
T-117-SE-82-G	T-117-SE82-SG	109	4.4		0.37	0.068
September 2003						
T-117-SE-84-G	T-117-SE84-SG	88	7.2		0.60	0.11
T-117-SE-85-G	T-117-SE85-SG	117	3.6		0.30	0.055
T-117-SE-86-G	T-117-SE86-SG	102	3.3		0.28	0.051
T-117-SE-89-G	T-117-SE89-SG	700	***92***		7.7	1.4
	T-117-SE95-SG[a]	620	48		4.0	0.75
T-117-SE-91-G	T-117-SE91-SG	128	4.2		0.35	.065
T-117-SE-93-G	T-117-SE93-SG	203	7.5		0.62	0.12

[a] Field duplicate

SQS – Sediment Quality Standards (12 mg/kg-OC) **bold** indicates SQS exceedance

CSL – Cleanup Screening Level (65 mg/kg-OC) ***bold and italicized*** indicates CSL exceedance

dw – dry weight

OC – carbon normalized

EF – exceedance factor (concentration in mg/kg-OC/SQS [SQS EF] or CSL [CSL EF])

nc – not calculated because %TOC is either $\leq$0.2 or $\geq$5.0%. Dry weight concentration compared to apparent effects threshold (AET) equivalents of SQS (lowest AET: 130 µg/kg dw) and CSL (second lowest AET: 1,000 µg/kg dw).

Q – qualifier J – estimated value U – undetected

4.3.1.2 Polycyclic aromatic hydrocarbons

Fourteen surface sediment samples (T-117- SE08-SG, SE15-SG, SE21-SG, SE25-SG, SE27-SG, SE33-SG, SE36-SG, SE37-SG, SE39-SG, SE40-SG, SE43-SG, SE44-SG, SE45-SG and SE46-SG) were analyzed for PAHs. Sample T-117-SE25-SG exceeded the applicable SQS for three PAHs. Sample T-117-SE37-SG had 13 individual PAH SQS exceedances, 10 of which also exceeded the applicable CSL. Total high-molecular-weight PAHs (HPAHs) in this sample exceeded the SQS, and total low-molecular-weight PAHs (LPAHs) in this sample exceeded both the SQS and CSL. Multiple PAHs were detected in each sample. Detection limits were typical for relatively uncontaminated sediment samples, ranging from 19 to 40 µg/kg dry weight (dw). PAH exceedances are presented in Table 4-9. All PAH data are presented in Appendices D and E.

Table 4-9. Polycyclic aromatic hydrocarbons exceedances in surface sediment

Sample ID	Chemical	µg/kg dw	mg/kg-OC	Q	SQS	CSL	SQS EF	CSL EF
T-117-SE25-SG	Indeno(1,2,3-cd)pyrene	520	**37**		34	88	1.1	0.42
	Acenaphthene	250	**18**	J	16	57	1.1	0.31
	Phenanthrene	1,900	**140**		100	480	1.4	0.29
T-117-SE37-SG	2-Methylnaphthalene	1,400	***74***		38	64	1.9	1.2
	Acenaphthene	3,900	***210***		16	57	13	3.7
	Anthracene	4,300	**230**		220	1,200	1.0	0.19
	Benzo(a)anthracene	8,400	***440***		110	270	4.0	1.6
	Benzo(a)pyrene	7,900	***420***		99	210	4.2	2.0
	Benzo(g,h,i)perylene	1,200	**63**		31	78	2.0	0.81
	Chrysene	7,700	**410**		100	460	4.1	0.89
	Dibenzo(a,h)anthracene	640	***34***		12	33	2.8	1.0
	Dibenzofuran	4,200	***220***		15	58	15	3.8
	Fluoranthene	24,000	***1,260***		160	1,200	7.9	1.1
	Fluorene	5,500	***290***		23	79	13	3.7
	Indeno(1,2,3-cd)pyrene	1,900	***100***		34	88	2.9	1.1
	Phenanthrene	28,000	***1,500***		100	480	15	3.1
	Total HPAHs	85,000	**4,500**		960	5,300	4.7	0.8
	Total LPAHs	43,000	***2,300***		370	780	6.2	2.9

SQS – Sediment Quality Standards (12 mg/kg-OC) **bold** indicates SQS exceedance

CSL – Cleanup Screening Level (65 mg/kg-OC) ***bold and italicized*** indicates CSL exceedance

dw – dry weight

OC – carbon normalized

EF – exceedance factor (concentration in mg/kg-OC/SQS [SQS EF] or CSL [CSL EF])

Q – qualifier J – estimated value

4.3.1.3 Other chemicals

Twelve surface sediment samples (T-117-SE08-SG, SE15-SG, SE21-SG, SE25-SG, SE27-SG, SE33-SG, SE36-SG, SE37-SG, SE39-SG, SE44-SG, SE45-SG, and SE46-SG) were analyzed for eight trace metals: arsenic, cadmium, chromium, copper, lead, mercury, silver and zinc. There were no exceedances of SQS or CSL for metals. Fourteen surface sediment samples (T-117-SE08-SG, SE15-SG, SE21-SG, SE25-SG, SE27-SG, SE33-SG, SE36-SG, SE37-SG, SE39-SG, SE40-SG, SE43-SG, SE44-SG, SE45-SG, and SE46-SG) were analyzed for SVOCs. The hexachlorobenzene detection limit (0.44 mg/kg-OC) for sample T-117-SE21-SG exceeded the SQS. There were no other SVOC exceedances. Sample T-117-SE08-SG was analyzed for TBT. TBT (as ion) was not detected at 5.0 µg/kg dw. Three VOCs were analyzed in fourteen samples: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene. There were no exceedances of SQS or CSL for these compounds. All metal, SVOC, TBT and VOC data are presented in Appendices D and E.

Of the fourteen samples analyzed for metals and SVOCs, five were archived surface sediment samples from locations 15-G, 27-G, 36-G, 44-G and 46-G that were outside the removal boundary to assist in cleanup decisions. There were no exceedances of SQS or CSL for metals or SVOCs in these samples.

4.3.2 Subsurface sediment

Table 4-10 presents the total PCB results for the sediment cores, most of which were divided into six or seven sampling intervals. PCB concentrations for each initial core location are shown on Figure 4-3 and supplemental core locations are on Figure 4-2. Figures T1 through T6 are cross sections from each transect, vertically displaying total PCB concentrations in each core.

Table 4-10. Total PCB subsurface results compared to SMS

LOCATION	SAMPLE ID	DEPTH BELOW MUDLINE (ft)	TOTAL PCBS (µg/kg dw)	TOTAL PCBS (mg/kg-OC)	Q	SQS EF	CSL EF
Initial Sampling December 2003							
T-117-SE-15-SC	T-117-SE15-SC-01	0-1	310	**16**		1.3	0.24
	T-117-SE15-SC-12	1-2	320	**17**		1.4	0.26
	T-117-SE15-SC-24	2-4	216	**15**		1.3	0.23
	T-117-SE49-SC-24[a]	2-4	175	11		0.92	0.17
	T-117-SE15-SC-46	4-6	46	4.6	J	0.38	0.071
	T-117-SE15-SC-68	6-8	130	10		0.83	0.15
	T-117-SE15-SC-810	8-10	104	5.8		0.48	0.089
T-117-SE-16-SC	T-117-SE16-SC-0-0.9	0-0.9	3,400	***200***		17	3.1
	T-117-SE16-SC-0.9-1.3	0.9-1.3	2,900	***140***		12	2.1
	T-117-SE16-SC-1.3-2	1.3-2	590	**42**		3.5	0.65
	T-117-SE16-SC-24	2-4	1,900	***79***		6.6	1.2

LOCATION	SAMPLE ID	DEPTH BELOW MUDLINE (ft)	TOTAL PCBS (µg/kg dw)	TOTAL PCBS (mg/kg-OC)	Q	SQS EF	CSL EF
	T-117-SE16-SC-46	4-6	129	8.6		0.72	0.13
	T-117-SE16-SC-68	6-8	430	**31**		2.6	0.47
	T-117-SE16-SC-810	8-10	69	4.3		0.36	0.066
T-117-SE-17-SC	T-117-SE17-SC-01	0-1	3,700	***200***		16	3.0
	T-117-SE17-SC-12	1-2	3,200	***150***		12	2.2
	T-117-SE17-SC-24	2-4	280	**13**		1.1	0.20
	T-117-SE17-SC-46	4-6	67	8.1		0.67	0.12
	T-117-SE17-SC-68	6-8	100	**13**	J	1.1	0.2
	T-117-SE47-SC-68[a]	6-8	34	6.1		0.51	0.094
	T-117-SE17-SC-810	8-10	20	7.4	U	0.62	0.11
T-117-SE-20-SC	T-117-SE20-SC-01	0-1	2,800	***260***		21	3.9
	T-117-SE20-SC-12	1-2	420	**28**		2.3	0.43
	T-117-SE20-SC-24	2-4	145	**13**		1.1	0.20
	T-117-SE20-SC-46	4-6	60	4.6		0.38	0.071
	T-117-SE20-SC-68	6-8	18	0.78	J	0.065	0.012
	T-117-SE20-SC-810	8-10	118	4.2		0.35	0.065
T-117-SE-21-SC	T-117-SE21-SC-01	0-1	16,000	***760***		63	12
	T-117-SE21-SC-12	1-2	280	**16**		1.3	0.24
	T-117-SE21-SC-24	2-4	20	2.0	U	0.17	0.031
	T-117-SE21-SC-46	4-6	20	1.7	U	0.14	0.026
	T-117-SE21-SC-68	6-8	20	3.2	U	0.26	0.049
	T-117-SE21-SC-810	8-10	20	7.1	U	0.60	0.110
T-117-SE-23-SC	T-117-SE23-SC-01	0-1	51	3.2	J	0.27	0.049
	T-117-SE23-SC-12	1-2	21	1.2		0.097	0.018
	T-117-SE23-SC-24	2-4	158	5.6		0.47	0.087
	T-117-SE23-SC-46	4-6	220	**17**		1.4	0.26
	T-117-SE23-SC-68	6-8	210	12	J	0.97	0.18
	T-117-SE23-SC-810	8-10	68	3.6		0.30	0.055
T-117-SE-24-SC	T-117-SE24-SC-01	0-1	1,300	***110***		9.0	1.7
	T-117-SE24-SC-12	1-2	122	10		0.85	0.16
	T-117-SE24-SC-24	2-4	98	8.9		0.74	0.14
	T-117-SE24-SC-46	4-6	77	3.5		0.29	0.054
	T-117-SE24-SC-68	6-8	68	4.0	J	0.33	0.062
	T-117-SE24-SC-810	8-10	45	3.2	J	0.27	0.049
T-117-SE-25-SC	T-117-SE25-SC-01	0-1	2,000	***260***		22	4.0
	T-117-SE25-SC-12	1-2	380	**19**		1.6	0.29
	T-117-SE25-SC-24	2-4	97	4.6	J	0.38	0.071
	T-117-SE25-SC-46	4-6	64	3.8		0.31	0.058
	T-117-SE25-SC-68	6-8	45	6.1		0.51	0.094

LOCATION	SAMPLE ID	DEPTH BELOW MUDLINE (ft)	TOTAL PCBS (µg/kg dw)	TOTAL PCBS (mg/kg-OC)	Q	SQS EF	CSL EF
	T-117-SE25-SC-810	8-10	19	5.6	U	0.47	0.086
T-117-SE-30-SC	T-117-SE30-SC-01	0-1	990	***83***		6.9	1.3
	T-117-SE30-SC-12	1-2	158	12		1.0	0.19
	T-117-SE30-SC-24	2-4	20	nc	U	0.15	0.02
	T-117-SE30-SC-46	4-6	19	1.9	U	0.16	0.030
	T-117-SE30-SC-68	6-8	19	3.3	U	0.27	0.050
	T-117-SE30-SC-810	8-10	20	2.5	U	0.21	0.038
T-117-SE-31-SC	T-117-SE31-SC-01	0-1	51,000	***2,600***		213	39
	T-117-SE31-SC-12	1-2	26	1.7		0.14	0.027
	T-117-SE31-SC-24	2-4	19	1.5	U	0.12	0.022
	T-117-SE31-SC-46	4-6	19	2.8	U	0.23	0.043
	T-117-SE31-SC-68	6-8	20	2.7	U	0.23	0.042
	T-117-SE31-SC-810	8-10	20	4.0	U	3.0	0.062
	T-117-SE48-SC-810[a]	8-10	19	3.7	U	0.31	0.057
T-117-SE-35-SC	T-117-SE35-SC-01	0-1	135	6.4		0.54	0.099
	T-117-SE35-SC-12	1-2	480	**25**	J	2.1	0.39
	T-117-SE35-SC-24	2-4	920	**46**		3.8	0.71
	T-117-SE50-SC-24[a]	2-4	1140	**48**		4.0	0.74
	T-117-SE35-SC-46	4-6	480	**18**	J	1.5	0.28
	T-117-SE35-SC-68	6-8	210	**14**		1.2	0.22
	T-117-SE35-SC-810	8-10	14	2.2	J	0.18	0.033
T-117-SE-36-SC	T-117-SE36-SC-01	0-1	168	12	J	1.0	0.18
	T-117-SE36-SC-12	1-2	19	3.7	U	0.30	0.056
	T-117-SE36-SC-24	2-4	19	1.6	U	0.13	0.024
	T-117-SE36-SC-46	4-6	19	2.8	U	0.24	0.044
	T-117-SE36-SC-68	6-8	19	1.5	U	0.12	0.022
	T-117-SE36-SC-810	8-10	19	5.0	U	0.42	0.077
T-117-SE-37-SC	T-117-SE37-SC-01	0-1	3,100	***650***		54	9.9
	T-117-SE37-SC-12	1-2	19	4.2	U	0.35	0.065
	T-117-SE37-SC-24	2-4	19	nc	U	0.15	0.019
	T-117-SE37-SC-46	4-6	20	nc	U	0.15	0.02
	T-117-SE37-SC-68	6-8	18	nc	J	0.88	0.16
	T-117-SE37-SC-810	8-10	20	nc	U	0.15	0.020
T-117-SE-42-SC	T-117-SE42-SC-01	0-1	470	**36**		3.0	0.56
	T-117-SE42-SC-12	1-2	47	2.9		0.24	0.045
	T-117-SE42-SC-24	2-4	20	1.4	U	0.12	0.022
	T-117-SE42-SC-46	4-6	19	1.9	U	0.16	0.030
	T-117-SE42-SC-68	6-8	20	3.8	U	0.31	0.058
	T-117-SE51-SC-68 [a]	6-8	20	3.8	U	0.31	0.058

Location	Sample ID	Depth Below Mudline (ft)	Total PCBs (µg/kg dw)	Total PCBs (mg/kg-OC)	Q	SQS EF	CSL EF
	T-117-SE42-SC-810	8-10	19	3.9	U	0.32	0.060
T-117-SE-43-SC	T-117-SE43-SC-0-0.3	0-0.3	310	**63**		5.3	0.97
	T-117-SE43-SC-0.3-1	0.3-1	20	4.1	U	0.34	0.063
	T-117-SE43-SC-12	1-2	19	7.6	U	0.63	0.12
	T-117-SE43-SC-24	2-4	19	4.0	U	0.33	0.061
	T-117-SE43-SC-46	4-6	20	3.6	U	0.30	0.055
	T-117-SE43-SC-68	6-8	19	2.9	U	0.24	0.045
	T-117-SE43-SC-810	8-10	19	3.8	U	0.32	0.058
Supplemental Sampling							
March 2003							
T-117-SE-70-SC	T-117-SE70-SC-0-0.5	0-0.5	34,000	***1,400***		120	22
	T-117-SE70-SC-0.5-1	0.5-1	11,000	***550***		46	8.5
	T-117-SE70-SC-12	1-2	1,380	***73***		6.1	1.1
T-117-SE-71-SC	T-117-SE71-SC-01	0-1	730	**56**		4.7	0.86
	T-117-SE71-SC-12	1-2	19	nc	U	0.15	0.019
	T-117-SE71-SC-2-2.7	2-2.7	20	nc	U	0.15	0.020
T-117-SE-72-SC	T-117-SE72-SC-01	0-1	540	**25**		2.0	0.38
	T-117-SE72-SC-12	1-2	1,410	***74***		6.2	1.1
	T-117-SE72-SC-2-2.4	2-2.4	2,200	***110***		9.2	1.7
September 2003							
T-117-SE-89-SC	T-117-SE89-SC-02	0-2	380	**17.1**		1.4	0.26
T-117-SE-91-SC	T-117-SE91-SC-02	0-2	142	5.7		0.47	0.087
T-117-SE-93-SC	T-117-SE93-SC-02	0-2	150	6.2		0.52	0.096

[a] Field duplicate

SQS – Sediment Quality Standards (12 mg/kg-OC) **bold** indicates SQS exceedance

CSL – Cleanup Screening Level (65 mg/kg-OC) ***bold and italicized*** indicates CSL exceedance

dw – dry weight

OC – carbon normalized

EF – exceedance factor (concentration in mg/kg-OC/SQS [SQS EF] or CSL [CSL EF])

Q – qualifier J – estimated value U – undetected

nc – not calculated because %TOC is either ≤0.2 or ≥5.0%. Dry weight concentration compared to AET equivalents of SQS (lowest AET: 130 µg/kg dw) and CSL (second lowest AET: 1,000 µg/kg dw).

Archived core samples from locations 17-SC, 21-SC, 25-SC, 31-SC, and 37-SC within the removal boundary were also analyzed for metals and SVOCs, as specified in the original QAPP (Windward et al. 2003a) and comments made by EPA on the draft data report (Windward et al. 2004b). The top samples (0-1 ft) from the cores previously collected from these locations had total PCB concentrations above the CSL, but concentrations in samples collected at lower depths were at or below the SQS. The archived samples from the 1-2 or 2-4 ft intervals, depending on the location, were analyzed for metals and SVOCs to determine if the vertical extent of contamination is deeper than the top one to two feet for chemicals other than PCBs. At location 17-SC, the total PCB concentration in the 2-4 ft interval (13 mg/kg OC) was slightly above the SQS, so this interval and the interval below it (4-6 ft) were analyzed. The only exceedance of SMS was acenaphthene with a concentration of 29 mg/kg-OC (SQS=16 mg/kg-OC) in core sample T-117-SE-25-SC-24.

4.4 SOIL CHEMISTRY RESULTS

4.4.1 PCBs

Table 4-11 summarizes the PCB results compared to SMS for soil samples collected from two drainage ditches (DS-1 and DS-2) and fourteen soil boring locations. The PCB concentrations for soil boring samples from SB-1 to SB-6 are shown on Figure 4-4 and the supplemental soil sampling results are shown on Figure 4-2.

Table 4-11. Total PCBs in soil samples

LOCATION	SAMPLE ID	DEPTH BELOW GROUND SURFACE (ft)	TOTAL PCBS (µg/kg dw)	TOTAL PCBS (mg/kg-OC)	Q	SQS EF	CSL EF
Initial Sampling December 2003							
T-117-DS-1	T-117-DS1	0-0.5	***2,200***	nc	J	17	2.2
	T-117-DS1-D[a]	0-0.5	***1,600***	nc	J	12	1.6
T-117-DS-2	T-117-DS2	0-0.5	***4,600***	nc		35	4.6
T-117-SB-1	T-117-SB1-01	0-2.5	85,000	***7,100***		590	110
	T-117-SB1-02	2.5-5	33,000	***2,100***		180	32
	T-117-SB1-03	5-7.5	56	1.4		0.12	0.022
	T-117-SB1-04	7.5-10	2,700	***290***		24	4.5
	T-117-SB1-05	10-12.5	130	3.7		0.31	0.057
	T-117-SB1-06	12.5-15	20	nc	U	0.15	0.02
T-117-SB-2	T-117-SB2-01	0-2.5	150,000	***6,300***		530	97
	T-117-SB2-02	2.5-5	120,000	***4,800***		400	74
	T-117-SB2-03	5-7.5	5,600	***920***		77	14
	T-117-SB2-06	12.5-15	33	8.5		0.71	0.13
T-117-SB-3	T-117-SB3-01	0-2.5	29,000	***3,500***		290	54
	T-117-SB3-02	2.5-5	28,000	***3,200***		270	49
	T-117-SB3-03	5-7.5	6,700	***670***		56	10
	T-117-SB3-04	7.5-10	5,600	***680***		57	10
	T-117-SB3-05	10-12.5	19	5.6	U	0.47	0.086
	T-117-SB3-06	12.5-15	20	3.6	U	0.30	0.055
T-117-SB-4	T-117-SB4-01	0-2.5	20	2.4	U	0.20	0.037
	T-117-SB4-02	2.5-5	20	7.1	U	0.59	0.11
	T-117-SB4-03	5-7.5	4,000	***330***		28	5.1

LOCATION	SAMPLE ID	DEPTH BELOW GROUND SURFACE (ft)	TOTAL PCBS (µg/kg dw)	TOTAL PCBS (mg/kg-OC)	Q	SQS EF	CSL EF
	T-117-SB4-04	7.5-10	20	1.8	U	0.15	0.028
	T-117-SB4-05	10-12.5	16	nc	J	0.12	0.016
	T-117-SB4-06	12.5-15	20	nc	U	0.15	0.02
T-117-SB-5	T-117-SB5-01	0-2.5	15,000	***500***		42	7.7
	T-117-SB5-02	2.5-5	6,800	***1,000***		83	15
	T-117-SB5-03	5-7.5	18	6.0	J	0.50	0.092
	T-117-SB5-04	7.5-10	20	2.2	U	0.18	0.034
	T-117-SB5-05	10-12.5	140	**26**		2.2	0.40
	T-117-SB5-06	12.5-15	180	**53**		4.4	0.82
T-117-SB-6	T-117-SB6-01	0-2.5	5,100	***980***		82	15
	T-117-SB6-02	2.5-5	99	7.6		0.63	0.12
	T-117-SB6-03	5-7.5	20	2.9	U	0.24	0.045
	T-117-SB6-05	10-12.5	20	3.6	U	0.30	0.055
	T-117-SB6-06	12.5-15	20	3.6	U	0.30	0.055
Supplemental Sampling March 2003							
T-117-SB-7	T-117-SB7-01	0-1.5	200,000	***10,000***	J	830	150
T-117-SB-8	T-117-SB8-01	0-1.5	15,000	***380***		32	5.9
	T-117-SB15-01[a]	0-1.5	11,000	***370***		31	5.6
T-117-SB-9	T-117-SB9-01	0-1.5	100,000	***4,300***	J	360	67
T-117-SB-10	T-117-SB10-01	0-1.5	100,000	***3,800***	J	320	59
T-117-SB-11	T-117-SB11-01	0-1.5	70,000	***1,600***	J	130	24
T-117-SB-12	T-117-SB12-01	0-1.5	37,000	***1,200***		96	18
T-117-SB-13	T-117-SB13-01	0-1.5	5,000	***250***		21	3.8
T-117-SB-14	T-117-SB14-01	0-1.5	31,000	nc		240	31

[a] Field duplicate

SQS –Sediment Quality Standards (12 mg/kg-OC) **bold** indicates SQS exceedance

CSL – Cleanup Screening Level (65 mg/kg-OC) ***bold and italicized*** indicates CSL exceedance

dw – dry weight; OC – carbon normalized

EF – exceedance factor (concentration in mg/kg-OC/SQS [SQS EF] or CSL [CSL EF])

Q – qualifier J – estimated value U – undetected

nc – not calculated because %TOC is either $\leq$0.2 or $\geq$5.0%. Dry weight concentration compared to AET equivalents of SQS (lowest AET: 130 µg/kg dw) and CSL (second lowest AET: 1,000 µg/kg dw).

4.4.2 Other chemicals

Table 4-12 summarizes the detected exceedances of metals and SVOC results from the two drainage ditch sample locations.

Table 4-12. Detected metals and SVOC results exceeding SMS criteria in ditch samples

Location	Sample ID	Chemical	Result	Unit	SQS	CSL	SQS EF	CSL EF
T-117-DS-1	T-117-DS1	Benzoic acid	***2,000 J***	µg/kg dw	650	650	3.1	3.1
		Benzyl alcohol	***860***	µg/kg dw	57	73	15	12
		Zinc	**454**	mg/kg dw	410	960	1.1	0.47
	T-117-DS1-D[a]	Benzoic acid	***4,500 J***	µg/kg dw	650	650	6.9	6.9
		Benzyl alcohol	***1,000***	µg/kg dw	57	73	18	14
		Zinc	**430**	mg/kg dw	410	960	1.0	0.45
T-117-DS-2	T-117-DS2	Benzoic acid	***1,300***	µg/kg dw	650	650	2.0	2.0
		Benzyl alcohol	***190***	µg/kg dw	57	73	3.3	2.6

[a] Field duplicate

SQS – Sediment Quality Standard **bold** indicates SQS exceedance

CSL – Cleanup Screening Level ***bold and italicized*** indicates CSL exceedance

dw – dry weight

EF – Exceedance factor (concentration/SQS [SQS EF] or CSL [CSL EF])

J – Estimated value

Thirty-three soil boring samples were analyzed for PAHs. Two soil boring samples, T-117-SB-4-03 and T-117-SB-3-02, had elevated PAH concentrations above the SQS or CSL criteria (Table 4-13).

Table 4-13. PAHs in soil borings exceeding SMS criteria

Chemical	T-117-SB4-03	T-117-SB3-02	Unit	SQS	CSL
Acenaphthene	16	**25**	mg/kg-OC	16	57
Acenaphthylene	***100***	3.0	mg/kg-OC	66	66
Benzo(a)anthracene	**180**	**180**	mg/kg-OC	110	270
Benzo(a)pyrene	***320***	**180**	mg/kg-OC	99	210
Benzo(g,h,i)perylene	***92***	***83***	mg/kg-OC	31	78
Benzofluoranthenes (total-calculated)	***760***	**350**	mg/kg-OC	230	450
Chrysene	**330**	**220**	mg/kg-OC	100	460
Dibenzo(a,h)anthracene	**33**	**32**	mg/kg-OC	12	33
Dibenzofuran	**39**	13	mg/kg-OC	15	58
Fluoranthene	**780**	**440**	mg/kg-OC	160	1,200
Fluorene	**64**	23	mg/kg-OC	23	79
Indeno(1,2,3-cd)pyrene	***100***	**88**	mg/kg-OC	34	88
Phenanthrene	***750***	**280**	mg/kg-OC	100	480
Total HPAH (calculated)	**3,300**	**1,900**	mg/kg-OC	960	5,300
Total LPAH (calculated)	***1,100***	**430**	mg/kg-OC	370	780

SQS – Sediment Quality Standard bold indicates SQS exceedance

CSL – Cleanup Screening Level bold and italicized indicates CSL exceedance

HPAH – high polycyclic aromatic hydrocarbon; LPAH - low polycyclic aromatic hydrocarbon

OC – carbon normalized

EF – exceedance factor (concentration in mg/kg-OC/SQS [SQS EF] or CSL [CSL EF])

4.5 POTENTIAL UPLAND SOURCE CHEMISTRY RESULTS

4.5.1 Catch basins

Table 4-14 summarizes the PCB results compared to SMS for soil samples collected from the four catch basins. An additional soil sample not proposed in the QAPP, identified as T-117-CB-5-OUT, was collected from the outside margins around catch basin 5 to evaluate if soil from outside of the catch basin was a source to soil within the catch basin. Table 4-15 summarizes the detected exceedances of metals and SVOC results from two catch basin locations. Soil samples from catch basins 4 and 6 were only analyzed for PCBs. The catch basin results are shown on Figures 4-4 and 4-5.

Table 4-14. Total PCBs in catch basin soil samples

LOCATION	SAMPLE ID	TOTAL PCBS (µg/kg dw)	TOTAL PCBS (mg/kg-OC)	Q	SQS EF	CSL EF
Initial Sampling December 2003						
T-117-CB-1	T-117-CB1-SU	2,600	**52**	J	4.3	0.80
	T-117-CB1-SU-D[a]	3,000	***70***	J	5.8	1.1
T-117-CB-5	T-117-CB5	50,000	***1,200***		100	18
	T-117-CB5-OUT	1,400	**33**		2.8	0.51
Roadway Sampling March 2003						
T-117-CB-4	T-117-CB4-SU-01	**620**	nc		4.8	0.62
	T-117-CB4-SU-02[a]	**890**	nc		6.8	0.89
T-117-CB-6	T-117-CB6-SU	**140**	nc		1.1	0.14

[a] Field duplicate

SQS – (Sediment Quality Standards) 12 mg/kg-OC **bold** indicates SQS exceedance

CSL – (Cleanup Screening Level) 65 mg/kg-OC ***bold and italicized*** indicates CSL exceedance

dw – dry weight

OC – carbon normalized

EF – exceedance factor (concentration in mg/kg-OC/SQS [SQS EF] or CSL [CSL EF])

Q – qualifier J – Estimated value

nc – not calculated because no TOC data were collected; dry weight value compared to AET equivalents of SQS (lowest AET: 130 µg/kg dw) and CSL (second lowest AET: 1,000 µg/kg dw).

Table 4-15. Detected metals and SVOC results exceeding SMS criteria in catch basin soil samples

Location	Sample ID	Chemical	Result	Unit	SQS	CSL	SQS EF	CSL EF
T-117-CB-1	T-117-CB1-SU	Butyl benzyl phthalate	**44**	mg/kg-OC	4.9	64	9.0	0.69
		Pentachlorophenol	**480 J**	µg/kg dw	360	690	1.3	0.70
		Silver	***26.9***[b]	mg/kg dw	6.1	6.1	4.4	4.4
	T-117-CB1-SU-D[a]	Butyl benzyl phthalate	**56**	mg/kg-OC	4.9	64	11	0.88
		Pentachlorophenol	***3,500 J***	µg/kg dw	360	690	9.7	5.1
		Silver	***27.6***	mg/kg dw	6.1	6.1	4.5	4.5
T-117-CB-5	T-117-CB5	Bis(2-ethylhexyl)phthalate	***280***	mg/kg-OC	47	78	6.0	3.6
	T-117-CB5-OUT	Benzyl alcohol	***87***	µg/kg dw	57	73	1.5	1.2
		Bis(2-ethylhexyl)phthalate	***150***	mg/kg-OC	47	78	3.2	1.9
		Butyl benzyl phthalate	**10**	mg/kg-OC	4.9	64	2.0	0.16
		Zinc	**664**[b] **J**	mg/kg dw	410	960	1.6	0.69

[a] Field duplicate

[b] Result averaged with laboratory duplicate

SQS – Sediment Quality Standard — **bold** indicates SQS exceedance

CSL – Cleanup Screening Level — ***bold and italicized*** indicates CSL exceedance

EF – exceedance factor (concentration divided by applicable SQS or CSL)

J – estimated value

4.5.2 Groundwater and seep water

Groundwater samples were collected from four monitoring wells (MW-2, MW-4, MW-5, and MW-6). These monitoring wells are immediately adjacent to the shoreline bank. Floating product was not observed in the well water during the development, at the initiation and termination of the tidal study, or during purging. No PCBs, PAHs, or other chemicals were detected in monitoring well groundwater samples. During the additional NAPL investigation no product was observed. Water levels in the wells fluctuated as expected, and the monitoring timeframe successfully captured the slack water response in each well to the low tide event in the LDW. NAPL investigation data and calculated plots of tidal fluctuation in the wells are included in Appendix F.

Water samples were collected from three seeps along the shoreline. Seep samples differ from groundwater samples in that they can also include surface sediment that is eroded by the seepage force of the water. Detected seep water chemical results are presented in Table 4-16. Both total and dissolved metal data were collected from the seeps, but only the total metals data are shown because of QA/QC concerns associated with the relatively long period of time that elapsed before samples analyzed for dissolved metals were filtered. No separate-phase product or product sheens were observed in the seep water.

T-117-SW-3 was resampled because it was suspected that the detected PCB results may have been an artifact of the suspended solids in the water sample. The sample was centrifuged and then analyzed resulting in an undetected concentration of 0.033 µg/L.

Table 4-16 Detected seep water sample results

Location	Sample ID	Chemical	Result	Unit
T-117-SW-1	T-117-SW1	copper (total)	0.003 [c]	mg/L
		zinc (total)	0.007	mg/L
T-117-SW-2	T-117-SW2	bis(2-ethylhexyl)phthalate	2.7 J	µg/L
		chromium (total)	0.006	mg/L
		copper (total)	0.002	mg/L
	T-117-SW4 [a]	bis(2-ethylhexyl)phthalate	15 J	µg/L
		chromium (total)	0.006	mg/L
		copper (total)	0.003	mg/L
T-117-SW-3	T-117-SW3	chromium (total)	0.007	mg/L
		copper (total)	0.004	mg/L
		total PCBs (non-centrifuged) [b]	0.94 J	µg/L
		total PCBs (centrifuged) [b]	0.033 U	µg/L

[a] Field duplicate

[b] Based on detection of Aroclor 1260

[c] Result averaged with laboratory duplicate

J – estimated value

4.5.3 Roadway soil samples

Six soil samples were collected from the roadway near the south entrance of T-117. This work was performed to further verify the suspected source of elevated soil PCB concentrations observed in and around catch basin 5. The results are presented in Table 4-17. The results were not compared to SQS or CSL criteria because the soils in the roadway do not appear to be a potential source of PCBs to the sediments, so these criteria are not relevant. The PCB concentrations in the roadway samples are shown on Figure 4-5.

Table 4-17. Total PCBs in roadway soil samples

Location	Sample ID	Total PCBs (µg/kg dw)
T-117-RW-01	T-117-RW-01-01	380
T-117-RW-02	T-117-RW-02-01	630
	T-117-RW-02-02[a]	660
T-117-RW-03	T-117-RW-03-01	620
T-117-RW-04	T-117-RW-04-01	330
T-117-RW-05	T-117-RW-05-01	520
T-117-RW-06	T-117-RW-06-01	320

[a] Field duplicate

dw –dry weight

4.6 TIDAL STUDY

A 24-hour tidal study was conducted in the four shoreline wells (MW-02, MW-04, MW-05 and MW-06) and one additional inland well (MW-03). The results of the tidal study were used to determine the appropriate sample time for groundwater wells, as well as a description of how that determination was made. Study data and calculated plots of tidal fluctuation in the wells are included in Appendix G. No discernible product layers that would influence the interpretation of water levels in the wells were observed in the wells.

4.7 SHORELINE ASPHALT MAPPING

Although asphalt and roofing waste materials were prevalent along most of the T-117 EAA shoreline, the more notable masses are presented in Table 4-18 and Figure 4-6. Field notes taken during the shoreline asphalt mapping are found in Appendix B. Photographs can be found in the asphalt mapping photo album on the accompanying CD.

Table 4-18. Location and description of asphalt masses along T-117 shoreline

PHOTO	TIME	NORTHING	EASTING	DESCRIPTION
1	1410	1275596	195180	at DS-1; large metal tank w/asphalt mass; at 5 ft above mud line
2	1422	1275576	195323	asphalt mass under brush; 30ft S of SB5; at 6-8 ft above mud line
3	1426	1275572	195338	small asphalt mass on rip-rap, 15 ft S of SB5; at 7.5 ft above mud line
4	1428	1275569	195355	asphalt, slag-like, 10 ft N of SB5; at 5-9 ft above mud line
5	1430	1275565	195359	asphalt mass, 3 ft N of Item 4; at 1 ft above mud line
6	1431	1275562	195371	large asphalt mass; 12 ft N of Item 5; 11.5 ft wide; at mud line to 9 ft
7	1433	1275542	195410	large, broad shelf of slag/waste roofing product; from 10ft N of Item 6 to 4 ft S of SB4; 33.5 ft wide; at mud line to 9 ft
8	1435	1275539	195419	steel drum at mud line; 17 ft S of SB4
9	1440	1275530	195428	at mud line; multiple 10-20 gal. asphalt masses; dispersed N 36 ft from Item 9
10	1445	1275512	195476	numerous asphalt masses intermixed in rip-rap
11	1447	1275503	195483	asphalt at mud line to 9 ft; 8 ft wide; 49 ft N of SB4
12	1450	1275477	195529	smaller asphalt mass; at 5 ft above mud line; 37 ft S of Seep 1/SB3
13	1452	1275462	195556	asphalt mass, 10 ft wide; at 1-6 ft above mud line; at Seep 1/SB3; held up by failed cribbing
14	1455	1275459	195561	asphalt mass, 3 ft N of Item 13; at 6-8 ft above mud line; 4 ft wide
15	1456	1275448	195562	asphalt mass, 10 ft N of Item 14; 6.5 ft wide; at 3.5-4.5 ft above mud line; sits on old cribbing
16	1458	1275424	195620	asphalt slag; at mud line to 5 ft; sits on old cribbing at/below SB2
17	1502	1275418	195629	roofing shingle and asphalt; 11ft N of Item 16; sits on cribbing; at 4-7 ft above mud line
18	1505	1275414	195637	asphalt slag behind cribbing; 16 ft N of SB2; 14 ft wide; ends at 26 ft S of SB1; at mud line to 8ft
19	1512	1275324	195709	asphalt mass and slag in rip-rap from 25 ft S of SB9 to 13 ft S of SB9; 12 ft wide; at 7-9 ft above mud line

PHOTO	TIME	NORTHING	EASTING	DESCRIPTION
20	1520	1275310	195723	asphalt at SB9; at 4-8 ft above mud line; 10 ft wide to N of SB9; also a crushed drum towards top of asphalt
21	1522	1275301	195729	asphalt mass, 4 ft N of drum and Item 20
22	1525	1275293	195735	asphalt; 4 ft N of Item 21; 3-8 ft above mud line; 6 ft wide
23	1530	1275267	195755	asphalt outcrop; below SB10; at 6-8 ft above mud line; 4 ft wide
24	1531	1275261	195759	asphalt, slag-like, 4 ft N of Item 23; 6-8 ft above mud line; 5 ft wide
25	1532	1275256	195762	asphalt outcrop, 2 ft N of Item 24; 6-8 ft above mud line; 6ft wide
26	1535	1275246	195758	asphalt and slag, also broken, rusted drum, 20 ft S of SB11; 6-8 ft above mud line; 6 ft wide
27	1538	1275241	195759	hose w/pipe halfway up bank; 1 7ft S of SB11
28	1545	1275195	195757	17 ft S of SB12; 3ft wide; at mud line to 6 ft

Datum = Washington State Plane North, NAD83, US survey ft

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6.0 Oversize Figures