Lower Duwamish Waterway
Slip 4 Early Action Area

Summary of Existing Information and Identification of Data Gaps

FINAL

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LIST OF ACRONYMS

cfs	cubic feet per second
CPAH	carcinogenic polycyclic aromatic hydrocarbons
CSL	cleanup screening level
CSCSL	Confirmed and Suspected Contaminated Sites List
CSO	combined sewer overflow
DB	database
DMMP	Dredged Material Management Program
DMMU	Dredged Material Management Unit
DSOA	Duwamish Sediment Other Area
Ecology	Washington Department of Ecology
EE/CA	engineering evaluation/cost analysis
EF	exceedance factor
EOF	emergency overflow
EP	extraction procedure
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FS	feasibility study
GC/FID	gas chromatograph/flame ionization detection
GIS	geographic information system
GTSP	Georgetown Steam Plant
HPAH	high-molecular weight polycyclic aromatic hydrocarbons
IDW	Inverse distance weighting
LAET	lowest apparent effects threshold
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
LPAH	low-molecular weight polycyclic aromatic hydrocarbons
LQG	large quantity generator
LUST	leaking underground storage tank
MCUL	minimum cleanup level
ML	maximum level
MLLW	mean lower low water
MTCA	Model Toxics Control Act
NMFS	National Marine Fisheries Service
NAVD	North American Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PSDDA	Puget Sound Dredged Disposal Analysis
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RM	river mile

SCL	Seattle City Light
SD	storm drain
SMS	sediment management standards
SPU	Seattle Public Utilities
SQS	sediment quality standards
SVOC	semivolatile organic compound
TBT	tributyltin
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TMDL	total maximum daily load
TPH	total petroleum hydrocarbon
TSD	treatment, storage, and disposal
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code
WARM	Washington Ranking Method
WDFW	Washington Department of Fish and Wildlife

1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The Lower Duwamish Waterway (LDW) in Seattle, WA was added to the U.S. Environmental Protection Agency's (EPA) National Priorities List (aka Superfund) in September 2001 because of chemical contaminants in sediments. The key parties involved in the LDW site are the Lower Duwamish Waterway Group (LDWG) (comprised of the City of Seattle, King County, the Port of Seattle, and The Boeing Company), EPA, and Washington Department of Ecology (Ecology). LDWG is conducting the LDW remedial investigation and feasibility study (RI/FS).

The first phase of the LDW RI used existing data to evaluate the nature and extent of chemical distributions in LDW sediments and presented preliminary risk estimates (Windward 2003h). A conceptual site model was developed for the LDW and described in the LDW Phase 1 RI report, Appendices A and B (Windward 2003h). The conceptual site model identifies chemical exposure pathways and possible effects for fish, the invertebrate community, plants, and humans that may come in contact with chemicals associated with sediment in the LDW. A revised conceptual site model will be submitted as part of the Phase 2 RI Work Plan.

Information obtained during the LDW Phase 1 RI was used to identify locations in the LDW that could be candidates for early cleanup action (Windward 2003e,h). Early cleanup action at these early action areas could potentially be implemented on accelerated schedules before completion of the feasibility study and Record of Decision for the LDW Superfund site. Slip 4 was one of the sites recommended by the LDWG as a candidate early action area (Figure 1-1).

Work at the Slip 4 Early Action Area is being conducted under Tasks 9 and 10 of the existing Administrative Order on Consent Statement of Work for the LDW, and per the requirements of the Slip 4 Work Plan (SEA 2003a). Two LDWG members are performing this work: the City of Seattle and King County.

This report, *Summary of Existing Information and Identification of Data Gaps*, fulfills the requirements of Task 1 of the Slip 4 Work Plan. The major objective of this report is to fully document existing environmental conditions in and adjacent to Slip 4. Data compiled in this report are limited to Slip 4, adjoining properties, and discharges to the slip. The existing sediment data have been compared to relevant regulatory criteria and guidelines, as appropriate. The report also identifies critical data gaps that will need to be addressed during site characterization and prior to possible remediation of the Slip 4 Early Action Area.

1.2 REPORT ORGANIZATION

This report presents the results of the Slip 4 data compilation and includes tabulated, mapped, and narrative summaries of the existing data in eight sections and four appendices. A series of geographic information system (GIS) maps, using both line drawings and aerial photographs as the base, supplement the information.

Section 2 describes the physical setting surrounding Slip 4 (i.e., terrain, buildings, and other structures) and the slip's configuration with respect to the Duwamish River. Currents and circulation, water depths, and dredging history are also discussed in this section. Section 3 discusses potential sources of chemicals resulting from existing land uses and practices, historical uses, groundwater, discharges (drains and outfalls), and spills. This section includes information on current upland property owners and operators and environmental investigations and cleanups on adjoining properties. Water quality is discussed in Section 4, and sediment quality (including sediment chemistry, toxicity, and tissue chemistry) is discussed in Section 5. Section 6 discusses natural resources in Slip 4, including special aquatic sites and threatened and endangered species. Human uses are described in Section 7. Data gaps and additional information that will need to be collected before the proposed cleanup boundary can be determined are identified in Section 8.

All figures and tables in this report are presented in separate sections following the report text. Aerial photographs and fire insurance maps are presented in Appendices A and B, respectively. The chemical data are contained in Appendix C. Finally, vertical distributions of selected chemicals are provided in Appendix D.

2.0 PHYSICAL ENVIRONMENT

Slip 4 is located approximately 2.8 miles [river mile (RM) 2.8] from the mouth of the Duwamish River on the east bank of the river. The slip itself is an arc-shaped portion of a pre-channelized Duwamish River meander. It is approximately 1,400 feet long, with an average width of 200 feet. The slip encompasses approximately 5.7 acres.

The physical setting of Slip 4 is depicted in Figures 2-1 through 2-3, which represent the most recent available spatial data. The Early Action Study Area depicted in Figure 2-1 and other figures in this report shows the general study area; the actual boundary of the area will be determined in the future following further investigation. Sources of information and the dates in which the spatial data were generated are provided in Table 2-1. No new data were collected as part of this existing information summary to describe Slip 4's physical features.

The coordinate system for all GIS figures presented in this report is Washington State Plane, North Zone (North American Datum of 1983, 1991 adjustment). The Seattle area shoreline is represented by the mean high water line[1]. The mean high water (MHW) shoreline data were obtained from the Seattle Public Utilities' (SPU) and King County GIS databases[2]. The property boundaries and taxpayer labels shown in Figure 2-1, and many other figures provided in this report, were derived from the Seattle Public Utilities' (SPU) GIS database. Parcels, upland contours, water, transportation, and utility features were exported from the SPU/City of Seattle GIS database in July 2002. The date of the last update for parcels is unknown and not documented in the metadata. Property owners in the near vicinity of Slip 4 include Crowley Marine Services, Inc. (herein referred to as Crowley), King County, First South Properties, and The Boeing Company. Slip 4 is owned by Pacific Terminals, a wholly-owned subsidiary of Crowley Maritime Corporation, and Boeing.

2.1 STRUCTURES

Structures in and adjacent to Slip 4 are shown in Figures 2-1 and 2-2. The most obvious structure in Slip 4 is Crowley's dock and berthing area along the northwestern shoreline, identified as the 8^{th} Avenue Terminal. This berthing area is made of concrete pilings with a concrete platform that extends over the water (see aerial photos in Appendix A). Barges visible in an aerial photo taken in 1999 are shown in Figure 2-1 to demonstrate how they are tied to the dock for loading and offloading. The berthing area at the mouth of Slip 4 appears to serve as the main transfer point. No other docks exist in Slip 4.

No buildings extend over the shoreline in Slip 4. In fact, the only buildings within 100 feet of the shoreline are two small structures located on Crowley's property and a small

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[1] The difference between mean high water and mean higher high water in Seattle is slightly less than 1 foot (0.86 feet) (USACE 2003).

[2] King County reports that their GIS waterbody data layer, including shoreline, was created in a 1997 joint project between Ecology and King County Water and Land Division from an initial source coverage of the standard WA Dept. of Natural Resources hydrography layer.

building on the southern perimeter of the First South Properties parcel. Larger buildings on Crowley's property are located over 200 feet from the slip in the northern portion of their parcel. A building owned by King County is located on East Marginal Way South approximately 150 feet from the head of Slip 4, and The Boeing Company's Building 2-122 (a building over 600 feet long) is located approximately 275 feet from the slip's southeastern shore.

Five public outfalls, including storm drains and emergency sewer overflows, are located at the head of Slip 4 (see Figure 3-1). These discharges are described in greater detail in Section 3.4. Additional private outfalls and storm drains are also located along the slip shoreline.

A bulkhead made of wooden pilings is located along a portion of the First South Properties' shoreline. The bulkhead appears to be old construction based on site visits in 2000 and 2003. The top of the bulkhead is "fenced" with large concrete blocks that would prevent debris from the adjacent lot from depositing into the slip.

Structures extending over the Duwamish River outside of Slip 4 are also shown in Figure 2-1. Docks with facilities to load and unload barges are found across the river from Slip 4 [Hurlen Construction and Morton Marine (Silver Bay Logging)]. Additional outfalls to the Duwamish River are also located in the vicinity of Slip 4 (see Figure 3-1).

2.2 BATHYMETRY

David Evans and Associates performed a bathymetric survey of the LDW, including Slip 4, in 2003 for the LDWG. The results of this 2003 survey are shown in Figure 2-3.

The slip is relatively shallow, ranging from +5.0 feet mean lower low water (MLLW) in depth at the head of the slip to approximately –20 feet MLLW at the mouth. The shallowest depths occur at the head and along the southeastern shoreline where the bottom relief gradually slopes to the current and historical dredging boundary located approximately halfway across the slip. At low tide, bottom sediments are exposed at the head and along the southeastern shoreline. In areas of historical dredging along the northern shoreline and in the eastern half of the slip, water depths range from –5 to –13 feet MLLW. In 1996, Crowley dredged the area shown in Figure 2-3 to a uniform depth of –17 feet MLLW (PTI 1995b).

2.3 DREDGING HISTORY

Most major dredge and fill operations in the Duwamish River occurred in the early 1900s. Beginning in 1895, the original meandering river was channelized to create the Duwamish Waterway. At the same time, parts of the original river and adjacent intertidal areas were filled with dredged sediment to form uplands. Slip 4 is a remnant of a meander in the original course of the river that was filled in 1918.

Dredge and fill operations in the Duwamish are conducted by the U.S. Army Corps of Engineers (USACE), Port of Seattle, and private landowners, and are regulated by the

USACE and other Dredged Material Management Program (DMMP) agencies. Information on dredging activity in Slip 4 was obtained from USACE permit records, DMMP suitability decisions, and various reports (PTI 1995a,b; Harper-Owes 1983; Tetra Tech 1988a). A chronology of permitted dredging projects in Slip 4 and nearby areas is shown in Table 2-2. Figure 2-4 shows the most recent dredging locations.

There are records of only two dredging projects in Slip 4. Both projects were conducted on the northwest side of the slip where dredging was required during wharf construction and to maintain access by ocean-going barges and tugboats during loading and unloading at the cargo terminal. The first project was conducted in 1981 by Marine Power and Equipment Company, Inc. They received a permit to dredge approximately 85,000 yd^3 of sandy silt from the western side of Slip 4. The target depth was –15 feet MLLW; post-dredging inspections confirmed a bottom depth elevation of –15.2 feet MLLW. The material was disposed of at the Four Mile Rock disposal site in Elliott Bay. In 1996, Crowley (who purchased the Marine Power and Equipment property in the early 1990s) again dredged the northwest side of Slip 4. Approximately 13,000 yd^3 of sediment were removed, resulting in post-dredge bottom depth of –17 feet MLLW. The dredged material was disposed of at the Puget Sound Dredged Disposal Analysis (PSDDA) open-water disposal site in Elliott Bay (approximately 3,250 yd^3) and at an upland location (USACE 1996).

Other dredging projects in the vicinity of Slip 4 include periodic maintenance dredging of the federal navigation channel by the USACE and dredging by private landowners on the west side of the river. The navigation channel adjacent to Slip 4 was last dredged by the USACE in 1978. On the west side of the river, opposite Slip 4, dredging projects were conducted at three different facilities between 1973 and 1999. These projects are also listed in Table 2-2, and locations are shown in Figure 2-4.

2.4 BANK ELEVATIONS AND SLOPES

Current bank and upland elevation contours were derived from orthophotos collected in 1993 and used as part of the Pathways Project Groundwater database (Figure 2-1). Based on this information, bank elevations range from +8 feet to between +14 feet and +16 feet (NAVD88). The bank slope is almost vertical under Crowley's pier and at a bulkhead located at First South Properties, and steeply sloping at the head of Slip 4 and along the Boeing shoreline.

The basic configuration of the Slip 4 shoreline has not been substantially altered since at least 1936. The primary shoreline alterations over the last 60 years have been construction of retaining walls with some infilling, bulkheads, and docks. Shoreline changes are shown in aerial photographs dating from 1936 to present (see Appendix A).

Bank alterations included the following.

<u>Southeast shoreline (currently First South Properties)</u>

- Late 1940s – bulkhead (approximately 300 feet long) constructed at approximately high water line

- By 1969 – retaining wall with infill constructed; original bulkhead extended

<u>Southwest shoreline (Boeing)</u>

- Between 1946 and 1960 - riprap placed along bank and road constructed at top of bank
- Early 1990s – removal of road and construction of pedestrian walkway and vegetated areas accompanied by placement of additional fill material along bank

<u>Northwest shoreline (currently Crowley)</u>

- Between 1946 and 1960 – filling near head of slip
- 1982 – construction of extensive pier and berthing area along most of shoreline.

2.5 CURRENTS AND CIRCULATION

Circulation in Slip 4 is influenced primarily by general circulation patterns in the Duwamish Waterway and secondarily by slip geometry. Surface water and groundwater discharge volumes to Slip 4 are relatively small compared to river input. Stormwater discharge can likely have intermittent and short-term effects on circulation depending on the magnitude and duration of the discharge and river and tidal stages. No information on specific circulation patterns, exchange times, or salinity data for Slip 4 was found during this review. However, there have been numerous hydrologic studies in the Duwamish Waterway, and general circulation patterns and characteristics in the vicinity of Slip 4 are described in this section. Additional information on river-wide hydrology has been described in Windward (2003h).

The lower reach of the Duwamish Waterway is a classic saltwater wedge estuary with a lower layer of nearly undiluted seawater moving upstream from Puget Sound and a surface layer of riverine fresh water mixed with saltwater. The estuary is tidally influenced from its mouth extending upriver to near the Black River convergence (RM12.1). The extent of saltwater intrusion varies from around the East Marginal Way bridge to Tukwila (RM 7.1 to 9.2) (Figure 1-1), depending on tidal stage and freshwater discharge volume. The farthest upriver section of nearly undiluted seawater (saltwater wedge toe) is consistently found at least as far up-channel as the South Park bridge (aka 16th Avenue South bridge), but can extend past the East Marginal Way Bridge during low river discharges in the summer (Figure 1-1) (USACE 1983). The saltwater wedge is present in the vicinity of Slip 4 throughout the year.

Where the waterway is stratified, the fresh water remains mostly in the upper 5 to 15 feet of the water column, but the thickness of this surface layer depends on freshwater inflow (King County 1999). There is virtually no mixing of fresh water downward into the saltwater layer; saltwater is mixed upward into the overriding freshwater layer, which becomes progressively more saline toward the mouth of the river (King County 1999, Booth and Herman 1998).

Tidal effects primarily control the water elevation in the Duwamish Waterway (King County 1999). The flow of fresh water in the Duwamish is primarily controlled by release at the Howard Hanson Dam and diversions from the Green River. Peak freshwater discharges generally occur, as a result of seasonal precipitation, from December through February, and secondary peaks occur during spring snowmelt, with lowest flow rates in August (Weston 1996). Flow rates vary from a maximum of 12,000 cubic feet per second (cfs) to a low of 195 cfs, with an average flow of 1,500 cfs (USACE 1983).

Circulation in the Duwamish Waterway is controlled by freshwater inflow and tidal action. In general, on a rising tide, water in both the bottom saltwater wedge and surface layer flows upstream. On a falling tide, the flow is downstream. Although water moves upstream and downstream with the tides, circulation in the vicinity of Slip 4 consists of a net downstream flow in the surface layer and a net upstream flow in the salt wedge layer (King County 1999). As the fresh water travels downstream, it mixes with the saltwater wedge (beginning at about RM 5.5) and becomes more saline, but in the vicinity of Slip 4 the waterway generally remains stratified with a distinct freshwater/low salinity surface layer overlying a saltwater bottom layer. Maximum stratification is observed during periods of high freshwater flow, but the lower waterway can become partially mixed during periods of low flow.

Flushing time (i.e., the average length of time for water to move through the estuary) in the Duwamish Waterway depends on river discharge and tidal exchange. When river flow is low and tidal exchange is at a minimum, the flushing time increases. The U.S. Geological Survey estimated that the average travel time for surface waters from RM 12.3 to the mouth is about 40 to 55 hours (USACE 1983).

2.6 SEDIMENT TRANSPORT

Sediment transport is influenced by many variables, including circulation, sediment loading from upland sources, channel morphology, and resuspension (e.g., propeller scour, dredging) (Windward 2003f). No detailed sediment transport or deposition studies have been conducted in Slip 4. Sediment transport studies in the lower Duwamish River were described by Windward (2003h) and are briefly summarized below.

Studies indicate that the lower Duwamish River is a net depositional environment, although sediment erosion and transport may still occur on a local scale. The greatest sediment accumulation is in the navigation channel. Upstream inputs to the lower river dominate sediment inputs. Hydrodynamics within the river, specifically the location of the salt wedge, control the location of bedload deposition in the river. Most of the suspended sediment from the upper river typically deposits in the vicinity of Turning Basin 3 (RM 4.7), upriver from Slip 4 (Harper-Owes 1983). Much of the finer fractions that remain suspended are transported out of the river in the surface layer. Currently, the USACE focuses its maintenance dredging on the upper channel (upstream of South Park bridge (aka 16th Avenue bridge) and Turning Basin 3. This reduces sedimentation in the lower reaches of the navigation channel (SEA 1999). The navigation channel outside Slip 4 has not been dredged since 1978. Deposition or erosion on the intertidal and shallow subtidal benches outside the navigation channel appears to be limited to minor changes in elevation (Windward 2003h).

Sediment transport in the Lower Duwamish Waterway was evaluated by McLaren and Ren (1994) using sediment trend analysis. They found that the navigation channel was generally subject to net deposition or in dynamic equilibrium. They suggested that fine sediment appeared to have a net residual transport downstream in the lower portions of the waterway (from Harbor Island to Slip 2), but there could be net upstream transport of fine-grained sediment particles from Slip 3 to Turning Basin 3. However, McLaren and Ren (1994) acknowledged that results from the upstream portion of the waterway should be viewed as preliminary because of limited numbers of samples and difficulties in interpretation. Furthermore, there are no other empirical data to confirm the model developed by McLaren and Ren (Windward 2003h). King County (1999) developed a hydrodynamic and chemical fate and transport model for the Duwamish River and collected extensive hydrodynamic and chemical data. Their results also indicated that the tidal wedge could provide some net transport of sediment upstream.

Stormwater and river input are sources of sediment to Slip 4; atmospheric and tidal contributions are comparatively minor. The McLaren and Ren (1994) study included three sediment samples collected in Slip 4. McLaren and Ren suggested a net transport of fine-grained material from the river into Slip 4. Historically, there has been localized sediment input from stormwater via the storm drain discharges at the head of Slip 4, although stormwater controls in recent years have likely decreased sediment inputs from these sources.

Soil erosion from upland areas is also a potential source of sediment, but is limited due to the large amount of paved upland area (over 75% impervious surface). The unpaved area at First South Properties is relatively flat, reducing soil erosion and transport in runoff to Slip 4. The only unpaved areas at Boeing Plant 2 are the park and landscaped areas. Vegetation along the top of the bank also acts to reduce soil erosion from the upland area. Exposed bank soils are present at the head of the slip and along the First South Properties shoreline and eroding soil from these areas likely enters Slip 4. However, over two-thirds of the Slip 4 bank is riprap or bulkhead and erosion and soil transport from these protected banks are minimal.

Several studies have estimated sediment accumulation rates in the lower Duwamish River (Windward 2003h). Average rates vary widely over the lower river, with highest values (up to approximately 100 cm/yr) reported at the turning basin declining to 1 – 50 cm/yr throughout rest of the lower river (Harper-Owes 1983). Windward (2003h) reported that approximately 0.3 meters of sediment accumulated in the navigation channel downstream of Slip 4 (RM 2.6 – 2.7) between 1967 and 1970; almost 0. 6 meters of sediment accumulated between 1971 and 1974. These accumulation rates yield an annual sediment accumulation rate of 10 to 15 cm/yr. Windward (2003h) also reported that annual sediment accumulation rates for the navigation channel between Slip 2 and the South Park bridge (aka 16th Avenue Bridge) (RM 1.7 to RM 3.4) are 10 – 25 cm/yr. Sediment accumulation in the navigation channel near Slip 4 is low enough that the navigation channel has not been dredged since 1978.

In Slip 4, Tetra Tech (1988c) estimated a minimum sediment accumulation rate of 0.8 cm/yr based on PCB concentrations in subsurface sediments. However, this estimate was based on very limited data and numerous assumptions, and may be less than the actual sedimentation rate. Crowley dredging records indicate that between the 1981 and 1996 dredging events approximately 1 to 1.5 feet of sediment accumulated in the center of the berthing area, converting to an estimated sediment accumulation rate of 2 - 3 cm/yr. However, this would be an overestimate if dredging created a depositional zone.

3.0 POTENTIAL SOURCES OF CHEMICALS

Sediments in Slip 4 have accumulated chemical contaminants from numerous sources, both potentially ongoing and historical. These chemicals entered the slip in different ways, either through direct discharges, inadvertent spills, bank erosion, groundwater seepage, surface water runoff, atmospheric deposition, or other non-point discharges. In an effort to identify potential sources of chemicals to Slip 4, this section discusses current and historical land uses and summarizes the results of various environmental investigations and cleanups on properties adjacent to the slip. Other potential point and non-point sources, such as discharges, groundwater seepage, and spills, are also discussed.

3.1 CURRENT LAND USE

Land use and property ownership information was compiled for upland properties immediately adjacent to Slip 4. These properties are currently owned by Crowley Marine Services, First South Properties, King County, and The Boeing Company (Figure 2-1).

Property ownership information was obtained from SPU GIS data and King County tax records. A title search on adjoining properties was conducted by EPA (Booz Allen Hamilton 2001). Current land use information was obtained from existing reports and inferred from a site visit in summer 2003, aerial photographs, Ecology databases, and existing GIS maps. The Ecology online databases were searched for information on current National Pollutant Discharge Elimination System (NPDES) permit numbers, underground storage tanks (USTs), leaking underground storage tank (LUST) release incidents, hazardous waste generator identification, and for inclusion of the property on the Washington Confirmed and Suspected Contaminated Sites List (CSCSL). Table 3-1 summarizes the results of this search.

3.1.1 Crowley Marine Services

A dock and berthing facility currently owned and operated by Crowley dominates Slip 4's northwestern shoreline (see Figures 2-1 and 2-2). The upland terminal is currently used for cargo container storage. Barges are routinely tied along Crowley's berth, but the major transfer point of cargo appears to be located at the mouth of Slip 4. The majority of Crowley's facility between the berth and 8th Avenue is paved, with only the area adjacent to East Marginal Way South remaining unpaved. In addition to Crowley, Northland Services (Northland) and Samson Tug and Barge Company, Inc. (Samson) are current operators at the property. These two companies provide barge line service between Seattle and Alaska, transporting containerized break-bulk and equipment. Northland also provides stevedoring services to other transportation companies (including Crowley and Samson).

Northland operates a cargo transfer facility and is named on the NPDES stormwater discharge permit for the site (SO3003646C; Table 3-1). Samson appears on the list of active hazardous waste generators (ID WAD980981849; Table 3-1). Crowley is an inactive hazardous waste generator.

3.1.2 First South Properties

First South Properties is the current owner of the land northeast of the slip; their ownership does not include any sediments in Slip 4. The property is currently occupied by Emerald Services and is being used to store portable toilets, storage tanks and containers, and large construction hauling/recycling containers and dumpsters (Figure 2-2). This parcel is partially paved. A trailer serves as an onsite office for the facility. One small building is located along the southern fence line that borders Boeing, but no information is available that describes this building's current use.

According to Emerald Services personnel, the facility (also known as Emerald Services' Webster Street facility) is currently used only for storage and dispatch, and no hazardous materials are handled at this site (Emerald Services 2003). However, Ecology lists the site as an active large quantity generator (LQG) (LQG ID WAD058364647), indicating the facility generates more than 2,200 lbs (1,000 kg) per month of hazardous waste (Ecology 2003a). The 2002 Dangerous Waste Annual Report Verification Form submitted to Ecology by Emerald Services lists 55 gallons of consolidated paint as the dangerous waste handled at the facility (Emerald Services 2002). According to the report, this waste was shipped offsite to the Emerald Services facility in Tacoma, Washington. The report also notified Ecology that the site now qualifies as a medium quantity generator as a result of decreasing the amount of waste generated. According to information in Ecology files, Cedar Grove Composting formerly operated on this property, and an NPDES permit (SO3002641) for stormwater discharge remains on file (Table 3-1). The property also appears on Ecology's list of USTs, under the name of Evergreen Marine Leasing (former owner), as a result of the in-place closure of two former USTs on the parcel (Table 3-1). It is not known whether these two closed-in-place tanks were included in the five USTs later removed from the parcel, as discussed in Section 3.2.3 below; however, Hart Crowser did note that one of the USTs had been partially filled with soil in a possible attempt to close it in place (Hart Crowser 1991).

3.1.3 King County

King County owns a small property and building northeast of First South Properties on East Marginal Way South. The building is a pump station associated with the Elliott Bay Interceptor (the sewer main running along the Duwamish to the West Point Treatment Plant). The pump station was built in 1966 and has operated since that time. There is an emergency overflow from the pump station to Slip 4 (Figure 3-1).

3.1.4 Boeing Plant 2

The Boeing Plant 2 facility occupies 107 contiguous acres between East Marginal Way South and the Duwamish River (Weston 1998a), on the southeastern side of the slip. Although much of the facility is used for storage, 12 buildings are used for manufacturing aluminum alloy, steel alloy, and titanium alloy parts for airplanes (Weston 1998a). Building 2-122 is located adjacent to Slip 4. This building was built in the early 1990s to house the Integrated Aircraft Systems Laboratory (Boeing 1993). An aerial photo from 1990 shows a large Boeing building situated next to the river with paved parking between the building and East Marginal Way South. The aerial photo taken in 1999 shows the riverside building removed, the new building situated in the center of the old parking area, and considerable landscaping incorporated with new parking surrounding the new building. The grounds between the parking area and Slip 4 now include public walking trails and trees. In addition, Weston (1998a) reported a single-family residence located on Webster Street northeast of Building 2-122. Tax information stored in the GIS identifies Paul F. Euchner as the owner of this dwelling.

The Boeing Plant 2 facility appears in five Ecology databases, as shown in Table 3-1. Plant 2 discharges stormwater under NPDES permit SO3000482D and is a LQG of hazardous waste. Several entries appear for this site on both the UST and LUST lists. Additional information on these tanks is provided in Section 3.2.4. The facility also is included on the CSCSL based on the confirmed releases of metals, petroleum products, halogenated and non-halogenated organic compounds, PCBs, and PAHs to groundwater, surface water, air, and/or soil, and the suspected release of these compounds to sediment. According to the list, the site received a Washington Ranking Method (WARM) rating of 1 (greatest assessed risk to human health and the environment) out of 5 (lowest assessed risk), and is undergoing an independent remedial action. It is also subject to an Administrative Order under RCRA. Work under that order is ongoing.

3.2 HISTORICAL USES AND ENVIRONMENTAL INVESTIGATIONS

The Duwamish River was a meandering lowland stream until the late 1890s when dredging and construction in the East and West waterways began. By 1918, the Duwamish River was established in its present course, and Slip 4 was preserved as a remnant of a meander (Weston 1998a). The following history of Slip 4 and the adjacent uplands is based on a review of Sanborn fire insurance maps (1929, 1949, and 1966), aerial photographs (Walker & Associates 1936, 1946, 1960, 1969, 1980, 1985, 1990, 1999, and 2002), and documents obtained from Seattle City Light (SCL) and Ecology. Aerial photographs are provided in Appendix A, and Sanborn fire insurance maps are provided in Appendix B. Historical information is also provided for the Georgetown Steam Plant (GTSP) because this facility discharged cooling water to Slip 4 and was identified by EPA as a potential source of chemicals to the slip (Tetra Tech 1988a, EPA 2003).

Many of the reports, maps, and letters reviewed for this report reference three parcel boundaries in the context of historic ownership and property transfers around Slip 4. Parcels D and F border the northwestern shoreline, currently owned by Crowley, and Parcel E constitutes the property currently owned by First South Properties. These former parcel boundaries are referenced in the following discussion to be consistent with the historic investigations. The locations of Parcels D, E and F are shown in Figures 3-2 through 3-4.

3.2.1 Crowley Marine Services

A site assessment of the Crowley property noted that an electric trolley bridge rounded the west side of this property in 1904 (Hart Crowser 1989a). The remaining area was vacant. Sanborn maps of 1929 show this site occupied by the Hydraulic Supply Manufacturing Company (Parcel D, mouth of Slip 4), Pankrantz Lumber Company (Parcel D, middle of Slip 4), and the Washington Excelsior and Manufacturing Company (Parcel F, head of Slip 4) (Sanborn 1929, Appendix B). (Parcel locations are shown in Figures 3-2 and 3-3.) The history of each parcel that currently constitutes Crowley's property is described below.

3.2.1.1 Parcel D

Land Use History

In 1929, the southern portion of Crowley's property was occupied by the Hydraulic Supply Manufacturing Company, a manufacturer of pipes, tanks, and perhaps hydraulic parts or equipment (Sanborn 1929). At the time, the factory consisted of a main manufacturing building and a pipe-dipping vat located between this building and the slip (Slip 4 was called Duwamish River Slough at this time). The Sanborn map of 1929 shows a furnace located on the north end of the building apparently used to heat the vat located inside. By 1949, the Hydraulic Supply Manufacturing Company added a chain manufacturing building between the pipe-dipping building and the Duwamish River. From this point to 1971, the buildings associated with this facility changed very little, but by 1980 all structures were demolished, leaving uncovered soil. In the 1985 aerial photo, this area and the area occupied by the lumber company were paved along with the newly constructed dock that currently occupies the northwestern shoreline of Slip 4. Aerial photographs from 1980 and 1985 show what appears to be a loading ramp near the Crowley dock on the northern side of Slip 4. This ramp does not appear in later photographs, but details regarding its demolition are not known.

The Pankrantz Lumber Company was a large facility occupying the northern half of Parcel D. The Sanborn map (1929) identifies a large lumberyard, sawmill, refuse burner, boiler, and planar on the site. In the 1936 aerial photo, logs were rafted inside Slip 4 prior to being processed at the lumber mill. Lumber was stacked west of the buildings. A rail system with a working crane transported lumber between the storage area and the slip, and a train rail spur extended from East Marginal Way South into the northern end of the facility. By 1946, all buildings once associated with Pankrantz Lumber were demolished, and the 1946 aerial photo shows the site covered with poles. The poles appear to have no bark or staining, which is often associated with treated wood. Logs were rafted and bundled in Slip 4. The Sanborn map of 1949 identifies the area as a pole yard, and a long steel shed is located adjacent to the main building of the Hydraulic Supply Manufacturing Company. In the northwest corner of the former Pankrantz property, a small building is labeled as the Puget Timber Company, and a pole-dipping tank is located at the terminus of the train rail spur. In a 1960 aerial photo there is no evidence of the pole-dipping tank, and a building occupies the site. Logs were still bundled and floating along the northwestern shoreline of Slip 4 in this photo. On the 1966 Sanborn map, the Puget Timber Company is no longer shown, and a steel culvert manufacturing company is located in its place. By 1969 (Walker 1969), the area once occupied by Pankrantz Lumber was almost vacant, and the lot remained vacant to at least 1980. By 1985, this area was paved as part of Crowley's container storage facility.

Environmental Investigations and Cleanups

Several investigations to assess conditions resulting from past site uses occurred at Parcel D from 1988 through 1990. Three site assessments were conducted prior to property transfer, and these reports provide information on site conditions at the time they were performed. Although Landau (1990) estimated soil remediation volumes and costs, no record of any cleanup activities at Parcel D was located in Ecology files.

The following investigative reports were reviewed:

- *Environmental Assessment – Parcel D Soil and Groundwater Conditions, Evergreen Marine Leasing Property, Seattle, Washington* (Hart Crowser, July 20, 1989).

- *Environmental Site Assessment, First Interstate Bank of Washington Property, 7400 8th Avenue South and 7343 East Marginal Way South, Seattle, Washington* (Landau Associates, Inc., June 8, 1990).

- *Supplemental Site Characterization Report, Parcel D, Evergreen Marine Leasing Property, Seattle, Washington* (Hart Crowser, November 15, 1990).

Weston completed a preliminary assessment of environmental conditions at Parcel D in 1988 (Hart Crowser 1989a, Landau 1990). Phase II subsurface soil and groundwater sampling was begun in November 1988 at two locations that were identified in the preliminary assessment as potentially impacted by historical site uses (Hart Crowser 1989a). Initially, five subsurface soil samples were collected from two borings (HC-MW-1A and HC-MW-4 in Figure 3-2), and selectively analyzed for total arsenic, leachability [extraction procedure (EP) toxicity], phenols, pesticides, PCBs, and volatile organic compounds (VOCs).

Total arsenic concentrations ranged up to 1,600 milligrams per kilogram (mg/kg), well above the 2001 Model Toxics Control Act (MTCA) Method A soil cleanup level for industrial properties (20 mg/kg). Arsenic, copper, and zinc were found to be slightly leachable in some samples. Screen analysis using gas chromatograph/flame ionization detection (GC/FID) of samples from one soil boring indicated the presence of some high molecular weight hydrocarbons (expressed as phenanthrene) at 110 parts per million (ppm). No phenols or pesticides were detected. Aroclor 1254 was detected in each of the two samples analyzed for PCBs, at concentrations of 0.220 ppm and 0.5 ppm, below the MTCA Method A level of 10 ppm for capped industrial sites (Hart Crowser 1989a, Ecology 2001). Acetone was the only VOC detected, but it was attributed to laboratory contamination (Hart Crowser 1989a).

Monitoring wells were installed in the subsurface borings, and groundwater samples from these wells were analyzed for dissolved metals, VOCs, semivolatile organic compounds (SVOCs), pesticides, and PCBs (Hart Crowser 1989a). Of the various dissolved metals that were detected, arsenic concentrations detected in HC-MW-1 [0.098 milligrams per liter (mg/L) and 0.099 mg/L, replicate] and the copper concentration in HC-MW-4 (0.005 mg/L) were the only constituent concentrations that exceeded current marine chronic surface water quality criteria (0.036 mg/L and 0.0031 mg/L for arsenic and copper, respectively). Bis(2-ethylhexyl)phthalate was the only SVOC detected, but it was also detected in the method blank and was attributed to sample contamination. No pesticides or PCBs were detected in groundwater (Hart Crowser 1989a).

Additional soil and groundwater sampling was performed in 1989 to delineate the extent of elevated arsenic concentrations in soil and to assess the extent of impact on groundwater quality (Hart Crowser 1989a). Thirty-three additional soil samples were collected in the northwestern portion of the parcel (HC-5 through HC-MW-20), and two additional monitoring wells were installed and sampled in the eastern (HC-MW-19) and western (HC-MW-20) portions of the parcel (Figure 3-2). Analytical results from the soil samples indicated that elevated arsenic concentrations (up to 2,800 mg/kg) in this area were limited to four "hot spots" in a 1-foot-thick layer of soil approximately 2.5 feet below ground surface (bgs). The elevated arsenic is attributed to the past use of the site as a pole-dipping facility that may have utilized arsenic compounds for wood treatment, as corroborated by the presence of wood debris/fibers noted in the samples. It was noted that phenols, which would also be expected in association with wood treatment processes, were not detected, even at low detection limits. Dissolved arsenic was detected in groundwater at 0.007 mg/L, below the marine chronic surface water quality criteria (36 ug/L). Hart Crowser (1989a) concluded that the arsenic hot spots in the area of the former pole-dipping yard were causing small, localized impacts on arsenic in site groundwater, but that migration of the elevated arsenic concentrations to the Duwamish was not significant.

Landau (1990) further investigated the site in April and May 1990 as part of a potential purchase evaluation by Boeing. Soil samples were collected from 14 additional soil borings (indicated by "D" prefixes on Figure 3-2) throughout the site, and were analyzed for VOCs, SVOCs, PCBs, total petroleum hydrocarbons (TPH), chlorinated phenolics, and selected metals. Concentrations of arsenic (up to 1,760 mg/kg), TPH (up to 29,000 mg/kg), carcinogenic PAHs (CPAHs, up to 1,396 mg/kg) and PCBs (up to 2.5 mg/kg) were detected in soil samples. Concentrations exceeded 2001 MTCA Method A soil cleanup levels for industrial properties for arsenic (20 mg/kg), TPH (2,000 mg/kg), and CPAHs (2 mg/kg, relating their toxicity to benzo(a)pyrene). The samples confirmed the localized zone of elevated soil arsenic concentrations identified during the previous Hart Crowser investigation, as well as extensive arsenic contamination in the vicinity of the former pipe-dipping facility and an upland sediment disposal area located in the vicinity of D-MW-6 (Figure 3-2). However, PAH contamination was found to be more extensive than that of arsenic (Landau 1990). An investigation performed in 1992 indicated that the sediment disposal area was in the vicinity of DB6/D-MW-6 and DB-13 (Patmont 1992). No additional information was located regarding the sediment disposal area.

Groundwater samples from three additional monitoring wells installed in the southwestern portion of the site (D-MW-2, D-MW-3, and D-MW-6) were analyzed for VOCs, SVOCs, TPHs, chlorinated phenolics, and selected metals (Landau 1990; Figure 3-2). VOCs, SVOCs, and metals were detected. VOCs consisted of methylene chloride (up to an estimated 1.4 ug/L), acetone (7.0 ug/L), cis-1,2-dichloroethene (1.5 ug/L), ethylbenzene (at an estimated 0.6 ug/L), and total xylenes (at an estimated 0.6 ug/L), There are no aquatic life criteria for these chemicals. Methylene chloride and ethylbenzene concentrations were below their respective surface water quality criteria for the human consumption of aquatic organisms (590 ug/L and 29,000 ug/L, respectively). Twelve SVOCs were detected, but only concentrations of bis(2-ethylhexyl)phthalate (up to 20 ug/L) and chrysene (1.4 ug/L in D-MW-6) exceeded water quality criteria for human consumption of aquatic organisms (2.2 ug/L and 0.018 ug/L, respectively). Bis(2-ethylhexyl)phthalate results were qualified as likely laboratory contamination (Landau 1990). Metals detected include arsenic (up to 0.009 mg/L), copper (0.003 mg/L), and zinc (up to 0.044 mg/L), but none of the detected metals concentrations exceeded marine chronic surface water quality criteria. TPHs were not detected (Landau 1990). Hart Crowser (1990) compared the groundwater and Slip 4 surface sediment data collected by Landau and reported that existing groundwater contaminant discharges from the site did not represent an identified sediment quality or associated ecological concern.

Hart Crowser (1990) conducted additional sampling in August and September 1990 to determine the extent of soils exceeding MTCA cleanup criteria and to characterize site groundwater quality. Forty-three soil samples from 10 borings (HC-101 through HC-110, Figure 3-2) in the southwestern portion of the site were analyzed for arsenic and PAHs. Selected samples were also analyzed for TPH and toxicity characteristic leaching procedure (TCLP). Groundwater samples were collected from seven onsite wells (HC-MW-1A, D-MW-2, D-MW-3, HC-MW-4, D-MW-6, HC-MW-19, and HC-MW-20) and one upgradient well on adjacent Parcel F (FMW-2, see Figure 3-3), and were analyzed for arsenic and PAHs (Hart Crowser 1990).

Concentrations of arsenic (up to 865 mg/kg), total CPAH (up to 83.5 mg/kg), and noncarcinogenic PAHs (up to 210 mg/kg as naphthalene) in the soil samples exceeded MTCA Method A soil cleanup levels for industrial properties. Hart Crowser estimated that approximately 9,000 cubic yards (cy) of soil at the site exceeded MTCA criteria. In groundwater, concentrations of CPAHs (totaling from an estimated concentration of 0.7 ug/L up to 22.6 ug/L) exceeded water quality criteria for human consumption of aquatic organisms (0.018 ug/L for each CPAH constituent) in four wells on the site (D-MW-2, D-MW-3, HC-MW-20, and D-MW-06). No records of soil or groundwater remediation activities resulting from these investigations were found during this review.

3.2.1.2 Parcel F

Land Use History

Hart Crowser (1989b) describes the area once occupied by the Washington Excelsior and Manufacturing Company as being residential in the early 1900s. By 1929, the area was used to store logs (adjacent to East Marginal Way South) and manufacture excelsior, which is fine wood shavings used as packing material. By 1950, the area once used to store logs was occupied by a manufacturer of aluminum windows and sashes (Hart Crowser 1989b). The 1985 aerial photo (Walker 1985) shows that the buildings that once housed the Washington Excelsior and Manufacturing Company have been demolished, leaving uncovered soil for storage. The same is true for the area closest to East Marginal Way South. Only a few buildings are left, and the remainder of the site is used for shipping container storage.

Environmental Investigations and Cleanups

Two investigations occurred at Parcel F from 1988 through 1990 to assess conditions resulting from past site uses. These site assessments were conducted prior to property transfer and reported property conditions that existed at the time they were performed. Although Landau (1990) estimated soil remediation volumes and costs, no record of any cleanup activities at Parcel F was located in Ecology files.

The following investigative reports relevant to Parcel F were reviewed:

- *Environmental Assessment – Parcel F Soil and Groundwater Conditions, Evergreen Marine Leasing Property, Seattle, Washington* (Hart Crowser, March 22, 1989).
- *Environmental Site Assessment, First Interstate Bank of Washington Property, 7400 8th Avenue South and 7343 East Marginal Way South, Seattle, Washington* (Landau Associates, Inc., June 8, 1990).

Hart Crowser (1989b) reported that an 8,000-gallon diesel UST and a 2,000-gallon gasoline UST were removed from the northeastern portion of the property in 1988 (Figure 3-3). Confirmation samples from both tank excavations indicated constituent concentrations in remaining soil were less than MTCA Method A soil cleanup levels for industrial properties.

Hart Crowser (1989b) collected composite soil samples from five areas in the central and eastern portions of the parcel (Figure 3-3). All samples were analyzed for EP toxicity metals, pesticides, and PCBs, and, based on field screening, two selected samples were analyzed for VOCs. The analytical results indicated that zinc, selenium, and cadmium were slightly leachable in some samples. Acetone was detected, but was attributed to laboratory contamination. Other VOCs detected were methylene chloride (8 ug/kg), ethylbenzene (up to 96 ug/kg), toluene (up to 120 ug/kg), and total xylenes (640 ug/kg). All detected VOC constituent concentrations were below MTCA Method A cleanup levels for industrial soils. The pesticide endosulfan I was detected in one sample at 17.7 ug/kg, which is well below the MTCA Method B cleanup level (21,000 mg/kg). Total

PCBs were detected in samples collected beneath two storage sheds, at concentrations of 120 ug/kg and 890 ug/kg, which are below the MTCA Method A soil cleanup level (10,000 ug/kg; Hart Crowser 1989b).

One subsurface soil sample collected from a boring near the center of the investigation area (HC-2; Figure 3-3) was analyzed for leachable (EP toxicity) metals, GC/FID screening for SVOCs, pesticides, and PCBs. Constituent concentrations were below detection limits for all analyses (Hart Crowser 1989b).

Two monitoring wells were installed on the parcel: one in the diesel UST excavation pit, prior to backfilling (MW-1; Figure 3-3), and the other in the subsurface soil boring (HC-2; Hart Crowser 1989b). Groundwater samples from these wells were analyzed for dissolved metals, VOCs, SVOCs, pesticides, and PCBs. Dissolved metals were detected in groundwater at concentrations typical of the Puget Sound region. All metals concentrations were below the marine chronic surface water quality criteria except copper, which was detected above the criterion (0.0031 mg/L) at a concentration of 0.012 mg/L in MW-1. Concentrations of VOCs, SVOCs, pesticides, and PCBs were below detection limits (Hart Crowser 1989b).

Landau (1990) conducted an additional investigation of soil and groundwater quality on Parcel F as part of a potential purchase evaluation investigation by Boeing. Two surface soil samples and 16 subsurface soil samples from five borings were collected for PCB and TPH analyses. The subsurface samples were also analyzed for VOCs, SVOCs, and metals. Several VOCs (up to 240 ug/kg), SVOCs (up to 63,000 ug/kg), and metals (up to 106 mg/kg) were detected in the samples. No constituent concentration exceeded the MTCA cleanup levels for industrial soils, although it should be noted that total chromium was detected at a maximum concentration of 21.4 mg/kg in one sample, which is above the Method A soil cleanup level for industrial properties (19 mg/kg) for hexavalent chromium but below the 2,000 mg/kg cleanup level for trivalent chromium. TPH concentrations were detected in the two surface samples only, at 130,000 mg/kg and 280,000 mg/kg; both these values exceeded MTCA Method A soil cleanup levels (2,000 mg/kg). Landau noted that these samples were collected in areas of visible soil staining that were estimated to include at least 5 cubic yards. PCBs were not detected in any of the samples (Landau 1990).

Landau installed and sampled three monitoring wells on the parcel (FMW1, FMW2, and FMW3). Groundwater samples were analyzed for VOCs, SVOCs, PCBs, TPH, and metals. Pentachlorophenol was detected at an estimated concentration of 1.1 ug/L in one well, below the marine chronic surface water quality criteria value of 3 ug/L. Bis(2-ethylhexyl)phthalate (up to 29 ug/L) and methylene chloride (up to 1.1 ug/L) concentrations were detected, but were qualified as possible sample contamination. All detected concentrations of bis(2-ethylhexyl)phthalate were above the 2.2 ug/L water quality criterion for the human consumption of aquatic organisms. Detected metals included arsenic (up to 0.002 mg/L), chromium (up to 0.011 mg/L), copper (up to 0.007 mg/L), and zinc (up to 0.017 mg/L). As Landau did not indicate analysis for dissolved metals, it is assumed these concentrations reflect total metals. The total copper concentration of 0.007 mg/L in FMW2 exceeded the marine chronic surface water quality criterion of 0.0031 mg/L for dissolved copper. PCB and TPH were not detected (Landau 1990).

Landau (1990) noted that the City of Seattle issued a permit for a 5,000-gallon UST to be installed at the Layrite Concrete facility in 1962. Since neither of the tanks removed from the property match this capacity, it is possible that the 5,000-gallon UST remains onsite. No record of remedial activities performed to address the TPH-contaminated soil or the possible remaining UST at Parcel F was found during this review.

3.2.2 East Marginal Way South

The northeastern end of Slip 4 is currently owned by Crowley Marine Services. It has very little open space available for storage or construction. Railroad tracks that currently run parallel to East Marginal Way South and pass by the head of Slip 4 were also mapped in 1929 (Sanborn 1929). This area is the location for several outfalls, which are described in greater detail in Section 3.4. A billboard is currently located between the head of the slip and the railroad tracks. The only other historic use observed on aerial photographs and Sanborn maps was vehicle parking adjacent to the roadway.

3.2.3 First South Properties

Land Use History

The Washington Machinery and Storage Company occupied the parcel currently owned by First South Properties in 1929 (Sanborn 1929). At that time, a railroad spur extended from East Marginal Way South into this property, parallel to the machine shop. The facility expanded by 1949 to include a separate building that housed an office and apparently a laboratory (Sanborn 1949). Grounds surrounding the machine shop were used to store machinery (Sanborn 1949, Walker 1946). In 1969 maps and photos, the Washington Machinery and Storage Company still appeared to be in operation, and the same buildings existed until the early 1980s. The aerial photo of 1985 shows the office and laboratory building but not the machine shop. By 1990, all buildings associated with the Washington Machinery and Storage Company were completely demolished.

In 1946, a lime plant between the Washington Machinery and Storage Company office and the slip, operated by J.A. Jack and Son(s), appears in aerial photos as an area dusted with white material (Sanborn 1949). A barge located in Slip 4 is shown near the lime plant and tied to a wooden bulkhead built along the southeastern shore of Slip 4 (Walker 1946). A crane-operated bucket loader appears to be moving sand or lime between the barge and adjacent uplands. By 1960, a portion of shoreline north of the loading facility shown in the 1946 photograph appears to have been infilled and bound by a retaining wall. Lime plant operations appear to have continued into the 1960s but had ceased by 1969.

Northwest Precote, Inc., an asphalt plant, was established south of the lime plant and adjacent to Webster Street by 1946 (Walker 1946, Sanborn 1949). Four new tanks were constructed along the waterfront by 1969, apparently associated with the asphalt plant since the lime plant had ceased operation (Walker 1969). The asphalt plant appears to be operating in the aerial photo of 1980, but whether or not the plant is functioning in 1985 is unknown. The circular tanks apparently associated with the asphalt plant in 1969 no longer appear in the aerial photo of 1980. The asphalt plant was demolished by 1990 (Walker 1990). Marine Power and Equipment, Evergreen Marine Leasing, and First South Properties were listed as property owners in the 1980s and 1990s.

The East Marginal Way pump station building was constructed at the terminus of the railroad spur by 1966 (Sanborn 1966). This building remains on the small parcel, which is currently owned by King County. The building located at the corner of Webster Street and Riverside Avenue and abutting the Boeing Company property boundary in the aerial photo of 1946 also still exists in recent aerial photos. The Sanborn map of 1949 identifies the building as a machine shop, but there is no current information available that documents the building as a residence or business. Four circular storage tanks were erected between this building and the slip sometime during the 1990s (Sanborn 1999). There is no information available that describes the use of these tanks.

Ecology files contained a note citing "deposition of dredge spoils from former owner marine leasing" (Ecology 2003b). However, an additional reference to the former use of the property as a wood treatment facility (not consistent with known land use at this property) as well as the parcel identification number, suggest that the entry regarding the deposition of dredged spoils on Parcel E may be in error and may refer to Parcel D (see Section 3.2.1.1).

Environmental Investigations and Cleanups

Several investigations occurred at Parcel E from 1988 through 1996 to assess conditions resulting from past site uses. The initial investigation identified chemical contamination in soils. A number of cleanup actions followed (including soil removal and groundwater monitoring), and these are described in the later reports. Ecology ultimately determined that no further action was required at this property.

The following investigative reports relevant to Parcel E were reviewed:

- *Environmental Site Assessment, First Interstate Bank of Washington Property, 7400 8th Avenue South and 7343 East Marginal Way South, Seattle, Washington* (Landau Associates, Inc., June 8, 1990).
- *Underground Tank Removal and Groundwater/Soil Quality Report, Parcel E, Evergreen Marine Leasing Property, Seattle, Washington* (Hart Crowser, October 22, 1991).
- *Additional Independent Remedial Action Report, Former Evergreen Marine Leasing Property – Parcel E, Seattle, Washington* (Hart Crowser, July 17, 1996).

Following a preliminary groundwater and subsurface soil investigation performed at the parcel by Hart Crowser in March 1989, Landau conducted a more extensive investigation in June 1990 (Hart Crowser 1991). This investigation included the collection of 33 soil samples from 10 of 12 borings (EB1 through EB12) and groundwater samples from the three wells (EMW-1 through E-MW-3), which were submitted for VOCs, SVOCs, PCBs, TPH, and metals analyses. The borings were primarily located in the vicinity of two identified USTs (Landau 1990; Figure 3-4).

Most locations sampled during the Landau investigation were excavated during later remedial activities (Hart Crowser 1991, 1996). In the remaining locations, the maximum detected TPH concentration (2,600 mg/kg) exceeded the Method A soil cleanup level for industrial properties (2,000 mg/kg diesel-range TPH), and detection limits were above 2001 MTCA cleanup levels (2,000 ug/kg for CPAHs, relating their toxicity to benzo(a)pyrene) in one sample. Maximum detected concentrations of cadmium (2.7 mg/kg) and lead (1,190 mg/kg) were slightly above the 2001 Method A soil cleanup level (2.0 mg/kg and 1,000 mg/kg, respectively). The maximum total chromium concentration detected (20.7 mg/kg) exceeded the MTCA level for hexavalent chromium (19.0 mg/kg). No PCBs were detected in the soil samples (Landau 1990).

As Landau (1990) gave no indication of analysis for dissolved metals, groundwater metals results are assumed to reflect total metals. Maximum concentrations of total arsenic (0.093 mg/L), copper (0.132 mg/L), and zinc (0.211 mg/L) detected in groundwater samples exceeded marine chronic surface water quality criteria for dissolved metals (0.036 mg/L, 0.0037 mg/L, and 0.085 mg/L, respectively). Detected concentrations of VOCs and LPAHs were below surface water quality criteria for human consumption of aquatic organisms. No TPH or PCB concentrations were detected in the groundwater samples (Landau 1990).

In 1991, five USTs were excavated and removed from the site, one monitoring well was abandoned (EMW3) and four additional monitoring wells were installed (MW-101 through MW-104; Figure 3-4), and 22 test pit excavations were conducted (Hart Crowser 1991). The five USTs excavated and removed from the parcel included:

- 8,000-gallon diesel tank
- 12,500-gallon buried railroad tank car containing heavy oil
- 1,000-gallon tank thought to contain stove oil
- 2,500-gallon diesel tank
- 1,000-gallon tank containing a soil/oil mixture (possibly a previous attempt to close the tank in place).

The last two tanks were previously not known to exist on the property, but were encountered during the removal of the first three tanks (Hart Crowser 1991).

Approximately 1,500 cy of visibly stained soil and rubble associated with the USTs were excavated from the site and disposed of at permitted or licensed offsite facilities (Hart Crowser 1991). Test pits were installed to assess the horizontal and vertical extent of the petroleum spoil contamination in the UST area and the area associated with the former asphalt plant. Following the UST excavations and test pit sampling, soils onsite contained TPH ranging from less than 10 to 25,000 mg/kg, and TPH concentrations in some areas were above 2001 MTCA Method A cleanup levels (2,000 mg/kg). Hart Crowser (1991) attributed these concentrations to the former practice of applying oils to ground surfaces for dust control and roadway stabilization.

Groundwater from MW-101, MW-102, MW-103, and MW-104 was sampled in October 1990, January 1991, and April 1991, and analyzed for VOCs, SVOCs, and TPHs. Analytical results indicated decreasing concentrations of TPHs and LPAHs and no detected VOC or CPAH concentrations. Hart Crowser (1991) performed an analysis of maximum constituent concentrations detected in groundwater to date. To evaluate potential impacts to Slip 4, Hart Crowser compared all groundwater concentrations from the UST excavation area to calculated worst-case criteria based on MTCA surface water protection criteria and sediment quality criteria. The calculated criteria did not include attenuation, dispersion, or dilution during transport. Hart Crowser determined that TPH and 2-methylnaphthalene concentrations in groundwater exceeded the worst-case criteria. The 2-methylnapthalene exceedance was detected in EMW-3, a former well within the excavated area. They also reported that TPH concentrations were declining and that 2-methylnaphthalene in the downgradient well nearest Slip 4 was below the worst-case criteria (Hart Crowser 1991).

Evergreen Marine Leasing submitted a request for a No Further Action (NFA) determination for the site to Ecology in the fall of 1994, but Ecology determined further remedial action was required (Marten & Brown 1997). Beginning in 1996, additional remedial excavations of TPH-contaminated soils were performed in accordance with Ecology’s recommendations (Marten & Brown 1997; Hart Crowser 1996). MW-102 was excavated during these activities and replaced with MW-102A (Hart Crowser 1996). Pending required monitoring of groundwater TPH concentrations, maintenance of the site, and the filing of a Restrictive Covenant for the site, the NFA for the TPH-diesel release was granted in 1997 (Ecology 1997). Groundwater data (from MW-101, MW-102A, and MW-103; Figure 3-4) demonstrating compliance with the NFA requirements was determined complete by Ecology in 1998 (Ecology 1998b).

3.2.4 The Boeing Company Plant 2

Land Use History

As mentioned in Section 3.1, Boeing Plant 2 occupies land southeast of Slip 4. This historical discussion includes only the northern portion of Plant 2 located next to Slip 4. In early aerial photos (up to 1946), this area was residential, looking similar to residential neighborhoods located directly across the Duwamish River. In the 1936 aerial photo, only one residence was built on the Slip 4 shoreline, and some residences appear to have small orchards and gardens that may have been used for producing small cash crops. In the aerial photo of 1946, the residence previously noted on Slip 4 was razed, and the area adjacent to the shoreline does not appear to be used. By 1960, the Boeing Company razed all homes within Boeing property boundaries shown in the photo of 1946 and built a large building (Building 2-01) immediately adjacent to Slip 4 and the Duwamish River. Parking lots fill the remaining area.

Building 2-01 contained a dangerous waste sump regulated as a Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal (TSD) unit (Figure 3-5). The dangerous waste sump was located in the center of the north end of Building 2-01. This sump was constructed in 1980 to collect various fluids used during cleaning and repair of landing gear assemblies from large aircraft, including hydraulic fluid that was drained out of and pumped into the landing gear mechanisms over the sump (Ecology Undated; CH2M Hill 1991). Generally, wastes stored in the sump were a mixture of water, oils, and nonhalogenated solvents. The materials accumulated in the sump until a sufficient amount had collected for pickup and offsite disposal by a licensed waste handler. The maximum capacity of the sump based on construction drawings was approximately 1,000 gallons; the maximum single-pickup volume of waste received for disposal on December 6, 1988 by the licensed waste handler was 950 gallons. Based on available information, there are no reports of water or fluids discharging from the sump. Unit drawings included in CH2M Hill (1991) do not show any drainage connections leading from the sump, including any connection to either of the two existing 24-inch Boeing outfalls to Slip 4.

A chemistry laboratory was located in the southwest portion of Building 2-01, and a small solvent storage building (Building 2-02) was located immediately northwest of Building 2-01 at the mouth of Slip 4. This configuration did not change until the early 1990s when, as noted in the previous section, buildings 2-01 and 2-02 were removed, and Building 2-122 was built within the footprint of Building 2-01 and the historic parking area. Landscaped parking and grounds now surround Building 2-122 and offer walking trails adjacent to the river. As of 1990, four outfalls discharged to Slip 4 from floor drains and roof drains in Building 2-01 and from the parking lot and streets east of the building (Figure 3-6). Boeing storm drain maps also show an outfall from Building 2-02 to Slip 4.

Eighteen underground tanks appear on Ecology database records for Plant 2; three are operational, seven have been removed, and eight are exempt from regulation per WAC 173-360-110, as they are apparently waste oil tanks used for heating (Ecology 2003d). Three UST releases have been reported; soil is the only media considered impacted in each case (not groundwater), based on information Ecology (2003c) has received. Ecology received a cleanup report for release #4073, and this release is reported cleaned up. No other information is available for this release. Ecology also has a cleanup report for release #2667 that occurred from a 10,000-gallon heating oil tank, but the spill status remains “cleanup started.” No cleanup report is on record at Ecology regarding release #1719 that involved a former 1,000-gallon gasoline UST that once held kerosene (Ecology 2003c).

Environmental Investigations and Cleanups

Several investigations occurred at the north end of Boeing Plant 2 from 1990 through 1994 to assess conditions resulting from past site uses and to document soil removal and cleanup actions. The following investigative reports were reviewed:

- *Phase II Subsurface Environmental Assessment, Proposed Integrated Aircraft Systems Laboratory Building, Seattle, Washington* (Weston, October, 1990).
- *Supporting Documentation for Engineer's Certification of Closure, Boeing Plant II, 2-01 Building Dangerous Waste Sump* (CH2M Hill, December 1991).
- *Leaking Underground Storage Tank Investigation, Proposed Integrated Aircraft System Laboratory Construction Site, Plant II, Seattle, Washington* (Weston, January 1992).
- *Release Assessment, Boeing—Plant 2, Seattle/Tukwila, Washington* (Weston, March 1994).

Weston (1990) performed a preconstruction environmental assessment of soil and groundwater around the perimeter of the former Building 2-01 at the north end of Plant 2 adjacent to Slip 4. The assessment was performed prior to demolition of the building, which occurred in spring of 1991, to characterize subsurface environmental conditions for construction of the 2-122 and 2-123 buildings. One surface soil sample, 36 subsurface soil samples from 21 soil borings, and groundwater samples were collected from six push-probe borings (B-20, B-27, B-28, B-31, B-33, and B-34; Figure 3-5).

The soil samples were selectively analyzed for VOCs, PAHs, SVOCs, pesticides/PCBs, TPH, and RCRA metals; groundwater samples were analyzed for VOCs, unfiltered metals, and oil and grease. Four of the soil borings and three of the push-probe groundwater stations were located along the north side of the former building in the vicinity of the shoreline of Slip 4 (Figure 3-5). One composite surface soil sample that was collected adjacent to electrical transformers near the southeast corner of Building 2-01 contained 14 mg/kg PCBs (Aroclor data not available). This PCB concentration exceeded the 2001 MTCA Method A soil cleanup level of 10 ppm for capped industrial sites (Weston 1990).

In subsurface soil, acetone (up to 190 ug/kg), 2-butanone (up to 34 ug/kg), 111-trichloroethane (up to 6 ug/kg), and trichloroethene (up to 9 ug/kg) were the only VOCs detected; all were below their 2001 MTCA Method A cleanup levels. Several PAHs were detected in subsurface soil at individual concentrations ranging from 71 to 28,000 ug/kg. In the seven subsurface soil samples analyzed for BNAs, di-n-octylphthalate (up to 200 ug/kg), naphthalene (28,000 ug/kg) and methylnaphthalene (8,800 ug/kg) were detected, in addition to several PAHs. Only naphthalene and several carcinogenic PAHs in one sample (B-24 located in the parking lot south of the former 2-01 building) exceeded the 2001 MTCA cleanup levels. PCBs were not detected in any of the subsurface soil samples. TPHs were detected in two subsurface soil samples at concentrations up to 103 mg/kg, below the 2001 MTCA cleanup levels. Metals were detected in subsurface soil at concentrations near background, except for copper (310 mg/kg), lead (160 mg/kg), and zinc (220 mg/kg) in one sample. Cadmium in one sample (B-36 near the southeast corner of the former 2-01 building) was the only metal that exceeded the 2001 MTCA Method A soil cleanup level for industrial properties (Weston 1990).

Vinyl chloride (2.0 ug/L) was the only VOC detected in groundwater; the detected concentration was well below the water quality criterion for human consumption of aquatic organisms (530 ug/L). Chromium (up to 11 mg/L), copper (2.7 mg/L), lead (0.7 mg/L), nickel (3.8 mg/L), and zinc (2.4 mg/L) were the only metals detected in groundwater. All of these metals were detected in one or more samples at concentrations that exceeded their respective marine chronic water quality criteria. However, metals concentrations from groundwater samples collected using push-probe sampling methods were typically turbid and were not representative of ambient metals concentrations in groundwater. Oil and grease was detected in several groundwater samples at concentrations ranging from 0.8 to 12 mg/L (Weston 1990).

The dangerous waste sump RCRA TSD unit in Building 2-01 was removed and closed in 1991 (CH2M Hill 1991). The sump was constructed of reinforced concrete and handled materials containing acetone, 2-butanone, toluene, and petroleum hydrocarbons. During closure activities, the dangerous waste sump was steam-cleaned with a detergent solution. Concrete and underlying soils were then sampled for comparison to closure performance standards. PCBs were not analyzed during closure activities. Following demolition of Building 2-01, the sump was demolished, and 343 tons of concrete and associated soil were disposed of at the hazardous waste landfill in Arlington, Oregon. An additional 270 tons of soil were excavated and disposed of at Arlington during three additional rounds of sampling and excavation. The maximum constituent concentrations detected prior to closure were 700 ug/kg for acetone, 31 ug/kg for 2-butanone, 8.3 ug/kg for toluene, and 100 mg/kg for TPH. The final excavation sidewall and floor soil samples were below performance standards: 100 ug/kg for acetone, 100 ug/kg for 2-butanone, 5 ug/kg for toluene, and 25 mg/kg for TPH. Soil and groundwater sampling results from the 1990 preconstruction environmental assessment around Building 2-01 were also used in the closure certification to document clean closure of the sump (CH2M Hill 1991). Ecology approved interim status closure of the Building 2-01 dangerous waste sump in July 1992 (Sellick 1992). The closure of the sump is not referred to as 'final closure', since other dangerous waste management units remain in operation at Plant 2 (CH2M Hill 1991).

Boeing performed a Release Assessment under an Administrative Order on Consent for a 3008(h) RCRA corrective action (Weston 1994). The assessment included an evaluation of groundwater quality data from the north end of Plant 2 in the vicinity of Slip 4, but did not include an evaluation of soil chemical data from the northern portion of Plant 2. In addition to the analytical results summarized above for the push-probe groundwater samples collected from the perimeter of the former 2-01 building, the Release Assessment also summarized data from three monitoring wells that were temporarily installed in the parking lot east of the building in the area now occupied by Building 2-122 (Figure 3-7). The full suite of groundwater analytes is not known. Arsenic (up to 30 mg/L) and chromium (up to 60 mg/L) were detected in unfiltered groundwater samples collected from the wells (Weston 1994). The maximum detected metals concentrations exceeded their respective marine chronic water quality criteria.

A leaking UST was removed in 1991 from an area just outside of the southeast corner of the former 2-01 building (Weston 1992). The 10,000-gallon tank (identified as Tank PL-3) was installed in 1954 to hold bunker C fuel oil. A total of 541 tons of petroleum-contaminated soil was removed from the vicinity of the former UST. The maximum soil TPH concentration measured from the removed material was 16,000 mg/kg of TPH (method WTPH-418.1). Following soil removal, the bottom of the excavation contained soil with a TPH concentration of 420 mg/kg of diesel (method 8015). Additional soil was not removed due to the presence of 1-2 feet of groundwater in the excavation bottom. One soil sample from the excavation was also analyzed for PCBs; no PCB Aroclors were detected. SEA was unable to determine if TPH impacts to groundwater were subsequently addressed.

Boeing is currently conducting a Resource Conservation and Recovery Act (RCRA) corrective action program at Plant 2. All of the RCRA corrective action upland investigation units are located south of Building 2-122 and do not include the redeveloped north end of Plant 2 adjacent to Slip 4. Similarly, the corrective action includes sediments in the Duwamish west of Plant 2 [i.e., Duwamish Sediment Other Area (DSOA)] but does not include sediments in Slip 4. The DSOA boundaries as administratively designed are the south edge of Slip 4 to the north, the Boeing/Jorgenson property line to the south, the approximate top of the eastern slope of the shipping channel, and the mean higher high water line to the east. This area was identified for corrective action based on PCBs in surface and subsurface sediment. PCB cleanup levels have not been established. Boeing proposed a performance-based remedy (Weston 1999a) and studies are continuing (EPA 2001). Data collected by Boeing in this area are included in Section 5 of this report.

3.2.5 Seattle City Light Georgetown Steam Plant Facility

Land Use History

The Seattle Electric Company built the GTSP in 1906. When it was built, the GTSP was located along an oxbow of the Duwamish River. In 1917, the oxbow was filled when the Duwamish River channel was straightened to form the Duwamish Waterway (City of Seattle 2001). At that time, a pumphouse was built to the northwest of Slip 4 to supply cooling water to the GTSP, and a flume measuring 7 feet wide and 5 feet deep was connected to the discharge tunnel to discharge the cooling water to Slip 4 (Bridgewater Group 2000). The location of the GTSP and flume are shown in Figure 3-8.

After Puget Sound Power and Light Company purchased the Seattle Electric Company in 1912, use of the GTSP declined (Bridgewater Group 2000). The City of Seattle Department of Lighting (now SCL) purchased the facility in 1951. In 1952, the Boeing Company leased the property where the flume was located and areas adjacent to the flume. Boeing constructed buildings in the leased area, including a fuel laboratory. Boeing installed storage tanks for fuel and other materials, and constructed various storm drains and cooling water pipes that discharged to the flume beginning as early as 1952 [see Bridgewater (2000) for detailed history of connections to the flume].

In 1961, Boeing requested permission to use an area on the north end of Boeing Field (King County Airport) for fire drill training (Bridgewater Group 2000). In 1963, King County purchased the northwestern portion of the facility property, which included the fire drill training area (also known as the North Boeing Field Fire Training Center), a large concrete oil storage tank, a warehouse, and a machinery shop. In 1967, the City issued Boeing a temporary permit to conduct fire training drills in a second area located approximately 50 feet southeast of the GTSP. This area is also referred to as the “fire training pit.” The fire training pit permit was cancelled in 1974 (Bridgewater Group 2000). The GTSP’s last production run was in the winter of 1964 (Bridgewater Group 2000). The plant was maintained on “cold standby” starting in 1971, and was officially retired in 1977 (City of Seattle 2001). The site was designated a National Historic Mechanical Engineering Landmark in 1980, and a National Historic Landmark and a City of Seattle Landmark in 1984 (Bridgewater Group 2000; City of Seattle 2001). The GTSP has been maintained as a museum since about 1995.

Environmental Investigations and Cleanups

A number of environmental investigations have been conducted at the GTSP and near the flume. Early studies identified chemical contamination in localized areas of the GTSP property and in sediments from the flume and Boeing storm drains that connected to the flume. Contaminated soils and sediments were removed from the site and flume, and sediment in the flume was monitored for a number of years. Additional sampling at the flume and GTSP was conducted in 1998 and 2002, respectively, and confirmed that no further action was required. Both historic and recent results are summarized in Bridgewater Group (2000, 2002). A brief synopsis is provided below. Information on the flume discharge and sampling data is provided in Section 3.4.3.

Site Soil and Sediment Sampling

SCL collected numerous samples at the GTSP in 1984. PCB concentrations in soil samples collected from a low-lying area on the GTSP property contained <0.1 to 91,000 mg/kg PCBs (Raven Systems & Research 1988). This area received runoff from the southeastern portion of the GTSP property and from a drainage ditch leading from the northern portion of Boeing Field, including discharges from the North Boeing Field Fire Training Center. Samples from the ditch contained 0.2 to 8.9 mg/kg PCBs. Composite soil samples collected between the GTSP building and low-lying area contained less than 1.5 mg/kg PCBs. Soil samples under paved areas at North Boeing Field southeast of the low-lying area contained 190 and 223 mg/kg PCBs (Raven Systems & Research 1988). Sediments in North Boeing Field storm drains had PCB concentrations ranging from 8.8 to 580 mg/kg (Thomson 1984). Based on the presence of PCBs, SCL covered the drainage ditch and low-lying area with plastic, and King County diverted surface runoff from northern Boeing Field in order to minimize flow into the ditch and low-lying area (Bridgewater Group 2000). In 1985, SCL conducted a cleanup of the low-lying area (as well as the GTSP discharge tunnel, the flume, and the portion of the Boeing storm drain that was connected to the head of the flume – see Section 3.4.3). Contaminated soils and sediment were removed. Confirmation soil samples from the GTSP low-lying area indicated that PCB concentrations were reduced to 11 mg/kg or less, with most concentrations below 4 mg/kg (Bridgewater Group 2000).

Other investigations in the vicinity of the flume have quantified significantly elevated concentrations of PCBs. A supplemental investigation conducted by Boeing at Building 3-333 found PCBs at concentrations up to 1,600 mg/kg in soils (AGI 1997, 1998a). During subsequent soil removal a broken section of pipe was discovered that may have been connected to floor drains in buildings 3-320 and 3-286 and to a nearby catch basin. The pipe contained a black oily substance that contained 25,300 mg/kg PCBs and 25,500 mg/kg TPH. Remedial activities in the vicinity of Building 3-333 (including the pipe) included soil removal and confirmation sampling. AGI (1998a) reported that PCB and TPH concentrations were below MTCA Method A cleanup levels on three sides of the excavation and in the vicinity of the pipe, but elevated levels remained on the fourth side and on the bottom of the excavation. These areas were reported to be isolated and of limited extent and no further action was taken (AGI 1998a). Sampling during removal of Boeing's oil/water separator UBF-55, located adjacent to the low-lying area described above, contained Aroclors 1248 and 1254 at concentrations up to 1,000 mg/kg and 570 mg/kg, respectively (AGI 1998b). No cleanup activities are described in this report.

GTSP Oil Tanks

SCL conducted sampling at several storage tanks present at the GTSP facility through the 1980s. Oil from the three feed oil USTs that formerly supplied fuel to the boilers was found to contain up to 20 ppm PCBs. The three feed oil USTs were removed in 1989. No PCBs were detected in soils excavated during the tank removal (Bridgewater Group 2000).

According to SCL, oil in a large concrete oil tank northeast of the site contained Aroclor 1260 at concentrations up to 3.4 ppm. This oil tank contained Bunker C fuel oil until May 1987. The large concrete oil tank was demolished in approximately 1988. No PCBs were detected in any of the soil or concrete samples collected in the vicinity of the concrete oil storage tank (Bridgewater Group 2000).

PCBs as Aroclor 1242 were detected in samples from the GTSP diesel tank at 4.3 ppm, and as Aroclor 1260 at 8.7 ppm. No PCBs were detected in soils excavated during the tank removal (Bridgewater Group 2000).

Phase II Environmental Site Assessment

The Bridgewater Group (2002) conducted a Phase II environmental site assessment of the GTSP property on behalf of SCL in 2001. No PCBs were detected in wipe samples taken beneath electrical equipment on the first floor of the GTSP (including the transformers and potheads), electrical equipment on the fifth floor gallery, or beneath the bearing lube oil pump and tank sampled. PCBs were not detected in four of five wipe samples from beneath electrical equipment on the fourth floor gallery, and Aroclor 1248 was detected at 1.1 ug/100 cm^2 in the fifth sample. No visual evidence of migration of dielectric fluid from the fourth floor gallery or boiler room to soil outside the building or to the condenser pit was observed (Bridgewater Group 2002).

PCBs were undetected in soil from the former Greeley Substation, former oil valve shed, and former Boeing fire training area (Bridgewater Group 2002). Total PCBs ranged from 0.18 to 4.3 mg/kg in soils at the scale model railroad.

Three soil samples collected from the former low-lying area were selected for analysis based on field indicators (e.g., discoloration or sheen). None of the total PCB concentrations exceeded the 10 mg/kg 2001 MTCA Method A Soil Cleanup Level for Industrial Properties (Bridgewater Group 2002).

Site Hazard Assessment

In 2001, Ecology and Public Health-Seattle& King County (Thomsen 2002) conducted a site hazard assessment at the GTSP. The site received a WARM rating of 5 out of 5 (lowest level of concern for risk to human health and the environment).

3.3 GROUNDWATER

Information on groundwater characteristics in the vicinity of Slip 4 is contained in two general reports on hydrogeology in the Duwamish basin (Harper-Owes 1985; Booth and Herman 1998). There have also been site-specific investigations at properties adjacent to Slip 4: Boeing Plant 2 (Weston 1998a), Evergreen Marine Leasing (currently Crowley) (Hart Crowser 1989a,b), and First South Properties (Landau 1990).

3.3.1 Hydrogeology

In the vicinity of Slip 4, groundwater is typically encountered within 6 to 10 feet of the ground surface. The entire Duwamish industrial area, including Slip 4, is underlain by a single, large alluvial aquifer system that extends from the water table to a depth of 70 to 80 feet bgs. This upper zone consists of sand and silty sand. It is generally unconfined, although interbedded layers of silt or clay can affect localized areas. Below 80 feet, there is a lower groundwater zone that becomes increasingly silty with clayey layers. These upper and lower groundwater zones are differentiated based on geology, vertical flow gradients, and/or the occurrence of saline groundwater pockets (Booth and Herman 1998).

Groundwater flow in the area is toward the Duwamish Waterway, as would be expected. Localized flow is influenced by the geometry of the Duwamish Waterway, including Slip 4, and by the buried river channel. Hart Crowser (1989a,b) reported that groundwater flow in the immediate vicinity of Slip 4 is directed radially toward the slip at both high and low tides, although there is saltwater intrusion and mixing at high tide when the tide rises above the groundwater elevation. In contrast, Landau (1990) states that groundwater flow is generally toward the slip at low tide (with gradients of 0.003 to 0.007) and away from the slip at high tide (with gradients of 0.001 to 0.003). Groundwater elevation contours and flow directions at both high tide and low tide as developed by Landau (1990) are shown in Figures 3-9a and 3-9b, respectively. Net flow is toward the slip. Groundwater inland of the buried river channel probably flows to the channel and then along it to Slip 4 and the river (Harper-Owes 1985). At North Boeing Field, a slight change in the predominant westward flow of groundwater was attributed to the higher hydraulic conductivity of the fill material in the meander compared to the surrounding native deposits (Landau 1992).

No record of a specific seep survey or reconnaissance in Slip 4 was found during this review. A seep was observed on the southeastern shoreline during a site visit in 2003. However, the source of this seep (e.g., groundwater, tidal) is not known.

Average linear flow velocities at Boeing Plant 2 ranged from 4.2 ft/yr in the lower zone to 25-26 ft/yr in the upper zone. Groundwater discharge rates were also calculated at Boeing Plant 2. Discharge from the upper zones occurred at an average rate of 2,892 ft^3/day (15 gallons per minute [gpm]) and from the lower zones at an estimated average rate of 2,146 ft^3/day (11 gpm), for a total discharge rate of 26 gpm (Weston 1998a).

Groundwater elevations are affected by seasonal changes in precipitation and groundwater recharge. In the Duwamish valley, these water level fluctuations are on the order of 1–2 feet, with lowest levels in late summer. In the vicinity of Slip 4 and along the LDW, the aquifer is also tidally influenced. From the shoreline to about 500 feet from the waterway, tidal cycles can cause several feet of groundwater level fluctuation and result in reversals of groundwater flow direction. The calculated time lag at Boeing Plant 2 was 0 to 4 hours, with wells closest to the waterway having the shortest time lags. Despite these frequent reversals, net groundwater flow in the vicinity is still towards Slip 4. At distances over 700 feet from the waterway, the tidal influence is very small.

Vertical groundwater flow within the upper 30 to 50 feet of the upper aquifer is generally downward, reflecting infiltration and recharge. Flow rates depend on the degree of infiltration (less in areas that are paved), the location and distance relative to the river, and the degree of silt and sand interbedding. Vertical groundwater flow at depths of 60 to 80 feet is upward, from the lower to upper zones. This gradient limits contaminant migration from the upper to lower groundwater zones, as does the lower permeability of the lower zone and salinity gradient (see below).

3.3.2 Groundwater Quality

Groundwater throughout the Duwamish Valley is naturally unsuitable for use as drinking water because of poor water quality. The groundwater is brackish or saline due to mixing with saltwater through both tidal action and the original estuarine deposits. Groundwater use as drinking water is also limited by high concentrations of natural metals (e.g., iron and manganese) that aesthetically limit water use (Duwamish Coalition 1998).

Brackish groundwater conditions are found at wells near the waterway and in the lower groundwater zone. Shallow aquifer conductivities are in the range of 2,000 to 3,000 µmhos/cm near the river. Specific conductivities over 5,000 µmhos/cm were reported in the lower groundwater zone at Boeing Plant 2 (Weston 1998a). Wells nearest the Duwamish have the highest conductivity, reflecting saltwater influence. Because less dense, fresh groundwater tends to migrate above the higher-density saline water, the potential for any shallow groundwater to mix or migrate to lower brackish zones is reduced.

Chemical contaminant concentrations in groundwater are related to local sources. Site-specific groundwater investigations have been conducted on the northwest (Crowley Marine Services/Evergreen Marine Leasing) and southeast sides of Slip 4 (Boeing Plant 2), as discussed in Sections 3.2.1, 3.2.3, and 3.2.4, above. Chemicals exceeding surface water quality criteria in at least one groundwater sample from areas adjacent to Slip 4 included arsenic, copper, zinc, bis(2-ethylhexyl)phthalate and PAHs. Locations of surface water quality criteria exceedances in groundwater at Parcels D, E, and F are shown in Figures 3-10, 3-11, and 3-12, respectively. However, all site-specific investigations concluded that groundwater contaminant migration, with respect to surface water quality, was deemed not significant.

3.4 DISCHARGES

Point source discharges to Slip 4 include private and public storm drains, pump station emergency overflows (EOF), and the GTSP flume. There are currently no direct industrial wastewater discharges to Slip 4 (Ecology 2000). Non-point discharges to Slip 4 include stormwater runoff that is not collected in a piped system and discharges directly to the slip as sheet flow. Groundwater discharge to Slip 4 is discussed in Section 3.3.

Current discharges to Slip 4 are listed in Table 3-2 and described below. Outfall locations based on the SPU (2003) survey are shown on Figure 3-1. This survey included outfalls that were visible at low tide. SPU mapped the outfall locations using GPS and field observations were recorded, but no information on current outfall operation or status (e.g., closed or active) was collected. The East Marginal Pump Station EOF was not located during the field survey, and the location shown in Figure 3-1 is from coordinates provided by King County. Known drainage lines are also shown in Figure 3-1. SPU guarantees accuracy (± 2 feet) on its public rights of way, including drainage lines, but there is no guarantee of drain line accuracy on private property features. For example, private facilities are responsible for (and in early years installed) their own collection systems, and these are not necessarily included in city records or inspections. King County GIS maps provided clarification on sewer line and outfall locations.

Current drainage basins for the publicly-owned outfalls are shown in Figure 3-13. Historic drainage basins are shown in Figure 3-14.

3.4.1 Storm Drains

Information on current and historical storm drains discharging to Slip 4 is provided in the following sections.

3.4.1.1 Existing Storm Drains

Public storm drains collect stormwater runoff from large areas, including roadways and adjacent private property. Public storm drains discharging to Slip 4 serve residential and industrial properties as well as I-5 (Figure 3-13). The following three publicly-owned storm drains discharge to Slip 4:

- **I-5 storm drain (SD).** The I-5 SD, owned by the Washington Department of Transportation, serves a total area of about 120 acres. It drains approximately 1.5 miles of I-5, 40 acres of primarily residential land located east of I-5, and part of the Georgetown neighborhood (including industrial, commercial, and residential areas).

- **Slip 4 SD.** The Slip 4 SD is owned by King County and currently drains approximately 290 acres located on the north end of the King County Airport/Boeing Field.

- **Slip 4 EOF/SD (117).** This EOF/SD is owned by the City of Seattle. Until about 1976, this system functioned as a raw sewage outfall for the far north end of the King County Airport/Boeing Field and the area to the north of the field. It was separated in 1976 and converted to a storm drain. At that time, the drain collected runoff from approximately 90 acres of land at the north end of the airport and also functioned as an emergency overflow for a City sewer pump station (#44) located on Airport Way S. Tetra Tech (1988b) reported that drainage from the Slip 4 EOF/SD was diverted to the Slip 4 SD sometime between 1985 and 1987. It currently conveys stormwater runoff from an area of about 3 acres located at the north end of the King County Airport/Boeing Field and continues to function as an emergency overflow for pump station #44.

Private storm drains discharge runoff collected from specific upland facilities or properties. Adjacent properties owned by Boeing and Crowley are almost entirely impervious surfaces (with the exception of the landscaped areas and park located on the Boeing property). Boeing Plant 2 and at least parts of Crowley are served by private storm drains. The First South Properties site is partially paved and is also served by a private drainage system.

Private outfalls were identified in SPU's 2003 outfall survey. Locations are shown on Figure 3-1 (SPU 2003) and described below:

- Two approximately 24-inch storm drains located on the south side of Slip 4, approximately 170 feet from the mouth of the slip, draining about 17.5 acres of Boeing Company property. Both drains are permitted under the NPDES industrial stormwater program.

- Five 4- to 6-inch outfalls located on the southeast side of Slip 4. All are located between about 700 to 1,000 feet from the mouth of the slip. The area served by these outfalls is uncertain, but they are all located on the First South Properties site. This property is covered by an industrial stormwater permit, but only 3 outfalls to Slip 4 (2 piped and 1 swale), are noted in the permit. The three permitted outfalls serve the western portion of the property adjacent to the slip. The eastern portion of the site drains to the King County interceptor located on East Marginal Way S.

- Six 8-inch outfalls located along the north side of Slip 4. It is not known if these private outfalls are currently active; however, one was observed to be flowing during the May 2003 field survey. The drainage area for these outfalls is unknown, although their location indicates that it is likely the Crowley property.

Point source discharges are regulated under the NPDES program. NPDES permits for stormwater discharge may be issued to individual facilities or to a general type of facility. Private facilities that are currently permitted to discharge stormwater include (Ecology 2000):

- Boeing Plant 2
- Cedar Grove Composting – Webster Yard (Former occupant of property currently owned by First South Properties)
- King County Airport Maintenance Shop (via Slip 4 storm drain)
- North Boeing Field (via Slip 4 storm drain)
- Northland Services 8th Avenue Terminal (Crowley property).

NPDES industrial stormwater permits recently began requiring collection of stormwater monitoring data. Base-level monitoring requirements include measurement of zinc, turbidity, oil and grease, and pH. Additional parameters may also be required. The first monitoring reports were due to Ecology in August 2003. These data may be compiled for Slip 4 dischargers once they become publicly available.

3.4.1.2 Historical Storm Drains

The five publicly-owned outfalls at the head of Slip 4 have been in place for many years, although the areas draining to these outfalls have changed significantly over time. The Georgetown flume was constructed in the early 1900s, and the Slip 4 EOF/SD (117) and Slip 4 SD outfalls are shown on drainage maps dating back to the early 1940s. The East Marginal Way EOF (W034) was installed in 1970 when King County (formerly Metro) constructed the Elliott Bay Interceptor, which conveys wastewater to the West Point treatment plant. The I-5 SD outfall was constructed by Washington Department of Transportation in about 1965. Figure 3-14 shows the approximate historical drainage basin boundaries (pre-1985) for these publicly-owned outfalls. It was generated by combining information from numerous maps dating back to 1944 that show the drainage system layout at various points in time.

Little information on historical private outfalls to Slip 4 was found during this review, and construction dates of the existing private outfalls are unknown.

Storm drain maps (Figure 3-6) show additional roof and parking lot drains discharging to Slip 4 from buildings formerly located at Boeing Plant 2. However, these buildings are no longer present, and the outfalls were not located or recorded in the SPU outfall survey and their current status is unknown.

Ecology files contain plans for a proposed stormwater collection system for the central section of the property currently occupied by First South Properties. Plans for this system indicate that it would include three catch basins and would discharge to a 42-inch storm drain along East Marginal Way South. The existence of this proposed system has not been confirmed. Additional information regarding other existing private drainage systems on the parcels adjacent to Slip 4 is not known.

Numerous facilities historically discharged to the publicly-owned storm drains. Some examples include:

- Parts of Boeing Plant 2 were permitted to connect to the Slip 4 EOF/SD in 1954 (Eaver and Nelson 1954).

- During an inspection in 1985, Metro reported numerous oil/water separators at North Boeing Field discharging to the storm drain. In particular, "the 3-315 building drum storage/oil separator facility, however, appeared to collect drainage from drums of various fuels, oils and solvents, as well as an electrical transformer/capacitor station. It is our understanding that this particular facility most likely connects to the storm sewer…" (Lampe 1985).

- In 1986, an Ecology inspection reported that Famco Transport lacked containment of oil tanks and truck wash areas; storm water from these areas discharged to the storm drain (Ecology 1986).

- A North Boeing Field industrial water discharge survey in 1994 discovered that process water and condensate water (including pump leaks to floor drains and condensate from room heaters and process heat exchangers) were discharging to the storm drain (Babich 1994).

3.4.2 Emergency Pump Station Overflows

Emergency pump station overflows are a type of sewer overflow. Pump stations lift sewage to a location where it can continue to flow downhill to the treatment plant[3]. If there is an equipment or power failure, an overflow route is needed to protect conveyance pipes and pumps from damage. These are called emergency overflows and only occur in the event of a serious system malfunction such as a pump failure or a blocked pipe.

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[3] Sanitary sewer lines in the vicinity of Slip 4 are connected to the West Point publicly-owned treatment plant.

There are two EOFs discharging to Slip 4: the City of Seattle's Slip 4 EOF/SD (117), and King County's East Marginal Way EOF (W034)[4].As explained earlier, the Slip 4 EOF/SD (117) was originally a raw sewage outfall, but was converted to a storm drain outfall in about 1976 after that local sewer line was hooked up to the Elliott Bay Interceptor at pump station #44. It continues to function as an emergency overflow for pump station #44 located on Airport Way South. The pump station is equipped with an emergency generator to ensure pump station operation during power failures. SPU records indicate that this pump station has not overflowed in the past four years (Schmoyer 2004). The East Marginal Way pump station is equipped with auxiliary power and would function only if the conveyance pipes became clogged or during an extreme emergency (e.g., simultaneous power failure and generator failure). There has not been a recorded overflow from this pump station since recordkeeping began in the 1970s.

3.4.3 Flume

The flume was constructed in the early 1900s and consists of both concrete and wooden sections. It begins at an underground concrete discharge tunnel from the condenser pit at the GTSP and extends approximately 0.4 miles to the head of Slip 4. Modifications have been made to the flume over the years to increase useable industrial area, and so parts of the flume have been covered. The following description is based on most recent (1985) SCL drawings, which have not been field-verified.

The head or upstream end of the flume is partially open and partially covered for a distance of approximately 100 feet. This upstream end includes the discharge tunnel that connects to a open concrete section, then to dual underground concrete pipes approximately 400 feet long. These pipes are connected to a short section of open, concrete-lined flume that in turn is connected to an open wooden flume that extends to East Marginal Way South. This open portion is approximately 1,240 feet in length. It meets a concrete header at the edge of East Marginal Way South, then becomes corrugated steel pipe that passes under East Marginal Way South to the outfall at the head of Slip 4.

The 6.5-foot-wide flume is located on property owned by the City of Seattle that varies between 20 and 45 feet in width. Areas adjacent to the flume not used by the City have been leased to Boeing. As industrial development occurred in the area, discharge pipes from adjacent properties and facilities were connected to the flume at numerous locations along its length. These included both permitted (e.g., Boeing cooling water discharge) and unpermitted connections.

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[4] Previous reports (e.g., Tetra Tech 1988a,b) identified the Slip 4 EOF/SD (117) as the Slip 4 CSO/SD (117). Similarly, the East Marginal Way EOF (W034) was identified in previous reports as the East Marginal Pump Station CSO (W034). Because both discharges are emergency pump station overflows rather than actual combined sewer overflows, the nomenclature has been updated in this report.

The flume was originally constructed to discharge cooling water from the GTSP after the river was straightened in 1916. However, over time numerous discharges to the flume from adjacent properties were constructed. These included stormwater, cooling water, and wastewater discharges. A 1984 -1985 survey mapped connections to the flume downstream of the two 42-inch concrete pipes (Geissinger 2003). Some documented examples of connections and uses of the flume include:

- SCL issued a permit to Boeing in 1965 for discharge of 600 gpm of cooling water into the flume (Van Hollebeke 1968). In 1969, Boeing was allowed to discharge an additional 100 gpm of cooling water and received a replacement permit to discharge a total of 700 gpm cooling water into the flume (Henry 1969, Scarvie 1969).

- In 1962, overflow from oil yard drain pit on Boeing property was discharged to flume via 6-inch iron pipe (Bridgewater 2000).

- In 1965, a storm drain from the Boeing property was connected to the head of the flume and discharged to flume until at least mid-1980s. Sampling of this storm drain in 1984 found PCBs up to 520 ppm, and the drain was subsequently cleaned (Raven Systems & Research 1988, Bridgewater 2000).

- Flume was used by Boeing as containment area for a 10,000-gallon methylene chloride tank beginning in 1982 (SCL 1982, Bridgewater 2000).

- Compressor cooling water from Boeing's Building 3-302 was discharged to the flume until 1987 when it was rerouted to the public storm drain (Cherberg 1987).

- In 1986, lubricating oil (maximum 10 gallons) was spilled to the flume from North Boeing Field (Wooten 1986).

No information on other facilities connecting directly to the flume was located.

Cooling water discharge from the GTSP was discontinued when the steam plant ceased operation in the 1960s. In 1985, the portion of the flume flowing from the dual concrete pipe section was surveyed as part of clean-up efforts. Twenty-nine (29) undocumented drains into the flume were located and closed. (The Seattle Engineering Department was notified and flagged related City side sewer cards "City Light Flume - Allow No Connections" as a measure to prevent further connections to the flume.) Based on Boeing facility plans (drawings 10-000-4504/SH M-1 and C3.YD-C100, dated 1985 and 1988, respectively), it appears that the 15-inch drain from the Boeing yard that originally discharged to the flume just below the concrete tunnel section was replumbed to the Slip 4 drain sometime between 1985 and 1988. Field verification is needed to confirm that this drain no longer connects to the flume and to verify if there are any other piped outfalls discharging to the flume. Boeing permits for cooling water discharge and use of the flume for containment of methylene chloride spills were discontinued in 1987. Current discharges to the flume consist primarily of stormwater runoff via sheet flow from adjacent roadways. See Figure 3-13 for the approximate location of the current flume drainage area.

Sections of the flume remain uncovered and continue to collect stormwater discharge from rainwater falling in the flume and runoff from immediately adjacent upland areas. In addition to Boeing, adjacent upland properties without direct connections to the flume but with possible overland runoff include storage areas and substations. Paved areas near Myrtle Street are used by Boeing to stage materials and equipment, and an undeveloped area (also near Myrtle Street) has been used by the City of Seattle to stage stockpiles of gravel, sand, and mixed soil and asphalt (Bridgewater Group 2000). Surface soil samples collected at the Myrtle Street property contained PCBs at 1.2 mg/kg and less than 1 mg/kg near the center of the property (Bridgewater Group 2000). (The MTCA Method A PCBs soil cleanup level for unrestricted use is 1 mg/kg PCBs.) The Willow Street Substation is unpaved and slopes toward the flume. During a site visit in 2000, Bridgewater Group (2000) observed no staining or other evidence of release around the perimeter of the substation or between the substation and the flume. The former Ellis Substation was also located near the flume. A soil sample collected in 1985 between the substation and the flume contained 0.071 mg/kg PCBs (Bridgewater Group 2000). Finally, warehouses and a motel are located along the flume south of Myrtle Street.

Additional information on the flume and its history is described by Raven Systems & Research (1988) and Bridgewater Group (2000).

3.4.4 Discharge Data Summary

Most data from Slip 4 discharges were collected in the mid-1980s in response to EPA's identification of contaminated sediments in Slip 4. Metro (1985) sampled sediments in the four major drains in 1984. They identified the flume and the Slip 4 EOF/SD (117) as sources of PCBs (Table 3-3). In 1985, Tetra Tech (1988a) collected sediment samples from the Slip 4 SD, I-5 SD, and Slip 4 EOF/SD (117). No problem chemicals were identified in the Slip 4 SD, and only one problem chemical was identified in the I-5 SD. However, in the Slip 4 EOF/SD (117), 16 problem chemicals were identified. These results are summarized in Table 3-4. No more recent data were located during this review.

SCL has collected numerous sediment samples in the flume, both before and after the 1985 cleaning and 1987 closure. Before cleaning, PCB concentrations in the flume ranged from 0 to 2,521 mg/kg (Raven Systems & Research 1988). Following cleanup and final closure in 1987, PCBs ranged from 0.25 to 14.26 mg/kg. Quarterly monitoring was conducted from 1989 through 1991. PCB concentrations at the head of the flume ranged from 1.6 to 103 mg/kg. During most of the monitoring events, PCB concentrations decreased with distance down the flume. Aroclor 1254 was the predominant mixture of PCBs that was detected. Regular monitoring of the flume ended during the winter of 1991 (Bridgewater Group 2000). The most recent flume sediment sampling was conducted in 1998 (HWA 1998). PCB concentrations ranged from undetected to 3.9 mg/kg.

Boeing sampled sediments in their stormwater collection system discharging to the head of the flume in the mid-1980s; PCB concentrations ranged from undetected to 520 mg/kg (Bridgewater Group 2000). Additional sediment samples from the Boeing storm drain collection system discharging to the Slip 4 storm drains were collected in 1992. PCB concentrations ranged from 0.094 to 426 mg/kg (Wilson 1993) and 5.1 to 160 mg/kg (Landau 1993). The sampling was followed by a major storm drain cleanout that included removing sediment from approximately 90% of the manholes, 81% of the catch basins, and 60%of the piping (Landau 1993).

3.5 SPILLS

The U.S. Coast Guard and Ecology were contacted regarding information on oil or chemical spills to Slip 4 (SEA 2003b,c). At both agencies, records prior to the 1990s are not centralized and consist primarily of individual incident reports. One very minor spill (1 gallon of hydraulic oil) attributable to equipment malfunction at Crowley occurred in 1997 (Ecology 2001). No other reports of spills from facilities adjacent to Slip 4 were found during a review of Ecology files. The U.S. Coast Guard provided information of spills on record occurring in the Duwamish River from 1992 to 2003, but based on available information, none appear to have occurred in the vicinity of Slip 4 (USCG 2003).

Correspondence between Ecology and SCL describes a February 1985 oil spill into Slip 4 (Brugger 1985, Croll 1985). The spill was investigated by the U.S. Coast Guard and was contained by Ecology. Ecology estimated that 50 gallons of oil were spilled. Ecology also determined that the oil was coming from the GTSP flume, but despite searching the entire length of the flume they were unable to identify the source. Two oil samples contained 67 and 80 mg/L of PCBs (Brugger 1985).

3.6 BANK EROSION

The banks of Slip 4 are armored by a sheet-piling wall along the northwest Crowley shoreline and by riprap along the Boeing facility shoreline, which minimize the erosion potential from these properties. Portions of the shoreline along the northeast Crowley shoreline, First South Properties parcel, and at the head of the slip are lined with discontinuous segments of wooden or cinderblock bulkheads, or are only partially armored with pavement debris (concrete, asphalt and brick) or coarse gravel and cobbles.

The wooden bulkhead along First South Properties southwestern shoreline is estimated from aerial photos to be approximately 50 years old. Indications of relatively recent fill placement observed along this bulkhead during a recent site visit suggest erosion has occurred in the past. Other evidence of bank erosion at the slip includes a minor amount of apparently eroded vegetation observed on the Crowley shoreline, and a small drainage gully leading from the upland portion of First South Properties to the slip.

Soil sampling investigations to date (Section 3.2) have not included collection of bank samples for chemical analysis.

3.7 ATMOSPHERIC DEPOSITION

Contaminants originating from nearby industries and city streets may be transported through the air and deposited at Slip 4 and in areas that drain to the slip. Contaminants deposited in the drainage areas are transported to the slip through surface water runoff via storm drains and EOFs. While chemical deposition from air directly to the slip likely occurs, this mechanism is not considered to result in contaminant concentrations above local background levels observed in the Duwamish.

4.0 WATER QUALITY

Water quality reflects surrounding land uses and chemical sources to the river and is one of the factors affecting the quality of aquatic habitat. Most sediment contaminants enter the sediments via the water column in either suspended solids or dissolved form.

Water quality data collected in Slip 4 are very limited, consisting of only two samples collected by NOAA in 2002. These data are discussed below in Section 4.2.3. Substantially more water quality data have been collected in the Duwamish River outside of Slip 4 by organizations including King County (and previously Metro), Ecology, the Port of Seattle, and the Muckleshoot Indian Tribe. While the emphasis was on conventional measurements rather than chemical analyses, some of these data are very briefly described below to provide an indication of general water quality conditions in the river outside Slip 4.

4.1 HISTORICAL DATA AND TRENDS

King County (2000) compiled and summarized historical water quality data from the Duwamish River. Their work is briefly summarized below and provides the basis for the following discussion.

Water quality investigations in the Duwamish River began in the 1950s with studies by the City of Seattle and Washington State Pollution Control Commission. Santos and Stoner (1972) reviewed historical water quality data up to 1967. In the mid-1960s, Metro began routine monitoring in the Duwamish that has continued to the present, and various organizations, including Ecology, the University of Washington, and the USACE, have been involved in water quality sampling in the estuary.

In general, water quality conditions in the Duwamish have improved from the poor conditions that existed from the 1940s through the mid-1980s. This is the result of the reduction of municipal and industrial discharges and the relocation of the south municipal treatment plant outfall from the Green River to Puget Sound (King County 2000). With the exception of temperature, most conventional parameters show improving water quality in the river.

4.1.1 Dissolved Oxygen

In the 1950s and 1960s, dissolved oxygen was generally adequate to support aquatic life, but values below the state’s minimum criteria were reported in bottom waters in late summer and in times of low freshwater inflow and low tidal exchange. Minimum dissolved oxygen concentrations have been increasing since the 1970s, with a jump in the rate of increase in 1987 due to diversion of the south municipal treatment plant outfall (King County 2000).

4.1.2 Temperature

Surface water temperatures in the urban areas throughout the region have been increasing due to increased urbanization, loss of riparian vegetation, and increased runoff from impervious surfaces. King County (2000) reported that since 1970, maximum temperatures in the lower Duwamish River have increased approximately 2°C based on monthly measurements at three stations in the lower river.

4.1.3 Metals

Implementation and enforcement of the Clean Water Act and NPDES restrictions on pollutant discharge in the 1970s dramatically reduced point-source discharges from municipal and industrial sources to the river. Levels of cadmium, chromium, copper, lead, mercury, nickel, and zinc, which were often above toxic thresholds in the early 1980s, have dropped to below the Washington State chronic water quality standards for aquatic life (King County 2000).

4.2 CURRENT CONDITIONS

4.2.1 Standards and Regulatory Status

The Washington State water quality standards are based on the beneficial use designations of the waterbody (WAC 173-201A). Designated uses for the Duwamish River (from the mouth to below the Black River) include the following:

- Aquatic Life Use: Salmon/Trout Rearing
- Recreational Use: Secondary Contact (e.g., wading)
- Water Supply: Industrial, Agricultural, and Stock Water
- Wildlife Habitat
- Harvesting
- Commerce and Navigation
- Boating
- Aesthetics.

The surface water quality standards adopted by Ecology and submitted to EPA in July 2003[5] are listed in Table 4-1.

The lower Duwamish River is included in Ecology's 1998 303(d) list of impaired water bodies that do not meet state water quality standards (Ecology 1998a)[6]. It is currently identified as failing to meet water quality standards for fecal coliform bacteria, dissolved oxygen, temperature, and pH, as well as numerous chemicals in sediments (Ecology 1998a, King County 2000). Federal law requires states to develop total maximum daily load (TMDL) or water cleanup plans for pollutants in waters that fail to meet state water

[5] The 2003 standards have not been approved by EPA.
[6] The 1998 303(d) list was the last one submitted to and approved by EPA. EPA did not require the states to prepare a 303(d) report in 2000. Ecology is in the process of preparing the 2002/2004 303(d) list.

quality standards. The TMDL establishes limits on pollutants that can be discharged to the waterbody and still allow state standards to be met. TMDLs (aka Water Cleanup Plans) that will be developed for Duwamish River water include pH, dissolved oxygen, fecal coliform bacteria, and temperature. These Water Cleanup Plans are included in Ecology's 2004 TMDL priority list and will be developed by Ecology and King County(Ecology 2003b, McBride and Butler 2003). TMDLs for contaminants in Duwamish River sediments will be addressed separately from water and will be developed as part of or in conjunction with future sediment cleanup plans.

The impact of water quality exceedances on aquatic life depends on the timing, spatial extent and degree of exceedance, and length of time water quality is adversely affected. The King County combined sewer overflow (CSO) risk-based water quality assessment for Elliott Bay and the Duwamish River concluded that the risks to water-column-dwelling organisms or salmon in the Duwamish from exposure to chemicals or physical stressors in the water column, with the exception of suspended solids, appeared to be minimal (King County 1999, 2000).

4.2.2 Recent Water Quality Data

4.2.2.1 Conventional Parameters

Various water sampling programs have been conducted in the Duwamish River; however, data collected by the King County Streams Monitoring Program was determined to be the most representative for purposes of evaluating current water quality conditions in the vicinity of Slip 4. The King County Stream Monitoring Program is ongoing and collects consistent, monthly samples at established stations in the Duwamish River and Waterway (King County 2000). There have been other investigations targeting specific areas or problems (e.g., CSOs), but these are less representative of general water quality conditions and are not included here.

Conventional water quality data in the lower Duwamish, based on monthly data collected between January 1999 and April 2003 by the King County Streams Monitoring Program, are summarized in Table 4-2. These data are from the nearest stations upstream (South Park/16th Avenue Bridge - Station 0307) and downstream (West Waterway, Spokane Street Bridge - Station 0305) of Slip 4 (Figure 1-1).

4.2.2.2 Metals and Organics

In August 2002, NOAA collected two surface (0.5-m depth) water samples in Slip 4 (Table 4-3) (Meador 2003). One sample was collected at the head of the slip and one sample was collected near the Crowley dock. The analyses were limited to PCBs and PAHs. PCBs were undetected. Total PAHs ranged from 0.1 to 0.72 ug/L.

There are little data for metals or organic chemicals in the Duwamish River outside of Slip 4. King County collected water samples at locations downstream of Slip 4 (at the Brandon CSO just upstream of Kellogg Island and at the Southwest Michigan CSO near

Slip 3). Samples were collected weekly and following storm events from October 1996 to June 1997. Grab samples were collected from 1 m below the surface and 1 m above the bottom at locations near the east and west banks and in the center of the channel. Most metals were detected but none of the concentrations, including all detection limits, exceeded the applicable Washington water quality criteria. Organic compounds were rarely detected except for benzoic acid, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate. Phthalate concentrations were higher in samples following storm events (King County 1999, Windward 2003h).

King County recently began a survey of endocrine-disrupting compounds in the Puget Sound water column, including one station in the Duwamish River south of Harbor Island (King County 2003, Mickelson 2003). Chlorinated pesticides, other pesticides (atrazine and vinclozolin), PCBs, PAH compounds, phthalates, hormonal compounds, and phenols are analyzed. A surface sample collected at the Harbor Island station on March 18, 2003, contained only two detected chemicals: naphthalene (0.083 ug/L) and phenanthrene (0.014 ug/L). There are no federal or state numerical water quality standards for these compounds. No chemicals were detected above the reporting limit in a sample collected one meter above the bottom.

5.0 SEDIMENT QUALITY

This section summarizes the sediment quality in and adjacent to Slip 4. Considered the medium of greatest concern in the slip, sediments are often the final repositories for chemicals discharged into aquatic systems. Many chemicals bind to, and thereby accumulate, in sediments. Sediment-dwelling aquatic organisms can accumulate these contaminants, and the contaminants may bioaccumulate in the food chain.

The emphasis in this summary is on recent (post-1990) sediment data within Slip 4 and in the river adjacent to the slip. A brief summary of historic sediment data collected prior to 1990 is provided, but only data collected after 1990 are presented in detail and evaluated in this report. Data collected after 1990 were obtained using standard collection and analysis procedures and are more likely to reflect recent conditions. The majority of investigations in Slip 4 have included the collection of sediment chemistry data, although some toxicity and bioaccumulation data have also been collected. All data types are described in the following sections

Data sets from 1990 to the present were compiled and evaluated (Table 5-1). Criteria for inclusion were the same as those used by Windward (2001a, 2003h) in compiling data for the LDW RI; any exceptions are noted. Survey and station locations are shown in Figure 5-1 and Figure 5-2, and all reported data are tabulated in Appendix C. Stations sampled prior to dredging are shown in Figure 5-3.

The recent sediment data from Slip 4 were collected to characterize dredged sediments or to assess sediment quality. Therefore, the analytes reported and criteria used to evaluate chemical data are determined by the PSDDA program and the Washington State SMS (WAC 173-201). These criteria are also used in the following summary of sediment data in Slip 4. The chemical analyses required by these programs and their respective criteria are provided for reference in Table 5-2.

5.1 SEDIMENT CHEMISTRY

5.1.1 Historic Investigations

Four investigations conducted prior to 1990 included collection of sediment data in Slip 4. Available information for each historical study is summarized in Table 5-3, and the results of each investigation are briefly described below.

EPA conducted two of the pre-1990 investigations. In 1982 - 1983, EPA collected three surface sediment samples in Slip 4 as part of a Duwamish River survey. Two of the 1982 sampling locations were located approximately 1/3 and 2/3 up the slip and one location was located near the mouth. The data were unpublished, but are included in Ecology's SEDQUAL database and were used in later EPA reports (PTI and Tetra Tech 1988). In 1985, EPA collected two samples in Slip 4 as part of the Elliott Bay Action Program investigation to identify contaminated areas in Elliott Bay and the lower Duwamish River. One station was located near the head of Slip 4 and the other station was located just outside the mouth. Based on the results of these two studies, EPA identified Slip 4 as a problem area (i.e., an area with high values for indices of contamination). Specifically, PCBs concentrations at the two stations nearest the head of the slip exceeded the lowest apparent effects threshold (LAET) or SQS[7]. EPA reported that PCBs concentrations decreased toward the mouth of the slip. They also identified PAH as problem chemicals in Slip 4 based on highest apparent effects threshold (HAET) exceedances. Again, concentrations decreased from the head to the mouth of the slip. EPA reported that DDE was detected at one station located at the head of the slip and exceeded the HAET. Metals did not exceed the SQS. The two 1985 sediment samples were also tested for toxicity using the amphipod *Rhepoxynius abronius.* Amphipod mortality in sediments from the station at the head of the slip was significantly greater than in reference sediments (PTI and Tetra Tech 1988; Hart Crowser 1989a,b).

The Metro/King County Laboratory Information Management System includes surface sediment data collected in 1984 from two locations in Slip 4 (near the head and midway) and one location just outside the mouth of the slip. Metals and oil and grease were analyzed. Lead and zinc exceeded the SQS at the station located at the head of the slip. There were no other exceedances (Stern 2003).

Finally, in 1989 Evergreen Marine Leasing collected cores to assess options for disposal of dredge material (Hart Crowser 1989a,b). Three sediment cores were collected in Slip 4: one at the head, one near the midpoint, and one near the mouth. Sampling intervals ranged from 0 – 24 cm to 0 – 46 cm. PCBs exceeded the LAET at the station near the head of Slip 4 and the 2LAET at the remaining two locations. There were no other AET exceedances. VOCs, pesticides, and most non-PAH organics were undetected. Chemical concentrations were generally highest at the head of the slip and decreased toward the mouth.

5.1.2 Current Data Sources and Data Quality Review

Sediment data for five of the six surveys listed in Table 5-1 were acquired from the LDW database developed by Windward. Data included in these five surveys were subjected to Windward's data review and verification process (Windward 2001a) and were not re-verified by SEA. Following Windward's initial review, EPA reviewed the data (Hiltner 2003). Data from three of the surveys listed in Table 5-1 were approved for use in both the LDW Phase 1 and Phase 2 RI: Weston 1996, 1997, and 1999b; and King County 1999). EPA also approved an additional data set for use with caveats (i.e., limited use of total PCB results): NOAA 1998. Data from the fifth survey, Exponent 1998, were approved for use in the Phase 1 RI, but are not yet approved for use in the Phase 2 RI.

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[7] TOC was not reported for EPA 1982 – 83 and Evergreen Marine Leasing surveys so most organic chemical concentrations cannot be compared to the SMS numerical criteria. Instead, concentrations are compared to AET values.

These data have been reviewed by Windward and a QA memorandum has been submitted to EPA for review and approval (Deshler and Pierce 2003). EPA's decision is pending.

Data from a sixth survey, Landau (1990), were acquired from the EPA's Site Inspection Lower Duwamish River CD and the source document (Weston 1999b). SEA verified 20% of these data and reviewed available quality assurance data. The City has requested the complete laboratory data for this investigation from Boeing. Upon receipt, a separate data validation report will be submitted to EPA for their review and approval. Consistent with the LDW RI, data from stations located in dredged areas are not included.

Additional information on these surveys is available in the original reports (Table 5-1). Summary information is also provided in reports by Windward (2001a,b).

These studies were performed after the implementation of Puget Sound Estuary Program (PSEP) guidelines and used similar analytical and reporting methods, with one exception. NOAA (1998) analyzed PCBs using non-standard HPLC/photodiode array detection methods; all other surveys analyzed PCBs using EPA standard method 8081 (or equivalent) by gas chromatography/electron capture detector. The total PCB results from the two different methods may not be comparable; however, data from both methods are presented in this report.

For the purposes of this existing information report, the six studies were considered appropriate for use. It is important to note that numerous data sets exist within the Duwamish River outside of Slip 4, and these have been summarized by Windward (2003h). The emphasis in this report is on Slip 4 and immediately adjacent areas in the river.

5.1.3 Surface Sediment

For purposes of the LDW RI and this Slip 4 report, surface sediment is defined as sediment less than 15 cm deep. This is the maximum depth at which most biological organisms are exposed to sediment. Data from the 0- to 15-cm depth or less are discussed in this section. Note that sediments collected from deeper intervals (e.g., 0 – 60 cm), using subsurface coring methods, are included in the discussion of subsurface sediments (see Section 5.1.4).

5.1.3.1 Conventionals

Total organic carbon (TOC) in Slip 4 surface sediments ranged from 0.07 to 5.4%, with most areas in the 1 – 3% range. The highest TOC concentrations were found at the head of the Slip and concentrations generally decreased toward the mouth (Figure 5-4). Within the Slip 4 Early Action Area, the only station with surface sediment TOC less than 0.2% [the limit for SMS carbon-normalization (Michelsen 1992)] was located just outside the mouth of the slip (station EST 175, Figure 5-2). Outside Slip 4, TOC ranged from 0.21 to 3.1%.

Percent fines (silt + clay) was calculated from existing surface sediment grain-size data in and adjacent to Slip 4 and mapped in Figure 5-5. Data coverage is limited, but provides a general indication of variations in grain-size distribution, which are shown as gradations in shading. In areas with few sampling stations (e.g., the mouth of Slip 4), inadequate data are available to interpolate between sampling points with a high degree of confidence. However, inverse-distance-weighting (IDW) methods were applied to the existing data to provide an indication of grain-size distribution[8]. The shading in Figure 5-5 shows that the southeastern shoreline of Slip 4 is somewhat sandier than the area adjacent to Crowley's pier. Sediments located adjacent to the southeastern shoreline are typically 50 – 70 percent fines, with some areas of more coarsely grained sediment (30 – 50 percent fines) that may represent upland fill materials or residuals from bank construction. Along the Crowley pier, fine-grained sediments, ranging from 76 to 86 percent fines, tend to deposit in the low topography where maintenance dredging has been performed. Fine-grained sediments also exist toward the head of Slip 4 (78 – 79 percent fines) where aerial photos show exposed mudflat (see Appendix A).

Outside of Slip 4, fine-grained sediments are found in the dredged areas. The fine-grained sediments extend out from the dredged areas into the navigation channel. There are relatively few samples within the navigation channel. Generally, however, sediments outside the dredged areas are sandy, ranging from 14 to 51 percent fines.

5.1.3.2 Metals and Semivolatile Organics

The majority of samples collected for the studies listed in Table 5-1 were analyzed for the Washington State sediment management standards (SMS) chemicals of concern. Other analytes reported by some of these studies include PCB congeners, butyltins, dioxins/furans, volatile organic compounds, resin acids, and acid-base-neutral extractable compounds and pesticides beyond those listed in the SMS. All sediment chemical data for the six studies are provided in Appendix C.

Existing metals and organics data for surface sediments are summarized in Table 5-4 (Slip 4) and Table 5-5 (Duwamish River just outside of Slip 4). The list of analytes presented in these tables includes the SMS chemicals of concern and additional chemicals reported in the PSDDA program (primarily pesticides and VOCs). PCB congener data are also included in the tables. One other chemical, carbazole, is reported because it was detected in several samples in the project area.

Among all chemicals in Slip 4, metals, LPAH, HPAH, bis(2-ethylhexyl)phthalate, dibenzofuran, Aroclors (Aroclor 1254, in particular), carbazole, and PCB congeners were detected in greater than 80% of the samples analyzed. The same chemicals were detected in samples outside Slip 4, although generally higher chemical concentrations occurred in Slip 4 compared to sediments located in the adjacent segment of the Duwamish River. Carbazole was not identified in the LDW RI as a chemical of potential concern based on

[8] TOC and grain size data were contoured using Arc Map Spatial Analyst with the default power setting of 2 and a variable search radius using the 8 nearest points.

the Phase 1 ecological and human health risk assessments. There are no SMS or PSDDA criteria for carbazole, and this chemical will not be considered further.

Butylins and dioxin/furans were analyzed in very few samples, but detected in all. Butyltins were analyzed in two samples from Slip 4, and were detected in both (40 ug/kg tributyltin [TBT]). A station just outside the mouth of Slip 4 had a TBT concentration of 6 ug/kg. Similarly, butyltins were analyzed in only four samples outside Slip 4, and were detected in each sample (21 to 46 ug/kg TBT). Dioxin/furans were analyzed in one sample collected just outside the mouth of Slip 4 and in one sample downstream of Slip 4. Total tetrachlorodibenzo-p-dioxin (TCDD) and tetrachlorodibenzofuran (TCDF) concentrations near the mouth of Slip 4 were 10 and 63 pg/g, respectively. Total TCDD and TCDF concentrations downstream of Slip 4 were 2.2 and 15 pg/g, respectively. The LDW RI risk assessments identified TCDD and TBT as chemicals of potential concern. There are no SMS or PSDDA criteria for these chemicals and so they are not included in the following criteria comparison.

Surface sediment results are compared to SMS sediment quality standards (SQS) and cleanup screening levels (CSL) in Figure 5-6 (see Table 5-2 for SQS and CSL values.) The SQS correspond to the long-term goals for sediment quality in Washington waters. Sediments that meet the SQS criteria are expected to have no adverse effects on biological resources and pose no significant risks to human health. The initial designation under the SQS is based on comparison with numerical criteria and these criteria are used in this evaluation of existing data. However, an exceedance of the SQS numerical criteria does not necessarily indicate adverse effects or toxicity, and biological testing may be used to confirm the initial designation regardless of chemical concentration. Additionally, the degree of SQS exceedance does not correspond to the level of sediment toxicity. The CSL or minimum cleanup level (MCUL) is defined as the maximum allowed chemical concentration and level of biological effects permissible at a cleanup site to be achieved by year 10 after cleanup has been completed. The MCUL (or CSL) is greater than or equal to the SQS and represents a higher level of risk to benthic organisms than SQS levels.

Exceedances of SMS criteria are mapped as “exceedance factors” (EFs) and are calculated in the following manner:

$$\text{EF} = \text{Concentration in sample / SQS}$$

EFs less than one indicate concentrations that do not exceed the SQS. EFs greater than one indicate concentrations exceeding the SQS, but a higher EF value does not directly correlate with higher toxicity. Exceedances of the MCUL (or CSL) are shown with an asterisk.

Data Within Slip 4. The chemical with the most frequent CSL exceedance in Slip 4 was total PCBs (Figure 5-6, Table 5-6). Exceedances of the PCBs CSL value occurred in surface sediment samples collected throughout the upper half of Slip 4. The magnitude of exceedance was greatest at the head of Slip 4 and decreased toward the mouth. PCB data are mapped in Figure 5-7. Although data coverage is limited and sampling stations are not ideally located for contouring purposes, the mapping provides a general picture of relative PCB concentrations. In areas with few sampling stations (e.g., dredged areas), inadequate data are available to interpolate between sampling points with a high degree of confidence. However, IDW methods were applied to provide an indication of chemical distributions based on existing data[9].

The second most frequent CSL exceedance in Slip 4 was bis(2-ethylhexyl) phthalate (Figures 5-6 and 5-8). Exceedances were observed in samples at the head of Slip 4 and at one station off of Boeing Plant 2. Other SQS exceedances were primarily confined to two areas within the slip. Metals (zinc, mercury, cadmium, and silver), and several HPAHs and LPAHs (acenaphthene and phenanthrene) exceeded SQS values in samples located adjacent to the outfalls at the head of Slip 4 (Figures 5-9, 5-10, 5-11). In this area, two metals (lead, cadmium) also exceeded CSL values at one station each. No LPAH or HPAH exceeded the CSL in Slip 4.

There are no SMS numerical criteria for pesticides, but these chemicals may be compared to PSDDA criteria. DDT was analyzed in 10 samples from Slip 4 but detected in only one (Station SD-DR178 at the head of the slip) at a concentration over 100 times greater than the PSDDA SL. Similarly, alpha-chlordane and dieldrin were analyzed in 10 samples but detected at only one station (also at station SD-DR178) at concentrations greater than PSDDA SLs.

Known and potential of chemicals of concern are defined as those detected chemicals that exceed the SQS in one or more surface sediment samples or, for chemicals without SMS numerical values, exceed the PSDDA screening level (SL) in one or more samples. Known and potential chemicals of concern in Slip 4, based on existing data, are listed in Table 5-6.

As shown in Figure 5-6, there were also numerous chemicals that were undetected in Slip 4 sediments but had detection limits that exceeded the SQS. These chemicals are listed in Table 5-7. None of SMS chemicals with detection limits greater than the SQS were detected at concentrations greater than the SQS in Slip 4. Three non-SMS chemicals (DDT, alpha-chlordane, and dieldrin) were each detected in one sample at concentrations greater than the SQS (see Table 5-6). There were only two samples in Slip 4 surface sediments (SD-DR-183 and SD-DR-182) where undetected chemicals were the only SQS exceedances (Figure 5-6). At all other locations, detected chemicals also exceeded the SQS.

Data Outside Slip 4. Comparable to Slip 4 sediments, total PCBs most frequently exceeded the SQS among all chemicals reported for the portion of Duwamish River

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[9]Organic and metal chemical concentration data were contoured using Arc Map Spatial Analyst. Due to the uneven distribution of sample locations and areas lacking data, the default power setting of 2 was raised to 4 to place more emphasis near the sample and reduce interpolated positives where sample data were sparse. A variable search radius using the 4 nearest points was used for calculating each interpolated cell.

located immediately outside of Slip 4. Unlike Slip 4, PCBs rarely exceeded the CSL in this area. Only three samples exceeded the PCBs CSL: EST12-10 located just outside of the mouth of Slip 4, and SD2B-DUW84 and SD2B-DUW85 located along the northeastern shoreline off Boeing Plant 2 (see Figure 5-6). PCBs SQS exceedances occurred along the southeastern shoreline, in the channel and the southwestern shoreline across from Slip 4, and in two samples collected along the channel south of Slip 4.

Unlike PCBs, bis(2-ethylhexyl)phthalate and metals did not exceed the SQS in the river outside of Slip 4. LPAHs and HPAHs exceeded SQS values at one station along Crowley's riverside shoreline (SD-DR175; see Figure 5-6). CSL exceedances of phenanthrene, fluorene, and total LPAH also occurred at this location.

Pesticides were analyzed in only one sample from the river outside Slip 4 and were not detected.

5.1.3.3 PCB Aroclors

The relative distributions of PCB Aroclors in Slip 4 surface sediments based on existing data are mapped in Figures 5-12 and 5-13. PCB Aroclor concentrations (ug/kg, dry weight) are presented in pie charts to show relative contributions of each Aroclor. In Figure 5-12, undetected Aroclor data are included at the reporting limit. Sections shown with crosshatching and a "U" qualifier indicate that the Aroclor was not detected at the concentration shown. In Figure 5-13, undetected Aroclors have been omitted. The size of the pie chart reflects the total PCB concentration relative to SMS. Aroclors 1016, 1221, and 1232 were not detected in the historical data sets reviewed for this report.

As shown in Figures 5-12 and 5-13, Aroclor 1254 is the greatest contributor to total PCBs (measured as Aroclors) in Slip 4 sediments. At most locations, Aroclor 1260 was the next greatest contributor, followed by Aroclors 1248 or 1242 (including 1016/1242), although there are exceptions to this trend. In the Duwamish River outside Slip 4, Aroclor 1254 is less dominant, with Aroclor 1260 at equal or greater concentrations than Aroclor 1254 in many samples. As noted in the previous section, PCBs concentrations were greatest at the head of Slip 4 and decreased towards the mouth. PCBs concentrations outside of Slip 4 were also elevated along the eastern shoreline upstream of Slip 4.

5.1.3.4 Surface Sediment Quality in Dredged Areas

One surface (0 – 15 cm) sediment sample was collected from the area adjacent to the Crowley marine terminal prior to dredging in 1996 (SL4 – 03, Figure 5-3). PCBs were the only detected chemical exceeding the SQS (EF = 1.36).

5.1.4 Subsurface Sediment

One of the six surveys listed in Table 5-1 included the collection of subsurface sediment cores in Slip 4. Landau (1990) collected 12 cores; however, four of these were obtained in an area that has since been dredged, and these are not included in the following data evaluation. However, a brief summary of the pre-dredging data is provided in Section

5.1.4.4. Core depths in the Landau investigation ranged from 6 to 10 feet. Various depth intervals were sampled (e.g., 2–4 feet, 4–6 feet). Subsurface samples were generally analyzed for SMS chemicals of concern. Other analytes included nickel, 1,3-dichlorobenzene, and pesticides. All sediment chemical data for subsurface sediments in Slip 4 are provided in Appendix C. The only recent subsurface data collected outside Slip 4 were from dredged areas, and these data are not included in the LDW database or this summary.

Existing metals and organics data in Slip 4 subsurface sediments are summarized in Table 5-8. Metals and bis(2-ethylhexyl)phthalate were detected in greater than 80% of the subsurface samples. PCBs were detected in 67% of the samples, and one or more PAHs were detected in 79% of the samples. No VOCs or pesticides were detected.

5.1.4.1 Comparison to Sediment Management Standards

Subsurface sediment samples in Slip 4 are compared to SQS in Figure 5-14. Chemicals exceeding the SQS in one or more samples are listed in Table 5-9. Although surface core samples (0 – 2 ft depth interval) are reported, the emphasis in this analysis is on subsurface sediments below 2 feet. The most frequent SQS and CSL exceedances in subsurface sediments greater than 2 feet deep were total PCBs. Exceedances of the PCBs SQS and CSL values occurred in subsurface sediments in the north half of the slip, although data from the south end of the slip is lacking due to dredging in the mid-1990s (PCBs in the pre-dredging samples from this area exceeded the SQS only in the 0 – 4 ft depth interval in two of four cores, see Section 5.1.4.4). Only two detected chemicals other than PCBs exceeded the SQS in subsurface sediments below 2 feet. Acenaphthene exceeded the SQS in two cores near outfalls at the head of the slip (SL4-06A, SL4-09A); fluoranthene also exceeded the SQS in one of these cores (SL4-09A). (Pre-dredging data also show PAH SQS exceedances in one core collected near a Crowley outfall at the south end of the slip; see Section 5.1.4.4.)

The depth distribution of subsurface sediment SQS and CSL exceedances is shown in Figure 5-15. Detected chemical exceedances by approximate depth interval include the following:

- **2- 4 ft depth interval:** Two of five cores in which this depth interval was analyzed have SQS exceedances. Detected analytes exceeding the SQS include PCBs and acenapthene. PCBs also exceed the CSL.

- **3- 5 ft and 4- 6 ft depth intervals:** Acenaphthene in two of six cores exceeds the SQS; fluoranthene exceeds the SQS in 1 core. There are no PCB exceedances in samples from this depth interval.

- **Greater than 6 ft depth interval:** Acenaphthene exceeds the SQS in one of these cores. PCBs exceed the SQS and CSL in two of six cores, possibly indicating historic sources of PCBs that were not present when later (i.e., 3 – 6 ft interval) sediments were deposited.

The maximum depth of SQS exceedance ranges from 4 feet to greater than 9 feet. CSL exceedances below 4 feet are observed in only two of the 10 cores: Station SL4-6A near the outfalls at the head of the slip, and Station SL4-10A in the vicinity of the outfalls at First South Properties[10]. At both locations, PCBs are the only chemical exceeding the CSL, and the maximum depth of PCBs exceeding the CSL is greater than 8 – 9 feet.

Similar to surface sediments, there are numerous undetected chemicals in subsurface sediments with detection limits greater than the SQS (Figure 5-14). In the majority of subsurface samples, undetected chemicals are the only chemicals exceeding the SQS. Hexachlorobenzene, benzyl alcohol, and 1,2,4-trichlorobenzene are undetected at levels above the SQS in nearly all samples. Other chemicals with detection limits greater than the SQS in two or more samples include dichlorobenzenes, methylphenols, benzoic acid, hexachlorobutadiene, pentachlorophenol, butyl benyzl phthalate, and n-nitrosodiphenylamine. Of these chemicals with detection limits exceeding the SQS, only butyl benzyl phthalate was found in Slip 4 sediments at detected concentrations greater than the SQS.

5.1.4.2 Vertical Distribution of Metals and Organic Compounds

Sediment profiles are provided in Appendix D for metals and selected organic compounds. The midpoint of the depth interval is plotted for each sample. Results for organic compounds are normalized to TOC concentrations. At Stations SL-05A, SL09A, and SL11A, a surface sample was collected within 25 feet of the core (see Figures 5-14 and 5-15 for station locations). These surface samples are included in the plots.

The concentrations of metals were generally highest in the uppermost depth interval [0-2 feet (0-60 cm) at most stations; 0-0.5 feet (0-15 cm) at Stations SL4-10A and SL4-12A, both located along the southern shoreline] and decreased with depth. Arsenic concentrations did not follow this trend at Stations SL4-08A (near the head of the slip) and SL4-09A (off First South Properties), which showed subsurface arsenic maxima at 2-4 and 3-5 feet, respectively. The concentration of arsenic in the surface sediment sample from Station SL4-09 was similar to the subsurface maximum at station SL4-09A. In addition, the concentrations of arsenic, cadmium, and mercury in the surface sediment sample from station SL4-11 (off Boeing Plant 2) were much lower than the concentrations of these metals in the sediment from the upper interval [0-2 feet (0-60 cm)] of the core. The concentration of silver was similarly much lower in the surface sediment sample from station SL4-09 than in the upper interval of the sediment core from station SL-09A. Cadmium, lead, and mercury levels in the surface sediment sample were slightly lower than the upper core interval at this location.

The TOC-normalized concentrations of the organic compounds illustrated in Appendix D (i.e., LPAH, HPAH, total PCBs, acenaphthene, fluoranthene, and bis[2-ethylhexyl]phthalate) also decreased with depth in most cases. A subsurface maximum

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[10] TOC in the 6- 9 ft depth interval of core SLA-6A is 0.2%, or equal to the limit for TOC normalization and comparison to the SMS (Michelsen 1992). The dry-weight PCB concentration in this sample (240 ug/kg) is also greater than the LAET for PCBs (130 ug/kg) but less than the highest AET (3,100 ug/kg).

was evident for acenaphthene at station SL4-09A. In addition, concentrations of PAHs and bis(2-ethylhexyl)phthalate were lower in the surface sediment sample (0-0.5 feet; 0-15 cm) at station SL-09 than the 0-2 foot (0-60 cm) core interval from station SL4-09A. The PCB concentration did not follow this trend.

At Station SL4-06A (closest to the outfalls at the head of the slip), TOC-normalized concentrations of all plotted analytes except acenaphthene showed an increase in the deepest interval (6-9 feet; 182-274 cm) with respect to the previous interval (4-6 feet; 121-182 cm). However, the TOC content of the 6-9 ft depth interval at this station was approximately one third the TOC content of the 4-6 ft interval. On a dry-weight basis, only the PCB concentrations were higher in the 6-9 ft interval than in the 4-6 ft interval. Results for PCBs are discussed in more detail in the following section.

At Station SL4-07A, also near the outfalls, PAHs were detected only in the 0-2 ft depth interval. For intervals below 2 feet, the values shown on the plots for LPAH, HPAH, acenaphthene, and fluoranthene represent method reporting limits that have been normalized for TOC. The fluctuating results for PAHs at this station, clearly evident on the plot for acenaphthene, are an artifact of TOC-normalization.

5.1.4.3 PCB Aroclors in Subsurface Sediment

In general, concentrations of PCBs tended to decrease with depth in the core samples. Exceptions to this trend were SL4-6A (closest to the outfalls) and SL4-10A (off First South Properties, where PCBs decreased in concentration with depth but increased again at the bottom. In some locations, PCBs were restricted to the top 2 - 4 feet, while in other locations, PCBs exceeded the CSL as deep as 9 feet (SL4-6A).

Relative concentrations of individual Aroclors in subsurface sediments are shown in Figures 5-16 and 5-17. In Figure 5-16, undetected Aroclor data are included at the reporting limit. Sections shown with crosshatching and a “U” qualifier indicate that the Aroclor was not detected at the concentration shown. In Figure 5-17, undetected Aroclors have been omitted. Like the surface sediments, Aroclor 1254 was generally proportionally greater than other measured PCB Aroclors, followed by Aroclor 1260 and Aroclor 1242/1248, in descending order of magnitude. This trend does not appear to change with depth of the core samples.

5.1.4.4 Subsurface Data Within Slip 4 Dredged Areas

Sediment chemistry data were collected from the area adjacent to the Crowley marine terminal prior to dredging in 1996 (Figure 2-4, Figure 5-3). Although these data no longer represent existing conditions and so were not included in the above discussion, they provide additional information on sediment conditions and are briefly described in this section.

One composite sample was collected in each of four DMMUs in 1995 (Figure 5-3). The 0 – 4 ft depth interval was sampled. In DMMUs 2, 3 and 4, PCBs were the only detected chemical that exceeded the SQS. PCBs did not exceed the CSL. In DMMU 1, near the mouth of Slip 4, PCBs and numerous PAHs exceeded the SQS, but not the CSL.

Four cores ranging from 6 to 9 feet deep were collected in the four dredged area DMMUs in 1996 and analyzed for PSDDA chemicals of concern. Stations locations are shown in Figure 5-3. At three of the four core locations, there were either no detected chemicals greater than the CSL or PCBs were the only chemical exceeding the CSL. At Station 4-1A at the mouth of Slip 4, there were no detected chemicals greater than the SQS in sediments up to 9 feet deep. At Stations 4-3A and 4-4A, PCBs were the only chemical exceeding the CSL. All PCB CSL exceedances in the dredged area were in sediments less than 4 feet deep.

At the fourth core location in the dredged area, Station 4-2A, numerous PAHs exceeded the CSL in sediments up to 6 feet deep (i.e., the deepest sample analyzed at this location). The greatest number of PAH exceedances (12 individual PAH, total LPAH, and total HPAH) and the highest PAH concentrations were reported in the 2 – 3 ft depth interval However, PAH concentrations in the 4 – 6 ft depth interval also exceeded the CSL. A surface sample was not collected at this location.

The results of toxicity and bioaccumulation tests conducted on sediments from this area prior to dredging are discussed in Sections 5.3 and 5.5, respectively.

5.2 POREWATER

One porewater sample was collected from surface sediment in Slip 4 at Station DR181 (Figure 5-2) and analyzed for metals. Data are summarized in Table 5-10 and are provided in Appendix C. The samples were unfiltered; particulate matter was removed by centrifuging and decanting (Weston 1998b). All detected priority pollutant metal concentrations were less than the chronic marine water quality criteria except for cadmium. The estimated cadmium concentration of 4 ug/L was greater than the chronic water quality standard of 2.2 ug/L. Butyltins were undetected (0.05 U ug/L).

5.3 SEDIMENT TOXICITY

The only toxicity data collected since 1990 in Slip 4 and vicinity were collected as part of sediment characterizations prior to removal of dredged sediments. Although all toxicity data are from sediments that are no longer present, results of the toxicity tests are briefly described below as an indication of possible sediment toxicity in Slip 4.

5.3.1 Historical Data Within Slip 4

Crowley completed a PSDDA full sediment characterization in 1995 as part of a dredging project (PTI 1995a). This dredged area is shown in Figure 2-4. In Crowley’s study, eight sediment cores up to 4 feet in length were collected and composited into four samples. All four samples were tested for toxicity using the 10-day amphipod (*Rhepoxynius abronius*), the sediment larval test (*Dendraster excentricus*), and the 20-day growth test (*Neanthes species*).

Amphipod mortality in the test samples ranged from 25 to 50%, and mean amphipod mortalities in three of the four samples showed statistically significant differences from the mean amphipod mortality observed in the Carr Inlet reference sample. In the sediment larval test and the 20-day growth test, no test samples elicited a toxic response compared with reference sediments. Mean larval combined mortality and abnormality in the larval test ranged from 13.7 to 27.7%. Mean *Neanthes* individual growth rate ranged from 0.75 to 0.85 mg/ind/day.

These data along with other supporting information were evaluated to determine the suitability of sediments for disposal at a PSDDA, unconfined, open-water disposal site. The two composite samples from the dredged area farthest from the mouth of the slip failed PSDDA suitability guidelines based on a single-hit failure of the amphipod bioassay interpretive criteria. The two composite samples from the dredged area nearest the mouth of the slip passed PSDDA suitability guidelines for toxicity; however, one of these samples was deemed unsuitable for disposal based on the outcome of a 28-day bioaccumulation test (see Section 5.5.1).

5.3.2 Historical Data Outside Slip 4

A complete summary of LDW bioassay testing is provided by Windward (2003h). Studies in the vicinity of Slip 4 are described here. As in Slip 4, the only bioassay data collected in the vicinity of Slip 4 since 1990 were collected as part of sediment characterizations prior to removal of dredged sediments. Hurlen Construction, located across the channel and north of Slip 4, completed two PSDDA dredging projects in 1990 and 1999. Morton Marine, located across the channel and south of Slip 4, completed a PSDDA dredging project in 1992.

These programs used a variety of toxicity tests. Hurlen Construction (Hart Crowser 1998) used the 10-day amphipod test (*Rhepoxynius abronius*) and the 20-day *Neanthes* growth test. Morton Marine used the 10-day amphipod test (*Rhepoxynius abronius*), the sediment larval test (*Dendraster excentricus*), the *Neanthes* acute bioassay, and the Microtox test. In 1990, Hurlen Construction used only the 10-day amphipod test (*Rhepoxynius abronius*) and the Microtox test. Sediment cores, 3 to 4 feet in length, were collected for both Hurlen Construction projects, while surface sediment samples (top 2 cm) were collected for the Morton project and for the Elliott Bay Action Program (PTI and Tetra Tech 1988). From these studies (a total of eight samples), only one sample elicited a statistically significant toxic response in the amphipod test compared with reference sediments. (This sample was not tested using the 20-day *Neanthes* growth test.)

Projects sampled and tested using PSDDA guidelines were evaluated relative to PSDDA unconfined, open-water guidelines. Of the six samples tested biologically for PSDDA disposal, all passed PSDDA's disposal guidelines. However, PSDDA agency representatives would not allow disposal of one dreding unit at a PSDDA site because several chemicals exceeded PSDDA maximum levels.

5.4 BENTHIC COMMUNITY STRUCTURE

No benthic macroinvertebrate community data for Slip 4 were found during this review. General descriptions of expected species and communities are provided in Section 6.1.2.

5.5 BIOACCUMULATION

Tissue chemistry data have been obtained for juvenile chinook salmon collected in Slip 4. These studies are described below. No tissue chemistry data from the river adjacent to Slip 4 were found during this review.

5.5.1 Historical Data Within Slip 4

Two studies have reported tissue chemistry data within Slip 4. A recent study by NOAA/NMFS (Seattle, WA) used existing bioaccumulation data from several studies, including those that collected fish tissue data from the Duwamish River (Meador 2000). This study references a field effort that involved the collection of fish from the lower Duwamish in May 2000. The field study was performed by NOAA/NMFS; however, the raw data are unpublished. As part of this unpublished study, juvenile chinook salmon (originating from a hatchery) were collected in Slip 4, tissue from 5-10 fish was mixed, and the tissues were analyzed for PCBs (whole body). The PCB values were compared to others collected from Kellogg Island, the Green River hatchery, and fish traps located upstream from the hatchery.

Whole-body PCB concentrations reported by NOAA/NMFS are listed in Table 5-11. In 2000, the mean whole-body PCB concentrations in hatchery fish and in wild fish were lower than those reported for hatchery fish collected in Slip 4 (Meador 2000).

In addition, in 1995-1996 Crowley performed bioaccumulation testing on a single sample as part of a maintenance dredging project in Slip 4. Although these sediments have since been dredged, they provide some indication of potential bioaccumulation in organisms from Slip 4 sediments. Tissue chemistry data were reported by PTI (1995b). The intent of the test was to measure the bioaccumulation of fluoranthene in organisms exposed to sediments collected in the dredged area adjacent to Crowley.

Fluoranthene in the sediments exceeded the PSDDA maximum level by 1.4 times (8,500 µg/kg, dry weight). Sediments were tested using the adult bivalve, *Macoma nasuta*, and the adult polychaete, *Nephtys caecoides*. Both species were placed together in the same testing chambers and exposed to test sediments over a 28-day exposure period. Mean post-exposure fluoranthene concentrations in organisms exposed to test and reference sediments were as follows:

Species	Fluoranthene Concentration (ppb wet wt.)	
	Test Sediment	Reference Sediment
Macoma	68.4	Undetected (<5 ppb)
Nepthys	28.5	Undetected (<5 ppb)

The USACE (1996) evaluated the tissue chemistry data and determined in a suitability decision that significant bioaccumulation of fluoranthene in both *Macoma* and *Nephtys* tissues had taken place at levels that may pose ecological health risks. The dredged material management unit represented by this sample was deemed unsuitable for unconfined, open-water disposal.

Additional data on tissue chemical concentrations in juvenile chinook from Slip 4 are currently being collected. The Lower Duwamish Waterway Group collected juvenile chinook tissue samples in Slip 4 in spring and summer 2003 in support of the LDW Phase 2 RI. Both wild and hatchery fish were collected and chemical analysis and data validation is underway. Composite whole-body tissue samples are being analyzed for TBT, PCBs, DDT and pesticides (Windward 2003d). It is anticipated that data will be available in early 2004. Stomach content analysis of fish from Slip 4 was planned but is not being conducted because insufficient quantities of fish were collected. Instead, one composite stomach content sample of fish from multiple locations in the Duwamish may be analyzed.

In addition, the LDWG conducted reconnaissance surveys to assess clam abundance in the lower Duwamish, including Slip 4, in summer 2003 (see Section 6.1.5). If harvestable numbers are present, samples from the intertidal area along the southeast shore of Slip may be collected and considered for analysis of SVOCs, metals, mercury, TBT, PCBs, or organochlorine pesticides (Windward 2003c,f).

5.5.2 Historical Data Outside Slip 4

Fish and shellfish tissue chemistry data collected in the LDW since 1990 were described by Windward (2003h). The majority of samples were collected in the vicinity of Kellogg Island (RM 1.0); some samples were also collected near Harbor Island. No tissue samples have been collected in the river adjacent to Slip 4.

5.6 HISTOPATHOLOGY

Although histopathology data were collected from the Duwamish River in the late 1980s as part of the Elliott Bay Action Program (PTI and Tetra Tech 1988) and by the Puget Sound Ambient Monitoring Program, no post-1990 histopathology data for Slip 4 were found during this review.

6.0 HABITAT ASSESSMENT

Slip 4 is located in a highly developed industrial area, and the shoreline and surrounding areas have been substantially modified and developed. Except for a small park that was developed in the 1990s, most upland habitat has been eliminated. However, the shoreline and marine areas in Slip 4 retain some of the habitat values of natural estuarine environments.

In this section, the general types of habitat found in the Slip 4 area are described, followed by brief summaries of species that are likely to be present in the area. Finally, habitats and endangered or threatened species at Slip 4 are assessed.

6.1 NATURAL RESOURCES

The shoreline and adjacent uplands at Slip 4 have not been systematically surveyed, but information on general habitat types was available from aerial and site photographs and site visits. Little specific data or information on species in Slip 4 was identified during this review. However, it is assumed that most species present in the LDW would likely be present in Slip 4.

6.1.1 Habitat Types

Most upland areas surrounding Slip 4 are developed (see Section 2), although there is some natural area associated with the public park on the southeast side of the slip (at Boeing Plant 2). The park is partially landscaped with ornamental and native flowers, shrubs, grasses, and trees. Species characteristic of disturbed areas (e.g., blackberries) are present along the shoreline, slope, and paths.

Nearly all of the Slip 4 shoreline has been highly modified and includes berths and wharves, riprap (some mixed with sand and gravel), exposed geotextile material, bulkheads, and miscellaneous fill (Figure 6-1). The small areas of unarmored shoreline are generally steep, eroded slopes, vegetated by mixed grasses and shrubs. There is little overhanging vegetation.

At Slip 4, two basic aquatic habitat types can be identified based on depth, sediment grain size, and general topography (Figure 6-1). The first general habitat type is sandy mud or muddy shallow subtidal areas. These areas are found along the center and northwest sides of Slip 4 at depths of -10 to –17 feet MLLW, and are over 60% fine-grained material. The second general habitat type is intertidal at the head and on the southeast side of the slip and is mudflat, composed primarily of 30 – 60% fine-grained material. There are also hard structures such as pilings and riprap. The existing aquatic habitat in Slip 4 supports populations of benthic and epibenthic invertebrates, likely provides habitat for migratory and resident fishes, and may provide feeding and resting areas for shorebirds, waterfowl, and marine birds. Probable aquatic habitat types and functions in Slip 4 are summarized in Table 6-1.

Tanner (1991) identified 4.7 acres at the head of Slip 4 as one of 24 potential intertidal habitat restoration sites in the lower Duwamish estuary. Further evaluation by Metro (1993) ranked Slip 4 low for habitat restoration potential relative to the other sites. They reported that significant habitat restoration in the slip would require regrading the adjacent upland and shoaling dredged subtidal areas, and that sediment contamination issues should be addressed. However, based on its inclusion in the 1991 list, the Lower Duwamish Community Plan (Green-Duwamish Watershed Alliance 1998) includes Slip 4 on its list of proposed habitat restoration projects for the lower Duwamish. There is currently no sponsor or funding source for Slip 4 habitat restoration.

6.1.2 Benthic Invertebrates

No benthic community data for Slip 4 were found during this review. The following descriptions are based on communities in similar habitat types and the limited monitoring results from other locations in the Duwamish.

Cordell et al. (1994, 1996) sampled benthic invertebrate communities at two intertidal reference sites in the Duwamish: at Kellogg Island and the turning basin. The grain sizes at these two locations are similar to intertidal areas at Slip 4, containing approximately 35percent fines. Mean porewater salinities at Kellogg Island and Turning Basin No. 3 [10.8 and 5.3 ppt, respectively], likely bracket those at Slip 4. Intertidal benthic invertebrate assemblages were similar to other locations in the Duwamish River estuary. Although there were differences between sites, the dominant benthic macrofauna included nematodes, oligochaetes, the gammarid amphipod *Corophium* spp., the cumacean *Leucon* sp., the polychaetes *Manayunkia aesturina* and *Hobsonia florida*, and several species in the family *Spionidae.* The bivalve *Macoma* spp. was present at most stations. The benthic meiofauna (small marine organisms) community was dominated by harpacticoid copepods and nematode worms (Cordell et al. 1994, 1996).

Discharges can dramatically affect and alter the benthic community in their immediate vicinity. There are several outfalls at the head of Slip 4, as well as discharge pipes that may or may not be active (see Section 3.4). These discharges may alter benthic communities in their immediate vicinity. For example, a benthic community survey conducted at the Duwamish/Diagonal CSO and storm drain indicated localized increases in abundance of organic enrichment-tolerant species, such as *Capitella* sp., and an overall reduction in diversity (King County 1999).

It is important to note that the benthic invertebrates in intertidal and subtidal habitats of the lower Duwamish are important as prey organisms for resident and migratory fishes, including outmigrating juvenile salmon (Thom et al. 1989, Simenstad et al. 1991, Cordell et al. 1996) and for resident and migratory shorebirds (Battelle et al. 2001, Cordell et al. 2001). The epibenthic organisms that are important in salmonid diets and some shorebirds are abundant in areas of sand and silt and among gradually sloping riprap containing sand and gravel. However, areas of steeply sloping riprap under concrete berths or aprons are less productive feeding habitat for juvenile salmonids (Meyer et al.1981).

6.1.3 Salmonids

The Duwamish River provides habitat for young and returning adult salmonids. General information on these species is summarized below. A comprehensive review of salmonid populations, life histories, and status in the Duwamish/Green River has been prepared by King County (2000) and can be consulted for additional information.

Salmon species currently in the Duwamish/Green River system include:

- Chinook salmon (*Oncorhynchus tshawytscha)*
- Coho salmon (*Oncorhynchus kisutch)*
- Chum salmon (*Oncorhynchus keta)*
- Pink Salmon *(Oncorhynchus gorbuscha)*
- Steelhead trout (*Oncorhynchus mykiss)*
- Cutthroat trout (*Oncorhynchus clarki clarki).*

Prior to the mid-1930s, pink salmon also used the Duwamish-Green River; however, these runs were essentially eliminated from the drainage until a few years ago (Williams et al. 1975, WDFW et al. 1993). In 2001, a significant number of pink salmon were observed in the river for the first time in 80 years. WDFW estimated that there were approximately 7,000 salmon, most likely strays from the Snohomish system, which had a huge run that year (along with other north Puget Sound rivers) (Cropp 2003). This year (2003) proved to be another banner year for pink salmon in the Duwamish-Green River, with estimates ranging from 160,000 to 320,000 salmon. Ocean conditions were evidently ideal for pink salmon, and large runs were observed throughout the Sound. The pink run in the Duwamish-Green is likely a combination of high survival from the 2001 spawning and additional strays from other systems in Puget Sound (Cropp 2003). WDFW biologists are unsure whether this trend will continue in future years, and according to Tom Cropp, “whatever natural selection pressures caused pink salmon to disappear from the system since the 1930s may still be a factor in whether they are a permanent fixture or not.”

Chinook and coho are the dominant salmon species in the Duwamish River. There are both composite (genetic mix of two or more distinct stocks) and wild stocks that migrate through the Duwamish. Stock types and status are summarized in Tables 6-2 and 6.3.

<u>6.1.3.1 Chinook, Coho, and Chum Salmon</u>

Salmon spawning does not occur in the Duwamish River, but begins in the lower Green River (RM 24) and continues upstream (King County 2000). Both adults and juveniles are found in the LDW. The majority of salmonids in the lower Duwamish during the spring and summer are juveniles.

The importance of estuaries, and particularly shallow nearshore areas, in the early life history of salmonids has been well documented (Meyer et al. 1981). These areas provide food, refuge from predators, and acclimation to saltwater. Thorpe (1994) reported that juvenile chinook salmon spend an average of 30 days in the estuary before moving on to open water. Juvenile salmonids in shallow nearshore areas generally feed on benthic invertebrates, but other prey items include insects, plankton, and, to a lesser degree, other fish (USACE 1983). Principal prey items vary in importance for each species, depending on size, habitat, and time of year. For example, stomach content analyses indicated that chum and chinook prey on epibenthic invertebrates in shallow habitat when they are small, but as they grow they rely more on planktonic prey (Meyer et al. 1981). Juvenile salmon captured in unarmored nearshore areas in Puget Sound often have a higher proportion of beach and terrestrial insects in their stomachs (Sobocinski et al. 2003).

Juvenile salmonid use of the Duwamish is well documented (Meyer et al. 1981, Weitkamp 2000, King County 2000). Table 6-2 lists the salmonid species, stock origin, status, and spawning season for the Duwamish/Green River. Meador (2000) confirmed juvenile salmon use in Slip 4, reporting that the catch per unit effort in Slip 4 was about 5 to 10 times higher than that for Kellogg Island on the same day. Windward performed juvenile salmon sampling near Kellogg Island, within Slip 4, and north and south of the mouth of the slip in May and June 2003. Results showed the variability of juvenile salmon use of these areas, with the catch at Kellogg Island 6 times greater than that for Slip 4 on the same day (Florer 2003).

In general, the greatest juvenile salmonid densities are found over shallow, sloping, relatively soft mud beaches (King County 2000). Juveniles are most often found in water at least 1 foot deep but rarely deeper than 4 feet from the surface (USACE et al. 1994). Juveniles of the various salmon species in the Duwamish tend to be segregated in time and habitat (Table 6-3). For example, chum are highly oriented toward shallow nearshore areas but are rarely found in deeper, mid-channel areas (Meyer et al. 1981). Chinook use nearshore areas, but are also found in deeper water. Temporally, juvenile salmonids are most abundant in the Duwamish between mid-April and mid-June. Peak abundance periods are related to hatchery releases.

Upstream migration of adult salmonids occurs throughout the year but is greatest in late summer and fall. Adults tend to stay in shallow nearshore areas before proceeding upriver (King County 2000). Salmonid run size and escapement (the upstream run of spawning salmonids) estimates are listed in Table 6-4. According to Tom Cropp, WDFW fish biologist**,** periodic fluctuations in run size, as shown in Table 6-4, are normal due to freshwater and marine environmental cycles (Cropp 2003). While many Puget Sound salmonid stocks are declining, the Duwamish/Green River chinook and coho stocks are considered healthy (Cropp 2003). There is concern, however, that the wild chinook stock may be overestimated due to contributions from hatchery fish.

Under the Endangered Species Act (ESA), chinook salmon are federally listed as threatened (state listed as candidate species), and Puget Sound coho are a federal candidate species (see Section 6.3).

6.1.3.2 Steelhead Trout

Steelhead are anadromous rainbow trout, who spend their adult lives in saltwater, but migrate to freshwater rivers and lakes to reproduce. Unlike salmon, they can survive spawning and can spawn in multiple years. King County (2000) reports two Duwamish/Green River winter steelhead stocks: a native wild spawning population and an early release hatchery stock. There is also a summer-run hatchery stock. Like the salmon species above, juvenile steelhead use shallow nearshore areas for feeding, refuge, and physiological transition from fresh to saltwater.

All Duwamish/Green River steelhead stocks are considered healthy (Cropp 2003), despite the declining trend in wild steelhead seen in the past 3 years and the poor return of hatchery steelhead this past season (see Table 6-4). Periodic fluctuations in run size are normal due to freshwater and marine environmental cycles. When longer-term downward trends become evident, or if populations suddenly drop to critical levels, additional conservation measures are taken until the problem can be rectified. For example, the WDFW closed the Duwamish/Green River from March 1 through May 31, 2003 to all fishing because the pre-season forecast for the wild steelhead run was not large enough to allow any targeted fisheries (WDFW 2003).

6.1.3.3 Coastal Cutthroat

Coastal cutthroat have complex life histories, and there are both resident and anadromous populations. Unlike other anadromous salmonids, cutthroat prefer to remain within a few miles of their natal stream. In rivers with extensive estuary systems, cutthroat move among intertidal and upriver areas or into saltwater, wherever they can find food. WDFW (2000) considers the Duwamish/Green coastal cutthroat stock distinct based the geographic distribution of its spawning grounds, but there are insufficient data to be absolutely certain. Few data are available concerning the abundance of this species in the Duwamish/Green River basin. Eleven cutthroat trout were captured in beach seines from February to June 1994 (Warner and Fritz 1995), but these data are inadequate to assess current status.

6.1.3.4 Bull Trout

Until recently, the bull trout (*Salvelinus confluentus*) was considered an inland form of Dolly Varden trout, but in 1978 biologists determined that bull trout was a separate species. It is difficult to distinguish the two species on appearance alone. Bull trout are highly mobile and exhibit four different life history forms (adfluvial, fluvial, resident, and anadromous[11]). They prefer habitats that include the cold waters (<59°F) found in headwater streams, rivers, and lakes connected to natal streams. The anadromous form

[11] **Fluvial** fish live in the main stem of rivers and streams. **Adfluvial** fish migrate between lakes and rivers. **Resident** fish are non-anadromous and spend their entire life cycle in freshwater. **Anadromous** fish spend their adult lives in saltwater but migrate to freshwater to spawn.

has been little studied, although they are known to migrate through Puget Sound and are believed to spend most of their time in the nearshore environments feeding on forage fishes.

Information and data on bull trout presence, abundance, and distribution in the Duwamish/Green watershed is lacking, and the stock status is unknown (WDFW 1998). Watson and Toth (1994) stated "it is unclear whether the Green River supports a population of bull trout." There is no information on the timing or distribution of bull trout spawning, if any, in the Green River (WDFW 1998).

Isolated observations of adult bull trout have been reported in the lower Duwamish, including one adult captured at RM 5 in 1994 and two adult bull trout/Dolly Varden (species unconfirmed) at RM 2.1 and 4.0 in the early 1980s. Eight adults were captured near Turning Basin 3 during two sampling events in August and September 2000 (Shannon 2001). It is not known if these fish were of Duwamish/Green River origin, were non-Duwamish/Green River fish temporarily in the Duwamish, or strays attempting to recolonize the basin (King County 2000).

6.1.4 Non-salmonid Fishes

The shallow nearshore areas in the Duwamish provide habitat for young and adults of over 40 different fish species (USACE 1983, Matsuda et al. 1968, Weitkamp and Campbell 1980, Meyer et al. 1981). A complete non-salmonid fish species list for the Duwamish/Green River system was compiled by the USACE (1983) and Windward (2003h), and is provided in Table 6-5.

Primary non-salmonid fish species include English sole, Pacific staghorn sculpin, starry flounder, shiner perch, snake prickleback, Pacific herring, and surf smelt (USACE 1983, USACE et al. 1994). Peak abundance times and habitat types for these species are summarized in Table 6-6. Other estuarine species found in the Duwamish include rainbow trout, bass, bluegill, suckers, sunfish and dace (USACE et al. 1994). Juveniles of many of these fish species rear throughout the spring and summer on mud/sand intertidal substrates in estuarine areas of Puget Sound.

6.1.5 Shellfish

Shellfish resources in the estuarine areas of the Duwamish, with the exception of Kellogg Island, are generally unquantified. Windward (2003g) performed a clam reconnaissance survey at 23 beaches within the LDW, including the Slip 4 area, in July 2003. During the 10-minute, minus-tide, sampling effort, the 4-person team attempted to collect as many clams as possible by locating clam siphon holes. Only two clams were found in Slip 4 during the survey, which were tentatively identified as horse clams (*Tresus capax*). The substrate in Slip 4 was found to be coarse sand. Windward (2003b) performed another clam sampling survey of the beaches in August 2003. Of the 23 beaches, eight beaches were ranked high for clam habitat, including the beach on the east side of Slip 4. Eight clams were found during the August 2003 survey, including two Baltic tellins (*Macoma* *balthica*), three bent-nose clams (*Macoma nasuta*) and two sand gapers (*Mya arenaria*). The substrate was found to be composed of 56.4 percent fines.

In an effort to estimate potential crab and shrimp harvest rates of recreational and subsistence fishers in the LWR, Windward (2003a) performed a pilot study and the first quarterly crab and shrimp survey in August and September 2003, respectively. Crab and shrimp sampling was performed at 38 locations in the LWR using rubber-wrapped crab traps and nestable shrimp pots. The pilot study determined that the optimal sampling time for producing the highest numbers of catch on a per-pull basis was 4 hours. Two locations were sampled in Slip 4 during the quarterly sampling: one near the mouth, and the other about halfway into the slip. The total catch at the sampling location within Slip 4 was two Dungeness crabs (*Cancer magister*). Six slender crabs (*Cancer gracilis*) were caught at the sampling site near the mouth. Of all 38 sampling locations within the LDW, only one dock shrimp (Pandalus danae) was captured at a sampling location near the mouth of the Duwamish.

Windward (2003h) observed mussels on several pilings and other structures in the lower, more saline portion of the LDW, although mussels have also been reported as far up river as slightly above Turning Basin 3.

6.1.6 Reptiles and Amphibians

It is unlikely that reptiles, other than perhaps common garter snakes, are present near Slip 4. Amphibians are also unlikely to be present in the area due to the lack of suitable habitat and their intolerance of saline or estuarine waters (USACE et al. 1994).

6.1.7 Birds

Bird species likely to present at Slip 4 include those adapted to urban environments, such as great blue heron, killdeer, a variety of gull species, swallows, sparrows, finches, rock doves, crows, Canada geese, belted kingfishers, spotted sandpipers, and European starlings. Fifteen bird species were observed in the waterfront park and Slip 4 area during a site visit on June 30, 2003 (Table 6-7). Additional bird species may be present during other times of the year. Bald eagles, peregrine falcons, and osprey have been observed along the Duwamish. Aquatic species include a variety of ducks, including mallards, gadwall, scoters, goldeneyes, and scaup. Pigeon guillemots, mergansers, grebes, and cormorants may feed on small fish (Cordell et al. 1996, USACE et al. 1994, Weston 1996). It is likely that these species would use Slip 4 primarily for resting and feeding, as nesting habitat and cover are limited.

6.1.8 Mammals

The highly developed land use surrounding Slip 4 makes most of the area unsuitable for many species, but the small park on the southeast side of Slip 4 may provide some habitat for terrestrial wildlife. Various small mammals that inhabit urban habitats could be present, including rabbits, opossums, mice, shrews, moles, bats, squirrels, muskrats, and raccoons. There are river otters in the lower Duwamish at Kellogg Island, but lack of suitable habitat makes it unlikely that this species would be found at Slip 4.

The Duwamish River provides habitat for several species of marine mammals that could enter Slip 4, although this is unlikely. Harbor seals and sea lions have been sighted in the Duwamish River corridor. Harbor seals were observed in the vicinity of Slip 4, in fall 2003 (Cummings 2004). A survey by WDFW from December 1998 to June 1999 found seals and sea lions on 17 and 16 occasions, respectively, during a 52-day survey period (WDFW 1999). The nearest haulouts to Slip 4 are located on Harbor Island. Steller sea lion and killer whale have been observed in Elliott Bay but there is no record of these species entering the Duwamish. Similarly, Dall's porpoise are present in the outer bay south of West Point, and minke and gray whales are occasionally reported in Elliott Bay, but these species are unlikely to enter the Duwamish.

6.2 SPECIAL AQUATIC SITES

Special aquatic sites are areas having unique or significant value to many species. An area identified and mapped as priority habitat has one or more of the following attributes:

- Comparatively high fish and wildlife density
- Comparatively high fish and wildlife species diversity
- Important fish and wildlife breeding habitat
- Important fish and wildlife seasonal ranges
- Important fish and wildlife movement corridors
- Limited availability
- High vulnerability to habitat alteration
- Unique or dependent species.

A priority habitat may be described by dominant plant species or successional stage (e.g., eelgrass meadows, old-growth forest) or may consist of a specific habitat element (e.g., consolidated marine/estuarine shorelines) of key value to fish and wildlife.

A database search of the Washington Department of Fish and Wildlife's (WDFW) Priority Habitat and Species Data System was conducted for Slip 4 and the surrounding area. No special aquatic sites are listed in the Slip 4 area, other than the classification of all the lower Duwamish as estuarine habitat.

6.3 THREATENED, ENDANGERED, AND SPECIES OF CONCERN

A database search of the WDFW's Priority Habitat and Species Data System was conducted for the Slip 4 area to determine whether species listed under the ESA are present. With the exception of chinook salmon, no federal- or state-listed sensitive, threatened, or endangered wildlife species are listed in the immediate vicinity of Slip 4. Similarly, the Natural Heritage Program indicated that they have no records of rare plants, high-quality native wetlands, or native plant communities in the vicinity of Slip 4.

Endangered, threatened, and candidate species that may be present in the Duwamish River, including Slip 4 or Elliott Bay, are discussed in the following sections.

6.3.1 Chinook Salmon

Puget Sound chinook salmon were listed as a federally threatened species on March 24, 1999. Washington State has listed chinook salmon as a candidate species. Critical habitat designated for this species includes all marine, estuarine, and river reaches accessible to listed chinook salmon in Puget Sound, and so includes the Duwamish River and Slip 4.

In February 2000, the National Marine Fisheries Service (NMFS) issued critical habitat designations for 19 salmon and steelhead evolutionary significant units (ESUs) on the West Coast, including the Puget Sound chinook stock. On April 30, 2002, a U.S. District Court approved a NMFS consent decree withdrawing the critical habitat designations for these 19 ESUs because of inadequate decision-making processes. Currently, the NMFS is completing a more thorough reanalysis and will reissue the designations at a future date. The ESA status for Puget Sound chinook remains unchanged (*www.nwr.noaa.gov*).

Juvenile chinook may spend several weeks in the Duwamish, including Slip 4, during their migration from river to ocean. Adults may also linger in these estuarine areas before proceeding upriver to spawn. Additional information on this species is presented in Section 6.1.

6.3.2 Coho Salmon

The NMFS determined in July 1995 that a listing for the coho salmon in Puget Sound was not warranted. However, this species was designated as a candidate for listing due to concerns over specific risk factors.

There are two coho stocks in the Green River that spend time in the Duwamish as juveniles and returning adults. Both are mixed, composite stocks. The Green River/Soos Creek stock is healthy, but the Newaukum Creek stock is depressed. Additional information is presented in Section 6.1.

6.3.3 Bull Trout

The U.S. Fish and Wildlife Service listed bull trout as threatened under the ESA in November 1999, but critical habitat has not yet been designated. The bull trout is listed as a state candidate species. As described in Section 6.1, information and data on bull trout presence, abundance, and distribution in the Duwamish/Green watershed is lacking, although isolated observations of adult bull trout in the lower Duwamish have been reported.

6.3.4 Non-salmonid Fishes

Two fish species occurring in Elliott Bay and possibly the Duwamish/Green River system are proposed for listing (i.e., candidate species) by Washington State: Pacific cod (*Gadus macrocephalus),* and the river lamprey (*Lampetra ayresi*). The river lamprey is also a federal species of concern.

6.3.5 Birds

Bald eagles (*Haliaeetus leucocephalus)* are federal- and state-listed threatened species that have been observed foraging in the general vicinity of Elliott Bay and the Duwamish River. However, no known perch or nest sites for these species have been reported near Slip 4. The nearest bald eagle nest is at Duwamish Head (identified as nest site #1023 by WDFW), which is located near Salty's Restaurant in West Seattle, approximately 5 miles from Slip 4 (Port of Seattle 1997).

Peregrine falcons (*Falco peregrinus*) are federal species of concern that nest in the greater Seattle area and are seen foraging for starlings, rock doves, and small ducks in the Duwamish corridor. A falcon pair has unsuccessfully attempted to nest under the West Seattle freeway bridge for several years now. The downtown falcon pair, which has fledged young in past years from their nest on top of the Washington Mutual tower, also was unsuccessful this year. New nesting sites in 2003 included the grain terminal near Queen Anne and the Eastgate Bridge on I-90 between Mercer Island and Bellevue (Anderson 2003). Peregrine falcon breeding success in Washington in recent years resulted in WDFW reclassifying the species from state threatened status to state sensitive in April 2002.

Purple martins (*Progne subis*), the largest members of the swallow family, have been observed foraging in the Slip 4 area. These migratory birds are candidates for listing by Washington State because of a loss of nesting habitat and competition from other cavity-nesting birds. However, the recent introduction of artificial cavities mounted on pilings and similar structures, including several along the lower Duwamish, have boosted the populations of purple martins in Puget Sound. According to Kevin Li (2003), there is an active colony at Jack Block Park (approximately 3 miles north of Slip 4) and smaller colonies at Terminal 105 and Kellogg Island (2.5 and 2 miles away, respectively).

7.0 HUMAN USES

The Duwamish corridor is the "industrial breadbasket" of King County, providing one of the largest manufacturing and industrial centers in the Pacific Northwest. Consequently, human use of the area surrounding Slip 4 is high and includes commercial, industrial, recreational, and some residential activities. Given the small size of Slip 4 and its highly industrial use, human activities there are limited to cargo shipping and container maintenance at Crowley's facilities on the slip's north shore, picnicking and walking at the small public park, and perhaps some recreational boating and fishing within and near the slip itself.

7.1 INDUSTRIAL ACTIVITIES

As described in Section 2.1, Crowley operates a marine container shipping service on the north shore of Slip 4. Known as the 8th Avenue Terminal, operations there are typical of other cargo facilities up and down the Duwamish. Steel containers are removed from truck chassis and stacked on barges for shipment to Alaska. During a site visit to Slip 4 on June 30, 2003, the slip was dominated by the presence of two barges being loaded with containers, vehicles, and other cargo.

7.2 FISHING

Commercial, recreational, and subsistence fishing occurs primarily in Elliott Bay, the East and West waterways, and in the Duwamish/Green River. Salmon are the most popular catch, but there is also a sport fishery for bottomfish near the mouth of the Duwamish. According to WDFW, the outlook for salmon fishing in 2003 is promising, given high expected returns of chinook, coho, chum, and even pink salmon (*www.wa.gov/wdfw*).

Fishing opportunities in the lower river are enhanced by several public access points, including two motorboat launches, three hand boat launches, and nine shoreline access sites. The small public park at the mouth of Slip 4 has no public access to the Duwamish River. However, there are access points to the slip itself, and fishing could occur via access by boat and land.

7.2.1 Commercial, Subsistence, and Ceremonial Tribal Fishing

Elliott Bay, the East and West waterways, and the lower Duwamish River are identified as usual and accustomed fishing areas for both the Muckleshoot and Suquamish tribes. Usual and accustomed fishing areas recognize commercial, subsistence, and ceremonial tribal fishing rights. Commercial fishing activities by tribal members are consistent with past treaties with the federal government and subsequent court decisions. The Muckleshoot Tribe is the only tribe with federally recognized treaty rights in the vicinity of Slip 4 (St. Amant 2003). The Duwamish Tribe has been unsuccessful in their efforts to be federally recognized as an organized Indian tribe and therefore is ineligible for treaty fishing rights.

Muckleshoot and Suquamish tribal members harvest chinook, coho, chum, and steelhead salmon in these traditional fishing areas in late summer, fall, and winter. They employ set and drift gillnets and hook-and-line gear to meet their fish allotments. Fishing seasons and fishing gear for each of the three salmonid species are described below:

- **Chinook Salmon**. Members of the Muckleshoot Tribe conduct a 3-week test fishery in late July and early August, results of which are used to determine whether the first 12-hour full-fleet fishery will take place in August. Five sites are fished one night per week with one net at each site. If certain minimum amounts of chinook are caught in the pre-season fishery, the first full opening is scheduled. The catch in the first full opening is then used to determine if an additional 24-hour opening is warranted for the following week. Fishing usually occurs on Wednesday evenings and ends on Thursday mornings of specified weeks in August. Fishing gear consists of drift gillnets up to 1,200 feet long in Elliott Bay and set gillnets up to 200 feet long in the East and West waterways and in the Duwamish River (Cropp 2003, Port of Seattle 1997). The first opening in 2003 was Wednesday, August 6, at which time 3,000 chinook salmon were caught by gillnetters as far upstream on the Duwamish as the turning basin. Approximately 80 nets were set throughout the river, with no specific reports of fishing within Slip 4 (Hage 2003).

- **Coho and Chum Salmon**. Fishing takes place from mid-September to early December. The tribes deploy nets similar in dimension to those used in the chinook fishery. Fishing occurs 24 hours a day (Cropp 2003, Port of Seattle 1997).

- **Steelhead**. Fishing takes place 3 days per week, for 3 weeks in early December. This fishery provides an in-season update for the hatchery run size. The tribes then fish 5 days per week until their allotted number of either hatchery or wild fish has been caught. They may then use hook-and-line gear to catch any uncaught fish in either allotment (Cropp 2003, Port of Seattle 1997).

Commercial fishing for estuarine fishes in Elliott Bay is limited by a 1989 ban on commercial bottom trawling in Puget Sound and commercial shipping and ferry traffic.

7.2.2 Sport Fishing

Similar to the commercial fishery, sport fishing in the Duwamish is focused primarily on salmon. This fishery is intensely managed by WDFW and coincides with seasonal runs. Elliott Bay and the Duwamish River are popular fishing locations. The salmon fishing season in the Duwamish Waterway area is open from November 1-30, with a two-fish limit, of which one may be a chinook (22-inch minimum size). The season opens again from December 16 until the end of February, with a one-fish limit (22-inch chinook minimum). Fishing seasons within Elliott Bay have similar catch requirements but are open during the summer months during brief periods (approximately 4 days each) (*www.wa.gov/wdfw*). In 2003, sport fisheries occurred from August 4-7 and again from August 11-14. There is also a considerable sport fishery for bottomfish in the bay near the Duwamish estuary. Sport fishing within Slip 4 is possible, but the extent and frequency are unknown.

7.2.3 Subsistence/Tribal Fishing

Evidence of subsistence fishing (i.e., utilizing fish from the LDW as the sole source of protein) in the river is somewhat limited. Recent surveys have documented relatively high seafood consumption for several Puget Sound populations (Suquamish Tribe 2000, EPA 1999), some of which may be fishing the river for subsistence reasons (Marcia Henning, outreach coordinator for the state's Environmental Health Assessments, believes that many people who fish the river, including Samoan, Tongan, Vietnamese, Hmong, Lao, and Russian immigrants, many of whom do not speak English, are fishing for subsistence purposes (Welch 2002). County health officials have issued advisories against consuming shellfish and eating too much bottomfish from the lower reaches of the river, but communicating these risks to immigrant populations has been difficult. Subsistence/tribal fishing may be limited at this time, but this use may change in the future.

7.3 OTHER RECREATION

The recreational value of the lower Duwamish River is lessened by intensive urban-industrial development along the river. Most of the land area adjacent to and surrounding Slip 4 is devoted to industrial use, except for the small park on the southeastern side of the slip that is maintained by Boeing. This street-end park is a public access site; however, no signage is evident at the park entrance. During a site visit on June 30, 2003, eight "public use only" parking spots were observed. One enters the unnamed park by walking down a paved walkway between two chain-link fences. The pavement becomes a gravel pathway a short distance later, and the vegetation becomes more diverse, including a mixture of native and non-native species. The pathway encircles a small hill with a viewing bench overlooking the Duwamish. Blackberry brambles and riprap along the shore limit access to the river from the park.

While no people were observed using the park during the site visit, the park trails and bench area were maintained. According to B.J. Cummings (2003), the park is a popular spot for Boeing employees to eat lunch. Visitation by the public is likely very low because of the lack of signage and the general appearance that the park is privately owned. Besides picnicking, possible recreational activities at the park include walking and nature study.

Other recreational activities within and near the slip may include kayaking, canoeing, and motorboating. Few, if any, people engage in activities such as swimming, SCUBA diving, and windsurfing in the lower reaches of the Duwamish. These activities are curtailed by the extensive commercial use of the river.

8.0 DATA GAPS

Additional information will need to be collected before the proposed cleanup boundary can be identified and the engineering evaluation/cost analysis (EE/CA) process initiated. Potential data gaps were identified based on information presented in this report, as well as the approach used at other early action areas (i.e., Terminal 117) and data needs identified for the overall LDW RI (Windward 2003h). The potential data gaps determined to be applicable to conditions at Slip 4 are listed in Table 8-1. Data gaps relate to physical features, sources, chemical and biological characterization and geotechnical information. Information is needed in each of these areas to either define the early action remediation area or to support the engineering design for the remediation effort.

The sampling design and rationale for the collection of new data by the City of Seattle and King County, as part of the characterization of Slip 4, will be provided to EPA in a separate set of sampling and analysis plans. Data collection and analyses may include iterative phases and, based on the results of future sampling (including source control evaluations), additional data may need to be collected. In addition, data collection to support engineering analyses may be required during the EE/CA.

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TABLES

Table 2-1. GIS Data Source Summary.

Theme	File Name	Description	Source	Date
Area of Interest	DataQueryArea_slip4.shp	Data query area of spatial information selected for analysis	SEA	2003
Area of Interest	early_action_area_SEA_0503_Poly	Slip 4 Early Action Area (Work Plan for Investigation Tasks)	SEA/SPU	2003
Bathymetry	winw05_sh3_e55_a345_v3.tif	Shaded relief model of multibeam sonar survey	LDW Bathymetric Survey DRAFT; David Evans & Assoc.	2003
Channel	Channel.shp	Approximate location of navigation channel	LDWG Phase 1 RI GIS (Windward)	1997
Chemistry	selected_locations_EXCEEDANCE_FACTORS.shp	Chemical concentrations screened from DB with SQS/CSL EFs per sample location (used in EF Figures)	LDWG Phase 1 RI DB (Windward)	2003
Chemistry	selected_locations_6_Chemicals.shp	Chemical concentrations (6) screened from DB with SQS/CSL EFs per sample location (used in Grid Interpolation)	LDWG Phase 1 RI DB (Windward)	2003
Chemistry	selected_locations_AROCLORS.shp	PCB Aroclor concentration cross-tabulation per location	LDWG Phase 1 RI DB (Windward)	2003
Contours	contours.shp	Upland 2 ft contour intervals, NAVD 88.	Pathways Project Groundwater CD	1993
Dredging	dmmu's.shp	Historical dredging in the navigation channel	USACE	Unknown
Dredging	sea-composites-2.shp	DMMU composite areas relating to sediment chemistry	USACE suitability determination memoranda	1990-2000
Dredging	sea-dmmus-marine-power-81.shp	Marine Power & Equipment DMMU	USACE dredge permits	1981
Dredging	sea-dmmus-w-marine-const-82.shp	Western-Marine-Construction-82-D DMMU	USACE dredge permits	1982
Fines Distribution	SCL_SummaryPercentFines_20030910.shp	Sample fines screened from DB for use in Grid Interpolation	LDWG Phase 1 RI DB (Windward)	2003
Habitat	slip4-habitat-types.shp	Habitat areas sketched referencing 1999 aerials; created for the Slip 4 area	SEA/SPU 1999 aerial images	1999
Hydro	oldsh.shp	Historical shoreline of the Duwamish River	Pathways Project Groundwater CD	1980
Hydro	wtrbdy.shp	Water bodies; a determination of MHW line along the shore, typically the 8 ft. NAVD contour	Seattle Public Utilities GIS, King County GIS	1997-2001
Imagery	Digital aerial photos(tif)	Color ortho photos, 1/2 foot resolution, July 1999	Seattle Public Utilities GIS/Triathlon	1999
Imagery	Nagative KC-02 5-17	Walker and Assoc. Aerial Photographs	Walker and Assoc.	2002
Property	parcels.shp	Assessors taxlots	Seattle Public Utilities GIS	1994/2002
Sediment Data	selected_locations_w_test_type.shp	Selected sample locations with test matrix attribute	LDWG Phase 1 RI DB (Windward)	2003
Sediment Data	Selected_Station_locations.shp	Selected station locations within the data query area	LDWG Phase 1 RI DB (Windward)	2003
Structure	bldg-partl-update-2000.shp	SPU/GIS building shapefile updated to 1999 photos within data query area	SPU GIS	1999

Table 2-1. GIS Data Source Summary.

Theme	File Name	Description	Source	Date
Structure	docks-piers-barges.shp	Waterway structures in and around Slip 4	SEA, 1999 images	1999
Structure	nbfield-flume-layers.dwg	Features exported from CAD drawing	Unknown	Unknown
TOC Distribution	TOC_from_EFs_selected-stations_shape.shp	TOC screened from DB for use in Grid Interpolation	LDWG Phase 1 RI DB (Windward)	2003
Trans	paveedge.shp	Paved road edges	SPU GIS	1994
Trans	snd.shp	Street network centerline	SPU GIS	1994
Utilities	Building_2-01_St.Plane.shp	Historical Boeing Plant II with drainage features	Storm Sewer Master M111-1988 and 1990 aerial photo.	1988
Utilities	dwulat.shp	Storm/Sewer Lateral line	SPU GIS	2000
Utilities	dwulatpt.shp	Storm/Sewer Lateral feature point	SPU GIS	2000
Utilities	dwumnl.shp	Storm/Sewer Main line	SPU GIS	2000
Utilities	dwumnlpt.shp	Storm/Sewer Main feature point	SPU GIS	2000
Utilities	outfall-we.shp	Lower Duwamish outfall location survey	SPU	2003
Utilities	sewer.shp	King County Wastewater Treatment sewer mainlines	KC-WTD GIS	2000
Utilities	slip4_drainage-basins	Slip 4 outfall drainage basins	SPU GIS	2003

Table 2-2. Summary of Dredging in Slip 4 and Vicinity.

Agency/Company	Year	Maximum Quantity - yd^3 (per plans or permit)	Approximate Dredged Depth (ft MLLW)
Slip 4			
Marine Power and Equipment	1981 (5 yr)	85,000	-15
8th Avenue Terminal/Crowley Marine	1996	13,000	-17
Navigation Channel			
USACE, Station 157 - 223	1960	48,126	-15 to -20
USACE, Station 157 - 223	1964	251,355	-15 to -20
USACE, Station 155- 203	1978	130,000	-15 to -20
Other Private Facilities in Vicinity			
Hurlen Construction	1973	1,300	---
	1990[a]	4,000	---
	1999	15,100	---
Western Marine Construction	1983	4,000	-10
Morton	1992	7,990	---

[a] Original permit received in 1987 for 10- yr period.

Note: The term for most permits is 3 years; exceptions are noted. Whenever possible, the date listed is the year dredging was actually completed. Reported volumes are from permit applications or suitability decisions and therefore reflect maximum possible quantities rather than the actual volume of material that may have been removed.

References: PTI (1995a,b), USACE (1996), Harper-Owes (1985), Tetra Tech (1988a), USACE permits and suitability decisions.

Table 3-1. Regulatory Database Listings for Facilities Adjacent to Slip 4.

Property		**Address**	**NPDES Permit**	**UST List (# USTs, Status)**	**LUST List (# Reported Releases, Status)**	**Hazardous Waste Generator Status**	**CSCSL**
Parcel D/F	Crowley Marine Services Inc.	7400 8th Ave S	Not Listed	Not Listed	Not Listed	Inactive	Not Listed
	Northland Services Transfer Station		SO3003646C	Not Listed	Not Listed	Active Transfer Facility	
	Samson Tug & Barge Co Inc.		Not Listed	Not Listed	Not Listed	WAD980981849	
Parcel E	Emerald Services	7343 E Marginal Way S	Not Listed	Not Listed	Not Listed	LQG, WAD058364647	Not Listed
	Evergreen Marine Leasing		Not Listed	2 Closed in Place	Not Listed	Not Listed	
	Cedar Grove Composting		SO3002641C	Not Listed	Not Listed	Not Listed	
Boeing Plant 2		7755 E Marginal Way S	SO3000482D	3 Operational, 8 Exempt, 7 Removed	2 Cleanup Started, 1 Reported Cleaned Up	LQG, WAD009256819	Site ID 2100
Georgetown Steam Plant		1131 South Elizabeth	Not Listed	4 Removed	Reported Cleaned Up	Not Listed	Site ID 6487827
North Boeing Field		7500 E Marginal Way	SO3000226D	4 Operational; 3 Exempt; 21 Removed; 3 Closed in Place	4 Reported Cleaned Up	LQG, WAD980982037	Site ID 2050 Site ID 2053 (Boeing North Field JP4 Tanks)

Notes:
NPDES: National Pollutant Discharge Elimination System.
UST List: Ecology's Underground Storage Tank list.
LUST List: Ecology's Leaking Underground Storage Tank list.
CSCSL: Ecology's Confirmed and Suspected Contaminated Sites List.
LQG: Large Quantity Generator.

Table 3-2. Slip 4 Outfalls (Tetra Tech 1988a,b; Schmoyer 2003).

Name	Outfall Diameter (inches)	Estimated Annual Discharge (Mgal/yr)	Drainage Area (acres)	Description
I-5 Storm Drain	72	10	120	Drains approximately 1.5 miles of I-5 between S. Dawson St. and S. Myrtle St., 40 acres of primarily residential land east of I-5, and part of Georgetown neighborhood (industrial, commercial, residential).
Georgetown Flume	60	---	Unknown	Originally installed to discharge cooling water from SCL's Georgetown Steamplant. Numerous side drains from North Boeing Field and other unidentified sources were sealed in 1985. Currently discharges stormwater entering open flume.
Slip 4 EOF/SD (117)	24	140 (SD)[a]	3 (SD); 75 (EOF)	City of Seattle emergency overflow for sanitary sewer pump station and currently drains small area on north end of King County airport (Boeing Field)[b]. Reported that stormwater discharge from this drain was diverted to the 60 inch Slip 4 Storm Drain (described below) in about 1976.
Slip 4 Storm Drain	60	150	290	Drains part of King County Airport (Boeing Field).
East Marginal Way Pump Station EOF (W034)	36	---	318	King County/Metro emergency sewer overflow pump station[c].
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Private SD	8	Unknown	Unknown	Located at Crowley Marine property.
Private SD	8	Unknown	Unknown	Located at Crowley Marine property.
Private SD	6	Unknown	Unknown	Located at First South Properties.

Table 3-2. Slip 4 Outfalls (Tetra Tech 1988a,b; Schmoyer 2003).

Name	Outfall Diameter (inches)	Estimated Annual Discharge (Mgal/yr)	Drainage Area (acres)	Description
Private SD	6	Unknown	Unknown	Located at First South Properties.
Private SD	4	Unknown	Unknown	Located at First South Properties.
Private SD	6	Unknown	Unknown	Located at First South Properties.
Private SD	6	Unknown	Unknown	Located at First South Properties.
Private SD	24?	Unknown	Unknown	Located at Boeing Plant 2.
Private SD	24?	Unknown	Unknown	Located at Boeing Plant 2.

[a]The City of Seattle Slip 4 EOF (117) (formerly CSO [117]) is an emergency overflow. Discharge from this EOF results from an equipment or power failure. Therefore, discharge from the EOF is infrequent and the annual discharge is most often zero (Tetra Tech 1988b).

[b]SPU records indicate that there have been no overflows from this pump station in the last four years (Schmoyer 2004).

[c]There has not been a recorded overflow from the East Marginal Way pump station since recordkeeping began in the 1970s.

Table 3-3. Chemical Concentrations (mg/kg) in Drain Sediments Entering Slip 4 in 1984 (Metro 1985, *as cited in Tetra Tech 1986*).

Analyte	Slip 4 EOF/SD	Slip 4 SD	I-5 SD	Georgetown Flume (near head)	Georgetown Flume (near midpoint)
Arsenic	37.6	115	11	116	27.7
Cadmium	24.1	31.6	1.79	2.88	6.33
Chromium	105	126	33.8	95.3	89.5
Copper	178	119	30.0	227	103
Nickel	29.8	37.4	31.3	35.5	24.8
Lead	649	248	447	698	529
Zinc	571	218	349	494	433
PCBs	103	20	<1	137	18

Table 3-4. Concentrations of Problem Chemicals in Slip 4 Drain Sediments in 1985 (Tetra Tech 1988a).

Analyte	Slip 4 EOF/SD	Slip 4 SD	I-5 SD
Metals (mg/kg)			
Cadmium	33.9	---[a]	---
Lead	745	---	556 & 714
Mercury	9.02E	---	---
Silver	19.1E		---
Organics (ug/kg dry wt.)			
Naphthalene	3000	---	---
Fluorene	4900	---	---
Phenanthrene	7200	---	---
Fluoranthene	9900	---	---
Indeno(1,2,3-c,d)pyrene	2100E	---	---
LPAH	16000E	---	---
HPAH	40000E	---	---
2-methyl-naphthalene	6200	---	---
4-methylphenol	1400E	---	---
p,p'-DDE	3400X	---	---
p,p'-DDT	4300X	---	---
PCBs	260000E	---	---

[a]Dashes indicate that chemical was not identified by Tetra Tech (1988a) as a problem chemical (i.e., did not exceed highest apparent effects threshold).

E = estimated

X = low internal standard recovery

Table 4-1. Washington State Water Quality Criteria for Conventional Parameters in the Lower Duwamish River (WAC 173-201A)[a].

Parameter	User Category	Curent Freshwater Standard
Fecal Coliform Bacteria	Secondary Contact Recreation	Geometric mean <200 colonies/100 mL, not more than 10% over 400 col/100 mL
Dissolved Oxygen	Salmon and Trout Rearing and Migration	> 6.5 mg/L[b]
Temperature	Salmon and Trout Rearing and Migration	< 17.5°C[c]
pH	Salmon and Trout Rearing and Migration	6.5 - 8.5
Turbidity	Salmon and Trout Rearing and Migration	<10 NTU when background turbidity <50 NTU, <20% increase when background >50 NTU
Total Dissolved Gas	Salmon and Trout Rearing and Migration	< 100% of saturation at any point of sample collection
Ammonia	----	Dependent on water temperature and pH

[a]Standards adopted by Ecology and submitted to EPA in July 2003. These standards have not yet been approved by EPA.

[b]1-day minimum

[c]7-day average of daily maximum temperature

Table 4-2. Water Quality in the Lower Duwamish River. (Data for selected parameters collected downstream[a] and upstream[b] of Slip 4, January 1999 - April 2003) (Mickelson 2003).

Parameter	Station	Depth	Number of Measurements	Range
Temperature (^oC)	305	Surface	50	5.1 - 17.3
		Bottom	50	6.3 - 14.6
	307	Surface	54	4.8 - 19.8
		Bottom	44	7.4 - 16.3
Dissolved Oxygen (mg/L)	305	Surface	51	5.9 - 11.2
		Bottom	51	3.4 - 11
	307	Surface	55	4.2 - 12
		Bottom	46	3.2 - 9.4
Turbidity (NTU)	305	Surface	51	0.64 - 23
		Bottom	51	0.5 - 3.9
	307	Surface	54	1.7 - 33.1
		Bottom	46	1.7 - 19
pH	305	Surface	35	7.41 - 7.88
		Bottom	31	7.65 - 8
	307	Surface	36	7.18 - 7.86
		Bottom	29	7.62 - 7.94
Ammonia - Nitrogen (mg/L)	305	Surface	51	0.05 - 0.08
		Bottom	43	0.01 - 0.05
	307	Surface	54	0.01 - 0.09
		Bottom	46	0.01- 0.11
Fecal coliform	305	Surface	51	2 - 750
		Bottom	51	0 - 100
	307	Surface	55	5 - 740
		Bottom	45	2 - 120
Escherichia coli	305	Surface	49	1 - 540
		Bottom	49	0 - 66
	307	Surface	51	9 - 660
		Bottom	45	2 - 110

Table 4-2. Water Quality in the Lower Duwamish River. (Data for selected parameters collected downstream[a] and upstream[b] of Slip 4, January 1999 - April 2003) (Mickelson 2003).

Parameter	Station	Depth	Number of Measurements	Range
Salinity (PSS)	305	Surface	36	4.7474 - 29.225
		Bottom	41	8.421 - 30.627
	307	Surface	27	2.0074 - 27.702
		Bottom	35	23.126 - 29.834
Total Suspended Solids (mg/L)	305	Surface	50	1 - 25.9
		Bottom	51	1.3 - 13.2
	307	Surface	31	1.8 - 30
		Bottom	46	2.7 - 138

[a]Station 0305, Spokane St. Bridge
[b]Station 0307, 16th Avenue Bridge

Table 4-3. Slip 4 Water Sampling Results (Meador 2003).

Sample Location	PCBs (Method 8082)	Total PAHs (ng/mL) (Method 8720C-SIM)
1 - near Crowley dock opposite tanks[a]	not detected[c]	0.1
2 - head of slip[b]	not detected[c]	0.72

[a]47 32.150', 122 19.173'
[b]47 32.180; 122 19.133'
[c]Method reporting limit (MRL) for most PCB congeners was 4.9 to 5.0 ng/L (Meador 2003)

Table 5-1. Existing Sediment Chemistry Data Collected from 1990 to 2003.

Report Title	Year Sampled	Station/ Sample Prefix	Sample Information	Analytes[a]	Reference
Environmental Site Assessment, First Interstate Bank of Washington Property, 7400 8th Ave S. & 7343 E. Marginal Way S.	1990	SL-	Surface samples (0 - 15 cm), Subsurface cores (up to 10 ft)	metals, semivolatiles, volatiles, PCB Aroclors, pesticides, TOC	Landau 1990
Duwamish Waterway Phase 1 Site Report	1997	R-	Surface samples (0 - 10 cm)	metals, volatiles, semivolatiles, PCB Aroclors, conventionals	Exponent 1998
Duwamish Waterway Sediment Characterization Study Report	1997	EST, EIT, WES, WIT, WST	Surface samples (0 - 10 cm)	PCB congeners, grain size, TOC	NOAA 1998
Site Inspection Report: Lower Duwamish River (RK 2.5 - 11.5) Seattle, Washington	1998	DR-	Surface samples (0 - 10 cm)	metals, semivolatiles, volatiles, organotins, PCB Aroclors and congeners, pesticides, dioxin/furans, grain size, TOC	Weston 1999b
Additional Investigations Outside and Adjacent to Slip 4					
RCRA Facility Investigation Duwamish Waterway Sediment Investigation, Plant 2	1994 - 1996	SD-DUW	Surface samples (0 - 10 cm)	PCB Aroclors, grain size, TOC	Weston 1996, 1997
King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay	1997	WQA	Surface samples (0 - 2 cm)	metals, semivolatiles, volatiles, PCB Aroclors, conventionals	King County 1999

[a]Not all analytes analyzed in all samples.

Table 5-2. Numerical Criteria for Puget Sound Marine Sediments.

	Dredged Material Management Program (PSDDA)		**Sediment Management Standards**	
	SL	**ML**	**SQS**	**CSL/MCUL**
Metals	***(mg/kg, dry weight)***		***(mg/kg, dry weight)***	
Antimony	150	200	---	---
Arsenic	57	700	57	93
Cadmium	5.1	14	5.1	6.7
Chromium	--	--	260	270
Copper	390	1,300	390	390
Lead	450	1,200	450	530
Mercury	0.41	2.3	0.41	0.59
Nickel	140	370	---	---
Silver	6.1	8.4	6.1	6.1
Zinc	410	3,800	410	960
Organics	***(ug/kg, dry weight)***		***(mg/kg organic carbon)***	
LPAHs	5,200	29,000	370	780
Naphthalene	2,100	2,400	99	170
Acenaphthylene	560	1,300	66	66
Acenaphthene	500	2,000	16	57
Fluorene	540	3,600	23	79
Phenanthrene	1,500	21,000	100	480
Anthracene	960	13,000	220	1,200
2-Methylnaphthalene	670	1,900	38	64
HPAHs	12,000	69,000	960	5,300
Fluoranthene	1,700	30,000	160	1,200
Pyrene	2,600	16,000	1,000	1,400
Benzo(a)anthracene	1,300	5,100	110	270
Chrysene	1,400	21,000	110	460
Benzofluoranthenes	3,200	9,900	230	450
Benzo(a)pyrene	1,600	3,600	99	210
Indeno(1,2,3-c,d)pyrene	600	4,400	34	88
Dibenzo(a,h)anthracene	230	1,900	12	33
Benzo(g,h,i)perylene	670	3,200	31	78
Chlorinated Hydrocarbons				
1,3-Dichlorobenzene	170	---	---	---
1,4-Dichlorobenzene	110	120	3.1	9
1,2-Dichlorobenzene	35	110	2.3	2.3
1,2,4-Trichlorobenzene	31	64	0.81	1.8
Hexachlorobenzene	22	230	0.38	2.3
Phthalates				
Dimethylphthalate	1,400	---	53	53
Diethylphthalate	1,200	---	61	110
Di-n-buylphthalate	5,100	---	220	1,700
Butylbenzylphthalate	970	---	4.9	64
Bis(2-ethylhexyl)phthalate	8,300	---	47	78
Di-n-octylphthalate	6,200	---	58	4,500

Table 5-2. Numerical Criteria for Puget Sound Marine Sediments.

	Dredged Material Management Program (PSDDA)		Sediment Management Standards	
	SL	**ML**	**SQS**	**CSL/MCUL**
Miscellaneous				
Dibenzofuran	540	1,700	15	58
Hexachlorobutadiene	29	270	3.9	6.2
Hexachloroethane	1,400	14,000	---	---
N-nitrosodiphenylamine	28	130	11	11
Total PCBs	130	3,100	12	65
Chlorinated Pesticides				
Total DDT	6.9	69	---	---
Aldrin	10	---	---	---
Chlordane	10	---	---	---
Dieldrin	10	---	---	---
Heptachlor	10	---	---	---
Lindane	10	---	---	---
Volatile Organic Compounds				
Ethylbenzene	10	50	---	---
Tetrachloroethene	57	210	---	---
Total xylene	40	160	---	---
Trichloroethene	160	1,600	---	---
Ionizable Organic Compounds	***(ug/kg, dry weight)***		***(µg/kg, dry weight)***	
Phenol	420	1,200	420	1,200
2-Methylphenol	63	77	63	63
4-Methylphenol	670	3,600	670	670
2,4-Dimethylphenol	29	210	29	29
Pentachlorophenol	400	690	360	690
Benzyl Alcohol	57	870	57	73
Benzoic Acid	650	760	650	650

Table 5-3. Historic (pre-1990) Sampling in Slip 4.

Survey	Sampling Date	Sample Type	Analytes	Data Source	Reference
EPA 1982 - 1983	1982	surface	SVOC, PCBs, pesticides, metals, conventionals	SEDQUAL database	EPA 1982, 1983
EPA - Elliott Bay Action Program	Sept - Oct 1985	surface (0 - 2 cm)	VOC, SVOC, PCBs, pesticides, metals,	SEDQUAL database	PTI and Tetra Tech 1988
King County/Metro	April 1984	surface[a]	metals, oil and grease	King County LIMS[b]	Stern 2003
Evergreen Marine Leasing	1989	cores (up to 46 cm)	VOC, SVOC, PCBs, pesticides, metals, conventionals	source documents	Hart Crowser 1989a,b

[a]Depth unconfirmed but probably 0 - 2 cm (Stern 2003).

[b]Laboratory Information Management System

Table 5-4. Summary of Slip 4 Surface Sediment Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
SMS Chemicals of Concern								
Inorganics								
Arsenic (mg/kg, dry wt)	23	23	100	7.3	34.2	18.5	14.7	31.3
Cadmium (mg/kg, dry wt)	23	23	100	0.337	7.5	1.8	0.9	3.5
Chromium (mg/kg, dry wt)	23	23	100	22	118	56	42	97.3
Copper (mg/kg, dry wt)	23	23	100	41	154	83	69	140
Lead (mg/kg, dry wt)	23	23	100	29.8	721	146.2	86	326
Mercury (mg/kg, dry wt)	23	23	100	0.04	1.12	0.26	0.19	0.46
Silver (mg/kg, dry wt)	22	22	100	0.14	5.7	1.3	0.8	2.2
Zinc (mg/kg, dry wt)	23	23	100	92	536	208	159	411
LPAHs								
Naphthalene (ug/kg, dry wt)	22	16	73	30	130	65	60	130
Anthracene (ug/kg, dry wt)	22	21	95	61 J	2800	357	160	700
Acenaphthene (ug/kg, dry wt)	22	18	82	30	1300	167	64	250
Acenaphthylene (ug/kg, dry wt)	22	8	36	19	140	55	34	80
Fluorene (ug/kg, dry wt)	22	20	91	20	390	110	69 J	260
Phenanthrene (ug/kg, dry wt)	22	22	100	37 J	8000	1058	480	2400
2-Methylnaphthalene (ug/kg, dry wt)	22	15	68	20	120	47	37 M	90
Total LPAH (calc'd) (ug/kg, dry wt)	22	22	100	37	11645	1702	785	4339
HPAHs								
Pyrene (ug/kg, dry wt)	22	20	91	120	9900	2327	1200	7500
Fluoranthene (ug/kg, dry wt)	22	22	100	100	13000	2250	1400	3600
Chrysene (ug/kg, dry wt)	22	22	100	67	3800	1169	740	3000
Benzo(a)anthracene (ug/kg, dry wt)	22	22	100	41 J	3900	903	540	2500
Benzo(a)pyrene (ug/kg, dry wt)	22	22	100	47	3500 J	829	420	1700
Benzo(b)fluoranthene (ug/kg, dry wt)	13	13	100	240	4700 J	1175	580	2400
Benzo(k)fluoranthene (ug/kg, dry wt)	13	13	100	200	3300 J	818	490	1700
Benzofluoranthenes (total-calc'd) (ug/kg, dry wt)	22	22	100	120	8000	2254	1250	5100
Indeno(1,2,3-cd)pyrene (ug/kg, dry wt)	22	22	100	36 J	2300 J	579	320	1300
Dibenzo(a,h)anthracene (ug/kg, dry wt)	22	20	91	30	680 J	205	100	670
Benzo(g,h,i)perylene (ug/kg, dry wt)	22	19	86	20	2100 J	319	100	830
Total HPAH (calc'd) (ug/kg, dry wt)	22	22	100	411	34170	9484	5160	21328
Chlorinated Hydrocarbons								
1,2-Dichlorobenzene (ug/kg, dry wt)	22	0	0					
1,4-Dichlorobenzene (ug/kg, dry wt)	22	0	0					
1,2,4-Trichlorobenzene (ug/kg, dry wt)	22	0	0					
Hexachlorobenzene (ug/kg, dry wt)	22	1	5	1.7 J	1.7 J	1.7	1.7 J	1.7 J
Phthalates								
Diethyl phthalate (ug/kg, dry wt)	22	1	5	44 J	44 J	44	44 J	44 J
Dimethyl phthalate (ug/kg, dry wt)	22	5	23	20	70	34	24 J	28 J
Di-n-butyl phthalate (ug/kg, dry wt)	22	12	55	20	200 M	76	62	120
Di-n-octyl phthalate (ug/kg, dry wt)	22	16	73	26 J	2700	447	200 J	1100
Butyl benzyl phthalate (ug/kg, dry wt)	22	15	68	20	500	95	47 J	270
Bis(2-ethylhexyl)phthalate (ug/kg, dry wt)	22	22	100	250	11000 K	2411	1100	5100

Table 5-4. Summary of Slip 4 Surface Sediment Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
Miscellaneous Chemicals								
Dibenzofuran (ug/kg, dry wt)	22	18	82	24 M	280	84	50	220
Hexachlorobutadiene (ug/kg, dry wt)	22	0	0					
N-Nitrosodiphenylamine (ug/kg, dry wt)	22	1	5	780	780	780	780	780
PCBs								
Aroclor-1016 (ug/kg, dry wt)	13	0	0					
Aroclor-1016/1242 (ug/kg, dry wt)	9	4	44	590	2100	1078	630	990
Aroclor-1221 (ug/kg, dry wt)	13	0	0					
Aroclor-1232 (ug/kg, dry wt)	13	0	0					
Aroclor-1242 (ug/kg, dry wt)	13	5	38	59	1600 J	463	76	446
Aroclor-1248 (ug/kg, dry wt)	22	5	23	140	680	394	200	650
Aroclor-1254 (ug/kg, dry wt)	22	22	100	56	34000	4284	1200	9700
Aroclor-1260 (ug/kg, dry wt)	22	15	68	84 J	2400	508	260	944 J
PCBs (total-calc'd) (ug/kg, dry wt)[a]	39	39	100	56	34000	4269	1400	16400
Ionizable Organics								
Phenol (ug/kg, dry wt)	22	8	36	20 J	120	45	26 J	75 M
2-Methylphenol (ug/kg, dry wt)	22	0	0					
4-Methylphenol (ug/kg, dry wt)	16	3	19	22	93	49	22	33 J
2,4-Dimethylphenol (ug/kg, dry wt)	22	0	0					
Pentachlorophenol (ug/kg, dry wt)	22	0	0					
Benzoic acid (ug/kg, dry wt)	22	1	5	130 J	130 J	130	130 J	130 J
Benzyl alcohol (ug/kg, dry wt)	22	0	0					
Selected Non-SMS Chemicals								
Inorganics								
Antimony (mg/kg, dry wt)	6	0	0					
Nickel (mg/kg, dry wt)	23	23	100	17.4	52	31	28	44
Butyltins								
Dibutyltin as ion (ug/kg, dry wt)	2	2	100	20 J	32 J	26	20 J	20 J
n-Butyltin (ug/kg, dry wt)	2	1	50	8 J	8 J	8	8 J	8 J
Tetrabutyltin (ug/kg, dry wt)	2	0	0					
Tributyltin as ion (ug/kg, dry wt)	2	2	100	40	40 J	40	40	40
Misc. Organics								
1,3-Dichlorobenzene (ug/kg, dry wt)	22	0	0					
Carbazole (ug/kg, dry wt)	13	12	92	20	410	110	50	180
Hexachloroethane (ug/kg, dry wt)	22	0	0					
Ethylbenzene (ug/kg, dry wt)	1	0	0					
Tetrachloroethene (ug/kg, dry wt)	1	0	0					
Trichloroethene (ug/kg, dry wt)	1	0	0					
Pesticides								
4,4'-DDD (ug/kg, dry wt)	10	1	10	840	840	840	840	840
4,4'-DDE (ug/kg, dry wt)	10	1	10	370 J	370 J	370	370 J	370 J
4,4'-DDT (ug/kg, dry wt)	10	1	10	1670	1670	1670	1670	1670

Table 2-1. GIS Data Source Summary.

Theme	File Name	Description	Source	Date
Area of Interest	DataQueryArea_slip4.shp	Data query area of spatial information selected for analysis	SEA	2003
Area of Interest	early_action_area_SEA_0503_Poly	Slip 4 Early Action Area (Work Plan for Investigation Tasks)	SEA/SPU	2003
Bathymetry	winw05_sh3_e55_a345_v3.tif	Shaded relief model of multibeam sonar survey	LDW Bathymetric Survey DRAFT; David Evans & Assoc.	2003
Channel	Channel.shp	Approximate location of navigation channel	LDWG Phase 1 RI GIS (Windward)	1997
Chemistry	selected_locations_EXCEEDANCE_FACTORS.shp	Chemical concentrations screened from DB with SQS/CSL EFs per sample location (used in EF Figures)	LDWG Phase 1 RI DB (Windward)	2003
Chemistry	selected_locations_6_Chemicals.shp	Chemical concentrations (6) screened from DB with SQS/CSL EFs per sample location (used in Grid Interpolation)	LDWG Phase 1 RI DB (Windward)	2003
Chemistry	selected_locations_AROCLORS.shp	PCB Aroclor concentration cross-tabulation per location	LDWG Phase 1 RI DB (Windward)	2003
Contours	contours.shp	Upland 2 ft contour intervals, NAVD 88.	Pathways Project Groundwater CD	1993
Dredging	dmmu's.shp	Historical dredging in the navigation channel	USACE	Unknown
Dredging	sea-composites-2.shp	DMMU composite areas relating to sediment chemistry	USACE suitability determination memoranda	1990-2000
Dredging	sea-dmmus-marine-power-81.shp	Marine Power & Equipment DMMU	USACE dredge permits	1981
Dredging	sea-dmmus-w-marine-const-82.shp	Western-Marine-Construction-82-D DMMU	USACE dredge permits	1982
Fines Distribution	SCL_SummaryPercentFines_20030910.shp	Sample fines screened from DB for use in Grid Interpolation	LDWG Phase 1 RI DB (Windward)	2003
Habitat	slip4-habitat-types.shp	Habitat areas sketched referencing 1999 aerials; created for the Slip 4 area	SEA/SPU 1999 aerial images	1999
Hydro	oldsh.shp	Historical shoreline of the Duwamish River	Pathways Project Groundwater CD	1980
Hydro	wtrbdy.shp	Water bodies; a determination of MHW line along the shore, typically the 8 ft. NAVD contour	Seattle Public Utilities GIS, King County GIS	1997-2001
Imagery	Digital aerial photos(tif)	Color ortho photos, 1/2 foot resolution, July 1999	Seattle Public Utilities GIS/Triathlon	1999
Imagery	Nagative KC-02 5-17	Walker and Assoc. Aerial Photographs	Walker and Assoc.	2002
Property	parcels.shp	Assessors taxlots	Seattle Public Utilities GIS	1994/2002
Sediment Data	selected_locations_w_test_type.shp	Selected sample locations with test matrix attribute	LDWG Phase 1 RI DB (Windward)	2003
Sediment Data	Selected_Station_locations.shp	Selected station locations within the data query area	LDWG Phase 1 RI DB (Windward)	2003
Structure	bldg-partl-update-2000.shp	SPU/GIS building shapefile updated to 1999 photos within data query area	SPU GIS	1999

Table 2-1. GIS Data Source Summary.

Theme	File Name	Description	Source	Date
Structure	docks-piers-barges.shp	Waterway structures in and around Slip 4	SEA, 1999 images	1999
Structure	nbfield-flume-layers.dwg	Features exported from CAD drawing	Unknown	Unknown
TOC Distribution	TOC_from_EFs_selected-stations_shape.shp	TOC screened from DB for use in Grid Interpolation	LDWG Phase 1 RI DB (Windward)	2003
Trans	paveedge.shp	Paved road edges	SPU GIS	1994
Trans	snd.shp	Street network centerline	SPU GIS	1994
Utilities	Building_2-01_St.Plane.shp	Historical Boeing Plant II with drainage features	Storm Sewer Master M111-1988 and 1990 aerial photo.	1988
Utilities	dwulat.shp	Storm/Sewer Lateral line	SPU GIS	2000
Utilities	dwulatpt.shp	Storm/Sewer Lateral feature point	SPU GIS	2000
Utilities	dwumnl.shp	Storm/Sewer Main line	SPU GIS	2000
Utilities	dwumnlpt.shp	Storm/Sewer Main feature point	SPU GIS	2000
Utilities	outfall-we.shp	Lower Duwamish outfall location survey	SPU	2003
Utilities	sewer.shp	King County Wastewater Treatment sewer mainlines	KC-WTD GIS	2000
Utilities	slip4_drainage-basins	Slip 4 outfall drainage basins	SPU GIS	2003

Table 3-1. Regulatory Database Listings for Facilities Adjacent to Slip 4.

Property		**Address**	**NPDES Permit**	**UST List (# USTs, Status)**	**LUST List (# Reported Releases, Status)**	**Hazardous Waste Generator Status**	**CSCSL**
Parcel D/F	Crowley Marine Services Inc.	7400 8th Ave S	Not Listed	Not Listed	Not Listed	Inactive	Not Listed
	Northland Services Transfer Station		SO3003646C	Not Listed	Not Listed	Active Transfer Facility	
	Samson Tug & Barge Co Inc.		Not Listed	Not Listed	Not Listed	WAD980981849	
Parcel E	Emerald Services	7343 E Marginal Way S	Not Listed	Not Listed	Not Listed	LQG, WAD058364647	Not Listed
	Evergreen Marine Leasing		Not Listed	2 Closed in Place	Not Listed	Not Listed	
	Cedar Grove Composting		SO3002641C	Not Listed	Not Listed	Not Listed	
Boeing Plant 2		7755 E Marginal Way S	SO3000482D	3 Operational, 8 Exempt, 7 Removed	2 Cleanup Started, 1 Reported Cleaned Up	LQG, WAD009256819	Site ID 2100
Georgetown Steam Plant		1131 South Elizabeth	Not Listed	4 Removed	Reported Cleaned Up	Not Listed	Site ID 6487827
North Boeing Field		7500 E Marginal Way	SO3000226D	4 Operational; 3 Exempt; 21 Removed; 3 Closed in Place	4 Reported Cleaned Up	LQG, WAD980982037	Site ID 2050
							Site ID 2053 (Boeing North Field JP4 Tanks)

Notes:
NPDES: National Pollutant Discharge Elimination System.
UST List: Ecology's Underground Storage Tank list.
LUST List: Ecology's Leaking Underground Storage Tank list.
CSCSL: Ecology's Confirmed and Suspected Contaminated Sites List.
LQG: Large Quantity Generator.

Table 3-2. Slip 4 Outfalls (Tetra Tech 1988a,b; Schmoyer 2003).

Name	Outfall Diameter (inches)	Estimated Annual Discharge (Mgal/yr)	Drainage Area (acres)	Description
I-5 Storm Drain	72	10	120	Drains approximately 1.5 miles of I-5 between S. Dawson St. and S. Myrtle St., 40 acres of primarily residential land east of I-5, and part of Georgetown neighborhood (industrial, commercial, residential).
Georgetown Flume	60	---	Unknown	Originally installed to discharge cooling water from SCL's Georgetown Steamplant. Numerous side drains from North Boeing Field and other unidentified sources were sealed in 1985. Currently discharges stormwater entering open flume.
Slip 4 EOF/SD (117)	24	140 (SD)[a]	3 (SD); 75 (EOF)	City of Seattle emergency overflow for sanitary sewer pump station and currently drains small area on north end of King County airport (Boeing Field)[b]. Reported that stormwater discharge from this drain was diverted to the 60 inch Slip 4 Storm Drain (described below) in about 1976.
Slip 4 Storm Drain	60	150	290	Drains part of King County Airport (Boeing Field).
East Marginal Way Pump Station EOF (W034)	36	---	318	King County/Metro emergency sewer overflow pump station[c].
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Unknown	8	Unknown	Unknown	Located at Crowley Marine property.
Private SD	8	Unknown	Unknown	Located at Crowley Marine property.
Private SD	8	Unknown	Unknown	Located at Crowley Marine property.
Private SD	6	Unknown	Unknown	Located at First South Properties.

Table 3-2. Slip 4 Outfalls (Tetra Tech 1988a,b; Schmoyer 2003).

Name	Outfall Diameter (inches)	Estimated Annual Discharge (Mgal/yr)	Drainage Area (acres)	Description
Private SD	6	Unknown	Unknown	Located at First South Properties.
Private SD	4	Unknown	Unknown	Located at First South Properties.
Private SD	6	Unknown	Unknown	Located at First South Properties.
Private SD	6	Unknown	Unknown	Located at First South Properties.
Private SD	24?	Unknown	Unknown	Located at Boeing Plant 2.
Private SD	24?	Unknown	Unknown	Located at Boeing Plant 2.

[a]The City of Seattle Slip 4 EOF (117) (formerly CSO [117]) is an emergency overflow. Discharge from this EOF results from an equipment or power failure. Therefore, discharge from the EOF is infrequent and the annual discharge is most often zero (Tetra Tech 1988b).
[b]SPU records indicate that there have been no overflows from this pump station in the last four years (Schmoyer 2004).
[c]There has not been a recorded overflow from the East Marginal Way pump station since recordkeeping began in the 1970s.

Table 4-1. Washington State Water Quality Criteria for Conventional Parameters in the Lower Duwamish River (WAC 173-201A)[a].

Parameter	User Category	Curent Freshwater Standard
Fecal Coliform Bacteria	Secondary Contact Recreation	Geometric mean <200 colonies/100 mL, not more than 10% over 400 col/100 mL
Dissolved Oxygen	Salmon and Trout Rearing and Migration	> 6.5 mg/L[b]
Temperature	Salmon and Trout Rearing and Migration	< 17.5^{o}C[c]
pH	Salmon and Trout Rearing and Migration	6.5 - 8.5
Turbidity	Salmon and Trout Rearing and Migration	<10 NTU when background turbidity <50 NTU, <20% increase when background >50 NTU
Total Dissolved Gas	Salmon and Trout Rearing and Migration	< 100% of saturation at any point of sample collection
Ammonia	----	Dependent on water temperature and pH

[a]Standards adopted by Ecology and submitted to EPA in July 2003. These standards have not yet been approved by EPA.

[b]1-day minimum

[c]7-day average of daily maximum temperature

Table 5-1. Existing Sediment Chemistry Data Collected from 1990 to 2003.

Report Title	Year Sampled	Station/ Sample Prefix	Sample Information	Analytes[a]	Reference
Environmental Site Assessment, First Interstate Bank of Washington Property, 7400 8th Ave S. & 7343 E. Marginal Way S.	1990	SL-	Surface samples (0 - 15 cm), Subsurface cores (up to 10 ft)	metals, semivolatiles, volatiles, PCB Aroclors, pesticides, TOC	Landau 1990
Duwamish Waterway Phase 1 Site Report	1997	R-	Surface samples (0 - 10 cm)	metals, volatiles, semivolatiles, PCB Aroclors, conventionals	Exponent 1998
Duwamish Waterway Sediment Characterization Study Report	1997	EST, EIT, WES, WIT, WST	Surface samples (0 - 10 cm)	PCB congeners, grain size, TOC	NOAA 1998
Site Inspection Report: Lower Duwamish River (RK 2.5 - 11.5) Seattle, Washington	1998	DR-	Surface samples (0 - 10 cm)	metals, semivolatiles, volatiles, organotins, PCB Aroclors and congeners, pesticides, dioxin/furans, grain size, TOC	Weston 1999b
Additional Investigations Outside and Adjacent to Slip 4					
RCRA Facility Investigation Duwamish Waterway Sediment Investigation, Plant 2	1994 - 1996	SD-DUW	Surface samples (0 - 10 cm)	PCB Aroclors, grain size, TOC	Weston 1996, 1997
King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay	1997	WQA	Surface samples (0 - 2 cm)	metals, semivolatiles, volatiles, PCB Aroclors, conventionals	King County 1999

[a]Not all analytes analyzed in all samples.

Table 5-2. Numerical Criteria for Puget Sound Marine Sediments.

	Dredged Material Management Program (PSDDA)		**Sediment Management Standards**	
	SL	**ML**	**SQS**	**CSL/MCUL**
Metals	***(mg/kg, dry weight)***		***(mg/kg, dry weight)***	
Antimony	150	200	---	---
Arsenic	57	700	57	93
Cadmium	5.1	14	5.1	6.7
Chromium	--	--	260	270
Copper	390	1,300	390	390
Lead	450	1,200	450	530
Mercury	0.41	2.3	0.41	0.59
Nickel	140	370	---	---
Silver	6.1	8.4	6.1	6.1
Zinc	410	3,800	410	960
Organics	***(ug/kg, dry weight)***		***(mg/kg organic carbon)***	
LPAHs	5,200	29,000	370	780
Naphthalene	2,100	2,400	99	170
Acenaphthylene	560	1,300	66	66
Acenaphthene	500	2,000	16	57
Fluorene	540	3,600	23	79
Phenanthrene	1,500	21,000	100	480
Anthracene	960	13,000	220	1,200
2-Methylnaphthalene	670	1,900	38	64
HPAHs	12,000	69,000	960	5,300
Fluoranthene	1,700	30,000	160	1,200
Pyrene	2,600	16,000	1,000	1,400
Benzo(a)anthracene	1,300	5,100	110	270
Chrysene	1,400	21,000	110	460
Benzofluoranthenes	3,200	9,900	230	450
Benzo(a)pyrene	1,600	3,600	99	210
Indeno(1,2,3-c,d)pyrene	600	4,400	34	88
Dibenzo(a,h)anthracene	230	1,900	12	33
Benzo(g,h,i)perylene	670	3,200	31	78
Chlorinated Hydrocarbons				
1,3-Dichlorobenzene	170	---	---	---
1,4-Dichlorobenzene	110	120	3.1	9
1,2-Dichlorobenzene	35	110	2.3	2.3
1,2,4-Trichlorobenzene	31	64	0.81	1.8
Hexachlorobenzene	22	230	0.38	2.3
Phthalates				
Dimethylphthalate	1,400	---	53	53
Diethylphthalate	1,200	---	61	110
Di-n-buylphthalate	5,100	---	220	1,700
Butylbenzylphthalate	970	---	4.9	64
Bis(2-ethylhexyl)phthalate	8,300	---	47	78
Di-n-octylphthalate	6,200	---	58	4,500

Table 5-3. Historic (pre-1990) Sampling in Slip 4.

Survey	**Sampling Date**	**Sample Type**	**Analytes**	**Data Source**	**Reference**
EPA 1982 - 1983	1982	surface	SVOC, PCBs, pesticides, metals, conventionals	SEDQUAL database	EPA 1982, 1983
EPA - Elliott Bay Action Program	Sept - Oct 1985	surface (0 - 2 cm)	VOC, SVOC, PCBs, pesticides, metals,	SEDQUAL database	PTI and Tetra Tech 1988
King County/Metro	April 1984	surface[a]	metals, oil and grease	King County LIMS[b]	Stern 2003
Evergreen Marine Leasing	1989	cores (up to 46 cm)	VOC, SVOC, PCBs, pesticides, metals, conventionals	source documents	Hart Crowser 1989a,b

[a]Depth unconfirmed but probably 0 - 2 cm (Stern 2003).

[b]Laboratory Information Management System

Table 5-4. Summary of Slip 4 Surface Sediment Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
SMS Chemicals of Concern								
Inorganics								
Arsenic (mg/kg, dry wt)	23	23	100	7.3	34.2	18.5	14.7	31.3
Cadmium (mg/kg, dry wt)	23	23	100	0.337	7.5	1.8	0.9	3.5
Chromium (mg/kg, dry wt)	23	23	100	22	118	56	42	97.3
Copper (mg/kg, dry wt)	23	23	100	41	154	83	69	140
Lead (mg/kg, dry wt)	23	23	100	29.8	721	146.2	86	326
Mercury (mg/kg, dry wt)	23	23	100	0.04	1.12	0.26	0.19	0.46
Silver (mg/kg, dry wt)	22	22	100	0.14	5.7	1.3	0.8	2.2
Zinc (mg/kg, dry wt)	23	23	100	92	536	208	159	411
LPAHs								
Naphthalene (ug/kg, dry wt)	22	16	73	30	130	65	60	130
Anthracene (ug/kg, dry wt)	22	21	95	61 J	2800	357	160	700
Acenaphthene (ug/kg, dry wt)	22	18	82	30	1300	167	64	250
Acenaphthylene (ug/kg, dry wt)	22	8	36	19	140	55	34	80
Fluorene (ug/kg, dry wt)	22	20	91	20	390	110	69 J	260
Phenanthrene (ug/kg, dry wt)	22	22	100	37 J	8000	1058	480	2400
2-Methylnaphthalene (ug/kg, dry wt)	22	15	68	20	120	47	37 M	90
Total LPAH (calc'd) (ug/kg, dry wt)	22	22	100	37	11645	1702	785	4339
HPAHs								
Pyrene (ug/kg, dry wt)	22	20	91	120	9900	2327	1200	7500
Fluoranthene (ug/kg, dry wt)	22	22	100	100	13000	2250	1400	3600
Chrysene (ug/kg, dry wt)	22	22	100	67	3800	1169	740	3000
Benzo(a)anthracene (ug/kg, dry wt)	22	22	100	41 J	3900	903	540	2500
Benzo(a)pyrene (ug/kg, dry wt)	22	22	100	47	3500 J	829	420	1700
Benzo(b)fluoranthene (ug/kg, dry wt)	13	13	100	240	4700 J	1175	580	2400
Benzo(k)fluoranthene (ug/kg, dry wt)	13	13	100	200	3300 J	818	490	1700
Benzofluoranthenes (total-calc'd) (ug/kg, dry wt)	22	22	100	120	8000	2254	1250	5100
Indeno(1,2,3-cd)pyrene (ug/kg, dry wt)	22	22	100	36 J	2300 J	579	320	1300
Dibenzo(a,h)anthracene (ug/kg, dry wt)	22	20	91	30	680 J	205	100	670
Benzo(g,h,i)perylene (ug/kg, dry wt)	22	19	86	20	2100 J	319	100	830
Total HPAH (calc'd) (ug/kg, dry wt)	22	22	100	411	34170	9484	5160	21328
Chlorinated Hydrocarbons								
1,2-Dichlorobenzene (ug/kg, dry wt)	22	0	0					
1,4-Dichlorobenzene (ug/kg, dry wt)	22	0	0					
1,2,4-Trichlorobenzene (ug/kg, dry wt)	22	0	0					
Hexachlorobenzene (ug/kg, dry wt)	22	1	5	1.7 J	1.7 J	1.7	1.7 J	1.7 J
Phthalates								
Diethyl phthalate (ug/kg, dry wt)	22	1	5	44 J	44 J	44	44 J	44 J
Dimethyl phthalate (ug/kg, dry wt)	22	5	23	20	70	34	24 J	28 J
Di-n-butyl phthalate (ug/kg, dry wt)	22	12	55	20	200 M	76	62	120
Di-n-octyl phthalate (ug/kg, dry wt)	22	16	73	26 J	2700	447	200 J	1100
Butyl benzyl phthalate (ug/kg, dry wt)	22	15	68	20	500	95	47 J	270
Bis(2-ethylhexyl)phthalate (ug/kg, dry wt)	22	22	100	250	11000 K	2411	1100	5100

Table 5-4. Summary of Slip 4 Surface Sediment Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
Miscellaneous Chemicals								
Dibenzofuran (ug/kg, dry wt)	22	18	82	24 M	280	84	50	220
Hexachlorobutadiene (ug/kg, dry wt)	22	0	0					
N-Nitrosodiphenylamine (ug/kg, dry wt)	22	1	5	780	780	780	780	780
PCBs								
Aroclor-1016 (ug/kg, dry wt)	13	0	0					
Aroclor-1016/1242 (ug/kg, dry wt)	9	4	44	590	2100	1078	630	990
Aroclor-1221 (ug/kg, dry wt)	13	0	0					
Aroclor-1232 (ug/kg, dry wt)	13	0	0					
Aroclor-1242 (ug/kg, dry wt)	13	5	38	59	1600 J	463	76	446
Aroclor-1248 (ug/kg, dry wt)	22	5	23	140	680	394	200	650
Aroclor-1254 (ug/kg, dry wt)	22	22	100	56	34000	4284	1200	9700
Aroclor-1260 (ug/kg, dry wt)	22	15	68	84 J	2400	508	260	944 J
PCBs (total-calc'd) (ug/kg, dry wt)[a]	39	39	100	56	34000	4269	1400	16400
Ionizable Organics								
Phenol (ug/kg, dry wt)	22	8	36	20 J	120	45	26 J	75 M
2-Methylphenol (ug/kg, dry wt)	22	0	0					
4-Methylphenol (ug/kg, dry wt)	16	3	19	22	93	49	22	33 J
2,4-Dimethylphenol (ug/kg, dry wt)	22	0	0					
Pentachlorophenol (ug/kg, dry wt)	22	0	0					
Benzoic acid (ug/kg, dry wt)	22	1	5	130 J	130 J	130	130 J	130 J
Benzyl alcohol (ug/kg, dry wt)	22	0	0					
Selected Non-SMS Chemicals								
Inorganics								
Antimony (mg/kg, dry wt)	6	0	0					
Nickel (mg/kg, dry wt)	23	23	100	17.4	52	31	28	44
Butyltins								
Dibutyltin as ion (ug/kg, dry wt)	2	2	100	20 J	32 J	26	20 J	20 J
n-Butyltin (ug/kg, dry wt)	2	1	50	8 J	8 J	8	8 J	8 J
Tetrabutyltin (ug/kg, dry wt)	2	0	0					
Tributyltin as ion (ug/kg, dry wt)	2	2	100	40	40 J	40	40	40
Misc. Organics								
1,3-Dichlorobenzene (ug/kg, dry wt)	22	0	0					
Carbazole (ug/kg, dry wt)	13	12	92	20	410	110	50	180
Hexachloroethane (ug/kg, dry wt)	22	0	0					
Ethylbenzene (ug/kg, dry wt)	1	0	0					
Tetrachloroethene (ug/kg, dry wt)	1	0	0					
Trichloroethene (ug/kg, dry wt)	1	0	0					
Pesticides								
4,4'-DDD (ug/kg, dry wt)	10	1	10	840	840	840	840	840
4,4'-DDE (ug/kg, dry wt)	10	1	10	370 J	370 J	370	370 J	370 J
4,4'-DDT (ug/kg, dry wt)	10	1	10	1670	1670	1670	1670	1670

Table 5-4. Summary of Slip 4 Surface Sediment Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
DDTs (total-calc'd) (ug/kg, dry wt)	10	1	10	2880	2880	2880	2880	2880
Aldrin (ug/kg, dry wt)	10	0	0					
alpha-Chlordane (ug/kg, dry wt)	10	1	10	26	26	26	26	26
Dieldrin (ug/kg, dry wt)	10	1	10	280	280	280	280	280
Endrin (ug/kg, dry wt)	10	0	0					
gamma-BHC (ug/kg, dry wt)	10	0	0					
Heptachlor (ug/kg, dry wt)	10	0	0					
Heptachlor epoxide (ug/kg, dry wt)	10	0	0					
PCB Congeners and Total PCBs and PCTs								
PCB-101 (ug/kg, dry wt)	23	23	100	16 J	5600 J	527	160 J	930 J
PCB-105 (ug/kg, dry wt)	22	22	100	2.4	560	55	20	92
PCB-110 (ug/kg, dry wt)	17	17	100	8.5	3000	362	110	710
PCB-118 (ug/kg, dry wt)	23	22	96	8.3	2200	204	66	280
PCB-123 (ug/kg, dry wt)	6	0	0					
PCB-126 (ug/kg, dry wt)	22	0	0					
PCB-128 (ug/kg, dry wt)	23	23	100	3.4 J	620 J	67	18 J	150 J
PCB-138 (ug/kg, dry wt)	23	23	100	4.4	1400	160	56	310
PCB-153 (ug/kg, dry wt)	23	23	100	13 J	3000 J	305	100 J	520 J
PCB-156 (ug/kg, dry wt)	23	20	87	0.74	160	19	6.9	36
PCB-157 (ug/kg, dry wt)	22	12	55	1	56	10	4	12
PCB-167 (ug/kg, dry wt)	6	5	83	1	15	6	2	8
PCB-169 (ug/kg, dry wt)	23	0	0					
PCB-170 (ug/kg, dry wt)	23	23	100	2.1	250	33	16	65
PCB-18 (ug/kg, dry wt)	6	5	83	2 J	170 J	47	4 J	52 J
PCB-180 (ug/kg, dry wt)	23	21	91	3.4	330	47	23	85
PCB-187 (ug/kg, dry wt)	6	6	100	5	35	15	7	24
PCB-189 (ug/kg, dry wt)	23	6	26	1.5	10	3.4	1.9	3.2
PCB-195 (ug/kg, dry wt)	6	2	33	4	6	5	4	4
PCB-206 (ug/kg, dry wt)	6	3	50	3	7	5	3	4
PCB-209 (ug/kg, dry wt)	6	1	17	1	1	1	1	1
PCB-28 (ug/kg, dry wt)	6	6	100	3 J	120 J	29	6 J	27 J
PCB-44 (ug/kg, dry wt)	6	6	100	8 J	190 J	60	15 J	94 J
PCB-52 (ug/kg, dry wt)	0							
PCB-66 (ug/kg, dry wt)	6	6	100	21	440	147	38	230
PCB-77 (ug/kg, dry wt)	23	8	35	1.1	15	5.1	3.6	7.3
PCB-81 (ug/kg, dry wt)	6	0	0					
PCBs + PCTs (total) (ug/kg, dry wt)	17	17	100	110	26000	3406	1100	7100
Polychlorinated Terphenyls (total) (ug/kg, dry wt)	17	17	100	13	550	87	41	160

[a]Total PCBs sample numbers include both total Aroclor and total congener data.
J = Estimated
K = Reported concentration is less than the quantitation limit.
M = Estimated value of analyte found and confirmed by analyst but with low spectral match.

Table 5-5. Summary of Surface Sediment Chemistry Data Outside Slip 4.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
SMS Chemicals of Concern								
Inorganics								
Arsenic (mg/kg, dry wt)	23	23	100	4.3	16	10.4	10.3	14
Cadmium (mg/kg, dry wt)	23	15	65	0.12	0.72	0.31	0.31	0.41
Chromium (mg/kg, dry wt)	23	23	100	15	29	23	23	26.8
Copper (mg/kg, dry wt)	23	23	100	24	57	36	35	46
Lead (mg/kg, dry wt)	23	23	100	11.8	32.3	19.1	16.4	31.4
Mercury (mg/kg, dry wt)	23	23	100	0.05	0.17	0.10	0.09	0.15
Silver (mg/kg, dry wt)	23	14	61	0.14	0.35	0.22	0.22	0.3
Zinc (mg/kg, dry wt)	23	23	100	53	117	76	70	95
LPAHs								
Naphthalene (ug/kg, dry wt)	19	3	16	20	60	37	20	30
Anthracene (ug/kg, dry wt)	19	15	79	20	1500	174	50	330
Acenaphthene (ug/kg, dry wt)	19	10	53	30	740	134	53.3	110
Acenaphthylene (ug/kg, dry wt)	19	3	16	20	60	40	20	40
Fluorene (ug/kg, dry wt)	19	12	63	20	1700	200	60	120
Phenanthrene (ug/kg, dry wt)	19	19	100	70	16000	1100	160	790
2-Methylnaphthalene (ug/kg, dry wt)	19	2	11	30	80	55	30	30
Total LPAH (calc'd) (ug/kg, dry wt)	19	19	100	90	20030	1446	220	1350
HPAHs								
Pyrene (ug/kg, dry wt)	19	19	100	150	11000	1134	310	2700
Fluoranthene (ug/kg, dry wt)	19	19	100	190	18000	1656	390	4200
Chrysene (ug/kg, dry wt)	19	19	100	100	3400	491	190	1800
Benzo(a)anthracene (ug/kg, dry wt)	19	19	100	80	3000	421	140 J	1500
Benzo(a)pyrene (ug/kg, dry wt)	19	19	100	70	1200	259	120	1100
Benzo(b)fluoranthene (ug/kg, dry wt)	19	19	100	80	2000	363	160	1500
Benzo(k)fluoranthene (ug/kg, dry wt)	19	16	84	70	1300	292	150	1000
Benzofluoranthenes (total-calc'd) (ug/kg, dry wt)	19	19	100	120	3300	609	285	2500
Indeno(1,2,3-cd)pyrene (ug/kg, dry wt)	19	19	100	50	660	150	100	480
Dibenzo(a,h)anthracene (ug/kg, dry wt)	19	10	53	20	150	53	30	130
Benzo(g,h,i)perylene (ug/kg, dry wt)	19	19	100	40	450	119	80	340
Total HPAH (calc'd) (ug/kg, dry wt)	19	19	100	950	41160	4866	1661	13250
Chlorinated Hydrocarbons								
1,2-Dichlorobenzene (ug/kg, dry wt)	18	1	6	1.7 J	1.7 J	1.7	1.7 J	1.7 J
1,4-Dichlorobenzene (ug/kg, dry wt)	19	4	21	1.6 J	2.6 J	2.2	1.8 J	2.6 J
1,2,4-Trichlorobenzene (ug/kg, dry wt)	18	0	0					
Hexachlorobenzene (ug/kg, dry wt)	19	3	16	3.1 J	20	9	3.1 J	3.5 J
Phthalates								
Diethyl phthalate (ug/kg, dry wt)	19	0	0					
Dimethyl phthalate (ug/kg, dry wt)	19	2	11	20	40	30	20	20
Di-n-butyl phthalate (ug/kg, dry wt)	19	5	26	20	70	39	20	54 J
Di-n-octyl phthalate (ug/kg, dry wt)	19	0	0					
Butyl benzyl phthalate (ug/kg, dry wt)	19	6	32	20	42 J	29	30	30

Table 5-5. Summary of Surface Sediment Chemistry Data Outside Slip 4.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
Bis(2-ethylhexyl)phthalate (ug/kg, dry wt)	19	14	74	100	610	279	250	510 J
Miscellaneous Chemicals								
Dibenzofuran (ug/kg, dry wt)	19	6	32	40	750	179	70	80
Hexachlorobutadiene (ug/kg, dry wt)	19	0	0					
N-Nitrosodiphenylamine (ug/kg, dry wt)	19	0	0					
PCBs								
Aroclor-1016 (ug/kg, dry wt)	28	0	0					
Aroclor-1221 (ug/kg, dry wt)	22	0	0					
Aroclor-1232 (ug/kg, dry wt)	22	0	0					
Aroclor-1242 (ug/kg, dry wt)	28	1	4	560	560	560	560	560
Aroclor-1248 (ug/kg, dry wt)	28	2	7	94	170	132	94	94
Aroclor-1254 (ug/kg, dry wt)	28	27	96	25 J	2700	223	67	560
Aroclor-1260 (ug/kg, dry wt)	28	24	86	28 J	1100	135	60	230
PCBs (total-calc'd) (ug/kg, dry wt)[a]	51	50	98	24	4360	259	115	540
Ionizable Organics								
Phenol (ug/kg, dry wt)	19	7	37	20	290	83	20	110
2-Methylphenol (ug/kg, dry wt)	19	1	5	58 J	58 J	58	58 J	58 J
4-Methylphenol (ug/kg, dry wt)	5	1	20	66 J	66 J	66	66 J	66 J
2,4-Dimethylphenol (ug/kg, dry wt)	16	0	0					
Pentachlorophenol (ug/kg, dry wt)	19	0	0					
Benzoic acid (ug/kg, dry wt)	19	1	5	300 J	300 J	300	300 J	300 J
Benzyl alcohol (ug/kg, dry wt)	19	0	0					
Selected Non-SMS Chemicals								
Inorganics								
Antimony (mg/kg, dry wt)	23	2	9	3.8 J	10 J	7	3.8 J	3.8 J
Nickel (mg/kg, dry wt)	23	23	100	10.2	23.4	18.2	18.4	23.3
Butyltins								
Dibutyltin as ion (ug/kg, dry wt)	4	4	100	6	13 J	10	10	11 J
n-Butyltin (ug/kg, dry wt)	4	4	100	5 J	12 J	9	9 J	10 J
Tetrabutyltin (ug/kg, dry wt)	4	0	0					
Tributyltin as ion (ug/kg, dry wt)	4	4	100	21	46	35	31	42
Misc. Organics								
1,3-Dichlorobenzene (ug/kg, dry wt)	19	3	16	1.6 J	2.4 J	2.0	1.6 J	1.9 J
Carbazole (ug/kg, dry wt)	19	6	32	20	370	100	30	120
Ethylbenzene (ug/kg, dry wt)	1	0	0					
Hexachloroethane (ug/kg, dry wt)	19	0	0					
Tetrachloroethene (ug/kg, dry wt)	1	0	0					
Trichloroethene (ug/kg, dry wt)	1	0	0					
Methylmercury (ug/kg, dry wt)	9	9	100	0.35	0.91	0.77	0.75	0.91
Pesticides								
4,4'-DDD (ug/kg, dry wt)	1	0	0					
4,4'-DDE (ug/kg, dry wt)	1	0	0					

Table 5-5. Summary of Surface Sediment Chemistry Data Outside Slip 4.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
4,4'-DDT (ug/kg, dry wt)	1	0	0					
DDTs (total-calc'd) (ug/kg, dry wt)	1	0	0					
Aldrin (ug/kg, dry wt)	1	0	0					
alpha-Chlordane (ug/kg, dry wt)	1	0	0					
Dieldrin (ug/kg, dry wt)	1	0	0					
Endrin (ug/kg, dry wt)	1	0	0					
gamma-BHC (ug/kg, dry wt)	1	0	0					
Heptachlor (ug/kg, dry wt)	1	0	0					
Heptachlor epoxide (ug/kg, dry wt)	1	0	0					
PCB Congeners and Total PCBs and PCTs								
PCB-101 (ug/kg, dry wt)	36	34	94	1 J	74 J	23	21 J	56 J
PCB-105 (ug/kg, dry wt)	36	29	81	0.46 J	8.1	3.3	2.5	7.5
PCB-110 (ug/kg, dry wt)	23	22	96	2.9	28	11	8.8	22
PCB-118 (ug/kg, dry wt)	37	34	92	1	23	7	4	19
PCB-123 (ug/kg, dry wt)	14	0	0					
PCB-126 (ug/kg, dry wt)	37	0	0					
PCB-128 (ug/kg, dry wt)	37	15	41	1 J	17 J	5	3.6 J	12 J
PCB-138 (ug/kg, dry wt)	37	33	89	2.3	32 J	8	7 J	16
PCB-153 (ug/kg, dry wt)	36	36	100	3 J	48 J	15	13 J	37 J
PCB-156 (ug/kg, dry wt)	37	13	35	0.33 J	4 J	1	0.87	2.2
PCB-157 (ug/kg, dry wt)	37	3	8	0.44	2	1	0.44	1.7
PCB-167 (ug/kg, dry wt)	14	1	7	1 J	1 J	1	1 J	1 J
PCB-169 (ug/kg, dry wt)	37	0	0					
PCB-170 (ug/kg, dry wt)	37	32	86	1 J	11	3	3 J	8
PCB-18 (ug/kg, dry wt)	14	0	0					
PCB-180 (ug/kg, dry wt)	37	33	89	2 J	19	6	4 J	14
PCB-187 (ug/kg, dry wt)	14	14	100	1 J	7 J	3	2 J	4 J
PCB-189 (ug/kg, dry wt)	37	0	0					
PCB-195 (ug/kg, dry wt)	14	1	7	1 J	1 J	1	1 J	1 J
PCB-206 (ug/kg, dry wt)	14	1	7	1 J	1 J	1	1 J	1 J
PCB-209 (ug/kg, dry wt)	14	0	0					
PCB-28 (ug/kg, dry wt)	14	5	36	1 J	2 J	1	1 J	2 J
PCB-44 (ug/kg, dry wt)	14	10	71	1 J	5 J	2	1 J	2 J
PCB-66 (ug/kg, dry wt)	14	9	64	2 J	21 J	6	4 J	6
PCB-77 (ug/kg, dry wt)	37	1	3	0.7	0.7	0.7	0.7	0.7
PCB-81 (ug/kg, dry wt)	14	0	0					
PCBs + PCTs (total) (ug/kg, dry wt)	23	23	100	24	450	144	120	280
PCTs (total) (ug/kg, dry wt)	24	23	96	4.8 J	6500	302	13	52

[a]Total PCBs sample numbers include both total Aroclor and total congener data.

J = Estimated

Table 5-6. Known and Potential Chemicals of Concern in Slip 4 Surface (0-15 cm) Sediments[a].

SMS Chemicals	No. of Samples Analyzed	No. of Samples Exceeding SQS	No. of Samples Exceeding CSL
PCBs (total)	39	36	25
Bis(2-ethylhexyl)phthalate	22	14	10
Dibenzo(a,h)anthracene	22	6	0
Indeno(1,2,3-cd)pyrene	22	6	0
Chrysene	22	5	0
Mercury	23	4	1
Fluoranthene	22	4	0
Butyl benzyl phthalate	22	3	0
Total HPAH	22	3	0
Zinc	23	3	0
Lead	23	2	1
Benzo(a)anthracene	22	2	0
Benzofluoranthenes (total)	22	2	0
Di-n-octyl phthalate	22	2	0
Phenanthrene	22	2	0
Cadmium	23	1	1
N-Nitrosodiphenylamine	22	1	1
Benzo(a)pyrene	22	1	0
Benzo(g,h,i)perylene	22	1	0
Non-SMS Chemicals			
DDT (total)	10	1[b]	1[c]
Dieldrin	10	1[b]	---[d]
alpha-Chlordane	10	1[b]	---[d]

[a]Known and potential chemicals of concern defined as detected chemicals exceeding the SQS in one or more surface sediment samples or, for chemicals without SMS numerical criteria, exceeding the PSDDA SL.

[b]Exceeds PSDDA SL.

[c]Exceeds PSDDA ML.

[c]No PSDDA ML for this chemical.

Table 5-7. Summary of Undetected Chemicals Exceeding Sediment Criteria in Slip 4 Surface Sediments[a].

Chemical	No. of Samples Analyzed	No. of Samples with Detection Limits Exceeding SQS	No. of Samples with Detection Limits Exceeding CSL
SMS Chemicals			
Hexachlorobenzene	22	16	7
1,2,4-Trichlorobenzene	22	15	6
2,4-Dimethylphenol	22	8	8
Benzyl alcohol	22	8	8
1,2-Dichlorobenzene	22	6	6
Hexachlorobutadiene	22	6	4
1,4-Dichlorobenzene	22	4	3
2-Methylphenol	22	3	3
Benzoic acid	22	2	2
N-Nitrosodiphenylamine	22	2	2
Butyl benzyl phthalate	22	2	0
Dibenzo(a,h)anthracene	22	1	0
Pentachlorophenol	22	1	0
Non-SMS Chemicals			
DDTs (total-calc'd)	9	7[b]	4[c]
Aldrin	9	6[b]	0
alpha-Chlordane	9	6[b]	0
Dieldrin	9	6[b]	0
Heptachlor	9	4[b]	0
Lindane	9	4[b]	0

[a]None of the SMS chemicals in this table were detected in any samples at concentrations greater than the SQS. DDT, alpha-chlordane, and dieldrin were each detected in one sample at concentrations greater than the SQS.

[b]Exceeds PSDDA SL

[c]Exceeds PSDDA ML

Table 5-8. Summary of Slip 4 Subsurface Sediment Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
SMS Chemicals of Concern								
Inorganics								
Arsenic (mg/kg, dry wt)	24	24	100	5.7	39.7	19.9	18.8	34.8
Cadmium (mg/kg, dry wt)	24	22	92	0.096	5.4	1.1	0.216	3.5
Chromium (mg/kg, dry wt)	24	24	100	27.3	101	51	43.4	88.9
Copper (mg/kg, dry wt)	24	24	100	28.3	137	58	50.2	100
Lead (mg/kg, dry wt)	24	24	100	4.7	507	60	15.9	194
Mercury (mg/kg, dry wt)	24	13	54	0.04	1.36	0.25	0.1	0.42
Silver (mg/kg, dry wt)	15	15	100	0.05	12.1	2.1	0.12	6.9
Zinc (mg/kg, dry wt)	24	24	100	48.8	381	101	64.9	239
LPAHs								
Naphthalene (ug/kg, dry wt)	24	9	38	12 M	430	95	16	130
Anthracene (ug/kg, dry wt)	24	15	63	8.8 J	1000	217	29	900
Acenaphthene (ug/kg, dry wt)	24	13	54	5.7 J	1400	326	78	1200
Acenaphthylene (ug/kg, dry wt)	24	5	21	33 M	150	80	40	110 M
Fluorene (ug/kg, dry wt)	24	13	54	5.8 J	250	82	34 J	250
Phenanthrene (ug/kg, dry wt)	24	18	75	8.4 M	2500	390	44	1200
2-Methylnaphthalene (ug/kg, dry wt)	24	4	17	34 M	350	123	43 J	66 M
Total LPAH (calc'd) (ug/kg, dry wt)	24	19	79	10	5200	887	110	3316
HPAHs								
Pyrene (ug/kg, dry wt)	24	19	79	14	7300	1397	87	7300
Fluoranthene (ug/kg, dry wt)	24	19	79	18	10000	1568	83	6800
Chrysene (ug/kg, dry wt)	24	19	79	8.4 J	3900	562	33	2900
Benzo(a)anthracene (ug/kg, dry wt)	24	18	75	9.2 J	3400	488	32	2300
Benzo(a)pyrene (ug/kg, dry wt)	24	18	75	4.9 M	2100	291	25	1400
Benzo(b)fluoranthene (ug/kg, dry wt)	6	0	0					
Benzo(k)fluoranthene (ug/kg, dry wt)	0							
Benzofluoranthenes (total-calc'd) (ug/kg, dry wt)	24	18	75	13 J	6200	811	61	4100
Indeno(1,2,3-cd)pyrene (ug/kg, dry wt)	24	10	42	25	1300	332	160	910
Dibenzo(a,h)anthracene (ug/kg, dry wt)	24	4	17	69 M	490	232	110 M	260
Benzo(g,h,i)perylene (ug/kg, dry wt)	24	2	8	18	140 J	79	18	18
Total HPAH (calc'd) (ug/kg, dry wt)	24	19	79	49.2	28630	4496	254	21870
Chlorinated Hydrocarbons								
1,2-Dichlorobenzene (ug/kg, dry wt)	24	0	0					
1,4-Dichlorobenzene (ug/kg, dry wt)	24	0	0					
1,2,4-Trichlorobenzene (ug/kg, dry wt)	24	0	0					
Hexachlorobenzene (ug/kg, dry wt)	24	0	0					
Phthalates								
Diethyl phthalate (ug/kg, dry wt)	24	0	0					
Dimethyl phthalate (ug/kg, dry wt)	24	0	0					
Di-n-butyl phthalate (ug/kg, dry wt)	24	5	21	11 J	1600	378	78 J	120 M
Di-n-octyl phthalate (ug/kg, dry wt)	24	5	21	11 J	2700	773	35	1000
Butyl benzyl phthalate (ug/kg, dry wt)	24	3	13	24	840	331	24	130

Table 5-8. Summary of Slip 4 Subsurface Sediment Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Mean Detected Concentration	Median Detected Concentration	95th Percentile
Bis(2-ethylhexyl)phthalate (ug/kg, dry wt)	24	20	83	4.7 J	7100	944	120	6900
Miscellaneous Chemicals								
Dibenzofuran (ug/kg, dry wt)	24	5	21	8.3 J	210	108	50 J	150
Hexachlorobutadiene (ug/kg, dry wt)	24	0	0					
N-Nitrosodiphenylamine (ug/kg, dry wt)	24	0	0					
PCBs								
Aroclor-1016/1242 (ug/kg, dry wt)	21	5	24	20	850	334	20	690
Aroclor-1248 (ug/kg, dry wt)	21	0	0					
Aroclor-1254 (ug/kg, dry wt)	21	14	67	8.9 J	150000	12935	500	19000
Aroclor-1260 (ug/kg, dry wt)	21	5	24	270	3400	1178	400	1400
PCBs (total-calc'd) (ug/kg, dry wt)[a]	21	14	67	8.9	150000	13475	990	22400
Ionizable Organics								
Phenol (ug/kg, dry wt)	24	0	0					
2-Methylphenol (ug/kg, dry wt)	24	0	0					
4-Methylphenol (ug/kg, dry wt)	24	0	0					
2,4-Dimethylphenol (ug/kg, dry wt)	24	0	0					
Pentachlorophenol (ug/kg, dry wt)	24	0	0					
Benzoic acid (ug/kg, dry wt)	24	0	0					
Benzyl alcohol (ug/kg, dry wt)	24	0	0					
Selected Non-SMS Chemicals								
Inorganics								
Nickel (mg/kg, dry wt)	24	24	100	17	44	27	25	37
Chlorinated Hydrocarbons								
1,3-Dichlorobenzene (ug/kg, dry wt)	24	0	0					
Hexachloroethane (ug/kg, dry wt)	24	0	0					
Pesticides								
4,4'-DDD (ug/kg, dry wt)	21	0	0					
4,4'-DDE (ug/kg, dry wt)	21	0	0					
4,4'-DDT (ug/kg, dry wt)	21	0	0					
Aldrin (ug/kg, dry wt)	21	0	0					
alpha-Chlordane (ug/kg, dry wt)	21	0	0					
Dieldrin (ug/kg, dry wt)	21	0	0					
Endrin (ug/kg, dry wt)	21	0	0					
gamma-BHC (ug/kg, dry wt)	21	0	0					
Heptachlor (ug/kg, dry wt)	21	0	0					
Heptachlor epoxide (ug/kg, dry wt)	21	0	0					

[a]Total PCBs sample numbers include both total Aroclor and total congener data.

J = Estimated
M = Estimated value of analyte found and confirmed by analyst but with low spectral match.

Table 5-9. Summary of Detected Chemicals Exceeding SMS in Slip 4 Subsurface Sediments.

Chemical	Depth Interval (ft)[a]	No. of Samples Analyzed	No. of Samples Exceeding SQS	No. of Samples Exceeding CSL
Acenaphthene	0 - 2	6	3	0
	2 - 4	5	1	0
	3 - 5	2	1	0
	4 - 6	5	1	0
	6 - 8	4	0	0
	6 - 9	1	1	0
	6 - 10	1	1	0
Benzo(a)anthracene	0 - 2	6	1	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Benzofluoranthenes (total-calc'd)	0 - 2	6	1	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Bis(2-ethylhexyl)phthalate	0 - 2	6	5	3
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Butyl benzyl phthalate	0 - 2	6	2	0
	2 - 4	5	1	0
	3 - 5	2	0	0
	4 - 6	5	1	0
	6 - 8	4	0	0
	6 - 9	1	1	0
	6 - 10	1	1	0
Cadmium	0 - 2	6	1	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Chrysene	0 - 2	6	2	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0

Table 5-9. Summary of Detected Chemicals Exceeding SMS in Slip 4 Subsurface Sediments.

Chemical	Depth Interval (ft)[a]	No. of Samples Analyzed	No. of Samples Exceeding SQS	No. of Samples Exceeding CSL
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Dibenzo(a,h)anthracene	0 - 2	6	1	0
	2 - 4	5	1	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	1	0
Di-n-octyl phthalate	0 - 2	6	1	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Fluoranthene	0 - 2	6	3	0
	2 - 4	5	0	0
	3 - 5	2	1	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Indeno(1,2,3-cd)pyrene	0 - 2	6	2	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Lead	0 - 2	6	1	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
Mercury	0 - 2	6	2	1
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0
PCBs (total-calc'd)	0 - 2	6	5	4

Table 5-9. Summary of Detected Chemicals Exceeding SMS in Slip 4 Subsurface Sediments.

Chemical	Depth Interval (ft)[a]	No. of Samples Analyzed	No. of Samples Exceeding SQS	No. of Samples Exceeding CSL
	2 - 4	5	2	2
	3 - 5	2	0	0
	4 - 6	4	0	0
	6 - 8	3	1	1
	6 - 9	1	1	1
Silver	0 - 2	3	2	2
	2 - 4	2	0	0
	3 - 5	1	0	0
	4 - 6	4	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
Total HPAH	0 - 2	6	1	0
	2 - 4	5	0	0
	3 - 5	2	0	0
	4 - 6	5	0	0
	6 - 8	4	0	0
	6 - 9	1	0	0
	6 - 10	1	0	0

[a]All samples within this depth interval are included in the sample numbers. For example, a sample from 3.5 - 4.5 ft is included in the sample number count for 3 - 5 ft.

Table 5-10. Summary of Slip 4 Surface Sediment Porewater Chemistry.

Chemical Name	Number of Samples	Number of Detections	Detection Frequency (%)	Concentration
Inorganics				
Antimony (ug/L)	1	0	0	
Arsenic (ug/L)	1	1	100	34
Cadmium (ug/L)	1	1	100	4 J
Chromium (ug/L)	1	0	0	
Copper (ug/L)	1	0	0	
Lead (ug/L)	1	1	100	2
Mercury (ug/L)	1	0	0	
Nickel (ug/L)	1	0	0	
Silver (ug/L)	1	0	0	
Zinc (ug/L)	1	0	0	
Butyltins				
Dibutyltin as ion (ug/L)	1	0	0	
n-Butyltin in porewater (ug/L)	1	0	0	
Tetrabutyltin (ug/L)	1	0	0	
Tributyltin as ion (ug/L)	1	0	0	

J = Estimated

Table 5-11. Summary of PCBs Concentrations in Whole-body Juvenile Chinook Salmon (Meador 2000)

Location	**Year Collected**	**Mean (Standard Deviation) (ng/g dry weight)**
Kellogg Island	1989	960 (297)
	1993	650 (252)
	2000[a]	194 (137)
Green River Hatchery	1989	687 (63)
	1993	410 (14)
	2000	78 (14)
Fish traps (upstream of hatchery)	2000[1]	42 (14)
Slip 4	2000	1095 (1265)

[a]wild fish

Table 6-1. Aquatic Habitat Types and Functions at Slip 4[a].

Taxa	Intertidal Mudflats	Shallow Subtidal	Pilings, Hard Structures
Algae	Macroalgae	Micro- and macroalgae	Substrate for macroalgae
Invertebrates	Benthic infaunal communities	Benthic infaunal communities	Epibenthic macroinvertebrates (mussels, barnacles)
Juvenile salmon	Feeding, refuge	Feeding, migration, refuge	Some feeding
Estuarine and migratory fish	Feeding	Feeding, rearing	Feeding, rearing
Shorebirds	Feeding, resting	Feeding	Some feeding
Waterfowl, marine birds	Feeding	Feeding, resting	Some feeding

[a]Harbor seals are sometimes seen hunting for food as far up-river as Slip 4, usually on a seasonal basis.

Source: USACE et al. (1994).

Table 6-2. Salmon Species in the Duwamish River.

Species	**Stock Origin**	**Production**	**Status**	**Spawning Period**	**ESA Status**
Chinook - summer/fall					
Duwamish/Green	Mixed	Composite	Healthy	Sept - Oct	Threatened
Newaukum Creek	Mixed	Wild	Healthy	Sept - Oct	Threatened
Chum - fall					
Duwamish/Green	Mixed	Composite	Unknown	Late Nov - Dec	Not warranted
Crisp Creek	Hatchery	Cultured	Healthy	Late Nov - Dec	Not warranted
Coho					
Green/Soos Creek	Mixed	Composite	Healthy	Late Oct - mid-Dec	Candidate
Newaukum Creek	Mixed	Composite	Depressed	Late Oct - mid-Jan	Candidate
Steelhead - summer					
Duwamish/Green	Hatchery	Wild	Healthy	Probably Feb - April	Not warranted
Steelhead - winter/early winter					
Duwamish/Green	Native	Wild	Healthy	Early March - mid-June	Not warranted
Duwamish/Green	Hatchery	Cultured	Healthy	---	Not warranted
Bull trout					
Green River	Native	Wild	Unknown	Unknown	Threatened
Coastal cutthroat trout					
Green River	Native	Wild	Unknown	Probably Feb - May	Not warranted

Sources: WDFW et al. (1993), WDFW (1998, 2000); King County (2000), Cropp (2003).

Table 6-3. Juvenile Salmonids in the Duwamish River.

Species	**Period of Greatest Abundance**[a]	**Habitat Type**
Chinook salmon	Early May - June	Shallow and mid-channel
Coho salmon	Late April, late May-early June	Shallow nearshore and mid-channel
Chum salmon	Early April - early July	Shallow nearshore
Steelhead trout	Spring	Shallow nearshore and mid-channel

Sources: Matsuda et al. (1968), Meyer et al. (1981), USACE (1983).
[a]Peak abundance is related to hatchery releases.

Table 6-4. Duwamish/Green River Salmonid Run Size and Escapement Summary by Year.

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Chinook Run Size											
Wild	15366	15216	10076	5350	8178	9944	8646	10409	8840	11778	9429
Hatchery	20278	7003	8470	7899	9591	13175	19285	12342	11975	11275	10582
Chinook Escapement											
Wild	7035	10548	5267	2476	4078	7939	6026	9967	7312	11025	6170
Hatchery	9284	4855	4428	3656	4784	10518	13414	11200	9296	10450	6903
Coho Run Size [a]											
Wild	17693	2813	7721	2933	9642	16296	5791	4947	6310	2402	22648
Hatchery	105154	59124	42850	40880	101415	31144	23023	13586	22816	23196	104600
Coho Escapement											
Wild	2465	541	2782	1797	4839	7224	3956	1450	1160	1245	2743
Hatchery	15120	11010	13771	15359	40648	10819	14959	7490	8964	8200	43774
Steelhead Run Size											
Wild	2822	1369	2282	2015	2094	2486	2855	NA	2457	2965	2257
Hatchery	2901	1896	3000	2160	1397	2458	1791	1050	574	1537	605
Steelhead Escapement											
Wild	1484	944	1942	1722	1821	2300	2633	NA	2362	2574	1705
Hatchery	227	129	168	150	110	344	155	225	86	231	60

Sources: Cropp (2003), Haymes (2003).
NA = Not available.
[a] Coho run size data only include fishery catches for the inside portion of Puget Sound.
Coho orginating from the Duwamish/Green that were harvested in the Strait of Juan de Fuca, Pacific Ocean, and all Canadian fisheries are excluded.
The runsize estimation method from 1997 to present includes sport catches, and the 1997-2001 hatchery runsize estimates include the returns to the Elliott Bay net pen program.

Table 6-5. Non-salmonid Fish Species in the Duwamish/Green River System.

Species		Scientific Name	Abundance/Occurrence [a]
Pelagic			
	Surf smelt	*Hypomesus pretiosus*	Common/Estuary
	Longfin smelt	*Spirinchus thaleichthus*	Abundant/Estuary, Freshwater
	Pacific herring	*Clupea pallasi*	Common/Estuary
	River lamprey	*Lampetra ayresi*	Rare
	Three-spine stickleback[b]	*Gasterosteus aculeatus*	Common/Estuary, Freshwater
	Pacific sand lance	*Ammodytes hexapterus*	Common/Estuary
Demersal			
	Shiner surfperch	*Cymatogaster aggregata*	Abundant/Estuary, Freshwater
	Buffalo sculpin	*Enophrys bison*	Rare
	Starry flounder	*Platichthys stellatus*	Common/Estuary
	English sole	*Pleuronectes vetulus*	Abundant/Estuary
	Rock sole	*Lepidopsetta bilineata*	Common/Estuary
	Dover sole	*Microstomus pacificus*	Common/Estuary
	Butter sole	*Isopsetta isolepis*	Common/Estuary
	Hybrid sole	*Inopsetta ischyra*	Rare
	Sand sole	*Psettichthys melanostictus*	Common/Estuary
	Snake prickleback	*Lumpenus sagitta*	Abundant/Estuary
	Pacific tomcod	*Microgadus proximus*	Rare
	Pacific cod	*Gadus macrocephalus*	Rare
	Ratfish	*Hydrolagus colliei*	Rare
	Penpoint gunnel	*Apodichthys flavidus*	Rare
	Saddleback gunnel	*Pholis ornata*	Rare
	Crescent gunnel	*Pholis laeta*	Common/Estuary
	Bay goby	*Lepidogobius lepidus*	Rare
	Pile perch	*Rhacochilus vacca*	Rare
	Striped seaperch	*Embiotoca lateralis*	Rare
	Prickley sculpin	*Cottus asper*	Rare
	Pacific staghorn sculpin	*Leptocottus armatus*	Abundant/Estuary
	Padded sculpin	*Artedius fenestralis*	Common/Estuary
	Soft sculpin	*Gilbertidia sigalutes*	Rare
	Walleye pollock	*Theragra chalcogramma*	Rare
	Redsided shiner	*Richardsonius balteatus*	Common/Estuary
	Largescale sucker	*Catastomus macrocheilus*	Rare

Sources: Windward (2003h), USACE (1983).

[a] Abundance and occurrence only provided for common and abundant species.
Abundance Citations: Miller et al. (1975), Weitkamp and Campbell (1980), Warner and Fritz (1995), West et al. (2001), *as cited in Windward (2003h).*
Occurrence Citations: Eschmeyer and Herald (1983), Battelle et al. (2001).

[b] The three-spine stickleback is also considered a demersal species.

Table 6-6. Most Common Non-salmonid Fish Species in Shallow Nearshore Areas of the Duwamish River.

Species	**Period of Greatest Abundance**	**Relative Abundance**
Pacific staghorn sculpin	May	Most abundant
Starry founder	NA	Not particularly abundant
Shiner surfperch	Late April - fall	Abundant
English sole	NA	Abundant
Snake prickleback	Late spring and summer	Abundant
Pacific herring	November - December[a]	Not particularly abundant
Longfin smelt	NA	Abundant
Surf smelt	May - December	Common

Source: Windward (2003h)

NA = Not available.

[a] May be found in surface waters (not necessarily nearshore) from May through December.

Table 6-7. Bird Species Observed in the Slip 4 Area on June 30, 2003[a].

Common Name	**Scientific Name**
Glaucous-winged Gull	*Larus glaucescens*
Rock Dove	*Columba livia*
American Crow	*Corvus brachyrhynchos*
Violet-green Swallow	*Tachycineta thalassina*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapillus*
Bewick's Wren	*Thryomanes bewickii*
American Robin	*Turdus migratorius*
European Starling	*Sturnus vulgaris*
Spotted Towhee	*Pipilo maculatus*
Savannah Sparrow	*Passerculus sandwichensis*
Song Sparrow	*Melospiza melodia*
White-crowned Sparrow	*Zonotrichia leucophrys*
House Finch	*Carpodacus mexicanus.*
American Goldfinch	*Carduelis tristis*
House Sparrow	*Passer domesticus*

[a] Species observed from approximately 11:30 AM until 12:00 PM.

Table 8-1. Potential Data Gaps for Slip 4 Characterization.

Potential Data Gap[1]	Collect Additional Data/Priority	Rationale	Anticipate Data Will Be Generated By	Anticipate Data Will Be Generated In
Bathymetry	No/Low	Data collected by LDWG in 2003 are adequate. (see Section 2.2).	NA	NA
Bank Elevations and Slopes	Yes/High	Data for areas above +5 ft MLLW needed to generate engineering drawings, calculate remediation volumes, develop remediation options.	EE/CA PRPs	2005
Sediment Transport Study	No/Low	A sediment transport study is being performed for the LDW. The information obtained from this study will be evaluated, as appropriate, for Slip 4. A specific study is not warranted in Slip 4 due to its depositional nature (see Section 2.6).	NA	NA
Pollutant Source Information	Yes/High	Evaluate ongoing sources in basin to assess potential for recontamination (see Section 3).	City and County Source Control Programs, Ecology	2004/2005
Water Quality Data	No/Low	General Duwamish River water quality information is sufficient (see Section 4).	NA	NA
Surface Sediment Quality	Yes/High	Additional chemical data are needed to adequately characterize surface sediment chemical distributions (see Section 5.1).	City/County	2004
Subsurface Sediment Quality	Yes/High	Additional chemical data are needed to adequately characterize subsurface sediment chemical distributions (see Section 5.1).	City/County	2004
Intertidal/Bank Sediment Quality	Yes/High	Additional chemical data are needed to adequately characterize intertidal and bank sediment quality and assess potential to impact Slip 4 sediments (see Section 5.1).	City/County	2004
Sediment Toxicity	Maybe/Medium	Toxicity testing of surface sediments may occur if surface sediment concentrations (with the exception of total PCBs) exceed the CSL and if the area in question is not already a strong candidate for cleanup.	City/County	To Be Determined
Geotechnical Data	Yes/High	Data on sediment type and strength are needed to evaluate potential remediation alternatives.	City/County	2004
Groundwater Data	No/Low[2]	Based on existing groundwater data, there is no evidence that groundwater may impact Slip 4 sediments (see Sections 3.2 and 3.7).	NA	NA

Table 8-1. Potential Data Gaps for Slip 4 Characterization.

Potential Data Gap[1]	Collect Additional Data/Priority	Rationale	Anticipate Data Will Be Generated By	Anticipate Data Will Be Generated In
Seep Chemical Data	No/Low[2]	Based on existing groundwater data there is no evidence that groundwater may impact Slip 4 sediments (see Sections 3.2 and 3.7).	NA	NA
Habitat Assessment	No/Low	Existing information and future LDWG bathymetric data will provide necessary information (see Section 6).	NA	NA

[1]Benthic community, tissue, and porewater data have not been identified as data gaps in Slip 4.
[2] Data collection not currently required, but future collection may be warranted based on results of source control evaluations.

NA – not applicable

APPENDIX C

Sediment Chemistry and Porewater Data

Appendix C
List of Tables

Table C-1. Conventional Measurements in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Ammonia (mg/kg, dry wt_)	Clay (%)	Fines (percent silt+clay) (%)	Gravel (%)	Rocks (%)	Sand (%)	Silt (%)	Sulfides (total) (mg/kg, dry wt_)	Total Organic Carbon (TOC) (% dry wt_)	Total solids (%, wet wt_)
BOEING97	10/08/97	R10	SD0063	0	10		10	73		1	26	63		2.3	47.3
BOEING97	10/08/97	R11	SD0068	0	10		15	59			15	70		2.1	43.7
BOEING97	10/08/97	R12	SD0064	0	10		8	35		2	63	27		2	61
BOEING97	10/08/97	R13	SD0069	0	10		18	33		2	25	55		2	47.7
BOEING97	10/08/97	R14	SD0065	0	10		11	85			15	74		2.2	56.4
BOEING97	10/08/97	R15	SD0066	0	10		12	56		1	43	44		2.5	53.9
BOEING97	10/08/97	R9	SD0067	0	10		13	59			18	69		2.3	45.8
LANDAU90	04/23/90	SL4-05	SL4-05	0	15									2.4	
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182									2.2	
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228									0.88	
LANDAU90	04/23/90	SL4-06	SL4-06	0	15									4.3	
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60									2.6	
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121									0.77	
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182									0.58	
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274									0.2	
LANDAU90	04/23/90	SL4-07	SL4-07	0	15									3.5	
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60									1	
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121									0.08	
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182									0.23	
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304									0.066	
LANDAU90	04/23/90	SL4-08	SL4-08	0	15									2	
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60									1.8	
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121									2.6	
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182									2.9	
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243									0.49	
LANDAU90	04/23/90	SL4-09	SL4-09	0	15									2.1	
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60									2.6	
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152									2.6	
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243									3.2	
LANDAU90	04/23/90	SL4-10	SL4-10	0	15									0.68	
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15									1.6667	
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121									1.4	
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243									5.4	
LANDAU90	04/23/90	SL4-11	SL4-11	0	15									0.38	
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60									2.2	
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106									1.5	
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137									0.78	
LANDAU90	04/23/90	SL4-12	SL4-12	0	15									0.52	
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60									0.35	
LANDAU90	04/23/90	SL4-12A	SL4-12A-0-0.5	0	15									0.78	
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182									0.67	
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10		18.96	85.85		0.01 U	14.14	66.89		2.87	
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10		9.33	78.69		0.04	27.71	69.36		3.44	
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10		11.22	77.82		0.01	22.17	66.6		2.83	
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10		15.4	69.37		0.38	30.24	53.97		2.63	
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10		17.23	76.19		0.21	23.6	58.96		2.34	
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10		10.74	52.54		1.71	45.74	41.8		4.54	
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10		9.2	68.66		0.27	31.09	59.46		1.8	
NOAA97	09/15/97	EIT063	EIT07-01	0	10		7.23		36.33		41.27	15.16		1.27	
NOAA97	09/15/97	EIT064	EIT07-02	0	10		4.67		34.52		49.9	10.91		1.49	
NOAA97	09/15/97	EIT066	EIT07-03	0	10		3.58		25.88		64.45	6.1		0.54	
NOAA97	09/15/97	EIT067	EIT07-04	0	10		6.57		1.66		78.34	13.43		1.08	

Table C-1. Conventional Measurements in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Ammonia (mg/kg, dry wt_)	Clay (%)	Fines (percent silt+clay) (%)	Gravel (%)	Rocks (%)	Sand (%)	Silt (%)	Sulfides (total) (mg/kg, dry wt_)	Total Organic Carbon (TOC) (% dry wt_)	Total solids (%, wet wt_)
NOAA97	09/15/97	EIT068	EIT07-05	0	10		1.81		13.62		81.18	3.39		0.3	
NOAA97	09/15/97	EIT069	EIT08-01	0	10		9.93		0.2		67.02	22.85		3.27	
NOAA97	09/15/97	EIT070	EIT08-02	0	10		4.2		64.19		21.59	10.02		1.4	
NOAA97	09/15/97	EIT072	EIT08-03	0	10		7.52		18.96		54.42	19.1		1.51	
NOAA97	09/15/97	EST163	EST12-01	0	10		15.76		10.78		32.13	41.33		2.1	
NOAA97	09/15/97	EST164	EST12-02	0	10		21.09		0.34		22.56	56		1.96	
NOAA97	09/15/97	EST165	EST12-03	0	10		26.57		0.09		5.14	68.19		2.32	
NOAA97	09/15/97	EST168	EST12-04	0	10		26.83		0.09		7.56	65.52		2.34	
NOAA97	09/15/97	EST169	EST12-05	0	10		20.89		0.07		21.49	57.55		2.06	
NOAA97	09/15/97	EST170	EST12-06	0	10		22.58	82.71	0.01 U		17.29	60.13		2.08	
NOAA97	09/15/97	EST171	EST12-07	0	10		2		3.08		88.23	6.69		0.31	
NOAA97	09/15/97	EST172	EST12-08	0	10		15.06	54.22	0.44		45.34	39.16		1.7	
NOAA97	09/15/97	EST173	EST12-09	0	10		18.19	70.47	0.02		29.51	52.28		1.85	
NOAA97	09/15/97	EST175	EST12-10	0	10		1.68		1.83		93.66	2.83		0.13	

U = undetected

Table C-2. Metals Concentrations in Sediments and Porewater Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Tin	Vanadium	Zinc
Bulk Sediment (mg/kg)																													
BOEING97	10/08/97	R10	SD0063	0	10			12.4			1.3		35		75		117			0.38	29			0.8					190
BOEING97	10/08/97	R11	SD0068	0	10			13.8 J			0.9		34		64		62			0.2	28			1.5					149
BOEING97	10/08/97	R12	SD0064	0	10			7.3			0.5		22		41		43			0.12	19			0.5					100
BOEING97	10/08/97	R13	SD0069	0	10			11.4			0.6		29		60		46			0.14	24			0.8					126
BOEING97	10/08/97	R14	SD0065	0	10			14.7			2.2		46		69		107			0.34	34			5.7					167
BOEING97	10/08/97	R15	SD0066	0	10			11.9			0.9		31		48		48			0.19	21			0.7					109
BOEING97	10/08/97	R9	SD0067	0	10			13.4			1.2		35		70		96			0.2	28			1.1					169
LANDAU90	04/23/90	SL4-05	SL4-05	0	15			31.3			1.9		69.8		92.6		127			0.23	36			2.2					189
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182			32.5			0.278		40.8		55.8		15.1			0.09	24			0.11					58.3
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228			22.7			0.096		44.5		41.5		15.9			0.05 U	24			0.09					63.3
LANDAU90	04/23/90	SL4-06	SL4-06	0	15			28.5			3.5		104		140		507			0.18	52			0.462					536
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60			38.3			5.4		93.9		137		507			1.36	44			12.1					381
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121			12.9			1.7		65.3		94.5		123			0.04 U	33			4.7					151
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182			7.7			0.16		47.3		46.4		12.3			0.06 U	27			0.07					64.9
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274			7.2			0.172		51.6		49.7		12.1			0.05 U	29			0.16					66.1
LANDAU90	04/23/90	SL4-07	SL4-07	0	15			29.8			4.4		97.3		154		721			0.47	52			0.786					491
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60			32.5			4		88.9		100		235			0.16	37			5.9					251
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121			10			0.1 U		34.2		33.8		4.7			0.04 U	21								52.6
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182			5.7			0.13		38.5		34.9		5			0.06 U	24								61.7
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304			6.1			0.081 U		47.4		28.3		6.6			0.04 U	26								68.5
LANDAU90	04/23/90	SL4-08	SL4-08	0	15			23			7.5		118		153		326			0.46	42			1.5					411
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60			21.9			1.6		51.7		57.3		57			0.17	25								105
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121			29.6			0.252		41.3		50.2		16.4			0.07	23								66.8
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182			21.1			0.162		43.4		51.5		18.8			0.07 U	24			0.1					67.2
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243			15.1			0.105		42		33.1		7.6			0.05 U	23			0.07					63.3
LANDAU90	04/23/90	SL4-09	SL4-09	0	15			32.3			2.8		91.4		136		147			0.3	44			2.6					269
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60			22			3.5		84.7		112		194			0.42	39			6.9					239
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152			31.1			0.9		51.2		63.8		51			0.25	25			0.256					105
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243			18.8			0.216		41		59.3		15.8			0.08	25			0.12					61.4
LANDAU90	04/23/90	SL4-10	SL4-10	0	15			29.1			2		80.4		95.3		154			0.11	37			2.2					223
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15			34.2			2.1		75.9		102		188			0.19	34			1.7					224
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121			9.7			0.379		40.3		52		16.5			0.1	34			0.649					60.9
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243			11.7			0.426		29.8		48.9		15.9			0.04	34			0.628					49.9
LANDAU90	04/23/90	SL4-11	SL4-11	0	15			17.3			0.611		85.2		106		86			0.04	37			0.88					159
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60			39.7			3.2		101		88.3		75			0.32	30								160
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106			34.8			0.186		43.9		55.9		22.3			0.1	23								69.8
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137			23.7			0.148		41.7		39.8		9.6			0.05	22								57.6
LANDAU90	04/23/90	SL4-12	SL4-12	0	15			9.8			0.337		64.3		42.6		37			0.05	27			0.14					110
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60			16.7			0.14		27.3		33.2		6.9			0.05 U	17								48.8
LANDAU90	04/23/90	SL4-12A	SL4-12A-0-0.5	0	15			20.9			0.417		61.6		67.4		40			0.07	31								120
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182			6.9			0.097		28.5		30.7		5.3			0.05 U	18			0.05					54.3
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10	22200	10 UJ	17.1	100	0.43	0.66	6640	35	10	67	33700	49.3	9060	339	0.21	22.7	2940	10	0.53	14600	0.15	5	91	148
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	18400	10 UJ	16.3	144	0.37	2.74	11700	50	10	93	34000	215	8060	291	0.46	25.7	2460	8	1.65	11800	0.17	6	66	300
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10	21400	10 UJ	14.8	136	0.41	1.84	9270	42	10	82	32100	120	8740	286	1.12	25.3	2810	9	1.06	13100	0.17	6	71	242
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10	17700	10 UJ	13.5	81	0.36	0.56	5870	28	9	55	27300	38.1	7480	281	0.17	19	2480	9	0.47	11700	0.12	4	59	123
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10	22600	10 UJ	12.2	157	0.42	0.8	7180	35	10	65	32200 J	58.2 J	8230	328	0.24	23.7 J	2800	24 J	0.59	12500	0.16 J	6	73	139
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10	14800	10 UJ	10.9	58	0.33	0.49	11400	22	7	41	21400	29.8	6350	210	0.13	17.4	2100	7	0.34	9930	0.1	3 UJ	51	92
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	16900	10 UJ	18	64	0.39	1.47	5240	40	8	45	24500	35.4	6800	230	0.24	22.4	2380	8	0.81	9680	0.13	4	60	120
Porewater (ug/L)																													
LODRIV98	08/11/98	DR181	PW-DR181-0000	0	10	50 U	50 U	34	74	5 U	4 J	320000	10 U	10 U	4 U	9870	2	1040000	2200	0.1 U	30 U	306000	20 U	1 U	8990000	1 U	10 U	12	10 U

U = undetected
J = estimated

Table C-3. Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	2-Chloro-naphthalene	2-Methyl-naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(g,h,i)-perylene	Benzo(k)-fluoranthene	Benzo-fluoranthenes (total-calc'd)	Carcinogenic PAHs (calc'd)	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno-(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene	Total HPAH (calc'd)	Total LPAH (calc'd)	Total PAH (calc'd)
Sediments (ug/kg, dry wt)																												
BOEING97	10/08/97	R10	SD0063	0	10	19 U	44	110	21	220	930	1300 J	1600	630	990	2590	1865	1300	280 J	2300	110	880	61	890	2000	12210	1412	13622
BOEING97	10/08/97	R11	SD0068	0	10	19 U	41 J	73 J	19 UJ	170 J	580	990	1300	330 J	720	2020	1358.1	910	130 J	1800	72	470	58	580	1000 UJ	7230	953	8183
BOEING97	10/08/97	R12	SD0064	0	10	19 U	25	30	19 U	96	330	460	750	250	500	1250	680.1	510 J	60 J	680	33	330	36	320	900	4770	515	5285
BOEING97	10/08/97	R13	SD0069	0	10	19 U	24	31	19 U	72	280	350 J	580	190 J	300	880	525.2	380	76 J	840	37	250	44	220	700 UJ	3246	404	3650
BOEING97	10/08/97	R14	SD0065	0	10	19 U	53 J	53 J	19 U	85	240	420	480	250	490	970	605.8	360	88 J	680	35	260	63	53 J	1200	4468	289	4757
BOEING97	10/08/97	R15	SD0066	0	10	20 U	46	74	27	160	320	420	560	88	480	1040	593.2	440	47 J	1100	74 J	140	130	320	1100	4695	785	5480
BOEING97	10/08/97	R9	SD0067	0	10	19 U	42 J	64	19	180	700	1100	1300	520 J	840	2140	1555	1000	220 J	1800	69 J	730	67	640	1300	9510	1039	10549
LANDAU90	04/23/90	SL4-05	SL4-05	0	15		37 M	44	34	160	880	490		53		1900		920	160	1400	63	450	34 U	740	2500	6853 T	1041 T	
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182		16 U	16 U	16 U	16 M	15 J	16 U	16 U	16 U		16 UT		20	16 U	56	7.9 J	16 U	12 M	37	44	135 T	72.9 T	
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228		13 U	13 U	13 U	10 J	13 J	11 J		13 U		21		17	13 U	41	13 U	13 U	15	29	33	115 T	54 T	
LANDAU90	04/23/90	SL4-06	SL4-06	0	15		120	250	75	2800	2000	1300		100		4600		2900	670	3000	390	1400	130	8000	1900	13270 T	11645 T	
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60		150 U	1400	150	900	3400	2100		140 J		6200		3900	490	10000	250	1300	150 U	2500	7300	28630 T	5200 T	
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121		13 U	130	13 U	14	32	58		18		70		33	13 U	98	13 U	29	13 U	26	130	398 T	170 T	
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182		12 U	110	12 U	12 U	14	7.4 J		12 U		24		21	12 U	54	12 U	12 U	12 U	12 U	49	145.4 T	110 T	
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274		13 U	35	13 U	13 U	9.8 M	4.9 M		13 U		18		15	13 U	53	13 U	13 U	13 U	8.4 M	42	124.7 T	43.4 T	
LANDAU90	04/23/90	SL4-07	SL4-07	0	15		71 J	1300	140	900	3900	1700		100		6500		3800	470	13000	260	1300	110	1800	9900	34170 T	4510 T	
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60		59 U	96	59 U	210	750	520		59 U		1600		870	110 M	2400	110	340	45 M	810	2000	6990 T	1271 T	
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121		12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U		12 UT		12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UT	12 UT	
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182		13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U		13 UT		13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 UT	13 UT	
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304		12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U		12 UT		12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UT	12 UT	
LANDAU90	04/23/90	SL4-08	SL4-08	0	15		36 M	230	80	700	2500	1700		98		5100		3000	430	7300	260	1200	69 J	3000	5100	21328 T	4339 T	
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60		74 U	460	74 U	200	470	290		74 U		410		630	74 U	2200	55 J	230	74 U	290	2100	5920 T	1005 T	
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121		14 U	5.7 J	14 U	8.8 J	14 J	12 J		14 U		29		20	14 U	49	5.8 J	14 U	14 U	27	49	144 T	47.3 T	
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182		15 U	15 U	15 U	13 M	22	21		15 U		39		33	15 U	72	8.5 J	15 U	13 J	44	60	208 T	78.5 T	
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243		12 U	12 U	12 U	12 U	12 U	8.5 J		12 U		19		8.7 J	12 U	18	12 U	12 U	12 U	10 J	14	49.2 T	10 T	
LANDAU90	04/23/90	SL4-09	SL4-09	0	15		25 J	250	60 U	300	590	420		35 M		1400		740	95	2000	260	320	41 J	830	1800	6000 T	1681 T	
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60		66 M	620	110 M	1000	2300	1400		86 U		4100		2900	260	6800	130	910	74 M	1200	7300	21870 T	3134 T	
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152		43 J	1200	66 J	540	1200	390		79 U		1300		1400	69 M	5500	250	170	430	830	4400	13129 T	3316 T	
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243		15 U	15 U	15 U	20	24	21		15 U		47		39	15 U	83	7.9 J	15 U	16	40	87	254 T	83.9 T	
LANDAU90	04/23/90	SL4-10	SL4-10	0	15		65 U	65 U	65 U	190	540	410		31 J		1200		750	100	1400	29 J	300	73	480	1200	4731 T	772 T	
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15		65 U	46 J	45 J	300	890	790		53 J		2400		1300	170	2200	62 J	530	65 U	590	2700	8633 T	1043 T	
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121		64 U	37 J	64 U	96	140	120		64 U		240		200	64 U	860	34 J	73	64 U	180	770	2163 T	347 T	
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243		350	78	61 U	64	110	87		61 U		180		190	61 U	770	140	78	61 U	620	1200	2435 T	902 T	
LANDAU90	04/23/90	SL4-11	SL4-11	0	15		55 U	55 U	55 U	55 U	41 J	47		55 U		120		67	55 U	100	55 U	36 J	55 U	37 J	120	411 T	37 T	
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60		34 M	55 J	33 M	140	230	150		82 U		230		340	82 U	590	61 J	160	130	290	850	2320 T	709 T	
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106		14 U	12 J	40	29	33	25		14 U		61		32	14 U	110	11 J	25	120	71	100	325 T	283 T	
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137		13 U	13 U	13 U	13 U	9.2 J	6.9 M		13 U		13 J		8.4 J	13 U	30	13 U	13 U	13 U	12 J	21	75.5 T	12 T	
LANDAU90	04/23/90	SL4-12	SL4-12	0	15		61 U	61 U	61 U	61 J	240	140		61 U		440		570	61 U	1200	61 U	73	61 U	170	850	3073 T	231 T	
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60		12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U		12 UT		12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 U	12 UT	12 UT	
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182		13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U		13 UT		13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 U	13 UT	13 UT	
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10	20 U	20	50	20 U	130	420	420	610	120	530	1140	620	600	40	1100	70	220	20 U	480	1100	5160	730	5890
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	20 U	90	250	20 U	540	2600	3500 J	4700 J	2100 J	3300 J	8000	5097	3500	680 J	3600	190	2300 J	60	2400	7500	33780	3440	37220
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10	20 U	30	70	20 U	210	1200	1700	2400	830	1700	4100	2457	1700	250	2300	70	1100	30	1100	3700	16880	1480	18360
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10	20 U	20 U	50	20 U	70	230	190	350	20	270	620	302.2	320	30	620	50	120	30	210	620	2770	410	3180
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10	20 U	20 U	30	20 U	80	280	340	410	260	320	730		410	70	690	40	270	30	270	810	3860	450	
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10	20 U	20 U	20 U	20 U	70	180	50	240	20 U	200	440	131.3	230	30	400	20	50	20 U	150	230	1610	240	1850
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	20 U	20 U	20 U	20 U	20 U	50	20 U	70	20 U	60	130	33.5	50	20 U	100	20 U	20 U	20 U	70	70	400	70	470

U = undetected
J = estimated
M = estimated value of analyte found and confirmed by analyst but with low spectral match

Table C-4. Phenol Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	2,4,5-Trichloro-phenol	2,4,6-Trichloro-phenol	2,4-Dichloro-phenol	2,4-Dimethyl-phenol	2,4-Dinitro-phenol	2-Chloro-phenol	2-Methyl-phenol	2-Nitro-phenol	3-Methylphenol and 4-Methylphenol Coelution	4-Chloro-3-methyl-phenol	4-Methyl-phenol	4-Nitro-phenol	Pentachloro-phenol	Phenol
Sediments (ug/kg, dry wt)																			
BOEING97	10/08/97	R10	SD0063	0	10	96 U	96 U	58 U	19 U	190 UJ	19 U	19 U	96 U		38 U	19 U	96 UJ	96 UJ	24 J
BOEING97	10/08/97	R11	SD0068	0	10	97 U	97 U	58 UJ	19 U	190 UJ	19 U	19 UJ	97 U		39 U	22	97 U	97 U	26 J
BOEING97	10/08/97	R12	SD0064	0	10	96 U	96 U	58 U	19 U	190 UJ	19 U	19 U	96 U		39 U	19 U	96 UJ	96 UJ	19 U
BOEING97	10/08/97	R13	SD0069	0	10	97 U	97 UJ	58 U	19 U	190 U	19 U	19 U	97 U		39 U	19 UJ	97 UJ	97 U	19 U
BOEING97	10/08/97	R14	SD0065	0	10	97 U	97 U	58 U	19 U	190 UJ	19 U	19 U	97 U		39 U	33 J	97 UJ	97 UJ	24 J
BOEING97	10/08/97	R15	SD0066	0	10	98 U	98 U	59 U	20 U	200 UJ	20 U	20 U	98 U		39 U	20 U	98 UJ	98 UJ	34 J
BOEING97	10/08/97	R9	SD0067	0	10	95 U	95 U	57 U	19 U	190 UJ	19 U	19 U	95 U		38 U	19 U	95 UJ	95 UJ	20 J
LANDAU90	04/23/90	SL4-05	SL4-05	0	15				68 U			34 U				34 U		170 U	68 U
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182				32 U			16 U				16 U		79 U	32 U
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228				26 U			13 U				13 U		65 U	26 U
LANDAU90	04/23/90	SL4-06	SL4-06	0	15				66 U			33 U				93		160 U	75 M
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60				300 U			150 U				150 U		740 U	300 U
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121				25 U			13 U				13 U		62 U	25 U
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182				25 U			12 U				12 U		62 U	25 U
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274				25 U			13 U				13 U		63 U	25 U
LANDAU90	04/23/90	SL4-07	SL4-07	0	15				170 U			87 U				87 U		430 U	170 U
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60				120 U			59 U				59 U		300 U	120 U
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121				24 U			12 U				12 U		61 U	24 U
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182				26 U			13 U				13 U		65 U	26 U
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304				23 U			12 U				12 U		59 U	23 U
LANDAU90	04/23/90	SL4-08	SL4-08	0	15				140 U			71 U				71 U		350 U	140 U
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60				150 U			74 U				74 U		370 U	150 U
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121				28 U			14 U				14 U		70 U	28 U
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182				30 U			15 U				15 U		74 U	30 U
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243				24 U			12 U				12 U		60 U	24 U
LANDAU90	04/23/90	SL4-09	SL4-09	0	15				120 U			60 U				60 U		300 U	120 U
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60				170 U			86 U				86 U		430 U	170 U
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152				160 U			79 U				79 U		390 U	160 U
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243				31 U			15 U				15 U		77 U	31 U
LANDAU90	04/23/90	SL4-10	SL4-10	0	15				130 U			65 U				65 U		330 U	130 U
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15				130 U			65 U				65 U		320 U	130 U
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121				130 U			64 U				64 U		320 U	130 U
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243				120 U			61 U				61 U		310 U	120 U
LANDAU90	04/23/90	SL4-11	SL4-11	0	15				110 U			55 U				55 U		280 U	110 U
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60				160 U			82 U				82 U		410 U	160 U
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106				29 U			14 U				14 U		72 U	29 U
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137				25 U			13 U				13 U		63 U	25 U
LANDAU90	04/23/90	SL4-12	SL4-12	0	15				120 U			61 U				61 U		310 U	120 U
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60				24 U			12 U				12 U		61 U	24 U
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182				26 U			13 U				13 U		65 U	26 U
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR178	CC	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	40
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	120
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U

U = undetected
J = estimated

Table C-5. Phthalate Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Bis(2-ethylhexyl)-phthalate	Butyl benzyl phthalate	Diethyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate
Sediments (ug/kg, dry wt)											
BOEING97	8-Oct-97	R10	SD0063	0	10	2300	72 J	19 U	28 J	59 J	19 U
BOEING97	8-Oct-97	R11	SD0068	0	10	1400	67 J	44 J	24 J	46 J	250 J
BOEING97	8-Oct-97	R12	SD0064	0	10	490	30 J	19 U	19 U	25	26 J
BOEING97	8-Oct-97	R13	SD0069	0	10	700	43 J	19 U	19 U	19 U	53
BOEING97	8-Oct-97	R14	SD0065	0	10	880	34 U	19 U	19 U	210 UJ	110 U
BOEING97	8-Oct-97	R15	SD0066	0	10	800	21 J	20 U	20 U	20 U	50 J
BOEING97	8-Oct-97	R9	SD0067	0	10	1500	53 J	19 U	26 J	34	200 J
LANDAU90	23-Apr-90	SL4-05	SL4-05	0	15	3600	34 U	34 U	34 U	34 U	34 U
LANDAU90	23-Apr-90	SL4-05A	SL4-05A-4-6	121	182	16 U	16 U	16 U	16 U	16 U	16 U
LANDAU90	23-Apr-90	SL4-05A	SL4-05A-6.8-7.5	207	228	4.7 J	13 U	13 U	13 U	13 U	13 U
LANDAU90	23-Apr-90	SL4-06	SL4-06	0	15	11000 K	500	33 U	98 U	200 M	2700
LANDAU90	23-Apr-90	SL4-06A	SL4-06A-0-2	0	60	6900	840	150 U	150 U	1600	1000
LANDAU90	23-Apr-90	SL4-06A	SL4-06A-2-4	60	121	110	24	13 U	13 U	13 U	35
LANDAU90	23-Apr-90	SL4-06A	SL4-06A-4-6	121	182	73	12 U	12 U	12 U	12 U	11 J
LANDAU90	23-Apr-90	SL4-06A	SL4-06A-6-9	182	274	75	13 U	13 U	13 U	13 U	13 U
LANDAU90	23-Apr-90	SL4-07	SL4-07	0	15	8600	87 U	87 U	87 U	110	1100
LANDAU90	23-Apr-90	SL4-07A	SL4-07A-0-2	0	60	1800	130	59 U	59 U	59 U	120
LANDAU90	23-Apr-90	SL4-07A	SL4-07A-2-4	60	121	11 J	12 U	12 U	12 U	12 U	12 U
LANDAU90	23-Apr-90	SL4-07A	SL4-07A-4-6	121	182	55	13 U	13 U	13 U	13 U	13 U
LANDAU90	23-Apr-90	SL4-07A	SL4-07A-6-10	182	304	12 U	12 U	12 U	12 U	12 U	12 U
LANDAU90	23-Apr-90	SL4-08	SL4-08	0	15	3700	71 U	71 U	71 U	120	400
LANDAU90	23-Apr-90	SL4-08A	SL4-08A-0-2	0	60	910	74 U	74 U	74 U	81	74 U
LANDAU90	23-Apr-90	SL4-08A	SL4-08A-2-4	60	121	12 J	14 U	14 U	14 U	14 U	14 U
LANDAU90	23-Apr-90	SL4-08A	SL4-08A-4-6	121	182	15 U	15 U	15 U	15 U	15 U	15 U
LANDAU90	23-Apr-90	SL4-08A	SL4-08A-6-8	182	243	15	12 U	12 U	12 U	12 U	12 U
LANDAU90	23-Apr-90	SL4-09	SL4-09	0	15	1100	60 U	60 U	60 U	62	600
LANDAU90	23-Apr-90	SL4-09A	SL4-09A-0-2	0	60	7100	86 U	86 U	86 U	120 M	2700
LANDAU90	23-Apr-90	SL4-09A	SL4-09A-3-5	91	152	79 U	79 U	79 U	79 U	79 U	79 U
LANDAU90	23-Apr-90	SL4-09A	SL4-09A-6-8	182	243	13 J	15 U	15 U	15 U	15 U	15 U
LANDAU90	23-Apr-90	SL4-10	SL4-10	0	15	2200	47 J	65 U	65 U	65 U	520
LANDAU90	23-Apr-90	SL4-10A	SL4-10A-0-0.5	0	15	3300	60 J	65 U	65 U	71	160 M
LANDAU90	23-Apr-90	SL4-10A	SL4-10A-2-4	60	121	310	64 U	64 U	64 U	64 U	64 U
LANDAU90	23-Apr-90	SL4-10A	SL4-10A-6-8	182	243	190	61 U	61 U	61 U	61 U	61 U
LANDAU90	23-Apr-90	SL4-11	SL4-11	0	15	250	55 U	55 U	55 U	55 U	90
LANDAU90	23-Apr-90	SL4-11A	SL4-11A-0-2	0	60	570	82 U	82 U	82 U	78 J	160 U
LANDAU90	23-Apr-90	SL4-11A	SL4-11A-2.5-3.5	76	106	120	14 U	14 U	14 U	11 J	14 U
LANDAU90	23-Apr-90	SL4-11A	SL4-11A-3.5-4.5	106	137	120	13 U	13 U	13 U	13 U	13 U
LANDAU90	23-Apr-90	SL4-12	SL4-12	0	15	990	61 U	61 U	61 U	61 U	110
LANDAU90	23-Apr-90	SL4-12A	SL4-12A-0.5-2	15	60	240	12 U	12 U	12 U	12 U	12 U
LANDAU90	23-Apr-90	SL4-12A	SL4-12A-4-6	121	182	260	13 U	13 U	13 U	13 U	13 U
LODRIV98	11-Aug-98	DR177	SD-DR177-0000	0	10	700	50	20 U	20 U	20	20 U
LODRIV98	11-Aug-98	DR178	CC	0	10	5100	270	20 U	70	100	570 J
LODRIV98	11-Aug-98	DR179	SD-DR179-0000	0	10	2800	120	20 U	20	70	260
LODRIV98	11-Aug-98	DR180	SD-DR180-0000	0	10	500	30	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR181	SD-DR181-0000	0	10	790	40	20 U	20 U	20 U	70
LODRIV98	11-Aug-98	DR182	SD-DR182-0000	0	10	340	20	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR183	SD-DR183-0000	0	10	50	20 U	20 U	20 U	20 U	20 U

U = undetected
J = estimated
K = reported concentration is less than the detection limit

Table C-6. Organotin Concentrations in Sediments and Porewater Inside Slip 4.

Survey	Date	Station	SampleID	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Dibutyltin as ion	n-Butyltin	Tetrabutyltin	Tributyltin as ion
Sediments (ug/kg, dry wt)									
LODRIV98	11-Aug-98	DR174	SD-DR174-0000	0	10	11 J	12 J	10 U	46
LODRIV98	11-Aug-98	DR178	SD-DR178-0000-CC	0	10	32 J	45 UJ	5 UJ	40 J
LODRIV98	11-Aug-98	DR181	SD-DR181-0000	0	10	20 J	8 J	5 UJ	40
LODRIV98	11-Aug-98	DR183	SD-DR183-0000	0	10	5 UJ	5 UJ	5 UJ	6 J
LODRIV98	11-Aug-98	DR194	SD-DR194-0000	0	10	13 J	10 J	10 U	42
LODRIV98	11-Aug-98	DR221	SD-DR221-0000	0	10	10	9 J	5 U	31
LODRIV98	11-Aug-98	DR232	SD-DR232-0000	0	10	6	5 J	5 U	21
Porewater (ug/L)									
LODRIV98	11-Aug-98	DR181	PW-DR181-0000	0	10	0.05 UJ	0.05 UJ	0.05 UJ	0.05 UJ

U = undetected
J = estimated

Table C-7. PCB Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Aroclor-1016	Aroclor-1016/1242	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	PCBs (total-calc'd)	PCBs + PCTs (total)	PCTs (total)
Sediments (ug/kg, dry wt)																
BOEING97	10/08/97	R10	SD0063	0	10	18 U		37 U	18 U	210 UJ	680	2000	500	3180		
BOEING97	10/08/97	R11	SD0068	0	10	19 U		37 U	19 U	180 U	300	1200	280	1780		
BOEING97	10/08/97	R12	SD0064	0	10	19 U		38 U	19 U	120 UJ	200	1200	200	1600		
BOEING97	10/08/97	R13	SD0069	0	10	19 U		39 U	19 U	81 U	140	960	220	1320		
BOEING97	10/08/97	R14	SD0065	0	10	19 U		39 U	19 U	6100 UJ	1900 U	14000	2400	16400		
BOEING97	10/08/97	R15	SD0066	0	10	20 U		39 U	20 U	160 UJ	390 UJ	1100	260	1360		
BOEING97	10/08/97	R9	SD0067	0	10	18 U		36 U	18 U	230 UJ	650	1800	500	2950		
LANDAU90	04/23/90	SL4-05	SL4-05	0	15		2100				400 U	9700	1400 U	11800		
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182		20 U				20 U	11 J	20 U	11		
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228		20 U				20 U	20 U	20 U	20 U		
LANDAU90	04/23/90	SL4-06	SL4-06	0	15		200 U				200 U	1000	330 U	1000		
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60		20000 U				20000 U	150000	20000 U	150000		
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121		200 U				200 U	1300	600 U	1300		
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182		20 U				20 U	62	20 U	62		
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274		20 U				20 U	240	20 U	240		
LANDAU90	04/23/90	SL4-07	SL4-07	0	15		630				400 U	3800	700 U	4430		
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60		200 U				400 U	2300	300 U	2300		
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121		20 U				20 U	8.9 J	20 U	8.9		
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182		20 U				20 U	20 U	20 U	20 U		
LANDAU90	04/23/90	SL4-08	SL4-08	0	15		990				1000 U	9300	1000 U	10290		
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60		690				20 U	1100	270	2060		
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121		20				20 U	87	50 U	107		
LANDAU90	04/23/90	SL4-09	SL4-09	0	15		4000 U				4000 U	34000	4000 U	34000		
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60		2000 U				2000 U	19000	3400	22400		
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152		20				20 U	87	50 U	107		
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243		20 U				20 U	20 U	20 U	20 U		
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15		590				600 U	4300	910	5800		
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121		850				900 U	2600	420	3870		
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243		440 U				600 U	3800	1400	5200		
LANDAU90	04/23/90	SL4-11	SL4-11	0	15		200 U				200 U	730	200 U	730		
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60		90				100 U	500	400	990		
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106		20 U				20 U	20 U	20 U	20 U		
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137		20 U				20 U	20 U	20 U	20 U		
LANDAU90	04/23/90	SL4-12	SL4-12	0	15		20 U				20 U	56	31 U	56		
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60		20 U				20 U	20 U	20 U	20 U		
LANDAU90	04/23/90	SL4-12A	SL4-12A-0-0.5	0	15		20 U				20 U	96	120	216		
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182		20 U				20 U	20 U	20 U	20 U		
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10	20 UJ		40 U	20 U	76	20 U	417	139 J	632		
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	20 UJ		40 U	20 U	1600 J	20 U	4500	944 J	7044		
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10	20 UJ		40 U	20 U	446	20 U	2300	612 J	3358		
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10	20 UJ		40 U	20 U	59	20 U	339	129 J	527		
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10	20 UJ		40 U	20 U	136	20 U	1220	316 J	1672		
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	234	84 J	318		
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	61	61 J	122		
NOAA97	09/15/97	EIT063	EIT07-01	0	10									2300	2400	100
NOAA97	09/15/97	EIT064	EIT07-02	0	10									1800	1800	28
NOAA97	09/15/97	EIT066	EIT07-03	0	10									600	610	15
NOAA97	09/15/97	EIT067	EIT07-04	0	10									130	150	17
NOAA97	09/15/97	EIT068	EIT07-05	0	10									82	110	28
NOAA97	09/15/97	EIT069	EIT08-01	0	10									3300	3400	66
NOAA97	09/15/97	EIT070	EIT08-02	0	10									25000	26000	550
NOAA97	09/15/97	EIT072	EIT08-03	0	10									1200	1300	76
NOAA97	09/15/97	EST163	EST12-01	0	10									7000	7100	130
NOAA97	09/15/97	EST164	EST12-02	0	10									4100	4200	110
NOAA97	09/15/97	EST165	EST12-03	0	10									1400	1400	43
NOAA97	09/15/97	EST168	EST12-04	0	10									1100	1100	42
NOAA97	09/15/97	EST169	EST12-05	0	10									6600	6800	160
NOAA97	09/15/97	EST170	EST12-06	0	10									740	780	41
NOAA97	09/15/97	EST171	EST12-07	0	10									190	200	13
NOAA97	09/15/97	EST172	EST12-08	0	10									300	340	40
NOAA97	09/15/97	EST173	EST12-09	0	10									200	220	16

Table C-7. PCB Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Aroclor-1016	Aroclor-1016/1242	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	PCBs (total-calc'd)	PCBs + PCTs (total)	PCTs (total)
Sediments (ug/kg, dry wt)																
NOAA97	09/15/97	EST175	EST12-10	0	10									350	360	9.7
NOAA97	09/15/97	EST179	EST13-04	0	10									240	280	45

U = undetected
J = estimated

Table C-8. PCB Congener Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	PCB-101	PCB-105	PCB-110	PCB-114	PCB-118	PCB-123	PCB-126	PCB-128	PCB-138	PCB-153	PCB-156	PCB-157	PCB-167	PCB-169	PCB-170	PCB-18	PCB-180	PCB-187	PCB-189	PCB-195	PCB-206	PCB-209	PCB-28	PCB-44	PCB-55	PCB-66	PCB-77	PCB-81
Sediments (ug/kg, dry wt)																																	
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10	20 J	9		2 U	23	5 U	1 U	7	38	23	4	1 U	2	1 U	6	5 J	9	7	1 U	2 U	3	1 U	6 J	15 J	44 J	38	1 UJ	1 U
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	310 J	92		12 U	280	31 U	4 U	71 J	400	260	36	10	15	1 U	47	170 J	83 J	35	2	6	7	1	120 J	190 J	890 J	440	6 U	1 U
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10	120 J	37		6 U	140	20 U	2 U	29	200	140	17	4	8	1 U	26	52 J	37	24	5 U	4	4	1 U	27 J	94 J	310 J	230	5 U	1 U
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10	19 J	6		2 U	18	5 U	1 U	6	32	21	3	1	2	1 U	6	4 J	9	6	1 U	1 U	1 U	1 U	4 J	11 J	37 J	30	1 UJ	1 U
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10	74	20		10 U	65	10 U	10 U	18	100	64	10 U	10 U	10 U	10 U	24	10 U	24	13	10 U	10 U	10 U	10 U	12	40	120	120	10 U	10 U
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10	16 J	5		1 U	13	2 U	1 U	4	22	14	2	1 U	1	1 U	4	2 J	6	5	1 U	1 U	1 U	1 U	3 J	8 J	22 J	21	1 UJ	1 U
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	3 J	2		1 U	4	1 U	1 U	1	9	7	1 U	1 U	1 U	1 U	3	1 UJ	4	3	1 U	1 U	1 U	1 U	2 J	2 J	2 J	5	1 UJ	1 U
NOAA97	09/15/97	EIT063	EIT07-01	0	10	590 J	47	270		140		0.22 U	81 J	160	280 J	16	7.3		0.55 U	44		55		1.5								2.2	
NOAA97	09/15/97	EIT064	EIT07-02	0	10	460 J	31	200		93		0.32 U	46 J	94	260 J	9.2	3.6		0.81 U	19		23		0.36 U								1.1	
NOAA97	09/15/97	EIT066	EIT07-03	0	10	160 J	13	71		39		0.18 U	14 J	30	88 J	2.9	0.14 U		0.44 U	7.3		9.5 U		0.2 U								0.2 U	
NOAA97	09/15/97	EIT067	EIT07-04	0	10	38 J	3.3	14		8.3		0.18 U	5.8 J	7.9	22 J	0.74	0.14 U		0.45 U	3.1		4.7 U		0.2 U								0.2 U	
NOAA97	09/15/97	EIT068	EIT07-05	0	10	22 J	2.4	8.5		5.5 U		0.18 U	3.4 J	4.4	13 J	0.16 U	0.14 U		0.45 U	2.1		3.4		0.2 U								0.2 U	
NOAA97	09/15/97	EIT069	EIT08-01	0	10	700 J		330		230		1.4 U	90 J	180	470 J	22			0.76 U	39		48		1.9								7.3	
NOAA97	09/15/97	EIT070	EIT08-02	0	10	5600 J	560	3000		2200			620 J	1400	3000 J	160	56		0.39 U	250		330		10								15	
NOAA97	09/15/97	EIT072	EIT08-03	0	10	350 J	24	140		78		0.32 U	39 J	71	160 J	8	3.6		0.78 U	25		28		0.35 U								1.4	
NOAA97	09/15/97	EST163	EST12-01	0	10	930 J	120	710		410		0.25 U	160 J	310	690 J	36	12		0.62 U	69		95		1.7								6.1	
NOAA97	09/15/97	EST164	EST12-02	0	10	540 J	73	420		240		0.39 U	92 J	190	510 J	23	7.4		0.97 U	50		63		0.44 U								3.6	
NOAA97	09/15/97	EST165	EST12-03	0	10	280 J	23	130		69		0.32 U	36 J	56	140 J	6.9	3.9		0.78 U	19		22		0.36 U								0.35 U	
NOAA97	09/15/97	EST168	EST12-04	0	10	250 J	24	110		66		0.55 U	29 J	57	130 J	6.9	2.7		1.3 U	16		23		0.6 U								0.6 U	
NOAA97	09/15/97	EST169	EST12-05	0	10	1300 J	82	610		280		0.55 U	150 J	240	520 J	29	11		1.3 U	65		85		3.2								4.1	
NOAA97	09/15/97	EST170	EST12-06	0	10	170 J	18	73		44		0.62 U	18 J	37	100 J	3.9	0.48 U		1.4 U	14		19		0.68 U								0.68 U	
NOAA97	09/15/97	EST171	EST12-07	0	10	48 J	5.5	22		15		0.18 U	5.3 J	11	29 J	1.2	0.15 U		0.46 U	2.7		3.7		0.21 U								0.21 U	
NOAA97	09/15/97	EST172	EST12-08	0	10	70 J	7.6	28		18		0.33 U	12 J	20	40 J	1.6	0.26 U		0.75 U	6.7		11		0.36 U								0.36 U	
NOAA97	09/15/97	EST173	EST12-09	0	10	50 J	6.2	21		16		0.46 U	5.6 J	13	30 J	0.4 U	0.36 U		1.1 U	6.4		9.5		0.5 U								0.5 U	
NOAA97	09/15/97	EST175	EST12-10	0	10	74 J	0.34 U	9.7		0.56 J		0.38 U	15 J	17	67 J	1.9	0.3 U		0.88 U	26		51		0.42 U								0.42 U	

U = undetected
J = estimated

Table C-9. Dioxin and Furan Concentrations in Sediments Inside Slip 4.

Survey	Station	Date	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-HxCDF	1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-HxCDF	1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDF	2,3,4,6,7,8-HxCDF	2,3,4,7,8-PeCDF	2,3,7,8-TCDD	2,3,7,8-TCDD TEQ (ng/kg, dry wt)	2,3,7,8-TCDF	OCDD	OCDF	Total HpCDD	Total HpCDF	Total HxCDD	Total HxCDF	Total PeCDD	Total PeCDF	Total TCDD	Total TCDF
Sediments (pg/g, dry wt)																															
LODRIV98	DR183	08/11/98	SD-DR183-0000	0	10	100	32	2.3 U	1.4 U	4.2 U	5.6 J	2 U	3.8 U	0.18 U	1.3 U	1.1 U	1.6 U	2.5 U	0.66 U	4.5067	2.5	640	97	250	110	45	36	5.5 U	66	10	63

U = undetected
J = estimated

Table C-10. Pesticide Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	alpha-BHC	alpha-Chlordane	alpha-Endosulfan	beta-BHC	beta-Endosulfan	DDTs (total-calc'd)	Dieldrin	Endosulfan sulfate	Endrin	Endrin aldehyde	Endrin ketone	gamma-BHC	gamma-Chlordane	Heptachlor	Heptachlor epoxide	Toxaphene
Sediments (ug/kg, dry wt)																									
LANDAU90	04/23/90	SL4-05	SL4-05	0	15	40 U	180 U	50 U	270 U		30 U					40 U		40 U			20 U		20 U	20 U	
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		9 U	1 U	
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228	2 U	2 U	3 U	1 U		1.5 U					2 U		2 U			1 U		6 U	1 U	
LANDAU90	04/23/90	SL4-06	SL4-06	0	15	20 U	20 U	31 U	40 U		15 U					20 U		20 U			10 U		10 U	15 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60	2000 U	2000 U	2000 U	1000 U		1500 U					2000 U		2000 U			1000 U		1000 U	1000 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121	20 U	20 U	20 U	30 U		15 U					20 U		20 U			10 U		10 U	30 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		6 U	1 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274	2.5 U	3.5 U	2 U	1 U		1.5 U					2 U		2 U			1 U		6 U	1 U	
LANDAU90	04/23/90	SL4-07	SL4-07	0	15	40 U	110 U	40 U	85 U		30 U					40 U		40 U			20 U		20 U	20 U	
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60	20 U	50 U	20 U	30 U		15 U					25 U		20 U			10 U		10 U	30 U	
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-08	SL4-08	0	15	100 U	220 U	100 U	190 U		75 U					100 U		100 U			50 U		50 U	50 U	
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60	2 U	15 U	6 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-09	SL4-09	0	15	400 U	960 U	400 U	630 U		300 U					400 U		400 U			200 U		200 U	200 U	
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60	220 U	220 U	210 U	100 U		150 U					450 U		200 U			100 U		100 U	100 U	
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15	40 U	100 U	40 U	120 U		30 U					40 U		50 U			20 U		20 U	20 U	
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121	40 U	40 U	40 U	160 U		30 U					40 U		40 U			20 U		20 U	20 U	
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243	40 U	50 U	40 U	260 U		30 U					40 U		60 U			20 U		20 U	20 U	
LANDAU90	04/23/90	SL4-11	SL4-11	0	15	20 U	23 U	20 U	16 U		15 U					20 U		20 U			10 U		10 U	10 U	
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60	6 U	12 U	6 U	20 U		1.5 U					7 U		8 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-12	SL4-12	0	15	2 U	2 U	2 U	2 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-12A	SL4-12A-0-0.5	0	15	2 U	2.2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182	2 U	2 U	2 U	1 U		1.5 U					2 U		2 U			1 U		1 U	1 U	
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	840	370 J	1670	10 U	10 U	26	100 U	13	200 U	2880	280	200 U	200 U	130	200 U	10 U	204	10 U	100 U	3700 U
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	20 U	10 U	25 U	10 U	10 U	10 U	10 U	10 U	20 U	25 U	13	20 U	20 U	20 U	20 U	10 U	10 U	10 U	10 U	170 U

U = undetected
J = estimated

Table C-11. Volatile Organic Compound Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	1,1,1,2-Tetra-chloro-ethane	1,1,1-Tri-chloro-ethane	1,1,2,2-Tetra-chloro-ethane	1,1,2-Tri-chloro-ethane	1,1,2-Tri-chloro-trifluoro-ethane	1,1-Dichloro-acetone	1,1-Dichloro-ethane	1,1-Dichloro-ethene	1,1-Dichloro-propene	1,2,3-Trichloro-benzene	1,2,3-Trichloro-propane	1,2,4-Trichloro-benzene	1,2,4-Trimethyl-benzene	1,2-Dibromo 3-chloro-propane	1,2-Dibromo-ethane (EDB)	1,2-Dichloro-benzene	1,2-Dichloro-ethane	1,2-Dichloro-propane	1,3,5-Trimethyl-benzene	1,3-Dichloro-benzene	1,3-Dichloro-propane	1,4-Dichloro-benzene	1-Chloro-butane	2,2-Dichloro-propane	2,4-Dinitro-toluene
Sediments (ug/kg, dry wt)																														
BOEING97	10/08/97	R10	SD0063	0	10												19 U				19 U				19 U		19 U			96 U
BOEING97	10/08/97	R11	SD0068	0	10												19 U				19 U				19 U		19 U			97 U
BOEING97	10/08/97	R12	SD0064	0	10												19 U				19 U				19 U		19 U			96 U
BOEING97	10/08/97	R13	SD0069	0	10												19 UJ				19 UJ				19 U		19 UJ			97 U
BOEING97	10/08/97	R14	SD0065	0	10												19 U				19 U				19 U		19 U			97 U
BOEING97	10/08/97	R15	SD0066	0	10												20 U				20 U				20 U		20 U			98 U
BOEING97	10/08/97	R9	SD0067	0	10												19 U				19 U				19 U		19 U			95 U
LANDAU90	04/23/90	SL4-05	SL4-05	0	15												34 U				34 U				34 U		34 U			
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182												16 U				16 U				16 U		16 U			
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228												13 U				13 U				13 U		13 U			
LANDAU90	04/23/90	SL4-06	SL4-06	0	15												33 U				33 U				33 U		33 U			
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60												150 U				150 U				150 U		150 U			
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121												13 U				13 U				13 U		13 U			
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182												12 U				12 U				12 U		12 U			
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274												13 U				13 U				13 U		13 U			
LANDAU90	04/23/90	SL4-07	SL4-07	0	15												87 U				87 U				87 U		87 U			
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60												59 U				59 U				59 U		59 U			
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121												12 U				12 U				12 U		12 U			
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182												13 U				13 U				13 U		13 U			
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304												12 U				12 U				12 U		12 U			
LANDAU90	04/23/90	SL4-08	SL4-08	0	15												71 U				71 U				71 U		71 U			
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60												74 U				74 U				74 U		74 U			
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121												14 U				14 U				14 U		14 U			
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182												15 U				15 U				15 U		15 U			
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243												12 U				12 U				12 U		12 U			
LANDAU90	04/23/90	SL4-09	SL4-09	0	15												60 U				60 U				60 U		60 U			
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60												86 U				86 U				86 U		86 U			
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152												79 U				79 U				79 U		79 U			
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243												15 U				15 U				15 U		15 U			
LANDAU90	04/23/90	SL4-10	SL4-10	0	15												65 U				65 U				65 U		65 U			
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15												65 U				65 U				65 U		65 U			
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121												64 U				64 U				64 U		64 U			
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243												61 U				61 U				61 U		61 U			
LANDAU90	04/23/90	SL4-11	SL4-11	0	15												55 U				55 U				55 U		55 U			
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60												82 U				82 U				82 U		82 U			
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106												14 U				14 U				14 U		14 U			
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137												13 U				13 U				13 U		13 U			
LANDAU90	04/23/90	SL4-12	SL4-12	0	15												61 U				61 U				61 U		61 U			
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60												12 U				12 U				12 U		12 U			
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182												13 U				13 U				13 U		13 U			
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	6.6 U	3.3 U	3.3 U	3.3 U	6.6 U	3.3 U	20 U	3.3 U	16.6 U	3.3 U	20 U	3.3 U	3.3 U	3.3 U	20 U	3.3 U	20 U	3.3 U	3.3 U	200 U
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	4.6 U	2.3 U	2.3 U	2.3 U	4.6 U	2.3 U	20 U	2.3 U	11.4 U	2.3 U	20 U	2.3 U	2.3 U	2.3 U	20 U	2.3 U	20 U	2.3 U	2.3 U	200 U

U = undetected
J = estimated

Table C-11. Volatile Organic Compound Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	2,6-Dinitro-toluene	2-Chloro-toluene	2-Hexanone	2-Nitro-propane	4-Chloro-toluene	Acetone	Benzene	Bromo-benzene	Bromo-chloro-methane	Bromo-dichloro-methane	Bromoform	Bromo-methane	Carbon disulfide	Carbon tetra-chloride	Chloro-benzene	Chloro-ethane	Chloroform	Chloro-methane	cis-1,2-Dichloro-ethene	cis-1,3-Dichloro-propene	Cymene	Dibromo-chloro-methane	Dibromo-methane	Dichloro-methane	Diethyl ether	Ethyl Methacrylate
Sediments (ug/kg, dry wt)																															
BOEING97	10/08/97	R10	SD0063	0	10	96 U																									
BOEING97	10/08/97	R11	SD0068	0	10	97 U																									
BOEING97	10/08/97	R12	SD0064	0	10	96 U																									
BOEING97	10/08/97	R13	SD0069	0	10	97 UJ																									
BOEING97	10/08/97	R14	SD0065	0	10	97 U																									
BOEING97	10/08/97	R15	SD0066	0	10	98 U																									
BOEING97	10/08/97	R9	SD0067	0	10	95 U																									
LANDAU90	04/23/90	SL4-05	SL4-05	0	15																										
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182																										
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228																										
LANDAU90	04/23/90	SL4-06	SL4-06	0	15																										
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60																										
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121																										
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182																										
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274																										
LANDAU90	04/23/90	SL4-07	SL4-07	0	15																										
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60																										
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121																										
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182																										
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304																										
LANDAU90	04/23/90	SL4-08	SL4-08	0	15																										
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60																										
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121																										
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182																										
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243																										
LANDAU90	04/23/90	SL4-09	SL4-09	0	15																										
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60																										
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152																										
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243																										
LANDAU90	04/23/90	SL4-10	SL4-10	0	15																										
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15																										
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121																										
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243																										
LANDAU90	04/23/90	SL4-11	SL4-11	0	15																										
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60																										
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106																										
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137																										
LANDAU90	04/23/90	SL4-12	SL4-12	0	15																										
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60																										
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182																										
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10	200 U																									
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	200 U	3.3 U	6.6 U	16.6 U	3.3 U	114 J	3.3 U	3.3 U	3.3 U	3.3 U	6.6 U	16.6 U	4 J	3.3 U	3.3 U	6.6 U	3.3 U	3.3 U	3.3 U	3.5 U	3.3 U	3.3 U	3.3 U	16.6 U	3.3 U	3.3 U
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10	200 U																									
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10	200 U																									
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10	200 U																									
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10	200 U																									
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	200 U	2.3 U	4.6 U	11.4 U	2.3 U	29.8 UJ	2.3 U	2.3 U	2.3 U	2.3 U	4.6 U	11.4 U	1.5 J	2.3 U	2.3 U	4.6 U	2.3 U	2.3 U	2.3 U	2.4 U	2.3 U	2.3 U	2.3 U	11.4 U	2.3 U	2.3 U

U = undetected
J = estimated

Table C-11. Volatile Organic Compound Concentrations in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Ethyl-benzene	Hexa-chloro-benzene	Hexa-chloro-ethane	iso-Propyl-benzene	Methyl ethyl ketone	Methyl iso-butyl ketone	n-Butyl-benzene	Nitro-benzene	n-Propyl-benzene	Penta-chloro-ethane	sec-Butyl-benzene	Styrene	tert-Butyl-benzene	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro-ethene	trans-1,3-Dichloro-propene	trans-1,4-Dichloro-2-butene	Tri-chloro-ethene	Tri-chloro-fluoro-methane	Vinyl chloride	Xylene (meta & para)	Xylene (ortho)
Sediments (ug/kg, dry wt)																												
BOEING97	10/08/97	R10	SD0063	0	10		1.7 J	19 U					19 U															
BOEING97	10/08/97	R11	SD0068	0	10		0.9 U	19 UJ					19 U															
BOEING97	10/08/97	R12	SD0064	0	10		1 UJ	19 U					19 U															
BOEING97	10/08/97	R13	SD0069	0	10		1 U	19 U					19 U															
BOEING97	10/08/97	R14	SD0065	0	10		97 UJ	19 U					19 U															
BOEING97	10/08/97	R15	SD0066	0	10		1 UJ	20 U					20 U															
BOEING97	10/08/97	R9	SD0067	0	10		0.9 UJ	19 U					19 U															
LANDAU90	04/23/90	SL4-05	SL4-05	0	15		34 U	68 U																				
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182		16 U	32 U																				
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228		13 U	26 U																				
LANDAU90	04/23/90	SL4-06	SL4-06	0	15		33 U	66 U																				
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60		150 U	300 U																				
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121		13 U	25 U																				
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182		12 U	25 U																				
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274		13 U	25 U																				
LANDAU90	04/23/90	SL4-07	SL4-07	0	15		87 U	170 U																				
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60		59 U	120 U																				
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121		12 U	24 U																				
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182		13 U	26 U																				
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304		12 U	23 U																				
LANDAU90	04/23/90	SL4-08	SL4-08	0	15		71 U	140 U																				
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60		74 U	150 U																				
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121		14 U	28 U																				
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182		15 U	30 U																				
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243		12 U	24 U																				
LANDAU90	04/23/90	SL4-09	SL4-09	0	15		60 U	120 U																				
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60		86 U	170 U																				
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152		79 U	160 U																				
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243		15 U	31 U																				
LANDAU90	04/23/90	SL4-10	SL4-10	0	15		65 U	130 U																				
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15		65 U	130 U																				
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121		64 U	130 U																				
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243		61 U	120 U																				
LANDAU90	04/23/90	SL4-11	SL4-11	0	15		55 U	110 U																				
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60		82 U	160 U																				
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106		14 U	29 U																				
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137		13 U	25 U																				
LANDAU90	04/23/90	SL4-12	SL4-12	0	15		61 U	120 U																				
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60		12 U	24 U																				
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182		13 U	26 U																				
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	3.3 U	20 U	20 U	16.6 U	16.8	6.6 U	3.3 U	20 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	6.2 U	16.6 U	3.3 U	3.3 U	3.3 U	6.6 U	3.3 U
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	2.3 U	20 U	20 U	11.4 U	11.8	4.6 U	2.3 U	20 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	4.3 U	11.4 U	2.3 U	2.3 U	2.3 U	4.6 U	2.3 U

U = undetected
J = estimated

Table C-12. Concentrations of Miscellaneous Compounds in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	1,2-Diphenyl-hydrazine	2-Nitroaniline	3,3'-Dichloro-benzidine	3-Nitroaniline	4,6-Dinitro-o-cresol	4-Bromophenyl phenyl ether	4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Nitroaniline	Allyl Chloride	Benzoic acid	Benzyl alcohol	bis-(2-chloro-ethoxy)-methane	bis-(2-chloro-ethyl)-ether	bis-(2-chloro-isopropyl)-ether	bis-chloro-isopropyl ether	Carbazole	Coprostanol	Dibenzo-furan	Hexachloro-butadiene	Hexachloro-cyclo-pentadiene
Sediments (ug/kg, dry wt)																										
BOEING97	10/08/97	R10	SD0063	0	10		96 U	96 U	120 UJ	190 UJ	19 U	58 U	19 U	96 UJ		190 UJ	19 UJ	19 U	38 U		19 U	150 J		84	19 U	96 UJ
BOEING97	10/08/97	R11	SD0068	0	10		97 U	97 U	120 U	190 U	19 U	58 U	19 U	97 U		190 U	19 U	19 U	39 UJ		19 U	130 J		71	19 U	97 UJ
BOEING97	10/08/97	R12	SD0064	0	10		96 U	96 U	120 UJ	190 UJ	19 U	58 U	19 U	96 UJ		190 UJ	19 UJ	19 U	39 U		19 U	67 J		33	19 U	96 UJ
BOEING97	10/08/97	R13	SD0069	0	10		97 U	97 U	120 UJ	190 UJ	19 UJ	58 U	19 U	97 U		190 U	19 U	19 UJ	39 U		19 U	44		33	19 U	97 U
BOEING97	10/08/97	R14	SD0065	0	10		97 U	97 U	120 UJ	190 UJ	19 U	58 U	19 U	97 UJ		190 UJ	19 UJ	19 U	39 U		19 U	37 J		29	19 U	97 UJ
BOEING97	10/08/97	R15	SD0066	0	10		98 U	98 U	120 UJ	200 UJ	20 U	59 U	20 U	98 UJ		200 UJ	20 UJ	20 U	39 U		20 U	47 J		69	20 U	98 UJ
BOEING97	10/08/97	R9	SD0067	0	10		95 U	95 U	110 UJ	190 UJ	19 U	57 U	19 U	95 UJ		190 UJ	19 UJ	19 U	38 U		19 U	140 J		62	19 U	95 UJ
LANDAU90	04/23/90	SL4-05	SL4-05	0	15											340 U	170 U							45	68 U	
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182											160 U	79 U							16 U	32 U	
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228											130 U	65 U							13 U	26 U	
LANDAU90	04/23/90	SL4-06	SL4-06	0	15											130 J	160 U							220	66 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60											1500 U	740 U							150	300 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121											120 U	62 U							13 U	25 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182											120 U	62 U							12 U	25 U	
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274											130 U	63 U							13 U	25 U	
LANDAU90	04/23/90	SL4-07	SL4-07	0	15											870 U	430 U							280	170 U	
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60											590 U	300 U							50 J	120 U	
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121											120 U	61 U							12 U	24 U	
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182											130 U	65 U							13 U	26 U	
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304											120 U	59 U							12 U	23 U	
LANDAU90	04/23/90	SL4-08	SL4-08	0	15											710 U	350 U							120	140 U	
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60											740 U	370 U							74 U	150 U	
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121											140 U	70 U							14 U	28 U	
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182											150 U	74 U							15 U	30 U	
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243											120 U	60 U							12 U	24 U	
LANDAU90	04/23/90	SL4-09	SL4-09	0	15											600 U	300 U							150	120 U	
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60											860 U	430 U							120	170 U	
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152											790 U	390 U							210	160 U	
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243											150 U	77 U							15 U	31 U	
LANDAU90	04/23/90	SL4-10	SL4-10	0	15											650 U	330 U							65 U	130 U	
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15											650 U	320 U							24 M	130 U	
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121											640 U	320 U							64 U	130 U	
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243											610 U	310 U							61 U	120 U	
LANDAU90	04/23/90	SL4-11	SL4-11	0	15											550 U	280 U							55 U	110 U	
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60											820 U	410 U							82 U	160 U	
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106											140 U	72 U							8.3 J	29 U	
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137											130 U	63 U							13 U	25 U	
LANDAU90	04/23/90	SL4-12	SL4-12	0	15											610 U	310 U							61 U	120 U	
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60											120 U	61 U							12 U	24 U	
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182											130 U	65 U							13 U	26 U	
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		50		50	20 U	100 UJ
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U	3.3 U	200 U	50 U	40 U	40 U	40 U		410		120	20 U	100 UJ
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		180		50	20 U	100 UJ
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20		40	20 U	100 UJ
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		40		30	20 U	100 UJ
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U	2.3 U	200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ

U = undetected
J = estimated

Table C-12. Concentrations of Miscellaneous Compounds in Sediments Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Iodomethane	Isophorone	Methacrylonitrile	Methoxychlor	Methyl Acrylate	Methyl Methacrylate	Methyl-mercury	N-Nitroso-dimethylamine	N-Nitroso-di-n-propylamine	N-Nitroso-diphenylamine	Tert-butyl methyl ether	pH
Sediments (ug/kg, dry wt)																	
BOEING97	10/08/97	R10	SD0063	0	10		19 U							38 U	19 U		
BOEING97	10/08/97	R11	SD0068	0	10		19 U							39 U	19 U		
BOEING97	10/08/97	R12	SD0064	0	10		19 U							39 U	19 U		
BOEING97	10/08/97	R13	SD0069	0	10		19 U							39 U	19 U		
BOEING97	10/08/97	R14	SD0065	0	10		19 U							39 U	19 U		
BOEING97	10/08/97	R15	SD0066	0	10		20 U							39 U	20 U		
BOEING97	10/08/97	R9	SD0067	0	10		19 U							38 U	19 U		
LANDAU90	04/23/90	SL4-05	SL4-05	0	15										34 U		
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182										16 U		
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228										13 U		
LANDAU90	04/23/90	SL4-06	SL4-06	0	15										780		
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60										150 U		
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121										13 U		
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182										12 U		
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274										13 U		
LANDAU90	04/23/90	SL4-07	SL4-07	0	15										87 U		
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60										59 U		
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121										12 U		
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182										13 U		
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304										12 U		
LANDAU90	04/23/90	SL4-08	SL4-08	0	15										71 U		
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60										74 U		
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121										14 U		
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182										15 U		
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243										12 U		
LANDAU90	04/23/90	SL4-09	SL4-09	0	15										60 U		
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60										86 U		
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152										79 U		
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243										15 U		
LANDAU90	04/23/90	SL4-10	SL4-10	0	15										65 U		
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15										65 U		
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121										64 U		
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243										61 U		
LANDAU90	04/23/90	SL4-11	SL4-11	0	15										55 U		
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60										82 U		
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106										14 U		
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137										13 U		
LANDAU90	04/23/90	SL4-12	SL4-12	0	15										61 U		
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60										12 U		
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182										13 U		
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	3.3 U	20 U	16.6 U	99	16.6 U	6.6 U			40 U	40 U	3.3 U	
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	2.3 U	20 U	11.4 U	10 U	11.4 U	4.6 U			40 U	40 U	2.3 U	

U = undetected
J = estimated

Table C-13. Concentrations of Organic Carbon-Normalized SMS Analytes Inside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Total LPAH (calc'd)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	2-Methylnaphthalene
Sediments (mg/kg total organic carbon)													
BOEING97	10/08/97	R10	SD0063	0	10	61.4	2.65	0.913	4.78	4.78	38.7	9.57	1.91
BOEING97	10/08/97	R11	SD0068	0	10	45.4	2.76	0.905 UJ	3.48 J	3.43	27.6	8.1 J	1.95 J
BOEING97	10/08/97	R12	SD0064	0	10	25.8	1.8	0.95 U	1.5	1.65	16	4.8	1.25
BOEING97	10/08/97	R13	SD0069	0	10	20.2	2.2	0.95 U	1.55	1.85	11	3.6	1.2
BOEING97	10/08/97	R14	SD0065	0	10	13.1	2.86	0.864 U	2.41 J	1.59	2.41 J	3.86	2.41 J
BOEING97	10/08/97	R15	SD0066	0	10	31.4	5.2	1.08	2.96	2.96 J	12.8	6.4	1.84
BOEING97	10/08/97	R9	SD0067	0	10	45.2	2.91	0.826	2.78	3 J	27.8	7.83	1.83 J
LANDAU90	04/23/90	SL4-05	SL4-05	0	15	43.4	1.42 U	1.42	1.83	2.63	30.8	6.67	1.54 M
LANDAU90	04/23/90	SL4-05A	SL4-05A-4-6	121	182	3.31	0.545 M	0.727 U	0.727 U	0.359 J	1.68	0.727 M	0.727 U
LANDAU90	04/23/90	SL4-05A	SL4-05A-6.8-7.5	207	228	6.14	1.7	1.48 U	1.48 U	1.48 U	3.3	1.14 J	1.48 U
LANDAU90	04/23/90	SL4-06	SL4-06	0	15	271	3.02	1.74	5.81	9.07	186	65.1	2.79
LANDAU90	04/23/90	SL4-06A	SL4-06A-0-2	0	60	200	5.77 U	5.77	53.8	9.62	96.2	34.6	5.77 U
LANDAU90	04/23/90	SL4-06A	SL4-06A-2-4	60	121	22.1	1.69 U	1.69 U	16.9	1.69 U	3.38	1.82	1.69 U
LANDAU90	04/23/90	SL4-06A	SL4-06A-4-6	121	182	19	2.07 U	2.07 U	19	2.07 U	2.07 U	2.07 U	2.07 U
LANDAU90	04/23/90	SL4-06A	SL4-06A-6-9	182	274	21.7	6.5 U	6.5 U	17.5	6.5 U	4.2 M	6.5 U	6.5 U
LANDAU90	04/23/90	SL4-07	SL4-07	0	15	129	3.14	4	37.1	7.43	51.4	25.7	2.03 J
LANDAU90	04/23/90	SL4-07A	SL4-07A-0-2	0	60	127	4.5 M	5.9 U	9.6	11	81	21	5.9 U
LANDAU90	04/23/90	SL4-07A	SL4-07A-2-4	60	121	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
LANDAU90	04/23/90	SL4-07A	SL4-07A-4-6	121	182	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U
LANDAU90	04/23/90	SL4-07A	SL4-07A-6-10	182	304	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U
LANDAU90	04/23/90	SL4-08	SL4-08	0	15	217	3.45 J	4	11.5	13	150	35	1.8 M
LANDAU90	04/23/90	SL4-08A	SL4-08A-0-2	0	60	55.8	4.11 U	4.11 U	25.6	3.06 J	16.1	11.1	4.11 U
LANDAU90	04/23/90	SL4-08A	SL4-08A-2-4	60	121	1.82	0.538 U	0.538 U	0.219 J	0.223 J	1.04	0.338 J	0.538 U
LANDAU90	04/23/90	SL4-08A	SL4-08A-4-6	121	182	2.71	0.448 J	0.517 U	0.517 U	0.293 J	1.52	0.448 M	0.517 U
LANDAU90	04/23/90	SL4-08A	SL4-08A-6-8	182	243	2.04	2.45 U	2.45 U	2.45 U	2.45 U	2.04 J	2.45 U	2.45 U
LANDAU90	04/23/90	SL4-09	SL4-09	0	15	80	1.95 J	2.86 U	11.9	12.4	39.5	14.3	1.19 J
LANDAU90	04/23/90	SL4-09A	SL4-09A-0-2	0	60	121	2.85 M	4.23 M	23.8	5	46.2	38.5	2.54 M
LANDAU90	04/23/90	SL4-09A	SL4-09A-3-5	91	152	128	16.5	2.54 J	46.2	9.62	31.9	20.8	1.65 J
LANDAU90	04/23/90	SL4-09A	SL4-09A-6-8	182	243	2.62	0.5	0.469 U	0.469 U	0.247 J	1.25	0.625	0.469 U
LANDAU90	04/23/90	SL4-10	SL4-10	0	15	114	10.7	9.56 U	9.56 U	4.26 J	70.6	27.9	9.56 U
LANDAU90	04/23/90	SL4-10A	SL4-10A-0-0.5	0	15	62.6	3.9 U	2.7 J	2.76 J	3.72 J	35.4	18	3.9 U
LANDAU90	04/23/90	SL4-10A	SL4-10A-2-4	60	121	24.8	4.57 U	4.57 U	2.64 J	2.43 J	12.9	6.86	4.57 U
LANDAU90	04/23/90	SL4-10A	SL4-10A-6-8	182	243	16.7	1.13 U	1.13 U	1.44	2.59	11.5	1.19	6.48
LANDAU90	04/23/90	SL4-11	SL4-11	0	15	9.74	14.5 U	14.5 U	14.5 U	14.5 U	9.74 J	14.5 U	14.5 U
LANDAU90	04/23/90	SL4-11A	SL4-11A-0-2	0	60	32.2	5.91	1.5 M	2.5 J	2.77 J	13.2	6.36	1.55 M
LANDAU90	04/23/90	SL4-11A	SL4-11A-2.5-3.5	76	106	18.9	8	2.67	0.8 J	0.733 J	4.73	1.93	0.933 U
LANDAU90	04/23/90	SL4-11A	SL4-11A-3.5-4.5	106	137	1.54	1.67 U	1.67 U	1.67 U	1.67 U	1.54 J	1.67 U	1.67 U
LANDAU90	04/23/90	SL4-12	SL4-12	0	15	44.4	11.7 U	11.7 U	11.7 U	11.7 U	32.7	11.7 J	11.7 U
LANDAU90	04/23/90	SL4-12A	SL4-12A-0.5-2	15	60	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U
LANDAU90	04/23/90	SL4-12A	SL4-12A-0-0.5	0	15								
LANDAU90	04/23/90	SL4-12A	SL4-12A-4-6	121	182	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U
LODRIV98	08/11/98	DR177	SD-DR177-0000	0	10	25.4	0.697 U	0.697 U	1.74	2.44	16.7	4.53	0.697
LODRIV98	08/11/98	DR178	SD-DR178-0000-CC	0	10	100	1.74	0.581 U	7.27	5.52	69.8	15.7	2.62
LODRIV98	08/11/98	DR179	SD-DR179-0000	0	10	52.3	1.06	0.707 U	2.47	2.47	38.9	7.42	1.06
LODRIV98	08/11/98	DR180	SD-DR180-0000	0	10	15.6	1.14	0.76 U	1.9	1.9	7.98	2.66	0.76 U
LODRIV98	08/11/98	DR181	SD-DR181-0000	0	10	19.2	1.28	0.855 U	1.28	1.71	11.5	3.42	0.855 U
LODRIV98	08/11/98	DR182	SD-DR182-0000	0	10	5.29	0.441 U	0.441 U	0.441 U	0.441	3.3	1.54	0.441 U
LODRIV98	08/11/98	DR183	SD-DR183-0000	0	10	3.89	1.11 U	1.11 U	1.11 U	1.11 U	3.89	1.11 U	1.11 U
NOAA97	09/15/97	EIT063	EIT07-01	0	10								
NOAA97	09/15/97	EIT064	EIT07-02	0	10								
NOAA97	09/15/97	EIT066	EIT07-03	0	10								
NOAA97	09/15/97	EIT067	EIT07-04	0	10								
NOAA97	09/15/97	EIT068	EIT07-05	0	10								
NOAA97	09/15/97	EIT069	EIT08-01	0	10								
NOAA97	09/15/97	EIT070	EIT08-02	0	10								
NOAA97	09/15/97	EIT072	EIT08-03	0	10								
NOAA97	09/15/97	EST163	EST12-01	0	10								
NOAA97	09/15/97	EST164	EST12-02	0	10								
NOAA97	09/15/97	EST165	EST12-03	0	10								
NOAA97	09/15/97	EST168	EST12-04	0	10								
NOAA97	09/15/97	EST169	EST12-05	0	10								
NOAA97	09/15/97	EST170	EST12-06	0	10								
NOAA97	09/15/97	EST171	EST12-07	0	10								
NOAA97	09/15/97	EST172	EST12-08	0	10								
NOAA97	09/15/97	EST173	EST12-09	0	10								
NOAA97	09/15/97	EST175	EST12-10	0	10								

Sample	Total HPAH (calc'd)	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzofluoranthenes (total-calc'd)	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)-anthracene	Benzo(g,h,i)-perylene
SD0063	531	100	87	40.4	56.5	113	56.5 J	38.3	12.2 J	27.4
SD0068	344	85.7	47.6 UJ	27.6	43.3	96.2	47.1	22.4	6.19 J	15.7 J
SD0064	239	34	45	16.5	25.5 J	62.5	23	16.5	3 J	12.5
SD0069	162	42	35 UJ	14	19	44	17.5 J	12.5	3.8 J	9.5 J
SD0065	203	30.9	54.5	10.9	16.4	44.1	19.1	11.8	4 J	11.4
SD0066	188	44	44	12.8	17.6	41.6	16.8	5.6	1.88 J	3.52
SD0067	413	78.3	56.5	30.4	43.5	93	47.8	31.7	9.57 J	22.6 J
SL4-05	286	58.3	104	36.7	38.3	79.2	20.4	18.8	6.67	2.21
SL4-05A-4-6	6.14	2.55	2	0.682 J	0.909	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U
SL4-05A-6.8-7.5	13.1	4.66	3.75	1.48 J	1.93	2.39	1.25 J	1.48 U	1.48 U	1.48 U
SL4-06	309	69.8	44.2	46.5	67.4	107	30.2	32.6	15.6	2.33
SL4-06A-0-2	1100	385	281	131	150	238	80.8	50	18.8	5.38 J
SL4-06A-2-4	51.7	12.7	16.9	4.16	4.29	9.09	7.53	3.77	1.69 U	2.34
SL4-06A-4-6	25.1	9.31	8.45	2.41	3.62	4.14	1.28 J	2.07 U	2.07 U	2.07 U
SL4-06A-6-9	62.4	26.5	21	4.9 M	7.5	9	2.45 M	6.5 U	6.5 U	6.5 U
SL4-07	976	371	283	111	109	186	48.6	37.1	13.4	2.86
SL4-07A-0-2	699	240	200	75	87	160	52	34	11 M	5.9 U
SL4-07A-2-4	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
SL4-07A-4-6	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U
SL4-07A-6-10	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U
SL4-08	1070	365	255	125	150	255	85	60	21.5	4.9
SL4-08A-0-2	329	122	117	26.1	35	22.8	16.1	12.8	4.11 U	4.11 U
SL4-08A-2-4	5.54	1.88	1.88	0.538 J	0.769	1.12	0.462 J	0.538 U	0.538 U	0.538 U
SL4-08A-4-6	7.17	2.48	2.07	0.759	1.14	1.34	0.724	0.517 U	0.517 U	0.517 U
SL4-08A-6-8	10	3.67	2.86	2.45 U	1.78 J	3.88	1.73 J	2.45 U	2.45 U	2.45 U
SL4-09	286	95.2	85.7	28.1	35.2	66.7	20	15.2	4.52	1.67 M
SL4-09A-0-2	841	262	281	88.5	112	158	53.8	35	10	3.31 U
SL4-09A-3-5	505	212	169	46.2	53.8	50	15	6.54	2.65 M	3.04 U
SL4-09A-6-8	7.94	2.59	2.72	0.75	1.22	1.47	0.656	0.469 U	0.469 U	0.469 U
SL4-10	696	206	176	79.4	110	176	60.3	44.1	14.7	4.56 J
SL4-10A-0-0.5	518	132	162	53.4	78	144	47.4	31.8	10.2	3.18 J
SL4-10A-2-4	155	61.4	55	10	14.3	17.1	8.57	5.21	4.57 U	4.57 U
SL4-10A-6-8	45.1	14.3	22.2	2.04	3.52	3.33	1.61	1.44	1.13 U	1.13 U
SL4-11	108	26.3	31.6	10.8 J	17.6	31.6	12.4	9.47 J	14.5 U	14.5 U
SL4-11A-0-2	105	26.8	38.6	10.5	15.5	10.5	6.82	7.27	3.73 U	3.73 U
SL4-11A-2.5-3.5	21.7	7.33	6.67	2.2	2.13	4.07	1.67	1.67	0.933 U	0.933 U
SL4-11A-3.5-4.5	9.68	3.85	2.69	1.18 J	1.08 J	1.67 J	0.885 M	1.67 U	1.67 U	1.67 U
SL4-12	591	231	163	46.2	110	84.6	26.9	14	11.7 U	11.7 U
SL4-12A-0.5-2	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U
SL4-12A-0-0.5										
SL4-12A-4-6	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U
SD-DR177-0000	180	38.3	38.3	14.6	20.9	39.7	14.6	7.67	1.39	4.18
SD-DR178-0000-CC	982	105	218	75.6	102	233	102 J	66.9 J	19.8 J	61 J
SD-DR179-0000	596	81.3	131	42.4	60.1	145	60.1	38.9	8.83	29.3
SD-DR180-0000	105	23.6	23.6	8.75	12.2	23.6	7.22	4.56	1.14	0.76
SD-DR181-0000	165	29.5	34.6	12	17.5	31.2	14.5	11.5	2.99	11.1
SD-DR182-0000	35.5	8.81	5.07	3.96	5.07	9.69	1.1	1.1	0.661	0.441 U
SD-DR183-0000	22.2	5.56	3.89	2.78	2.78	7.22	1.11 U	1.11 U	1.11 U	1.11 U
EIT07-01										
EIT07-02										
EIT07-03										
EIT07-04										
EIT07-05										
EIT08-01										
EIT08-02										
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EST12-09										
EST12-10										

Sample	1,2-Dichlorobenzene	1,4-Dichlorobenzene	1,2,4-Trichlorobenzene	Hexachlorobenzene	Dimethyl phthalate	Diethyl phthalate	Di-n-butyl phthalate	Butyl benzyl phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dibenzofuran	Hexachlorobutadiene	N-Nitroso-diphenylamine	PCBs (total-calc'd)
SD0063	0.826 U	0.826 U	0.826 U	0.0739 J	1.22 J	0.826 U	2.57 J	3.13 J	100	0.826 U	3.65	0.826 U	0.826 U	138
SD0068	0.905 U	0.905 U	0.905 U	0.0429 U	1.14 J	2.1 J	2.19 J	3.19 J	66.7	11.9 J	3.38	0.905 U	0.905 U	84.8
SD0064	0.95 U	0.95 U	0.95 U	0.05 UJ	0.95 U	0.95 U	1.25	1.5 J	24.5	1.3 J	1.65	0.95 U	0.95 U	80
SD0069	0.95 UJ	0.95 UJ	0.95 UJ	0.05 U	0.95 U	0.95 U	0.95 U	2.15 J	35	2.65	1.65	0.95 U	0.95 U	66
SD0065	0.864 U	0.864 U	0.864 U	4.41 UJ	0.864 U	0.864 U	9.55 UJ	1.55 U	40	5 U	1.32	0.864 U	0.864 U	745
SD0066	0.8 U	0.8 U	0.8 U	0.04 UJ	0.8 U	0.8 U	0.8 U	0.84 J	32	2 J	2.76	0.8 U	0.8 U	54.4
SD0067	0.826 U	0.826 U	0.826 U	0.0391 UJ	1.13 J	0.826 U	1.48	2.3 J	65.2	8.7 J	2.7	0.826 U	0.826 U	128
SL4-05	1.42 U	1.42 U	1.42 U	1.42 U	1.42 U	1.42 U	1.42 U	1.42 U	150	1.42 U	1.88	2.83 U	1.42 U	492
SL4-05A-4-6	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U	0.727 U	1.45 U	0.727 U	0.5
SL4-05A-6.8-7.5	1.48 U	1.48 U	1.48 U	1.48 U	1.48 U	1.48 U	1.48 U	1.48 U	0.534 J	1.48 U	1.48 U	2.95 U	1.48 U	2.27 U
SL4-06	0.767 U	0.767 U	0.767 U	0.767 U	2.28 U	0.767 U	4.65 M	11.6	256 K	62.8	5.12	1.53 U	18.1	23.3
SL4-06A-0-2	5.77 U	5.77 U	5.77 U	5.77 U	5.77 U	5.77 U	61.5	32.3	265	38.5	5.77	11.5 U	5.77 U	5770
SL4-06A-2-4	1.69 U	1.69 U	1.69 U	1.69 U	1.69 U	1.69 U	1.69 U	3.12	14.3	4.55	1.69 U	3.25 U	1.69 U	169
SL4-06A-4-6	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	12.6	1.9 J	2.07 U	4.31 U	2.07 U	10.7
SL4-06A-6-9	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	37.5	6.5 U	6.5 U	12.5 U	6.5 U	120
SL4-07	2.49 U	2.49 U	2.49 U	2.49 U	2.49 U	2.49 U	3.14	2.49 U	246	31.4	8	4.86 U	2.49 U	127
SL4-07A-0-2	5.9 U	5.9 U	5.9 U	5.9 U	5.9 U	5.9 U	5.9 U	13	180	12	5 J	12 U	5.9 U	230
SL4-07A-2-4	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	13.8 J	15 U	15 U	30 U	15 U	11.1
SL4-07A-4-6	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	5.65 U	23.9	5.65 U	5.65 U	11.3 U	5.65 U	8.7 U
SL4-07A-6-10	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	18.2 U	34.8 U	18.2 U	
SL4-08	3.55 U	3.55 U	3.55 U	3.55 U	3.55 U	3.55 U	6	3.55 U	185	20	6	7 U	3.55 U	515
SL4-08A-0-2	4.11 U	4.11 U	4.11 U	4.11 U	4.11 U	4.11 U	4.5	4.11 U	50.6	4.11 U	4.11 U	8.33 U	4.11 U	114
SL4-08A-2-4	0.538 U	0.538 U	0.538 U	0.538 U	0.538 U	0.538 U	0.538 U	0.538 U	0.462 J	0.538 U	0.538 U	1.08 U	0.538 U	4.12
SL4-08A-4-6	0.517 U	0.517 U	0.517 U	0.517 U	0.517 U	0.517 U	0.517 U	0.517 U	0.517 U	0.517 U	0.517 U	1.03 U	0.517 U	
SL4-08A-6-8	2.45 U	2.45 U	2.45 U	2.45 U	2.45 U	2.45 U	2.45 U	2.45 U	3.06	2.45 U	2.45 U	4.9 U	2.45 U	
SL4-09	2.86 U	2.86 U	2.86 U	2.86 U	2.86 U	2.86 U	2.95	2.86 U	52.4	28.6	7.14	5.71 U	2.86 U	1620
SL4-09A-0-2	3.31 U	3.31 U	3.31 U	3.31 U	3.31 U	3.31 U	4.62 M	3.31 U	273	104	4.62	6.54 U	3.31 U	862
SL4-09A-3-5	3.04 U	3.04 U	3.04 U	3.04 U	3.04 U	3.04 U	3.04 U	3.04 U	3.04 U	3.04 U	8.08	6.15 U	3.04 U	4.12
SL4-09A-6-8	0.469 U	0.469 U	0.469 U	0.469 U	0.469 U	0.469 U	0.469 U	0.469 U	0.406 J	0.469 U	0.469 U	0.969 U	0.469 U	0.625 U
SL4-10	9.56 U	9.56 U	9.56 U	9.56 U	9.56 U	9.56 U	9.56 U	6.91 J	324	76.5	9.56 U	19.1 U	9.56 U	
SL4-10A-0-0.5	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	4.26	3.6 J	198	9.6 M	1.44 M	7.8 U	3.9 U	348
SL4-10A-2-4	4.57 U	4.57 U	4.57 U	4.57 U	4.57 U	4.57 U	4.57 U	4.57 U	22.1	4.57 U	4.57 U	9.29 U	4.57 U	276
SL4-10A-6-8	1.13 U	1.13 U	1.13 U	1.13 U	1.13 U	1.13 U	1.13 U	1.13 U	3.52	1.13 U	1.13 U	2.22 U	1.13 U	96.3
SL4-11	14.5 U	14.5 U	14.5 U	14.5 U	14.5 U	14.5 U	14.5 U	14.5 U	65.8	23.7	14.5 U	28.9 U	14.5 U	192
SL4-11A-0-2	3.73 U	3.73 U	3.73 U	3.73 U	3.73 U	3.73 U	3.55 J	3.73 U	25.9	7.27 U	3.73 U	7.27 U	3.73 U	45
SL4-11A-2.5-3.5	0.933 U	0.933 U	0.933 U	0.933 U	0.933 U	0.933 U	0.733 J	0.933 U	8	0.933 U	0.553 J	1.93 U	0.933 U	1.33 U
SL4-11A-3.5-4.5	1.67 U	1.67 U	1.67 U	1.67 U	1.67 U	1.67 U	1.67 U	1.67 U	15.4	1.67 U	1.67 U	3.21 U	1.67 U	2.56 U
SL4-12	11.7 U	11.7 U	11.7 U	11.7 U	11.7 U	11.7 U	11.7 U	11.7 U	190	21.2	11.7 U	23.1 U	11.7 U	10.8
SL4-12A-0.5-2	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	3.43 U	68.6	3.43 U	3.43 U	6.86 U	3.43 U	5.71 U
SL4-12A-0-0.5														27.7
SL4-12A-4-6	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	1.94 U	38.8	1.94 U	1.94 U	3.88 U	1.94 U	2.99 U
SD-DR177-0000	0.697 U	0.697 U	0.697 U	0.697 U	0.697 U	0.697 U	0.697	1.74	24.4	0.697 U	1.74	0.697 U	1.39 U	22
SD-DR178-0000-CC	0.581 U	0.581 U	0.581 U	0.581 U	2.03	0.581 U	2.91	7.85	148	16.6 J	3.49	0.581 U	1.16 U	205
SD-DR179-0000	0.707 U	0.707 U	0.707 U	0.707 U	0.707	0.707 U	2.47	4.24	98.9	9.19	1.77	0.707 U	1.41 U	119
SD-DR180-0000	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	0.76 U	1.14	19	0.76 U	1.52	0.76 U	1.52 U	20
SD-DR181-0000	0.855 U	0.855 U	0.855 U	0.855 U	0.855 U	0.855 U	0.855 U	1.71	33.8	2.99	1.28	0.855 U	1.71 U	71.5
SD-DR182-0000	0.441 U	0.441 U	0.441 U	0.441 U	0.441 U	0.441 U	0.441 U	0.441	7.49	0.441 U	0.441 U	0.441 U	0.881 U	7
SD-DR183-0000	1.11 U	1.11 U	1.11 U	1.11 U	1.11 U	1.11 U	1.11 U	1.11 U	2.78	1.11 U	1.11 U	1.11 U	2.22 U	6.78
EIT07-01														181
EIT07-02														121
EIT07-03														111
EIT07-04														12
EIT07-05														27.3
EIT08-01														101
EIT08-02														1810
EIT08-03														79.5
EST12-01														333
EST12-02														209
EST12-03														60.3
EST12-04														47
EST12-05														320
EST12-06														35.6
EST12-07														61.3
EST12-08														17.6
EST12-09														10.9
EST12-10														269

U = undetected
J = estimated
M = estimated value of analyte found and confirmed by analyst but with low spectral match

Table C-14. Conventional Measurements in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Ammonia (mg/kg, dry wt_)	Clay (%)	Fines (percent silt+clay) (%)	Gravel (%)	Rocks (%)	Sand (%)	Silt (%)	Sulfides (total) (mg/kg, dry wt_)	Total Organic Carbon (TOC) (% dry wt_)	Total solids (%, wet wt_)
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2	5.97	8		0.2		16.7	76	20 U	1.93	50.4
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2	5.61	7.6		0.4		29	63.7	20 U	1.94	50.3
DUWRIV97	02/01/97	WQA8AVE	L10623-3	0	2	6.9	9.7		0.5		36.7	52.8	20 U	2.03	50.2
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2	6	9.7		0.4		33.1	57.3	18 U	1.58	54.1
DUWRIV97	02/01/97	WQA8AVE	L10786-3	0	2	6.1	11.6		0.4		32	56.6	19 U	1.87	52.3
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2	6.4	14.2		0.2		29.9	55.4	19 U	1.67	51.8
DUWRIV97	02/01/97	WQA8AVE	L10788-3	0	2	7	14.7		1.2		29.3	54.7	26.6	1.77	52.7
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2	5.2	13.9		0.2		24.3	61	18 U	1.6	54.1
DUWRIV97	02/01/97	WQA8AVE	L10931-3	0	2	69	14.1		0.7		42	42.5	19 U	1.79	53.2
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10		4.73	24.66		0.04	75.29	19.93		0.87	
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10		5.87	50.58		0.26	49.15	44.71		1.59	
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10		10.56	64.35		0.91	34.72	53.79		1.74	
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10		7.99	40.41		1.83	57.76	32.42		1.21	
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10		16.8	86.9		0.01 U	13.11	70.1		3.06	
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10		6.74	48.7		0.07	51.22	41.96		1.37	
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10		6.17	41.47		0.24	58.28	35.3		1.17	
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10		6.76	44.76		0.14	55.09	38		1.5	
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10		7.78	51.33		0.01 U	48.67	43.55		1.25	
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10		11.33	56.83		0.14	43.03	45.5		1.53	
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10		16.52	73.58		4.28	22.14	57.06		1.57	
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10		5.39	36.31		0.37	63.32	30.92		0.95	
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10		14.29	80.04		0.01 U	23.49	65.75		2.09	
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10		9.41	43.61		0.31	56.08	34.2		1.37	
NOAA97	09/15/97	CH0013	CH04-01	0	10		18.45		0.23		29.65	51.67		1.56	
NOAA97	09/15/97	CH0018	CH05-01	0	10		12.62		2.72		49.71	34.96		1.2	
NOAA97	09/15/97	CH0019	CH05-02	0	10		15.17		0.06		39.84	44.93		1.5	
NOAA97	09/15/97	CH0021	CH06-02	0	10		13.99		0.01 U		37.03	48.98		1.65	
NOAA97	09/15/97	CH0022	CH06-03	0	10		17.97		0.31		31.17	50.54		1.79	
NOAA97	09/15/97	EIT075	EIT09-02	0	10		5.27		0.12		79.55	15.06		0.54	
NOAA97	09/15/97	EIT076	EIT09-03	0	10		2.13		45.98		47.55	4.34		0.54	
NOAA97	09/15/97	EIT078	EIT09-04	0	10		0.4		18.76		79.64	1.2		0.21	
NOAA97	09/15/97	EST179	EST13-04	0	10		10.29		0.21		58.73	30.77		0.98	
NOAA97	09/15/97	EST180	EST13-05	0	10		12.3		0.02		50	37.67		1.53	
NOAA97	09/15/97	EST181	EST13-06	0	10		13.49		0.41		36.35	49.75		1.79	
NOAA97	09/15/97	WES241	WEST08	0	10		3.66		0.08		86.09	10.17		0.31	
NOAA97	09/15/97	WIT269	WIT08-01	0	10		5.49		8.45		68.77	17.3		0.8	
NOAA97	09/15/97	WIT270	WIT08-02	0	10		5.06		1.55		82.06	11.33		0.52	
NOAA97	09/15/97	WIT271	WIT08-03	0	10		1.16		5.52		92.36	0.96		0.22	
NOAA97	09/15/97	WIT275	WIT09-01	0	10		11.26		8.4		42.49	37.84		1.4	
NOAA97	09/15/97	WIT276	WIT09-02	0	10		5.52		26.21		57.52	10.75		0.91	
NOAA97	09/15/97	WST325	WST10-01	0	10		18.95		0.09		19.72	61.25		1.85	
NOAA97	09/15/97	WST326	WST10-02	0	10		18.06		0.01 U		17.49	64.46		1.59	
NOAA97	09/15/97	WST333	WST11-01	0	10		14.88		0.01 U		32.25	52.87		1.59	
NOAA97	09/15/97	WST334	WST11-02	0	10		8.14		6.53		67.56	17.77		0.95	
NOAA97	09/15/97	WST335	WST11-03	0	10		17.99		0.01 U		28.58	53.43		1.93	
NOAA97	09/15/97	WST337	WST12-01	0	10		17.5		1.66		16.15	64.69		1.69	
NOAA97	09/15/97	WST338	WST12-02	0	10		15.99		0.07		19.05	64.9		1.9	
PLNT295	10/23/95	SD-DUW01	SD-DUW01-0000	0	9.144		8	61		0.01 U	38	53		1.4	
PLNT295	10/23/95	SD-DUW17	SD-DUW17-0000	0	9.144		7	42		0.01 U	57	35		1.4	
PLNT296	03/19/96	SD-DUW55	SD2B-DUW55-0000	0	9.144		13	73		0.01 U	26	60		1.7	
PLNT296	03/19/96	SD-DUW74	SD2B-DUW74-0000	0	9.144		2	14		2	83	12		1.2	
PLNT296	03/19/96	SD-DUW84	SD2B-DUW84-0000	0	9.144		6	39		0.01 U	59	33		1.5	

Table C-14. Conventional Measurements in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Ammonia (mg/kg, dry wt_)	Clay (%)	Fines (percent silt+clay) (%)	Gravel (%)	Rocks (%)	Sand (%)	Silt (%)	Sulfides (total) (mg/kg, dry wt_)	Total Organic Carbon (TOC) (% dry wt_)	Total solids (%, wet wt_)
PLNT296	03/19/96	SD-DUW85	SD2B-DUW85-0000	0	9.144		9	64		1.01	33	55		1.6	
PLNT296	03/19/96	SD-DUW86	SD2B-DUW86-0000	0	9.144		9	68		1	29	59		1.5	
PLNT296	03/19/96	SD-DUW87	SD2B-DUW87-0000	0	9.144		4	30		0.02	68	26		1.4	
PLNT296	03/19/96	SD-DUW88	SD2B-DUW88-0000	0	9.144		13	63		0.01 U	34	50		2	

U = undetected

Table C-15. Metals Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Tin	Vanadium	Zinc
Bulk Sediment (mg/kg)																													
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2	22400	3.8 J	11		0.28	0.28 UJ	6050	27		34.3	29000 J	13	7520		0.17	23.4	2300	4.8 U	0.38 U	9700	19 U			68.8
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2	20300	3 UJ	11		0.24	0.3 UJ	5650	26.4		35	27000 J	16.7	7080		0.13	22.3	2150	4.8 U	0.38 U	9090	19 U			76.9
DUWRIV97	02/01/97	WQA8AVE	L10623-3	0	2	19000 J	3 UJ	11		0.32	0.3 U	5320	25.5		35.9	27000 J	14	7130		0.11	23.1	2150	5 U	0.4 U	9160	20 U			68.9
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2	18000 J	2.8 UJ	12		0.26	0.28 U	5080	25.3		31.8	24000 J	12	6380		0.08	20.1	2030	4.6 U	0.37 U	8760	18 U			62.3
DUWRIV97	02/01/97	WQA8AVE	L10786-3	0	2	21000 J	2.9 UJ	14		0.29	0.31	5790	26.8		35.9	28000 J	13	7250		0.15	23.3	2330	4.8 U	0.38 U	8640	19 U			68.6
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2	20000 J	2.9 UJ	12		0.29	0.29 U	5600	26.6		35.1	27000 J	14	7240		0.08	23.2	2340	4.6 U	0.39 U	9190	19 U			70.7
DUWRIV97	02/01/97	WQA8AVE	L10788-3	0	2	21000 J	2.7 UJ	13		0.28	0.27 U	5830	26.8		35.3	27000 J	14	7290		0.08	23.3	2430	4.6 U	0.36 U	8710	18 U			73.2
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2	17000 J	2.8 UJ	12		0.24	0.28 U	5120	23.1		30.7	24000 J	13	6410		0.08	21.1	2010	4.6 U	0.37 U	8100	18 U			62.5
DUWRIV97	02/01/97	WQA8AVE	L10931-3	0	2	19000 J	2.6 UJ	16		0.43	0.26 U		23.9		33.5	26000 J	16.4			0.08	21.8		4.5 U	0.36 U		18 U			68.2
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	8730	10 UJ	7.4	29	0.23	0.13	3230	15	5	24	15300 J	15.5	3860	206	0.07	10.2	1100	5	0.16	5500	0.01 J	2 J	30	60
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	13000	10 UJ	9.6	54	0.27	0.41	4260	22	7	40	19400 J	28.6	5500	170	0.15	20.8	1400	4	0.35	6820	0.08	3	40	92
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	16700	10 UJ	12.2	57	0.34	0.33	4890	23	8	47	22800 J	21.6	6350	239	0.13	18.4	2000	5	0.23	9010	0.09	3	50	102
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	11700	10 UJ	7	39	0.28	0.33	3760	17	7	40	17600 J	19.4	4770	174	0.07	13.5	1400	4	0.22	7060	0.07	3 J	37	88
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	21100	10 UJ	14.3	74	0.43	0.41	6180	29	9	57	31300 J	31.4	8240	340	0.17	19.8	2900	6	0.3	14000	0.12	4	63	117
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	13500	10 J	9.3	119	0.26	0.16	4360	19	6	36	20000 J	31.7	5050	247	0.09	13.3	1700	4	0.17	8060	0.07	3	48	82
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	11100	10 UJ	9.9	37	0.23	0.12	3830	15	5	28	19900 J	23.3	4500	254	0.08	12.1	1200	4	0.15	7320	0.06	3	38	58
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	11200	10 UJ	8.1	32	0.24	0.72	3600	25	6	26	14800 J	32.3	4110	131	0.1	12.3	1400	3	0.24	6170	0.08	2 UJ	39	68
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	14200	10 UJ	8	45	0.29	0.37	4310	21	7	34	18800 J	22.2	5420	187	0.11	15.5	1800	4	0.24	7420	0.08	2 UJ	43	79
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	16800	10 UJ	10.3	5180	0.34	0.3	5180	23	8	40	23800 J	18.1	6430	254	0.1 J	16.8	2000	5 J	0.26	8810	0.06 J	3	53	82
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	16000	10 UJ	6.9	60	0.34	0.31	4660	22	8	36	21600 J	20.6	6240	225	0.11	17.8	2300	5	0.16	9420	0.09	2 UJ	44	76
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	10300	10 UJ	4.3	35	0.25	0.16	3410	15	6	24	15100 J	11.8	4380	144	0.05	12.6	1200	4	0.14	5890	0.05	1 J	32	53
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10	19400	10 UJ	12.2	67	0.38	0.35	5650	26	9	46	27600 J	22	7480	289	0.12	20.2	2600	5	0.25	11300	0.11	3	59	95
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	13300	10 UJ	7	50	0.32	0.22	4310	18	6	32	20000 J	14.2	5350	219	0.07	14.1	1700	5	0.2	8810	0.06	2 J	42	70

U = undetected
J = estimated

Table C-16. Polycyclic Aromatic Hydrocarbons (PAH) Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	2-Chloro-naphthalene	2-Methyl-naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a) -pyrene	Benzo(b)-fluoranthene	Benzo(g,h,i)-perylene	Benzo(k)-fluoranthene	Benzo-fluoranthenes (total-calc'd)	Carcinogenic PAHs (calc'd)	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno-(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene	Total HPAH (calc'd)	Total LPAH (calc'd)	Total PAH (calc'd)
Sediments (ug/kg, dry wt)																												
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2	32 U	85 U	38	32 U	48 J	120 J	97 J	196	65 J	85 U	196	157.82	167	85 U	340 J	48 J	63 J	85 UJ	230 J	290 J	1338	364	1702
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2	32 UJ	85 UJ	89 J	32 UJ	64 J	140 J	110 J	200 J	68 J	85 J	285	179.1	180 J	85 UJ	440 J	110 J	78 J	85 UJ	380 J	360 J	1661	643	2304
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2	30 U	79 U	30	30 U	30 UJ	81 J	74 J	120	55 J	79 UJ	120	120.6	105	79 U	270 J	30 UJ	57 J	79 UJ	150 J	220 J	982	180	1162
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2	31 U	83 U	53.3	31 U	65 J	190 J	130 J	274	120 J	120 J	394	217.43	243	83 U	560 J	68 J	100 J	83 UJ	400 J	400 J	2137	586.3	2723.3
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2	30 U	79 U	31	30 U	30 UJ	110 J	87 J	150	55 J	79 UJ	150	140.17	132	79 U	360 J	37 J	61 J	79 UJ	200 J	280 J	1235	268	1503
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	20 U	20 U	20 U	20 U	40	160	170	190	90	170	360	246.5	250	30	390	20	100	20 U	160	310	1860	220	2080
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	20 U	30	100	40	330	1500	1100	1500	340	1000	2500	1618	1800	130	2800	120	480	60	700	2600	13250	1350	14600
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	20 U	80	740	60	1500	3000	1200	2000	450	1300	3300	1990	3400	150	18000	1700	660	30	16000	11000	41160	20030	61190
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	20 U	20 U	20 U	20 U	50	140	130	140	80	130	270	189.9	190	20	260	20 U	90	20 U	130	280	1460	180	1640
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	20 U	20 U	40	20 U	80	280	240	330	120	250	580		340	30	840	60	150	20 U	280	540	3120	460	
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	20 U	20 U	20 U	20 U	20 U	90	110	120	80	100	220		140	20	210	20 U	100	20 U	90	170	1140	90	
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	20 U	20 U	20 U	20 U	20	90	120	130	90	110	240	172.5	150	20	220	20 U	100	20 U	110	220	1250	130	1380
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	20 U	20 U	20 U	20 U	50	130	90	100	40	90	190	133.9	190	20 U	190	20 U	60	20 U	70	150	1040	120	1160
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	20 U	20 U	20 U	20 U	80	350	320	340	160	310	650	465.2	420	50	700	20	210	20 U	200	590	3450	300	3750
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	20 U	20 U	20 U	20 U	40	150	120	150	80	150	300	181.1	210	20 U	400	20 U	100	20 U	140	310	1670	180	1850
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	20 U	20 U	110	20	140	1000	460	510	150	490	1000	707.4	840	50	4200	90	190	20	790	2700	10590	1170	11760
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	20 U	20 U	20 U	20 U	20 U	80	70	80	40	70	150	103	100	20 U	220	20 U	50	20 U	90	240	950	90	1040
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10	20 U	20 U	20 U	20 U	40	160	150	200	110	150	350	228.3	230	30	420	20	130	20 U	140	330	1910	200	2110
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	20 U	20 U	110	20 U	60	220	140	160	70	150	310	207.4	240	20 U	650	110	80	20 U	640	550	2260	920	3180

U = undetected
J = estimated

Table C-17. Phenol Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	2,4,5-Trichloro-phenol	2,4,6-Trichloro-phenol	2,4-Dichloro-phenol	2,4-Dimethyl-phenol	2,4-Dinitro-phenol	2-Chloro-phenol	2-Methyl-phenol	2-Nitro-phenol	3-Methylphenol and 4-Methylphenol Coelution	4-Chloro-3-methyl-phenol	4-Methyl-phenol	4-Nitro-phenol	Pentachloro-phenol	Phenol
Sediments (ug/kg, dry wt)																			
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2	220 U	220 U	54 U	54 UJ	110 UJ	110 UJ	54 U	54 U		110 U	54 U	110 U	54 UJ	220 U
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2	220 UJ	220 UJ	54 UJ	54 UJ	110 UJ	110 UJ	58 J	54 UJ		110 UJ	66 J	110 UJ	54 UJ	220 UJ
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2	200 U	200 U	50 U		98 UJ	98 UJ	50 UJ	50 U		98 U	50 UJ	98 U	50 UJ	200 UJ
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2	210 UJ	210 UJ	52 UJ		100 UJ	100 UJ	52 UJ	52 UJ		100 UJ	52 UJ	100 UJ	52 UJ	210 UJ
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2	200 UJ	200 UJ	50 UJ		98 UJ	98 UJ	50 UJ	50 UJ		98 UJ	50 UJ	98 UJ	50 UJ	200 UJ
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	110
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	30
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	90
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20
LODRIV98	08/11/98	DR223	CC	0	10	200 U	200 U	60 U	20 U	200 UJ	20 U	20 U	100 U	20 U	40 U		100 U	100 U	290
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	200 U	200 U	60 U	20 U	200 U	20 U	20 U	100 U	20 U	40 U		100 U	100 U	20 U

U = undetected
J = estimated

Table C-18. Phthalate Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Bis(2-ethylhexyl)-phthalate	Butyl benzyl phthalate	Diethyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate
Sediments (ug/kg, dry wt)											
DUWRIV97	1-Feb-97	WQA8AVE	L10535-3	0	2	327	32 U	54 U	22 U	54 U	32 UJ
DUWRIV97	1-Feb-97	WQA8AVE	L10601-3	0	2	510 J	42 J	54 UJ	22 UJ	54 J	32 UJ
DUWRIV97	1-Feb-97	WQA8AVE	L10785-3	0	2	250	30 U	50 U	20 U	50 U	30 U
DUWRIV97	1-Feb-97	WQA8AVE	L10787-3	0	2	203	31 U	52 U	21 U	52 U	31 U
DUWRIV97	1-Feb-97	WQA8AVE	L10930-3	0	2	250	30 U	50 U	20 U	50 U	30 U
LODRIV98	11-Aug-98	DR173	SD-DR173-0000	0	10	100	20 U	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR174	SD-DR174-0000	0	10	300	30	20 U	20 U	70	20 U
LODRIV98	11-Aug-98	DR175	SD-DR175-0000	0	10	270	20 U	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR193	SD-DR193-0000	0	10	130	20	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR194	SD-DR194-0000	0	10	610	30	20 U	40	20	20 U
LODRIV98	11-Aug-98	DR195	SD-DR195-0000	0	10	130 UJ	20 U	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR196	SD-DR196-0000	0	10	150 UJ	20	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR212	SD-DR212-0000	0	10	40 UJ	20 U	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR213	SD-DR213-0000	0	10	170 UJ	20 U	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR214	SD-DR214-0000	0	10	300	20 U	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR221	SD-DR221-0000	0	10	230 UJ	20 U	20 U	20 U	20	20 U
LODRIV98	11-Aug-98	DR222	SD-DR222-0000	0	10	130	20 U	20 U	20 U	20 U	20 U
LODRIV98	11-Aug-98	DR223	CC	0	10	350	30	20 U	20	30	20 U
LODRIV98	11-Aug-98	DR232	SD-DR232-0000	0	10	180	20 U	20 U	20 U	20 U	20 U

U = undetected
J = estimated

Table C-19. Organotin Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	SampleID	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Dibutyltin as ion	n-Butyltin	Tetrabutyltin	Tributyltin as ion
Sediments (ug/kg, dry wt)									
LODRIV98	11-Aug-98	DR174	SD-DR174-0000	0	10	11 J	12 J	10 U	46
LODRIV98	11-Aug-98	DR194	SD-DR194-0000	0	10	13 J	10 J	10 U	42
LODRIV98	11-Aug-98	DR221	SD-DR221-0000	0	10	10	9 J	5 U	31
LODRIV98	11-Aug-98	DR232	SD-DR232-0000	0	10	6	5 J	5 U	21

U = undetected
J = estimated

Table C-20. PCB Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Aroclor-1016	Aroclor-1016/1242	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	PCBs (total-calc'd)	PCBs + PCTs (total)	PCTs (total)
Sediments (ug/kg, dry wt)																
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2	26 U		26 U	26 U	26 U	26 U	40	26 U	40		
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2	26 U		26 U	26 U	26 U	26 U	48	48	96		
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2	24 U		24 U	24 U	24 U	24 U	46	24 U	46		
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2	25 U		25 U	25 U	25 U	25 U	46	25 U	46		
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2	24 U		24 U	24 U	24 U	24 U	24 U	24 U	24 U		
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	33	29 J	62		
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	332	162	494		
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	52	68	120		
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	66	52	118		
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	80	75	155		
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	28 J	36 J	64		
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	59	56	115		
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	20 UJ		40 UJ	20 UJ	20 UJ	20 UJ	25 J	52 J	77		
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	20 UJ		40 UJ	20 UJ	20 UJ	20 UJ	70 J	66 J	136		
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	67	44 J	111		
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	36	28 J	64		
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	74	58	132		
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10	20 UJ		40 U	20 U	20 U	20 U	69	84	153		
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	20 UJ		40 U	20 U	20 U	20 U	46	35	81		
NOAA97	09/15/97	CH0013	CH04-01	0	10									120	130	15
NOAA97	09/15/97	CH0018	CH05-01	0	10									220	220	4.8 J
NOAA97	09/15/97	CH0019	CH05-02	0	10									430	450	18
NOAA97	09/15/97	CH0021	CH06-02	0	10									110	240	130
NOAA97	09/15/97	CH0022	CH06-03	0	10									77	92	15
NOAA97	09/15/97	EIT075	EIT09-02	0	10									120	130	9.1
NOAA97	09/15/97	EIT076	EIT09-03	0	10											6500
NOAA97	09/15/97	EIT078	EIT09-04	0	10									100	110	7.8 J
NOAA97	09/15/97	EST179	EST13-04	0	10									240	280	45
NOAA97	09/15/97	EST180	EST13-05	0	10									230	280	52
NOAA97	09/15/97	EST181	EST13-06	0	10									110	130	22
NOAA97	09/15/97	WES241	WEST08	0	10									60	65	5.1 J
NOAA97	09/15/97	WIT269	WIT08-01	0	10									37	44	7.1 J
NOAA97	09/15/97	WIT270	WIT08-02	0	10									100	120	18
NOAA97	09/15/97	WIT271	WIT08-03	0	10									24	24	3 U
NOAA97	09/15/97	WIT275	WIT09-01	0	10									200	220	21
NOAA97	09/15/97	WIT276	WIT09-02	0	10									120	130	10
NOAA97	09/15/97	WST325	WST10-01	0	10									110	120	13
NOAA97	09/15/97	WST326	WST10-02	0	10									98	110	12
NOAA97	09/15/97	WST333	WST11-01	0	10									60	67	7.2 J
NOAA97	09/15/97	WST334	WST11-02	0	10									120	130	15
NOAA97	09/15/97	WST335	WST11-03	0	10									83	100	17
NOAA97	09/15/97	WST337	WST12-01	0	10									63	69	6.3 J
NOAA97	09/15/97	WST338	WST12-02	0	10									35	41	6.1 J
PLNT295	10/23/95	SD-DUW01	SD-DUW01-0000	0	9.144	57 U				57 U	57 U	220	200	420		
PLNT295	10/23/95	SD-DUW17	SD-DUW17-0000	0	9.144	53 U				53 U	120 U	260	280	540		
PLNT296	03/19/96	SD-DUW55	SD2B-DUW55-0000	0	9.144	61 U		120 U	61 U	61 U	61 U	160	130	290		
PLNT296	03/19/96	SD-DUW74	SD2B-DUW74-0000	0	9.144	42 U		85 U	42 U	42 U	42 U	70	60	130		
PLNT296	03/19/96	SD-DUW84	SD2B-DUW84-0000	0	9.144	53 U				53 U	170	580	230	980		
PLNT296	03/19/96	SD-DUW85	SD2B-DUW85-0000	0	9.144	56 U				560	850 U	2700	1100	4360		
PLNT296	03/19/96	SD-DUW86	SD2B-DUW86-0000	0	9.144	56 U				56 U	94	560	230	884		
PLNT296	03/19/96	SD-DUW87	SD2B-DUW87-0000	0	9.144	46 U				46 U	92 U	170	78	248		
PLNT296	03/19/96	SD-DUW88	SD2B-DUW88-0000	0	9.144	59 U		120 U	59 U	59 U	59 U	91	41 J	132		

U = undetected
J = estimated

Table C-21. PCB Congener Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	PCB-101	PCB-105	PCB-110	PCB-114	PCB-118	PCB-123	PCB-126	PCB-128	PCB-138	PCB-153	PCB-156	PCB-157	PCB-167	PCB-169	PCB-170	PCB-18	PCB-180	PCB-187	PCB-189	PCB-195	PCB-206	PCB-209	PCB-28	PCB-44	PCB-55	PCB-66	PCB-77	PCB-81
Sediments (ug/kg, dry wt)																																	
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	1 J	1 UJ		1 UJ	2 J	1 UJ	1 UJ	1 UJ	4 J	4 J	1 UJ	1 UJ	1 UJ	1 UJ	1 J	1 UJ	2 J	1 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 J	3 UJ	1 UJ	1 UJ
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	24 J	8 J		1 UJ	19 J	3 UJ	1 UJ	5 J	32 J	21 J	4 J	1 UJ	1 J	1 UJ	7 J	1 UJ	11 J	7 J	1 UJ	1 J	1 J	1 UJ	2 J	5 J	12 J	21 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	5 J	1 UJ		1 UJ	3 J	1 UJ	1 UJ	1 UJ	8 J	7 J	1 UJ	1 UJ	1 UJ	1 UJ	3 J	1 UJ	5 J	3 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 J	3 J	5 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	4 J	2 J		1 UJ	4	1 UJ	1 U	1 J	8 UJ	5 J	1 UJ	1 UJ	1 UJ	1 U	2 J	1 UJ	4 J	2 J	1 UJ	1 UJ	1 U	1 U	2 J	2 J	3 J	7 U	1 U	1 UJ
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	6 J	1 J		1 UJ	4 J	1 UJ	1 UJ	1 J	9 J	8 J	1 UJ	1 UJ	1 UJ	1 UJ	3 J	1 UJ	6 J	4 J	1 UJ	1 UJ	1 UJ	1 UJ	1 J	2 J	4 J	6 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	2 J	1 UJ		1 UJ	2 J	1 UJ	1 UJ	1 UJ	4 J	4 J	1 UJ	1 UJ	1 UJ	1 UJ	1 J	1 UJ	3 J	2 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 J	2 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	4 J	1 J		1 UJ	3 J	1 UJ	1 UJ	1 UJ	7 J	5 J	1 UJ	1 UJ	1 UJ	1 UJ	2 J	1 UJ	4 J	2 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	2 J	4 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	1 UJ	1 UJ		1 UJ	1	1 UJ	1 UJ	1 UJ	4	4	1 UJ	1 UJ	1 UJ	1 U	2 J	1 UJ	4 J	4 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	2 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	5 J	2 J		1 UJ	5	1 UJ	1 UJ	1 J	9	7	1 UJ	1 UJ	1 UJ	1 U	2 J	1 UJ	4 J	3 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	2 J	3 J	6 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	5 J	1 J		1 UJ	4	1 UJ	1 UJ	1 UJ	7 J	6 J	1 UJ	1 UJ	1 UJ	1 U	2 J	1 UJ	4	3	1 U	1 UJ	1 U	1 U	1 J	1 J	4 J	6	1 UJ	1 UJ
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	2 UJ	2 UJ		1 UJ	3 J	1 UJ	1 UJ	1 UJ	5 J	4 J	1 UJ	1 UJ	1 UJ	1 UJ	2 J	1 UJ	3 J	2 J	1 UJ	1 UJ	1 UJ	1 U	1 UJ	1 J	2 J	5 UJ	1 UJ	1 UJ
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	2 J	2 J		1 UJ	4	1 UJ	1 U	1 J	8 UJ	5 J	1 UJ	1 UJ	1 UJ	1 U	2 J	1 UJ	4 J	2 J	1 UJ	1 UJ	1 U	1 U	1 UJ	2 J	3 J	6 U	1 U	1 UJ
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10	4 J	1 J		1 UJ	3 J	1 UJ	1 UJ	1 UJ	7 J	6 J	1 UJ	1 UJ	1 UJ	1 UJ	3 J	1 UJ	5 J	3 J	1 UJ	1 UJ	1 UJ	1 UJ	1 J	1 J	3 J	4 J	1 UJ	1 UJ
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	1 J	1 UJ		1 UJ	3	1 UJ	1 U	1 UJ	5 UJ	3 J	1 UJ	1 UJ	1 UJ	1 U	1 J	1 UJ	2 J	1 J	1 UJ	1 UJ	1 U	1 U	1 UJ	1 J	2 J	4 U	1 U	1 UJ
NOAA97	09/15/97	CH0013	CH04-01	0	10	28 J	3.4	9.1		7.7 U		0.34 U	3.8 J	7	19 J	0.31 U	0.27 U		0.86 U	3.3		5.7		0.39 U								0.38 U	
NOAA97	09/15/97	CH0018	CH05-01	0	10	34 J	4.2	8.1		8.1		0.34 U	3.6 J	4.2	24 J	0.75	0.26 U		0.82 U	3.1		2.5		0.37 U								0.7	
NOAA97	09/15/97	CH0019	CH05-02	0	10	26 J		9.7		7.6		0.26 U	4.4 U	8.3	19 J	1	0.2 U		0.62 U	3.3		5 U		0.28 U								0.31 U	
NOAA97	09/15/97	CH0021	CH06-02	0	10	52 J	5.9	22		16		0.24 U	17 J	12	30 J	0.98	2		0.6 U	8.6		19		0.28 U								0.27 U	
NOAA97	09/15/97	CH0022	CH06-03	0	10	25 J	k	6.5		5.1		0.34 U	3 U	5.2	15 J	0.31 U	0.27 U		0.85 U	1.5		3.7		0.39 U								0.38 U	
NOAA97	09/15/97	EIT075	EIT09-02	0	10	34 J	3.6	12		8.7		0.2 U	5.1 U	8.9	23 J	0.87	0.16 U		0.48 U	3.4		4.9 U		0.22 U								0.24 U	
NOAA97	09/15/97	EIT078	EIT09-04	0	10	37 J	2.1	12		4.7		0.18 U	5.7 U	8.5	18 J	0.8	0.14 U		0.42 U	2.6		4 U		0.19 U								0.21 U	
NOAA97	09/15/97	EST179	EST13-04	0	10	67 J	7.1	25		19		0.19 U	12 J	16	44 J	2	1.7		0.44 U	11		17		0.2 U								0.22 U	
NOAA97	09/15/97	EST180	EST13-05	0	10	74 J	8.1	28		23		0.24 U	11 J	19	48 J	2.2	0.18 U		0.56 U	8		10		0.26 U								0.28 U	
NOAA97	09/15/97	EST181	EST13-06	0	10	37 J	3	10		8.4		0.23 U	5 U	7.3	23 J	0.8	0.18 U		0.54 U	4.8		7.6		0.25 U								0.27 U	
NOAA97	09/15/97	WES241	WEST08	0	10	16 J	1.7	4.6		4.5 U		0.29 U	2.5 J	3.7	13 J	0.26 U	0.23 U		0.71 U	2.9		4.9		0.32 U								0.32 U	
NOAA97	09/15/97	WIT269	WIT08-01	0	10	12 J	0.46 J	2.9		2.1		0.31 U	4 U	3.1	8 J	0.28 U	0.25 U		0.76 U	1.9 U		3.5		0.35 U								0.35 U	
NOAA97	09/15/97	WIT270	WIT08-02	0	10	28 J	2.5	5.1		3.7		0.37 U	7.3 U	7.4	21 J	0.33 U	0.29 U		0.9 U	12 U		14		0.41 U								0.41 U	
NOAA97	09/15/97	WIT271	WIT08-03	0	10		0.24 U	0.24 U		0.23 U		0.26 U	0.26 U	0.25 U		0.23 U	0.21 U		0.64 U	2 U		0.21 U		0.29 U								0.29 U	
NOAA97	09/15/97	WIT275	WIT09-01	0	10	56 J	7.5	21		16		0.18 U	7.3 J	14	37 J	1.5	0.15 U		0.46 U	4.2		6.8		0.21 U								0.2 U	
NOAA97	09/15/97	WIT276	WIT09-02	0	10	39 J	1.1	11		1.9		0.13 U	8 J	11	22 J	0.33 J	0.44		0.32 U	5.4		8.3		0.14 U								0.14 U	
NOAA97	09/15/97	WST325	WST10-01	0	10	30 J	4.2	8.8		8.1		0.35 U	8.3 U	6.9	20 J	0.3 U	0.27 U		0.84 U	4.8 U		7		0.39 U								0.38 U	
NOAA97	09/15/97	WST326	WST10-02	0	10	21 J	4.2	7.5		6.8		0.36 U	5.3 U	5.7	15 J	2	0.28 U		0.87 U	8.2 U		4.8		0.4 U								0.39 U	
NOAA97	09/15/97	WST333	WST11-01	0	10	19 J	2.9	5		3.7		0.5 U	1.5 U	3.3	12 J	0.44 U	0.39 U		1.2 U	4.1		2.6		0.56 U								0.56 U	
NOAA97	09/15/97	WST334	WST11-02	0	10	33 J	3.2	10		7.5		0.19 U	4.6 J	7.2	22 J	0.72	0.15 U		0.46 U	4.3		6.2		0.21 U								0.21 U	
NOAA97	09/15/97	WST335	WST11-03	0	10	24 J	3.2	5.8		5.8		0.47 U	3.8 U	3.9	14 J	0.41 U	0.36 U		1.1 U	3.1		3.9		0.52 U								0.52 U	
NOAA97	09/15/97	WST337	WST12-01	0	10	18 J	5.7	4.3		6		0.23 U	2.8 J	3.5	11 J	0.21 U	0.18 U		0.58 U	2.1		3.2		0.26 U								0.26 U	
NOAA97	09/15/97	WST338	WST12-02	0	10	12 J	1.3	3.2		2.6		0.23 U	1.6 U	2.3	7.4 J	0.21 U	0.19 U		0.59 U	1.2		2.1		0.27 U								0.26 U	

U = undetected
J = estimated

Table C-22. Dioxin and Furan Concentrations in Sediments Outside Slip 4.

Survey	Station	Date	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-HxCDF	1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-HxCDF	1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDF	2,3,4,6,7,8-HxCDF	2,3,4,7,8-PeCDF	2,3,7,8-TCDD	2,3,7,8-TCDD TEQ (ng/kg, dry wt)	2,3,7,8-TCDF	OCDD	OCDF	Total HpCDD	Total HpCDF	Total HxCDD	Total HxCDF	Total PeCDD	Total PeCDF	Total TCDD	Total TCDF
Sediments (pg/g, dry wt)																															
LODRIV98	DR221	08/11/98	SD-DR221-0000	0	10	130	18	2 U	1.7 U	3 U	5.7 J	0.96 U	4.5 U	0.12 U	0.85 U	0.6 U	0.78 U	1.1 U	0.38 U	3.7835	1.3 J	1300	55	440	68	42	21	2.1 U	14	2.2	15

U = undetected
J = estimated

Table C-23. Pesticide Concentrations in Sediments Oustide Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	alpha-BHC	alpha-Chlordane	alpha-Endosulfan	beta-BHC	beta-Endosulfan	DDTs (total-calc'd)	Dieldrin	Endosulfan sulfate	Endrin	Endrin aldehyde	Endrin ketone	gamma-BHC	gamma-Chlordane	Heptachlor	Heptachlor epoxide	Toxaphene
Sediments (ug/kg, dry wt)																									
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	2 U	2 U	2 U	1 UJ	1 U	2 U	1 U	1 U	2 U	2 U	2 UJ	2 U	2 U	2 U	2 U	1 U	1 U	1 U	1 U	10 U

U = undetected
J = estimated

Table C-24. Volatile Organic Compound Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	1,1,1,2-Tetra-chloro-ethane	1,1,1-Tri-chloro-ethane	1,1,2,2-Tetra-chloro-ethane	1,1,2-Tri-chloro-ethane	1,1,2-Tri-chloro-trifluoro-ethane	1,1-Dichloro-acetone	1,1-Dichloro-ethane	1,1-Dichloro-ethene	1,1-Dichloro-propene	1,2,3-Trichloro-benzene	1,2,3-Trichloro-propane	1,2,4-Trichloro-benzene	1,2,4-Trimethyl-benzene	1,2-Dibromo 3-chloro-propane	1,2-Dibromo-ethane (EDB)	1,2-Dichloro-benzene	1,2-Dichloro-ethane	1,2-Dichloro-propane	1,3,5-Trimethyl-benzene	1,3-Dichloro-benzene	1,3-Dichloro-propane	1,4-Dichloro-benzene	1-Chloro-butane	2,2-Dichloro-propane	2,4-Dinitro-toluene
Sediments (ug/kg, dry wt)																														
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2												1.4 UJ				1.4 UJ				2.4 J		2.6 J			22 U
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2																				1.9 J		2.6 J			22 UJ
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2												1.3 UJ				1.3 UJ				1.6 J		1.8 J			20 U
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2												1.3 UJ				1.3 UJ				1.3 UJ		1.6 J			21 U
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2												1.3 UJ				1.7 J				1.3 UJ		1.3 UJ			20 U
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	2.9 U	2.9 U	2.9 U	2.9 U	58.5 U	29.2 U	2.9 U	5.8 U	2.9 U	2.9 U	14.6 U	20 U	2.9 U	5.8 UJ	2.9 U	20 U	2.9 U	2.9 U	2.9 U	20 U	2.9 U	20 U	2.9 U	2.9 U	200 U
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10												20 U				20 U				20 U		20 U			200 U
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10												20 U				20 U				20 U		20 U			200 U

U = undetected
J = estimated

Table C-24. Volatile Organic Compound Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	2,6-Dinitro-toluene	2-Chloro-toluene	2-Hexanone	2-Nitro-propane	4-Chloro-toluene	Acetone	Benzene	Bromo-benzene	Bromo-chloro-methane	Bromo-dichloro-methane	Bromoform	Bromo-methane	Carbon disulfide	Carbon tetra-chloride	Chloro-benzene	Chloro-ethane	Chloroform	Chloro-methane	cis-1,2-Dichloro-ethene	cis-1,3-Dichloro-propene	Cymene	Dibromo-chloro-methane	Dibromo-methane	Dichloro-methane	Diethyl ether	Ethyl Methacrylate
Sediments (ug/kg, dry wt)																															
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2	22 U																									
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2	22 UJ																									
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2	20 U																									
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2	21 U																									
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2	20 U																									
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	200 U																									
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	200 U																									
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	200 U																									
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	200 U																									
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	200 U																									
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	200 U																									
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	200 U																									
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	200 U																									
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	200 U																									
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	200 U																									
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	200 U	2.9 U	5.8 U	14.6 U	2.9 U	117 UJ	2.9 U	2.9 U	2.9 U	2.9 U	5.8 U	14.6 U	5.8 U	2.9 U	2.9 U	14.6 U	2.9 U	14.6 U	2.9 U	3.1 U	2.9 U	5.8 U	2.9 U	14.6 U	5.8 U	2.9 U
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	200 U																									
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10	200 U																									
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	200 U																									

U = undetected
J = estimated

Table C-24. Volatile Organic Compound Concentrations in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Ethyl-benzene	Hexa-chloro-benzene	Hexa-chloro-ethane	iso-Propyl-benzene	Methyl ethyl ketone	Methyl iso-butyl ketone	n-Butyl-benzene	Nitro-benzene	n-Propyl-benzene	Penta-chloro-ethane	sec-Butyl-benzene	Styrene	tert-Butyl-benzene	Tetra-chloro-ethene	Toluene	trans-1,2-Dichloro-ethene	trans-1,3-Dichloro-propene	trans-1,4-Dichloro-2-butene	Tri-chloro-ethene	Tri-chloro-fluoro-methane	Vinyl chloride	Xylene (meta & para)	Xylene (ortho)
Sediments (ug/kg, dry wt)																												
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2		1.4 UJ	54 UJ					54 U															
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2		3.1 J	54 UJ					54 UJ															
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2		1.3 UJ	50 UJ					50 U															
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2		1.3 UJ	52 UJ					52 U															
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2		3.5 J	50 UJ					50 U															
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10		20	20 U					20 U															
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	2.9 U	20 U	20 U	2.9 U	5.8 U	5.8 U	2.9 U	20 U	2.9 U	5.8 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.7 U	14.6 U	2.9 U	58.5 UJ	14.6 U	5.8 U	2.9 U
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10		20 U	20 U					20 U															
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10		20 U	20 U					20 U															

U = undetected
J = estimated

Table C-25 . Concentrations of Miscellaneous Compounds in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	1,2-Diphenyl-hydrazine	2-Nitroaniline	3,3'-Dichloro-benzidine	3-Nitroaniline	4,6-Dinitro-o-cresol	4-Bromophenyl phenyl ether	4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Nitroaniline	Allyl Chloride	Benzoic acid	Benzyl alcohol	bis-(2-chloro-ethoxy)-methane	bis-(2-chloro-ethyl)-ether	bis-(2-chloro-isopropyl)-ether	bis-chloro-isopropyl ether	Carbazole	Coprostanol	Dibenzo-furan	Hexachloro-butadiene	Hexachloro-cyclo-pentadiene
Sediments (ug/kg, dry wt)																										
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2	110 U	220 U			110 U	22 U		32 U	220 UJ		220 U	54 U	54 U	32 UJ		110 UJ	54 U	542	54 U	54 U	54 UJ
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2	110 UJ	220 UJ			110 UJ	22 UJ		32 UJ	220 UJ		300 J	54 UJ	54 UJ	32 UJ		110 UJ	54 UJ	440 J	76 J	54 UJ	54 UJ
DUWRIV97	02/01/97	WQA8AVE	L10623-3	0	2																					
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2	98 U	200 U			98 U	20 U		30 U			200 U	50 UJ	50 U	30 UJ		98 UJ	50 U	200 U	50 U	50 U	50 UJ
DUWRIV97	02/01/97	WQA8AVE	L10786-3	0	2																					
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2	100 U	210 U			100 UJ	21 U		31 U			210 UJ	52 UJ	52 U	31 UJ		100 UJ	52 U	210 U	52 U	52 U	52 UJ
DUWRIV97	02/01/97	WQA8AVE	L10788-3	0	2																					
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2	98 U	200 U			98 UJ	20 U		30 U			200 UJ	50 UJ	50 U	30 UJ		98 UJ	50 U	200 U	50 U	50 U	50 UJ
DUWRIV97	02/01/97	WQA8AVE	L10931-3	0	2																					
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 U
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		120		60	20 U	100 UJ
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		370		750	20 U	100 UJ
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		40		40	20 U	100 UJ
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		30		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U	2.9 U	200 U	50 U	40 U	40 U	40 U		20		80	20 U	100 UJ
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10		100 U	200 U	200 U	200 UJ	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20		20 U	20 U	100 UJ
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10		100 U	200 U	200 U	200 U	40 U	60 U	20 U	100 U		200 U	50 U	40 U	40 U	40 U		20 U		70	20 U	100 UJ
PLNT295	10/23/95	SD-DUW01	SD-DUW01-0000	0	9.144																					
PLNT295	10/23/95	SD-DUW17	SD-DUW17-0000	0	9.144																					

U = undetected
J = estimated

Table C-25 . Concentrations of Miscellaneous Compounds in Sediments Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Iodomethane	Isophorone	Methacrylonitrile	Methoxychlor	Methyl Acrylate	Methyl Methacrylate	Methyl-mercury	N-Nitroso-dimethylamine	N-Nitroso-di-n-propylamine	N-Nitroso-diphenylamine	Tert-butyl methyl ether	pH
Sediments (ug/kg, dry wt)																	
DUWRIV97	02/01/97	WQA8AVE	L10535-3	0	2		54 U					0.88	220 UJ	54 U	54 U		
DUWRIV97	02/01/97	WQA8AVE	L10601-3	0	2		54 UJ					0.87	220 UJ	54 UJ	54 UJ		
DUWRIV97	02/01/97	WQA8AVE	L10623-3	0	2							0.73					
DUWRIV97	02/01/97	WQA8AVE	L10785-3	0	2		50 UJ					0.75	200 UJ	50 UJ	50 U		
DUWRIV97	02/01/97	WQA8AVE	L10786-3	0	2							0.91					
DUWRIV97	02/01/97	WQA8AVE	L10787-3	0	2		52 UJ					0.91	210 UJ	52 UJ	52 U		
DUWRIV97	02/01/97	WQA8AVE	L10788-3	0	2							0.35					
DUWRIV97	02/01/97	WQA8AVE	L10930-3	0	2		50 UJ					0.82	200 UJ	50 UJ	50 U		
DUWRIV97	02/01/97	WQA8AVE	L10931-3	0	2							0.73					
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	2.9 U	20 U	5.8 U	1 U	5.8 U	2.9 U			40 U	40 U	5.8 U	
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10		20 U							40 U	40 U		
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10		20 U							40 U	40 U		
PLNT295	10/23/95	SD-DUW01	SD-DUW01-0000	0	9.144												7.8
PLNT295	10/23/95	SD-DUW17	SD-DUW17-0000	0	9.144												7.3

U = undetected
J = estimated

Table C-26. Concentrations of Organic Carbon-Normalized SMS Analytes Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Total LPAH (calc'd)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	2-Methylnaphthalene	Total HPAH (calc'd)	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzofluoranthenes (total-calc'd)	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene
Sediments (mg/kg total organic carbon)																					
DUWRIV97	02/01/97	VE	L10535-3	0	2	18.9	4.4 UJ	1.66 U	1.97	2.49 J	11.9 J	2.49 J	4.4 U	69.3	17.6 J	15 J	6.22 J	8.65	10.2	5.03 J	3.26 J
DUWRIV97	02/01/97	VE	L10601-3	0	2	33.1	4.38 UJ	1.65 UJ	4.59 J	5.67 J	19.6 J	3.3 J	4.38 UJ	85.6	22.7 J	18.6 J	7.22 J	9.28 J	14.7	5.67 J	4.02 J
DUWRIV97	02/01/97	VE	L10785-3	0	2	11.4	5 UJ	1.9 U	1.9	1.9 UJ	9.49 J	1.9 UJ	5 U	62.2	17.1 J	13.9 J	5.13 J	6.65	7.59	4.68 J	3.61 J
DUWRIV97	02/01/97	VE	L10787-3	0	2	35.1	4.97 UJ	1.86 U	3.19	4.07 J	24 J	3.89 J	4.97 U	128	33.5 J	24 J	11.4 J	14.6	23.6	7.78 J	5.99 J
DUWRIV97	02/01/97	VE	L10930-3	0	2	16.8	4.94 UJ	1.88 U	1.94	2.31 J	12.5 J	1.88 UJ	4.94 U	77.2	22.5 J	17.5 J	6.88 J	8.25	9.38	5.44 J	3.81 J
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	25.3	2.3 U	2.3 U	2.3 U	2.3	18.4	4.6	2.3 U	214	44.8	35.6	18.4	28.7	41.4	19.5	11.5
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	84.9	3.77	2.52	6.29	7.55	44	20.8	1.89	833	176	164	94.3	113	157	69.2	30.2
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	1150	1.72	3.45	42.5	97.7	920	86.2	4.6	2370	1030	632	172	195	190	69	37.9
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	14.9	1.65 U	1.65 U	1.65 U	1.65 U	10.7	4.13	1.65 U	121	21.5	23.1	11.6	15.7	22.3	10.7	7.44
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	15	0.654 U	0.654 U	1.31	1.96	9.15	2.61	0.654 U	102	27.5	17.6	9.15	11.1	19	7.84	4.9
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	6.57	1.46 U	1.46 U	1.46 U	1.46 U	6.57	1.46 U	1.46 U	83.2	15.3	12.4	6.57	10.2	16.1	8.03	7.3
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	11.1	1.71 U	1.71 U	1.71 U	1.71 U	9.4	1.71	1.71 U	107	18.8	18.8	7.69	12.8	20.5	10.3	8.55
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	8	1.33 U	1.33 U	1.33 U	1.33 U	4.67	3.33	1.33 U	69.3	12.7	10	8.67	12.7	12.7	6	4
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	24	1.6 U	1.6 U	1.6 U	1.6	16	6.4	1.6 U	276	56	47.2	28	33.6	52	25.6	16.8
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	11.8	1.31 U	1.31 U	1.31 U	1.31 U	9.15	2.61	1.31 U	109	26.1	20.3	9.8	13.7	19.6	7.84	6.54
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	74.5	1.27	1.27	7.01	5.73	50.3	8.92	1.27 U	675	268	172	63.7	53.5	63.7	29.3	12.1
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	9.47	2.11 U	2.11 U	2.11 U	2.11 U	9.47	2.11 U	2.11 U	100	23.2	25.3	8.42	10.5	15.8	7.37	5.26
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10	9.57	0.957 U	0.957 U	0.957 U	0.957	6.7	1.91	0.957 U	91.4	20.1	15.8	7.66	11	16.7	7.18	6.22
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	67.2	1.46 U	1.46 U	8.03	8.03	46.7	4.38	1.46 U	165	47.4	40.1	16.1	17.5	22.6	10.2	5.84
NOAA97	09/15/97	CH0013	CH04-01	0	10																
NOAA97	09/15/97	CH0018	CH05-01	0	10																
NOAA97	09/15/97	CH0019	CH05-02	0	10																
NOAA97	09/15/97	CH0021	CH06-02	0	10																
NOAA97	09/15/97	CH0022	CH06-03	0	10																
NOAA97	09/15/97	EIT075	EIT09-02	0	10																
NOAA97	09/15/97	EIT078	EIT09-04	0	10																
NOAA97	09/15/97	EST179	EST13-04	0	10																
NOAA97	09/15/97	EST180	EST13-05	0	10																
NOAA97	09/15/97	EST181	EST13-06	0	10																
NOAA97	09/15/97	WES241	WEST08	0	10																
NOAA97	09/15/97	WIT269	WIT08-01	0	10																
NOAA97	09/15/97	WIT270	WIT08-02	0	10																
NOAA97	09/15/97	WIT271	WIT08-03	0	10																
NOAA97	09/15/97	WIT275	WIT09-01	0	10																
NOAA97	09/15/97	WIT276	WIT09-02	0	10																
NOAA97	09/15/97	WST325	WST10-01	0	10																
NOAA97	09/15/97	WST326	WST10-02	0	10																
NOAA97	09/15/97	WST333	WST11-01	0	10																
NOAA97	09/15/97	WST334	WST11-02	0	10																
NOAA97	09/15/97	WST335	WST11-03	0	10																
NOAA97	09/15/97	WST337	WST12-01	0	10																
NOAA97	09/15/97	WST338	WST12-02	0	10																
PLNT295	10/23/95	SD-DUW01	SD-DUW01-0000	0	9.144																
PLNT295	10/23/95	SD-DUW17	SD-DUW17-0000	0	9.144																
PLNT296	03/19/96	SD-DUW55	SD2B-DUW55-0000	0	9.144																
PLNT296	03/19/96	SD-DUW74	SD2B-DUW74-0000	0	9.144																
PLNT296	03/19/96	SD-DUW84	SD2B-DUW84-0000	0	9.144																
PLNT296	03/19/96	SD-DUW85	SD2B-DUW85-0000	0	9.144																
PLNT296	03/19/96	SD-DUW86	SD2B-DUW86-0000	0	9.144																
PLNT296	03/19/96	SD-DUW87	SD2B-DUW87-0000	0	9.144																
PLNT296	03/19/96	SD-DUW88	SD2B-DUW88-0000	0	9.144																

U = undetected
J = estimated

Table C-26. Concentrations of Organic Carbon-Normalized SMS Analytes Outside Slip 4.

Survey	Date	Station	Sample	Upper Sample Depth (cm)	Lower Sample Depth (cm)	Dibenzo(a,h)-anthracene	Benzo(g,h,i)-perylene	1,2-Dichlorobenzene	1,4-Dichlorobenzene	1,2,4-Trichlorobenzene	Hexachlorobenzene	Dimethyl phthalate	Diethyl phthalate	Di-n-butyl phthalate	Butyl benzyl phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dibenzofuran	Hexachlorobutadiene	N-Nitroso-diphenylamine	PCBs (total-calc'd)
Sediments (mg/kg total organic carbon)																					
DUWRIV97	02/01/97	VE	L10535-3	0	2	4.4 U	3.37 J	0.0725 UJ	0.135 J	0.0725 UJ	0.0725 UJ	1.14 U	2.8 U	2.8 U	1.66 U	16.9	1.66 UJ	2.8 U	2.8 U	2.8 U	2.07
DUWRIV97	02/01/97	VE	L10601-3	0	2	4.38 UJ	3.51 J		0.134 J		0.16 J	1.13 UJ	2.78 UJ	2.78 J	2.16 J	26.3 J	1.65 UJ	3.92 J	2.78 UJ	2.78 UJ	4.95
DUWRIV97	02/01/97	VE	L10785-3	0	2	5 U	3.48 J	0.0823 UJ	0.114 J	0.0823 UJ	0.0823 UJ	1.27 U	3.16 U	3.16 U	1.9 U	15.8	1.9 U	3.16 U	3.16 U	3.16 U	2.91
DUWRIV97	02/01/97	VE	L10787-3	0	2	4.97 U	7.19 J	0.0778 UJ	0.0958 J	0.0778 UJ	0.0778 UJ	1.26 U	3.11 U	3.11 U	1.86 U	12.2	1.86 U	3.11 U	3.11 U	3.11 U	2.75
DUWRIV97	02/01/97	VE	L10930-3	0	2	4.94 U	3.44 J	0.106 J	0.0813 UJ	0.0813 UJ	0.219 J	1.25 U	3.13 U	3.13 U	1.88 U	15.6	1.88 U	3.13 U	3.13 U	3.13 U	1.5 U
LODRIV98	08/11/98	DR173	SD-DR173-0000	0	10	3.45	10.3	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	11.5	2.3 U	2.3 U	2.3 U	4.6 U	7.13
LODRIV98	08/11/98	DR174	SD-DR174-0000	0	10	8.18	21.4	1.26 U	1.26 U	1.26 U	1.26 U	1.26 U	1.26 U	4.4	1.89	18.9	1.26 U	3.77	1.26 U	2.52 U	31.1
LODRIV98	08/11/98	DR175	SD-DR175-0000	0	10	8.62	25.9	1.15 U	1.15 U	1.15 U	1.15 U	1.15 U	1.15 U	1.15 U	1.15 U	15.5	1.15 U	43.1	1.15 U	2.3 U	6.9
LODRIV98	08/11/98	DR193	SD-DR193-0000	0	10	1.65	6.61	1.65 U	1.65 U	1.65 U	1.65 U	1.65 U	1.65 U	1.65 U	1.65	10.7	1.65 U	1.65 U	1.65 U	3.31 U	9.75
LODRIV98	08/11/98	DR194	SD-DR194-0000	0	10	0.98	3.92	0.654 U	0.654 U	0.654 U	0.654	1.31	0.654 U	0.654	0.98	19.9	0.654 U	1.31	0.654 U	1.31 U	5.07
LODRIV98	08/11/98	DR195	SD-DR195-0000	0	10	1.46	5.84	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	9.49 UJ	1.46 U	1.46 U	1.46 U	2.92 U	4.67
LODRIV98	08/11/98	DR196	SD-DR196-0000	0	10	1.71	7.69	1.71 U	1.71 U	1.71 U	1.71 U	1.71 U	1.71 U	1.71 U	1.71	12.8 UJ	1.71 U	1.71 U	1.71 U	3.42 U	9.83
LODRIV98	08/11/98	DR212	SD-DR212-0000	0	10	1.33 U	2.67	1.33 U	1.33 U	1.33 U	1.33 U	1.33 U	1.33 U	1.33 U	1.33 U	2.67 UJ	1.33 U	1.33 U	1.33 U	2.67 U	5.13
LODRIV98	08/11/98	DR213	SD-DR213-0000	0	10	4	12.8	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	13.6 UJ	1.6 U	1.6 U	1.6 U	3.2 U	10.9
LODRIV98	08/11/98	DR214	SD-DR214-0000	0	10	1.31 U	5.23	1.31 U	1.31 U	1.31 U	1.31 U	1.31 U	1.31 U	1.31 U	1.31 U	19.6	1.31 U	1.31 U	1.31 U	2.61 U	7.25
LODRIV98	08/11/98	DR221	SD-DR221-0000	0	10	3.18	9.55	1.27 U	1.27 U	1.27 U	1.27 U	1.27 U	1.27 U	1.27	1.27 U	14.6 UJ	1.27 U	5.1	1.27 U	2.55 U	4.08
LODRIV98	08/11/98	DR222	SD-DR222-0000	0	10	2.11 U	4.21	2.11 U	2.11 U	2.11 U	2.11 U	2.11 U	2.11 U	2.11 U	2.11 U	13.7	2.11 U	2.11 U	2.11 U	4.21 U	13.9
LODRIV98	08/11/98	DR223	SD-DR223-0000-CC	0	10	1.44	5.26	0.957 U	0.957 U	0.957 U	0.957 U	0.957	0.957 U	1.44	1.44	16.7	0.957 U	0.957 U	0.957 U	1.91 U	7.32
LODRIV98	08/11/98	DR232	SD-DR232-0000	0	10	1.46 U	5.11	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	1.46 U	13.1	1.46 U	5.11	1.46 U	2.92 U	5.91
NOAA97	09/15/97	CH0013	CH04-01	0	10																7.69
NOAA97	09/15/97	CH0018	CH05-01	0	10																18.3
NOAA97	09/15/97	CH0019	CH05-02	0	10																28.7
NOAA97	09/15/97	CH0021	CH06-02	0	10																6.67
NOAA97	09/15/97	CH0022	CH06-03	0	10																4.3
NOAA97	09/15/97	EIT075	EIT09-02	0	10																22.2
NOAA97	09/15/97	EIT078	EIT09-04	0	10																47.6
NOAA97	09/15/97	EST179	EST13-04	0	10																24.5
NOAA97	09/15/97	EST180	EST13-05	0	10																15
NOAA97	09/15/97	EST181	EST13-06	0	10																6.15
NOAA97	09/15/97	WES241	WEST08	0	10																19.4
NOAA97	09/15/97	WIT269	WIT08-01	0	10																4.63
NOAA97	09/15/97	WIT270	WIT08-02	0	10																19.2
NOAA97	09/15/97	WIT271	WIT08-03	0	10																10.9
NOAA97	09/15/97	WIT275	WIT09-01	0	10																14.3
NOAA97	09/15/97	WIT276	WIT09-02	0	10																13.2
NOAA97	09/15/97	WST325	WST10-01	0	10																5.95
NOAA97	09/15/97	WST326	WST10-02	0	10																6.16
NOAA97	09/15/97	WST333	WST11-01	0	10																3.77
NOAA97	09/15/97	WST334	WST11-02	0	10																12.6
NOAA97	09/15/97	WST335	WST11-03	0	10																4.29
NOAA97	09/15/97	WST337	WST12-01	0	10																3.73
NOAA97	09/15/97	WST338	WST12-02	0	10																1.84
PLNT295	10/23/95	SD-DUW01	SD-DUW01-0000	0	9.144																30
PLNT295	10/23/95	SD-DUW17	SD-DUW17-0000	0	9.144																38.6
PLNT296	03/19/96	SD-DUW55	SD2B-DUW55-0000	0	9.144																17.1
PLNT296	03/19/96	SD-DUW74	SD2B-DUW74-0000	0	9.144																10.8
PLNT296	03/19/96	SD-DUW84	SD2B-DUW84-0000	0	9.144																65.3
PLNT296	03/19/96	SD-DUW85	SD2B-DUW85-0000	0	9.144																273
PLNT296	03/19/96	SD-DUW86	SD2B-DUW86-0000	0	9.144																58.9
PLNT296	03/19/96	SD-DUW87	SD2B-DUW87-0000	0	9.144																17.7
PLNT296	03/19/96	SD-DUW88	SD2B-DUW88-0000	0	9.144																6.6

U = undetected
J = estimated