



**Lower Duwamish Waterway
Early Action Area 4
Final Summary of Existing
Information and Identification of
Data Gaps Report**

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List of Acronyms and Abbreviations

| | |
|----------|---|
| Anchor | Anchor Environmental, LLC |
| AOC | Area of Concern |
| AOD | argon-oxygen-decarbonization |
| AHT | acid waste hold tank |
| AST | aboveground storage tank |
| BEHP | bis(2-ethylhexyl)phthalate |
| bgs | below ground surface |
| BMP | Best Management Practices |
| BNA | base-neutral acid |
| Boeing | Boeing Company |
| BTEX | benzene, toluene, ethylbenzene, and xylene |
| CAD | AutoCAD |
| cDCE | cis-1,2-dichloroethene |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CMS | Corrective Measure Study |
| COC | Constituent of Concern |
| cPAH | carcinogenic polycyclic aromatic hydrocarbons |
| CSCSL | Confirmed and Suspected Contaminated Site List |
| CSL | Contaminant Screening Level |
| DCE | dichloroethene |
| DDC | density-driven convection |
| DO | dissolved oxygen |
| DRPH | diesel-range petroleum hydrocarbons |
| DSOA | Duwamish Sediment Other Area |
| E & E | Ecology and Environment, Inc. |
| EAA | Early Action Area |
| EAF | electric arc furnace |
| Ecology | Washington State Department of Ecology |
| EMF | Electrical Manufacturing Facility |
| EPA | U.S. Environmental Protection Agency |
| EPI | Environmental Partners, Inc. |
| ERD | enhanced reductive dechlorination |
| FAA | Federal Aviation Administration |
| Farallon | Farallon Consulting, LLC |
| FCMS | Focused Corrective Measures Study |
| FS | Feasibility Study |
| gpd | gallons per day |
| GRPH | gasoline-range petroleum hydrocarbons |
| IM | Interim Measure |
| KCIA | King County International Airport |

List of Acronyms and Abbreviations (cont.)

| | |
|------------------------|---|
| LDW | Lower Duwamish Waterway |
| LNAPL | light nonaqueous-phase liquid |
| LUST | leaking underground storage tank |
| Metro | King County Metro |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MoRPH | motor oil-range petroleum hydrocarbons |
| MTCA | Model Toxics Control Act |
| NPDES | National Pollutant Discharge Elimination System |
| NFA | No Further Action |
| NTU | nephelometric turbidity unit |
| OA | Other Area |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PCE | tetrachloroethene |
| Plant 2 | Boeing's Plant 2 |
| PMCL | Proposed Maximum Contaminant Level |
| ppm | parts per million |
| RCRA | Resource Conservation and Recovery Act |
| RFI | RCRA Facility Investigation |
| RI | Remedial Investigation |
| SCL | Seattle City Light |
| SHA | Site Hazard Assessment |
| SMS | Sediment Management Standard |
| sq-ft. | square foot/feet |
| SQS | Sediment Quality Standard |
| SVOC | semivolatile organic compound |
| SWMU | Stormwater Management Unit |
| SWPPP | Stormwater Pollution Prevention Plan |
| TCE | trichloroethene |
| tDCE | trans-1,2-dichloroethene |
| TPH | total petroleum hydrocarbons |
| TRI | Toxics Release Inventory |
| TSD | treatment, storage, and disposal |
| UST | underground storage tank |
| VOC | volatile organic compound |
| WAC | Washington Administrative Code |
| Windward | Windward Environmental, LLC |
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| µg/m ² /day | micrograms per meter squared per day |

1.0 Introduction

1.1 Background and Purpose

The Lower Duwamish Waterway (LDW) in Seattle, Washington, was added to the U.S. Environmental Protection Agency's (EPA's) National Priorities List in September 2001 because of chemical contamination in the sediment of the waterway. The LDW Superfund site is made up of approximately 5.5 miles of the downstream portion of the Duwamish River that flows into Elliott Bay, Seattle (Figure 1).

The key parties involved in the LDW Superfund site are the LDW Group (composed of the City of Seattle, King County, the Port of Seattle, and the Boeing Company [Boeing]), the Washington State Department of Ecology (Ecology), and the EPA. The LDW Group is conducting a Remedial Investigation/Feasibility Study (RI/FS) for the LDW Superfund site. Data collected during a Phase I RI was used to identify locations that could be candidates for early cleanup action. Early Action Area (EAA)-4 was identified by the LDW Group as a high priority site for sediment cleanup (Windward Environmental, LLC [Windward], 2003a). Ecology is the lead agency for source control for the LDW Superfund site. Source control is the process of finding and stopping or reducing to the maximum extent practicable (or "as much as is feasible") pollution releases to waterway sediments. The goal of source control is to prevent sediments from becoming recontaminated following cleanup. Before further sediment cleanup work can begin, Ecology must determine the source control actions necessary for EAA-4.

As part of source control efforts for EAA-4, Ecology tasked Ecology and Environment, Inc. (E & E), to prepare this *Summary of Existing Information and Identification of Data Gaps Report*. The purpose of this report is to document readily available information regarding potential sources of sediment recontamination and contaminant migration pathways in EAA-4. In addition, this report identifies data gaps to be filled to assess the potential for recontamination to EAA-4.

1.2 Report Organization

Section 2.0 of this report provides a summary of background information on EAA-4, including a description of the properties within the drainage, chemicals of concern to LDW sediments, and potential migration pathways. Section 3.0 describes potential sources of contaminants to EAA-4 sediments including upland facilities, groundwater, stormwater, bank erosion, and atmospheric deposition. Data gaps that must be addressed to complete development of a Source Control Action Plan are also summarized in Section 3.0. Section 4.0 provides a list of documents cited in the report. Section 5.0 contains the figures, and Section 6.0 contains the tables prepared for the report.

Information presented in this report was obtained from the following sources:

- Ecology Hazardous Waste Facility Database;
- Ecology Industrial Stormwater General Permits;
- Ecology National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Permit Database;
- Ecology Northwest Regional Office Central Records;

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- Ecology Underground Storage Tank (UST) and Leaking Underground Storage Tank (LUST) lists;
- EPA file logs;
- King County Geographic Information System Center Parcel Viewer and Property Tax Records;
- King County Industrial Waste Office; and
- Washington Confirmed and Suspected Contaminated Site List (CSCSL).

2.0 Early Action Area 4

EAA-4 extends approximately 4,500 feet along the eastern bank of the LDW from Slip 4 to the south side of the Jorgensen Forge property (miles 2.9 to 3.7¹; Figure 2). EAA-4 encompasses surface drainage for approximately 132 acres of commercial and industrial properties, as well as a portion of roadway in the LDW basin (King County, 2007). The four properties that drain into EAA-4 are Boeing Plant 2 (Plant 2), Jorgensen Forge, a portion of the King County International Airport (KCIA), and a small portion of East Marginal Way South, a four-lane arterial. These properties have been identified as potential sources of sediment recontamination in EAA-4.

2.1 Site Description

General background information and a description of the greater LDW Superfund site and the history behind its development are provided in the Phase I RI Report (Windward, 2003b).

Historical and current commercial and industrial operations in the LDW include cargo handling and storage, marine construction, boat manufacturing, marina operations, concrete manufacturing, paper and metals fabrication, food processing, and airplane parts manufacturing (Windward, 2003b).

Extensive topographic modifications have been made to the Duwamish River throughout EAA-4, including the filling of tideflats, old channel areas, floodplains, and lowlands to create a straightened river channel and allow for industrial operations to expand their land parcels (Farallon Consulting, LLC [Farallon] and Anchor Environmental, LLC [Anchor], 2006). This realignment moved the Duwamish River from its former location at the present day KCIA to its current location to the west (Weston, 1996).

The general direction of groundwater flow in the Duwamish Valley is toward the LDW, although the direction may vary locally depending on the nature of subsurface material and, temporally, based on proximity to the LDW and the influence of tidal action. Groundwater flow to EAA-4 occurs between 9 and 13 feet below ground surface (bgs); however, the depth to groundwater may fluctuate up to 2 feet in seasonal response during the rainy season (Farallon, 2004).

Groundwater monitoring data in the EAA-4 drainage area indicates that the apparent direction of shallow groundwater flow is towards the southwest and tidal influences have been identified, particularly on the western portion of the action area (Boeing, 2006a; Farallon and Anchor, 2006). The tidal influence diminishes with increasing distance from the waterway, and is negligible (less than 1 percent) approximately 800 to 900 feet from the waterway (Boeing, 2006a). Horizontal hydraulic gradients along the shoreline of EAA-4 change in tidally influenced areas, with groundwater flow directions temporarily reversing during high tides in areas immediately adjacent to the waterway (Boeing, 2006a).

2.2 Constituents of Concern

The sediments throughout EAA-4 have been documented to be impacted at levels of concern by polychlorinated biphenyls (PCBs), phthalates, polynuclear aromatic hydrocarbons (PAHs), and metals in some portions of the area (Windward, 2003b).

¹ Note: These miles are based on measurements taken from the south end of Harbor Island; they are not official River Miles.

Contaminated soil and groundwater under several facilities have been identified as potential sources of sediment recontamination in EAA-4. Boeing is investigating and cleaning up hazardous waste contamination at Plant 2 under EPA's Resource Conservation and Recovery Act (RCRA). In 1994, EPA and Boeing signed an Administration Order of Consent, which required Boeing to perform a corrective action at Plant 2. Ecology is in the final stages of negotiating a draft Agreed Order with Jorgensen Forge. This formal agreement will allow Jorgensen Forge and Ecology to conduct a source control investigation at the site to determine whether the site is an ongoing source of elevated chemical concentrations to the LDW. Bank and sediment cleanup at Jorgensen Forge will be conducted under a separate Administrative Order of Consent with EPA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and will be coordinated with the EPA RCRA order for Plant 2.

Results of sediment and groundwater sampling in EAA-4 are summarized in tables 1, 2, 3, and 4. Investigations that identify contaminants of potential concern within the EAA-4 area within various media are summarized below.

2.2.1 Boeing Plant 2 Studies

Since the EPA and Boeing signed an Administration Order of Consent in 1994, over 2,600 soil samples from more than 950 locations have been collected and analyzed (Ernst, 2007). In addition, over 3,200 groundwater samples from almost 750 locations and 510 sediment samples from 271 locations in the LDW near Plant 2 have been collected and analyzed (Ernst, 2007). Chemicals detected in soil and groundwater included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCBs, total petroleum hydrocarbons (TPHs), and metals. Groundwater monitoring continues and is discussed in more detail in Section 3.2.3.4. Chemicals detected in sediment include PCBs, PAHs, and metals. Findings from recent site investigations detected the following Constituents of Concern (COCs):

- **Antimony** was detected in one sample in the 2-66s Area. This sample, at a concentration of 576 milligrams per kilogram (mg/kg), exceeded the soil screening level protective of surface water (464 mg/kg).
- **Arsenic** was detected in 15 soil samples in the 30-acre, 2-40s Area (Environmental Partners, Inc., and Golder Associates, Inc. [EPI and Golder Associates], 2006a). Concentrations of samples ranged from 8 mg/kg to 13 mg/kg. Arsenic was also detected in three samples in the 13-acre, 2-60s Area, with a maximum concentration of 10 mg/kg (EPI and Golder Associates, 2006b). In the 2-66s Area, arsenic was detected in 19 samples, with concentrations ranging from 7.4 mg/kg to 76 mg/kg (EPI and Golder Associates, 2005a). Concentrations of all samples exceeded the Puget Sound Basin background concentration (7.3 mg/kg) calculated by Ecology (1994).
- **Cadmium** was detected in 12 soil samples in the 2-40s Area, with concentrations ranging from 1.41 mg/kg to 292 mg/kg (EPI and Golder Associates, 2006a). Cadmium was also detected in the 2-60s Area, at concentrations ranging from 0.4 to 0.6 mg/kg (EPI and Golder Associates, 2006b). In the 2-66s Area, cadmium was detected in 34 samples, at concentrations ranging from 1.31 mg/kg to 171 mg/kg (EPI and Golder Associates, 2005a). Only those samples collected in the 2-40s Area and 2-66s Area exceeded the soil screening level protective of surface water (1.21 mg/kg).
- **Copper** was detected in 22 soil samples in the 2-40s Area, at concentrations ranging from 36.5 mg/kg to 1,740 mg/kg (EPI and Golder Associates, 2006a). Copper was detected in three samples in the 2-60s Area at concentrations ranging from 40 mg/kg to 55.3 mg/kg (EPI and Golder Associates, 2006b). In the 2-66s Area, copper was detected in 30 samples, at concentrations ranging from 39.1 mg/kg to 28,100 mg/kg (EPI and Golder Associates, 2005a).

Concentrations of the samples collected in these three areas exceeded the Puget Sound Basin background concentration (36.4 mg/kg).

- **Cyanide** was detected in 55 soil samples in the 2-40s Area, at concentrations ranging from 0.21 mg/kg to 4,600 mg/kg (EPI and Golder Associates, 2006a). Cyanide was also detected in three samples in the 2-60s Area at concentrations ranging from 0.24 mg/kg to 1.2 mg/kg (EPI and Golder Associates, 2006b). In the 2-66s Area, cyanide was detected in 11 samples, at concentrations ranging from 0.21 mg/kg to 0.92 mg/kg (EPI and Golder Associates, 2005a). These samples all exceeded the soil screening level protective of surface water (0.2 mg/kg).
- **Hexavalent chromium** was detected in two samples in the 2-40s Area, at concentrations of 26.5 mg/kg and 68.8 mg/kg (EPI and Golder Associates, 2006a). Both samples were above the soil screening level protective of surface water (19.2 mg/kg).
- **Lead** was detected in two samples in the 2-40s Area, at concentrations of 2,150 mg/kg and 3,150 mg/kg (EPI and Golder Associates, 2006a). Lead was also detected in nine samples in the 2-66s Area at concentrations ranging from 1,150 mg/kg to 17,300 mg/kg (EPI and Golder Associates, 2005a). Both samples in the 2-40s Area exceeded the soil screening level protective of surface water (1,620 mg/kg), while the majority of samples collected in the 2-66s Area exceeded this screening level.
- **Manganese** was detected in three samples in the 2-66s Area, at concentrations ranging from 2,610 mg/kg to 3,170 mg/kg (EPI and Golder Associates, 2005a). These concentrations exceeded the soil screening level protective of surface water (1,146 mg/kg).
- **Mercury** was detected in nine samples in the 2-60s Area, at concentrations ranging from 0.04 mg/kg to 0.28 mg/kg (EPI and Golder Associates, 2006b). However, only two of these nine samples exceeded the soil screening level (0.07 mg/kg). Mercury was also detected in 37 samples in the 2-66s Area, at concentrations ranging from 0.072 mg/kg to 6.6 mg/kg (EPI and Golder Associates, 2005a), all of which the samples in the 2-66s Area exceeded the soil screening level.
- **Nickel** was detected in five soil samples in the 2-40s Area, at concentrations ranging from 49 mg/kg to 1,770 mg/kg (EPI and Golder Associates, 2006a). Nickel was also detected in 20 samples in the 2-66s Area at concentrations ranging from 40 mg/kg to 1,140 mg/kg (EPI and Golder Associates, 2005a). All the samples in the 2-40s Area and the majority of samples in the 2-66s Area exceeded the soil screening level protective of surface water (47.8 mg/kg).
- **Selenium** was detected in two samples in the 2-40s Area, both at concentrations of 9 mg/kg (EPI and Golder Associates, 2006a). Selenium was also detected in three samples in the 2-66s Area, all at concentrations of 8 mg/kg (EPI and Golder Associates, 2005a). All five samples exceed the soil screening level protective of surface water (7.38 mg/kg).
- **Silver** was detected in 15 soil samples in the 2-40s Area, at concentrations ranging from 0.4 mg/kg to 60 mg/kg (EPI and Golder Associates, 2006a). Silver was detected in six samples in the 2-60s Area at concentrations ranging from 0.4 mg/kg to 0.5 mg/kg (EPI and Golder Associates, 2006b). In the 2-66s Area, silver was detected in 34 samples, at concentrations ranging from 0.4 mg/kg to 274 mg/kg (EPI and Golder Associates, 2005a). All of these samples, except one in the 2-60s Area, exceeded the surface water screening level (0.32 mg/kg).
- **Thallium** was detected in 17 soil samples collected in the 2-40s Area, at concentrations ranging from 5 mg/kg to 30 mg/kg (EPI and Golder Associates, 2006a). Thallium was also detected in 14

samples in the 2-66s Area at concentrations ranging from 6 mg/kg to 42 mg/kg (EPI and Golder Associates, 2005a). All of these samples exceeded the surface water screening level (0.67 mg/kg).

- **Zinc** was detected in five soil samples in the 2-40s Area, at concentrations ranging from 118 mg/kg and 595 mg/kg (EPI and Golder Associates, 2006a). Zinc was also detected in 31 samples in the 2-66s Area. Concentrations of these samples ranged from 104 mg/kg and 18,700 mg/kg (EPI and Golder Associates, 2005a). Samples collected in both areas exceeded the soil screening level protective of surface water (101 mg/kg).

Other Areas at or near Plant 2

Sediment investigations in the LDW, offshore of Plant 2, identified the nature and extent of PCB contamination, which is generally confined to the upper 4 feet of sediment (Ernst, 2007). Metals contamination is much less common and mostly restricted to sediments along the Southwest Bank. Boeing has identified a roughly 15-acre area of intertidal and subtidal sediments (referred to as the Duwamish Sediments Other Area [DSOA]) along Plant 2 that will require dredging and capping. The investigation of sediment contamination has now been expanded into the navigation channel to more fully document the western boundary of the DSOA.

A series of 29 shoreline wells is monitored quarterly for metals, VOCs, and PCBs; Boeing has completed 19 quarterly sampling events of these wells (Ernst, 2007). Three of these wells are installed along the shoreline on the northwest corner of Jorgensen's property to monitor releases from the 2-66 area (recent damage to the most southerly well led to decommissioning of that well). The monitoring shows several VOCs, including vinyl chloride, present in groundwater at concentrations above EPA's criteria for surface water at some locations; however, VOC concentrations are generally declining and impacts are primarily limited to areas immediately downgradient of the sheet pile walls and at the Electrical Manufacturing Facility (EMF) plume, which originates east of the KCIA. Metals concentrations are also generally below criteria for surface water; the most significant exception to this is in wells located in the Southwest Bank area (EPI and Golder Associates, 2006c). The Southwest Bank fill material, placed in the 1940s, is considered to be the source for these exceedances and is targeted to be excavated in conjunction with the DSOA remedy. PCBs are intermittently detected in groundwater at low concentrations in one area of the Southwest Bank, which is subject to the planned excavation (Ernst, 2007).

In 2005, Boeing completed the investigation of a PCB release discovered in the southwest corner of Plant 2, at the boundary with the Jorgensen Forge facility adjacent to the now-removed Seattle City Light (SCL) substation. This investigation identified the limits of subsurface soil contaminated by PCBs and TPH (Floyd|Snider, Inc., 2005). As part of this work, catch basin solids were also sampled in the area along three separate stormwater lines draining Plant 2, Jorgensen Forge, and/or KCIA, and PCBs were found in each of the lines (Ernst, 2007). Boeing plugged its manholes to eliminate the chance of contaminated solids being discharged to the LDW. Following EPA approval, Boeing intends to excavate PCB-contaminated soil in the SCL substation area and remove Boeing's stormwater lines in the area in 2008 (Ernst, 2007). Ecology and EPA are also working with other parties on non-Boeing sources in other stormwater drain lines.

2.2.2 Jorgensen Forge Findings, August 2004

Samples of subsurface fill, fill from the shoreline bank-face, and debris piles located at the toe of the shoreline bank at the Jorgensen Forge site were collected from direct-push borings.

PCBs in Fill

Concentrations of PCBs with screening levels ranging from 0.003 mg/kg to 0.668 mg/kg were detected in fill samples collected from various depths in all subsurface fill borings. Fill samples collected from the shoreline bank-face indicated concentrations of PCBs ranging from 0.0255 mg/kg to 4.54 mg/kg, while samples collected from the debris piles had concentrations of PCBs ranging from 2.06 mg/kg to 2.34 mg/kg.

Metals in Fill

- **Arsenic** was detected in subsurface fill samples collected from two soil borings at concentrations of 61.7 mg/kg and 62.7 mg/kg, both of which exceeded the Washington Sediment Management Standards (SMS) Sediment Quality Standard (SQS) of 57 mg/kg for arsenic in sediment, but are below the Contaminant Screening Level (CSL) of 93 mg/kg. Concentrations of arsenic found in the five other samples ranged from 3.47 mg/kg to 25.7 mg/kg—below the SMS. Arsenic was also detected in the shoreline bank-face fill at concentrations ranging from 9.95 mg/kg to 64.9 mg/kg. One sample of the shoreline bank-face fill exceeded the SQS, but did not exceed the CSL.
- **Chromium** was detected in two samples collected from the shoreline bank-face fill, at concentrations of 350 mg/kg and 386 mg/kg, exceeding the SQS (260 mg/kg) and the CSL (270 mg/kg) criterion.
- **Copper** was detected in shoreline bank-face fill samples at concentrations ranging from 72.4 mg/kg to 561 mg/kg, with only one sample exceeding the SQS (390 mg/kg) and the CSL (390 mg/kg) criterion.
- **Lead** concentrations, ranging from 543 mg/kg to 1,530 mg/kg, were observed in the subsurface fill, and concentrations of 1,010 mg/kg to 5,450 mg/kg were observed in shoreline bank-face fill samples. These concentrations exceeded the SQS (450 mg/kg) and CSL (530 mg/kg) criterion.
- **Nickel** in subsurface fill samples was detected between 61 mg/kg and 5,560 mg/kg; however, nickel does not have a promulgated SMS screening level.
- **Zinc** was detected in two subsurface borings at concentrations of 1,320 mg/kg and 1,380 mg/kg, while zinc ranged from 986 mg/kg to 5,430 mg/kg in shoreline bank-face fill samples. These concentrations exceeded the SQS (410 mg/kg) and the CSL (960 mg/kg) criterion.
- **Copper, lead, chromium, and zinc** samples from debris piles indicated concentrations exceeding the SQS and the CSL criteria. Results also identified the presence of arsenic, mercury, and nickel in the samples, but with concentrations below the SQS and the CSL criteria.

Groundwater

Monitoring wells have been installed throughout the Jorgensen Forge site to monitor groundwater quality downgradient of documented releases of hydrocarbons. Metals detected above the laboratory practical

quantitation limits in groundwater at the Jorgensen Forge site include total arsenic, barium, cadmium, chromium, copper, iron, manganese, mercury, selenium, and zinc. However, only cadmium was detected at a concentration above the Model Toxics Control Act (MTCA) Method A cleanup level, from Monitoring Well-1. Exceedences of the MTCA Method A cleanup level for dissolved and/or total arsenic were also identified in the Boeing monitoring wells (i.e., PL2-JF01C and PL2-JF02A) located along the northwestern portion of the Jorgensen property shoreline. No exceedences have been identified on the property since 2003.

2.2.3 Summary

Based on the results of sampling conducted between 2004 and 2007, the following chemicals are considered to be COCs at EAA-4, with regard to potential sediment recontamination:

PCBs have been detected in subsurface fill samples at both the Plant 2 and Jorgensen Forge sites. Samples collected offshore of Plant 2, in the EAA-4, identified PCB contamination in the upper 4 feet of sediment (Ernst, 2007). In 2004, fill samples containing detectable-levels of PCBs also were collected from the shoreline bank-face and debris piles at Jorgensen Forge. In 2005, an investigation discovered a PCB-release in the southwest corner of Plant 2, at the property boundary with Jorgensen Forge (Floyd|Snider Inc., 2005). Catch basin solids were sampled in the area along three separate stormwater lines historically or currently draining Plant 2, Jorgensen Forge, and/or KCIA; PCBs were found in each line (Ernst, 2007). Boeing has since plugged its manholes to eliminate the chance of contaminated solids being discharged to the LDW.

Fourteen COCs were detected in fill material in the southeast corner (i.e., 2-40s, 2-60s, and 2-66s areas) of Plant 2, and predominantly along the shoreline bank-face and debris piles at the Jorgensen Forge. These 14 COCs include:

- Antimony;
- Arsenic;
- Cadmium;
- Copper;
- Cyanide;
- Hexavalent chromium;
- Lead;
- Manganese;
- Mercury;
- Nickel;
- Selenium;
- Silver;
- Thallium; and

- Zinc.

2.3 Potential Contaminant Migration Pathways to Sediment

It is necessary to evaluate potential contaminant migration pathways that may exist between the potential sources and the LDW to assess potential sources of sediment recontamination. Media relevant to source control that can be impacted by human activities are water, soil, and air. Such contaminated media can impact sediments through several migration pathways, including direct discharges, stormwater discharges, groundwater, spills, bank erosion/leaching, and atmospheric deposition. The potential contaminant migration pathways evaluated for EAA-4 are described below and are discussed in more specific detail in Section 3.0.

2.3.1 Direct Discharges

The direct discharge of contaminants to the waterway from commercial, industrial, private, or municipal outfalls may impact sediment quality, depending on the origin and character of the effluent. Many direct discharges are permitted under the NPDES program. Permitted discharges, whether or not they exceed applicable permit levels, may result in sediment contamination. In EAA-4 there are three Industrial Stormwater Permits (Nos. SO3000482D, SO3003231C, and SO3000343D).

2.3.2 Stormwater Discharge

Stormwater enters the waterway via storm drains and pipes, ditches, streams, or directly from properties adjacent to the waterway. Stormwater pollution is generated when rain contacts contaminants that have accumulated in or on exposed soils and surfaces. Stormwater pollution also comes from illegal discharges or illicit connections to storm sewers. Contaminated solids that collect in storm drains/pipes, ditches, or creeks may be carried to the waterway by stormwater. In the LDW area, 80 industrial sites are authorized to discharge under the general NPDES permit for industrial stormwater. In addition, three individual NPDES permits are active for given industrial operations in the area. The City of Seattle and King County are municipal NPDES permittees for stormwater.

The EAA-4 drainage basin includes several point discharges to the LDW from three private stormwater drainage systems: Plant 2, Jorgensen Forge, and a portion of the KCIA (Figure 2; Ecology, 2007a). A small portion of the East Marginal Way South public storm drain system also drains to EAA-4. These outfalls in EAA-4 are part of a larger network of public and private outfalls discharging to the LDW in the south Seattle area (Figure 3; King County and Seattle Public Utilities, 2005).

In identifying potential contaminant sources to EAA-4, the discussion of stormwater in this report focuses on the stormwater drainage systems, including the potential for the stormwater drainage systems to serve as migration pathways for site-related contaminants to the LDW. Stormwater drainage systems that contain contaminants (e.g., within oil/water separator sludges, catch basins, or sediments) or that drain areas of known soil or groundwater contamination are potential contaminant migration pathways. Contaminants from spills or contaminated soil can migrate into the stormwater drainage system through surface water runoff; it is also possible that contaminated groundwater could migrate into the stormwater drainage system.

2.3.3 Groundwater

Contaminated groundwater may enter directly into the LDW via groundwater recharge and seeps, or infiltrate storm drains/pipes, ditches, or streams that discharge to the waterway. Contaminants in soil

resulting from spills and releases to adjacent (and possibly upland) properties may be transported to the groundwater and subsequently be released to EAA-4.

2.3.4 Spills

Spills of waste materials containing COCs may occur directly to EAA-4. The Stormwater Pollution Prevention Plan (SWPPP) and Best Management Practices (BMPs) should always be implemented at the site to manage potential spills.

2.3.5 Bank Erosion/Leaching

Waterway bank soil, contaminated fill, waste piles, landfills, and surface impoundments may release contaminants directly to the EAA-4 through erosion, soil erosion to stormwater, or leaching to groundwater.

2.3.6 Atmospheric Deposition

Air pollution can enter the waterway directly or through stormwater, thus becoming a possible source of sediment contamination to EAA-4. Air pollution can be localized, such as paint overspray, sandblasting, and fugitive dust and particulates from loading/unloading of raw materials (i.e., sand, gravel, and concrete), or it can be widely dispersed from vehicle emissions and industrial smokestacks.

3.0 Potential Sources of Sediment Recontamination and Data Gaps

3.1 Introduction

The LDW sediments in the EAA-4 have been impacted by chemical contaminants from a variety of sources, both historical and potentially ongoing. These chemicals may have entered into the LDW system in a variety of ways: upland facilities, stormwater discharges; groundwater transport; bank erosion; and atmospheric deposition. The two industrial facilities in the EAA-4 drainage basin, Boeing Plant 2 and Jorgensen Forge, have been identified as potential sources of sediment contamination. These facilities, as well as other potential sources of contamination (i.e., KCIA and East Marginal Way South) to EAA-4 sediments, are discussed in this section.

3.1.1 Upland Facilities

In identifying potential chemical sources to the EAA-4, this section discusses current and historical land uses and summarizes environmental investigations and cleanups at the following four facilities/areas that have been identified as potential sources of contamination: Plant 2, Jorgensen Forge, KCIA, and a small section of East Marginal Way South. Figure 1 shows the extent of the EAA-4 draining basin and the location of the four facilities/areas of interest.

Current land-use information was obtained from existing reports, Ecology databases, and was inferred from aerial photographs. The Ecology online databases were searched for information on current NPDES permit numbers, USTs, LUST release incidents, hazardous waste facilities, and for inclusion of the property on the Washington CSCSL. Property ownership information was obtained from King County tax records and from existing reports. Table 5 summarizes property information and Table 6 summarizes the results of the regulatory search.

3.1.2 Stormwater Discharge

In identifying potential contaminant sources to EAA-4, this section discusses the stormwater drainage systems at the four potential sources of contamination, including the potential for the stormwater drainage systems to serve as migration pathways of site-related contaminants to the LDW. Stormwater drainage systems that contain contaminants (e.g., within oil/water separator sludge, catch basins, or sediments) or that drain areas of known soil or groundwater contamination are potential contaminant migration pathways. Contaminants from spills or contaminated soil can migrate into the stormwater drainage system through surface water runoff; it is also possible that contaminated groundwater could migrate into the stormwater drainage system.

The EAA-4 drainage basin includes several point discharges to the LDW from three private stormwater drainage systems: Plant 2, Jorgensen Forge, and a portion of the KCIA (Figure 2; Ecology, 2007a). A small portion of the East Marginal Way South public storm drain system also drains to EAA-4. Several public and private outfalls in this action area also discharge to the LDW (Figure 3; King County and Seattle Public Utilities, 2005).

Private waterfront properties are generally serviced by private on-site drainage systems, discharging directly to the waterway. These systems are generally smaller than public storm drain systems, and are owned and maintained by the property owner. Public storm drain systems collect and convey stormwater runoff from roadways and upland properties to the waterway. There are several private storm drain

outfalls and one city storm drain outfall that discharge to the LDW within EAA-4 (Figure 3). Other outfall types that are not included within EAA-4 include combined sewer overflows and emergency overflows. Based on the information reviewed, there are no unknown piped outfalls that discharge to EAA-4 (King County and Seattle Public Utilities, 2005).

3.1.3 Groundwater

In general at EAA-4, shallow groundwater is encountered between 9 to 13 feet bgs and exists under unconfined conditions. The general direction of shallow groundwater flow is toward the LDW, although the direction may vary locally depending on the nature of the subsurface material and temporally based on proximity to the LDW and the influence of tidal action. High tides can cause temporary groundwater flow reversals, generally within 300 to 500 feet of the LDW (Ecology, 2006).

3.1.4 Spills

Spills of contaminants have a possibility of occurring in the four potential sources of contamination in EAA-4. These contaminants may migrate from surface water runoff, through storm drains, into the LDW. Plant 2 has recorded spills for the past three years in their SWPPP. Spill control and cleanup actions prevented discharge to the LDW for all of these incidents at Plant 2. There are no documented spills at Jorgensen Forge or KCIA. However, there have been three documented releases of petroleum product and cutting oil to the soil and groundwater. All three releases were contained within isolated areas and do not present a source of contamination to the LDW.

3.1.5 Bank Erosion/Leaching

Plant 2 and Jorgensen Forge are the two potential sources of contamination in EAA-4 located along the bank of the LDW. At Plant 2, Boeing plans to excavate contaminated sediment from the southwest bank of the LDW and then place a cap in those areas. The final plans have not been completed or approved by the EPA. Investigations of the shoreline bank fill at Jorgensen Forge indicate there is PCB and metals contamination. Historic erosion of this bank fill likely resulted in PCB and metals contamination in the adjacent sediments of the LDW. Although shoreline armoring is in place at the Jorgensen Forge facility, bank erosion and leaching into the LDW still occurs and may be a significant source of contamination (see Appendix A).

3.1.6 Atmospheric Deposition

Contaminants originating from nearby city streets and industry may be transported and deposited through the air at EAA-4 and areas drained by outfalls from Plant 2, Jorgensen Forge, and KCIA facilities. Contaminants deposited within the EAA-4 drainage areas are transported to EAA-4 via surface water runoff. There is not enough information about this contaminant transport mechanism to determine whether it could result in contaminant concentrations within EAA-4 above local background levels observed in the LDW.

3.2 Boeing Plant 2

3.2.1 Current Operations

This property lies within the City of Seattle and the City of Tukwila, along the eastern shore of the LDW. Plant 2 occupies approximately 109 acres of developed, topographically flat land, covered by buildings and paved yards. Most buildings are slab-on-grade with below grade utilities (Figure 4; EPI and Golder Associates, 2006a). Current operations at the facility are primarily limited to vehicle maintenance in

Building 2-15, vehicle traffic between buildings, and operation/support of research and development activity. Current manufacturing operations are predominantly for research and development purposes, and are located in buildings 2-10, 2-88, and 2-122. Past manufacturing operations also occurred in buildings 2-31, 2-40, 2-41, and 2-44 (Boeing, 2007a).

Plant 2 is bounded by East Marginal Way South, a four-lane arterial, to the east; Jorgensen Forge, an active steel and aluminum forge, to the south; Slip 4 and Emerald Services, Inc., to the north; and the LDW to the west. The LDW is a federally maintained shipping channel of the Duwamish River; Slip 4 is an off-channel extension of the waterway. Plant 2 is served by both truck and rail, and was historically accessible from the waterway. Plant 2 is divided into northern and southern sections by an arterial, 16th Avenue South, which services the 16th Avenue South Bridge over the LDW (EPI and Golder Associates, 2006a).

According to King County's Tax Assessor website, Plant 2 is located on the following parcels, all owned by Boeing (King County, 2007):

- Parcel 0001600020 – 7755 East Marginal Way South is 29.99 acres, zoned for heavy industrial use. This parcel contains three structures: a 128,904 square foot (sq-ft.) warehouse (built in 1942); an 83,335 sq-ft. industrial engineering building (built in 2000); and a 44,300 sq-ft. industrial engineering building (built in 2000);
- Parcel 3324049002 – 7755 East Marginal Way South is 28.65 acres, zoned for heavy industrial use. This parcel contains six structures: a 68,775 sq-ft. storage warehouse (built in 1947), a 497,594 sq-ft. storage warehouse (built in 1937), a 269,010 sq-ft. storage warehouse (built in 1951), a 126,768 sq-ft storage warehouse (built in 1940), a 78,191 sq-ft. industrial light manufacturing building (built in 1952), and a 21,648 sq-ft. office building (built in 1987);
- Parcel 2824049009 – 7755 East Marginal Way South is 8.02 acres, zoned for heavy industrial use. This parcel contains two structures: a 461,347 sq-ft. office building (built in 1960), and a 67,294 sq-ft. auditorium (built in 1993);
- Parcel 2185000005 – No listed address. This 6.07-acre property is zoned for heavy industrial use, but is used for parking;
- Parcel 0022000005 – 1135 South Webster Street is 37.5 acres, zoned for heavy industrial use. This parcel contains four structures: a 494,835 sq-ft. industrial engineering building (built in 1992), a 406,979 sq-ft. industrial light manufacturing building (built in 1953), a 39,666 sq-ft. distribution warehouse (built in 1952), and an 18,622 sq-ft. industrial light manufacturing building (built in 1992);
- Parcel 2924049056 – No listed address. This 0.23-acre property is zoned for industrial use and is used for parking;
- Parcel 2924049112 – No listed address. This 1.61-acre property is zoned and used for parking; and
- Parcel 0022000195 – No listed address. This 0.5-acre property is zoned for industrial use and contains no structures.

The following surrounding land use information was obtained from the King County online tax assessor parcel viewer (King County, 2007):

- Plant 2 is bordered to the west by the LDW;
- To the north/northwest of Plant 2 is Slip 4, part of the EAA-3 site. Slip 4 is located approximately 2.8 miles from the southern end of Harbor Island. The slip is approximately 1,400 feet long, with an average width of 200 feet, and encompasses approximately 6.4 acres (Ecology, 2006);
- To the northeast of Plant 2 is Parcel 2924049043, a 5.27-acre property zoned for general purpose industrial use, owned by Emerald Services, Inc. The King County Tax Assessor website lists no address and states that the property is a vacant office;
- To the south of Plant 2 is the Jorgensen Forge property, Parcel 0001600023, located at 8531 East Marginal Way South. This 20.58-acre property is zoned for heavy industrial use and contains 14 structures. See Section 3.3 for details on the Jorgensen Forge facility;
- To the east of Plant 2 is the KCIA, Parcel 2824049007. The whole property contains 564.77 acres and 101 structures; however, only 26 acres are included in the EAA-4 (Figure 2). See Section 3.4 for details on the portion of this property that is in the EAA-4; and
- A portion of this property, Parcel 0022000165, is located at 1206 South Austin Street. This site is located in between parcels owned by Boeing. This 0.25-acre property is zoned for residential use and contains one structure, a 1,840 sq-ft. house built in 1900, owned by Paul Euchner.

Plant 2 is listed in Ecology's online CSCSL database (Facility Site ID No. 2100; Ecology, 2007b). The facility is listed as having confirmed groundwater, surface water, soil, air, and sediment contamination. The contaminants are listed as halogenated organic compounds, EPA priority pollutants—metals and cyanide, PCBs, petroleum products, non-halogenated solvents, and PAHs. According to this database, this facility was listed as a hazard site on February 25, 1992. The interim action is listed as being effective March 1, 2000 through August 8, 2008.

Plant 2 is not listed on Ecology's online LUST or UST databases (Ecology, 2007c). However, the following USTs are listed in Boeing's revised 2007 SWPPP (Boeing, 2007a):

- Two 15,000-gallon, double-walled USTs (UPL-063 and UPL-064), containing gasoline and diesel, are located at Building 2-05;
- A 1,000-gallon, double-walled UST (UPL-065), containing diesel, is located at Building 2-36, in the South Yard;
- Two 30,000-gallon, double-walled USTs (UPL-007 and UPL-008), containing jet fuel, are located at Building 2-15, in the Southeast Yard;
- A 7,000-gallon, double-walled UST (UPL-783), containing hydraulic oil, is located at Building 2-12 in the Northwest Yard; and
- A 12,000-gallon, double-walled gallon UST (UPL-784), containing hydraulic oil, is located at Building 2-122, in the North Yard.

Plant 2 is not listed in Ecology's online NPDES and State Waste Discharge Permit database (Ecology, 2007d).

Ecology issued an Industrial Stormwater General Permit for Plant 2 (Permit No. SO3000482D). The parameters of this permit are for fecal coliform (maximum of 400 per 100 milliliters), dissolved oxygen (DO; minimum of 6.5 milligrams per liter [mg/L]), and pH (maximum of 8.5 standard units and minimum of 6.5 standard units; Ecology, 2007e).

Plant 2 is listed on Ecology's online Hazardous Waste Facility Search (Facility Identification No. WAD009256819; Ecology, 2007f). This facility has been issued a Waste Discharge Permit by King County Department of Natural Resources and Parks, Industrial Waste Program (Permit No. 7811-01). This permit was effective on April 28, 2006 and expires on April 27, 2011. Four industrial waste discharges have been identified:

- Building 2-15 car wash – for a daily maximum discharge volume of 4,500 gallons per day (gpd);
- Building 2-49 Groundwater Remediation Treatment System – for a maximum discharge volume of 2,000 gpd;
- Building 2-10 waterjet cutting machine – for a maximum discharge volume of 4,000 gpd; and
- Building 2-122 Wastewater Pretreatment Plant – for a maximum discharge volume of 30,000 gpd.

A search of EPA's online Toxics Release Inventory (TRI) database was conducted for information on toxic chemical releases and other waste management activities. In general, these releases and activities are reported annually by certain covered industry groups, as well as federal facilities (EPA, 2007a). This database search focused on Release Reports, Waste Transfer Reports, and Waste Quantity Reports. Databases for Release Reports and Waste Transfer Reports contain data from 1988 to 2004. The database for Waste Quantity Reports contains data from 1991 to 2004. Plant 2's TRI Facility Identification No. is 98108BNGRS7755E (Standard Industrial Classification Code 3728). Table 7 lists the results of the search.

3.2.2 Historic Use

Plant 2 is located on the east bank of the Duwamish Waterway in the cities of Seattle and Tukwila. Historically, Plant 2 specialized in manufacturing aluminum alloy, steel alloy, and titanium alloy parts for airplanes. This facility was built on farmland in the late 1930s, and became a significant manufacturing facility during World War II (EPI and Golder Associates, 2006a). Since 1936, Boeing has manufactured airplane parts at Plant 2, using a wide range of hazardous chemicals including heavy metals (chrome, zinc, copper, cadmium, and silver); cyanide; mineral acids and bases; petroleum products; PCBs; and chlorinated solvents, such as trichloroethylene. In recent years, the character of Plant 2 has shifted toward research and administration (EPI and Golder Associates, 2006a).

3.2.3 Environmental Investigations and Cleanup Activities

3.2.3.1 Upland Facilities

Boeing is investigating and cleaning up hazardous waste contamination at Plant 2, under RCRA (Identification No. WAD009256819). In 1994, EPA and Boeing signed an Administration of Consent, which required Boeing to perform corrective action at Plant 2 in a manner acceptable to the EPA. The facility developed a RCRA Facility Investigation (RFI), which used a RCRA unit-by-unit approach to investigate the site. When corrective measures were being evaluated for groundwater, this unit-by-unit approach was found to be inadequate for remedy selection, due to the more integrated nature of

groundwater contaminant distributions. After the development of the RFI, the Uplands Corrective Measure Study (CMS) was prepared. Boeing, along with EPA and Ecology, conducted focused investigations to enable the Uplands CMS to proceed. Plant 2 has been divided into seven “CMS Study Areas” to facilitate the development and screening of RCRA corrective measures (Figure 5; EPI and Golder Associates, 2006a). These are, from the south to the north:

- South Yard Area;
- 2-60s Area;
- 2-66 Area;
- 2-40s Area;
- North Area;
- 2-31 Area; and
- 2-10 Area.

The EPA has approved Work Plans for the South Yard Area, the 2-60s Area, and the 2-66 Area. Data Gap Investigation Reports have been approved for the South Yard Area and the 2-60s Area. A Work Plan has been submitted for the 2-40s Area, but has not yet been accepted by the EPA. No Work Plan or Data Gap Investigation Report has been prepared for the North Area, 2-31 Area, or 2-10 Area.

The following information is presented in reports that have not yet been accepted by the EPA.

3.2.3.2 South Yard Area

The southern portion of Plant 2 is referred to as the South Yard Area, and consists of approximately 13 acres (Figure 6). The South Yard Area extends from the northern exterior wall of buildings 2-80, 2-81, and 2-85; south to the Jorgensen Forge property and railroad line; east to East Marginal Way; and west to the boundary line of the 2-66 Area (EPI and Golder Associates, 2005b). The South Yard Area contains buildings 2-80/81, 2-83, 2-84, 2-85, 2-88, 2-117, and 2-126 (EPI and Golder Associates, 2005b).

Within the South Yard Area, there are 18 RCRA units that fall in the following categories (also see Table 8):

- Two Stormwater Management Units (SWMUs) are RCRA-regulated treatment, storage, and disposal (TSD) facilities;
- Ten SWMUs are not TSD facilities, but defined as “any discernable unit at which solid wastes have been placed at any time;”
- Three areas of concern (AOCs); and
- Three Other Areas (OAs).

The following is a summary of the 18 RCRA units in the South Yard Area from the December 2005 Work Plan (information obtained from EPI and Golder Associates, 2005b):

SWMU 2-104.71 (OA 16 - Central Drummed Waste Staging Area)

This TSD unit was built in 1981 and functioned as a Central Drummed Waste Staging Area at Building 2-104 (TSD Area 1). The aboveground closure of this TSD was completed in 1994, prior to the RFI. The aboveground closure did not include underlying soils or groundwater. Unit OA 16 has been designated as a unit containing residual subsurface soil or groundwater contamination from the closed TSD. SWMU 2-104.71 is considered a closed RCRA unit and has since been removed from further consideration in the CMS.

SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area)

This area, a deactivated waste oil and coolant holding area, is located within the South Yard Area reclamation yard. In 1993, the sump and aboveground portions of the unit were demolished and removed.

Between 1989 and 1995, soil samples were collected from 40 locations. Chlorinated solvents and their degradation compounds were detected in several locations at concentrations requiring further consideration including tetrachloroethene (PCE), trichloroethene (TCE), dichloroethenes, and vinyl chloride, PCBs, TPHs, arsenic, nickel, and bis(2-ethylhexyl)phthalate (BEHP). Groundwater samples from seven wells were analyzed. Chlorinated solvents, benzene, toluene, and dissolved copper were detected at concentrations requiring further consideration.

SWMU 78.B (Oil/Water Separator at Building 2-87)

This unit was an oil/water separator, located on the south side of Building 2-87. During investigations at this unit, low levels of PCBs were detected in the soil at 10 feet bgs. This contaminated soil was removed and replaced. The soil at SWMU 78.B and the vadose-zone soils at this unit was previously granted a "No Further Action" (NFA) status from the EPA, which will be reviewed prior to the development of the applicable workplan for future data gap investigations.

AOC 2-84.62 (Machine Pits)

This unit consists of two machine pits. These machine pits began operation in the 1940s, but has since been decommissioned. This unit is located in the central portion of where Building 2-83 now stands, used for collecting oil and metal shaving debris from the associated machinery. An excavation was completed in June, 2000, to remove lead, zinc, and PCB-impacted soils. The EPA previously granted a NFA status for this unit, which will be reviewed prior to development of the applicable workplan for future data gap investigations.

OA-3 (Former UST PL-23)

This unit was a 1,000-gallon gasoline UST, located beneath the roadway south of Building 2-80. This UST, along with 5 cubic yards of soil, was removed in 1992. An additional 80 cubic yards of soil was excavated in 1998, after Building 2-80 was demolished, and soil samples were analyzed. The EPA previously granted a NFA status for soils and vadose-zone soils, which will be reviewed prior to development of the applicable workplan for future data gap investigations.

SWMU 79.A (Cisterns 1, 2, and 3)

This unit consists of three cisterns located along the eastern boundary of the South Yard Area, near Building 2-89. These cisterns were used to dispose of process wastes from various operations until 1955, and were decommissioned in 1986. Soils were excavated and samples were analyzed during the decommissioning. The samples contained metals, PCBs, and SVOCs in vadose-zone soil at depths from

6 to 11 feet bgs. In 1999, an additional approximately 900 cubic yards of soil, which could have potentially contacted groundwater, was excavated. Confirmatory sample analysis revealed COCs were present in the remaining soil where the excavation had been terminated at existing railroad tracks and aboveground structures where the impacted soils could not be removed. Groundwater samples were collected from wells surrounding the cistern. Vinyl chloride, TCE, and arsenic were detected at concentrations requiring further consideration.

SWMU 79.B (Cistern 4)

This unit is located along the eastern boundary of the South Yard Area, at the northeastern corner of Building 2-87, north of SWMU 79.A. This cistern was used until 1955 and was decommissioned in 1986. Approximately 540 cubic yards of soil was excavated during two excavation events. Soil samples were collected for analysis. Heavy metals and PCBs were detected at concentrations that required further consideration. Soils that could potentially contact groundwater were excavated to a depth of 10 to 11 feet bgs. Confirmatory soil samples met the Interim Measure (IM) objective. Groundwater samples, collected from 13 wells, detected various COCs including 1,1-dichloroethene (DCE), 1,2-DCE, cis-1,2-dichloroethene (cDCE), TCE, PCE, vinyl chloride, BEHP, Aroclor 1254, arsenic, chromium, copper, and lead.

SWMU 79.C (Cistern 5)

This unit was located along the southeast fence line, north of Building 2-83. This cistern, along with the surrounding soil, was removed in 1955. In 1988 and 1992, soil and groundwater samples were collected for analysis. Soil samples revealed BEHP and copper at concentrations requiring further consideration. No constituents were detected in the groundwater at concentrations requiring further consideration.

SWMU 2-87.65 (Machine Pit)

This unit is a reinforced concrete trench located at the south wall of Building 2-109. The trench was used to collect coolant, lubricants, and hydraulic oils dripping from the associated machinery. Soil samples collected during the RFI contained TPHs and PCBs at concentrations requiring further consideration. The unit was removed in May, 1999. During the removal, approximately 220 cubic yards of impacted soil was excavated, and confirmatory soil samples were collected for analysis. PCBs were detected at levels requiring further consideration.

OA16

This unit consists of soil and groundwater associated with the aboveground TSD at SWMU 2-104.71 (Central Drummed Waste Staging Area). Soils were sampled and metals were detected during the closure of SWMU 2-104.71. In 1999, confirmatory soil samples were collected for analysis and approximately 80 cubic yards of soil was removed that may have contained cadmium, chromium, copper, mercury, and BEHP. Bis(2-ethylhexyl)phthalate was detected in one sample, but not at sufficiently elevated levels to require further consideration.

SWMU 2-78.1 (Oil/Water Separator)

This unit is located in the middle of the southern boundary of the South Yard Area. The oil/water separator collects stormwater runoff to remove oil. The stormwater is then discharged to the King County Metro (Metro) stormwater system. This oil/water separator is currently in operation. Soil samples were collected for analysis. Petroleum hydrocarbons were not detected; therefore, groundwater sampling was not required per the RFI protocols. A NFA decision has been requested from EPA, but the EPA has requested groundwater and soil be discussed further.

SWMU 78.5 (Oil/Water Separator)

This unit is located southwest of Building 2-60, next to Building 2-85. The oil/water separator collects stormwater runoff to remove oil. The stormwater is then discharged to the Metro sanitary sewer. Soil samples were collected for analysis and no constituent was detected at concentrations requiring further consideration at the time. A NFA decision has been requested from EPA, but the EPA has requested groundwater and soil be discussed further.

SWMU 2-80.56 (Sink Sump)

This unit is located in Building 2-80, near Column DJ-28. Washing liquids from this location were drained into the sump and discharged to the Metro wastewater treatment plant. This sink sump was disconnected in 1993 and removed in 1998. Soils were excavated and samples were collected for analysis. Arsenic, copper, mercury, selenium, and silver were detected at concentrations requiring further analysis. Groundwater samples were collected for analysis. Dissolved arsenic and dissolved nickel were detected at concentrations requiring further consideration.

SWMU 2-80.57 (Generator Sump)

This unit, located in Building 2-80, consists of an above-grade, concrete containment structure. The generator sump was decommissioned in 1993. Soil samples collected near the sump were analyzed and found to contain silver. Groundwater samples have been collected for analysis. Benzene, dissolved arsenic, and dissolved copper were detected above concentrations requiring further consideration. An NFA decision has been requested from EPA, but the EPA has requested groundwater and soil be discussed further.

SWMU 2-89.68 (Reclamation Yard)

This unit, located in the southeastern corner of the South Yard Area, was a reclamation yard from 1942 to 1996 and consisted of approximately 8 acres of concrete pavement. This reclamation yard contains several SWMUs and an OA:

- SWMU 2-91.70 – Located at the northwestern boundary of SWMU 2-89.68.
- SWMU 2-78.1 – Located in the northwestern area of SWMU 2-89.68 in the middle of the southern boundary of the South Yard Area.
- OA 16 – Located on the northern boundary of SWMU 2-89.68.
- SWMU 78.B – Located adjacent to OA 16.
- SWMU 79.A – Located upgradient, along the eastern edge of SWMU 2-89.68.

Soil samples were collected from 39 soil borings and test pits from 1991 to 1994 (locations include areas on the Jorgensen Forge property to the south). Chemicals were detected in soils at concentrations requiring further consideration including vinyl chloride, various SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)-anthracene, indeno(1,2,3-cd)pyrene, and BEHP), PCBs (Aroclors 1254 and 1260), and TPHs. Groundwater had concentrations of BEHP and metals (copper and dissolved nickel) that required further consideration.

AOC 2-80.58 (Deactivated Sump)

This area consisted of two furnaces used to heat metal parts, two metal quench tanks, and a rack used to hold the metal parts. The tanks and furnaces were located in concrete pits used as secondary containment. The unit was decommissioned before the Administrative Order of Consent was effective in 1994, and has since been removed.

Two soil samples were collected adjacent to the unit and analyzed for PCBs, TPHs, and metals; results revealed Aroclor 1260 and selenium. A NFA has been requested from the EPA, but the EPA has requested groundwater and soil be discussed further in the CMS.

AOC 2-86.63 (Wet Paint Booth)

This unit, located in the northeast corner of Building 2-86, was a 1,800-gallon-capacity steel aboveground storage tank (AST). In 1992, the tank was removed and the unit was converted to a dry paint booth.

Soil samples were collected from two soil borings. No VOCs, SVOCs, or TPHs were detected. However, at 7 feet bgs, mercury was detected at a concentration requiring further consideration. No VOCs and TPHs were detected in groundwater samples, but dissolved arsenic and copper were detected at concentrations requiring further consideration. A NFA was requested, but the EPA has requested groundwater and soil to be further discussed.

OA 10 (Former UST PL-23)

OA 10, located between buildings 2-68 and 2-80, was the location of a former 2,000-gallon UST (PL-23). This UST was primarily used for kerosene storage. In 1986, this UST along with approximately 10 cubic yards of TPH-impacted soil was removed.

Soil samples were collected from seven soil borings near the former UST. Diesel-range petroleum hydrocarbons (DRPH) and TPH-gasoline were detected in three soil samples. No TPH was detected in the four groundwater samples collected. A NFA decision was requested from the EPA, but the EPA has requested that groundwater and soil at OA 10 be further evaluated in the CMS.

Portions of two RCRA units, which were each TSD facilities within the South Yard Area, have been partially closed (EPI and Golder Associates, 2005b). These were aboveground TSD structures and did not include closure or resolution of subsurface groundwater and soil issues. The two units are:

- SWMU 2-104.71 (Central Drummed Waste Staging Area) – Refers to the aboveground structures and has been partially closed. OA 16 was designated as a RCRA “Other Area” and includes any residual subsurface soil or groundwater contamination associated with SWMU 2-104.71.
- SWMU 2-91.70 (Deactivated Waste Oil and Coolant Holding Area) – Refers to the aboveground TSD structures and subsurface groundwater and soil. The aboveground portion of this unit has been closed. Groundwater and soil are being further evaluated.

A NFA was approved by the EPA for vadose-zone soils in three RCRA units (EPI and Golder Associates, 2005b). The EPA previously granted the NFA status which will be reviewed prior to development of applicable workplan for future data gap investigations. Groundwater associated with these units will be further evaluated. These units are:

- SWMU 78.B (Oil/Water Separator);

- AOC 2-84.62 (Machine Pit); and
- OA 3 (former UST PL-23).

Sections of the South Yard Area have been redeveloped and IMs have been conducted at six RCRA units, as part of that redevelopment to facilitate the construction of new buildings (EPI and Golder Associates, 2005b). These IMs focused solely on soil cleanup. The IMs are:

- SWMU 79.A (Cisterns 1, 2, and 3);
- SWMU 79.B (Cistern 4);
- SWMU 79.C (Cistern 5);
- SWMU 2-87.65 (Machine Pit); and
- OA 16.

South Yard Data Gap Investigation Report Summary

The following points summarize the Data Gap Investigation Report conducted by Boeing (EPI and Golder Associates, 2006d). (Note: The EPA has commented on this report and Boeing has submitted their responses. The final report has not yet been accepted by the EPA.)

Physical Conceptual Site Model for the South Yard Area: Some hydrogeologic data gaps were identified in the Work Plan. As a result of the data gap investigation, sufficient data exist to provide a general sense of groundwater elevations and groundwater flow direction along the border between Plant 2 and Jorgensen Forge. There is not enough tightly-spaced water level data to determine flow volumes or exact flow directions across the property line. A more focused water-level data gathering effort would need to be performed to obtain such information. Boeing intends to pursue a joint hydrologic investigation with Jorgensen Forge to provide the additional data needed for this evaluation.

Current Data: The lack of current groundwater data was identified as a data gap in the Work Plan. With the completion of the fieldwork, sufficient current groundwater data was obtained for further evaluation of groundwater COCs, and subsequent remedy selection in the CMS.

Source Control: Data gaps related to the potential presence of new sources in the soil were identified in the Work Plan. With the completion of fieldwork summarized in the Data Gap Investigation Report, sufficient current soil data were obtained to evaluate this data gap, and no new sources have been identified.

Completed Pathways: Data gaps related to contaminant transport via the soil to groundwater pathway were identified in the Work Plan. With the completion of the fieldwork summarized in the Data Gap Investigation Report, sufficient data have been obtained to evaluate this data gap.

Background Data: This data gap has been filled with the use of the natural background concentrations for metals established for the Puget Sound Basin in the evaluation of soil results, and the use of EPA-accepted site-specific background values for arsenic, copper, and manganese in groundwater.

Exceedance of Screening Levels by Analytical Reporting Limits: Data gaps related to reporting limits, and exceeding screening levels, were identified in the Work Plan. With the completion of the fieldwork,

sufficient data was obtained to evaluate this data gap. The following conditions were noted in the report, with respect to reporting limit issues:

- Benzo(a)anthracene and chrysene reporting limits in soil are slightly above the screening levels for EPA Method 8270C analyses. However, all samples analyzed by EPA Method 8270C were also analyzed by EPA Method 8270C Selected Ion Monitoring; the reporting limits associated with the second method were below the screening levels for these two constituents.
- Silver reporting limits (0.4 mg/kg) in soil slightly exceeded the screening level (0.323 mg/kg) in approximately 40 percent of the data gap soil samples. The slightly elevated reporting limits were due to the variance in the percent solids in the samples analyzed, which impacted the corresponding reporting limits.
- Thallium was not detected in any data gap soil samples; however, the reporting limits in soil were greater than the screening levels. The analytical laboratory inadvertently analyzed thallium by EPA Method 6010, instead of EPA Method 200.8, as required by the Work Plan. Procedures for preliminary data review have been implemented by Boeing to provide earlier recognition of such situations and ensure there are no reoccurrences.

Data collected as part of the South Yard Area Data Gap Investigation will be evaluated, interpreted, and applied to future remedy selection in the CMS Volume IIIc Report. The Volume IIIc Report will also evaluate comparisons of current and historical areas of COC impacts above screening levels (EPI and Golder Associates, 2006d).

Groundwater Analysis

For the Data Gap Investigation, groundwater samples were collected and chemical analysis conducted for priority pollutant metals plus manganese and hexavalent chromium (chromium VI). Six inorganics (all metals) are included in the original South Yard Area area-specific groundwater COC list. In addition to the six original area-specific metal COCs, two additional inorganic constituents (mercury and zinc) were detected above their respective screening levels in dissolved (filtered) samples (EPI and Golder Associates, 2006d).

The following is a summary of the eight inorganic COCs in the South Yard Area (EPI and Golder Associates, 2006d). A total of 45 samples were analyzed for each constituent (see Table 1 for a summary of groundwater analytical data and Figure 7 for sample locations):

- *Arsenic*: Of the 45 samples analyzed for arsenic, 40 had detections above the arsenic screening level (0.2 micrograms per liter [$\mu\text{g/L}$]). The screening level for arsenic in groundwater was adjusted to a background concentration (8.0 $\mu\text{g/L}$) in Plant 2. Twenty-two of the 45 data gap investigations were above the background-adjusted arsenic screening level (8.0 $\mu\text{g/L}$). Arsenic was detected at concentrations ranging from 0.2 $\mu\text{g/L}$ to 99.8 $\mu\text{g/L}$. High arsenic concentrations at a facility are generally related to areas of reducing geochemical conditions.
- *Copper*: Analytical results indicated copper was not detected above its screening level (3.1 $\mu\text{g/L}$) in any of the dissolved (filtered) samples. However, copper was detected above its screening level in the total (unfiltered) groundwater samples from three wells (PL2-115A, PL2-117A, and PL2-153A). The screening level for copper in groundwater was adjusted to background concentrations (8.0 $\mu\text{g/L}$). Data gap investigation results for copper in groundwater ranged from 0.5 $\mu\text{g/L}$ to 1.2 $\mu\text{g/L}$; total copper results ranged from 0.5 $\mu\text{g/L}$ to 52.4 $\mu\text{g/L}$.

- *Lead*: Analytical results indicated lead was not detected above in any of the dissolved (filtered) samples. Lead from well PL2-117A was above 12 µg/L in the total (unfiltered) sample; however, the sample had a turbidity value of 158 nephelometric turbidity units (NTU) and was likely a false positive for lead, caused by particulate matter suspended in the sample. Dissolved lead ranged from 1.0 µg/L to 5.0 µg/L; total lead ranged from 1.0 µg/L to 12.0 µg/L.
- *Manganese*: Forty-four samples had detections above the manganese screening level (100 µg/L). Approximately one third of the detected concentrations of manganese were greater than 2,000 µg/L. Analytical results ranged from 90 µg/L to 6,930 µg/L. Total manganese results ranged from 96 µg/L to 4,850 µg/L.
- *Nickel (soluble salts)*: There were no detections above nickel's screening level (8.2 µg/L) in any of the dissolved (filtered) samples. Dissolved nickel analytical results ranged from 0.5 µg/L to 7.0 µg/L. Total nickel results ranged from 1.0 µg/L to 27.2 µg/L (EPI and Golder Associates, 2006d).
- *Selenium*: Analytical results indicate that selenium was not detected above its screening level in any of the dissolved (filtered) samples. Three of the non-detect samples (from wells PL2-106C, PL2-110C, and PL2-155C) were at a reporting limit to 100 µg/L. There were also no detections of total selenium; however, two of the non-detects (in wells PL2-155C and PL2-106C) were at a reporting limit of 100 µg/L. The elevated reporting limits noted in samples from C-level wells were reported to be caused by the saline groundwater, which is found at depths greater than 60 feet bgs (EPI and Golder Associates, 2006d).
- *Mercury*: Dissolved mercury was detected above the mercury screening level (0.025 µg/L) for the protection of surface water in one well, PL2-154a, at a concentration of 0.0604 µg/L. No mercury detections were above the mercury screening level for the protection of indoor air (184 µg/L; EPI and Golder Associates, 2006d).
- *Zinc*: Dissolved zinc was detected above its screening level (81 µg/L) in two locations (PL2-602B and PL2-603B). Three total zinc samples indicated a result above 81 µg/L. Results for dissolved zinc in groundwater ranged from non-detect (6.0 µg/L) to 717 µg/L. Total zinc results ranged from 6.0 µg/L to 953 µg/L (EPI and Golder Associates, 2006d).

Semivolatile Constituents and Polychlorinated Biphenyls

Two semivolatile constituents (2,4-dimethylphenol and BEHP) and one PCB (Aroclor 1254) were originally identified as area-specific COCs in groundwater in the South Yard Area; five additional SVOC constituents were detected in samples collected during the Data Gap Investigation (EPI and Golder Associates, 2006d). None of the five additional samples were detected above their applicable screening level. The results found:

- *2,4-dimethylphenol*: No samples above its screening level were detected in 23 sample locations. Analytical results for 2,4-dimethylphenol in groundwater ranged from non-detect (1.0 µg/L) to 97 µg/L.
- *BEHP*: No samples above its screening level were detected at 23 sample locations. All results were non-detect at a limit of 1.0 µg/L.
- *Aroclor 1254*: No detections were observed at 28 sample locations.

Semivolatile Organic Compounds

The seven SVOCs detected in the original South Yard Area area-specific groundwater samples include benzene, 1,1-DCE, cDCE, PCE, 1,1,2-trichloroethane, TCE, and vinyl chloride (EPI and Golder Associates, 2006d). The results found:

- *Benzene*: Two of the 45 samples had detections above its screening level (4.48 µg/L). Both samples were from the A-level of the aquifer adjacent to SWMU 2-78.1 (Oil/Water Separator) and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Results ranged from non-detect (0.2 µg/L) to 5.7 µg/L.
- *1,1-Dichloroethene*: There were detections above its screening level (0.382 µg/L) in three of the 45 samples. All three samples were collected from the A-level of the aquifer. The detections are concentrated at SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area) and SWMU 78.5 (Oil/Water Separator). Results ranged from non-detect (0.2 µg/L) to 1.9 µg/L.
- *cis-1,2-Dichloroethene*: There were no detections above its screening level (1,130 µg/L) in the 45 samples, but 24 non-detects were observed in the A-level aquifer. Non-detect results ranged from 0.2 µg/L to 83 µg/L.
- *PCE*: Two of the 45 samples had detections in the A-level aquifer above its screening level (0.822 µg/L). Results ranged from non-detect (0.2 µg/L) to 0.8 µg/L.
- *1,1,2-Trichloroethane*: There were no detections from the 45 sample locations. Results ranged within the non-detect limits (0.2 µg/L to 1.0 µg/L).
- *TCE*: Thirteen of the 45 samples had detections above the surface water screening level (0.302 µg/L), and one detection was above the air screening level (110 µg/L). All but one of the detections were from samples collected from the A-level of the aquifer, and are associated with SWMU 79, SWMU 2-89-68 (Reclamation Yard), and SWMU 2-91-70 (Deactivated Waste Oil and Coolant Storage Area). Results ranged from non-detect (0.2 µg/L) to 110 µg/L.
- *Vinyl chloride*: Twenty-four of the 45 samples had detections above the surface water screening level (0.731 µg/L). All 24 samples were located in the A- and B-levels of the aquifer, which correspond to likely sources in SWMU 79 and SWMU 2-89-68 (Reclamation Yard). There were no detections above the air screening level (371 µg/L). Results ranged from non-detect (0.2 µg/L) to 31 µg/L.

Petroleum Hydrocarbons

Petroleum hydrocarbons were not originally part of the South Yard Area area-specific COC list for groundwater, but samples were collected and analyzed for petroleum hydrocarbons to support soil data gap investigations. Samples were analyzed for gasoline-range petroleum hydrocarbons (GRPH) and DRPHs. Two petroleum hydrocarbon ranges were detected in the samples above their screening level (500 µg/L): DRPHs and motor oil-range petroleum hydrocarbons (MoRPHs). These were also added to the area-specific groundwater COC list for the South Yard Area. Results for DRPH ranged from non-detect (at 250 µg/L) to 8,900 µg/L. Results for GRPH were all non-detect (at 250 µg/L). The MoRPH ranged from non-detect (at 250 µg/L) to 1,300 µg/L (EPI and Golder Associates, 2006d).

Groundwater Hydrogeologic Results

It appears that the generalized direction of groundwater flow along most of the border between Plant 2 and the Jorgensen Forge property is approximately parallel to the border or slightly toward the Jorgensen Forge property (Figure 8).

Soil Analysis

Soil data gaps were evaluated on a RCRA unit-by-unit basis, as opposed to an area-wide basis used to evaluate groundwater. The following is a summary of the soil COCs in the South Yard Area (also see Table 2 for a summary of soil analytical data and Figure 7 for sample locations; EPI and Golder Associates, 2006d).

Inorganics – The following 11 metals are COCs in soil for the South Yard Area (taken from EPI and Golder Associates, 2006d):

- **Arsenic:** Four of the 45 samples had detections of arsenic above reporting limits. One of the four samples, collected from 50 feet bgs, had a concentration (8 mg/kg) greater than its screening level (7.3 mg/kg). The maximum concentration of arsenic (12 mg/kg) was detected in a sample collected from DP-SY-08, near the western end of Building 2-83 at 5 feet bgs. This maximum concentration value does not exceed the direct contact exposure pathway screening level (33.3 mg/kg).
- **Cadmium:** Cadmium was detected above reporting limits in eight of the 45 soil samples. Concentrations ranged from 0.2 mg/kg to 4.3 mg/kg. Only one of the eight detected concentrations (4.3 mg/kg) was above its screening level protective of surface water (1.21 mg/kg) and was present in a sample collected at 1 foot bgs, from DP-SY-06, near the western end of Building 2-83. The maximum concentration (4.3 mg/kg) of cadmium in soil was below both the overall maximum concentration of cadmium in the South Yard Area soil (3,700 mg/kg) and the direct contact exposure pathway screening level (667 mg/kg).

Addressing cadmium via the surface water pathway consisted of evaluating whether groundwater had been impacted by cadmium in soils at SWMU 79.A (cisterns 1, 2, 3), SWMU 79.B (Cistern 4), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Cadmium was not detected in groundwater from the existing monitoring wells or from the new direct-push sampling locations associated with SWMU 79.A and SWMU 79.B. Cadmium was also not detected in groundwater samples from any of the five locations associated with SWMU 2-91.70.

- **Chromium VI:** There were no detections above its screening level in any of the 15 soil samples collected from five locations. Addressing chromium VI via the surface water pathway consisted of determining whether groundwater had been impacted by chromium VI in soils at SWMU 79.B (Cistern 4). Chromium VI was detected at 12 µg/L in a sample associated with SWMU 79.B, but was not detected in samples collected adjacent to this RCRA unit. All concentrations detected were below its screening level of 19.2 mg/kg.
- **Copper:** Copper was detected in all 45 samples, although no concentrations exceeded the soil screening level (36.4 mg/kg). Concentrations ranged from 9 mg/kg to 32 mg/kg. The maximum concentration in soil was below both the overall maximum concentration of copper in the South Yard Area soil (830 mg/kg) and the direct contact exposure pathway screening level (49,300 mg/kg).

Addressing copper via the surface water pathway consisted of determining whether groundwater had been impacted by copper in soils at SWMU 79.B (Cistern 4), SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area), near AOC 2-86.63 (Wet Paint Booth), and at the west end of Building 2-83. Copper was detected in groundwater samples collected from locations associated with SWMU 79.B at 0.7 µg/L, and from SWMU 2-91.70 at 1.3 µg/L. Although copper was not detected in any of the groundwater samples collected by direct-push probes advanced at the west end of Building 2-83, it was detected (at 0.6 µg/L) in a sample that characterizes both the west end of Building 2-83 and AOC 2-86.63. All detected concentrations of copper were below the groundwater screening level protective of surface water (3.1 µg/L).

- *Manganese*: No information was provided for manganese in the Data Gap Investigation Report.
- *Mercury*: There were detections of mercury above reporting limits in nine of the 45 samples. Concentrations ranged from 0.04 mg/kg to 0.1 mg/kg. The maximum concentration (0.1 mg/kg) was detected in a sample collected near the western end of Building 2-83. This maximum concentration was below the direct contact exposure pathway screening level (41.9 mg/kg). Addressing mercury via the surface water pathway consisted of determining whether groundwater had been impacted by mercury in soils at SWMU 79.B (Cistern 4), SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area), near AOC 2-86.63 (Wet Paint Booth), and at the west end of Building 2-83. Mercury was detected (at 0.0604 µg/L) in groundwater from a sample associated with SWMU 79.B above the groundwater screening level protective of surface water (0.025 µg/L).
- *Nickel (Soluble Salts)*: There were no detections of nickel above reporting limits in any of the 45 soil samples. Concentrations ranged from 6 mg/kg to 30 mg/kg, none of which exceeded the soil screening level (47.8 mg/kg). In addition, all samples were below the direct contact exposure pathway screening level (26,700 mg/kg). Addressing nickel via the surface water pathway consisted of determining whether groundwater had been impacted by nickel in soils at SWMU 79.B (Cistern 4) and at SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Nickel was detected in all groundwater samples associated with these units. Concentrations were all below the groundwater screening level (8.2 µg/L), and ranged from 0.6 µg/L to 3.9 µg/L.
- *Silver*: Two detections of silver in the 45 samples were above reporting limits. These detections (7.1 mg/kg and 2.1 mg/kg) exceeded the soil screening level protective of surface water (0.323 mg/kg) and were both collected at 1 foot bgs. These concentrations were below the direct contact exposure pathway screening level (6,670 mg/kg). Addressing silver via the surface water pathway consisted of determining whether groundwater had been impacted by silver in soils at SWMU 79.B (Cistern 4), AOC 2-80.58 (Deactivated Sump), SWMU 2-89.68 (Reclamation Yard), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Silver was not detected above reporting limits in any of the groundwater samples collected.
- *Selenium*: There were no detections above reporting limits in any of the 45 soil samples. Addressing selenium via the surface water pathway consisted of determining whether groundwater had been impacted in soils at AOC 2-80.58 (Deactivated Sump), SWMU 2-80.56 (Sink Sump), 2-89.68 (Reclamation Yard), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). There were no detections above reporting limits in any of the groundwater samples.
- *Thallium (Soluble Salts)*: There were no detections above reporting limits in any of the 45 samples. Addressing thallium via the surface water pathway consisted of determining whether groundwater had been impacted by thallium in soils at AOC 2-80.58 (Deactivated Sump),

SWMU 2-89.68 (Reclamation Yard), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Thallium was not detected in any of the groundwater samples.

- **Zinc:** There were no detections of zinc above reporting limits in any of the 45 samples. All samples were below the soil screening level protective of surface water (101 mg/kg), and concentrations ranged from 17 mg/kg to 83.8 mg/kg. The highest detected concentration was below the direct contact exposure pathway screening level (400,000 mg/kg). Addressing zinc via the surface water pathway consisted of determining whether groundwater had been impacted by zinc in soils at SWMU 70.A (cisterns 1, 2, 3), SWMU 79.B (Cistern 4), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Zinc was detected in three samples associated with SWMU 79.A, two samples associated with SWMU 79.B, and one sample associated with SWMU 2-91.70. All detections were below the groundwater screening level protective of surface water (81 µg/L).

Semivolatile Organic Compounds and Polychlorinated Biphenyls

The COC list for soils includes total PCBs, three aroclors, and eight SVOCs, which are as follows: total PCBs, Aroclor 1260, benzo(b)fluoranthene, dibenz(a,h)anthracene, Aroclor 1016/1242, benzo(a)anthracene, benzo(k)fluoranthene, indeno(1, 2, 3-cd)pyrene, aroclor 1254, benzo(a)pyrene, chrysene, and BEHP (EPI and Golder Associates, 2006d). These are summarized below:

- **Carcinogenic PAHs:** Carcinogenic PAHs (cPAHs) were detected in 13 out of 33 soil samples, two of which had a concentration greater than their respective soil screening level protective of surface water. In addition, cPAHs were detected above the soil screening level protective of surface water in two samples collected in the central portion and west end of the SWMU 2-89.68 (Reclamation Yard). Benzo(b)fluoranthene, benzo(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, and chrysene were all detected above their respective screening levels in soil samples from 1 foot bgs. However, cPAHs were not detected in groundwater from the same location. All detected cPAH concentrations were below their respective direct contact exposure pathway screening levels.
- **BEHP:** BEHP was detected above reporting limits in one out of 33 soil samples. Concentrations of BEHP (at 100 micrograms per kilogram [µg/kg]) were detected in soil from 1 foot bgs, below the soil screening level protective of surface water (1,570 µg/kg). Furthermore, BEHP was not detected in deeper samples or from groundwater samples from this location. The maximum concentration was below the direct contact exposure pathway screening level (1,790,000 µg/kg). Addressing BEHP via the surface water pathway consisted of evaluating whether groundwater had been impacted by BEHP in soils at SWMU 79.A (cisterns 1, 2, 3), SWMU 89.68 (Reclamation Yard), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). BEHP was not detected above reporting limits in any groundwater samples.
- **PCBs:** PCBs were detected in eight of the 45 soil samples. Aroclor 1254 was detected in eight of the samples and Aroclor 1260 was detected in seven samples. Concentrations of PCBs ranged from 82 µg/kg to 540 µg/kg, all above the soil screening level protective of surface water (33 µg/kg). These concentrations were generally found in shallow soils in the areas adjacent to buildings 2-83 and 2-88. The maximum concentration detected was 540 µg/kg. Addressing PCBs via the surface water pathway consisted of evaluating whether groundwater had been impacted by PCBs in soils at SWMU 79.A (cisterns 1, 2, 3), SWMU 79.B (Cistern 4), and SWMU 2-89.68 (Reclamation Yard). PCBs were not detected in any groundwater samples.

Volatile Organic Compounds

The following 10 VOCs were COCs in soil for the South Yard Area (EPI and Golder Associates, 2006d):

- *Benzene*: There was one detection of benzene above reporting limits in the 45 soil samples. However, the detected concentration (12 µg/kg) was below the soil screening level protective of surface water (25.3 µg/kg), and below the direct contact exposure pathway screening level (1,360,000 µg/kg). Benzene was also detected in a groundwater sample (at 2 µg/L) from the same location, but below the groundwater screening level protective of surface water (4.48 µg/L). Addressing benzene via the surface water pathway consisted of evaluating whether groundwater had been impacted by benzene in soils at AOC 2-80.58 (Deactivated Sump), SWMU 78.5 (Oil/Water Separator), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Benzene was not detected in groundwater that was associated with AOC 2-80.58. Benzene was detected (at 0.3 µg/L) in groundwater associated with SWMU 78.5, but below the groundwater screening level protective of surface water. Benzene was detected in two samples (at 1.1 µg/L and 5.3 µg/L) associated with SWMU 2-91.70, and one of the sample concentrations exceeded the groundwater screening level protective of surface water.
- *Methylene Chloride*: This chemical was detected (at 5.7 µg/kg) in one of the 45 soil samples, below the soil screening level protective of surface water (828 µg/kg) and the direct contact exposure pathway screening level (9,940,000 µg/kg). Methylene chloride was not detected in groundwater at this location. Addressing methylene chloride via the surface water pathway consisted of evaluating whether groundwater had been impacted by soils at SWMU 2-89.68 (Reclamation Yard). There were no detections in groundwater samples associated with this unit.
- *TCE*: There were 17 detections of TCE in the 45 soil samples above reporting limits. Concentrations ranged from 1.2 µg/kg to 130 µg/kg. Ten of these detections exceeded the screening level protective of surface water (2.0 µg/kg). Addressing TCE via the surface water pathway consisted of verifying that groundwater had not been impacted by soils at SWMU 78.B (Oil/Water Separator), SWMU 78.5 (Machine Pit), SWMU 79.A (cisterns 1, 2, 3), SWMU 79.B (Cistern 4), SWMU 2-89.68 (Reclamation Yard), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). There were two detections in groundwater, at locations associated with SWMU 79.A, that exceeded the groundwater screening level protective of surface water (0.302 µg/L). There was one detection in groundwater, in a location associated with SWMU 79.B, that exceeded the groundwater screening level protective of surface water. Four groundwater samples, in locations associated with SWMU 2-89.68, exceeded the groundwater screening level protective of surface water. Three groundwater samples, in locations associated with SWMU 2-91.79, exceeded groundwater screening levels protective of surface water.
- *1,1-Dichloroethene*: There were no detections of 1,1-DCE above reporting limits in any of the 45 soil samples. Addressing 1,1-DCE via the surface water pathway consisted of evaluating whether groundwater had been impacted at SWMU 2-87.65 (Machine Pit), SWMU 2-89.8 (Reclamation Yard), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). There were two detections in the area associated with SWMU 2-89.68, but these detections were below the groundwater screening level protective of surface water (0.382 µg/L). There were three detections associated with SWMU 2-91.70 that were above the groundwater screening level protective of surface water.
- *PCE*: There were 11 detections of PCE in the 45 soil samples above reporting limits. Concentrations ranged from 1.7 µg/kg to 110 µg/kg. Three of these exceeded the screening level protective of surface water (8.72 µg/kg); all the samples were located in the southeast corner of

the South Yard Area. Addressing PCE via the surface water pathway consisted of evaluating whether groundwater had been impacted in soils at SWMU 2-89.68 (Reclamation Yard) and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). Furthermore, PCE was detected in one groundwater sample associated with SWMU 2-89.68, but this concentration was below the groundwater screening level protective of surface water (0.82 µg/L). There were also two detections (3.8 µg/L and 1.2 µg/L) adjacent to or downgradient from SWMU 2-91.70, above the groundwater screening level protective of surface water in groundwater.

- *Vinyl Chloride*: There were five detections of vinyl chloride, out of the 45 soil samples, above reporting limits. Concentrations ranged from 2.2 µg/kg to 11 µg/kg. Three of the five samples, collected at 10 feet bgs in the southeast corner of the South Yard Area, exceeded the screening level protective of surface water (4.59 µg/kg). Addressing vinyl chloride via the surface water pathway consisted of verifying that groundwater had not been impacted by vinyl chloride in soils at SWMU 79.A (Cisterns 1, 2, 3), SWMU 79.B (Cistern 4), SWMU 2-89.68 (Reclamation Yard), and SWMU 2-91.70 (Deactivated Waste Oil and Coolant Storage Area). There were four detections from SWMU 79.A, SWMU 79.B, and SWMU 2-89.68 that exceeded the groundwater screening level protective of surface water. Five samples from SWMU 2-91.70 had detections that exceeded the groundwater screening level protective of surface water.
- *Cis-1,2-Dichloroethene*: There were six detections in the 45 soil samples above reporting limits. Concentrations ranged from 2.0 µg/kg to 48 µg/kg, well below the screening level protective of surface water (7,725 µg/kg) and the direct contact exposure pathway screening level (7,990,000 µg/kg). Addressing cDCE consisted of evaluating the air pathway. The maximum concentration was below the proposed air pathway screening level (794 µg/kg).
- *Toluene*: Of the 45 soil samples collected, there were two detections below the soil screening level protective of surface water (109,000 µg/kg). There were no detections in the groundwater from these locations. Addressing data gaps for toluene via the surface water pathway consisted of verifying that groundwater had not been impacted by toluene in soils at AOC 2-80.58 (Deactivated Sump) and SWMU 78.5 (Oil/Water Separator). There were no detections in any of the groundwater samples associated with these units.
- *Ethylbenzene*: There were no detections of ethylbenzene in any of the 45 soil samples. Addressing ethylbenzene via the surface water pathway consisted of evaluating whether groundwater had been impacted by ethylbenzene in soils at AOC 2-80.58 (Deactivated Sump) and SWMU 78.5 (Oil/Water Separator). There were no detections of ethylbenzene in the groundwater samples.
- *1,1,1-Trichloroethane*: There was one detection of 1,1,1-trichloroethane in the 45 soil samples. This detection (at 1.2 µg/kg) was from soil collected west of SWMU 78.5 (Oil/Water Separator), and was well below the soil screening level protective of surface water (1,200,000 µg/kg). Addressing 1,1,1-trichloroethane in soil consisted of evaluating the air pathway. The maximum soil concentration was below the proposed air pathway screening level (27,000 µg/kg).

Petroleum Hydrocarbons

Analysis was conducted for GRPHs, DRPHs, and MoRPH. Of the three samples tested, all had detections of DRPHs, but none were reported at concentrations greater than the soil screening level. Concentrations ranged from 15 mg/kg to 34 mg/kg—well below the direct contact exposure pathway screening level (2,000 mg/kg). No GRPHs were detected in the three samples from the data gap investigation (EPI and Golder Associates, 2006d).

3.2.3.3 2-60s Area

The 2-60s Area, located north of the South Yard of Plant 2, consists of approximately 13 acres (Figure 5). This area is bordered by East Marginal Way South to the east; the South Yard Area to the south; the 2-66 Area to the west; and the 2-40s Area to the north. The 2-60s Area contains buildings 2-48, 2-51, 2-64, and part of Building 2-108. Demolition and decommissioning activities have resulted in slabs remaining at former buildings 2-61, 2-62, 2-63, and 2-65 (EPI and Golder Associates, 2005c).

No RCRA units have been closed within the 2-60s Area of Plant 2. One RCRA unit, SWMU 77.B (PCB Retention Tank), was previously granted a NFA status for soils from EPA, which will be reviewed prior to development of the applicable workplan for future data gap investigations (EPI and Golder Associates, 2005c).

Within the 2-60s Area, there are a total of 14 RCRA units including 10 SWMUs, 2 AOCs, and 2 OAs (see Table 9 for a Summary of the RCRA Units and Figure 9 for locations; EPI and Golder Associates, 2005c). The following is a summary of the RCRA units at the 2-60s Area (Information taken from EPI and Golder Associates, 2005c):

SWMU 77.B

This unit, located between buildings 2-63 and 2-65, included a retention tank, a concrete-bermed pad used to house transformers, and associated underground piping running from the pad to the retention tank and a 2,000-gallon steel UST (PL-47). The PCB-retention tank was removed in 1986. Soil samples were collected in this area for analysis. No COCs were detected in soil, at concentrations reported in the RFI, as requiring further consideration. No groundwater samples were collected. The EPA determined that NFA is required for vadose-zone soil. Groundwater was further evaluated in the CMS.

SWMU 78.C

This unit, located between buildings 2-64 and 2-65, includes an oil/water separator used to collect stormwater runoff and remove any mixed residual oils and other petroleum hydrocarbons that may have been deposited onto paved areas by motor vehicles and other incidental activities. The remaining stormwater from the separator is discharged to the Metro sanitary sewer. Soil samples were collected for analysis and no COCs were detected, at concentrations reported in the RFI, as requiring further consideration. A NFA was requested from EPA; however, the EPA requested that groundwater and soil be further evaluated during the CMS.

SWMU 2-63.47

This unit was a dilute chrome tank, located in Building 2-63, near column J-3. The tank was used to hold wastewater produced during the model-making processes. The tank was decommissioned and removed in the mid-1990s. Soil samples were collected for analysis. Nickel and mercury were both detected at concentrations requiring further analysis. High reporting limits were also associated with cyanide and arsenic. A NFA was requested from EPA; however, the EPA requested that groundwater and soil be further evaluated in the CMS.

SWMU 2-64.48

This unit, located between buildings 2-63 and 2-64 (also referred to as PL-51), consisted of a 1,000-gallon UST. The tank was initially installed in 1970 as an oil/water separator. The UST was removed before 1993, when soil samples were collected for analysis. Chrysene, Aroclor 1254, copper, and silver were all detected at concentrations requiring further consideration. Groundwater samples were not

collected for analysis because metal analyst concentrations were low and all elevated concentrations were limited to the upper soil horizon, indicating downward migration had not occurred. A NFA decision was requested from the EPA; however, EPA requested that groundwater and soil be further evaluated during the CMS.

SWMU 2-64.49

This unit consisted of an air compressor building sump and accumulation area in Building 2-64. Most of this system was decommissioned in 2003, although one air compressor remains in use. The condensate received by the trenches and sump is composed primarily of water, which is then transferred to a 1,000-gallon UST (SWMU 2-64.48) located outside the northeastern corner of the building. In 1993 and 1994, soil samples were collected for analysis. Arsenic and mercury were detected at concentrations requiring further consideration. In 1994, groundwater samples were collected for analysis. Dissolved arsenic, copper, and nickel were detected at concentrations requiring further consideration. A NFA was requested from EPA; however, the EPA requested groundwater and soil be further evaluated in the CMS.

SWMU 2-65.50

This unit was a machine pit, located at the north end of Building 2-65, near column BB-19. This machine pit remains in operation. In 1993, new machinery was installed, including a hydraulic oil tank, and soil samples were collected for analysis. Aroclor 1254 and PCBs were detected in a near surface sample from SB-06510, requiring further analysis during the CMS.

SWMU 2-62.43

This unit consisted of a tank line and a series of five tanks in an aboveground, concrete, secondary containment, located in Building 2-62, between columns G/J-11/12. The primary use of this tank was for pre-treating metal arts prior to painting. This unit has since been decommissioned. In 1993, soil samples were collected for analysis during demolition of Building 2-62. Benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and oil and grease-range TPH were all detected at concentrations requiring further considerations. A NFA decision was requested from EPA; however, the EPA requested that groundwater and soil be further evaluated during the CMS.

SWMU 2-70.55

This unit was located at the southeast corner of Building 2-70 and included a steam-cleaning area and 950-gallon UST (PL-50). The tank, secondary containment, and associated soil were removed in 1998. In 1993, 1994, and 1998, soil samples were collected for analysis. No VOCs, SVOCs, PCBs, or metals were detected at concentrations requiring further consideration. Groundwater samples were collected for analysis. Some metals were detected, but they were not considered a concern, since metals were not detected in soil samples at concentrations requiring further consideration. A NFA was requested from the EPA; however, the EPA requested that groundwater and soil be further evaluated during the CMS.

SWMU 77.4

This unit was located south of Building 2-62 and consisted of a 2,000-gallon PCB retention UST (PG-46). This tank was removed in 1986. Soils were collected for analysis. No constituents were detected in soil samples; consequently, groundwater samples were not required. A NFA decision was requested from the EPA; however, the EPA requested groundwater and soil be further evaluated during the CMS.

AOC 2-62.46 (formerly SPL-062-009)

This unit, formerly referred to as SPL-062-009, was a sump on the south side of Building 2-62. This sump was removed in 2003. An excavation was conducted and soil samples were collected for analysis. The following constituents were detected, at concentrations reported in the RFI, as requiring further considerations: BEHP, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, TPH, PCBs, cadmium, mercury, copper, and zinc. Groundwater and soil were further evaluated in the CMS.

AOC 2-62.45

This unit is located in the northern half of Building 2-62, and consisted of six wet paint booths and a sump used until 2003. All paint booths and the sump have since been removed. In 1993, soil samples were collected for analysis. Five SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene) were detected at concentrations requiring further analysis. Grease-range TPH was detected at concentrations requiring further consideration in soil excavated during the removal of an acrylic tank sump located by Paint Booth #3. From 1993 to 1996, groundwater samples were collected for analysis. Vinyl chloride, PCE, TCE, arsenic, and copper were all detected at concentrations requiring further consideration. A NFA was requested from EPA; however, the EPA has requested groundwater and soil be further evaluated during the CMS.

OA 9 (including SWMU 2-78.6)

This unit consists of three former 3,333-gallon USTs (PL-16, 17, and 18), located south of Building 2-44 and east of Building 2-51. This unit included oil/water separators that were removed in 1986. Impacted soil was also removed, while soil samples were collected for analysis. Volatile aromatic hydrocarbon constituents and TPH were detected in borings PL2-311A, PL2-310A, and SB-04412 at concentrations requiring further consideration. Groundwater samples were collected for analysis from 1993 to 1996. Benzene, ethylbenzene, and copper were all detected at concentrations requiring further consideration. Groundwater and soil were further evaluated during the CMS (EPI and Golder Associates, 2005c).

OA 12

The southern portion of Building 2-63 and the area between buildings 2-63 and 2-65 were designated as OA 12 after VOCs, metals, and TPH were detected in groundwater and soil samples under Building 2-63 during the preconstruction investigation in 1994. Metals, VOCs, SVOCs, PCBs, and TPH were all selected as potential COCs. In 1993, soil borings were collected for analysis. No VOCs, SVOCs, or PCBs were detected at concentrations requiring further analysis (EPI and Golder Associates, 2005c). Arsenic, TPH, cyanide, nickel, and copper were all detected at concentrations requiring further consideration. Groundwater samples were collected for analysis from 1993 to 1994. TCE, PCE, vinyl chloride, and copper were all detected at concentrations requiring further consideration (EPI and Golder Associates, 2005c).

Groundwater Analysis

In 2006, a data gap investigation was conducted, and monitoring wells and direct-push probes were installed. Three new monitoring wells, 26 existing monitoring wells, and 26 probe locations were sampled in 2006 to provide the current COC concentrations of the 2-60s Area. Soil samples were also collected for laboratory analysis and geologic logging, as described in the Volume IVb CMS Report (see Table 3 for a summary of groundwater analytical data and Figure 9 for sample locations; EPI and Golder Associates, 2006b).

No new site-wide COCs were added as a result of the 2-60s Area Data Gap Investigation; however, four existing site-wide COCs were added to the 2-60s Area area-specific COC list (EPI and Golder Associates, 2006b). They include:

- Aroclor 1260 (and by default, Total PCBs);
- BEHP;
- Mercury; and
- Zinc.

Seven inorganic constituents, consisting of six metals and cyanide, are included in the 2-60s Area area-specific groundwater COC list. Two area-specific COCs for the 2-60s Area were added as a result of the Area Data Gap Investigation (EPI and Golder Associates, 2006b). The area-specific inorganic COCs in groundwater for the 2-60s Area include:

- Arsenic;
- Copper;
- Cyanide;
- Manganese;
- Mercury (new COC);
- Nickel (soluble salts); and
- Zinc (new COC).

Aroclor 1260

The PCB, Aroclor 1260, was detected above its screening level (0.01 µg/L) in 4 of the 13 samples. There were two A-level areas and one B-level area where Aroclor 1260 concentrations were above the screening level. Aroclor 1260 was not analyzed for the C-level aquifer. In the A-level groundwater sample from 2-60-DP-15, concentrations of Aroclor 1260 ranged from non-detect to 0.073 µg/L (EPI and Golder Associates, 2006b).

Arsenic

During the 2-60s Area Data Gaps Investigation, arsenic was analyzed in groundwater samples in all 29 monitoring wells and 26 direct-push probes (18 samples from both the A- and B-levels of the aquifer) for a total of 73 groundwater sample locations. Arsenic was detected in 59 samples, and at concentrations above the arsenic screening level (0.2 µg/L) in 57 of those samples (EPI and Golder Associates, 2006b). Since the 2-60s Data Gap Investigation was performed, the arsenic screening level has been adjusted to a background level (8.0 µg/L), based on total (unfiltered) samples. Six dissolved arsenic sample results were at concentrations above this background-adjusted screening level. Only two total arsenic sample results (from PLS-604A and PL2-606A) with acceptable turbidity values (less than 5 NTU) were at concentrations above the background value (EPI and Golder Associates, 2006b).

Data gap investigation analytical results for dissolved arsenic in groundwater ranged from non-detect (0.2 µg/L) to 47.0 µg/L, with the highest concentration in a sample from probe 2-60-DP-21, located at Building 2-48 (EPI and Golder Associates, 2006b). Total arsenic results for the Data Gaps Investigation ranged from 0.3 µg/L to 34.7 µg/L, with the highest concentration noted in the sample from a new well (PL2-606A), located in OA-9 (former USTs PL-16, 17, and 18; EPI and Golder Associates, 2006b).

There are three areas of arsenic above the background adjusted screening level in the A-level of this aquifer. Dissolved arsenic was not detected above its background-adjusted screening level in the B- and C-levels of the aquifer (EPI and Golder Associates, 2006b).

BEHP

BEHP was analyzed from 12 direct-push probe locations in the A-level of the aquifer, and at eight probe locations in the B-level of the aquifer, for a total of 20 samples. BEHP was detected in three of the 20 samples, with two above its screening level (3.0 µg/L; EPI and Golder Associates, 2006b). There was one co-located in the A-level and B-level area of BEHP above its screening level, at direct-push probe 2-60-DP-16, although this chemical was not analyzed for in the C-level aquifer. BEHP concentrations ranged from non-detect to 3.4 µg/L in the A-level sample (EPI and Golder Associates, 2006b).

Copper

During the 2-60s Area Data Gaps Investigation, copper was analyzed in groundwater samples in all 29 monitoring wells and 26 direct-push probes (18 sampled from both the A- and B-levels of the aquifer), for a total of 73 groundwater sample locations. Copper was detected in 49 of the samples, with 22 samples above the screening level (3.1 µg/L; EPI and Golder Associates, 2006b). The screening level for copper was adjusted to background level (8.0 µg/L). Seven of the samples had dissolved copper concentrations above the background-adjusted screening level, and three samples had total copper concentrations above the background-adjusted screening level; however, the total copper sample from well PL2-327A had a turbidity of 17.1 NTU and, therefore, may be suspected and/or biased, due to the high turbidity (EPI and Golder Associates, 2006b).

There were three A-level areas of dissolved copper concentrations above the background-adjusted screening level. Dissolved copper was not detected above the background-adjusted screening levels in the B- or C-levels of the aquifer (EPI and Golder Associates, 2006b).

Data from the 2-60s Area Data Gap Investigation for dissolved copper in groundwater ranged from non-detect (0.5 µg/L) to 74.6 µg/L in an A-level sample from direct-push probe 2-60-DP-25. Total copper results ranged from non-detect (0.05 µg/L) to 52.4 µg/L in a sample from monitoring well PL2-117A; however, this total copper sample had a high turbidity of 158 NTU and is considered invalid by the 5 NTU or less turbidity criterion (EPI and Golder Associates, 2006b).

Cyanide

During the 2-60s Area Data Gaps Investigation, cyanide was analyzed in groundwater samples collected at 50 locations (18 monitoring wells, 19 A-level and 13 B-level direct-push probes). Total cyanide was detected in four of the samples above the screening level for the protection of surface water (5.0 µg/L; EPI and Golder Associates, 2006b). The four samples were from wells PL2-314A, PL2-326A, and PL2-327A, and from direct-push probe 2-60-DP-18 in the A-level sample (EPI and Golder Associates, 2006b).

There was one A-level area of total cyanide, at concentrations above the screening level (probe 2-60-DP-18). Total cyanide was not detected above the screening level in the B-level of the aquifer, and was not analyzed for in the C-level of the aquifer (EPI and Golder Associates, 2006b).

Data from the 2-60s Area Data Gap Investigation for total cyanide in groundwater ranged from non-detect (5.0 µg/L) to 64 µg/L in the A-level sample (direct-push probe 2-60-DP-18; EPI and Golder Associates, 2006b).

Manganese

During the 2-60s Area Data Gaps Investigation, manganese was analyzed in groundwater samples in all 29 monitoring wells and 26 direct-push probes (18 sampled from both the A- and B-levels of the aquifer), for a total of 73 groundwater sample locations. Manganese was detected in all samples, with 55 samples above the screening level (100 µg/L). The screening level was adjusted to the background level (2,000 µg/L). Three of the samples had dissolved manganese concentrations above the background-adjusted screening level, and one sample had a total manganese concentration above the background-adjusted screening level (EPI and Golder Associates, 2006b).

There was one A-level area of dissolved manganese concentrations above the background-adjusted screening level. Dissolved manganese was also detected above the background-adjusted screening level in a sample from location 2-60-DP-05 in the B-level of the aquifer. Dissolved manganese was not detected above the background-adjusted screening level in the C-level aquifer (EPI and Golder Associates, 2006b).

Data from the 2-60s Area Data Gap Investigation for dissolved manganese in groundwater ranged from 2.0 µg/L (PL2-325A) to 5,290 µg/L (PL2-606A; EPI and Golder Associates, 2006b).

Mercury

During the 2-60s Area Data Gaps Investigation, mercury was analyzed in groundwater samples from all 29 monitoring wells and 26 direct-push probes (18 sampled from both the A- and B-levels of the aquifer), for a total of 73 groundwater sample locations. The A-level sample from probe 2-60-DP-25 was the only groundwater sample with dissolved mercury above the screening level (0.025 µg/L). Data for dissolved mercury in groundwater ranged from non-detect to 0.106 µg/L in the A-level samples from probe 2-60-DP-25. Total mercury results were all non-detect at a reporting limit of 0.025 µg/L (EPI and Golder Associates, 2006b).

Nickel (Soluble Salts)

During the 2-60s Area Data Gaps Investigation, nickel was analyzed in groundwater samples in all 29 monitoring wells and 26 direct-push probes (18 sampled from both the A- and B-levels of the aquifer), for a total of 73 groundwater sample locations. Dissolved nickel was detected in 72 samples, with 6 samples above the screening level (8.2 µg/L). Total nickel was detected above the nickel screening level in one sample from well PL2-327A (EPI and Golder Associates, 2006b).

There were two A-level areas and one B-level area of dissolved nickel concentrations above the screening level. No detections were noted in the C-level of the aquifer. Data for dissolved nickel in groundwater ranged from non-detect to 37.8 µg/L in an A-level sample from 2-60-DP-06 (EPI and Golder Associates, 2006b). Total nickel ranged from non-detect to 8.3 µg/L in samples from well PL2-327A; however, this total nickel sample had a turbidity of 17.1 NTU and may be biased due to the high turbidity (EPI and Golder Associates, 2006b).

Zinc

During the 2-60s Area Data Gaps Investigation, zinc was analyzed in groundwater samples in all 29 monitoring wells and 26 direct-push probes (18 sampled from both the A- and B-levels of the aquifer), for

a total of 73 groundwater sample locations. Zinc was detected in 50 groundwater samples, with one sample (from direct-push probe 2-60-DP-06) above the screening level of 81 µg/L (EPI and Golder Associates, 2006b). Total zinc was not detected above the screening level.

One A-level area had a dissolved zinc concentration above the screening level. No concentrations were detected in the B- or C-levels of the aquifer. Dissolved zinc in the A-level sample from direct-push probe 2-60-DP-06 ranged from non-detect to 158 µg/L (EPI and Golder Associates, 2006b). Total zinc ranged from non-detect to 28 µg/L from PL2-316A; however, this total zinc sample had a turbidity of 9.5 NTU and, therefore, may be biased due to the high turbidity (EPI and Golder Associates, 2006b).

Volatile Organic Compounds

Seven VOCs were identified as area-specific COCs in groundwater for the 2-60s Area (EPI and Golder Associates, 2006b).

- *Benzene*: There were detections in 10 of the 73 samples. Four samples were above the screening level (4.48 µg/L). There was no detection above the screening level protective of indoor air (1,400 µg/L). There was one A-level area of benzene, and none in the B- and C-levels of the aquifer. Benzene concentrations ranged from non-detect at 0.2 µg/L to 110 µg/L.
- *1,1-Dichloroethene*: There were four detections out of the 73 samples, none of which were above the screening level (0.382 µg/L) or the screening level protective of indoor air (42.3 µg/L). Concentrations ranged from non-detect (0.2 µg/L) to 100 µg/L.
- *Ethylbenzene*: There were four detections out of the 73 samples, none of which were above the screening level (2,100 µg/L) or above the screening level protective of indoor air of 9,500 µg/L. Concentrations ranged from non-detect (0.2 µg/L) to 900 µg/L.
- *Methylene Chloride*: There were no detections in the 73 samples, and all concentrations were below the non-detect value (0.2 µg/L), well below the screening level (190 µg/L).
- *PCE*: There were 11 detections from the 73 samples, 8 of which were above the screening level (0.822 µg/L), but below the screening level protective of indoor air (1,520 µg/L). Concentrations ranged from non-detect (0.2 µg/L) to 15 µg/L.
- *TCE*: There were 32 detections from the 73 samples, 28 of which were above the screening level for the protection of surface water (0.302 µg/L). There were also detections above the screening level (62 µg/L) protective for indoor air at one location. Concentrations ranged from 0.2 µg/L to 250 µg/L.
- *Vinyl Chloride*: There were 28 detections from the 73 samples, 13 of which were above the screening level (0.731 µg/L) protective of surface water. Concentrations ranged from non-detect (0.2 µg/L) to 15 µg/L.

There were 22 additional VOCs that were detected in groundwater samples collected during the 2-60s Area Data Gap Investigation. None of these VOCs were detected at concentrations above respective screening levels; therefore, no new COCs for the VOC constituent group were added to the 2-60s Area area-specific COC list, or to the site-wide COC list (EPI and Golder Associates, 2006b).

Petroleum Hydrocarbons

Groundwater samples were collected and analyzed for GRPH and DRPH. Both constituents were detected in groundwater samples, at concentrations above their screening levels (500 µg/L and 800 µg/L, respectively; EPI and Golder Associates, 2006b).

Soil Analysis

Soils were evaluated on a unit-by-unit basis, as opposed to an area-wide basis (see Table 4 for a summary of soil analytical data and Figure 9 for sample locations; EPI and Golder Associates, 2006b). The following seven metals and cyanide were COCs in soil:

- *Arsenic*: Of the 87 soil samples collected, three samples were above reporting limits; however they did not exceed screening levels. Addressing data gaps for arsenic in soil consisted of verifying arsenic concentrations in the area, located between the south end of buildings 2-63 and 2-65, where the historic maximum concentration of arsenic (76 mg/kg) was detected. In the Data Gap Investigation, a maximum concentration of arsenic (10 mg/kg) was detected in three samples collected near the northern end of the Building 2-63 slab, at 5 feet bgs; near the middle of the Building 2-63 slab, at 1-foot bgs; and near the former sump (AOC 262.46). These samples did not exceed the direct contact exposure pathway screening level (33.3 mg/kg).
- *Cadmium*: Of the 87 soil samples collected, three samples were above reporting limits. Concentrations ranged from 0.4 mg/kg to 0.6 mg/kg; but below the soil screening level protective of surface water (1.21 mg/kg). Cadmium was not detected above reporting limits in groundwater (and, therefore, below groundwater screening levels).
- *Copper*: All 87 soil samples had detections of copper, but none exceeded the soil screening level (36.4 mg/kg). Concentrations ranged from 8.4 mg/kg to 29.1 mg/kg. Addressing copper via the surface water pathway consisted of determining whether groundwater was impacted by copper in soils at AOC 2-62.46, and assessing the extent of copper in soil at the southeast corner of the Building 2-65 slab. None of the locations with copper detections were associated with AOC 2-62.46. Concentrations of dissolved copper at these locations ranged from 1.6 to 5 µg/L.
- *Cyanide*: Of the 87 soil samples collected, three samples were above reporting limits and the soil screening level protective of surface water (0.202 mg/kg). Concentrations ranged from 0.24 mg/kg to 0.56 mg/kg. Addressing cyanide in soil consisted of determining concentrations at AOC 2-62.46 and at the southwest corner of the Building 2-65 slab. There were no detections from these areas. Addressing cyanide via the surface water pathway also consisted of determining whether groundwater had been impacted by cyanide in soils at AOC 2-62.46, at the southwest corner of the Building 2-65 slab, down gradient of OA 12, in the vicinity of SWMU 2-63.47, and between the slabs of buildings 2-63 and 2-65. Total cyanide was detected in four samples above the screening level (5.0 µg/L) for the protection of surface water; these were all from A-level aquifer samples.
- *Mercury*: Of the 87 soil samples collected, nine samples were above reporting limits, with two samples exceeding the screening level (0.07 mg/kg). Concentrations ranged from 0.04 mg/kg to 0.11 mg/kg. Addressing mercury in soil consisted of determining concentrations at SWMU 2-63.47, AOC 2-62.46, and UST PL-37. Mercury was detected in two samples in the vicinity of SWMU 2-63.47, none of which exceeded the screening level. In the vicinity of AOC 2-62.46, one sample was observed 5 feet bgs, slightly exceeding its screening level (0.07 mg/kg). Near UST PL-37, one detection, at 10.5 feet bgs, was below the screening level.

- *Silver*: Of the 87 soil samples collected, there were six detections, five of which exceeded the soil screening level protective of surface water (0.323 mg/kg). Concentrations ranged from 0.9 mg/kg to 5.3 mg/kg. Addressing silver in soil consisted of determining concentrations at AOC 2-62.46 and in the area between the south end of the slabs for buildings 2-63 and 2-65. There were no detections of silver in these areas. Silver was not detected above the screening level in any of the groundwater samples.
- *Thallium (Soluble Salts)*: Of the 87 soil samples collected, there were 14 detections; however, none exceeded the screening level (0.669 mg/kg). Addressing thallium, via the surface water pathway, consisted of determining whether groundwater had been impacted by thallium in soils. Thallium was not detected above the reporting limit (0.2 µg/L) in any of the associated groundwater samples.
- *Zinc*: All 87 soil samples had detections of zinc above reporting limits, but they were all below the soil screening level protective of surface water (101 mg/kg). Concentrations ranged from 12 mg/kg to 94.9 mg/kg. Addressing zinc in soils consisted of determining the concentrations at AOC 2-62.46. There were no detections of zinc in all sampled depths in this area. Addressing zinc via the surface water pathway also consisted of determining whether groundwater had been impacted by zinc in soils at AOC 2-62.46. Dissolved zinc was detected (158 µg/L) in groundwater from one location above the screening level (81 µg/L) for the protection of surface water. Total zinc was not detected above the screening level in any samples.

Semivolatile Organic Compounds and Polychlorinated Biphenyls

The following SVOCs and PCBs are COCs in soil for the 2-60s Area (EPI and Golder Associates, 2006b):

- *Carcinogenic PAHs*: There were 13 detections from 36 soil samples, with none greater than their respective soil screening levels. Addressing cPAHs, via the surface water pathway, consisted of confirming groundwater has not been impacted by cPAHs in soils at AOC 2-62.46, OA 12, SWMU 2-70.55, and the southwest corners of Building 2-65. No cPAHs were detected in any groundwater samples collected in these areas.
- *BEHP*: There were nine detections from 36 soil samples above reporting limits, but below the soil screening level protective of surface water (1,570 µg/kg). Concentrations ranged from 67 µg/kg to 800 µg/kg. Addressing BEHP via the surface water pathway consisted of confirming that groundwater was not impacted by soils at AOC 2-62.46. There was no detection in any groundwater samples from this area.
- *PCBs*: Of the 24 soil samples collected, there were four detections, with concentrations ranging from 33 µg/kg to 400 µg/kg. Three samples were above the soil screening level protective of surface water (33 µg/kg). Addressing PCBs in soil consisted of evaluating concentrations at AOC 2-62.46, SWMU 2-70.55, and the southeast corner of the Building 2-65 slab. Aroclor 1260 was detected to the west and down-gradient of AOC 2-62.46, from 1 foot bgs to 10 feet bgs.

Volatile Organic Compounds

The following 10 VOCs are COCs in soil for the 2-60s Area (EPI and Golder Associates, 2006b):

- *1,2,4-Trimethylbenzene*: Of the 87 soil samples collected, there were two detections near SWMU 2-78.6. Addressing 1,2,4-trimethylbenzene in soil consisted of evaluation of the air pathway.

The maximum soil concentration of 57,000 µg/kg exceeded the proposed air pathway screening level (2,360 µg/kg).

- *Isopropylbenzene*: Of the 87 soil samples collected, there was one detection (6,800 µg/kg) at 10 feet bgs. This was located near SWMU 2-78.6. The air pathway was also evaluated. The maximum soil concentration was below the proposed air pathway screening level (1,270 µg/kg).
- *PCE*: Of the 87 soil samples collected, there were 29 detections, with seven detections above the reporting limit. Concentrations ranged from 1.2 µg/kg to 8.4 µg/kg. There were detections (1.6 µg/kg) from soils collected at 10 feet bgs, in the middle of Building 2-65. The maximum concentration was below the direct contact exposure pathway screening level (136,000 µg/kg).
- *1,3,5-Trimethylbenzene*: Of the 87 soil samples collected, there was one detection (2,300 µg/kg) at 10 feet bgs. This location is near SWMU 2-78.6. Addressing 1,3,5-trimethylbenzene in soil consisted of evaluating the air pathway. The maximum concentration was below the proposed air pathway screening level of 2,470 µg/kg.
- *n-Butylbenzene*: Of the 87 soil samples collected, there was one detection (9,700 µg/kg) at 10 feet bgs. This detection was located near SWMU 2-78.6. The air pathway was also evaluated. The maximum soil concentration was below the proposed air pathway screening level (4,640 µg/kg).
- *TCE*: Of the 87 soil samples collected, there were 11 detections, with one above reporting limits (160 µg/kg) at 10 feet bgs. Three of the 11 samples detected concentrations exceeding the screening level protective of surface water (8.72 µg/kg).
- *Benzene*: Of the 87 soil samples collected, there was one detection above reporting limits. The concentration of this sample was 12 µg/kg at 10 feet bgs. This was below the soil screening level protective of surface water (25.3 µg/kg), and below the direct contact exposure pathway screening level (1,360,000 µg/kg).
- *n-Propylbenzene*: Of the 87 soil samples collected, there was one detection (6,100 µg/kg) at 10 feet bgs, near SWMU 2-78.6. The air pathway was also evaluated. The maximum soil concentration was below the proposed air pathway screening level (1,360 µg/kg).
- *Naphthalene*: Of the 87 soil samples collected, there were five detections, with concentrations ranging from 6.9 µg/kg to 38,000 µg/kg. The maximum concentration exceeded the air pathway screening level (24,800 µg/kg). This level was below the soil screening level protective of surface water.
- *Ethylbenzene*: Of the 87 soil samples collected, there was one detection. The air pathway was also evaluated. The maximum soil concentration (13,000 µg/kg) exceeded the 2004 soil screening level of 2,520 µg/kg.
- *Sec-butylbenzene*: Of the 87 soil samples collected, there was one detection (4,700 µg/kg) at 10 feet bgs. The air pathway was also evaluated. The maximum soil concentration was below the proposed air pathway screening level (7,860 µg/kg).

Petroleum Hydrocarbons

Only one category of petroleum hydrocarbons, GRPH, was identified as a COC in soil for the 2-60s Area. There were four detections, out of 10 samples, from the Data Gap Investigation. Concentrations ranged

from 9.9 mg/kg to 3,900 mg/kg, two of which exceeded the screening level protective of surface water (30 mg/kg).

3.2.3.4 2-66 Area

The 2-66 Area is toward the southwest area of Plant 2 (Figure 5). This area is bordered to the east by the 2-60s Area and the South Yard Area; to the southeast by Jorgensen Forge; and to the northwest by the LDW and the 2-40s Area. The 2-66 Area contains major portions of Building 2-49 and the former Building 2-66 slab. This area includes the Southwest Bank CMS Study Area and the SCL Transformer Investigation Area (EPI and Golder Associates, 2005a).

Within the 2-66 Area there are 10 identified RCRA units, including four AOCs and six OAs. No RCRA units have been closed within the 2-66 Area of Plant 2 (Figure 10; EPI and Golder Associates, 2005a).

The RCRA units are summarized as follows (information taken from EPI and Golder Associates, 2006e):

- AOC 2-108.72 (Wet Paint Booths);
- AOC 2-108.73 (Paint Booth Sump); and
- OA 17 (Transformer Vaults).

The groundwater associated with these units will be further evaluated (Table 10). These RCRA units are summarized as follows (information taken from EPI and Golder Associates, 2006e):

AOC 2-108.73 (Paint Booth Sump)

This unit is located in Building 2-108. The sump collected overflow, including water containing lacquers and paints from the Wet Paint Booths (AOC 2-108.72). The sump was cleaned and filled in 1993. Soil samples have been collected for analysis. Silver was detected at a concentration requiring further consideration. No groundwater samples were collected. The silver concentration was further addressed in a data gap investigation, and soil and groundwater remedies were further evaluated in the CMS.

AOC 2-108.72 (Wet Paint Booths)

This unit consisted of two wet paint booths that have since been decommissioned. The booths were located at the north end of Building 2-108, near columns B-3/5. In 1994, soil samples were collected for analysis. No analytcs were detected at concentrations that required further consideration. It was anticipated that soil remedies for this unit did not need to be evaluated further in the CMS; however, at the time the Work Plan was written, a final determination had not been made. Groundwater was further evaluated in the CMS.

OA 17.13 (Transformer Vaults)

OA 17 consists of seven below-grade transformer vaults (vaults 2, 3, 5, 6, 7, 8 and 13), located in the tunnel system beneath buildings 2-40, 2-41, and 2-49. Transformer vault 3 is the only OA 17.3 vault located within the 2-66 Area. During the RFI inspection, the sumps and vaults did not contain any water, indicating high integrity and leak tightness. Surface wipe and concrete chip samples collected during vault decontamination indicated PCBs were present in the floor and sump structure concrete. Soil samples were collected for analysis. The soil analysis confirmed that no release to soil had occurred at any of the OA 17 transformer vaults. Groundwater samples were also collected for analysis. No analytes were detected at concentrations requiring further consideration. The EPA previously had determined a

NFA for vadose-zone soil, which will be reviewed prior to development of the applicable workplan for future data gap investigations.

OA 1 and OA 2

OA 1 is located to the southwest of Building 2-66 and OA 2 is in Building 2-66 soil; these areas overlap. OA 1 was defined as the southwestern corner of Building 2-66 and the southwest yard, located near Building 2-66, bounded by the LDW to the west, and Building 2-108 to the south. A former 15,000-gallon UST (PL-19) was located in the southwest yard. A sheet pile enclosure has been installed within the OA 1 unit, and encompasses a significant portion of the known TCE release in the soil and groundwater. In early 1995, an IM was implemented, floating petroleum product was removed, and a product recovery system was installed. From the installation of the recovery system in 1995, to 2000, over 1,200 gallons of product were removed. An IM was also implemented using density-driven convection (DDC) to perform mass removal and destruction of VOCs within the Sheetpile Containmentment.

OA 2 was originally defined as fill material, containing metals mixed with ash and wood debris. Approximately 300 cubic yards of this fill was excavated in 1990. In 1988, and from 1990 to 1994, a total of 84 historical and RFI soil borings were extracted in the OA 1 and OA 2 units. Nine VOCs, eight SVOCs, one PCB, and various metals were detected at concentrations requiring further considerations. The majority of VOC exceedences were in OA 1.

Both OA 1 and OA 2 also include the Southwest Bank, which forms the southwest edge of the 2-66 Area along the LDW. The current bank is composed of riprap and a significant amount of debris fill containing concrete rubble, metal scraps, and brick. Soil samples were collected from the Southwest Bank for the Southwest Bank IM. The sampling was conducted to define both the vertical and horizontal limits of the debris to support design of the removal action. Six metals and several PCBs were detected at concentrations exceeding SQS. The uplands CMS for OA 1 and OA 2 will focus on addressing remedies for groundwater and soil contaminants remaining after completion of the Southwest Bank CMS.

AOC 2-66.52 (Machine Pit)

This unit is located in Building 2-66, between columns C/E-8/9. The machine pit was in operation for two years, then removed in 1992. From 1993 to 1994, soil samples were collected for analysis. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k) fluoroanthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, SVOCs, silver, cyanide, and mercury were all detected at concentrations requiring further consideration. A NFA was requested from the EPA; however, the EPA requested groundwater and soil be further evaluated.

AOC 2-66.53 (TCE Degreaser)

This unit is the site of a 5,000-gallon TCE degreaser, located on the west side of Building 2-66, near columns H-14 and H-15. This degreaser was decommissioned in 1993. From 1992 to 1995, soil samples were collected for analysis. Metals, TCE, cadmium, copper, cyanide, mercury, nickel, silver, and zinc were all detected at concentrations requiring further analysis. Groundwater samples were collected for analysis. Vinyl chloride, TCE, 1,1,2-TCA, PCBs, arsenic, cadmium, copper, thallium, and zinc were all detected at concentrations requiring further consideration. Groundwater and soils were further evaluated during the CMS.

OA 14 (Building 2-49 Machine Pit)

This machine pit, in the central portion of Building 2-49, was filled and covered in 1991. Soil samples were collected for analysis. Aroclors 1254 and 1260 were detected at concentrations requiring further

consideration. Groundwater samples were not collected at this OA. A NFA was requested from the EPA; however, the EPA requested groundwater and soils be further evaluated in the CMS.

OA 11 (Building 2-72 Area)

Although Building 2-72 has been removed, this unit also includes a small storage building located south of the former Building 2-66, and the area east of the former Building 2-72. In 1988, 1991, 1994, and 1995, soil samples were collected for analysis. Ethylbenzene, TCE, PCBs (aroclor 1260 and 1262), TPH, arsenic, cadmium, mercury, nickel, selenium, silver, and thallium were all detected at concentrations requiring further analysis. Groundwater samples were also collected for analysis in 1991, 1992, and from 1994 to 1996. Benzene, ethylbenzene, toluene, TCE, 1,1-DCE, vinyl chloride, arsenic, copper, nickel, thallium, and zinc were all detected at concentrations requiring further consideration.

OA 19 (Building 2-49 Stretch Press Pit and Outfall No. 12)

This unit is located at the northwest corner of former Building 2-49. Soil samples were collected in this area for analysis. In 2 of the 8 soil samples collected, Aroclor 1260 and cyanide were detected at concentrations requiring further consideration. Groundwater samples had no detections that required further consideration. A NFA was requested from the EPA, however, the EPA requested groundwater and soil be further evaluated in the CMS.

Outfall No. 12 was connected to transformer vault 12 (OA 17) then discharged to the waterway bank surface, at the southwest edge of the facility. In 1997, approximately 22 tons of impacted soil and sediment were excavated. Sediment samples were collected for analysis. Aroclors 1260 and 1254 were detected at concentrations requiring further consideration.

The Data Gap Investigation Report has not been completed for the 2-66 Area. The proposed sampling locations are found in Figure 11.

Density-Driven Convection System (2-66 Area IM System)

The two DDC wells were in operation as IM technology, inside the sheet pile containment structure, near former Building 2-66. The objective of this IM was to remove contaminant mass from the subsurface within the sheet pile structure (EPI and Golder Associates, 2006f).

Since the system startup in March 2004, 667.8 pounds of solvent have been physically removed from Plant 2. Quarterly sampling was conducted on November 6, 2006; Boeing will deliver a report on soil samples collected from within the sheet pile and the recalculation of contaminant mass remaining within the sheet pile to the EPA. The sheet pile remedy issue will be discussed in later reports (Boeing, 2006b).

The 2-66 Area IM System quarterly performance monitoring is timed to occur with the quarterly Shoreline Monitoring Program, taking advantage of the fact that seven of the 2-66 Area IM monitoring wells are included in both programs (EPI and Golder Associates, 2006f).

Historically, there was an underground TCE tank and piping system outside the southwest corner of former Building 2-66. This tank and piping system has since been removed. Soil and groundwater impacts from this tank and piping were noted during environmental investigations. In 1993, an IM consisting of interlocking steel sheet piles was installed around approximately 90 percent of the mass of TCE contamination. The sheet piles extend to a depth of approximately 50 bgs. Based on the data, the majority of the contaminant mass inside the sheet pile is located at depths shallower than 20 feet bgs (EPI and Golder Associates, 2006e).

The COC for the area enclosed by the sheet pile include TCE and its degradation products—cDCE and vinyl chloride. The degradation products are the result of natural attenuation of TCE occurring in the subsurface (EPI and Golder Associates, 2006f).

The DDC system was installed from late 2003 through early 2004. This system consists of two DDC wells installed within the sheet pile structure and 11 new monitoring wells/piezometers installed within and around the sheet pile structure. When the system was first installed, it was first operated in Soil Vapor Extraction-only mode for remediation of vadose-zone soil, prior to full-scale, closed-loop DDC operation, which includes groundwater treatment. In June 2004, the operation began in startup DDC mode (EPI and Golder Associates, 2006f).

Operational sampling is performed monthly and includes groundwater sampling and vapor sampling of the DDC wells and multiple points along the vapor treatment system. This sampling is conducted quarterly and includes groundwater sampling of a network of 33 monitoring wells, both inside and outside the sheet pile structure (EPI and Golder Associates, 2006f).

From June 25, 2004, until August 8, 2006, VOCs measured in wells decreased in concentration. Of the two DDC wells, VOC concentrations were greater at monitoring well DDC2-66-1 because the majority of the contamination existed near this well. Conversely, less VOC concentrations were consistently measured at monitoring well DDC2-66-2 because lower contaminant concentrations originally existed in that area (EPI and Golder Associates, 2006f).

Eighth-quarter VOC concentrations from shallow and deep piezometers at monitoring well DDC-1 and DDC-2 generally remained unchanged, or decreased slightly, relative to seventh-quarter data. The vapor VOC concentrations decreased from June 2004 to August 2006. The data indicated month-to-month fluctuations, occasionally increasing in vapor phase concentration, but were downward over the remedial time period. The reported vapor concentrations were indicative that VOCs in the groundwater were successfully stripped in the vapor phase by the DDC wells (EPI and Golder Associates, 2006f).

Total VOC concentrations in groundwater samples from both DDC wells have decreased from the start of DDC operation, in late June 2004 through the end of the eighth quarterly DDC operation period, on August 8, 2006. The average stripping efficiency of both wells remains high, indicating a successful operation. The overall decrease in extracted vapor concentrations from both DDC wells was expected, based on the observation of the successful DDC operation (EPI and Golder Associates, 2006f).

Groundwater from 33 monitoring wells and piezometers were sampled as part of the quarterly monitoring. Increases in total VOCs for some wells occurred because the operation of the DDC wells mixed areas of high groundwater VOC concentration with areas of low VOC concentration, resulting in total VOC concentrations increasing somewhat at some sample points. In addition, biodegradation was boosted by air injection and groundwater recirculation (the nature of the DDC wells operation), degrading TCE into DCE, and then DCE into vinyl chloride. Thus, temporary increases in DCE and vinyl chloride was anticipated and observed in some wells (EPI and Golder Associates, 2006f).

Increases have been noted in some total metals results from monitoring wells PL2-010A and PL2-021A. These two wells are located immediately adjacent to the two DDC wells and, thus, are subjected to low pH conditions. This localized effect demonstrates that acid injection into the DDC wells over two years of operation has mobilized metals only in the vicinity of these two closest wells. Adjustments to the acid metering system are ongoing to maintain sufficiently low pH in the DDC wells and infiltrations galleries, preventing plugging by iron precipitation or other reaction products formed by introduction of oxygen in the groundwater. Total and dissolved metal concentrations inside the DDC wells have increased approximately two to five times over baseline concentrations. Metals concentrations at monitoring wells

near DDC wells PL2-010A and PL2-021A have shown similar increases. These wells have also shown decreased pH from acid injection (EPI and Golder Associates, 2006f).

Monitoring wells outside the sheet pile and B- and C- level wells inside the sheet pile are unaffected by DDC system operations (EPI and Golder Associates, 2006f).

Transformer Investigation

In August of 2001, Boeing discovered high levels of PCBs in the soil underlying the area by the West Bank electrical substation, located adjacent to the southern border of the Facility. Soils in the vicinity were excavated to attempt to define the extent of the PCBs. A Phase I and a Phase II investigation was conducted to define this PCB contamination. The four transformers at the West Bank substation were drained of their fluid and removed in 2004 (Floyd|Snider Inc., 2005).

The sediments located along the southern portion of the Southwest Bank, the DSOA, and along the northern portion of Jorgensen Forge (to approximately Jorgensen Outfall 9) were studied as part of the Transformer Investigation. PCB migration from the Area of Discovery did not reach the waterway via subsurface transport mechanisms; however, they are believed to have historically reached the waterway via the storm system that discharged through Boeing Outfalls 9/9A. The manhole has been plugged as a temporary measure for source control. PCBs released from Outfall 9/9A contributed to the contamination in the southern portion of the present DSOA. PCBs released from the Property Line Outfalls contributed to the area of PCB contamination in front of the Property Line Outfalls (Floyd|Snider Inc., 2005).

Shoreline Groundwater Monitoring

Beginning in 2001, groundwater samples were collected and analyzed in support of two separate and concurrent evaluations. The first evaluation, referred to as the “Sediment Cap Impact Evaluation,” is described in the *CMS Phase Sediment Cap Impact Evaluation Groundwater Monitoring Plan*. This plan was designed to provide an assessment of the potential for contaminated groundwater, discharging from the facility, to contaminate the clean sediment backfill proposed as part of the DSOA remedy. The second evaluation is described in the *CMS Phase Effectiveness of Buildings 2-10 and 2-66 Interim Measures Monitoring Plan*. This evaluation is designed to assess the effectiveness of the sheet pile containment structure IMs, and is referred to as the “Effectiveness Evaluation.” Both of these evaluations involve quarterly groundwater monitoring (EPI and Golder Associates, 2006c).

Seven of the Shoreline Monitoring Program wells are included in the *Quarterly Performance Monitoring Program for the Building 2-66 IMs Density-Driven Convection Well System Project* (Figure 12; EPI and Golder Associates, 2006c). The seven wells common to both monitoring programs are:

- PL2-JF01AR;
- PL2-JF01B;
- PL2-JF01C;
- PL2-030A;
- PL2-030C;
- PL2-043B; and
- PL2-044B.

In an effort to increase monitoring efficiency, Boeing coordinates the two quarterly sampling schedules with the sampling of seven wells common to both programs, under the Shoreline Monitoring Program (EPI and Golder Associates, 2006c).

In August 2006, the most recent sampling event, 25 of the 28 shoreline monitoring wells were sampled. Dissolved metals, VOCs, total metals and PCBs were detected in the samples (EPI and Golder Associates, 2006c).

The EPA has requested that Boeing conduct SVOC monitoring in the shoreline monitoring wells. This monitoring is to verify that no SVOCs are being transported via the groundwater from upland areas to on-site sediments (Ernst, 2007).

Volatile Organic Compounds

In the August 2006 sampling event, 18 of the 28 monitoring wells were sampled, and the following 11 VOCs were detected (EPI and Golder Associates, 2006c):

- *1,1-Dichloroethane* – detected in monitoring wells PL2-030A, PL2-043B, and PL2-044B at concentrations of 0.4 µg/L, 0.6 µg/L, and 0.6 µg/L, respectively. The screening level in groundwater under the draft CMS is 112,000 µg/L.
- *Acetone* – detected in monitoring wells PL2-013AR, PL2-015B, PL2-420A, and PL2-443A at concentrations of 1.8 µg/L, 1.5 µg/L, 1.9 µg/L, and 1.2 µg/L, respectively. The screening level in groundwater under the draft CMS is 6,430,000 µg/L.
- *Benzene* – detected in monitoring well PL2-030A at a concentration of 2.6 µg/L. The screening level in groundwater under the draft CMS is 4.48 µg/L.
- *Carbon Tetrachloride* – detected in monitoring well PL2-015AR at a concentration of 0.9 µg/L. The screening level in groundwater under the draft CMS is 0.526 µg/L.
- *Chlorobenzene* – detected in monitoring well PL2-JF01AR at a concentration of 22.0 µg/L. The screening level in groundwater under the draft CMS is 1,600 µg/L.
- *Chloroform* – detected in monitoring wells PL2-015A and PL2-015AR at concentrations of 0.4 µg/L, and 3.3 µg/L, respectively. The screening level in groundwater under the draft CMS is 56.1 µg/L.
- *cDCE* – detected in 10 monitoring wells at concentrations ranging from 0.2 µg/L, to 1,800 µg/L. One of the samples, PL2-258B, has a concentration above the draft CMS screening level of 1,550 µg/L.
- *PCE* – detected in monitoring well PL2-015AR at a concentration of 1.0 µg/L. The screening level in groundwater under the draft CMS is 0.822 µg/L.
- *Trans-1,2-Dichloroethene (tDCE)* – detected in monitoring wells PL2-030A and PL2-258A at concentrations of 0.3 µg/L and 22.0 µg/L, respectively. The screening level in groundwater under the draft CMS is 10,000 µg/L.
- *TCE* – detected in monitoring wells PL2-013A, PL2-013AR, PL2-015A, PL2-015AR, and PL2-044B at concentrations of 2.6 µg/L, 5.0 µg/L, 2.1 µg/L, 29.0 µg/L, and 0.3 µg/L, respectively. The screening level in groundwater under the draft CMS is 0.302 µg/L.

- *Vinyl Chloride* – detected in monitoring wells PL2-013AR, PL2-015B, PL2-030A, PL2-258A, PL2-420A, PL2-443A, PL2-JF01AR, PL2-JF01B, and PL2-JF02A at concentrations ranging from 0.3 µg/L to 850 µg/L. Five of the nine samples with detected vinyl chloride had concentrations above the draft CMS screening level of 0.731 µg/L.

TCE, cDCE, tDCE, and vinyl chloride were frequently detected, particularly in areas of the sheet pile IMs. VOCs were associated with Plant 2 operations.

During the August 2006 sampling event, 22 of the 28 shoreline monitoring wells were sampled for metals (EPI and Golder Associates, 2006c). The following 13 metals were detected:

- *Antimony* – total antimony was detected in one sample at a concentration of 3.0 µg/L; well below the screening level (513 µg/L).
- *Arsenic* – dissolved arsenic was detected in 17 samples and total arsenic was detected in 19 samples. Two of the dissolved and four of the total arsenic detections were above the background screening level (8.0 µg/L).
- *Beryllium* – total beryllium was detected in one monitoring well (PL2-233A) at a concentration of 2.7 µg/L, well below the beryllium screening level (135 µg/L).
- *Cadmium* – dissolved cadmium was detected in monitoring well PL2-013A and total cadmium was detected in monitoring well PL2-013A at concentrations of 130 µg/L and 137 µg/L, respectively. This is above the cadmium screening level (8.8 µg/L).
- *Chromium* – total chromium was detected above the screening level (50 µg/L) in monitoring well PL2-233A, at a concentration of 150 µg/L. This sample had a turbidity of 515 NTU; therefore, total metals results may be biased high for this sample.
- *Copper* – dissolved copper was detected in 14 samples and total copper was detected in 18 samples. One of the 14 dissolved and three of the 14 total copper detections were above the background-adjusted screening level (8.0 µg/L).
- *Lead* – total lead was detected from monitoring well PL2-233A at a concentration of 3.0 µg/L—below its screening level of 8.1 µg/L. This sample had a turbidity of 515 NTU; therefore, the results may be biased high for this sample.
- *Manganese* – dissolved manganese was detected in 16 samples and total manganese was detected in 18 samples. Three of the dissolved and three of the total manganese detections were above the background-adjusted screening level (2,000 µg/L).
- *Mercury* – total mercury was detected above the screening level (0.025 µg/L) in monitoring well PL2-233A, at a concentration of 0.0295 µg/L. This sample had a turbidity of 515 NTU; therefore, results may be biased high for this sample.
- *Nickel* – total and dissolved nickel was detected in 22 samples. Four of the total nickel and two of the dissolved nickel concentrations were above the screening level (8.2 µg/L).
- *Silver* – dissolved silver was detected in monitoring well PL2-013A at a concentration of 45 µg/L. Total silver was detected in seven samples. One dissolved and one total silver sample, both from monitoring well PL2-013A, had detections above the screening level (1.9 µg/L).

- *Vanadium* – dissolved and total vanadium was detected in 14 samples. None of these were above the screening level (2,810 µg/L).
- *Zinc* – dissolved zinc was detected in five groundwater samples. Total zinc was detected in 11 samples. Three dissolved and five total zinc samples had detections above the zinc screening level of 81 µg/L.

Groundwater samples from monitoring wells PL2-023A and PL2-023AR were analyzed for low concentrations of PCBs. These wells were selected because PCBs were historically detected at low concentrations in monitoring well PL2-036A during the RFI. No PCBs were detected in either well. Quarterly groundwater monitoring is ongoing in this area.

3.2.3.5 2-40s Area

The 2-40s Area consists of approximately 30 acres, and is bordered to the south by the 2-60s and 2-66 Areas; to the north by the 2-31 Area; to the west by the LDW; and to the east by East Marginal Way South (Figure 5). The 2-40s Area contains buildings 2-40, 2-41, 2-44, and 2-45 (EPI and Golder Associates, 2006a).

The western edge of the 2-40s Area abuts the LDW, along the rear bulkhead wall that parallels the waterway the full length of buildings 2-41, 2-44, and 2-49. The western-most 50 feet of buildings 2-41, 2-44, and 2-49 extend over the waterway and are supported by wood piles. The ground surfaces on the waterway side of the rear bulkhead wall are below the customary high water mark, and are considered sediments and not soils. For this reason, RCRA units (or portions of RCRA units) and features found west (waterway side) of the rear bulkhead wall in the 2-40s Area are managed as part of the DSOA, through a parallel RCRA process under the same order. The RCRA units accounted for under the DSOA include the west end of Underflow Flume (WMUS 2-41.36), Quench Tanks (SWMU 2-41.35), Outfall #23 area (OA 20), Outfall #16 area (OA 22B), Outfall #14 area (OA 22A), and TCE degreaser (AOC 2-41.29; EPI and Golder Associates, 2006a).

Within the 2-40s Area, there are 15 identified RCRA units (Figure 13; EPI and Golder Associates, 2006a). These RCRA units are categorized as follows:

- Five SWMUs were used as TSD facilities;
- Two SWMUs were not TSD facilities, but were defined in the Order as “any discernable unit at which solid wastes have been placed at any time;”
- One AOC, a category of units defined in the Order as “any area of the facility where a release to the environment of a hazardous waste or hazardous constituents has occurred, is suspected to have occurred, or may occur;” and
- Seven OAs, a category of units not defined within the Order, but which, by practice, are treated identically to an AOC.

There are three RCRA units in the 2-40s Area where the EPA had previously determined that a NFA was needed for vadose-zone soils; this will be reviewed prior to the development of the applicable workplan for future data gap investigations (EPI and Golder Associates, 2006a). Groundwater associated with these units will be evaluated further in the CMS. These units are:

- OA 17 (Transformer Vaults OA 17.2, OA 17.5, OA 17.6, OA 17.7, and OA 17.8);

- SWMU 2-41.30 (Manhole Vault); and
- SWMU 2-41.34 (Tunnel Area).

The following is a summary of the RCRA units in the 2-40s Area (Table 11; Information taken from EPI and Golder Associates, 2006a):

OA 17 (Transformer Vaults)

This unit consists of seven below-grade transformer vaults (vaults 2, 3, 5, 6, 7, 8, and 13), located in a tunnel system beneath buildings 2-40, 2-41, and 2-49. Transformer vaults 17.2, 17.5, 17.6, 17.7, and 17.8 are vaults located within the 2-40s Area. Surface wipe and concrete chip samples collected during vault decontamination indicated that PCBs were present in the floor and sump structure concrete. Soil samples were collected for analysis to confirm there had been no releases into the environment. Soil sampling confirmed that no release to soil had occurred at any of the OA 17 transformer vaults. Groundwater samples also had no detected constituents requiring further consideration. The EPA had previously determined a NFA for vadose-zone soil (ground surface to 12 feet bgs), which will be reviewed prior to the development of the applicable workplan for future data gap investigations.

SWMU 2-41.30 (Manhole Vault)

This vault was previously filled with water, which was analyzed and determined to be un-impacted. In 1995, soil samples were collected near this unit for analysis. Mercury was detected at levels requiring further consideration. Groundwater samples were also collected for analysis. Nickel and vinyl chloride were detected at concentrations requiring further consideration. The EPA had previously determined that a NFA is needed for vadose-zone soil, which will be reviewed prior to the development of the applicable workplan for future data gap investigations.

SWMU 2-41.34 (Tunnel Area)

This unit consists of soil beneath a tunnel floor in Building 2-41, in which a section of the Underflow Flume (SWMU 2-41.36) is located. The flume leaked in 1992 and again in 1993. In 1994, soil samples were collected for analysis. Cyanide was detected at a concentrations (0.21 to 0.23 mg/kg) requiring further consideration. However, at the concentration detected, cyanide would not pose a threat to potential surface water receptors. The EPA had previously determined that a NFA was needed for vadose-zone soil; this will be reviewed prior to the development of the applicable workplan for future data gap investigations.

SWMU 2-41.33 (Deactivated Anodic Tank Line)

The Anodic Tank Line was located in Building 2-41. The tank was decommissioned, decontaminated, and disassembled in 1993. The unit consisted of a series of tanks ranging from 10 to 1,300 gallons in capacity. Soils samples were collected for analysis. Inorganics were detected at concentrations requiring further consideration, which confirmed a release from the southwest sump. This resulted in completion of IMs.

The IMs, conducted between December 1993 and December 1997, consisted of removal of the concrete floor and excavating approximately 200 cubic yards of soil beneath the structure. Soil samples were collected for analysis; it was determined that the lateral extent of soil impacted by metals was not delineated during previous investigations. Additional soil sampling was conducted, and low concentrations of 19 inorganic analytes were detected in one or more of the samples. However, vanadium was the only constituent that was detected at concentrations requiring further consideration. Groundwater

samples were collected for analysis. Dissolved arsenic, copper, and nickel were detected at concentrations requiring further consideration.

SMWU 2-41.36 (Underflow Flume)

This unit is a concrete underflow flume that was abandoned in place in 1987. In 1994, soil samples were collected for analysis. Arsenic and cyanide were detected at concentrations requiring further consideration. Soil samples were also collected in the Under-building Area, close to the discharge end of the flume. Cadmium, zinc, PCBs, and PAHs were detected at elevated concentrations relative to SMS. An IM in 1997 removed approximately 30 cubic yards of PCB-contaminated sediment. A seep sample was collected close to this unit and copper, lead, and zinc were all detected at concentrations requiring further consideration. Sediment contamination potentially associated with this unit on the waterway side of the rear bulkhead wall will be has been or will be addressed under DSOA remedial action.

OA 13 (Building 2-44 Steam Drain)

This unit is located near a machining area in the north-central portion of Building 2-44. Soil samples have been collected for analysis. Aroclor 1254 and cyanide were detected at concentrations requiring further consideration. Groundwater samples had dissolved arsenic at concentrations requiring further consideration.

OA 18 (Building 2-40 East Parking Lot Area)

This unit is located east of Building 2-40. Soil sampling has detected 13 SVOCs (mostly PAHs), Aroclor 1248, TPHs, arsenic, beryllium, copper, cyanide, lead, mercury, nickel, silver, thallium, and zinc at concentrations requiring further consideration. Historical photos from the 1940s indicated this area was used as an airplane tow path between Plant 2 and KCIA. Groundwater samples contained benzene, vinyl chloride, arsenic, beryllium, copper, lead, nickel, and zinc at concentrations requiring further consideration.

OA 7 (Building 2-40 Soil)

This unit is defined by soil containing elevated SVOC and thallium concentrations in the southern central portion of Building 2-40. Soil samples contained benzo(a)anthracene, benzo(a)pyrene, benzo(b)floranthene, chrysene, indeno(1,2,3-cd)pyrene, thallium, mercury, selenium, and silver detected at concentrations requiring further consideration. Groundwater samples, which were analyzed for PCBs due to its proximity to the former transformer vault, contained no PCBs. Both groundwater and soil were further evaluated in the CMS.

AOC 2-41.32 (Deactivated Paint Booths and Sump)

This unit consisted of paint booths for painting metal parts, and a sump. These were in operation until the early 1990s. Water containing paint residue was disposed of periodically. Soil samples were collected for analysis. Arsenic, copper and mercury were detected at concentrations requiring further consideration. Groundwater was also collected for analysis. Arsenic, copper, mercury, and nickel were detected at concentrations requiring further consideration. Soil and groundwater were further assessed in the CMS.

AOC 2-41.31 (Machine Pits)

This unit includes more than 35 machine pits and various sumps, located throughout Building 2-41, which have all since been decommissioned. These are all grouped into a SWMU, due to their common potential

for impacts from lubricating or waste oils, dripping or released from cutting machines and presses. In 1994 and 1995, soil samples were collected for analysis. Results found TPHs were detected at concentrations requiring further consideration. Groundwater samples were also collected for analysis in 1994 and 1996. Arsenic, vinyl chloride, and copper were detected at concentrations requiring further consideration.

Additional groundwater and soil sampling was conducted downgradient (west) of the sumps and machine pits. Aroclors 1254 and 1260, arsenic, DRPH, MoRPH, and vanadium were all detected at concentrations requiring further consideration. Acetone, copper, and nickel were detected in groundwater at concentrations requiring further consideration.

AOC 2-41.35 (Quench Tanks)

This unit is the former location of three below-grade tanks in Building 2-41 that were decommissioned in 1992. This unit is completely located on the LDW side of the rear bulkhead wall, beneath Building 2-41. Soil samples collected in 1995 contained concentrations of cadmium, chromium, mercury, and zinc exceeding SMS. In 1995, groundwater samples collected contained no analytes requiring further consideration. This unit has been or will be addressed under DSOA.

AOC 2-41.29 (TCE Degreaser)

This unit was located in Building 2-41 and consisted of a steel TCE degreaser tank that was decommissioned in 1993. Soil samples have been collected for analysis. Cadmium, PCBs, PAH, TCE, and methyl ethyl ketone (2-butanone) were detected at elevated concentrations (EPI and Golder Associates, 2006a). Groundwater samples have been routinely collected as part of Boeing's Shoreline Monitoring Program. Vinyl chlorine has been detected in shoreline monitoring groundwater at concentrations above the screening level. Sediment and porewater associated with this unit has been or will be addressed under DOSA.

OA 22.A

This unit is Outfall 14. The area in front of this outfall was designated OA 22, which is directly north of the OA 19 area. Sediments have been sampled, and COCs with elevated concentrations relative to SMS included PCBs and phthalate esters. The sediment contamination related to this outfall has been or will be addressed under DOSA.

OA 20

This unit was associated with Outfall 23, consisted of a cluster of six smaller pipes, and was located adjacent to AOC 2-41.29 (TCE Degreaser). Surface samples detected PCBs and phthalates at elevated concentrations. The sediment contamination related to this outfall has been or will be addressed under DOSA.

OA 22.B

This unit is associated with Outfall 16. Surface samples were collected and COCs with detected elevated concentrations relative to SMS included PCBs, cadmium, chromium, zinc, and phthalate esters. The sediment contamination related to this outfall has been or will be addressed under DOSA.

The Data Gap Investigation Report for the 2-40s Area has not yet been submitted to the EPA.

Electrical Manufacturing Facility Plume

Ongoing remedial actions have been occurring in the EMF plume underlying the 2-40s Area. The EMF plume is not a RCRA unit. This facility is located east of KCIA, and upgradient of Plant 2. The plume is a chlorinated VOC plume and portions of the plume underlie the 2-40s Area of the facility (EPI and Golder Associates, 2006a).

Based on existing data, groundwater impacts associated with the EMF plume are limited to the B-level of the aquifer in the 2-40s Area of Plant 2. However, an upward vertical hydraulic gradient direction occurs near the waterway causing the EMF plume to rise somewhat, possibly into the A-level of the aquifer, as it approaches the waterway (EPI and Golder Associates, 2006a).

In 2002, remediation technology selected for the EMF plume was Enhanced Reductive Dechlorination (ERD) using biostimulants, such as sodium lactate or sugar solution (EPI and Golder Associates, 2006a). In 2003, an ERD pilot test was conducted in coordination with EPA (EPI and Golder Associates, 2006a).

Based on the pilot test results, a full scale ERD program was implemented. Several rounds of sodium lactate solution injections were performed during 2004 and 2005; down gradient wells were monitored to evaluate the effectiveness of the remediation effort. In 2005, the EPA required the EMF plume to be transferred from Ecology's Voluntary Cleanup Program to EPA's purview, and ongoing remediation work associated with the Voluntary Cleanup Program at Plant 2 be halted until further evaluations were conducted under the CERCLA Order (EPI and Golder Associates, 2006a).

Analytical results of groundwater testing, following injections of sodium lactate solution into the EMF plume, showed decreases in chlorinated VOC concentrations within the EMF plume. Boeing plans to continue the ERD work, and it will be administered under a new CERCLA Order, covering the full length of the EMF plume, including that underlying the 2-40s Area of Plant 2 (EPI and Golder Associates, 2006a). The EMF plume will be further delineated and evaluated. Delineation of the entire plume will be determined both laterally and vertically (EPI and Golder Associates, 2006a).

3.2.3.6 North Yard

The Work Plan and the subsequent Data Gap Investigation have not yet been completed for the North Yard. There are two RCRA units in the North Yard:

SWMU 2-01.1 (Landing Gear Cleaning Sump)

Airplane landing gear was cleaned in Building 2-01 at the northern end of Plant 2. A 1,000-gallon capacity landing gear cleaning sump was constructed of reinforced concrete to contain wastes generated during repair and cleaning of landing gear assemblies for large jet aircraft. Building 2-01, built in 1954, was demolished in 1991 (PRC Environmental Management, Inc., 1992). Subsurface conditions were evaluated prior to building closure and demolition. Chrysene, TCE, 1,1,1-trichloroethane, methyl ethyl ketone, acetone, pyrene, di-n-octylphthalate, and TPHs were detected in soil samples (PRC Environmental Management, Inc., 1992). Chromium and vinyl chloride were detected in groundwater samples. No further investigations of the soil are recommended (PRC Environmental Management, Inc., 1992).

SWMU 2-09.2 (Chrome Waste Tanks)

Building 2-09 contains two 4,000-gallon tanks made of chromic acid-resistant fiberglass. One tank is used to hold chrome-bearing rinse waters (PRC Environmental Management, Inc., 1992).

3.2.3.7 2-31 Area

The Work Plan and the subsequent Data Gap Investigation have not yet been completed for the 2-31 Area. The 2-31 CMS Study area contains nine RCRA units, six of which had been approved for a NFA by the EPA, and which will be reviewed prior to the development of the applicable workplan for future data gap investigations (Weston Solutions, 2000a). The following is a summary of the RCRA units in the 2-31 Area:

AOC 2-31.21 (TCE Degreaser)

This degreaser began operation in 1945, was replaced in 1991, then decommissioned and removed in 1995. This degreaser unit was located in the northwest corner of Building 2-31 (Weston Solutions, 2000a).

Potential COCs included TCE, DCE, vinyl chloride, and petroleum hydrocarbons (Weston Solutions, 2000a). In addition, TCE was detected at 16,000 µg/kg in soil, above the Proposed Maximum Contaminant Level (PMCL) of 5,500 µg/kg. Groundwater was sampled from 1993 to 1996. Vinyl chloride and TCE were detected above the PMCLs in groundwater samples (55 µg/L and 2.9 µg/L, respectively). The following constituents were also detected above their PMCLs: total arsenic (3 µg/L), total copper (2.9 µg/L), total lead (5.6 µg/L), total nickel (8.3 µg/L), total selenium (71 µg/L), and total thallium (6.3 µg/L).

SWMU 2-31.18 (Area B Acid Waste Hold Tank)

This acid waste hold tank was a dangerous waste management unit, installed in the 1960s to store acid wastes generated by manufacturing processes at Plant 2 (Weston Solutions, 2000a). The unit was located on the north side of Building 2-31.

Potential COCs included inorganics (Weston Solutions, 2000a). Soil samples were collected in 1994. Aroclor 1260 was detected above its PMCL of 33 µg/kg. The following inorganics were detected above PMCLs: arsenic, cadmium, chromium, copper, mercury, nickel, and zinc. Groundwater samples were collected from 1994 to 1996. Furthermore, TCE and vinyl chloride were detected above their PMCLs (55 µg/L and 2.9 µg/L, respectively).

SWMU 2-31.26 (Anodizing Tank Line)

This tank line was installed in 1979, decommissioned in 1994, and removed in 1995. This unit was located in the southern portion of Building 2-31. The tank line was primarily used for cadmium, chromium, and nickel plating.

Potential COCs included inorganics, including cyanide and chromium (Weston Solutions, 2000a). Soil samples were collected in 1995. Arsenic, mercury, and cyanide were detected at concentrations above soil PMCLs. Groundwater samples were not collected because the soil constituent concentrations were low.

OA 17.4 (Transformer Vault 4)

This unit is located in Building 2-25 and consisted of a below-grade vault in the tunnel system, beneath the building (Weston, 1999a).

Constituents of concern included PCBs and petroleum hydrocarbons associated with transformer coolant oils. No PCBs were detected in any of the soil samples, and oil-range petroleum hydrocarbons were

detected at concentrations below the PMCL (Weston, 1999a). There have been no releases of potential COCs from this unit to subsurface soil, at concentrations above PMCLs. Soil, to depth of groundwater, was removed as part of the demolition of the Building 244.

SWMU 2-31.20 (Deactivated Cyanide Hold Area)

This unit was a roofed brick and concrete containment area located in the northern portion of Building 2-31, which was formerly used to store 5- to 900-gallon containers of cyanide wastes (Weston, 1999a). This unit was a Plant 2 TSD area.

Potential COCs included cadmium, chromium, copper, cyanide, lead, and zinc compounds. There have been no releases of COCs from this unit to subsurface soil at concentrations above PMCLs (Weston, 1999a). This unit has undergone closure and received closure approval from Ecology.

SWMU 2-31.22 (Brush Plating Area)

This unit was located near column WJ-8 in Building 2-31. This area was used for manual cleaning, plating, anodizing, and alodining of parts. This unit was installed around 1984 and decommissioned in 1995.

Potential COCs included VOCs, petroleum hydrocarbons, and inorganics, including hexavalent chromium and cyanide. Copper was detected in soil samples above the PMCL of 33.6 mg/kg. Based on the magnitude and distribution of these data with respect to the unit, there have been no releases of COCs from the unit to subsurface soil at concentrations above PMCLs (Weston, 1999a).

SWMU 2-31.23 (Ammonium Persulfate Tank)

The process chemicals used at this unit included ammonium persulfate and sulfuric acid. No soil or groundwater sampling was performed based on the lack of any indication of a release and the solid integrity of the secondary containment. There was no evidence of any releases to the environment (Weston, 1999a).

SWMU 2-31.24 (Sodium Hydroxide Developer)

The sodium hydroxide developer room was located in Building 2-31. It consisted of a large rotating metal wheel within a tank drip pan, two aboveground processing tanks, and miscellaneous hoses and pumps located within a fiberglass-lined floor sump. The unit operated from 1982 to 1995.

Potential COCs associated with the process chemicals were inorganics (Weston, 1999a). No soil samples could be collected because the unit is located above a basement tunnel. Any releases from the unit would have discharged to the concrete basement tunnel floor, which displayed no evidence of staining or releases.

SWMU 2-31.25 (Anodize Aluminum Room)

This room was located in Building 2-31 and consisted of several 10- to 30-gallon processing tanks, above secondary containment pans, on grade. The unit started operations in approximately 1980 and was removed in 1995.

Potential COCs included inorganics, including cyanide and hexavalent chromium (Weston, 1999a). No soil samples could be collected because the unit is located above a basement tunnel. Any releases from

the unit would have discharged to the concrete basement tunnel floor, which displayed no evidence of staining or releases.

3.2.3.8 2-10 Area

The Work Plan and the subsequent Data Gap Investigation have not yet been completed for the 2-10 Area. The 2-10 CMS Study Area contains 21 RCRA units, four of which had previously been granted a NFA status for soils by the EPA, and which will be reviewed prior to the development of the applicable workplan for future data gap investigations (Weston Solutions, 2000b). The following is a summary of the RCRA units at the 2-10 area:

AOC 2-10.1AA (Hydraulic Stamp Machines and Sumps)

This unit consisted of 10 secondary containment structures for hydraulic stamp machines located at the north end of Building 2-10. These containment structures collected leaks and drips of oil from the stamp machines (Weston Solutions, 2000b). An IM has consisted of constructing a sheet pile structure surrounding this unit (Weston Solutions, 2000b).

Potential COCs included VOCs, PCBs, petroleum hydrocarbons, and inorganics from hydraulic and lubricating oils, coolants, and metal materials used at this unit (Weston Solutions, 2000b). Soil samples were collected in 1994. Thallium was detected above its PMCL (8.9 mg/kg) at 9 mg/kg and nickel was detected above its PMCL of 38.2 mg/kg, at 39 mg/kg (Weston Solutions, 2000b). Groundwater samples were collected in 1995. No analytes were detected at concentrations greater than the PMCLs in groundwater (Weston Solutions, 2000b).

AOC 2-10.1AB (Hydraulic Stamp Machines and Sumps)

This unit consisted of a sump located in the west-central portion of Building 2-10. The sump collected leaks of oil from hydraulic stamp machines. This unit has been decommissioned (Weston Solutions, 2000b).

Potential COCs included PCBs, petroleum hydrocarbons, and inorganics from hydraulic and lubricating oils, coolants, and metal materials used at this unit (Weston Solutions, 2000b). Soil samples were collected from 1992 to 1995. Oil-range petroleum hydrocarbons were detected at a concentration of 290 mg/kg, slightly above the PMCL of 200 mg/kg (Weston Solutions, 2000b). Mercury was detected at 0.09 mg/kg, slightly above the PMCL of 0.07 mg/kg (Weston Solutions, 2000b). No groundwater samples have been collected because the soil constituent concentrations were low and isolated to a single distinct location.

AOC 2-10.5 (Paint Booth Area)

This unit consists of eight wet paint booths, some of which started operation in 1956. All of the booths have now been decommissioned (Weston Solutions, 2000b).

Potential COCs included VOCs and inorganics (Weston Solutions, 2000b). Soil samples were collected from 1992 to 1994. No VOCs were detected at concentrations above PMCLs. Copper was reported at 84.2 mg/kg, exceeding its PMCL of 36.4 mg/kg (Weston Solutions, 2000b). No groundwater samples were collected because only copper was found above its PMCL in only the upper 1-foot soil horizon, indicating no downward migration had occurred.

AOC 2-10.2A (Decommissioned Machine Sumps)

This unit, an approximate 39,000-sq. ft. area within Building 2-10, contained several decommissioned machine sumps. The western portion of this unit lies within the sheet pile containment structure for AOC 2-10.4A (Weston Solutions, 2000b).

Potential COCs associated with this unit included VOCs, PCBs, and petroleum hydrocarbons from lubricants and cutting oils (Weston Solutions, 2000b). Soil samples were collected in 1992. No VOCs or TPH were detected at concentrations greater than PMCLs (Weston Solutions, 2000b). VOCs, including TCE, DCE, and vinyl chloride, were detected in groundwater above PMCLs. The distribution of VOCs in only one well next to the degreaser suggests the VOCs are a likely result of operation of the degreaser and not a release from the machine sumps (Weston Solutions, 2000b).

AOC 2-10.3A (North TCE Degreaser)

This unit was a steel tank within a concrete secondary containment structure that had a sump. This AOC was located in Building 2-10. Metal parts were placed in the degreaser to remove oils and grease. The north TCE degreaser was decommissioned in 1993 and all equipment was subsequently removed. A sheet pile containment structure was installed around the degreaser area in 1994, as stated in IM for source area containment (Weston Solutions, 2000b).

Potential COCs included VOCs and petroleum hydrocarbons (Weston Solutions, 2000b). Soil samples were collected from 1992 to 1994. Vinyl chloride and TCE were the only VOCs detected in soil at concentrations above PMCLs (5,500 µg/kg and 290 µg/kg, respectively; Weston Solutions, 2000b). Aroclor 1260 was detected at a concentration of 89 µg/kg, exceeding the PMCL of 33 µg/kg (Weston Solutions, 2000b). Nickel and zinc were detected above their PMCLs (38.2 mg/kg and 107 mg/kg, respectively; Weston Solutions, 2000b).

Groundwater samples were collected from 1992 to 1996. Six VOCs were detected at concentrations above PMCLs. Vinyl chloride, 1,1-DCE, and TCE were detected the most frequently (Weston Solutions, 2000b). Dissolved arsenic and copper were also detected above PMCLs (3 µg/L and 2.9 µg/L, respectively).

AOC 2-10.4A (South TCE Degreaser)

This degreaser was decommissioned in 1993. This unit formerly consisted of two degreaser tanks, within concrete sumps, located in Building 2-10. All equipment has been removed. Sheet piling was installed around the degreaser in 1994 as an IM for source area containment (Weston Solutions, 2000b).

Potential COCs included VOCs and petroleum hydrocarbons associated with metal parts (Weston Solutions, 2000b). Soil samples were collected from 1993 to 1994. TCE and vinyl chloride were the only constituents detected at concentrations above soil PMCLs (5,500 µg/kg and 290 µg/kg, respectively; Weston Solutions, 2000b). Groundwater samples were collected from 1992 to 1996. Vinyl chloride, TCE, 1,1,2-Trichloroethane, and 1,1-DCE were detected at concentrations aboveground water PMCLs (55 µg/L, 25 µg/L, 2.9 µg/L, and 1.9 µg/L, respectively; Weston Solutions, 2000b).

AOC 2-10.6A (Quench Tank)

This unit, which is no longer active, consisted of a quench tank and a rinse tank. The concrete quench tank was historically used to hold Jo Quench P-52, a quenching solution containing inorganic nitrate and polyalkylene glycol (Weston Solutions, 2000b).

Potential COCs for this AOC were VOCs and inorganics (Weston Solutions, 2000b). Soil samples were collected from 1992 to 1995. No constituents were reported at concentrations above the soil PMCLs. Groundwater samples were collected from 1992 to 1995. No VOCs were detected at concentrations greater than PMCLs (Weston Solutions, 2000b). Dissolved arsenic (14 µg/L) was reported at a concentration above the groundwater PMCL of 3 µg/L (Weston Solutions, 2000b).

OA 4 (Scattered PCB Exceedances)

This unit consists of relatively low concentrations of PCBs in shallow surface soil at scattered locations on the facility. These were identified during pre-RFI investigations under paved areas surrounding buildings 2-10, 2-15, and north of Building 2-31. The origin of the PCB is unknown (Weston Solutions, 2000b).

No PCBs were considered to be potential COCs at any of the units in the vicinity of these areas. Soil sampling was conducted from 1992 to 1995. No VOCs, base-neutral acids (BNAs), or TPH were detected at concentrations greater than PMCLs (Weston Solutions, 2000b). Aroclor 1260 was detected above the PMCL (33 µg/kg). Cadmium was detected at a concentration greater than the PMCL (1.28 mg/kg; Weston Solutions, 2000b). Mercury was detected at a concentration greater than the PMCL (0.07 mg/kg; Weston Solutions, 2000b). Nickel and zinc were detected at a concentration greater than PMCLs (38.2 mg/kg and 107 mg/kg, respectively). No groundwater sampling was conducted because PCBs tend to be found most readily in soil; therefore, soil sampling was adequate to characterize the OA.

OA 5 (Fueling Station Area)

This unit is located immediately north of Building 2-15 and contained three gasoline-containing USTs—two 5,000-gallon and one 7,000-gallon. All three tanks were removed in 1986. During the removal, approximately 800 cubic yards of soil were excavated and disposed (Weston Solutions, 2000b).

Potential COCs included VOCs, BNAs, PCBs, petroleum hydrocarbons, and inorganics associated with the fuels stored in the USTs (Weston Solutions, 2000b). Soil samples were collected in 1992. Mercury was the only analyte detected at a concentration above the PMCL (0.07 mg/kg; Weston Solutions, 2000b). Groundwater samples were collected from 1986 to 1996. Benzene was detected at 57 µg/L, exceeding the PMCL (43 µg/L; Weston Solutions, 2000b).

OA 6 (Northeast Area)

This unit is located in the northeast corner of the facility. Groundwater in this area contained inorganic concentrations (Weston Solutions, 2000b).

Potential COCs included VOCs, BNAs, PCBs, petroleum hydrocarbons, and inorganics (Weston Solutions, 2000b). Soils were sampled from 1990 to 1992. PCBs were detected at two locations above the PMCL (33 µg/L). Arsenic was detected above the PMCL (7.3 mg/kg; Weston Solutions, 2000b). Cadmium, copper, mercury, and silver were detected above PMCLs (1.28 mg/kg, 36.4 mg/kg, 0.07 mg/kg, and 0.3 mg/kg, respectively; Weston Solutions, 2000b).

Groundwater samples were collected from 1990 to 1996. 1,1-DCE was detected at 2.6 µg/L, exceeding the PMCL (1.9 µg/L). TPH oil and grease was detected at 1.8 µg/L (there was no PMCL for petroleum hydrocarbons in groundwater). Arsenic, copper, and nickel had detections above PMCLs (3 µg/L, 2.9 µg/L, and 8.3 µg/L, respectively; Weston Solutions, 2000b).

OA 8 (SWMU 2-09.2) Building 2-09 Chrome Waste Tanks

This unit was located in the immediate vicinity of Building 2-09 and the southwest corner of Building 2-10, near the shoreline of the LDW. This OA included a chrome waste tank system containing two 4,000-gallon waste-holding tanks (Weston Solutions, 2000b). The tanks were decommissioned in 1993.

Potential COCs included cadmium, chromium, and lead. Soil samples were collected from 1992 to 1995. Aroclor 1260 was detected at 180 µg/kg, above the PMCL (33 µg/kg); cadmium was detected, above the PMCL (1.28 mg/kg; Weston Solutions, 2000b). Lead, zinc, and cyanide were also detected above PMCLs (of 400 mg/kg, 107 mg/kg, and 0.2 mg/kg, respectively; Weston Solutions, 2000b).

Groundwater samples were collected from 1992 to 1994. No VOCs or petroleum hydrocarbons were detected at concentrations greater than PMCLs (Weston Solutions, 2000b). Copper was detected above its PMCL (2.9 µg/L) at 3 µg/L and 5 µg/L (Weston Solutions, 2000b).

OA 15 (Building 2-15 Steam Clean Sump)

This unit is located in the central-eastern portion of Building 2-15. It was defined by elevated concentrations of TCE and lead in soil, which were discovered during a pre-construction assessment (Weston, 1999b).

Potential COCs included VOCs, PCBs, and inorganics from steam cleaning operations. Copper and nickel were detected in soil samples above PMCLs (Weston, 1999b). Nickel exceeded the PMCL by 1.25 times and copper exceeded the PMCL by an order of magnitude. Both of these exceedences were from the same sample, collected from 1-foot bgs (Weston, 1999b).

The size of the sump was relatively small and previous actions removed most of the affected soil. The extent of the remaining affected soil appears to be limited in size and volume.

SWMU 2-10.7 (Paint Strip Tank Line)

The paint strip tank line was operated from approximately 1956 to 1992 and located at the south end of Building 2-10. The equipment has been removed and only the concrete structures remain in-place. Process chemicals used at this unit included chromic and phosphoric acid; paint; and TURCO, a corrosive fluid used for paint stripping containing hydrofluoric acid; dichloromethane; and phenol (Weston Solutions, 2000b).

Potential COCs associated with this unit included VOCs, BNAs, and inorganics from paint and stripping products. Groundwater samples have not been collected at this unit. Soil samples were collected in 1993 and 1994. The constituents detected above PMCLs were inorganics and found in only one near-surface sample, suggesting that the constituents in soil are limited to the upper soil horizon and localized in extent (Weston Solutions, 2000b).

SWMU 2-10.8 (Anodic and Alodine Tank Lines)

These tank lines began operation in approximately 1954, and were shut down and later decommissioned by 1993. They were located in the southwest corner of Building 2-10. The equipment has been removed, and only the concrete structures remain in-place. A portion of this building overhangs the bank of the LDW.

Potential COCs at this unit were VOCs, petroleum hydrocarbons, and inorganics. Soil sampling was conducted from 1992 to 1994 and groundwater sampling was conducted from 1992 to 1996. The

analytical results indicated cyanide was the only COC detected at concentrations in the soil above the PMCL (the highest concentration was 5.2 mg/kg; Weston Solutions, 2000b). Vinyl chloride was detected at concentrations above the PMCL (2.9 µg/L) in four groundwater samples (Weston Solutions, 2000b). Dissolved copper was also detected above the PMCL (2.9 µg/L) at a concentration of 3.0 µg/L (Weston Solutions, 2000b).

SWMU 2-10.9 (Aluminum Chem Mill Area)

The Aluminum Chem Mill was located in Building 2-10, between the north and south TCE degreasers, near column D-32. It consisted of 11 large open tanks, averaging 3,000 gallons in capacity, and grouped with a series of secondary containment structures (Weston Solutions, 2000b). Airplane parts were chemically milled in the tanks using a variety of caustic solutions, acids, and etchants. This mill began operation in approximately 1960 and was decommissioned in 1993. The equipment has been removed and the concrete structures remain in-place.

Potential constituents were VOCs and inorganics. Soil samples were collected from 1992 to 1994, and groundwater samples were collected from 1992 to 1996. The data indicated VOCs have not impacted the soil and groundwater at this unit (Weston Solutions, 2000b). Nickel, zinc, and cyanide concentrations were above PMCLs in soil, while arsenic, copper, selenium, and thallium concentrations were above PMCLs in groundwater (Weston Solutions, 2000b).

SWMU 78.7 (Oil/Water Separators)

This unit is located west of Building 2-13 and consists of oil/water separators 21 and 22. These separators have been in operation since the early 1940s or 1950s. The separators collect stormwater runoff and then remove the oil from the stormwater (Weston Solutions, 2000b). Oil from the separator is regularly pumped out and shipped off-site for disposal. Stormwater is discharged to the Metro sanitary sewer.

Potential COCs included PCBs and petroleum hydrocarbons. Soil sampling was conducted in 1994. One soil sample reported concentrations of Aroclor 1260 above the PMCL (33 µg/kg; Weston Solutions, 2000b). No TPH was detected. No groundwater samples were collected because the PCB concentrations were very low and limited to the upper soil horizon (0 to 5 feet bgs; Weston Solutions, 2000b).

SWMU 78.A

No information regarding this RCRA unit was found in the site files.

SWMU 2-10.4 (Zyglo Penetrant Spray Booth)

This spray booth was located near column A-15 in Building 2-10. The booth was used to spray Zyglo penetrant on airplane parts, which were then rinsed and inspected with ultraviolet light in order to detect cracks, holding the fluorescent penetrant (Weston, 1999c).

Potential COCs included VOCs. No VOCs were detected in any of the soil samples analyzed (Weston, 1999c). This RCRA unit had previously been given a NFA status for soils by the EPA; this status will be reviewed prior to the development of the applicable workplan for future data gap investigations.

SWMU 2-15.13 (Boiler Valve Pit)

This unit was a concrete pit, originally used to contain the valves and piping associated with two Bunker C fuel USTs, located to the east of Building 2-15. These tanks were removed in 1998.

Potential COCs included petroleum hydrocarbons. No PCBs were detected in any of the soil samples collected. Oil-range petroleum hydrocarbons were detected at concentrations below the PMCL (Weston, 1999c). Groundwater samples did not contain concentrations of petroleum hydrocarbons above detection limits. No organics were detected above PMCLs in groundwater (Weston, 1999c). This RCRA unit had previously been given a NFA status for soils by the EPA, which will be reviewed prior to the development of the applicable workplan for future data gap investigations.

SWMU 2-15.14 (Bulk Storage Tank Pit, Oil/Water Separator, and Oil/Water Handling Tank)

This unit consists of a fabricated steel oil/water separator and an 85-gallon steel tank, and is located on the southeast side of Building 2-15.

Potential COCs included petroleum hydrocarbons. No petroleum hydrocarbons were detected in groundwater (Weston, 1999c). This RCRA unit had previously been given a NFA status for soils by the EPA; this status will be reviewed prior to the development of the applicable workplan for future data gap investigations.

AOC 2-10.5A (Polishing Tank and Former Paint Booth)

This unit was used for small-scale, experimental use rather than full-scale production. The paint booth has since been removed. One soil boring was advanced in this area and no VOCs were detected above PMCLs (Weston, 1999c). Due to the small scale and limited use of this unit, the intact and stain-free conditions of the concrete floor, and the available analytical data, it is unlikely that any releases to the environment have occurred (Weston, 1999c). This RCRA unit had previously been given a NFA status for soils by the EPA; this status will be reviewed prior to the development of the applicable workplan for future data gap investigations.

Interim Measures in the 2-10 Area

In September 2006, there was an IM in the 2-10 Area (Figure 5) to remove UST PL-52 in SWMU 2-15.7A. This UST was a 1,000-gallon waste storage tank. This tank and its ancillary piping originally functioned as an oil/water separator, plumbed to receive liquids from the Building 2-15 steam clean area (Golder Associates, 2006a).

The condition of the ancillary piping, formerly used to convey wastewater between the sump in the steam cleaning room (OA 15) and UST PL-52, was checked and the piping was cleaned and plugged. Video inspections of the piping, between OA 15 and PL-52, were conducted to enable an assessment of the integrity of the pipe and determine whether releases may have occurred from the pipe. The video surveys indicated no releases likely occurred from the pipe, and the piping was in good condition with no holes or corrosion (Golder Associates, 2006a). Concentrations of PCBs, cPAHs, and arsenic were detected in various soil samples at levels slightly above PCLs, and/or 2004 screening levels.

Stormwater Pollution Prevention Plan

The 2007 revision of Boeing's SWPPP for Plant 2 (Permit No. S03-000482D) includes a potential pollutant source inventory identifying activities or practices that may be a source of stormwater pollution (Boeing, 2007a). The potential sources identified for Plant 2 are listed in Table 12.

3.2.3.9 Stormwater Discharge

Stormwater Drainage System

The Plant 2 stormwater drainage system includes approximately 360 catch basins, 120 storm drain manholes, six oil/water separators, five shut-off valves, and three biofiltration swales (Boeing 2007a). There are 24 active outfalls draining to the LDW (Figures 14 and 15; Boeing 2007b). The stormwater outfall identification system was modified between 2000 and 2007 (see Figure 16 for Plant 2 outfalls, with their former identifiers). Information pertaining to each of the 24 active outfalls, including the former outfall identifier, outfall diameter, drainage basin area, and a brief description of the drainage area they serve, is summarized in Table 13. Fifteen of the 24 active outfalls primarily discharge stormwater falling upon building roofs. The remaining nine active outfalls (A, B, H, I, J, K, L, V, Z) drain mostly paved areas, or paved areas and building roofs combined. The drainage basins of lines J and Z include some public roadway runoff from the 16th Avenue South Bridge and roadway (Line J), and East Marginal Way South (Line Z; Boeing 2007a). There is also an active 24-inch KCIA stormwater line that discharges at the southern boundary of Plant 2, located approximately 10 feet in the Jorgensen Forge property. According to Plant 2's SWPPP, this outfall is not a Boeing outfall; however, there was a historical connection from the Plant 2 facility to this outfall (Golder Associates and Floyd|Snider Inc., 2006). Several of these outfalls are partially or entirely submerged during high tides. Plant topography is relatively flat, sloping on average less than half of a percent toward the LDW (Boeing, 2007a). Tidal changes in Elliot Bay cause significant changes in the LDW water level adjacent to the plant.

There are no identified areas where stormwater from off-site runs onto Plant 2. However, because Plant 2 is located between East Marginal Way South and the LDW, some discharge from off-site flows through City of Seattle and City of Tukwila storm drain systems, and enters the Plant 2 system. Consequently, some discharge from off-site sources commingles with Plant 2 storm drainage before reaching the LDW. These commingled waters are discharged at Outfall No. Z (9A; City of Tukwila) and Outfall No. J (27; City of Seattle). No data has been collected to evaluate the relative flow from non-Boeing sources through these outfalls (Boeing, 2007a).

Stormwater lines X and Y previously collected stormwater in the 2-60s and 2-66 CMS study areas (Figure 5), which housed buildings 2-66, 2-65, 2-64, 2-63 and 2-62 (Figure 17). These subject buildings, with the exception of Building 2-64, were removed in recent years, and all that remains are concrete slabs, asphalt paved areas, and stormwater drains. The EPA ordered that the X and Y lines be removed, as solids collected from within these lines were found to contain elevated concentrations of PCBs and metals. The removal work was scheduled to be completed in May 2007. Beginning in January 2006, a temporary stormwater collection and treatment system was installed to replace the drainage capacity of lines X and Y. This construction activity resulted in the temporary sealing of the surface of all the catch basins and manholes on lines X and Y, removing those lines from service, and installing new drains, lines, asphalt swales, and treatment vaults, and conveying treated stormwater into stormwater Line Z. Line Z is immediately south of the lines X and Y (Golder Associates, 2006b).

Stormwater Source Control Activities

The following sections describe historical and recent source control activities at Plant 2.

Previous Source Control Activities

Over the past several decades, as the activity at Plant 2 has changed from aerospace manufacturing to office-oriented research and development and warehousing, many historical sources of contamination to the waterway have been eliminated. For example, the transition from manufacturing has resulted in the elimination of hundreds of hazardous chemicals and waste generation processes, along with the

concurrent decommissioning, cleanup, and interim closure of many inactive RCRA waste management units (EPI and Golder Associates, 2006b).

Specific activities undertaken by Boeing to control or eliminate sources of contaminants to the waterway include installing three sheet pile enclosures to contain solvent-contaminated soil and groundwater; removing of free petroleum product from groundwater; and replacing hazardous materials, such as chlorinated solvents, with less toxic alternatives. For example, fluids containing PCBs above 50 parts per million (ppm) have been drained from all transformers at Plant 2, and replaced with non-PCB containing fluids (EPI and Golder Associates, 2006b).

Historical releases in some parts of Plant 2 have been a source of PCB contamination to the LDW, and have been eliminated, controlled, or identified for future actions. For example, a subsurface transformer vault in Building 2-49 was once connected to Outfall 12 (part of Line W) by a sump pump; after a spill of transformer fluids containing PCBs was automatically pumped to Outfall 12, the line to the waterway was replaced and PCBs were removed from the system in the 1990s. Similarly, there were historical PCB releases to soil at an Outfall 9 (part of Line Z) manhole structure near former SCL transformers at the southern property boundary; this pathway to surface water has been controlled and the stormwater manhole has been temporarily plugged. Other stormwater lines that parallel the property line with Jorgensen Forge have also been assessed for possible sources and have been plugged, where possible, as an initial control (EPI and Golder Associates, 2006b).

Recent Source Control Activities

A storm system survey was recently conducted to identify PCB- and metal-constituents in storm solids present in Plant 2 stormwater structures. The survey was conducted in two phases, from August through October 2005. Eight stormwater lines, draining most of the paved portions of Plant 2, were selected for the initial phase (Tier 1) of the survey, in which a sample of accumulated solids was collected from the furthest downgradient structure associated with each line (i.e., the last catchment along the main trunk line prior to the outfall or prior to discharge from municipal storm drains; EPI and Golder Associates, 2006b).

At catch basins containing inserts (retrofitted traps for accumulation of solids), samples were collected from within the insert and at the bottom of the catch basin. Because samples were collected from the base of catchments specifically designed to retain particulates, they are not representative of the quality of suspended solids actually discharged to the LDW. However, these data were used as a screening tool to prioritize source control efforts; if PCBs were detected at a screening concentration exceeding 1 ppm in a Tier 1 sample, additional samples (Tier 2) were collected from upgradient catchments along the line in order to better identify the sources and extent of the contaminants (EPI and Golder Associates, 2006b).

In general, PCBs were detected well above 1 ppm in Line X (2,600 ppm) and Line Y (37 ppm), and slightly above 1 ppm in Line I (EPI and Golder Associates, 2006b). Elevated concentrations of lead, chromium, and mercury were also detected in solids samples associated with these lines. Thus, Tier 2 sampling was subsequently conducted along lines X, Y, and I (EPI and Golder Associates, 2006b).

Results from the Tier 2 sampling indicated storm solids in most upgradient catch basins along lines X and Y were impacted by PCBs. The PCB concentrations in Tier 2 samples associated with Line X ranged from 3.9 to 660 ppm, while concentrations in Line Y samples ranged from 8.8 to 134 ppm (EPI and Golder Associates, 2006b). These PCBs were detected at concentrations between 0.5 and 1.5 ppm in Tier 2 samples, associated with Line I. All catch basins associated with lines X and Y were cleaned of solids in August (Tier 1 structures) and November (Tier 2 structures) of 2005. Cleanout of catch basins along Line I was completed in May 2006. The fact that PCBs were detected in the solids within the inserts

(where present) indicates that an ongoing source of PCBs exists in the drainage area of lines X and Y, as the catch basins and inserts are cleaned periodically.

In the winter of 2006, lines X and Y were decommissioned and their stormwater drainages were diverted from lines X and Y to a new stormwater collection system and a treatment vault was plumbed to line Z which was designed to effectively remove solids. The *Interim Measure Work Plan for Stormwater Lines X & Y* (Golder Associates, 2006b) describes the decommissioning, and presents the permanent removal and management approaches for lines X and Y (Golder Associates, 2006b).

Following the storm system survey, floor caulking and sealants in building slabs and roadways within the drainage areas of lines X and Y were tested to identify potential sources of PCBs to storm solids. Results indicated some PCB-containing products, applied as joint caulking and floor sealants, are present along sections of the floor slabs. Along Line X, PCB concentrations in joint material samples ranged from non-detect to 740 ppm, and concentrations in floor sealant samples ranged from non-detect to 350 ppm (EPI and Golder Associates, 2006b). In Line Y samples, PCB concentrations in joint material ranged from non-detect to 40,500 ppm, and concentrations in floor sealant ranged from non-detect to 54 ppm (EPI and Golder Associates, 2006b). The PCB-contaminated joint caulking and floor sealant in that part of Plant 2 will be removed as part of demolition and/or redevelopment actions. Further characterization of the caulk at Plant 2 is being evaluated under the *Draft Interim Measure Work Plan, Characterization of Caulk in Concrete Pavements at Boeing Plant 2*.

The following structural and non-structural measures have been adopted to control potential stormwater pollution at Plant 2 (Boeing, 2007a):

All Outfalls

- Secondary containment and weather protection is provided for outside container storage areas;
- Secondary containment is provided for liquid materials in tanks;
- Waste containers and tanks are managed according to the Washington Administrative Code (WAC) 173-303;
- Underground petroleum product tanks are managed according to WAC 173-360;
- Manufacturing activities occur only inside buildings;
- Catch basins and oil/water separators are inspected yearly and cleaned as necessary;
- The Boeing Fire Department periodically tests emergency systems;
- Plans are implemented (SWPPP, hazardous waste management plan, hazardous material management plan, spill prevention, control and countermeasures plan, comprehensive contingency plan and facility response plan);
- Training and inspection programs are in place;
- Storm drain covers are located near catch basins where there are more potential pollutant sources;
- Spill kits are provided in outdoor work areas;
- Pavement is swept on a regular basis;

- Particulate air emissions are controlled and permitted;
- Plant access is restricted only to Boeing personnel and authorized contractors;
- BMPs are implemented; and
- Other material and waste management practices are implemented.

Outfall No. Z (9A)

- Stormwater in the vicinity of transformer vaults discharges to the ground or these vaults have controlled discharges via secondary containment;
- Emissions from spray coating booths are controlled by water washing or dry filter to reduce the amount of particulates that may accumulate on nearby pavements;
- Emissions from the woodworking shop are controlled by a cyclone/baghouse combination, helping reduce solids accumulating on nearby pavement;
- Catch basins have SC-type oil/water separation capability;
- Storm drain covers are ready for use at catch basins in higher risk areas;
- Tanks APL-120, APL-164, and the two emergency generators have secondary containment;
- Hard piping is used on two chillers by Building 2-80 and the North End;
- Outside material storage and waste areas are protected from the weather and have secondary containment;
- An emergency shutoff valve is present and tested periodically; and
- A berm has been constructed along the south fenceline to prevent off-site run-on.

Outfall No. Z (11)

- Transformers have secondary containment;
- Drain covers are ready for use in catch basins at high use areas;
- All catch basins have SC-type oil/water separation capability;
- Tank APL-305 has secondary containment and overflow protection; and
- Stormwater in the vicinity of the spray booth and woodworking shop is protected by dry filters and a cyclone, respectively.

Outfall No. I (14)

- Material and waste storage areas are protected from the weather and have secondary containment;

- Drainage from the forklift parking area (under Building 2-48) flows through an oil/water separator;
- Tank APL-149 has secondary containment and overflow protection;
- Drain covers are ready for use in catch basins at high use areas;
- All catch basins have SC-type oil/water separation capability;
- Stormwater in the vicinity of the spray coating booth is protected by dry filters; and
- An emergency shutoff valve is present and tested periodically.

Outfall No. J (27)

- The pump in the catch basin nearest Tank UPL-065 is disabled when this tank is filled;
- An SC-type oil/water separator has been installed in the catch basin downstream of the pump;
- Piping between emergency generator buildings (2-J [27], 2-30 and 2-36) is double-walled;
- Containment berms are present in the doorways at buildings 2-J (27), 2-30, and 2-36;
- Stormwater at the transformers drains to the ground; and
- The generator day tank has secondary containment.

Outfall No. I (28)

- Transformers and material storage sheds have secondary containment;
- Drainage from the 2-05 fueling area and area surrounding tanks UPL-063 and UPL-064 flows through an oil/water separator;
- Drainage from the automotive vehicle maintenance area and the area surrounding tanks APL-162, APL-517, APL-063, UPL-007, and UPL-008 flows through an oil/water separator;
- The steam clean area at Building 2-15 is managed as dangerous waste;
- Wastewater discharge from the car wash at Building 2-15 is routed to the sanitary sewer and permitted by King County;
- Fill pipes for tanks UPL-007 and UPL-008 have spill containment;
- The catch basin nearest the fill for tanks UPL-007 and UPL-008 has a shutoff valve that is closed when filling occurs;
- The area surrounding the fill pipe for tank APL-063 is bermed; and
- Tanks APL-517, APL-063, and APL-162 have secondary containment and overflow protection

Outfall No. B (35)

- The fuel handling area for tanks APL-001 and APL-002 is bermed and drains into a large spill containment sump. The sump is pumped through an oil/water separator under manual control;
- Catch basins in the area of tanks APL-001 and APL-002 have SC-type oil/water separation capability;
- The 2-120 central accumulation area is sheltered from the weather and provided with secondary containment;
- Pumps in sumps at the 2-120 are manually operated;
- Drainage from the fuel handling area at the 2-13 and the hazardous waste storage area at the 2-120 flows through an oil/water separator;
- Tanks APL-001, APL-002 and APL-053 have secondary containment; and
- Stormwater flow from the generator day tank and transformer discharge through an oil/water separator.

Outfall No. A (36)

- There are three bio-filtration swales in the 36 drainage areas;
- There are shut-off valves at the inlet to the biofiltration swales, which are periodically tested; and
- Emissions from the spray coating booth are controlled by dry filters.

Stormwater Drainage System Sampling and Potential as a Contaminant Migration Pathway

In 2005, Boeing completed the investigation of a PCB release discovered in the southwest corner of Plant 2, along the boundary of the Jorgensen Forge property, adjacent to a now-removed SCL substation. This investigation identified the limits of subsurface soil contaminated by PCBs and TPH. As part of this work, catch basin solids were also sampled in the area along three separate stormwater lines draining Plant 2, Jorgensen Forge, and/or KCIA properties; PCBs were found in each line as shown in Figure 20. Boeing plugged its manholes to eliminate the chance of contaminated solids being discharged to the LDW. In 2008, following EPA approval, Boeing intends to excavate PCB-contaminated soil in the SCL substation area and remove Boeing's stormwater lines in that area (Ernst, 2007). Ecology and EPA are also working with other parties on non-Boeing sources in other storm lines (Ernst, 2007).

Regarding stormwater source control, Boeing has eliminated or replaced a number of drainages found to contain PCBs and/or metals. Comprehensive testing of catch basin solids in 2005 indicated that contaminants, primarily PCBs and metals, were accumulating in the catch basin solids in several areas. All catch basins were cleaned and routine sampling continues to assess these structures over time. Two adjacent storm drainage lines in particular, lines X and Y, warranted prompt action. Boeing initiated construction of a modern drainage system to replace them and plugged the problem lines. In 2007, Boeing plans to remove lines X and Y during the initial stages of redevelopment of this area (Ernst, 2007).

The EPA has also recently approved a work plan to sample and evaluate suspended solids and actual storm water discharges (as opposed to the solids retained in catch basins) throughout Plant 2. This evaluation will identify the presence of any ongoing sources and associated risks to the LDW, and trigger actions to ensure the timely control of those sources (Ernst, 2007). Boeing has an ongoing road and parking area street sweeping program to reduce the introduction of solids to the stormwater system.

The Plant 2 stormwater drainage system drains areas of known groundwater and/or soil contamination and, therefore, is a potential migration pathway of site-related contaminants to the LDW. Outfall Z drains drainage basins 34, 35, 36, 37, and 39 (Figure 14 and Table 13), which encompasses the South Yard, and 2-60s and 2-66 CMS study areas (Figure 5). The 2-40s CMS Study Area is drained by outfalls L, M, N, O, P, Q, R, S, T, U, V, W, and Z. Furthermore, the drainage basins of lines J and Z include some public roadway runoff from the 16th Avenue South Bridge and roadway (Line J), and East Marginal Way South (Line Z). Little information is available concerning the potential migration of contaminants to the LDW from these sources. In addition to the known PCB contamination referred in the above paragraphs, the South Yard, 2-60s, 2-66, and 2-40s CMS study areas have also been found to have groundwater and soil contamination. Out of the seven CMS study areas, the South Yard Area, 2-60s Area, and 2-66 Area have had a Work Plan accepted by the EPA; and a Data Gap Investigation Report submitted to, but not yet accepted by, the EPA. The 2-40s Area has had a Work Plan submitted, but not yet accepted by, the EPA. No Work Plan or Data Gap Investigation Report has yet been prepared for the North End, 2-31 Area, and 2-10 Area.

Areas that have been studied have all shown some form of soil and/or groundwater contamination. The remaining study areas (that have yet to be studied) contain contamination, as well. As a result, if contamination is present in the remaining study areas, the entire Plant 2 area could potentially contribute contaminants to the LDW through the stormwater drainage system.

3.2.3.10 Groundwater

Plant 2 is located in the central portion of the Duwamish Valley, adjacent to the tidally influenced LDW. Industrial development of the area, beginning in the 1930s, resulted in pavement or buildings covering a large portion of Plant 2 (EPI and Golder Associates, 2006a).

The soils in the upper 100 feet beneath Plant 2 consist of four major geologic units.

Within the uppermost unit, the first 3 to 9 feet of soil are comprised of a dark gray to brown fill that is a loose to very dense, fine to medium sand, and gray to grayish-brown gravel. Much of the fill appears to be alluvial in nature and probably reflects dredge spoils from modifications to the Duwamish River channel at the beginning of the 20th Century. Some debris exists within the fill. The fill is underlain by a discontinuous layer of brownish to greenish-gray to black silt, and a soft organic silt layer that is approximately 2 feet thick (EPI and Golder Associates, 2006a).

Beneath the silt is the shallow portion of the upper aquifer, consisting of poorly graded, dark gray, fine to medium sand, with varying amounts of silt. This alluvial unit extends from approximately 10 feet bgs to approximately 50 feet bgs. Underlying this unit are older Duwamish River alluvial deposits consisting of thick, coarsening-upward sequences of inter-bedded sand and silty sand. These alluvial deposits extend from approximately 40 to 50 feet bgs to approximately 80 feet bgs (EPI and Golder Associates, 2006a).

At approximately 80 feet bgs, monitoring well logs from Plant 2 describe a distinctive marine silt layer with shell fragments. The contact between the overlying silty sand and the marine silt is sharp and is readily noted in the field. The marine silt layer is underlain by a dense gray glacial till unit. These two low-permeability deposits form an aquitard that isolates the shallow aquifer (upper 80 to 100 feet) from the deeper aquifers beneath Plant 2 (EPI and Golder Associates, 2006a).

Groundwater occurs in the alluvial aquifer, generally starting at 9 to 13 feet bgs. The general groundwater flow direction is southwest, towards the LDW. The majority of groundwater from Plant 2 flows directly to the waterway without crossing other properties, except for limited migration across the southern property line and onto the northern portion of the Jorgensen Forge facility. Even in that location, the dominant flow direction appears to be approximately parallel to the fence line and toward the LDW (EPI and Golder Associates, 2006a).

The LDW in the vicinity of Plant 2 is a tidally controlled marine embayment, with a fresh water lens of outgoing river water on top of the denser (more saline) marine waters. The sediments, while alluvial in nature, have salinities consistent with the marine waters from Elliott Bay. A saline groundwater wedge extends into the Uplands, from the waterway, and deeper deposits (greater than 60 feet) contain groundwater with high salinity, due to trapped sea water that was present at the time of sedimentation. The groundwater column ranges from saline at depth, to fresh on the top (EPI and Golder Associates, 2006a).

Shallow monitoring wells, generally in the upper 30 feet, are referred to as A-level wells. Wells installed deeper in this sand unit (generally from 30 to 60 feet bgs) are referred to as B-level wells. At approximately 60 feet bgs, the silt content increases in a gradational change that can be distinguished based on field observations. The aquifer material below this layer is referred to as the C-level of the upper aquifer, and wells installed below 60 feet are referred to as C-level wells (EPI and Golder Associates, 2006a).

Groundwater flow is primarily horizontal with a calculated average flow velocity range of 490 to 970 feet per year, in the upper A- and B-levels of the aquifer, and 4.2 feet per year in the C-level of the aquifer (EPI and Golder Associates, 2006a).

Details concerning the extent of contamination that has been found in the seven CMS study areas are provided in their respective sections. The data gap section details areas from the South Yard Area and 2-60s Area, where the contaminant plume is not delineated. In these areas, there is a possibility that contaminants could reach the LDW. The following is a summary of COCs that were detected in the South Yard Area and 2-60s Study Area during their Data Gap Investigations:

- Arsenic;
- Benzene;
- Copper;
- 1,1-DCE;
- DRPH;
- Manganese;
- Mercury;
- MoRPH;
- PCE;
- TCE;

- Vinyl chloride; and
- Zinc;

The following COCs had detections in soil above reporting limits in the South Yard Area during the Data Gap Investigations (EPI and Golder Associates, 2006d):

- Aroclor 1254;
- Aroclor 1260;
- Arsenic;
- Benzo(a)fluroanthene;
- Benzo(a)anthracene;
- Benzo(k)fluroanthene;
- Benzo(a)pyrene;
- BEHP;
- Benzene;
- Cadmium;
- Chrysene;
- Copper;
- cDCE;
- DRPH;
- Mercury;
- Nickel;
- PCE;
- Silver;
- TCE;
- 1,1,1-trichloroethane;
- Toluene;
- Vinyl chloride; and
- Zinc.

COCs, via the surface water pathway, were evaluated to assess whether groundwater had been impacted by COCs in soils. The following COCs in soils were also found in groundwater above screening levels protective of surface water in the South Yard Area:

- Benzene;
- 1,1-DCE;
- Mercury;
- PCE;
- TCE; and
- Vinyl chloride.

The following COCs had detections in groundwater above screening levels in the 2-60s Area during the Data Gap Investigations (EPI and Golder Associates, 2006b):

- Aroclor 1260;
- Arsenic;
- BEHP;
- Benzene;
- Copper;
- Cyanide;
- 1,1-DCE;
- DRPH;
- Ethylbenzene;
- GRPH;
- Manganese;
- Mercury;
- Nickel (soluble salts);
- PCE;
- Vinyl chloride; and
- Zinc.

The following COCs had detections in soil above reporting limits in the 2-60s Area during the Data Gap Investigations (EPI and Golder Associates, 2006b):

- Arsenic;
- BEHP;
- Benzene;
- n-Butylbenzene;
- Sec-Butylbenzene;
- Cadmium;
- Cyanide;
- Ethylbenzene;
- GRPH;
- Isopropylbenzene;
- Mercury;
- Naphthalene;
- PCBs;
- PCE;
- n-Propylbenzene;
- Silver;
- TCE;
- 1,2,4-trimethylbenzene;
- 1,2,5-trimethylbenzene; and
- Zinc.

COCs were evaluated, via the surface water pathway, and assessed to determine whether groundwater had been impacted by COCs in soils. The following COCs in soils were also found in groundwater above screening levels protective of surface water in the 2-60s Area (EPI and Golder Associates, 2006b):

- Cyanide;
- Mercury;
- PCBs;

- PCE; and
- Zinc.

3.2.3.11 Spills

The spill log for Plant 2 indicated the following discharges occurred at the facility within the past three years (Note: this log only included spills that had the potential to discharge into the LDW since April 1998). Spill control and cleanup actions prevented discharge to the LDW for all of these incidents (Boeing, 2007a).

- April 3, 2003. An unknown volume of non-contact cooling water (potable water) was spilled at the 2-16 plant services terminal.
- October 6, 2003. 13,000 gallons of waste water from paint booth discharge was spilled at Building 2-62.
- December 12, 2003. An unknown volume of potable water from a water main break was spilled at the south end of Building 2-62.
- September 22, 2004. 300 gallons of waste water from a tank overflow at the 2-83 wind tunnel was spilled at Building 2-83.
- December 6, 2004. An unknown volume of turbid rain water from parking lot construction was spilled at the former Boeing Operations Center parking lot north of Building 2-25.
- March 7, 2005. 2 quarts of used motor oil from a used oil tank overflow was spilled at Building 2-15, door E-19.
- October 7, 2005. 150 gallons of wash water was spilled at Building 2-10.
- November 11, 2005. 200 gallons of wash water was spilled at Building 2-15.
- January 10, 2006. An unknown volume of unknown automotive foam was spilled on the east side of Building 2-15.
- December 30, 2006. 100 gallons of potable water (pressure washing of pavement) was spilled to the northeast of Building 2-15.

3.2.3.12 Bank Erosion/Leaching

A Data Gap Investigation has not been conducted for the 2-66, 2-40, 2-31, 2-10, and North End areas, which all have part of the study area that is located along the banks of the LDW (Figure 5). It is possible that contaminants in these parts of Plant 2 may contribute to ongoing contamination to the LDW.

Plant 2 is nearly (98 percent) covered by impervious materials such as concrete, asphalt, and building roofs. There is virtually no stormwater overland flow from the site; instead, it is contained within the storm drain system. Generally, the west side of the property facing the Duwamish Waterway slopes so that stormwater flows back through the storm drain system, as opposed to over the bank and into the LDW. Also, the Duwamish bank is partially vegetated and lined with rip-rap to reduce possible erosion (Boeing, 2007a). Several of the discharge points have been noted by the EPA to have erosion around the discharge point area.

Duwamish Sediment Other Area and Southwest Bank Focused Corrective Measures Study

The DSOA and Focused Corrective Measures Study (FCMS) include dredging, with subsequent capping and/or backfilling of the DSOA open-water areas (Figure 18; MCS Environmental, Inc., 2006). This area includes the western and southern boundary extensions, as described below:

- Dredging with subsequent capping and backfilling of the Under-building Area;
- Removal of sediment and subsequent backfilling of the Outfall 12 area; and
- Removal of contaminated bank fill material from the Southwest Bank area, with subsequent reconstruction of the bank.

The DSOA is an interim measure and not a final remedy. The DSOA portion of the CMS was originally defined (although the boundaries have never been approved by the EPA) as the cleanup of sediment contiguous to the facility to the west with boundaries established by the south edge of Slip 4 to the north; the western projection of the Plant 2-Jorgensen Forge property line to the south; the approximate top of the eastern slope of the shipping channel to the west; and the mean higher high water line to the east. The boundary of the DSOA was subsequently extended to the west to the Federal Navigation Channel and to the south, approximately 100 feet (MCS Environmental, Inc., 2006), and may be further expanded based upon April 2007 sampling.

During the RFI, samples were collected throughout the uplands and in water areas adjacent to the facility. The Duwamish Waterway Sediment Investigation, a component of the RFI, collected surface sediment samples (0 to 4 inches) at approximately 60 locations (excluding additional samples collected in the vicinity of Outfall 12) within the DSOA (MCS Environmental, Inc., 2006). Samples were analyzed for total organic carbon, PCBs, metals, and SVOCs. In addition, subsurface sediment cores were collected at 16 locations within the DSOA. Subsurface composite samples (2 to 5 feet long) were collected from each of the cores and were also analyzed for total organic carbon, PCBs, metals, and SVOCs (MCS Environmental, Inc., 2006). The RFI evaluation indicated the following:

- PCBs were wide-spread in front of the Plant 2 facility and were detected in the majority of the samples.
- Metals were detected in a few locations at Plant 2, predominately at the toe of the Southwest Bank (an area where metal-containing debris was found in the shoreline fill).
- A few other SVOCs, primarily PAHs and phthalates, were detected in the sediments, but always within the footprint defined by the broader and more extensive PCB contamination.

Based on the findings in the RFI, PCBs and seven metals (cadmium, chromium, copper, lead, mercury, silver, and zinc) were identified as COCs for the DSOA. Elevated metal concentrations were largely limited to the toe of the slope at the Southwest Bank, and were limited in depth (MCS Environmental, Inc., 2006). Their source is suspected to be in the bank fill materials, as the highest concentrations of metals within the Southwest Yard Area are found in the bank materials and at the toe of the slope. The metals were found in areas that also contained PCB contamination, but the metals contamination was neither as extensive nor as deep as the PCB contamination (MCS Environmental, Inc., 2006).

Subsequent to the RFI, 101 subsurface sediment cores were collected within and upriver of the DSOA (MCS Environmental, Inc., 2006). Subsurface sediment cores from 81 locations within, or immediately adjacent to, the DSOA were used in the geospatial analysis (MCS Environmental, Inc., 2006).

All of the post-RFI core sampling focused on refining the depth and extent of PCB and metals contamination. After the collection and review of the post-RFI data, a technical working group was formed to perform a geospatial analysis of the data. The following spatial trends are evident (MCS Environmental, Inc., 2006):

- In the 2- to 3-foot intervals, elevated concentrations of PCBs are wide-spread across the DSOA, except in some of the near shore areas north of the 16th Avenue South Bridge (MCS Environmental, Inc., 2006).
- Concentrations of PCBs significantly decreased in the 4- to 5-foot intervals, as compared to the 2- to 3-foot intervals. In the 4- to 5-foot intervals, PCB concentrations are below the SQS in the northern one-third of the DSOA and in most of the near shore section of the middle third of the DSOA. Elevated concentrations of PCBs are present in the 4- to 5-foot intervals, near the navigation channel and south of the 16th Avenue South Bridge (MCS Environmental, Inc., 2006).
- In the 5- to 6-foot intervals, PCB concentrations in all of the DSOA north of the Southwest Bank are below the SQS (MCS Environmental, Inc., 2006).
- Elevated PCB concentrations extend to a deeper depth near the south end of the DSOA (MCS Environmental, Inc., 2006).
- Samples selected for metals analysis at the Southwest Bank show that elevated metals concentrations did not extend below the 3- to 4-foot layer. Metals were otherwise collocated with PCBs and did not extend below the depth that PCBs were found (MCS Environmental, Inc., 2006).

A physical conceptual site model was developed for the sediments in the DSOA to aid in the evaluation of the dredge and fill alternatives and to better understand potential design requirements (MCS Environmental, Inc., 2006). Two alternatives for the DSOA Corrective Measure were evaluated. They are:

- *Alternative 1:* A fixed 4-foot total dredge depth and cap/backfill alternative (the original concept of the DSOA Corrective Measure). This alternative leaves behind some areas with sediment PCB concentrations exceeding the SQS beneath an engineered cap. In areas where sediments are not expected to substantially exceed the SQS, the engineered cap is replaced with simple backfilling to existing grade.
- *Alternative 2:* A variable-depth dredge and backfill alternative, where it is expected that no sediments substantially exceeding the SQS will remain followed by backfilling to return the site to grade.

Both of these DSOA alternatives will result in a restored sediment surface that meets the SQS for the top 4-inch surface layer (MCS Environmental, Inc., 2006). The DSOA remedy will include the removal of contaminated sediments from the Duwamish Waterway shoreline and the placement of clean backfill and/or capping materials.

Boeing conducted an analysis of these two alternatives. The performance expectation for the variable-depth dredge and backfill rated equal to or higher than the 4-foot dredge and cap/backfill alternative (MCS Environmental, Inc., 2006). In addition, the cost for implementing the variable-depth dredge alternative is estimated to be approximately \$100,000 less than the 4-foot dredge alternative. Based on

the results, Boeing recommended that the EPA select the variable-depth dredge and backfill alternative as the corrective measure for the DSOA.

The western boundary of the cleanup has not been agreed upon. Boeing proposed an appropriate western boundary for the DSOA cleanup (the eastern margin of the federal navigation channel) as derived from the *2001-2005 Formal Dispute Resolution Decision Process* (as cited in Boeing, 2006a), however, the EPA would like to expand sampling into the federal navigation channel.

The corrective measures for the Under-building Area, Outfall 12, and the Southwest Bank will be implemented concurrently with the DSOA Corrective Measure (MCS Environmental, Inc., 2006).

Under-Building Area

The Under-building Area is an approximately 1,000-foot long section of buildings (2-41, 2-44, and 2-49) overhanging the LDW. The overhanging portion is 50 feet wide and is supported by wooden piles and is physically separated from the uplands by a continuous bulkhead wall. Running underneath the overhang are a number of pipes, vaults, and other utility infrastructures that once supported the former manufacturing operations in the buildings. The surface beneath the overhang is a steep riverbank slope, covered with riprap extending to a scalloped sediment interface that is only exposed during low tide.

There are seven RCRA units in the Under-building Area (MCS Environmental, Inc., 2006). The first four units have a footprint that straddles the boundary between the uplands and the DSOA. The last three units are outfalls that daylight in the Under-building Area. The seven RCRA units are:

- SWMU 2-41.35 (Quench Tanks);
- AOC 2-41.29 (J-25 TCE Degreaser);
- SWMU 2-41.36 Of the 73 groundwater samples, there were 11 detections above the screening level (0.822 µg/kg; Underflow Flume);
- OA 19 (Outfall 12 and Stretch-Press Pit [only stretch-press pit portion straddles boundary]);
- OA 20 (Outfall 23);
- OA 22.A (Outfall 14);
- OA 22.B (Outfall 16); and
- Outfall 12.

Sampling in the Under-building Area was concentrated in areas associated with uplands RCRA units that extend through the bulkhead, IM areas, or in RCRA units associated with the outfalls. Various investigations conducted in the Under-building Area found samples with elevated levels of metals and organic COCs (at or above the SQS) were always within the more wide-spread footprint of PCBs, and appear to be restricted to recent depositional sediments (MCS Environmental, Inc., 2006). The native alluvium deposits are considered to be generally free of COCs.

There have been two IMs conducted in the Under-building Area; the Underflow Flume IM and the Building 2-41 Debris Area IM. Further investigations of the under building areas will be conducted in association with the Alternative Corrective Measures Evaluation Report.

In the Underflow Flume IM, previous sediment samples indicated elevated concentrations of PCBs that justified removal, via an IM (MCS Environmental, Inc., 2006). During this IM, samples were collected near the Underflow Flume to finalize the design and determine the depth to which sediment was to be removed. Approximately 30 cubic yards were removed at the Underflow Flume (MCS Environmental, Inc., 2006). Sediments with concentrations of PCBs above the SQS remain in place below the backfilled IM excavation.

During the Building 2-41 Debris Area IM, the IM targeted an isolated area where sediment containing elevated lead concentrations had been identified. Fourteen samples were collected for design of the IM (MCS Environmental, Inc., 2006). Approximately 20 cubic yards of sediment were removed during the IM. Two confirmation samples were collected from the bottom of the excavations before backfilling.

The Outfall 12 area is in the intertidal zone located on the bank at the south end of the Building 2-49, adjacent to the Southwest Bank. An IM was conducted in this area, removing sediment and soils with elevated concentrations of PCBs (MCS Environmental, Inc., 2006). Approximately 20 cubic yards of sediment were removed at Outfall 12. Sediments with concentrations of PCBs above SQS remain in place below the backfilled IM excavation.

Additional sampling in the Outfall 12 area was conducted during the DSOA and Outfall 12 characterization (MCS Environmental, Inc., 2006). This characterization indicated that elevated PCB concentrations extend to a depth of approximately 5 to 6 feet below mudline (about 2 feet below the prior IM backfill), in an approximate 10-foot-by-12-foot area of the prior Outfall 12 area IM. Outside the footprint of the prior IM, elevated concentrations of PCBs were limited to 2 to 3 feet below the mudline. The Outfall 12 action was designed to remove sediments with elevated concentrations of COCs, leaving in place sediments that are not expected to substantially exceed the SQS. Excavation adjacent to the Outfall 12 area will be to a depth of 4 feet bgs for both alternatives in the DSOA. In addition, within the footprint of the prior IM, sediment will be removed to a depth of approximately 6 feet below the mudline. After excavation, the Outfall 12 area will be backfilled with clean sand material to restore elevations. This excavation is expected to be less than 100 cubic yards. Some of the material in this area is expected to exceed Toxic Substance Control Act levels for PCBs (>50 ppm) and will require special handling.

Southwest Bank Corrective Measure

The Southwest Bank refers to the southern most portion of Plant 2, fronting the LDW, specifically the section of riverbank located between the Plant 2 southern border and Building 2-49, approximately 400 feet to the north.

A variety of chemical data has been collected at the Southwest Yard (MCS Environmental, Inc., 2006). These data primarily consist of analysis of surface sediment (collected offshore of the Southwest Bank), surface soil (exposed along the bank itself), subsurface soil (collected from soil borings within the Southwest Yard), and groundwater. Additional subsurface soil data were collected in the summer of 2001, as part of the preliminary design of the Southwest Bank CMS.

Elevated metals concentrations (primarily cadmium, copper, lead, and zinc) found in Southwest Bank soils appeared to be related to large amounts of debris found within the upper deposits of the Southwest Bank fill (MCS Environmental, Inc., 2006). Furthermore, PCBs were also occasionally detected. The locations where PCBs were detected did not correlate with locations of elevated metals concentrations.

The preliminary conclusion of that evaluation was that the Southwest Bank had a sufficiently steep slope (approximately 1:1), and contained enough construction debris and contaminated soil that removal of the debris within the Southwest Bank was deemed more practical than capping this material (MCS Environmental, Inc., 2006). Removal of the bulk of the contaminated bank fill material was selected as

the preferred alternative in the Southwest Bank FCMS, submitted to, and approved by, the EPA. The Southwest Bank corrective measure will be timed to occur concurrently with DSOA dredging, and the design documents for the Southwest Bank will be integrated into the larger DSOA design (MCS Environmental, Inc., 2006).

3.2.4 Data Gaps

3.2.4.1 Upland Facilities

At Plant 2, Boeing is conducting Data Gap Investigations, one at a time, for each of the seven CMS study areas. Data gaps for all potential sources of contamination are summarized in Table 14. The South Yard Area and 2-60s Area have had work plans submitted to, and accepted by, the EPA; and data gap investigation reports have been submitted for each area to, but not yet accepted by, the EPA. The 2-40s Area has had a Work Plan submitted to, but not yet accepted by, the EPA. No information regarding CMS study areas 2-10, 2-31, and North Yard were found during a review of files from Ecology.

Data collected as part of the Data Gap Investigations will be evaluated, interpreted and applied to future remedy selections. The future reports will also evaluate comparisons to historical areas of COC impacts above screening levels. EPA has requested the Boeing start sampling for SVOCs in the shoreline monitoring wells to address this data gap. Another data gap regarding upland facilities is the EMF plume detected in Plant 2. This plume originates along the east side of KCIA and has migrated onto Plant 2. Under a CERCLA Order, additional investigations will be conducted and will address how this plume will be reduced and/or eliminated (also see Section 3.2.4.3).

3.2.4.2 Stormwater Discharge

An AutoCAD (CAD) drawing showing Plant 2's stormwater drainage system, including drainage basins, stormwater drain lines, flow direction, catch basins, manholes, oil/water separators and pump stations, was reviewed (Boeing, 2007b). This CAD drawing was used to generate Figure 14 and Figure 15. Multiple CAD layers showing buildings and areas of contamination that can overlay the stormwater drainage layer would be effective. This would determine which features are located in which drainage basin, and determine which stormwater drain (and associated outfall) drains to the LDW.

Boeing's Plant 2 SWPPP states that, because Plant 2 is located between East Marginal Way South and the LDW, some discharge from off-site flows through City of Seattle and City of Tukwila storm drain systems and enters the Plant 2 system. Consequently, some discharge from off-site sources commingles with Plant 2 storm drainage before reaching the LDW. The drainage basins of lines J and Z include some public roadway runoff from the 16th Avenue South Bridge and roadway (Line J), and from East Marginal Way South (Line Z). These commingled waters are discharged at Outfall Z (9A; City of Tukwila) and Outfall J (27; City of Seattle). No data has been collected to evaluate the relative flow from non-Boeing sources through these outfalls (Boeing, 2007a). More information, including a Geographic Information System layer showing the locations of the City of Seattle and City of Tukwila discharge connections to Plant 2's stormwater drainage system, and in-line sediment samples within the City of Seattle and City of Tukwila systems immediately prior to discharge into Plant 2's stormwater drainage system, is needed. This would assist with determining the potential migration pathway of contaminants from the City of Tukwila's public roadway drainage from East Marginal Way South, through Plant 2's Outfall Z, and the City of Seattle's public roadway drainage from the 16th Avenue South Bridge, through Plant 2's Outfall J, to the LDW.

Furthermore, one city storm drain outfall is shown as discharging to the LDW within EAA-4 (Figure 3). More information is required to determine if this is Outfall J (or a different outfall), as it discharges to EAA-4, at the 16th Avenue South Bridge.

3.2.4.3 Groundwater

In the South Yard Area Data Gap Investigation Report, it was stated that the flow volumes or exact flow directions across the property line to the Jorgensen Forge facility have not been determined (EPI and Golder Associates, 2006d). A more focused water level data-gathering effort would need to be performed to obtain such information. Boeing intends to pursue a joint hydrologic investigation with Jorgensen Forge to provide the additional data needed for this evaluation (EPI and Golder Associates, 2006d).

There are several groundwater contaminant plumes that could contribute to the recontamination of the LDW. The dissolved copper, dissolved mercury, dissolved nickel, TCE, and vinyl chloride groundwater plumes in the 2-60s Area appear to extend into the 2-66 study area, which is adjacent to the LDW (EPI and Golder Associates, 2005c). The most recent porewater investigation conducted by the LDW (*Data and Analysis Report: Porewater Sampling of Lower Duwamish Waterway – Final*; Windward, 2006) identified detected concentrations of halogenated volatile organic compounds (i.e., 1,1-dichloroethane [0.2 to 0.3 µg/L], cis-1,2-dichloroethene [0.2 to 1.7 µg/L], trichloroethene [0.2 µg/L], and vinyl chloride [0.2 to 13 µg/L]) within the LDW adjacent to the Boeing/Jorgensen property line intersection. This data provides some evidence that the 2-66 study area may be contributing chemicals to the waterway. The extent of this plume needs to be determined during the 2-66 Area Data Gap Investigation; this would include a full delineation of the plume along the LDW. Findings of this delineation should be incorporated in future CMSs.

In the South Yard Area, plumes of the following groundwater contaminants do not appear to be fully delineated, and could potentially contribute to the recontamination of the LDW: dissolved arsenic, dissolved manganese, dissolved zinc, benzene, 1,1-DCE, PCE, TCE, vinyl chloride, TPH-diesel range, and TPH-motor oil range (EPI and Golder Associates, 2005c). The plumes are delineated only up to the property line between Plant 2 and Jorgensen Forge. As stated in the above paragraph for the 2-66 Area, a full delineation of the groundwater plumes is necessary to evaluate the potential for the plumes to impact the LDW.

3.2.4.4 Spills

No data gaps have been identified for spills at the Plant 2 facility.

3.2.4.5 Bank Erosion/Leaching

Elevated metals concentrations (primarily cadmium, copper, lead, and zinc) found in Southwest Bank soils (Southwest Bank CMS) appear to be related to large amounts of debris found within the upper deposits of the Southwest Bank fill (MCS Environmental, Inc., 2006). In addition, PCBs were also occasionally detected in this area. The locations where PCBs were detected did not correlate with locations of elevated metals concentrations.

The preliminary conclusion of the Southwest Bank evaluation was that there was a sufficiently steep slope (approximately 1:1), and the area contained enough construction debris and contaminated soil, that removal of the debris within the Southwest Bank was deemed more practical than capping the material (MCS Environmental, Inc., 2006). Removal of the bulk of the contaminated bank fill material was selected as the preferred alternative in the Southwest Bank FCMS, submitted to, and approved by, the EPA. The Southwest Bank corrective measure will be timed to occur concurrently with DSOA dredging, and the design documents for the Southwest Bank will be integrated into the larger DSOA design. This

design has not yet been completed. No additional data gaps have been identified for bank erosion/leaching at the Plant 2.

3.3 Jorgensen Forge

3.3.1 Current Operations

The Jorgensen Forge Corporation facility is located at 8531 East Marginal Way South in Seattle. The site occupies approximately 21.6 acres between Slip 4 and Slip 6 on the east bank of the LDW (Figure 2). The land use surrounding the facility is primarily industrial. The facility is part of a larger, contiguous, industrial area that extends from Harbor Island through the Duwamish Waterway corridor. The site is bounded by Plant 2 to the north, the Boeing-Isaacson property to the south, the KCIA to the east, and the LDW to the west.

Currently, manufacturing operations on-site consist of precision-machined forgings from material grades, including carbon and low-alloy steels, duplex stainless grades, aluminum alloys, titanium alloys, and nickel-base alloys for the commercial aircraft, aerospace, energy (i.e., oil exploration), power generation, automotive, and shipbuilding industries.

The site is developed and includes the following facilities: a machine shop, forge shop, melt shop, aluminum heat treating area, former power house, rectifier room, office building, and storage areas. The majority of the site is covered with impermeable surfaces that consist of asphalt, concrete paving, and buildings. Along the western shoreline area of the property, there are some portions of the ground surface that are covered with gravel.

According to the King County Tax Assessor website, the facility is located on Parcel No. 0001600023. This 21.6-acre property is owned by Jorgensen Forge Corporation and contains the following 14 structures (Figure 19):

- A two-story, 10,308-sq. ft. office building (built in 1950);
- A 29,264-sq. ft. industrial light manufacturing building (built in 1943);
- A 72,708-sq. ft. industrial light manufacturing building (built in 1943);
- A 6,042-sq. ft. office building (built in 1943);
- A 4,296-sq. ft. service garage (built in 1943);
- A two-story, 150,578-sq. ft. industrial light manufacturing building (built in 1943);
- A 8,184-sq. ft. industrial light manufacturing building (built in 1943);
- A 11,831-sq. ft. equipment building (built in 1943);
- A 1,728-sq. ft. office building (built in 1943);
- A 2,480-sq. ft. laboratories building (built in 1943);
- A 10,966-sq. ft. equipment building (built in 1943);
- A 3,969-sq. ft. equipment building (built in 1987);

- A 3,000-sq. ft. storage warehouse building (built in 1979); and
- A 12,393-sq. ft. industrial light manufacturing building (built in 1987).

To the south of the site (address not listed, Parcel No. 0001600014) is the approximate 10-acre Boeing-Isaacson property, owned by Boeing. The property is currently a vacant commercial property. To the north of the site (7755 East Marginal Way South) is an approximate 30-acre property (Parcel No. 0001600020), which is the southern section of Boeing Plant 2. This property contains several buildings including warehouses, offices, and industrial engineering and light manufacturing buildings. To the west of the site is the LDW. To the east of the site (8700 East Marginal Way South) is an approximate 9-acre property (Parcel No. 0001600049) owned by King County. The property is currently part of the KCIA. Also to the east of the site (6505 Perimeter Rd South) is an approximate 565-acre property (Parcel No. 2824049007) owned by King County. This property is currently the KCIA and contains an air terminal and hangars (King County, 2007).

Decades ago, the western portion of the the Jorgensen Forge site contained an embayment of the Duwamish Waterway. A review of aerial photographs and historic information indicates this embayment was filled in the early 1940s (EPA, 2003), although the exact year could not be determined. The source of the fill is likely the result of historical hydraulic dredging conducted in the LDW by the U.S. Army Corps of Engineers (Farallon and Anchor, 2006).

The west side of the Jorgensen Forge site is a relatively steep eastern bank of the LDW. Approximately 8 to 9 vertical feet of the bank adjacent the site extends above the mean higher high water elevation (11.1 feet above mean lower low water). The shoreline bank of the site is heavily armored with a variety of materials. The northern portion is armored with riprap and woody debris. The middle portion of the bank consists of riprap intermixed between remnant timber piles. The upper elevations of the bank area are densely vegetated. A gravel surface extends to the top of the bank, along the majority of this area of the shoreline. The southern portion is a vertical sheet steel pile/concrete bulkhead (Farallon and Anchor, 2006).

The Jorgensen Forge facility currently has an EPA Superfund Order (CERCLA Order No. 10-2003-0001) to address contamination in sediments of the LDW and Shoreline Bank Area adjacent the facility (EPA, 2007b). In addition, Ecology has issued an Agreed Order (No. DE 4127) to address contamination within the upland portion of the Jorgensen Forge facility (Ecology, 2007g). These orders from EPA and Ecology are working concurrently.

The Jorgensen Forge facility is listed as a hazardous facility on Ecology's online Hazardous Site Facility Search Database and its RCRA Site Identification No. is WAD000602813 (Ecology, 2007e).

According to Ecology's online NPDES and State Water Discharge Permit database, there is no NPDES Individual Wastewater Discharge permit for this site (Ecology, 2007d). The Jorgensen Forge facility has been issued a NPDES Industrial Stormwater General Permit (No. SO3003231C) by Ecology. The parameters for this permit are for turbidity (Action Level of 50 NTU), petroleum – oil and grease (Action Level of 30 mg/L), total copper (Action Level of 149 ug/L), total lead (Action Level of 159 ug/L), total zinc (Action Level of 372 ug/L), and pH (303d listed Action Level range of 6.5 to 8.5 standard pH units) (Ecology, 2004 and 2007d). There is currently no Wastewater Discharge Permit from King County Industrial Waste Program for Jorgensen Forge.

The EPA TRI database annually records toxic releases and other waste management activities. Available data includes reports on releases, water transfers, and waste quantity from 1988 to 2004. The information from the database indicates that all waste from Jorgensen Forge (TRI Identification No.

98108RLMJR8531E) has been transferred off-site for waste management. Waste includes metals and metal compounds such as aluminum, chromium, lead, manganese, molybdenum, nickel, and zinc. The quantity of waste materials ranged from 156 to 640,250 pounds, depending on the chemical and the year (EPA, 2007b).

3.3.2 Historic Use

This property was developed in 1942, and operated from 1942 to 1965 as a fabricator of structural steel, and tractor and road equipment. On-property operations included forging, heat-treating, and galvanizing by Isaacson Iron Works, which operated as a U.S. naval vessel manufacturer. From approximately 1953 to 1963, Bethlehem Steel operated a steel distribution center on the northwestern portion of the property. Bethlehem Steel operations consisted of cutting prefabricated steel rods to customers' specifications. From 1965 to 1992, this property was owned and operated by the Earle M. Jorgensen Company. In July, 1992, the facility was purchased by a plant management group and became the Jorgensen Forge Corporation.

3.3.3 Environmental Investigations and Cleanup Activities

3.3.3.1 Upland Remedial Investigations

Environmental investigations and cleanup activities have been conducted at Jorgensen Forge under the RCRA program (RCRA Site ID No. WAD000602813; Ecology, 2007f). In 1991, Ecology responded to complaints that petroleum contamination occurred at the Jorgensen Forge facility. After a site visit, the inspector determined the site required further inspection. In 1992, the Jorgensen Forge property was added to Ecology's Integrated Site Information Systems list of confirmed and suspected contaminated sites, to await further assessment under the MTCA (Ecology, 2007b).

In 1991, an 8,000-gallon gasoline UST and associated pipelines were removed from the Jorgensen Forge property. The tank was in good condition and sediment sampling in the tank vicinity indicated that the tank did not impact subsurface soils. During this removal, two additional unregistered USTs (including a 1,000-gallon UST and a 2,000-gallon UST) were identified and removed. Both tanks were in poor conditions, with 30 to 50 holes in each tank. These holes ranged in size from 0.1 to 4 inches in diameter. It was also determined that the subsurface soil was impacted by petroleum released from these USTs. Approximately 36 cubic yards of soil were removed during the excavation of the USTs. In May 1991, a preliminary groundwater investigation was conducted at the locations of the two unregistered UST locations (SEACOR, 1993).

Data gathered during the investigation indicated that petroleum hydrocarbons in excess of cleanup levels were present in the groundwater and soil beneath both of the former UST locations. Investigations concluded that petroleum hydrocarbons impacted the soil and groundwater hydraulically downgradient to the west-southwest of the former UST locations. This study did not delineate the aerial extent of the impacted groundwater. As a result of this contamination, an air sparging and vapor extraction remediation system was installed to reduce the concentration of petroleum hydrocarbons in the groundwater in Area 3. This system was effective in lowering contamination concentrations throughout the majority of Area 3. Where concentrations were not decreasing, additional air sparging and vapor extraction wells were installed and the system was modified to effectively reduce contamination concentrations (SEACOR, 1997).

Periodic groundwater sampling and analysis have been conducted prior to and after the installation of the remediation system in 1993. During continued monitoring, concentrations of contaminants showed a

downward trend. After 1996, all monitoring well sample results were below analytical method reporting limits for petroleum hydrocarbons (SEACOR, 1997).

During the summer of 1993, Ecology conducted a Site Hazard Assessment (SHA) of the Jorgensen Forge property, assigning a site ranking of 5 (1 being the highest level of concern, 5 being the lowest). This ranking was determined according the groundwater pathway scoring for petroleum contamination (Ecology, 2005).

From 1991 to 1996, SEACOR conducted investigations, groundwater monitoring, and interim remedial actions of petroleum hydrocarbons (oil and gasoline) in soil and groundwater in three areas of the Jorgensen Forge property. The three areas were reported to have releases which included cutting oil beneath equipment in the north portion of the forge shop building, hydraulic oil from an oil/water separator adjacent to the northwest corner of the acid waste hold tank (AHT) building into soil and groundwater, and diesel and gasoline in soil and groundwater from former USTs at the site (Dames and Moore, 1999).

A focused RI/FS of Area 3 was prepared, addressing soil and groundwater affected by the release of an unknown quantity of hydrocarbons, predominately gasoline, from one or more of the USTs that were removed from the facility. Key findings identified Total Recoverable Petroleum Hydrocarbons (petroleum oil), TPH-gasoline range, and benzene, toluene, ethylbenzene, and xylene (BTEX) compounds as COCs. There were minimal vadose-zone soil impacts from these constituents. Light nonaqueous-phase liquid (LNAPL) was not present on the groundwater surface. A dissolved BTEX plume in the groundwater, with a downgradient extent from the former UST location of approximately 100 feet, was delineated. The former USTs were determined as the source of the BTEX and TPH-gasoline range releases, and potentially the petroleum oil. Although the connection between the shallow groundwater and the waterway was confirmed, the groundwater impacts from the oil/water separator release are believed to be localized within the immediate vicinity of the former USTs (SEACOR, 1993).

In April 1995, groundwater monitoring by SEACOR detected the presence of immiscible diesel fuel or LNAPL on the surface of the groundwater in one of the Area 2 monitoring wells. The LNAPL was found near the AHT building which was used to store diesel fuel as a backup fuel for the furnaces in the fuel shop. The diesel was transported to and from the furnaces via a subsurface system of pipes. Leak testing of these tanks and piping was conducted in August 1996, following notification of the owner/operator in March 1996. Testing results determined that the likely source of diesel was a section of the return line beneath the AHT building. The results of SEACOR's investigation indicated that diesel fuel was present in the soil and the groundwater in the area between the AHT building and the Forge Shop building (Dames and Moore, 1999).

In 1999, soil and groundwater investigations were conducted to assess the changes to the lateral extent of the diesel plume in soil and groundwater since 1996. In addition, the scope of work included delineating the lateral extent of the oil-range TPH, downgradient of the oil/water separator and extraction wells. This was not previously delineated in the earlier investigations. To conduct this investigations, nine samples were collected between the AHT building and the forge shop building. Selected existing monitoring and extraction wells were assessed for fluid level measurements and groundwater sampling, where appropriate (Figure 19). Hydrocarbons (i.e., LNAPL) were observed in all wells except EW-2 (Dames and Moore, 1999).

Soil samples were collected at a depth of 7 to 10 feet bgs and analyzed for TPH as diesel and heavy oil. Diesel-range hydrocarbons were detected in soil samples P-1 through P-4 and P-7. Concentrations of petroleum hydrocarbons in these samples ranged from 34 mg/kg (P-7) to 15,000 mg/kg (P-4). Heavy oil-range TPH was not detected in the samples (Dames and Moore, 1999).

Groundwater samples from borings P-1 through P-5 and P-9 were analyzed for TPH as diesel and heavy oil. The analyzed results detected DRPH in groundwater samples from borings P-1 through P-5 and P-7. The diesel-range TPH concentrations ranged from 1.2 mg/L (P-2) to 96 mg/L (P-7). Heavy oil-range TPH was not detected in any of the groundwater samples (Dames and Moore, 1999).

Soil samples from borings P-1 through P-4 contained diesel TPH concentrations greater than the MTCA Method A soil cleanup levels (200 mg/kg). Results of the investigation determined the contaminated soil was bounded by well EW-2 to the north, borings SB-12 and P-5 to the south, boring SB-10 to the east, and boring P-7 to the west. The soil and groundwater data suggests the TPH-diesel range plume is similar in lateral extent as it was in 1996. Dissolved TPH-diesel range in the groundwater has migrated only slightly further south. The analytical results, as indicated that TPH as oil, was not detected in the current plume of dissolved TPH-diesel range. In addition, TPH as oil was not detected in the groundwater at EW-2 and P-9 (Dames and Moore, 1999).

3.3.3.2 EPA Investigation Administrative Order of Consent

During 2003, the EPA entered into an Administrative Order of Consent with the Earle M. Jorgensen Company. The purpose of the Administrative Order of Consent was to determine whether sediments in the LDW adjacent to the Jorgensen Forge site have been impacted by current or historical operations at the site. The investigation included soil borings, shoreline sediment sampling, catch basin sampling, an inactive outfall video reconnaissance survey, and a site stormwater drainage survey to assess PCB contamination (Farallon and Anchor, 2006).

From 2003 to 2006, Farallon and Anchor Environmental conducted a phased site investigation which entailed two rounds of sampling and preparation of an Investigation Data Summary Report. The task of the first phase was to identify potential sources of PCBs from current or historical operations at the site, define potential contamination pathways, and identify data gaps for further sampling. Results concluded there was no evidence that PCBs had been or are used at the Jorgensen Forge facility. The only on-site source of PCBs could be dielectric fluid, contained in some of the transformers owned and operated by SCL. However, there is no evidence that any release from these transformers has ever occurred on-site (Farallon and Anchor, 2006).

Fill placed on-site, in the embayment, was identified as a potential source of PCBs and metals contamination. The source of the fill is likely from historic hydraulic dredging for channel modification and maintenance of the LDW, conducted by the U.S. Army Corp of Engineers, or from unknown upland sources (Farallon and Anchor, 2006).

The second phase of investigation was to identify data gaps from the first phase, including investigations of bank erosion and the stormwater conveyance system. This second phase included sampling of the subsurface fill, shoreline bank fill, debris piles located at the toe of the shoreline bank, and solids in the stormwater catch basins. The scope of work also included a video survey of the outfalls and outfall reconnaissance survey. The third phase included collecting surface and subsurface sediment samples, solids residing in the stormwater catch basins, and water samples from outfall discharges from active outfalls (Farallon and Anchor, 2006). The results of the stormwater catch basins and outfall sampling are discussed in detail in Section 3.3.3.3.

The distribution of PCBs contamination on-site is consistent with the placement of fill from historic hydraulic dredging of the LDW (Farallon and Anchor, 2006).

Metals including arsenic, cadmium, chromium, copper, lead, silver, and zinc were found in subsurface fill in concentrations that exceeded screening levels. These metals are likely contained in the fill from hydraulic dredging and/or a result of historic site operations. The contaminants are contained within the

fill on-site, and widespread throughout the site. These contaminants are not a source of contamination to the LDW through groundwater or bank erosion (Farallon and Anchor, 2006).

Results of the sample analysis showed soil contamination of PCBs and several heavy metals at concentrations exceeding the MTCA (Figure 20). The results were forwarded to Ecology for review. After evaluating the data, Ecology decided that the Jorgensen Forge property should be re-ranked using data containing the new contaminants. For the new SHA, Jorgensen received a ranking of 1 (Ecology, 2005).

3.3.3.3 Stormwater Discharge

The Jorgensen Forge facility occupies approximately 20 upland acres, between Slip 4 and Slip 6, on the east bank of the LDW, approximately 3.6 miles south of Harbor Island (Figure 19; Farallon and Anchor, 2006). The stormwater drainage system at Jorgensen Forge and its potential to be a source of sediment recontamination in the LDW are discussed below.

Stormwater Drainage System

Jorgensen Forge contains a stormwater conveyance system that consists of 19 catch basins and underground piping that historically discharged and currently discharges to the LDW through four active outfalls (Figure 21; Farallon and Anchor, 2006). The stormwater conveyance system captures stormwater runoff from impermeable surfaces, including paved areas outside the existing buildings, and the building roof drains. Surface water within the interior of the buildings is not captured or delivered in the stormwater collection and conveyance system. Historically, nine outfalls, identified as outfalls 001 through 009, existed at the facility and discharged stormwater to the LDW (Figure 21). In the mid-1980s, outfalls 005 through 009 were plugged using concrete, and a dye tracer study was used to confirm complete enclosure of each outfall (Farallon and Anchor, 2006). Stormwater runoff from the facility currently discharges to the LDW through outfalls 001, 002, 003, and 004 (Figure 21). Stormwater runoff from the eastern side of the facility discharges to the Metro stormwater system (Farallon and Anchor, 2006).

Outfalls 005 through 009, which historically discharged roof drains and other unknown sources of stormwater, are inactive. The origins of stormwater discharging through inactive outfalls 006 through 009 have not been determined (Farallon and Anchor, 2006). To ensure that no flow currently discharges to the LDW from outfalls 006, 007, and 008, a video survey and underground stormwater conveyance line location was conducted by Applied Professional Services on August 26, 2004. The survey identified that the stormwater piping for outfalls 006, 007, and 008 were blocked approximately 10 linear feet eastward from the face of the bank. Applied Professional Services attempted to locate each of the stormwater lines from the upland portion of the site; however, as discussed above, the outfalls were plugged with concrete in the mid-1980s. In addition, a comprehensive site stormwater drainage investigation study conducted October 13 to 15, 2004, confirmed that no discharge occurred from historical outfalls 005 through 009 (Anchor, 2006).

Stormwater from impermeable surfaces and roof drains; groundwater that accumulates in the vacuum degasser pit, railroad scale sumps, electric furnace pit, argon-oxygen-decarbonization (AOD) and scale sumps; and non-contact cooling water from the cooling tower system are periodically discharged through outfalls 001, 002, 003, and 004 (Figure 21; Farallon and Anchor, 2006). Three outfalls collect stormwater and, in some cases, groundwater from sumps. Stormwater from the parking area adjacent to the site is discharged to the Metro stormwater system. Outfall 001 collects stormwater, including roof drains, from the southern portion of the property. On occasion, small amounts of groundwater that accumulate in the Vacuum Degasser Pit also discharge to Outfall 001. Outfall 002 collects stormwater,

including roof drains, from the southern portion of the property. Outfall 003 collects stormwater, including roof drains, from the remainder of the property. On occasion, small amounts of groundwater that accumulate in the AOD scale sump also discharge to Outfall 003 (Anchor, 2006).

Based on discussions with Jorgensen Forge personnel, it was determined that Outfall 004 was previously designated as an active stormwater outfall and permitted under NPDES Permit No. SO3 - 003231. This outfall was designed to discharge water from the cooling tower concrete basin in the event that the cooling tower pump system malfunctioned or a pipe break resulted in water accumulation in this area. This outfall is supplied by a single catch basin in the bottom of the subgrade concrete basin. Any historical water discharged from this outfall would be composed of non-contact cooling water, supplied by King County. To the recollection of several long-term Jorgensen Forge personnel, a pump malfunction or pipe breakage has not occurred for over 10 years and, therefore, this outfall is considered to have very infrequent discharges to the LDW (Anchor, 2006).

A chemical inventory for the entire facility was completed in 1994 as part of the Spill Control Plan, included as an appendix to the SWPPP (Anchor, 2006). This chemical inventory is updated periodically to reflect materials used at the facility. Based on an evaluation of the stormwater system and the use of chemicals at the facility, areas of industrial activities that have potential to introduce pollutants to stormwater discharges, and the specific pollutants associated with each of these areas, have been identified. These areas of industrial activities are discussed below (Anchor, 2006).

Bag Houses

Two bag houses are used at Jorgensen Forge: the melting bag house and the billet grinding bag house. The melting bag house vacuum operation collects “dust” generated during melting operations through a bag filter system. Based on Toxic Characteristic Leaching Procedure test results conducted in January 2001 and August 2004, the collected melting bag house dust contained detectable concentrations of trace metals. The collected melting bag house dust is conveyed via a closed pipe to the contained (i.e., covered) bag filter disposal area in the melting bag house building. The dust is conveyed directly into a lined, sealed bin located on the slab-on-grade concrete floor, and disposed of off-site as a dangerous waste (classified as K061 waste; Anchor, 2006).

The billet grinding bag house collects steel and/or titanium grindings. The collected billet bag house dust is conveyed via a closed pipe to the contained (i.e., covered) bag filter disposal area. The dust is conveyed directly into a lined, sealed bin located on the slab-on-grade concrete floor, and disposed of off-site as a non-hazardous waste. Similar to the melting bag house, there is a potential for small amounts of dust to collect on the floor of the facility and be tracked outdoors where it could potentially enter a nearby catch basin (Figure 21) and be conveyed through Outfall 001 (Anchor, 2006).

Housekeeping activities (e.g., routine sweeping of the concrete floors, placement of filter fabric in the nearby catch basins, and frequent visual observations to monitor any potential dust accumulations on the floor) reduce the potential for these bag house areas to introduce pollutants to the stormwater drainage system (Anchor, 2006).

Sand Blasting Area

Sand blasting is no longer conducted at the site and the former sand blasting area is locked, prohibiting general personnel access (Anchor, 2006).

Sumps That Collect Groundwater

There are several sumps that function to collect infiltrating groundwater during periods of high groundwater table elevation (i.e., during winter months). These sumps pump the collected groundwater into the stormwater system, as described below.

- *Vacuum Degassing Pit Sump:* This sump is located under the vacuum-degassing area. During periods of high groundwater elevation (during prolonged storm periods), small amounts of groundwater infiltrate the sump area. The sump is located in an area removed from overhead pipes and operating parts, thus minimizing the potential for pollutants to enter the sump system. The collected groundwater is pumped to the Outfall 001 drainage line (Figure 21). This sump is not likely to contribute significant amounts of pollutants to the stormwater system (Anchor, 2006).
- *Electric Furnace Pit Sumps:* A sump is located under the two electric arc furnaces (EAFs; Figure 21). This sump was disconnected in early 2004 to minimize the potential for pollutants to enter the stormwater outfall drainage system. Groundwater that infiltrates into the sump is now manually pumped to the site oil/water separator and then discharged to King County's stormwater system (Anchor, 2006).
- *Argon Oxygen Decarbonization Scale Sump:* This sump is located in the melt shop building, under the AOD scale. This scale is used to weigh bulk metals that are used in the AOD unit. During periods of high groundwater elevations (during prolonged storm periods), small amounts of groundwater infiltrate into the sump area. The collected groundwater is pumped to the Outfall 003 drainage line (Figure 21). This sump is not likely to contribute significant amounts of pollutants to the stormwater system (Anchor, 2006).
- *Railroad Scale Sump:* This railroad scale sump is located on the rail track on the south side of the billet yard. The railroad scale is used infrequently (no more than four times per year) to weigh rail cars that deliver metals for the forging process. Groundwater that infiltrates into the sump is pumped to the Outfall 001 system. Oil absorbent pads are placed around the sump to capture potential lube oil drips from rail cars and minimize conveyance of these oils to the Outfall 001 drainage line. Further, the Spill Control Plan provides specific guidance in the event of a spill into the railroad scale area. This sump is not likely to contribute significant amounts of pollutants to the stormwater system (Anchor, 2006).

Floor Drains and Catch Basins

There are no floor drains within any of the site buildings. This significantly limits the potential for materials used within the buildings to enter the stormwater drainage (Anchor, 2006).

The catch basins are constructed to operate as a spill control separator. This design limits the introduction of buoyant fluids/solids (e.g., oil and grease) entering the stormwater drainage. Since approximately 1998, filter fabric and oil-absorbent booms have been installed in each stormwater catch basin to reduce the likelihood of runoff contributing significant amounts of pollutants to the stormwater system. The filter fabric and oil absorbent booms are inspected approximately monthly to ensure they are replaced, as necessary. In addition, each of the site's catch basins are inspected and maintained annually and cleaned approximately semi-annually. A summary of the floor drain and catch basin BMPs is included as an appendix to Jorgensen Forge's SWPPP (Anchor, 2006).

Melt Steel Slag Loading Area

Melt steel slag is generated during the refining process. There are two primary sources of steel slag produced at Jorgensen Forge: slag collected from the EAF and slag collected from the AOD unit. This steel slag is stored along the southern border of the property in large uncovered piles (Figure 21). The slag is either recycled for on-site use or removed for off-site disposal. The EAF and AOD slag contain various trace metals. Precipitation that comes in contact with the EAF and AOD piles is not conveyed into the stormwater drainage system (i.e., there are no catch basins or drains that lead into the stormwater drainage in the vicinity of the piles) and is, therefore, unlikely to contribute pollutants to the stormwater system. Runoff from these piles collects and ponds in the dirt area adjacent to the piles (Anchor, 2006).

Diesel Fueling Area

This area includes an aboveground diesel storage tank (3,000 gallons) and an area where waste chemicals are stored prior to off-site disposal. Waste chemicals include hydraulic oils, lube oils, and miscellaneous solvents. This area is fully enclosed in a building and uses a containment berm designed to contain all materials stored in this area. Delivery of diesel fuel is by tanker truck and transfer to the tank is by hose to the tank within the containment berm. Refueling of facility vehicles is accomplished with an electric station pump inside the building. The hose is extended to the vehicle outside the containment berm only during refueling (Anchor, 2006).

Stormwater Drainage System Sampling and Potential as a Contaminant Migration Pathway

Catch Basin Solids Sampling

Catch basin solids were collected from stormwater catch basins CB1 through CB4, located on the western, central, and eastern portions of Jorgensen Forge, on August 31, 2004 (Farallon and Anchor, 2006). The concentrations of PCBs detected in the solids samples collected from the catch basins ranged from 0.129 mg/kg (catch basin CB4) to 0.302 mg/kg (catch basin CB2). Following the catch basin sampling in August 2004, all of the on-site stormwater catch basins were thoroughly cleaned and removed of all residual solids. Additional sampling in these four catch basins was proposed as part of the third phase of the investigation to assess ongoing PCB- and metals-loading into the stormwater drainage system from solids recently (i.e., within nine months) deposited into the catch basins. As part of the third phase of the investigation, sampling of the catch basins was attempted in May 2005. During these attempts, each of the catch basins had insufficient (i.e., less than 0.4 inches of solids on the catch basin floor) solids accumulation; therefore, no sampling was performed. The lack of accumulated solids in the targeted catch basins following catch basin cleanout indicates that the on-site stormwater BMPs have successfully limited the amount of solids entering the on-site catch basins during rainfall events. Those BMPs include regularly scheduled comprehensive sweeping and/or vacuuming of all paved surfaces, as well as installation and regular replacement of filter fabric in each of the 19 catch basins. In addition, the lack of solids indicates that the solids identified during the second phase investigation likely were due to years of accumulation. See *Data Investigation Summary Report, Jorgensen Forge Facility* for a more detailed discussion of the catch basin solids sampling (Farallon and Anchor, 2006).

Outfall Discharge Water Sampling

Grab water samples were collected from outfalls 002 and 003 on May 19, 2005, during a rainfall event of sufficient intensity to produce surface water runoff. The LDW surface water elevations at the time of sampling were low enough to facilitate visual inspection of the discharge from each of the outfalls. However, insufficient discharge from outfalls 001 and 004 occurred during the rainfall event, so no samples were collected from these outfalls. The samples collected from outfalls 002 and 003 were

submitted for laboratory analysis of pH, total suspended solids, total PCBs, and total and dissolved metals. The outfall discharge concentrations were evaluated to determine whether the stormwater discharge to sediments pathway was contributing elevated levels of PCBs and/or metals to sediments adjacent to active outfalls 001, 002, and 003. Data evaluation determined that discharges from these outfalls, as measured during rainfall events, were not associated with the observed SMS exceedances. See *Data Investigation Summary Report, Jorgensen Forge Facility* for a more detailed discussion of the outfall discharge sampling (Farallon and Anchor, 2006).

Jorgensen Forge Facility – Boeing Plant 2 Facility Property Line Stormwater Outfall Sampling

Boeing conducted an investigation of stormwater structures in accordance with the EPA-approved Phase II Transformer Investigation Work Plan (Farallon and Anchor, 2006). The investigation included collecting and analyzing solids material within the 12- and 24-inch diameter stormwater lines, located in the easement on the northern portion of the Jorgensen Forge site, that convey stormwater runoff from Plant 2 and KCIA (Figure 20). In May 2005, solids samples were collected from the manholes located along the 12- and 24-inch stormwater outfalls. A video survey of the stormwater outfall conveyance pipes conducted at the same time identified two drainage lines were connected to the 24-inch stormwater outfall, including a 15-inch diameter pipe extending from Plant 2, and a 12-inch diameter pipe extending from Jorgensen Forge. No cross-connections from the Jorgensen Forge site were identified in the video survey of the 15-inch diameter storm drain line (Farallon and Anchor, 2006).

Solids samples were collected from three manhole locations, MN 37-2, SDMH-24B, and SDMH-24A, along the 24-inch diameter pipe; a manhole location on the previously unidentified Boeing 15-inch diameter pipe (MH37-7); and two manhole locations, SDMH-15B and SDMH-15A, along the 12-inch diameter pipe (Farallon and Anchor, 2006). The solids sampled from the 12-inch diameter pipe consisted of several inches of silty sand and/or gravel overlying approximately 0.5 inch of oily sludge in SDMH-15B to a bottom layer of silty sand sludge with a grey-black, oily appearance and a hydrocarbon odor in SDMH-15A. The solids sampled from the 24-inch diameter pipe consisted of several inches of silty sand and/or gravel overlying approximately 0.5 inch of oily sludge in MN 37-2, MN 37-7, and SDMH-24B, to very little accumulated granular material and the presence of oily sludge along the bottom surface in SDMH-24A (Farallon and Anchor, 2006).

The concentrations of PCBs detected in the granular samples, collected by Boeing, from the 24-inch diameter stormwater outfall (samples SD001 and SD004), upstream from the 12-inch diameter stormwater outfall that extends from Jorgensen Forge, were as high as 2,600 mg/kg (Figure 20; Farallon and Anchor, 2006). The analytical results of a sample collected from the 12-inch diameter stormwater pipe connecting Plant 2 to the 24-inch diameter stormwater outfall, upstream of the cross-connection of the 12-inch diameter pipe from Jorgensen Forge, detected a concentration of PCBs of 731 mg/kg. A concentration of PCBs of 10,000 mg/kg was detected in the sample of oily sludge collected downstream of the connection with the 12-inch diameter pipe extending from Jorgensen Forge (Farallon and Anchor, 2006).

Samples of solids material were collected from the 12-inch diameter pipe, extending from Jorgensen Forge to the 24-inch diameter stormwater outfall, at a distance of approximately 6 inches from the junction (Farallon and Anchor, 2006). The 12-inch diameter pipe was traced as far as possible onto the Jorgensen Forge site, and a sample of solids material was collected at a distance of approximately 40 feet from the junction by excavating vertically, cutting the pipe, and collecting an undisturbed sample of the black silty sand (Farallon and Anchor, 2006). The concentration of PCBs detected in the solids sample collected from the 12-inch diameter pipe was 1,100 mg/kg in the sample collected at 6 inches. The concentration of PCBs detected in the sample collected at a distance of 40 feet from the junction of the 12- and 24-inch diameter pipes was 6.5 mg/kg. The solids sample collected 6 inches from the junction of

the 12- and 24-inch diameter pipes was at an elevation that is tidally influenced (Farallon and Anchor, 2006).

The results of the stormwater drainage investigation indicated that the 12-inch diameter pipe, extending from Jorgensen Forge, is not the source of PCBs detected in the solids sample collected in the 24-inch diameter stormwater outfall. A more detailed discussion of the stormwater drainage investigation was provided to EPA in the Technical Memorandum Regarding Storm Drain Line Data Summary (Farallon and Anchor, 2006).

Outfalls Discharging to LDW

Outfalls 001, 002, and 003 currently discharge all collected stormwater runoff from Jorgensen Forge to the LDW during rainfall events (Farallon and Anchor, 2006). Outfall 004 does not appear to be affected or influenced by precipitation events. Site research produced no evidence that PCBs have been or are used at Jorgensen Forge, with the exception of dielectric fluid contained in some of the transformers on-site (Farallon and Anchor, 2006). Surface water in the interior of the current buildings is not captured and/or delivered to the stormwater collection and conveyance system. The relatively low concentrations of PCBs detected in the samples of solids collected from the catch basins on Jorgensen Forge, likely are the result of PCB-containing windblown soil and waste particulates that accumulated in the catch basins. The catch basins have recently been cleaned out and have been protected from further sedimentation through the implementation of BMPs. These procedures will decrease the likelihood that outfalls 001, 002, and 003 will contribute to PCB contamination of the LDW (Farallon and Anchor, 2006).

Metals used at Jorgensen Forge in the manufacturing processes are limited to the interior of buildings. Surface water in the interior of the buildings is not captured and/or delivered to the stormwater collection and conveyance system. This limits the potential for metals migration from manufacturing processes into the LDW. Large metal scraps used during manufacturing processes are stored outside the building, on pavement. Inspection of this pavement indicated that the pavement is in good condition (i.e., few visible cracks), which limits direct migration to groundwater (Farallon and Anchor, 2006). Stormwater that comes into contact with this stored metal is conveyed to the 19 on-site catch basins. The design of the catch basins, which were constructed to facilitate settling of particulates, and implementation of stormwater BMPs (e.g., on-site sweeping and use of filter fabric to limit solids infiltration into the catch basins) limit potential suspended metals that migrate to the catch basins. An evaluation of the potential for metals migration through the stormwater conveyance system, prior to and following the implementation of BMPs, is presented below (Farallon and Anchor, 2006).

The evaluation conducted during the third phase investigation concluded that metals concentrations of stormwater discharges from outfalls 002 and 003, collected during a single rainfall, were not above the applicable water quality screening levels. This indicates that the implementation of BMPs has successfully limited the introduction of solids into the stormwater conveyance system (Farallon and Anchor, 2006).

The elevated concentrations of chromium, copper, and zinc in the solids samples collected from catch basins indicated discharge of water through the stormwater conveyance system that potentially resulted in the deposition of solids into the LDW, containing concentrations of chromium, copper, and zinc exceeding the SQS and the CSL. To evaluate this potential pathway, the catch basin solids metals concentrations were compared to the surface sediment concentrations identified in the vicinity of the outfall discharge locations (Farallon and Anchor, 2006).

The concentrations of chromium, copper, and zinc detected in surface sediment adjacent to Jorgensen Forge, surrounding outfalls 003, 004, and 005, are similar to the concentrations detected in the solids

samples collected from the catch basins. Outfall 003 consists of an 18-inch diameter ductile iron pipe, extending through the sheet pile wall at an elevation of 8.91 feet above the mean lower low water. The surface of the bank beneath Outfall 003 is composed of armored rock. Stormwater discharged through Outfall 003 during low tides is expected to flow across the bank with little to no erosion of bank material and little to no deposition of solids. Any suspended solids in the stormwater stream, including metals, could be deposited on top of surface sediment when the velocity of the stormwater discharge decreases upon entering the LDW. This material could then be transported to the surrounding sediments during tidal fluctuations. Given the similarity in metals concentrations identified in sediments in the vicinity of this outfall and the catch basin solids (CB1, CB2, and CB3) conveyed through this outfall, prior to implementation of BMPs, Outfall 003 was a likely source of metals to the LDW (Farallon and Anchor, 2006).

Outfall 004 is an active outfall that, on rare occasions, discharges non-contact cooling water from the cooling tower system. Discussions with Jorgensen Forge personnel indicated the last discharge from this outfall occurred more than 10 years ago (Farallon and Anchor, 2006). Similarly, Outfall 005 is a historical outfall that has not discharged for at least 20 years. Given these outfalls have been inactive for many years; it is unlikely that they are the source of elevated surface sediment metals concentrations identified adjacent to their outfall discharge locations (Farallon and Anchor, 2006).

The analytical results of the solids samples collected from catch basin CB4 detected concentrations of chromium and copper exceeding the SQS and the CSL. The water and solids captured by catch basin CB4 are discharged through the stormwater conveyance system to Outfall 002. The results of surface sediment samples collected near Outfall 002 detected concentrations of chromium exceeding the SQS and CSL in surface sediment, indicating that discharge of stormwater through Outfall 002 was, prior to implementation of BMPs, a likely source of metals to the LDW (Farallon and Anchor, 2006).

Although previous investigations have found soil and groundwater contamination at the facility, the stormwater system sampling described above suggests that the Jorgensen Forge stormwater drainage system is not likely a continuing migration pathway of site-related contaminants to the LDW.

3.3.3.4 Groundwater

The Jorgensen Forge site is underlain by fill that was placed from hydraulic dredging of the LDW for channel modifications and maintenance by the U.S. Army Corp of Engineers. This fill consists of gray and brown sands that extend to a depth of 2 to 10 feet bgs. There is a silt layer between 8 to 10 feet bgs that represents the uppermost native soil. The site hydrogeology is complicated because of this historic fill placement over lenses and layers of clay and silt. These layers perch and locally confine groundwater in several locations. Depth to groundwater at the site occurs between 9 and 13 feet bgs (Farallon and Anchor, 2006). There is no documented use of groundwater for private or municipal wells for either drinking water or irrigation within a 2-mile radius (Ecology, 2005).

Shallow groundwater flow beneath the site apparently flows to the southwest, towards the LDW, under an average gradient of 0.0167 feet per foot. The groundwater gradient increases near the LDW, where tidal effects are prevalent. On the western side of the site, monitoring wells identify tidal influences on the groundwater. On the eastern portion of the site, water levels fluctuate seasonally, with water levels 1 to 2 feet higher during the rainy season (Farallon and Anchor, 2006).

The analytical results of groundwater samples collected from monitoring wells located throughout the site from 1993 to 2003 did not detect concentrations of PCBs above the MTCA Method A cleanup levels. These monitoring wells are shown on Figure 19. Monitoring wells that previously detected PCB

concentrations in the LNAPL samples of 1993 did not detect concentrations in 2003 (Farallon and Anchor, 2006).

Groundwater samples were collected in 1990 and 1992 from monitoring wells-1, -9, and -23, and analyzed for total metals. Concentrations of contaminants in these samples were screened for arsenic, barium, cadmium, chromium, copper, iron, manganese, mercury, selenium, and zinc above the laboratory practical quantitation limits. However, only cadmium was detected at a concentration above the MTCA Method A cleanup level from monitoring well-1. In 2001, concentrations of arsenic exceeded the MTCA Method A cleanup level from one monitoring well. There were no other metals detected in groundwater samples collected from the monitoring wells that exceeded the applicable MTCA Method A cleanup levels (Figure 19; Farallon and Anchor, 2006).

3.3.3.5 Spills

There have been no documented spills at the Jorgensen Forge site. However, there have been three documented releases of petroleum and cutting oil to soil and groundwater. These releases have been previously discussed under environmental investigations and cleanup actions. All three releases were contained within isolated areas and did not present a source of contamination to the LDW.

3.3.3.6 Bank Erosion/Leaching

Concentrations of PCBs and metals have been detected in the shoreline bank of the Jorgensen Forge facility. This bank material was likely dredged from the LDW and placed on-site as fill by the U.S. Army Corp of Engineers. Historically, bank erosion was likely a source of PCBs and metals contamination for the adjacent sediments in the LDW. Currently, the shoreline bank is heavily armored with riprap, woody debris, vegetation, and steel sheet pile/concrete bulkhead. However, contamination in the shoreline bank occurs within the intertidal zone which is flooded twice a day by tides (see photos in Appendix A). In addition, there are debris waste piles within this intertidal zone. For this reason, contamination of the shoreline bank is likely eroding and leaching into the sediments of the LDW.

3.3.4 Data Gaps

3.3.4.1 Upland Facilities

Although the fill at Jorgensen Forge has elevated concentrations of contaminants, it is unknown whether the upland area is a source of sediment recontamination to the LDW. The majority (over 80 percent) of the upland area is covered with impervious surfaces, reducing exposure of the fill to erosion. Ecology is concerned about unknown contamination in the southeast portion of the site, which is thought to have been historically occupied by a wood treating facility. On the Boeing-Isaacson property adjacent to this area, there is significant arsenic contamination. Further investigation and sampling should be conducted at the Jorgensen Forge facility to determine if arsenic contamination is present in the soils and leaching into the adjacent sediments.

There have been investigations related to releases of hydrocarbons to the soil within several areas at the Jorgensen Forge facility. In addition, semi-annual groundwater monitoring for many years has been conducted, measuring the TPH concentration and redox conditions in the soil at the time of sampling. However, the geochemical effects of petroleum hydrocarbons in the soil on the redox potential of the groundwater have not been investigated. This lack of evaluation is a data gap.

3.3.4.2 Stormwater Discharge

It is unclear who owns and operates the 15- and 24-inch diameter stormwater lines, located in the easement on the northern portion of the Jorgensen Forge site. These stormwater lines convey stormwater runoff from Plant 2 and KCIA (Figure 20). Ownership of these stormwater lines needs to be established.

Stormwater from impermeable surfaces and roof drains; groundwater that accumulates in the vacuum degasser pit, railroad scale sumps, and AOD and scale sumps are periodically discharged through outfalls 001, 002, 003, and 004 (Figure 21; Farallon and Anchor, 2006). The quality of the water discharged and the process through which water is discharged from the scale sumps needs to be determined.

Although previous investigations have found soil and groundwater contamination at the facility, the stormwater system sampling described in Section 3.3.3.2 suggests that the Jorgensen Forge stormwater drainage system is not likely a continuing migration pathway of site-related contaminants to the LDW.

3.3.4.3 Groundwater

Groundwater at the Jorgensen Forge site is present at depths of 9 to 15 feet bgs on the site's western portion and 11 to 21 feet on the site's eastern portion. The direction of shallow groundwater flow beneath the Jorgensen Forge site has consistently been observed to the southwest on the eastern portion of the Jorgensen Forge site with flow direction becoming more westerly near the LDW, with an average gradient of 0.0167 feet/foot. Tidal influences have been identified in monitoring wells located on the western portion of the Jorgensen Forge site (Farallon and Anchor, 2006).

Although a hydraulic connection between shallow groundwater and the LDW exists, the concentrations of TPH (as diesel-range organics and oil-range organics) detected in groundwater above the MTCA Method A cleanup levels on the eastern portion of the Jorgensen Forge site are not migrating and do not present a source of contamination to the LDW (Farallon and Anchor, 2006). However, this area requires continued monitoring to ensure that the contamination does not migrate towards the LDW.

As part of the Source Control Investigation, Jorgensen Forge anticipates developing a hydrogeological site model which will characterize the groundwater system, including tidal influence at the site.

Ecology is concerned about potential unknown contamination in the center of the site which was previously occupied by Isaacson Iron Works. There has been no groundwater sampling or monitoring in this area to determine the groundwater quality and flow direction. Groundwater monitoring in this area needs to be addressed.

3.3.4.4 Spills

No data gaps have been identified for spills within the Jorgensen Forge facility.

3.3.4.5 Bank Erosion/Leaching

No data gaps have been identified for bank erosion for the Jorgensen Forge facility.

3.4 King County International Airport

3.4.1 Current Operations

KCIA, also known as Boeing Field, is located at 7277 Perimeter Road South, Seattle. This facility is also listed under the address of the airport maintenance building, at 6518 Ellis Avenue, Seattle. The KCIA is a

general aviation airport, owned and operated by King County as a public utility. The site covers approximately 615 acres, 435 of which are impervious surface covered by buildings and paved areas. The remaining 180 acres consist of grass and landscape area. Twenty six acres of the KCIA is located in the EAA-4, and drains to the LDW (Figure 1). This area is located west of East Marginal Way South and both north and south of the Federal Aviation Administration (FAA) Air Traffic Control Tower.

The KCIA averages more than 300,000 operations (takeoffs and landings) each year, and serves small commercial passenger airlines, cargo carriers, private aircraft owners, helicopters, corporate jets, and military and other aircraft. The airport also is home to the Boeing Company's 737 aircraft flight-test program along with other Boeing operations (KCIA, 2007a).

According to the King County Tax Assessor website, the portion of KCIA located within EAA-4 is part of Parcel No. 2824049007, with a listed address of 6505 Perimeter Road South (King County, 2007). This parcel consists of 564.77 acres and 101 buildings that have various uses including office buildings, storage hangers, industrial light manufacturing, material storage sheds and warehouses, and service repair garages (King County, 2007). A map of the KCIA indicates the only buildings within EAA-4 are the FAA Air Traffic Control Tower and the Aircraft Rescue and Fire Fighting Facilities (Figure 22; KCIA, 2007a).

KCIA has a NPDES Industrial Stormwater General Permit (No. SO3000343D) for the airport maintenance shop, located north of the EAA-4 drainage basin. The parameters for this permit are for pH, with a minimum of 6.5 and a maximum of 8.5 standard pH units. This permit expires on September 20, 2007. Ecology plans to reissue Industrial Stormwater Permits on August 20, 2007. These reissued permits would be effective from September 20, 2007 through September 20, 2012 (Ecology, 2007e). According to Ecology's online NPDES and State Waste Discharge Permit database, this site does not have a NPDES Individual Wastewater Discharge Permit (Ecology, 2007d). KCIA has a SWPPP addressing the airport maintenance facilities, the paved areas (runways and taxiways), and activities such as deicing (KCIA, 2006).

The KCIA has been issued Wastewater Discharge Authorization No. 4109-01 (EPA ID No. WAD 980986848), from the King County Wastewater Treatment Division. This authorization allows the site to discharge limited amounts of industrial wastewater into King County's sewer system in accordance with effluent limitations and other requirements and conditions listed in the document. According to the permit, discharge is to West Point and consists of wastewater generated by transportation facility operations and undergoing a pre-treatment process of BMP, gravity separation, and carbon absorption as needed. The permit is effective from October 30, 2006 to October 29, 2011. The transportation facility operations are located outside of the EAA-4 drainage basin.

3.4.2 Historic Use

The airport is the homestead site of the original settlers who arrived in King County. In the early 1900s, the natural course of the Duwamish River, which meandered through much of the airport property, was straightened and filled.

Construction of the airport began in 1928. The airport served as the community's aviation center until December 6, 1941, when the U.S. Army took over the airport for strategic and production reasons. The airport remained under military jurisdiction through the end of World War II. In the late 1940s, the airport was reopened for passenger and other commercial traffic. After Seattle Tacoma International Airport opened in 1947, KCIA usage evolved to general aviation, serving industrial, business, and recreational purposes (Ecology, 2006).

3.4.3 Environmental Investigations and Cleanup Activities

3.4.3.1 Upland Facilities

On Ecology's online LUST database, KCIA is listed as having groundwater and soil cleanups reported at 6518 Ellis Avenue South, which is the address of the airport maintenance building. This building is located north of KCIA and outside of EAA-4. On Ecology's online UST database, the site is listed as having five USTs removed. The address of these removed USTs is 6518 Ellis Avenue South, which is the airport maintenance building. According to KCIA's UST summary, which was updated on March 1999, 28 USTs are located at the airport, with an additional 31 ASTs at this site (Ecology, 2007c). All USTs and ASTs are located outside of the EAA-4 drainage basin.

The facility is not listed on Ecology's online CSCSL database (Ecology, 2007b). There have been two cleanups noted for KCIA: one at American Avionics, located at 7023 Perimeter Road South; and one at the KCIA maintenance building, located at the north of the airport at 6518 Ellis Avenue South. Both of these areas are outside of EAA-4; therefore, they are not considered a potential contributor to sediment recontamination of EAA-4 (Ecology, 2006).

In 2001, KCIA sampled stormwater catch basin sediments and pavement caulk in the EAA-4 drainage area. During the sampling event, four sediment samples were collected from the storm drain system. The samples were analyzed for PCBs and metals including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. In addition, two samples of caulk were collected from the concrete joint areas and analyzed for PCBs. The analytic results of this sampling event indicated that elevated concentrations of cadmium (21.9, 2.70, and 3.94 mg/kg) and lead (276, 294, and 257 mg/kg) were detected at CB-1-F, CB 1802, and CB-4-F, respectively. The cadmium and lead concentrations were greater than the Method A cleanup levels for residential soil. In addition, three of the storm drain sediment samples and two of the caulk samples detected concentrations of PCBs. However, PCB concentrations in all samples were less than 1 mg/kg, which is the Method A cleanup level for PCBs (IT Corporation, 2001).

In 2005, KCIA sampled the stormwater system catch basins and pavement joint caulk for potential PCB contamination. During this sampling event, sediment samples were collected from three stormwater catch basins, two trenches, and joint compound samples from three concrete joint areas (Figure 23). The analytical results of this sampling event showed elevated concentrations of PCBs in one trench sample and one joint caulk sample. The results are presented in an excel file entitled *Catch Basin Sediment and Concrete Joint Compound PCB Sampling Results Lot 12 at King County International Airport, Seattle, Washington*, and show Aroclor 1260 concentrations of 2.67 mg/kg and 1.69 mg/kg at Trench 2 and JC-3, respectively (Renaud, 2007). These results exceed 1 mg/kg, which is the Method A cleanup level for PCBs.

The airport has been cleaning out accumulated solids from each stormwater catch basin on the airport semi-annually. Each oil/water separator is cleaned annually, or more frequently, if there are any accumulations noted during weekly inspections (Ecology, 2006).

Currently, Boeing has been working to remove PCB-contaminated joint material from the paved areas at North Boeing Field, outside of EAA-4. As of 2005, approximately 80,000 linear feet of joint caulk has been removed. It is estimated that an additional 1,400 linear feet of joint caulk is scheduled to be removed in 2007 from North Boeing Field (Ecology, 2006).

3.4.3.2 Stormwater Discharge

There are approximately 15 miles of drainage pipe in the KCIA stormwater drainage system. There are five outfalls or discharge points (Figure 24). There are two pumping stations, lifting water and pumping it out at two outfalls (outfalls 1 and 2). There are three gravity lines, feeding two outfalls (outfalls 3 and 4), that drain the south end of the airport. There are several off-site stormwater sources (Associated Grocers, Railroad Right-of-Way, City of Seattle, and others) which discharge into the KCIA drainage system. Some north end KCIA facilities are connected to a storm sewer system owned by the Washington State Department of Transportation, which serves the Interstate 5 freeway. Other non-KCIA-owned properties (Boeing Company, Museum of Flight, and City of Seattle) contribute stormwater at outfalls 3 and 4. Some KCIA properties along East Marginal Way South go into a combination of Boeing Company and City of Tukwila storm drainage systems (KCIA, 2007b).

The southern portion of KCIA is located in the Norfolk Drainage Basin, in EAA-7, not EAA-4; this portion of the airport consists of the southern end of the runway, known as 13R-31L, and the surrounding landscaped areas (E & E, 2007).

There is an active 24-inch line that discharges into the LDW at the southern boundary of Plant 2, located approximately 10 feet into the Jorgensen Forge property. There was a historical connection from the Plant 2 facility to this outfall (Golder Associates and Floyd|Snider Inc., 2006).

The area described by Ecology as “draining to the LDW in EAA-4 is within Drainage Basin 5” is approximately 26 acres (figures 25 and 26; KCIA, 2007b). Figure 2 shows the entire Drainage Basin 5 stormwater drainage system as included in the EAA-4 drainage basin. While all of this 26-acre drainage basin should discharge through Outfall 5, CAD files provided by KCIA show this is not the location where Outfall 5 drains into the LDW. According to Ecology, the 26-acre area drains through the aforementioned 24-inch line located on the property boundary between the Jorgensen Forge facility and Plant 2 (Figure 20).

Stormwater Drainage System Sampling and Potential as a Contaminant Migration Pathway

At KCIA, sampling of stormwater catch basins and joint caulk in 2005 found PCB contamination in two samples collected north of the FAA tower (Figure 23). This area is located within Drainage Basin 5, which drains through Outfall 5 to the LDW. Some PCB contamination was also found in the 24-inch diameter stormwater outfall that discharges to the LDW on the property boundary of Jorgensen Forge and Plant 2. Therefore, the KCIA stormwater drainage system is a potential migration pathway of site-related contaminants to the LDW.

3.4.3.3 Groundwater

There was no information found on groundwater studies or investigations for this area of KCIA. Based on groundwater conclusions discussed in sections 3.2.3.10 and 3.3.3.3, groundwater flow is assumed to flow toward the southwest, toward the LDW, and likely discharges to the LDW downstream of the EAA-4 drainage basin.

There is no known groundwater contamination on this portion of the facility. Based on the information reviewed, it is unlikely that this portion of the site contributes to ongoing recontamination of EAA-4 or other areas of the LDW.

3.4.3.4 Spills

No information was found that documented spills within the area of the KCIA that is within the EAA-4 drainage basin.

3.4.3.5 Bank Erosion/Leaching

The area of the KCIA within EAA-4 is inland from the LDW; therefore, this property has no shoreline to contribute to bank erosion or leaching to the LDW.

3.4.4 Data Gaps

3.4.4.1 Upland Facilities

The analytical results from the 2005 stormwater catch basin and joint caulk sampling event (as presented in an excel file entitled *Catch Basin Sediment and Concrete Joint Compound PCB Sampling Results Lot 12 at King County International Airport, Seattle, Washington*) have shown elevated levels of PCBs in the stormwater sediments of Trench 2 and the joint caulk sample at concrete joint area location JC-3 (Renaud, 2007). However, this data has yet to be presented in a formal report with data validation, discussion, and source identification. The source and extent of PCB contamination at KCIA remains a data gap.

Additional sampling and a report should determine where Drainage Basin 5 discharges to the LDW (see Section 3.4.4.2) and determine the extent and concentration of PCB contaminations within the stormwater sediments and joint caulk material at KCIA. This additional information will determine whether KCIA is a source of PCB contamination to the stormwater drainage system.

3.4.4.2 Stormwater Discharge

According to Ecology's scope of work, the 26-acre drainage basin (previously thought to be 3 acres) discharges to the LDW via the aforementioned 24-inch line, located along the property boundary between the Jorgensen Forge and Plant 2 (Figure 20). Following the review of CAD files provided by KCIA, this drainage basin was determined to be Drainage Basin 5, which is 26 acres and discharges through Outfall 5; however, it is not apparent where this outfall drains to the LDW. These CAD files portray the stormwater drainage system with drainage basin boundaries, drainage line, manhole, and catch basin locations. But there is no indication as to where outfalls discharge into the LDW. The KCIA SWPPP does not include a clear description of its drainage areas or outfall locations. According to the KCIA, Drainage Basin 5 drains from the Airport, via the 24-inch line, and connects with the City of Tukwila system before discharging to the LDW. However, as discussed in Section 3.5.3.2, the exact locations of the City of Tukwila's stormwater system and outfalls are unknown. Information on Outfall 5 and Drainage Basin 5 that includes the discharge point location, the location of drainage lines contributing to Outfall 5, and a written description of features included within Drainage Area 5 and activities conducted within the area, is needed.

The results of the 2005 stormwater system sampling event by KCIA showed elevated levels of PCBs in one sample at Trench 2. However, these results have not yet been presented in a formal report that details the analytic results, data validation, and investigation of potential sources of contaminants. This investigation needs to be completed.

3.4.4.3 Groundwater

There have been no groundwater investigations or monitoring for this portion of the airport; therefore it is unknown whether groundwater is contributing to the recontamination of the LDW.

3.4.4.4 Spills

No spills have been documented as occurring in this area of KCIA. No data gaps have been identified.

3.4.4.5 Bank Erosion/Leaching

Because of the large distance between this area and the LDW, potential contaminants from this area have not contributed to the LDW via bank erosion and leaching. No data gaps have been identified for bank erosion for this area of KCIA.

3.5 East Marginal Way South

3.5.1 Current Operations

East Marginal Way South runs in between the three potential sources of contamination that are identified for EAA-4 (Figure 1). The northern portion is located in the City of Seattle, and the southern portion is located in the City of Tukwila. Sampling has been conducted in the portion located in the City of Tukwila (See Section 3.5.2.1 for details).

3.5.2 Historic Use

No information regarding historic use in this portion of East Marginal Way South was found during the review of Ecology's files.

3.5.3 Environmental Investigations and Cleanup Activities

3.5.3.1 Upland Facilities

No information regarding environmental investigations and cleanup activities in this portion of East Marginal Way South was found during the review of Ecology's files.

3.5.3.2 Stormwater Discharge

A small portion of the East Marginal Way South right-of-way and the City of Tukwila Stormwater Drainage System drains to EAA-4 (Figure 27 and Figure 28). The northern portion is located in the City of Seattle and the southern portion is located in the City of Tukwila.

Mr. Ryan Larson, engineer at the City of Tukwila, suspects the drainage in this area drains to a point, and then is piped across Plant 2, to the LDW (Larson, 2007). According to Boeing, the City of Tukwila's public roadway drainage from East Marginal Way South discharges to the LDW, and through Plant 2's Outfall Z (Boeing, 2007a). Mr. Larson also mentioned that there is a large pipe that conveys drainage across the northern edge of the Jorgensen Forge site, but its location is unknown. This drainage pipe does not appear to be connected to the City of Tukwila's drainage system, but rather to the KCIA drainage system (Figure 20; Larson, 2007).

There is not enough information to determine whether or not the City of Tukwila's stormwater drainage system along East Marginal Way South is a potential migration pathway of site-related contaminants to the LDW. No information regarding environmental investigations and cleanup activities in this portion of East Marginal Way South was found during the review of Ecology's files.

3.5.3.3 Groundwater

No information specific to groundwater at East Marginal Way South was found during the file review; but, based on information from the area (detailed in this report), the general groundwater flow direction is west/southwest, towards the LDW.

3.5.3.4 Spills

No information regarding spills in this portion of East Marginal Way South was found during the review of Ecology's files.

3.5.3.5 Atmospheric Deposition

No information regarding spills in this portion of East Marginal Way South was found during the review of Ecology's files.

3.5.4 Data Gaps

3.5.4.1 Upland Facilities

No data gaps have been identified for this portion of East Marginal Way South.

3.5.4.2 Stormwater Discharge

The maps supplied by the City of Tukwila showed minimal information (figures 27 and 28). The drain lines and storm drain locations are shown on an aerial photo, but the lines are not labeled, and discharge points to the LDW are not indicated. More detailed information on maps, showing exact drain line locations and storm drain locations, is needed to determine if this portion of East Marginal Way South could potentially contribute to sediment recontamination of the LDW in EAA-4.

3.5.4.3 Groundwater

There have been no groundwater investigations or monitoring for this portion of East Marginal Way South; therefore, it is unknown whether groundwater is contributing to the recontamination of the LDW.

3.5.4.4 Spills

No data gaps have been identified for spills for this portion of East Marginal Way South.

3.6 Atmospheric Deposition

King County and Seattle Public Utilities have been monitoring atmospheric deposition to assess whether atmospheric deposition is a potential source of phthalates, particularly BEHP, in stormwater runoff (King County and Seattle Public Utilities, 2005). Sampling used passive deposition samplers (i.e., stainless steel bowls that drain into a glass bottle) at four locations in the LDW (as well as placing additional samplers in surrounding neighborhoods) to collect wet and dry deposition. Results showed PAH, benzyl butyl phthalate, and bis(2-ethylhexyl)phthalate in the Duwamish Valley at concentrations two to three times higher than outside the valley (i.e., Beacon Hill) during the winter months compared to the spring months (King County and Seattle Public Utilities, 2005). This finding is consistent with historic Puget Sound Clean Air Agency data showing atmospheric particulate concentrations trending higher during fall/winter months than during spring/summer months.

The King County/Seattle Public Utilities (2005) study concluded that the LDW sample results compared well with studies conducted within the same airshed (i.e., Georgia Basin) and with other regions (i.e., Great Lakes and Roskilde Fjord [Denmark] studies). PAH values observed in LDW samples (0.006 to 0.28 micrograms per meter squared per day [$\mu\text{g}/\text{m}^2/\text{day}$]) were comparable to the average values reported for the Georgia Basin airshed (0.004 to 0.36 $\mu\text{g}/\text{m}^2/\text{day}$). The BEHP values in the LDW (0.23 to 3.5 $\mu\text{g}/\text{m}^2/\text{day}$) were higher than the Georgia Basin average values (0.3 to 0.6 $\mu\text{g}/\text{m}^2/\text{day}$), but were comparable with the results from the Denmark study (0.068 to 2.16 $\mu\text{g}/\text{m}^2/\text{day}$). However, the study found that further air deposition testing would allow the source control efforts to evaluate the reproducibility of results and to perform correlations with existing atmospheric measurements (e.g., particulate concentrations).

Although no previous atmospheric deposition sampling has been conducted at any of the four sites draining to EAA-4, contaminants originating from nearby city streets and industry may be transported and deposited through the air at these sites. Contaminants deposited within the drainage areas are transported to these four areas via surface water runoff. There is not enough information about this contaminant transport mechanism to determine if it could result in contaminant concentrations within EAA-4 above local background levels observed in the LDW.

King County and Seattle Public Utilities concluded continual monitoring is required, as data at that time was insufficient. This sampling design assesses atmospheric deposition within the Duwamish Valley, near EAA-4. Therefore, no data gaps have been identified for atmospheric deposition for this area.

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5.0 Figures


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6.0 Tables


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Appendix A


Photolog of the Jorgensen Shoreline

| EAA-4 PHOTOGRAPHIC LOG: 1 | |
|--|---|
| Client name: WA Dept. of Ecology | Site Location: Jorgensen bank along the Lower Duwamish Waterway |
| Description: View of the Jorgensen Forge from the LDW. |  A wide-angle photograph showing the Jorgensen Forge industrial facility. In the foreground, there is a body of water (the Lower Duwamish Waterway). The middle ground features a rocky and vegetated bank. Behind the bank, several large white cylindrical tanks are visible, along with a large, dark industrial building with a prominent, curved, corrugated metal roof structure. The sky is clear and blue. |

| EAA-4 PHOTOGRAPHIC LOG: 2 | |
|---|---|
| Client name: WA Dept. of Ecology | Site Location: Jorgensen bank along the Lower Duwamish Waterway |
| Description: Locations of contaminated soils along shoreline. |  A photograph of a shoreline area. In the foreground, there is a rocky and vegetated bank. A yellow text label "Contaminated soils" is positioned above the bank, with two yellow arrows pointing to specific areas of the bank. In the background, a large, dark industrial building with a corrugated metal roof is visible. The sky is clear and blue. |

| EAA-4 PHOTOGRAPHIC LOG: 3 | |
|--|---|
| Client name: WA Dept. of Ecology | Site Location: Jorgensen bank along the Lower Duwamish Waterway |
| Description: PCB-containing waste piles, along the Jorgensen shoreline. |  |

| EAA-4 PHOTOGRAPHIC LOG: 4 | |
|---|--|
| Client name: WA Dept. of Ecology | Site Location: Jorgensen bank along the Lower Duwamish Waterway |
| Description: Jorgensen Waste Piles. Scrap metal waste in circle. |  |

| EAA-4 PHOTOGRAPHIC LOG: 5 | |
|---|--|
| Client name: WA Dept. of Ecology | Site Location: Jorgensen bank along the Lower Duwamish Waterway |
| Description: Close up of scrap metal waste |  |