

Port of Seattle
Terminal 108

Preliminary Assessment Report



Prepared for

Port of Seattle
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Seattle, Washington 98121

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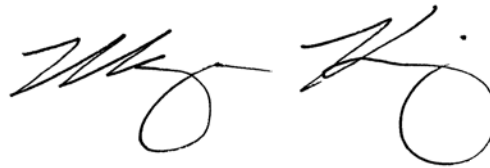
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The interpretations and conclusions contained in this report are based in part on site characterization data collected by others. Floyd|Snider cannot assure the accuracy of this information.

Preliminary Assessment Report

This document was prepared for
The Port of Seattle
under the supervision of:

A handwritten signature in black ink, appearing to read 'Megan King', is positioned above a horizontal line.

Name: Megan King, PE
Date: February 5, 2019

Table of Contents

1.0	Introduction	1-1
1.1	REGULATORY BACKGROUND	1-1
1.2	DOCUMENT SCOPE AND OBJECTIVES	1-1
1.3	SOURCES OF HISTORICAL INFORMATION	1-2
1.4	REPORT ORGANIZATION	1-2
2.0	Site Background	2-1
2.1	SITE LOCATION	2-1
2.1.1	Relationship to the Lower Duwamish Waterway Superfund Site.....	2-1
2.2	SITE DESCRIPTION	2-2
2.3	PRE-INDUSTRIAL AND INDUSTRIAL LAND USE AND ZONING	2-2
3.0	Geology and Hydrogeology.....	3-1
3.1	PHYSIOGRAPHIC PROVINCE UNDERLYING THE SITE.....	3-1
3.2	LOCAL STRATIGRAPHY AFFECTING SHALLOW GROUNDWATER	3-1
3.3	GROUNDWATER OCCURRENCE, FLOW DIRECTION, AND GRADIENTS	3-3
3.4	CONNECTIVITY TO DUWAMISH RIVER	3-4
4.0	Property Ownership and Operational Site History	4-1
4.1	FORMER AND CURRENT OWNERS AND OPERATORS	4-1
4.2	EVALUATION OF SITE ACTIVITIES THAT MAY HAVE RESULTED IN RELEASES OF WASTE MATERIALS AT OR FROM THE SITE	4-1
4.2.1	City of Seattle’s Diagonal Avenue South Sewage Treatment Plant Operations and Surface Impoundments	4-1
4.2.2	Federal Government’s Disposal of PCB-Contaminated Dredged Sediment	4-4
4.2.3	Chiyoda’s Shoreline Dredging for Site Development	4-6
4.2.4	Chevron’s Landfarming of Petroleum-Contaminated Soil.....	4-6
4.2.5	Lafarge’s Facility Improvements on the Western Parcel.....	4-7
4.2.6	Port of Seattle’s Terminal 108 Intertidal Habitat Mitigation Project and Public Access Improvements.....	4-7
4.2.7	Port of Seattle’s Redevelopment of Eastern Parcel	4-8
4.2.8	ConGlobal Industries’ Operations	4-9
4.2.9	Summary of Dredging, Filling, and Surface Grading.....	4-9

4.3	CURRENT OPERATIONS AT THE SITE	4-11
4.4	SITE HISTORY CONCLUSIONS AND SUMMARY OF CONTAMINANTS POTENTIALLY ASSOCIATED WITH SITE USE AND OPERATIONS	4-11
5.0	History of Adjacent Properties.....	5-1
5.1	FORMER WASHINGTON STATE LIQUOR CONTROL BOARD	5-1
5.1.1	Site History	5-1
5.1.2	Environmental Investigations and Site Status	5-2
5.2	U.S. GENERAL SERVICES ADMINISTRATION FEDERAL CENTER SOUTH.....	5-3
5.2.1	Site History	5-3
5.2.2	Environmental Investigations and Site Status	5-4
6.0	Summary of Environmental Investigations at the Site.....	6-1
6.1	SITE INVESTIGATIONS AND SITE STATUS	6-1
6.2	ACCEPTABILITY OF EXISTING DATA.....	6-3
6.2.1	Completeness.....	6-3
6.2.2	Representativeness	6-4
6.2.3	Data Quality and Data Validation.....	6-5
6.3	SUMMARY OF CURRENT PERMITS AND COMPLIANCE.....	6-5
7.0	Preliminary Screening Level Development and Evaluation of Existing Analytical Data	7-1
7.1	DEVELOPMENT OF PRELIMINARY SCREENING LEVELS BY MEDIA.....	7-1
7.1.1	Preliminary Screening Level Development for Soil	7-2
7.1.2	Preliminary Screening Level Development for Groundwater.....	7-3
7.2	COMPARISON OF DATA TO PRELIMINARY SCREENING LEVELS	7-4
7.2.1	Identification of Preliminary Soil Contaminants of Potential Concern	7-5
7.2.2	Identification of Preliminary Groundwater Contaminants of Potential Concern	7-5
8.0	Summary of Contaminants of Potential Concern and Sources.....	8-1
8.1	SUMMARY OF PRELIMINARY COPCS.....	8-1
8.2	POTENTIAL SOURCES OF PCBS.....	8-2
9.0	Potential Contaminant Migration and Exposure Pathways	9-1
9.1	SOIL	9-1

9.1.1	Potential for Migration of Contaminants in Soil to Groundwater	9-1
9.1.2	Potential for Migration of Bank Soil to Sediment	9-2
9.1.3	Potential for Human Direct Contact Exposure to Soil	9-3
9.1.4	Potential for Terrestrial Receptor Exposure to Soil	9-3
9.2	GROUNDWATER.....	9-3
9.2.1	Potential for Groundwater Discharge to Surface Water and Sediment	9-4
9.2.2	Potential for Vapor Intrusion	9-5
9.2.3	Potential for Human Direct Contact Exposure to Groundwater.....	9-5
9.3	STORMWATER	9-5
9.4	INDIRECT EXPOSURE VIA CONSUMPTION OF AQUATIC BIOTA THAT HAVE ACQUIRED SITE-RELATED CONTAMINANTS	9-5
10.0	PA Conclusions.....	10-1
11.0	References	11-1

List of Tables

Table 4.1	Summary of Industrial Owners and Operators, Uses, and Preliminary Contaminants of Potential Concern
Table 7.1	Soil Preliminary Screening Levels
Table 7.2	Groundwater Preliminary Screening Levels
Table 7.3	Frequency of Exceedance for Chemicals Detected in Vadose Zone Soil
Table 7.4	Frequency of Exceedance for Chemicals Detected in Saturated Soil
Table 7.5	Chemicals That Were Analyzed For but Not Detected in Soil
Table 7.6	Chemicals Never Analyzed For in Soil and/or Groundwater
Table 7.7	Frequency of Exceedance for Chemicals Detected in Groundwater
Table 7.8	Chemicals That Were Analyzed For but Not Detected in Groundwater
Table 8.1	Summary of Preliminary Contaminants of Potential Concern (embedded)

List of Figures

Figure 1.1	Site Location Map
Figure 2.1	Site Map
Figure 4.1	Historical Features

Figure 6.1	Historical Soil and Groundwater Sample Locations
Figure 8.1	Distribution of PCB Aroclor Concentrations Detected in Site Soil
Figure 8.2	Distribution of PCB Aroclor Concentrations Detected in Sediment Adjacent to Terminal 108
Figure 9.1	PCB Aroclor 1242 in Soil
Figure 9.2	PCB Aroclor 1248 in Soil
Figure 9.3	PCB Aroclor 1254 in Soil
Figure 9.4	PCB Aroclor 1260 in Soil
Figure 9.5	Total PCBs in Soil
Figure 9.6	Preliminary Screening Level Exceedances in Groundwater—Recent Data (2006–2013)

List of Appendices

Appendix A	Environmental Conditions Report (Windward 2009a)
Appendix B	Figure 1-2, Source Control Data Evaluation Report (AECOM 2014)
Appendix C	Historical Documentation

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
APN	Assessor Parcel Number
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below ground surface
BMP	Best management practice
BOD	Biological oxygen demand
Boeing	The Boeing Company
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CCI	Container Care International
Chevron	Chevron USA Products Company
Chiyoda	Chiyoda Corporation International
City	City of Seattle
COC	Contaminant of concern

Acronym/ Abbreviation	Definition
ConGlobal	ConGlobal Industries, Inc.
COPC	Contaminant of Potential Concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
CSO	Combined Sewer Overflow
CUL	Cleanup level
CY	Cubic yards
DCG One	DCG One Seattle
Diagonal Avenue STP	Diagonal Avenue South Sewage Treatment Plant
DoD	U.S. Department of Defense
DRO	Diesel-range organic
Ecology	Washington State Department of Ecology
ECR	Environmental Conditions Report
EAA	Early Action Area
EHSI	EHS-International, Inc.
Farallon	Farallon Consulting, LLC
FCS	Federal Center South
FOE	Frequency of Exceedance
FOIA	Freedom of Information Act
ft/ft	Feet per feet
Ford	Ford Motor Company
FS	Feasibility Study
gpd	Gallons per day
gpm	Gallons per minute
GSA	General Services Administration
GRO	Gasoline-range organic
IAA	Inter-Agency Agreement
ISGP	Industrial Stormwater General Permit
Kane	Kane Environmental, Inc.
Lafarge	Lafarge Cement Company
lb/day	Pounds per day
LDW	Lower Duwamish Waterway
µg/L	Micrograms per liter

Acronym/ Abbreviation	Definition
Metro	Municipality of Metropolitan Seattle
mg/kg	Milligrams per kilogram
MLLW	Mean lower low water
MRF	Material Recovery Facility
MTCA	Model Toxics Control Act
NOV	Notice of violation
NPDES	National Pollutant Discharge Elimination System
Order	Administrative Settlement Agreement and Order on Consent for Removal Action
ORO	Oil-range organic
PA	Preliminary Assessment
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCS	Petroleum-contaminated soil
PCUL	Preliminary Cleanup Level
Port	Port of Seattle
PSL	Preliminary Screening Level
RCRA	Resource Conservation and Recovery Act
Recology	Recology CleanScapes
Riley Group	Riley Group, Inc.
ROW	Right-of-Way
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SD	Storm drain
SHA	Site hazard assessment
SI	Site Investigation
Site	Terminal 108 Site
SMS	Sediment Management Standards
SOW	Statement of Work
SWPPP	Stormwater Pollution Prevention Plan
SPU	Seattle Public Utilities
SVOC	Semivolatile organic compound
T-108	Terminal 108

Acronym/ Abbreviation	Definition
TEE	Terrestrial ecological evaluation
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VCP	Voluntary Cleanup Program
VOC	Volatile organic compound
WAC	Washington Administrative Code
WSLCB	Washington State Liquor Control Board
WSPCC	Washington State Pollution Control Commission

1.0 Introduction

1.1 REGULATORY BACKGROUND

On April 5, 2018, an Administrative Settlement Agreement and Order on Consent for Removal Action (Order) was entered into by the Port of Seattle (Port) and the U.S. Environmental Protection Agency (USEPA) for the Terminal 108 Site (Site) located along East Marginal Way South on the east bank of the Lower Duwamish Waterway (LDW) Superfund Site in Seattle, Washington (Figure 1.1). Under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), USEPA, through the Order, is requiring the Port to perform a Preliminary Assessment (PA) and Site Investigation (SI), if warranted, based on the Statement of Work (SOW) included as Appendix B of the Order. The Port will conduct the PA and SI (if warranted) in accordance with the Order and consistent with the requirements specified in 40 Code of Federal Regulation (CFR) 300.410 Removal Site Evaluation, and other published USEPA guidance for conducting a PA and SI.

1.2 DOCUMENT SCOPE AND OBJECTIVES

The objectives of the PA, as identified in the SOW and as discussed in a meeting with USEPA on April 17, 2018, include the following:

- Develop comprehensive Site history. The historical operations sections reference work presented in the Environmental Conditions Report (ECR; Windward 2009a, included as Appendix A) and are expanded upon with newly located historical information regarding industrial operations, potential releases of hazardous materials, waste handling and disposal, and past cleanup activities at the Site.
- Evaluation of Site activities that may have resulted in releases at or from the Site, including the use of the Site for dewatering contaminated sediments that were hydraulically dredged in response to the 1974 General Services Administration (GSA) spill of polychlorinated biphenyls (PCBs) into the Duwamish Waterway from a barge owned by Alaska Puget United Transportation Company under contract to the U.S. Navy's Military Sea Transportation Service; operation of the Diagonal Avenue South Sewage Treatment Plant (Diagonal Avenue STP) and associated surface impoundments; and other activities either known or suspected to have released hazardous substances.
- Evaluation of all environmental data compared to the Washington State Department of Ecology's (Ecology's) 2018 LDW Preliminary Cleanup Level (PCUL) Workbook and Supplemental Information (Ecology 2018a and 2018b) and USEPA's Regional Screening Levels (RSLs; USEPA 2018).
- Identification of data gaps related to the comprehensive Site history and current conditions (referred to throughout this document as PA data gaps).
- Recommendations for additional environmental sampling at the Site necessary to resolve PA data gaps.

Per the SOW, after completion of the PA and based on recommendations provided herein, USEPA will determine whether additional environmental sampling is required at the Site to resolve identified PA data gaps, which will initiate completion of an Investigation Work Plan as the next phase of work.

1.3 SOURCES OF HISTORICAL INFORMATION

Available information pertaining to historical and current Site conditions and environmental data were reviewed and evaluated to assess migration pathways and receptors. Formal Freedom of Information Act (FOIA) requests were submitted to the following federal agencies: GSA, U.S. Army Corps of Engineers (USACE), and the U.S. Department of Defense (DoD). USEPA provided the Port with a list of Site documents from the Superfund Enterprise Management System database, but no formal FOIA request was submitted to the agency. Public Records Act (PRA) public disclosure requests were submitted to the following local agencies: Ecology, and King County and the City of Seattle (City) also provided relevant documents. Responsive records obtained from these agencies have been used in this PA to supplement the Site summary and evaluations included in the ECR and to summarize documentation that was either newly discovered or generated since the ECR was completed in 2009.

1.4 REPORT ORGANIZATION

This PA is organized as follows:

- **Section 2.0—Site Background.** Presents a description of the Site location and land use.
- **Section 3.0—Geology and Hydrogeology.** Describes general geomorphology, topography, stratigraphy, and groundwater characteristics at the Site.
- **Section 4.0—Property Ownership and Operational Site History.** Presents a summary of Site ownership beginning in 1938, an evaluation of Site activities that may have resulted in releases of waste materials at or from the Site, and a description of current operations.
- **Section 5.0—History of Adjacent Properties.** Presents a description of two adjacent properties, the former Washington State Liquor Control Board (WSLCB) facility, and the GSA Federal Center South (FCS), including history, environmental investigations, and site status.
- **Section 6.0—Summary of Environmental Investigations at the Site.** Presents a summary of all previous soil and groundwater investigations and stormwater permit compliance history and status, evaluates the usability of the existing data, and summarizes contaminants potentially associated with historical Site operations.
- **Section 7.0—Preliminary Screening Level Development and Evaluation of Existing Analytical Data.** Summarizes the process by which Preliminary Screening Levels (PSLs) for soil and groundwater were developed, and compares existing data against the PSLs to identify preliminary Contaminants of Potential Concern (COPCs).

- **Section 8.0—Summary of Contaminants of Potential Concern and Sources.** Summarizes the preliminary data screening conducted in the previous section and provides discussion of potential historical sources of PCBs at the Site.
- **Section 9.0—Potential Contaminant Migration and Exposure Pathways.** Identifies all potentially active contaminant transport mechanisms and exposure pathways at the Site, under current and future land use scenarios.
- **Section 10.0—PA Conclusions.** Provides summary of findings; and conclusions developed for the Site based on the results of the PA.
- **Section 11.0—References.** Provides a list of materials cited in this PA.

2.0 Site Background

2.1 SITE LOCATION

The Site is on the east bank of the LDW Superfund Site generally located at 4525 Diagonal Avenue South in Seattle, Washington, King County. The approximate geographic coordinates for the center of the Site are 47° 33' 43.46" north latitude and 122° 20' 32.63" west longitude. The location of the Site is shown on Figure 1.1.

2.1.1 Relationship to the Lower Duwamish Waterway Superfund Site

Between 1913 and 1917, the Duwamish River was channelized and dredged to form the Duwamish Waterway. The LDW Superfund Site consists of a 5-mile segment of the Duwamish Waterway measured from the southern tip of Harbor Island to just south of the Norfolk Combined Sewer Overflow. The LDW Superfund Site was added to the USEPA National Priorities List in September 2001 and to the Washington State Hazardous Sites List on February 2002 due to human health and ecological risk levels that warrant action under federal and state law. The Record of Decision (ROD; USEPA 2014) for the cleanup of the in-waterway portion of the LDW Superfund Site (441 acres) was published in 2014.

The LDW Superfund Site contaminants of concern (COCs) include PCBs, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), metals, and dioxins/furans. USEPA is responsible for administering the cleanup of LDW sediments, and Ecology is responsible for source control actions associated with the LDW Superfund Site. In 2003, USEPA identified seven candidate sediment sites for early action (Early Action Areas, or EAAs). One of the recommended EAAs, the Duwamish/Diagonal EAA, includes the adjacent Duwamish/Diagonal combined sewer overflow (CSO) and storm drain (SD) area on the east side of the LDW at the end of the Oregon Street right-of-way (ROW). The Site is located upland and adjacent to the LDW Superfund Site on the east bank of the LDW and directly abuts a portion of the Duwamish/Diagonal EAA (refer to Appendix B).

This PA identifies potential contaminant transport pathways associated with historical activities and the associated contamination present on the Site to determine if the site poses a potential risk to human health or the environment or a potential risk of recontamination to the LDW and Duwamish/Diagonal EAA. This includes comparison of existing Site soil and groundwater data to screening levels for the protection of surface water and sediments, as well as potential upland exposure pathways. This PA does not evaluate current surface water or sediment conditions within the LDW Superfund Site, nor does it evaluate the potential historical contribution of the Site to the LDW, because these evaluations are outside the scope of this PA.

2.2 SITE DESCRIPTION

The Site is currently owned by the Port and consists of two parcels, the Western Parcel and the Eastern Parcel, totaling a 23-acre area (Figure 2.1). In general, the topography is flat with a ground surface elevation of approximately 19 to 20 feet mean lower low water (MLLW).

The Western Parcel (King County Tax Assessor Parcel No. [APN] 7666700510) is approximately 9 acres and is currently vacant. This parcel is unpaved and primarily covered with vegetation. A Port public access area and a habitat mitigation area are accessible from Diagonal Avenue South, located along the southern shoreline, adjacent to the LDW. The public access area is landscaped with grass, trees, and shrubs, and an asphalt pathway leads to the LDW. The habitat mitigation area is one of 12 located along the LDW shoreline. Outside of the public access area, the shoreline is armored with riprap, and a wooden bulkhead and mudflat are located in the lower portion of the intertidal area.

The Eastern Parcel (APN 7666700515), currently leased by ConGlobal Industries, Inc. (ConGlobal), is approximately 14 acres. ConGlobal, an international company that operates container and chassis depots, uses the Eastern Parcel for container storage and truck chassis storage and repair. Approximately 9 acres of this parcel are paved. The Eastern Parcel is accessible via a private access gate on South Oregon Street. Compacted gravel covers approximately 5 acres of the Eastern Parcel, and stormwater is collected by a perforated polyethylene pipe system installed within the compacted gravel area to collect infiltrating stormwater in areas where cargo containers are stored. The majority of the Site is fenced; however, access to the Western Parcel is possible via Diagonal Avenue South.

The Site is bordered to the north by the South Oregon Street Right-of-Way (ROW), Terminal 106W, and the former WSLCB facility, currently owned by East Marginal Industrial, LLC; to the east by the King County pump station and East Marginal Way South; to the south by Diagonal Avenue South and the GSA FCS; and to the west by the LDW. The Site is adjacent to the LDW Superfund Site.

2.3 PRE-INDUSTRIAL AND INDUSTRIAL LAND USE AND ZONING

In the early 1900s, and prior to channelization of the Duwamish River between 1913 and 1917, the property was unoccupied tidal marsh. It is unknown who owned and operated the property from the early to mid-1900s. The first documented use of the property occurred in 1938 when it was developed by the City for use as the Diagonal Avenue STP. Based on review of Site geology, further discussed in Section 3.0, fill in the upland portion of the Site is consistent with the profile of hydraulic fill, dredge material from the former river channel, and sewage sludge. Based on historical aerial photographic review, the intertidal portions of the property were likely filled between 1969 and 1970 using imported fill material. However, the source of fill has not been identified in historical documentation. An open tidal channel, later converted to underground piping, extended along the north side of the property until at least the late 1960s (Windward 2009a).

Over the next several years, the property was used for various industrial purposes by several different owners and operators (refer to Section 4.0). Since at least 1975, the Site has been used for off-dock container storage and as a maintenance terminal (Windward 2009a; AECOM 2014). Currently, both the Eastern and Western Parcels of the property are zoned Industrial General 1 by the City.

3.0 Geology and Hydrogeology

3.1 PHYSIOGRAPHIC PROVINCE UNDERLYING THE SITE

The Site is located within the Duwamish Valley, a topographic basin south of downtown Seattle that extends from the origin of the Duwamish River, at the confluence of the Green and Black Rivers in Tukwila, to the river mouth at Elliott Bay. The Duwamish Valley was formed approximately 15,000 years ago by the retreat of the glaciers that covered the Puget Sound region (Troost and Booth 2008). Sediment originating from the Osceola Mudflow off Mount Rainier and other sources from surrounding mountains and hills was carried into the valley by the White River over a period of several thousand years. The Site is located in what was once a tidal marsh area associated with the Duwamish River delta.

Large portions of the tidal marsh area were filled in the early 1900s during engineering of the LDW. Between 1913 and 1917, the LDW was created by dredging a channel for the waterway and filling adjacent floodplain areas. Fill was placed using both mechanical and hydraulic methods and consisted primarily of dredged material produced during channelization of the LDW. Fill materials may have included soil and other geologic materials that were a by-product of other land development projects inland from the Duwamish River, such as re-grading projects, as well as other waste materials of the time including refuse.

The present topography of the Site is generally flat with gradual slopes downward to the east and northwest, away from the central part of the Site (Windward 2009a). The average ground surface elevation is approximately 19 feet MLLW.

3.2 LOCAL STRATIGRAPHY AFFECTING SHALLOW GROUNDWATER

A review of soil borings logged during development of monitoring wells on the property indicate that the shallow hydrostratigraphic units present at the Site consist of fill materials underlain by tidal marsh deposits (PGG 2007). Boring logs reviewed include borings with a typical depth of 15 to 20 feet below ground surface (bgs) and a maximum depth of 69.5 feet bgs.

Relevant hydrostratigraphic units in the Duwamish Valley consist of the following, from shallowest to deepest:

- Fill unit
- Tidal marsh deposits (top of Younger Alluvium, Qyal)
- Alluvial deposits (Younger Alluvium, Qyal, and Older Alluvium, Qoal)

As described in this section and in Section 3.3, groundwater may occur in all three units as the Duwamish Valley Aquifer or occur separately as a perched aquifer in the fill unit, depending on the local thickness, composition, and continuity of the tidal marsh deposits.

The fill unit is the uppermost water-bearing unit of the Site. This unit is often referred to as the shallow aquifer (hereafter “shallow fill aquifer”) in investigation documentation (Windward 2009a). At the Site, the fill may include hydraulic fill, dredged material from the former river channel, and some volume of sewage sludge (Windward 2009a). Filling is further described in Section 4.2.9. Boring logs indicate the fill material to be a predominantly heterogeneous deposit extending from the ground surface approximately 10 to 15 feet to the top of the native tidal marsh deposits (PGG 2007; Dames & Moore 1988). The fill is described as brown to black, loose to medium dense, moist to wet, very fine to medium-grained sand and silty sand (AGI 1992; PGG 2006). According to Dames & Moore (1988), in the west-central portion of the Site, fill consists of predominantly clean, poorly graded sands, loose to medium dense, interlayered with 6- to 12-inch lenses of non-plastic to low plasticity silt. According to Applied Geotechnology, Inc., most of the fill is consistent with dredged material, but dark gray to black sandy silt with organics encountered in MW-10 was identified as sewage sludge based on professional judgment (AGI 1992). The fill includes zones of significant organic content, localized cementation, and variations in percentage of silt and gravel content. During subsurface investigation at the property, the fill was usually identified by the presence of significant volumes of sand and anthropogenic materials, with a lack of peaty material. Along the Site shoreline, various outcrops of fill that lacked peaty material were identified.

Hydrogeologic properties of the fill layer at the Site are not well characterized. At the neighboring site to the south, the shallow fill aquifer was characterized as having “low to very low permeability” based on an investigation of the response of groundwater elevation to tidal fluctuation (Golder 2013). Boring logs indicating well-graded fine to medium sand in places and fine to medium silty sand in others (Windward 2009a) suggest that the material may have moderate to moderately high hydraulic conductivity.

Beneath the fill layer are tidal marsh deposits that are reportedly distinctive and easily identified as compact silts or sandy silts intermixed with peaty grass and root materials, based on advancement of monitoring wells on the property in 2006 (PGG 2006). Outcrops of tidal marsh deposits are visible along the shoreline near mean sea level. The tidal marsh deposits underlie the fill material at the Site from between 10 to 20 feet bgs (approximately 9 to -1 feet MLLW based on an average ground surface elevation of 19 feet MLLW). Boring logs indicate these deposits are brown to gray, very soft to soft, moist to wet, and composed of organic silts and clays.

The hydrogeologic properties of the tidal marsh deposits have not been characterized at the Site, although they are part of a discontinuous silt aquitard present throughout the Duwamish Valley that forms the top of the Younger Alluvium (Qyal) deposit. Often referred to as silt overbank deposits, Qyal is commonly identified as clayey silt and organic silt, although it also includes sandy silts and silty sands with abundant organics. Because it was deposited as a tideflat before modifications of the valley commenced in the 1900s, the tidal marsh layer forms a more uniformly silty deposit than the fill unit above. The continuity of the unit and its function as an aquitard between the shallow fill aquifer and underlying alluvial aquifer have not been investigated at the Site.

Beneath the tidal marsh aquitard, the Younger Alluvium continues as alluvial deposits that range from black, loose, wet, fine-grained sands to gray, medium stiff, wet, and very-fine-grained sandy silts (PGG 2006). Elsewhere in the Duwamish Valley, the Qyal extends to approximately 9 feet MLLW, suggesting a thickness at the Site of only 10 feet or less from the average ground surface elevation of approximately 19 feet MLLW. The Younger Alluvium grades downward into Older Alluvium (Qoal), which is characterized by a coarser, predominately sandy alluvium, still containing silt. The upper zone from 20 to 40 feet bgs is often sand. With depth, the unit increases in silt content. The lower sections of the Duwamish Valley Aquifer are saline due to their original formation as a submarine deposit of a river delta that originally extended to Auburn, Washington (Booth and Herman 1998).

Beneath the Qoal lie glacially overridden sediments that are associated with or predate the most recent glacial advance and retreat. Coarse-grained units within these deposits serve as aquifers. The lower 200 feet overlying bedrock are predominantly dense silt and clay.

3.3 GROUNDWATER OCCURRENCE, FLOW DIRECTION, AND GRADIENTS

In monitoring wells installed at the Site that have been completed in the shallow fill aquifer, groundwater is typically observed at approximately 5 to 6 feet MLLW, which generally corresponds to 9 to 10 feet bgs, because monitoring wells are generally located where ground surface elevations are approximately 15 MLLW. Boring logs reviewed include monitoring wells installed to a maximum depth of 20 feet bgs, or approximately 0 feet MLLW and up to approximately 10 feet into the tidal marsh deposit. Monitoring well MW-8 (shown in Figure 2.1) appears to have penetrated the fill and tidal marsh units and encountered the underlying Younger Alluvium, but did not encounter groundwater at the time of drilling.

Because the thickness of the fill unit is typically only about 10 feet, these measurements indicate a very small saturated thickness on the order of 0 to 4 feet in the shallow fill aquifer. Well development data further indicate the lack of available water in this unit, with several monitoring wells dry after recovery of 1 to 4 gallons (Windward 2009a). Boring logs installed in 1991 included several in which groundwater was not encountered to depths of approximately 20 feet bgs.

These measurements suggest a thin, perched aquifer, with uncertain hydraulic connection to the Duwamish Valley Aquifer below. Contaminant transport by groundwater in this thin, perched aquifer is expected to be a function of limited horizontal groundwater flow in directions dependent on local heterogeneities, with possibilities of isolated pockets of limited transport and of downward transport where the underlying tidal marsh deposit is absent or of sufficiently high permeability. Potential hydraulic connection between the shallow fill aquifer and the underlying Duwamish Valley Aquifer can be inferred from boring logs indicating that the tidal marsh silts were logged as wet or moist, although indications from boring logs are not conclusive indicators of hydraulic connection. Elsewhere in the Duwamish Valley, the fill unit is typically not saturated and not significant as a potential aquifer, although it may locally contain discontinuous lenses of perched groundwater or serve as the top of the Duwamish Valley Aquifer (Booth and Herman 1998). Groundwater (other than perched groundwater) is generally first encountered within the Younger Alluvium materials, and it comprises the shallow portion of the Duwamish

Valley Aquifer in the area. The Duwamish Valley Aquifer is a tidally influenced and generally unconfined aquifer, except where the tidal marsh silt deposits are present and continuous, where it can appear to be under semi-confined conditions. This effect is less noticeable where the tidal marsh silt deposit is thin, less fine-grained, or not continuous (Booth and Herman 1998).

Mapping of groundwater contours also indicates that groundwater in the shallow fill aquifer in the Western Parcel generally flows toward the LDW. In the Eastern Parcel, however, groundwater moves from a relative high in the center radially in all directions, but predominately to the north and east. The insubstantial and perched nature of the shallow fill aquifer may explain the observed radial groundwater flow directions in the shallow fill aquifer from a relative high in the north-central portion of the Site, in the Eastern Parcel (roughly between groundwater monitoring wells PGG-1 and PGG-2; Windward 2009a), instead of westerly toward the LDW.

The observed radial flow direction could be influenced by backfill materials in a former tidal channel that is evident in historical aerial photographs in the northeast area of the Site and shown on Figure 2.1. The former channel appears to have extended from East Marginal Way South northwesterly across the South Oregon Street ROW and then westerly toward the LDW. Based on available information, the channel was likely filled between 1962 and 1976 (PGG 2006); the channel was most likely backfilled when the Duwamish/Diagonal Combined Sewer Overflow (CSO)/Storm Drain (SD) stormwater and sewer lines were installed in 1966 and 1967 (King County et al. 2005). Windward Environmental, LLC, stated that “assuming that coarse-grained materials were used as backfill, the relic channel may be locally influencing groundwater flow in the shallow fill aquifer unit by providing a preferential pathway for flow” (Windward 2009a). This factor could help explain the radial flow direction observed, which included a component of flow easterly and generally toward the former channel. “Ultimately, the discharge point for this flow path is most likely the LDW, near the present-day location of the Duwamish/Diagonal CSO/SD and the Duwamish emergency overflow (EOF)” (Windward 2009a).

The shallow fill aquifer at a site adjacent to the south similarly included an overall westerly flow with mounding and multiple flow directions, which were thought to be influenced by higher permeability fill material in subsurface utility trenches or other excavations (Golder 2013).

Horizontal gradients at the Site based on well measurements in 2007 (Windward 2009a) were typically 0.001 feet per foot (ft/ft) westerly toward the river. Horizontal gradients observed in the shallow fill aquifer adjacent to the Site to the south were overall westward gradient toward the river, between approximately 0.002 and 0.004 ft/ft, with slightly less steep gradients observed in the southerly and easterly flow direction (0.001 to 0.002 ft/ft; Golder 2013).

3.4 CONNECTIVITY TO DUWAMISH RIVER

With some local irregularities associated with the insubstantial thickness and apparently perched nature of the shallow fill aquifer, the overall flow direction of this aquifer is toward the Duwamish River. Water within the aquifer is expected to either discharge directly to the Duwamish River, potentially emerge as bank seeps, or flow downward into the tidal marsh deposits and underlying alluvium, which comprise the upper portion of the Duwamish Valley

Aquifer, which discharges to the Duwamish River. Shallow groundwater in the valley area is not hydraulically connected to deeper or adjacent aquifers that could potentially be used for drinking water supply (Booth and Herman 1998). Measurements from locations adjacent to and south of the Site confirm that the shallow fill aquifer potentiometric surface is consistently higher than the Duwamish River, by approximately 3 feet (Golder 2013).

Groundwater near the LDW within the shallow fill aquifer unit is reportedly tidally influenced (Windward 2009a), although the data supporting this conclusion are unknown. Tidal influence of wells that penetrate the tidal marsh deposits would be expected, because these form the upper portion of the Duwamish Valley Aquifer. Tidal influence of wells that are screened above the tidal marsh deposits in the shallow fill aquifer would suggest that the shallow fill aquifer is hydraulically connected to the Duwamish Valley Aquifer and is not isolated as a perched aquifer.

A study of tidal influence adjacent to the Site to the south suggests that this effect may be limited. During a study of the adjacent FCS property in 2013, the range of observed tidal fluctuations in the Duwamish River ranged up to 14 feet. Only one monitoring well, EHSI-MW-2 (located 600 feet inland, adjacent to East Marginal Way South), exhibited water level fluctuations related to tidal fluctuations, with a time lag of 2 to 4 hours. The fluctuations were observed in a well that was farther from the river than some wells where no fluctuations were observed, suggesting that this well has a closer hydraulic connection to the river, despite being farther away. The limited tidal response in shallow fill aquifer monitoring wells was attributed to aquifer material with apparent low to very low permeability, which would limit the ability of the tidal fluctuations to propagate into the groundwater system (Golder 2013).

4.0 Property Ownership and Operational Site History

4.1 FORMER AND CURRENT OWNERS AND OPERATORS

Since development in the early 20th century, the Site has been used by different parties for various industrial purposes. The first known use of the property was the Diagonal Avenue STP, owned and operated by the City. The City operated the Diagonal Avenue STP in the central portion of the Site on the Eastern and Western Parcels from 1940 until 1962. In 1962, the Municipality of Metropolitan Seattle (Metro) took over operations of the plant while the City retained ownership. The Diagonal Avenue STP ceased operations in 1969 and was closed by 1970 when the West Point Treatment Plant was constructed. In 1972, the City sold the property to Chiyoda Corporation International (Chiyoda). In 1984, the Port acquired the property, and in 1985, the Port divided it into two parcels, the Eastern and Western Parcels. The Port sold the Eastern Parcel to Chevron USA Products Company (Chevron) in 1985. Chevron owned and operated the Eastern Parcel property until 1992, when it was then conveyed back to the Port. From 1989 until 1998, Lafarge Cement Company (Lafarge) leased the Western Parcel for a bulk cement terminal. In the mid-1990s, Container Care International (CCI), later known as ConGlobal, used the property for container storage and as a transfer yard (Windward 2009a). Currently, the Port owns both the Western and Eastern Parcels. As indicated above in Section 2.0, ConGlobal currently leases the Eastern Parcel.

A detailed description of former and current owners and operations, as well as pre-industrial and industrial history, are summarized in Section 3 of the ECR (Windward 2009a; included as Appendix A). Figure 4.1 shows aerial images of the Site during historical industrial operations between the 1960s and 1990s, as well as the current Site layout. A summary of owners and operators, associated property uses, and potential contaminants associated with historical operations on the Eastern and Western Parcels is summarized in Table 4.1.

4.2 EVALUATION OF SITE ACTIVITIES THAT MAY HAVE RESULTED IN RELEASES OF WASTE MATERIALS AT OR FROM THE SITE

4.2.1 City of Seattle's Diagonal Avenue South Sewage Treatment Plant Operations and Surface Impoundments

The City operated the Diagonal Avenue STP, formerly located in the central portion of the Eastern Parcel, from 1940 until 1962 when Metro took over operations. The Diagonal Avenue STP was initially designed to serve a population of 32,000 with a flow capacity of 8 million gallons per day (gpd). The Diagonal Avenue STP was the last unit (Unit No. 10) of the Henderson Street Trunk Sewer System and the first major primary treatment plant for disposal of combined sewage into the Duwamish (Sylliaasen 1940; Fitch 1945; Brown and Caldwell 1958). The plant was constructed to eliminate both floating and settleable sanitary waste from raw sewage and to protect aquatic resources in the LDW (Fitch 1945). Sewage was treated using sedimentation, chlorination, and sludge digestion. The plant structures were known to include two large clarifiers, two digesters, three glass-covered and one open air sludge drying beds, sludge ponds, a control house, and a pump house (refer to Figure 4.1), although the specific structural design details of the

Diagonal Avenue STP facilities are unknown. Sludge digestion residue was disposed of via “lagooning on plant grounds, by opening and closing a valve when necessary” (Fitch 1945). The Fitch report also stated that lagooning could be used for a 2-year period prior to abandonment (Fitch 1945). The control house of the plant contained a laboratory, a restroom, locker room, operation control room, and a chlorine room. The chlorine room was equipped with manually controlled chlorinators with a capacity of 500 pounds per day (lb/day). Chlorine, used as a disinfectant, could be applied to the clarifier influent or effluent. A rack for the storage of five 1-ton chlorine cylinders was located adjacent to the chlorine room (Sylliaasen 1940).

The drainage area included the Michigan Street Trunk Sewer and Henderson Street Trunk Sewer up to and including the Sewage Pumping Stations at Henderson Street, Grattan Street, and Holly Street, located on the shoreline of Lake Washington (Fitch 1945). Primary-treated effluent was discharged into the LDW through a 30-inch diameter steel outfall located approximately mid-way along the property shoreline. In 1962, a parking lot area was constructed on the southern portion of the property, and a drainage system associated with the parking area was installed, including an 18-inch diameter concrete outfall (Windward 2009a).

Between 1942 and 1945, the plant experienced numerous operational issues and was not operating as it was designed, resulting in periods of inactivity or shutdown at the plant (Fitch 1945). The following deficiencies and/or corrective measures were identified in the 1945 City report and other historical records (refer to Appendix C):

- In 1942, the pH of stale sludge was below 5.2. To address this issue, the clarifiers were drained, inflow was discontinued, and 1,100 pounds of lime was then added to the digesters to maintain a higher pH of 6.8, which was considered to be suitable for operations. This resulted in gassing and foaming, which subsided over a period of several days (Fitch 1945).
- Breaks in connection pipes occurred due to ground settling in the pipe gallery tunnel between units, clarifiers, digesters, and control buildings (Fitch 1945).
- To remedy time down from a labor shortage, automatic time clock controls were installed for pumping and re-circulating of sludge in the digesters, to prevent overflow, and to stop the inflow of sewage that would regularly occur. The automatic controls used mercury switches to pump control circuits (Fitch 1945).

In 1958, engineers from Brown and Caldwell and government officials developed a regional plan for sewage disposal that built on existing trunk sewer lines that were reaching capacity by the mid- to late-1950s. According to the 1958 Metropolitan Seattle Sewerage and Drainage Survey, flow to the Diagonal Avenue STP was limited by two upstream regulators, located at South Michigan Street and South Brandon Street upstream of the Diagonal Avenue STP and Slip 1, which provided a bypass directly to the Duwamish River. During periods of high rainfall and due to the nature of the combined storm and sewer systems, the plant frequently bypassed untreated sewage into the Duwamish River. By the mid- to late 1950s, the approximately 5,100-acre tributary area included a large industrial area of the eastern bank of the LDW (Brown and Caldwell 1958).

As indicated previously, three glass-covered and one open air sludge drying beds were located west of the clarifiers and digesters (Figure 4.1). The 1958 Brown and Caldwell report stated that the sludge beds were “glass covered in ‘greenhouse’ fashion and dried digested sludge [was] pulverized and utilized as a soil conditioner at city parks.” As summarized in the ECR, it was reported that at the time of facility closure, sludge up to 5 feet thick was left in the sludge ponds and drying beds and subsequently covered with fill material from an unknown source.

Historical documentation indicates that the Diagonal Avenue STP received both sewage and industrial waste (Fitch 1945; Brown and Caldwell 1958). In 1957, the sources of waste received from surrounding industries included adhesives and related chemicals, beverage bottling, cement handling and distribution, compressed gasses, food canning, metal plating, sawmill, steel fabrication, and truck manufacturing. During this time, biological oxygen demand (BOD) at the plant was reported to be 4,470 lb/day, and suspended solids were reported at 7,590 lb/day. It was estimated that after deduction of the BOD contribution from the residential population, that industrial wastes had a population equivalent of 15,000, approximately half of the capacity the Diagonal Avenue STP was designed to accommodate, and a waste volume of approximately 2,547.2 million gpd, or roughly 930 million gallons per year (Brown and Caldwell 1958).

Much of the industry in this area discharged to the Diagonal Avenue STP, although many of the individual facility connections of lesser importance to Diagonal Avenue STP operations are now unknown. Historical records indicate that The Boeing Company’s (Boeing’s) Plant 2 (Boeing Plant 2) discharged industrial waste to the Diagonal Avenue STP. Records relative to documented spills and pollution controls installed for preventative measures include the following:

- In January 1967, the Washington State Pollution Control Commission (WSPCC) approved Boeing’s proposed plan for the controlled release of chromium containing acid wastes to the plant. The plan included the transfer of alkaline waste, acid waste, and chrome waste solutions to holding tanks; neutralization of wastes prior to discharge to the plant; the controlled discharge of these wastes to the plant; and disposal of chrome waste solutions to chemical reclaimers. It was reported that an estimated 5,500 pounds per year of chromium, at a maximum concentration of 1.5 milligrams per kilogram (mg/kg), would enter the Diagonal Avenue STP during low flow conditions. WSPCC concluded that this concentration was acceptable for operations and would not impact the receiving water. WSPCC approved the proposed plan for the collection and disposal of these wastes at the plant (WSPCC 1967).
- In February 1967, Boeing submitted a proposed Pollution Control Program for Boeing Plant 2 due to chemical spills and subsequent contamination of sanitary sewer effluent. The plan presented additional structural modifications to four areas of Boeing Plant 2 to prevent spills from discharging to the Diagonal Avenue STP (Boeing 1967).
- On February 5, 1968, Metro reported a “large chrome spill” that had occurred to the Diagonal Avenue STP. It was assumed that the spill had originated from Boeing Plant 2 due to previous documented spills; however, Metro initiated an investigation but could not confirm whether Boeing was the responsible party (Metro 1968).

- On February 21, 1968, Boeing Plant 2 notified Metro that a release of “chromic acid solution” occurred to the Diagonal Avenue STP. It was reported that the temporary chromic acid holding tank had overflowed at a rate of 0.4 gallons per minute (gpm). It was estimated that approximately 110 gallons of solution containing 0.39 pounds per gallon of chrome discharged to the treatment plant at a concentration of 1.8 mg/kg, just above the acceptable limit of 1.5 mg/kg. As a result of this spill, Boeing stated that corrective actions would be taken to prevent future releases from occurring (Boeing 1968).
- Meeting minutes dated January 28, 1969, from the Industrial Waste Permit Group noted that Boeing was still experiencing problems with controlling chrome solution spills to the Diagonal Avenue STP, and another spill had occurred approximately 2 weeks prior to Boeing making modifications and installation of equipment to prevent reoccurrence of spills (IWP Group 1969).

At the time when operations at the plant ceased in 1969, the Diagonal Avenue STP was discharging between 10 and 15 million gpd of treated and untreated sewage and industrial waste to the LDW (Lane 1969), with the STP treating an average of 8 million gpd and an average of an additional 2.7 million gpd being shunted directly to the LDW via the upstream South Michigan Street and South Brandon Street bypasses described above. The plant was closed and the Diagonal Avenue STP outfall was decommissioned by 1970 when the Elliott Bay Interceptor pipeline was completed, and sewage and wastewater was re-routed to the West Point Treatment Plant (Windward 2009a). The Diagonal Avenue STP structures remained in place until 1977, 5 years after Chiyoda purchased the property. When the Diagonal Avenue STP was demolished, all of the structures were removed with the exception of portions of the clarifiers, which were broken in place to allow for drainage and filled with soil from an unknown source (Dames & Moore 1981).

4.2.2 Federal Government’s Disposal of PCB-Contaminated Dredged Sediment

In 1974, approximately 260 gallons of PCB transformer fluid containing Aroclor 1242 spilled into Slip 1 of the LDW from the north pier when an electrical transformer owned by the U.S. Air Force (USAF) was damaged while being loaded onto a barge. The barge was owned by the Alaska Puget United Transportation Company under contract to the U.S. Navy’s Military Sea Transportation Service. On November 18, 1975, the Air Material Command, a former division of the USAF, accepted responsibility for the spill, as documented in an internal memorandum received from GSA in response to the FOIA request. This memorandum also stated that the USACE was assigned responsibility for the removal of contaminated sediments (GSA 1975).

As summarized in the ECR, and confirmed in documentation provided by the USACE in response to the FOIA request, two cleanup actions occurred. In 1974, USEPA completed the initial dredging operation, but it was found to be incomplete, only recovering 80 gallons of the estimated approximately 260 gallons spilled. In 1976, the USACE completed additional hydraulic dredging of sediment from Slip 1 and the LDW, recovering another 170 gallons spilled, and dewatered the resulting slurry in the upland area of the Site (USEPA 1977). Chiyoda, the property owner at the

time, agreed to lease the property to USACE to store and treat approximately 10 million gallons of dredged sediment slurry into two treatment impoundments, located in the vicinity of the former northern Diagonal Avenue STP sludge ponds, located in the upland north-central area of the Site. The approximate locations of the Diagonal Avenue STP sludge ponds and the approximate PCB disposal area are shown on Figure 2.1. PCB-contaminated sediments were hydraulically dredged and pumped through a 10-inch-diameter pipeline from the dock area to a point of discharge in the southwest corner of the approximate PCB disposal area, where slurry (consisting of sediment, water, and flocculent) was then settled. After sediment and flocculent settled, water was decanted to the eastern portion of the PCB disposal area. From there, it was pumped to a holding tank where water was filtered and treated prior to discharge back to the LDW. The PCB disposal area was reported to be excavated to a depth of 10 to 12 feet bgs prior to placement of dredge slurry. Approximately 10,000,000 gallons of slurry was pumped to the PCB disposal area, resulting in 7,000 to 10,000 cubic yards (CY) of dredged material remaining in the impoundment area post-treatment.

Although the location of the PCB-contaminated dredged material is well documented, the current extent of residual material across the Site is unknown. In a Port internal memorandum dated November 12, 1980, Senior Engineer Wade Watson, in communication with USACE and USEPA regarding the recovery and disposal of PCB-contaminated material, stated that approximately 7,000 CY of dredged material was “almost exclusively” confined to the west side of the PCB disposal area. It was noted that the bounds of the contaminated material could not be determined, because PCB-contaminated dredged material was in a saturated fluid state when placed. As a result, the material was reportedly “displaced somewhat as uncontaminated fill was pushed across the surface by bulldozer” (POS 1980).

In 1981, in preparation for the sale of the property to the Port in 1984, Dames & Moore, on behalf of Chiyoda, advanced soil borings and excavated test pits to evaluate PCB and metals contamination in soil in and around the PCB disposal area. Concrete and debris, including a steel drum with unknown liquid contents, were encountered in two test pits locations (TP-7 and TP-8) within the eastern portion of the area (Dames & Moore 1981). Dames & Moore concluded that low-level PCB contamination was present between 2.5 and 20 feet bgs within the PCB disposal area boundaries. PCBs were also detected in soil samples in the area surrounding the PCB disposal area but at lower concentrations.

Contrary to the 1980 Port memorandum, Dames & Moore stated in a 1981 report that the PCB disposal area impoundments were left open for several months for drying and stabilization of loose and wet dredged material. The report also acknowledged that it was unknown whether sludge from the Diagonal Avenue STP sludge ponds was removed prior to filling. However, it was the opinion of Dames & Moore that sludge removal prior to filling likely did not occur (Dames & Moore 1981).

The FOIA request submitted to the DoD for records related to the 1974 GSA PCB spill was deferred to the USACE. Responsive records related to the 1974 GSA PCB spill, treatment, and disposal were received from the USACE. The majority of these records were consistent with the

previously reported information summarized in the ECR, with the exception of the 1975 GSA memorandum and the 1981 Dames & Moore report.

4.2.3 Chiyoda's Shoreline Dredging for Site Development

In 1977, Chiyoda completed dredging along the shoreline area in front of the Diagonal Avenue STP outfall to provide berthing space for future development of the Site, although development did not occur. It was estimated that 80,000 CY of material was dredged and used as fill for the former Diagonal Avenue STP sludge ponds and to grade the Site. Material excavated and stockpiled from the initial construction of the PCB disposal area was also used as fill (Windward 2009a). Based on aerial photograph review, it appears that after Chiyoda removed the former Diagonal Avenue STP facilities previously abandoned by the City and King County, Chiyoda completed filling and grading the PCB disposal area used by USACE and the former sludge drying beds and sludge ponds used by the City and King County.

4.2.4 Chevron's Landfarming of Petroleum-Contaminated Soil

In 1985, Chevron purchased a portion of the property with the intention of developing it into a petroleum distribution terminal; however, the terminal was never constructed. In 1990, for approximately 6 months, the northwest portion of the Eastern Parcel was used by Chevron to landfarm petroleum-contaminated soil (PCS; Windward 2009a). The soil was stockpiled prior to landfarming. As summarized in the ECR, approximately 1,400 CY of PCS excavated from a local service station with a leaking underground fuel storage tank was brought on site. This material contained petroleum concentrations greater than Ecology cleanup levels (CULs). The imported soil was stockpiled and then placed within the footprint of the Diagonal Avenue STP sludge ponds and the approximate PCB disposal area. The stockpile samples were non-detect for PCBs (Windward 2009a).

According to a 1991 report that documents landfarming procedures, in August 1990, the soil stockpile was spread out over a 200-square-foot area, at an even depth of approximately 2 feet, then sprayed with water (PEG 1991). The report stated that the soil was amended to promote biodegradation. The soil was then tilled and watered twice a week for a 6-week period (PEG 1991). Prior to relocating the stockpiled soil to the landfarming area, soil samples were collected and analyzed for total petroleum hydrocarbons (TPH); PCBs; and benzene, toluene, ethylbenzene, and xylenes (BTEX). TPH and BTEX were not detected at reporting limits. PCBs were detected in all samples except for one location. The highest reported PCB concentration for total PCBs was 6.9 mg/kg (PEG 1991).

The landfarmed soil was placed in a clay-lined area overlapping the Diagonal Avenue STP sludge ponds and approximate PCB disposal area. A 2-foot-thick clay cap was then reportedly placed, varying in elevation between 15 and 17.5 feet bgs. The soil remained in place until petroleum hydrocarbon concentrations were below Model Toxics Control Act (MTCA) Method A CULs (Windward 2009a). Soil samples were analyzed to verify that treatment was complete. Post-treatment, in native soil beneath the treatment cell, TPH concentrations ranged between

15 and 100 mg/kg. Aroclor 1248 was detected in post-treatment soils between 1.6 and 9.3 mg/kg¹ (PEG 1991).

In 1992, after the Port purchased the property back from Chevron and prior to redevelopment of the property for use as a container terminal, the landfarmed soil was reportedly removed and disposed of off site at a licensed facility (Windward 2009a). Documentation confirming the transfer of treated soil to the disposal facility was not available in the records reviewed.

4.2.5 Lafarge's Facility Improvements on the Western Parcel

Between 1989 and 1999, Lafarge leased the Western Parcel from the Port and in 1990 constructed a bulk cement transshipment facility on the southernmost portion of the Western Parcel. Several Site improvements were made during development of the Lafarge facility, including construction of a barge moorage pier and pneumatic conveyor system offshore in the LDW, approximately in the center of the parcel shoreline; a product transfer tower; four dry cement storage silos; a truck scale; and a truck wash-down area (Windward 2009a).

As reported in the ECR, in support of facility development, grading and shoreline modification occurred in the central and northern portions of the Western Parcel. The bank was cut back above 11.5 feet MLLW and stabilized with riprap in the central and northern portions of the Site (Windward 2009a). Excavated bank sediments located along the northern portion of the shoreline, as well as remaining dredged material from Chiyoda's 1977 dredging event, were graded across the northern portion of the parcel (Windward 2009a), and the area was subsequently seeded and planted. Analytical data for bank sediments collected prior to excavation was not located during the file review.

In the late 1990s, the bulk cement facility was removed and transported to another Lafarge location. The fixtures removed included the storage silos, office shed, truck scale and wash-down area, and rail car loading equipment (Windward 2009a). From 1999 to 2010, ConGlobal/CCI used a portion of the Western Parcel for a chassis storage area.

4.2.6 Port of Seattle's Terminal 108 Intertidal Habitat Mitigation Project and Public Access Improvements

To offset loss of an intertidal area at Terminal 30, located at 1901 East Marginal Way on the East Waterway across from Harbor Island, Terminal 108 (T-108) was selected as the location for an intertidal habitat mitigation project. In March 1987, the mitigation project, permitted by the USACE (Permit No. 071-0YB-2-010439), was constructed as a restoration action in compensation for impacts associated with Terminal 30 redevelopment (POS 1986a).

The ECR stated that "the majority of the soil and sediment removed during construction of the mitigation site was approved for open-water disposal in Elliott Bay" but did not indicate whether the material was placed in the uplands. However, a 1990 report stated that 6,600 CY of dredged

¹ The ECR appears to contain a typographical error, reporting the lower detected concentration as 106 mg/kg. The 1991 Pacific Environmental Group report reported a concentration of 1.6 mg/kg.

material was disposed of in the upland area and 1,125 CY was disposed of off site at Four Mile Rock (Tanner 1990). This report also stated that the “majority” of materials removed prior to the mitigation excavation were found to be “uncontaminated.” Consistent with the ECR, the presence of “garbage materials” and the need to dispose of 200 CY of material off site due to an elevated detection of lead was also noted (POS 1986b; Tanner 1990). The Port as-built, dated September 1987, confirmed that approximately 6,600 CY of dredged material was placed in the upland area of the Site and spread out in 1-foot-thick layer and seeded. The remaining material was disposed of off site at Four Mile Rock and at a landfill (POS 1986c). Composite soil sample results were located during the file review but are not included in the PA due to the inability to screen and compare composite soil results to PCULs and RSLs. Additionally, the location of these samples could not be confirmed. The data appear to have been collected prior to construction of the mitigation area; however, it could not be confirmed if these data were associated with this action. Sediment samples may also have been collected; however, these results were also not located during the file review.

In the early 1990s, additional public access improvements were made to the existing mitigation area. These improvements were intended to compensate for public access restrictions to the South Oregon Street ROW implemented during a future development of the container storage facility on the Eastern Parcel of the Site (Windward 2009a); however, the South Oregon Street ROW work was never completed. Public access enhancements included removal of approximately 0.5 acres of asphalt near the intertidal habitat mitigation area, installation of additional native plantings, and installation of other human-use features such as picnic tables and interpretive signage (Windward 2009a).

4.2.7 Port of Seattle’s Redevelopment of Eastern Parcel

In the early 1990s, the Port redeveloped the Eastern Parcel for use as a container storage and chassis repair yard to accommodate CCI’s expansion from the adjacent Terminal-106W. As part of this redevelopment, a paved access road was constructed across South Oregon Street, a four-lane truck access road was constructed from Diagonal Avenue South to the southern portion of the Eastern Parcel, and a rail spur was constructed along the south side of Diagonal Avenue South to the northwest corner of the parcel. During this time, the parcel was resurfaced with asphalt pavement and gravel for container storage and transport (Windward 2009a).

In 1992, approximately 5,000 CY of soil and fill material, including Chevron’s landfarmed soil, were removed from the property and replaced with newly imported fill material (Windward 2009a). In 1993, improvements were also made to the stormwater drainage system, including installation of drainage lines, an oil-water separator, catch basins, and new subsurface piping. Perforated polyethylene pipe was installed beneath the areas of gravel to collect infiltrating stormwater in the cargo container storage area. All stormwater collected in the Eastern Parcel is routed through an approved oil/water separator prior to discharge into the Duwamish/Diagonal SD piping beneath the South Oregon Street ROW and ultimately discharges to the LDW approximately 100 feet northwest of the Site (Windward 2009a).

4.2.8 ConGlobal Industries' Operations

In 2004, ConGlobal assumed operation of both parcels on the Site. In 2005, Nuprecon/ReNu Recycling leased approximately 2 acres of the southern portion of the Western Parcel for use as temporary storage for trucks and roll-off bins (PGG 2007). The Nuprecon/ReNu Recycling lease was transferred back to ConGlobal in August 2007. Currently, ConGlobal is the only tenant on the Site. ConGlobal operates a container terminal and maintenance area on the Eastern Parcel. A fueling area with three aboveground storage tanks (ASTs), including a 300-gallon, a 600-gallon, and a 1,200-gallon tank reportedly containing diesel, is located on the southern portion of the Eastern Parcel. Prior to 2010, ConGlobal also leased the Western Parcel for chassis storage and for use as a lay-down area.

Since 2008, ConGlobal has operated under an industrial National Pollutant Discharge Elimination System (NPDES) Industrial Stormwater General Permit (ISGP; WAR-010569) and a Stormwater Pollution Prevention Plan (SWPPP). The Port is a second permittee under the Phase I Municipal Permit. ConGlobal has received notices of violation (NOVs) for permit benchmark exceedances as well as complaints regarding illicit discharges to the LDW. A summary of permits and stormwater compliance inspections are included in Section 6.3.

In 2010, as a result of a Level 3 Corrective Action, ConGlobal installed modifications to the stormwater collection and conveyance system and added a stormwater treatment facility. All stormwater across the Eastern Parcel of the Site is collected and pumped to a central location, treated, and returned to an existing Metro sewer line for discharge to the Duwamish Waterway. As part of this work, Farallon Consulting, LLC (Farallon) installed a series of shallow soil borings to characterize soil quality for the proposed initial design, which included open detention ponds, as well as several hundred feet of trenching for new conveyance piping. Soil was classified and some analytical testing was performed. Analytical results are summarized in Section 6.1.

4.2.9 Summary of Dredging, Filling, and Surface Grading

The upland area of the Site has historically been filled by hydraulic and mechanical filling and placement of dredged material. As summarized in Section 3.2, previous investigations completed at the Site have consistently identified the hydraulic fill layer to be a predominantly heterogeneous deposit to depths of 10 to 15 feet bgs, overlying native tidal marsh deposits. Dredging and placement of sediments on the uplands have also occurred. Other sources of fill include sludge from the Diagonal Avenue STP and Chevron's PCS. Material has been placed on the Site from unknown sources. In addition, material has been moved around over time by grading and preparing surfaces for paving.

In summary, the following documented dredging, filling, and surface grading has occurred on the Site:

- In 1936, the property was undeveloped with a tidal channel located on the eastern and northern portions of the Eastern Parcel. It was reported by King County that the tidal channel on the north end of the property received untreated sewage from a small sewer system located to northeast of the Diagonal Avenue STP. Sometime

between 1962 and 1976, the tidal channel was filled in. The channel may have been filled concurrent with the Duwamish/Diagonal CSO/SD stormwater and sewer lines installation in 1966 and 1967. Clearing and grading on the northern and eastern portions of the property were observed in 1961 and 1970 aerial photographs.

- In 1961, a parking lot area was constructed on the southern portion of the Diagonal Avenue STP property, and a drainage system was installed associated with the parking area, including an 18-inch-diameter concrete outfall.
- In 1970, the Diagonal Avenue STP was demolished and all of the structures were removed with the exception of portions of the clarifiers, which were broken in place to allow for drainage and filled with soil from an unknown source. Sludge, up to 5 feet thick, was reportedly left in the Diagonal Avenue STP sludge ponds and drying beds and subsequently covered with fill material from an unknown source.
- In 1977, Chiyoda dredged the shoreline area in front of the Diagonal Avenue STP outfall to improve berthing. Dredged material was stockpiled on the northern portion of the Western Parcel and was used to fill the excavated PCB disposal area, fill nearshore areas, and grade the area of the former Diagonal Avenue STP. The material stockpiled from the initial excavation of the PCB disposal area was also used as fill.
- In 1987, the Port completed dredging for development of the intertidal mitigation area. It was reported that approximately 6,600 CY of dredged material was disposed of in the upland area, as confirmed by Port as-built records.
- In 1988 as part of Lafarge's facility improvements, excavated bank sediments, as well as dredged material along the northern portion of the shoreline (presumably remaining from Chiyoda's 1977 dredging), were graded across the northern portion of the parcel.
- In 1990, Chevron imported PCS for treatment via landfarming. Stockpiles were located adjacent to the landfarming area prior to placement in the sludge pond and PCB disposal areas.
- In the early 1990s as part of the Port redevelopment of the Eastern Parcel, a paved access road and rail spur were constructed, the property was re-surfaced with asphalt pavement and gravel for container storage, and a stormwater drainage system was installed. Between 1992 and 1993, approximately 5,000 CY of soil and fill material, including the soil landfarmed during Chevron's ownership of the property, was removed from the property for offsite disposal and replaced with newly imported fill material from an unknown source.

4.3 CURRENT OPERATIONS AT THE SITE

ConGlobal is currently the only industrial tenant located at the Site and operates a container terminal on the Eastern Parcel.² Containers are stored throughout the Eastern Parcel, and maintenance is conducted on the eastern end of the parcel. As summarized in Section 4.2.8, a fueling area is located on the southern portion of the Eastern Parcel.

The Western Parcel is currently vacant with an intertidal habitat mitigation area and a public access park, described in Section 4.2.6. The habitat mitigation area and Terminal 108 Park, also known as Diagonal Avenue South Public Shoreline Access, are located in the southwestern corner of the Site. The 1.2-acre park and habitat mitigation area has 700 linear feet of accessible shoreline.

4.4 SITE HISTORY CONCLUSIONS AND SUMMARY OF CONTAMINANTS POTENTIALLY ASSOCIATED WITH SITE USE AND OPERATIONS

The file review completed for the Site did not identify data gaps associated with the timeline of ownership or of historical use and operations at the Site. The only gap in Site ownership information is prior to the first industrial development of the property and, therefore, does not require additional investigation to address for completion of this PA.

Since development in the late 1930s, the Site has been used by multiple industrial and municipal operators. Industrial activity since the Port acquired the Site in 1984 has been fairly limited in support of primary operational use as an off-dock container storage and a maintenance terminal, but the placement of fill (i.e., dredged material placement, imported fill), grading, and sludge generation from industrial operations have been extensive and are the likely source of soil contamination.

Historical fill contains various materials that may have resulted in contamination in the uplands, as summarized in Section 4.0. These include placement of dredged material in the uplands from the LDW, landfarming for the treatment of PCS and/or regrading of Site soils during landfarming activities, imported material from unknown sources, upland placement of dredged material from the habitat mitigation area, and various filling and grading activities that have occurred over decades of operational use.

By-products from industrial and municipal operations include sludge generation from the Diagonal Avenue STP, which resulted in sludge being placed in lagoons and potentially regraded to other areas of the Site. The sludge lagoons were used for dewatering and treatment of PCB-contaminated sediment related to the 1974 GSA PCB spill.

Based on the identified historical Site uses and operations, the following chemical groups were identified as the contaminants most likely to be associated with past operations: metals, petroleum hydrocarbons and related chemicals, cPAHs, and PCBs.

² The Port leases a small portion of the Western Parcel to a tenant for storage of a 10,000 CY soil stockpile. This material was chemically tested and determined suitable for stockpiling at the Site. Stockpiles are maintained in accordance with the ISGP applicable to the Western Parcel. Additional details on this tenant were not reviewed as part of this PA, because there are no onsite activities associated with this tenant outside of the soil stockpile.

5.0 History of Adjacent Properties

5.1 FORMER WASHINGTON STATE LIQUOR CONTROL BOARD

5.1.1 Site History

The former WSLCB facility, currently owned by East Marginal Industrial, LLC, has been used for general warehousing and storage since it was constructed by the state of Washington in 1948. Historically, prior to channelization of the LDW, a tidal channel cut through the eastern edge of the property between the former WSLCB facility and the Site to the south. The property was reportedly hydraulically filled with dredged material from the main channel of the LDW (SAIC 2009).

The original 1948 warehouse was demolished in 1997 and rebuilt in 1999 with an 182,900-square-foot structure on the 11-acre property. In 2007, the warehouse was expanded. WSLCB also operated a vehicle maintenance and repair area on the property. Wastes generated at the facility reportedly included small quantities of batteries, fluorescent light tubes, and petroleum/oils (SAIC 2009). Various commercial and industrial tenants have occupied the warehouse for uses such as large format printing and materials recovery and recycling.

In May 2014, Recology CleanScapes (Recology) opened a Material Recovery Facility (MRF) in the western third of the multitenant warehouse building. The MRF is a processing center for the recovery and recycling of household and commercial garbage. Materials, such as paper, glass, metal, plastics, and other recyclables, are baled and processed for shipping off site. The MRF currently operates under a NPDES ISGP (No. WAR-301608).

In 2015, Boeing opened the Skyline Distribution Center model shop and warehouse in the multitenant warehouse. The warehouse uses electric forklifts with batteries that contain sulfuric acid. Due to the quantity of sulfuric acid, Boeing is required to report a list of hazardous substances in compliance with the Emergency Planning and Community Right-to-Know Act, Superfund Amendments and Reauthorization Act Title III. Boeing's Skyline Distribution Center is considered to be a small-quantity generator of hazardous waste (Resource Conservation and Recovery Act [RCRA] Site ID WAH000040506) and subject to inspections by Ecology.

Since at least 2015, DCG One Seattle (DCG One) has operated a digital and large-format printing business at the former WSLCB facility. DCG One is a medium-quantity generator of hazardous waste and subject to inspections by Ecology.

Currently, the multitenant warehouse is occupied by Recology's MRF, Boeing's Skyline Distribution Center, DCG One, Seattle Envelope Company, Variable Maps, Inc., State of Washington Seattle Facilities, and Ticket Envelope Company. Although other tenants occupy the property, Ecology had records for only WSLCB, Recology's MRF, Boeing's Skyline Distribution Center, and DCG One.

5.1.2 Environmental Investigations and Site Status

Between the early 1990s and 2008, the former WSLCB facility had several violations and housekeeping issues noted during site inspections completed by Ecology, Seattle Public Utilities (SPU), and Metro. Violations included discharges of various wastes including antifreeze and wastewater used to steam clean batteries into catch basins, secondary containment was not installed for storage of oils and solvent, hazardous wastes had not been properly labeled, and materials such as scrap metal were stored outdoors and uncovered. As a result, the former WSLCB facility was listed on the Washington State Hazardous Sites List (Ecology Facility Site ID 1891210). In 2008, after routine inspections continued to identify housekeeping issues and non-compliant discharges at the facility, Ecology required WSLCB to obtain coverage under the NPDES ISGP. In 2011, the WSLCB was considered to be a medium-quantity generator of hazardous waste (RCRA Site ID Number WAH000040506) and subject to hazardous waste inspections.

The former WSLCB facility was first reviewed and summarized in the *Lower Duwamish Waterway Early Action Area 1 Duwamish/Diagonal Way (RM 0.1 to 0.9) Summary of Existing Information and Identification of Data Gaps for the Duwamish/Diagonal CSO/SD Basin* (SAIC 2009). This report summarized several violations that had occurred at the facility in the early 1990s. As a result, Ecology determined that the facility needed further characterization and evaluation.

In January 2011, HartCrowser completed a Summary of Existing Information Report for the facility, which evaluated historical and current land use, releases of contaminants from potential source areas, potential for sediment contamination, and identified data gaps (HartCrowser 2011a). This report concluded that additional investigation was required to address the potential for sediment recontamination associated with imported dredge or fill material, past and current housekeeping and materials management, past industrial uses on the adjacent Site, and contamination associated with former heating oil underground storage tanks (USTs) located at the southeastern corner of the warehouse near the boiler room.

In March 2011, as a follow-up to the January work, a Reconnaissance Plan was completed to locate proposed sample locations for an upland soil and groundwater investigation (HartCrowser 2011b). It was proposed that soil and groundwater from eight borings would be advanced in areas of concern at the facility and completed as monitoring wells. Catch basin sampling was also planned. In April 2011, a Sampling and Analysis Plan (SAP) was completed for the work. The SAP specified that samples would be analyzed for a wide range of chemicals, including conventional parameters, TPH, gasoline and diesel, metals, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), PCBs, dioxins/furans, chlorinated pesticides, and polybrominated diphenyl ether (HartCrowser 2011c).

In July 2011 HartCrowser completed the Data Report summarizing the results of the work completed, as described in the April 2011 SAP (HartCrowser 2011d). Polycyclic aromatic hydrocarbons (PAHs) in soil were reported at concentrations above screening levels protective of sediment along the southern boundary of the property. One well (MW-4) had concentrations of PAHs greater than CULs for PAHs in groundwater. It should be noted that PAHs at the former

WSLCB facility were attributed to contamination present on the Site. Arsenic was reported in soil at concentrations greater than CULs; however, in general, metals were representative of background concentrations for the LDW. Zinc and PCBs were reported in catch basin sediment samples at concentrations greater than CULs. It was noted that the source of PCBs was unknown but could pose a risk to sediment recontamination. SVOCs were reported at low concentrations in catch basin sediment samples. Groundwater concentrations were less than CULs protective of sediment and determined to not likely be a risk for sediment contamination (HartCrowser 2011d). In October 2011, 8 of the 13 monitoring wells installed as part of the April 2011 investigation were decommissioned (HartCrowser 2012).

In 2014, Ecology issued the NPDES ISGP to Recology's MRF facility to cover discharges associated with industrial activity from the MRF operations. The MRF has a history of exceeding water quality benchmarks for zinc and turbidity. Due to frequent exceedances, Ecology issued a Level 2 Corrective Action. In 2015, although not required at the time, Aspect Consulting, LLC, and Clear Water Services, LLC, on behalf of Recology, completed a Level 3 Correction Action Engineering Report specifying improvements to address the quality of stormwater discharge (Aspect 2015).

Since 2015, numerous violations have been documented in Ecology records for the DCG One facility. In January 2017, Ecology completed a re-inspection to verify corrective actions had been taken from previous inspections. In general, Ecology records indicated that DCG One waste reporting to Ecology was inconsistent and materials were not appropriately being managed on site and/or disposed of off site. Violations included mislabeling materials, such as process ink and imaging oil, as hazardous but the waste profiles reported these wastes as non-hazardous; wastes and containers in the large-format printing area had not been designated; and 55-gallon drums of various ignitable wastes, such as ultraviolet inks with alcohol, were not secured (Ecology 2017a).

5.2 U.S. GENERAL SERVICES ADMINISTRATION FEDERAL CENTER SOUTH

5.2.1 Site History

The GSA FCS, a 32.99-acre property located at 4735 East Marginal Way South, was originally developed by Ford Motor Company's (Ford's) main assembly plant between 1930 and 1932. Two buildings, Buildings 1201 and 1206, were constructed during this time. Building 1206 was used as the oil house and was connected to Building 1201, the main assembly plant, through a network of underground pipelines and tunnels (GSA 2009a). As part of this development, Ford installed three 30,000-gallon bunker C oil USTs for boilers in Building 1201. The tanks were converted to heating oil storage tanks in the 1970s and 1980s (Ecology 2015).

In 1940, Ford released the plant to the U.S. Army for use as the Seattle Quartermaster Depot and Seattle Port of Embarkation. Building 1202 was constructed and the USACE took over activities on the property. The USACE occupied the property until at least 1956. From 1957 to 1960, Boeing began manufacturing interceptor missiles under contract to the USAF. According to facility plans, in 1973, the U.S. Government occupied the property after Boeing. USACE moved back into

Building 1202, and it was eventually used as a storage and shipment facility for Alaska Native Corporations. It was also used for assembling Amtrak Cascades high-speed rail cars. In 1969, Building 1203 was constructed for use as a motor pool (Ecology 2015). A former 1,000-gallon waste oil tank, used for disposal of fluids from maintenance activities until the early 1990s, and a former 12,000-gallon gasoline UST, used for fueling motor pool vehicles until the late 1980s, were located immediately adjacent to the west side of Building 1203. As indicated in GSA's "Response to EPA Regarding CERCLA Information Request," PCB-containing equipment, including capacitors, transformers, and fluorescent light ballasts, were used on the property from 1978 until 1985 (GSA 2009b).

In 2012, the northern portion of Building 1202, and later the southern portion, was demolished and a new building was constructed for the FCS complex as a result of the 2009 American Recovery and Reinvestment Act (ARRA). GSA manages the property on behalf of the United States and has leased space to various agencies of the federal government, including the current tenant, the USACE, and past tenants, including USAF Logistical Office and the Bureau of Indian Affairs (GSA 2009a). The USACE Seattle District Headquarters currently occupies Building 1202 for offices and warehousing. Building 1201 remains in the southeastern corner of the property.

5.2.2 Environmental Investigations and Site Status

The FCS is composed of two Ecology Voluntary Cleanup Program (VCP) sites: GSA FCS Building 1203, former GSA Motor Pool (VCP Project No. NW2177) and GSA FCS Building 1206 (VCP Project No. NW2930). Contamination in soil and groundwater related to the former USTs, as well as a debris fill area and chlorinated solvent plume, has been identified at the site. The following section describes regulatory status and environmental activities, including sampling and remedial actions that have occurred on the FCS site.

5.2.2.1 GSA FCS Building 1203, Former GSA Motor Pool

The GSA FCS Building 1203 site, or former GSA Motor Pool, located in the northwestern portion of the property, entered the VCP in 2006 but was removed due to inactivity at the site. In 2009, the site re-entered into the VCP to address contamination related to the 1,000-gallon former waste oil and 12,000-gallon gasoline UST used to support motor pool operations and solvent contamination in a debris fill area containing pharmaceutical/medical waste. A former solvent pit was also located in the southwestern corner of the property. In 2011, after reviewing the VCP application and site characterization reports, Ecology determined that remedial action was necessary to address gasoline-, diesel-, and oil-range TPH and BTEX contamination in soil and groundwater. Further, Ecology determined that groundwater CULs did not meet the substantive requirements of MTCA, because there were detections of petroleum hydrocarbons, vinyl chloride, and trichloroethylene (TCE) in groundwater at the property (EHSI 2012).

Between 1998 and 2009, GSA conducted several environmental site investigations after the decommissioning and removal of the waste oil and gasoline USTs associated with former Building 1203. During initial sampling activities in 1998, it was determined that gasoline had been released below the former fuel dispenser unit. It was also discovered during tank closure activities that a

release of diesel and heavy oil occurred in the location of the waste oil UST. In 2010, EHSI-International, Inc. (EHSI) excavated and disposed of petroleum hydrocarbon impacted soil that had been previously identified in 1999. After the remedial excavation was completed and confirmation soil samples were collected, EHSI concluded that all contaminated soil had been successfully removed from the area (EHSI 2012).

EHSI reported that there were no locations remaining within these areas of the site with contaminated soil in exceedance of CULs. EHSI reported that Ecology determined that the site soil cleanup actions met the substantive requirements of MTCA. However, groundwater in three areas of the property exceeded applicable MTCA CULs. Contaminants in groundwater include heavy oil-range TPH in the debris fill area, chlorinated solvents at one monitoring well (EHSI-MW-7) located north of former Building 1202 in the vicinity of Diagonal Avenue South, and heavy oil-range TPH and benzene in one monitoring well (EHSI-MW-2) located east of former Building 1202. EHSI recommended further investigation and remediation of TPH-impacted groundwater (EHSI 2012).

Chlorinated solvents have been documented in groundwater across the property. Although the plume area is broad, only one location surrounding the area of monitoring well EHSI-MW-7 exceeds CULs. In 2012, EHSI completed a pilot study to determine whether enhanced bioremediation treatment would be effective in reducing concentrations of vinyl chloride in groundwater. EHSI also recommended quarterly groundwater monitoring for a period of 1 year to evaluate the effectiveness of treatment. It was determined that the biodegrading process was effective in treating chlorinated VOCs within the plume (EHSI 2012).

A debris fill area containing medical/pharmaceutical wastes, 5-gallon cans and 55-gallon drums containing petroleum products, and other debris including glass bottles and metal was located in close proximity to the former Building 1203. Ecology communications stated that “the release associated with this debris fill is unrelated to that associated with the UST/Motor Pool and may therefore be considered a separate site.” Ecology noted that groundwater contamination from the debris fill may be comingled with the UST/Motor Pool plume and/or the chlorinated solvent plume (Ecology 2011).

In 2010, TPH-contaminated soil, as well as metal drums and debris, were excavated from the debris fill area. It was reported that 1,080 tons of contaminated soil and 10,900 gallons of oily groundwater were disposed of off site. Medical waste was segregated out of the soil, characterized, and packaged as hazardous waste for disposal. Buried waste included corrosive liquids and acids, flammable liquids including mineral spirits and mineral oil, other corrosive and toxic liquids such as embalming fluids, and sodium and calcium hydroxide solutions. Drums and containers containing medical/pharmaceutical wastes were disposed of or recycled at an offsite licensed disposal facility (EHSI 2012). Confirmation soil sample results indicated that concentrations of gasoline-, diesel-, or heavy oil-range TPH; cPAHs; VOCs; or PCBs were not detected at concentrations at or greater than reporting limits. Low levels of naphthalene; six other non-carcinogenic PAHs; and arsenic, lead, barium, and chromium were detected in soil.

EHSI also recommended treating groundwater with in situ enhanced aerobic bioremediation in this area (EHSI 2012).

According to a 2013 Ecology opinion letter, it was determined that characterization for the site was not sufficient to establish a cleanup standard and select a cleanup action at the site. Ecology noted that confirmation soil samples had not been collected from the bottom of the UST/Motor Pool and debris fill area, and therefore, the vertical extent of contamination in these areas was unknown (Ecology 2013). Since 2008, groundwater samples in this area had not been collected, which was found to be insufficient for evaluating groundwater. Groundwater in the debris fill area had not been fully characterized. It was also noted that the chlorinated solvent plume had been delineated in the western portion of the property but not fully characterized in other areas of the site. Additionally, Ecology stated the source of the chlorinated solvent plume had not been determined. Although the exact source was not determined, several potential sources of solvents were identified either on or off site. The Site was not listed as an offsite source (EHSI 2012).

In 2015, to address concerns in the 2013 Ecology opinion letter, EHSI completed a site characterization study to further evaluate the UST/Motor Pool and central excavation areas, debris fill excavation area, and areas around EHSI-MW-7 and EHSI-MW-2. Additional sampling of the groundwater monitoring well network was completed to evaluate the extent of the chlorinated solvent plume in groundwater (EHSI 2015). It was concluded that concentrations of gasoline-range organics (GROs), diesel-range organics (DROs), and heavy oil-range organics (OROs) exceeded Ecology CULs in soil samples collected from the Motor Pool and central excavation areas and the EHSI-MW-2 area. VOCs in soil were reported at concentrations less than CULs. TPH in groundwater was reported at concentrations greater than CULs in the debris fill excavation area, near EHSI-MW-2, and machine oil UST area. VOCs in groundwater were reported at concentrations greater than CULs in the EHSI-MW-2 area, EHSI-MW-7 area, and the debris fill excavation area. EHSI stated that concentrations of vinyl chloride in groundwater greater than the CUL may be associated with the former solvent pit in the EHSI-MW-2 area.

To continue the VCP process, EHSI recommended meeting with Ecology to discuss the results of the study and future potential actions, completion of a Feasibility Study (FS) and select a preferred alternative, and submit a final FS to Ecology for review and approval. Currently, the site remains enrolled in the VCP, and Ecology's site status is listed as "cleanup started." It is unknown whether an FS was ever completed or whether a preferred alternative was selected for cleanup at the site. Groundwater contamination resulting from this offsite plume may be present in the southeast corner of the Site.

5.2.2.2 GSA FCS Building 1206

The GSA FCS Building 1206 site addresses contamination in soil associated with the three 30,000-gallon bunker C oil, and later heating oil, USTs formally located east of Building 1206 at the southeast corner of the property. In 2014, the three USTs containing oil and/or sludge were removed. The USTs were reported to be in good condition, and no releases were noted in the excavation. Minor releases of TPH (diesel and oil) were observed associated with former product piping or overfilling of USTs. Contaminated soil was excavated from three remedial excavation

areas surrounding the UST locations and appurtenances such as piping. Approximately 47 tons of PCS was excavated from these areas and disposed of off site at a licensed disposal facility. Riley Group, Inc. (Riley Group) reported that soil contamination at the site had been fully remediated. It was also reported that concentrations of TPH in samples of the water from the UST excavation were greater than CULs for groundwater, but it was unknown whether the water was contaminated from soil or whether the results were indicative of groundwater conditions on the site. Riley Group concluded that additional investigation would be needed to accurately determine groundwater conditions (Riley Group 2014).

To further evaluate contamination in groundwater, Kane Environmental, Inc. (Kane) was retained to install four monitoring wells at the property within the footprint of the former UST excavation area and one in a downgradient location. Four groundwater sampling events were completed between 2015 and 2016. Diesel was not detected in any of the samples. Heavy oil was detected at low concentrations, but less than CULs. Kane concluded that based on monitoring results, an application for a no further action determination could be submitted to Ecology.

In 2017, Ecology issued an opinion letter, citing the previous work by EHSI, Riley Group, and Kane, indicating that comments in a 2015 opinion letter relative to characterization of the site were not addressed, and therefore precluded Ecology from making any determinations. The letter also stated that Ecology's opinion "does not represent a determination by Ecology that a proposed remedial action will be sufficient to characterize and address the specified contamination at the Site or that no further remedial action will be required at the site upon completion of the proposed remedial action" and that the letter "does not provide an opinion regarding the sufficiency of any other remedial action proposed or conducted at the site" (Ecology 2017b). Currently, the site remains enrolled in the VCP, and Ecology's site status is listed as "cleanup started." It is unknown whether other site activities have occurred at the site since issuance of Ecology's opinion in 2017.

6.0 Summary of Environmental Investigations at the Site

In 2009, an ECR summarizing environmental investigations conducted at the Site was prepared by Windward Environmental, LLC, on behalf of the Port. The complete ECR is attached as Appendix A. The ECR details historical uses and environmental conditions at the Site and evaluates existing environmental data to inform long-term source control strategy planning at the Site. The ECR summarizes environmental investigations, including sampling and analyses of soil, groundwater, seep water, bank soil, and nearshore sediment, from the early 1980s until mid-2000s. Investigations completed prior to January 2009 are summarized in Section 4 of the ECR (Windward 2009a; included as Appendix A). The findings of the ECR are not repeated in this section, to avoid redundancy in reporting. This section provides a summary of investigations conducted at the Site since completion of the ECR in 2009, and Section 7.0 provides a screening evaluation of all available Site soil and groundwater data as required by the PA SOW.

6.1 SITE INVESTIGATIONS AND SITE STATUS

Several soil and groundwater investigations have been conducted on the Site (Figure 6.1) since the early 1980s, and more recently since completion of the ECR in 2009 (Windward 2009a; included as Appendix A). This section summarizes environmental investigations conducted at the Site since the ECR was completed in 2009. PCBs, TPH, BTEX, PAHs, and several metals have historically been the most commonly detected chemicals in environmental media at the Site.

Since January 2009, the Port has been developing and implementing a source control strategy for the Western Parcel to minimize or eliminate the potential for contaminants to reach the LDW. The Port is supporting the goals of the LDW source control program by implementing source control practices at the Site and other Port-owned properties. To support this effort, in October 2009, the Port prepared a Source Control Strategy Plan for the Western Parcel of the Site to present and assess likely source control issues and identify appropriate and effective controls (e.g., best management practices [BMPs] and remedial actions; Windward 2009b).

In spring 2010, the Port entered into the VCP to formalize interactions with Ecology on the LDW source control efforts at the Site (VCP Project No. NW2268). Since then, several work plans and status reports have been submitted to Ecology as part of the VCP project. From November 2012 through February 2014, several activities were conducted to address Site-wide source control data gaps, including monitoring well installation; soil sampling; several rounds of groundwater sampling; stormwater solids sampling; and bank soil sampling.

In 2012 and 2013, groundwater was collected from monitoring wells closest to the shoreline, PGG-2, PGG-3, PGG-5, PGG-6, and MW-15. Groundwater samples were analyzed for metals (arsenic, manganese, nickel, lead, and zinc), PAHs, PCBs, TPH, BTEX, and PAHs (AECOM 2014).

In December 2012, soil samples were collected from five locations (BS-1 through BS-5) along the LDW bank and analyzed for PCBs, PAHs, metals, and total organic carbon (TOC).

In February 2013, stormwater solids samples were collected from manhole locations MH-001, MH-002, MH-003, and MH-004 and analyzed for PCBs, PAHs, copper, zinc, and TOC. PCBs, PAHs, and metals were detected at all manhole locations sampled.

LDW surface sediment immediately adjacent to the Site was not sampled as part of the source control evaluation (refer to Appendix B), but existing data from the LDW Remedial Investigation/Feasibility Study were reviewed by AECOM (AECOM 2014). Sediment data results for PCBs, PAHs, and metals were compared to bank soil results. PCBs were detected at concentrations slightly greater than the Sediment Quality Standards, but less than the cleanup screening level, in receiving sediment adjacent to the Site (Eastern and Western Parcels). No metals exceedances were noted (AECOM 2014).

In September 2013, Farallon, on behalf of ConGlobal, collected additional soil samples from soil boring locations along the boundary between the Western and Eastern Parcels (B-1 to B-8), with particular focus around B-6 in the northern portion of the sampled area to determine whether soil conditions were suitable for construction of a stormwater infiltration pond as part of the proposed stormwater treatment system (summarized in Section 4.2.8). In November, an additional 10 borings were advanced (B-9 through B-18). Soil samples were analyzed for PCBs, PAHs, TPH (diesel and gasoline range), metals, and TOC.

In April 2014, the Port and Ecology entered into Inter-Agency Agreement (IAA) No. C1400216. In partial fulfillment of the requirements of the IAA, the Port completed stabilization and rehabilitation of approximately 345 linear feet of eroding shoreline of the Site in June 2015. Approximately 240 linear feet of bank at the project site was stabilized using alternative techniques, including anchored, large woody debris and native riparian vegetation. Post-construction bank samples, T018-B1, T108-B2, and T108-B3, were collected and analyzed for PCBs, PAHs, and metals. These samples represent the chemical quality of the exposed bank soil, and were collected from the final surface (top 6 inches) of the graded banks. The Final As-Built and Performance Report was completed by the Port in August 2015 (POS 2015).

From 2014 to 2015, the Port completed line cleaning on stormwater conveyance systems that discharge to the LDW at multiple Port-owned terminals under the IAA (POS and EA 2015). In May 2015, sediment trap collection bottles were installed in two manhole locations (MH7640 and MH7646) at the Site in preparation for post-line-cleanout sampling. Post-cleanout samples were analyzed for physical parameters and chemical analyses including PCBs, PAHs, metals, dioxins/furans, and SVOCs. Due to limited sample volume, solids from MH7646 were not analyzed for SVOCs and PAHs. Solids from MH7646 were also not analyzed for dioxins/furans.

In July 2015, the Site was terminated from the VCP due to inactivity. The Ecology termination letter indicated that as a next step, Ecology may conduct a site hazard assessment (SHA) and rank the Site for further action, identify potentially liable parties for site cleanup, and initiate discussions for an agreed order or consent decree governing further action at the Site. In February 2016, Ecology completed an SHA and ranked the Site overall as a 2 (1 represents the highest relative risk and 5 the lowest).

Since the bank stabilization work and storm solids sampling after the line cleaning in 2015 under the IAA, the Port has not completed any environmental investigations or cleanup activities at the Site.

6.2 ACCEPTABILITY OF EXISTING DATA

The purpose of this PA is to gather information on site conditions, releases, potential releases, and exposure pathways, which can be used to determine whether a cleanup may be required or to identify areas of concern for further study. Existing data are generally considered acceptable if:

- The analytical schedule is sufficient to identify subsurface contamination resulting from current and past activities at the Site (which are described in Section 2.0);
- The reporting limits and analytical methods allow the data to be compared to screening levels relevant to the Site (which are described in Section 7.0); and
- The data are representative of current conditions, including appropriate spatial distribution to identify subsurface contamination (which is discussed in the following sections).

The sections that follow evaluate the acceptability of the existing soil and groundwater data with respect to data quality objectives of this PA. As indicated in the sections that follow, the current Site data are considered acceptable for use for the purposes of this PA.

It is assumed that future evaluations of Site conditions may supplement, eliminate, or replace historical datasets should new data be collected.

6.2.1 Completeness

This section evaluates the completeness of the dataset as a whole, with respect to spatial distribution of samples and vertical characterization of the subsurface and completeness of the analytical schedule. Location- and chemical-specific information is evaluated in more detail in Section 7.0.

Soil and groundwater data have been analyzed for all analytical classes that are expected to be present at the Site based on current and former Site activities, which are summarized in Section 4.4. In both media, analyses were conducted for metals, PCBs, PAHs, TPH, and BTEX. The greatest number of soil samples were collected and analyzed for Total PCBs and metals, which is appropriate given the nature of Site activities and the physical properties of these chemicals.

The greatest number of groundwater samples were collected and analyzed for Total PCBs, metals, PAHs, and TPH. The groundwater dataset includes more samples analyzed for total metals than for dissolved metals.

Soil and groundwater sample locations are shown on Figure 6.1. The greatest soil sampling density corresponds to the location of significant historical features shown on Figures 2.1 and 4.1, including the approximate area of the Diagonal Avenue STP sludge ponds and the PCB disposal area. Soil samples were collected and analyzed at depths ranging from 0 feet bgs to

27 feet bgs. This depth range provides an appropriate vertical distribution for evaluation of data relative to criteria protective of direct contact exposure and cross-media exposure pathways.

Groundwater samples have been collected at spatially disperse locations across the Site. Well locations generally correspond to locations of significant features and include a network of wells along the northern property boundary, proximate to the former tidal channel. Additional wells are located within the Western Parcel proximate to the LDW Superfund Site.

Generally, the monitoring wells installed nearest the shoreline and at the property boundary have been sampled most recently and most regularly. Seventeen monitoring wells (C-1 through C-6; MW-7 through MW-14; and Well 84-1, Well 84-2, and Well A) are historical wells that were sampled most recently in either 1984 or 1992, depending on location. Eight monitoring wells (MW-15 and PGG-1 through PGG-7) have been sampled recently, with sample dates ranging between 2006 and 2013. Each of these wells has been sampled at least three times.

As noted previously, wells are screened at depths of no more than 20 feet bgs. It may be appropriate to evaluate well screen depth in more detail in a later phase of work to determine if shallow results are representative of all groundwater that may be impacted by Site activities, and to ensure that shoreline well results are representative of discharge quality.

Field measurements of depth to water vary significantly for shoreline wells, with a minimum depth to water of 8.6 feet bgs in well PGG-5 and a maximum depth to water of 19 feet bgs in well PGG-2. Across all monitoring events, depth to water measurements vary by 1 foot for shoreline wells. Measured depth to water varies by 6 feet for well PGG-2, indicating that the groundwater table is significantly influenced by surface water intrusion at this location.

6.2.2 Representativeness

As discussed in the previous sections, multiple operations, Site uses, and activities have occurred that resulted in impacts to Site soils. Redistribution of those historically impacted soils is also known to have occurred at the Site; however, these historical operations ceased at the Site in 1992. Given the historical time frame of activities and dates and scope of sampling events, all available soil data are assumed to be generally acceptable for use in this PA.

Groundwater data have been collected at the Site between 1984 and 2013. For the purposes of this PA, evaluation of groundwater conditions focuses on data collected within the past 15 years. Historical data collected prior to 2006 are subject to elevated reporting limits as a result of reduced analytical sensitivity of many historical analysis methods. Additionally, these data may not be representative of current groundwater quality, particularly for TPH, BTEX, and other chemicals where natural attenuation is possible.

Operations, Site topography and physical features of the Eastern Parcel have not changed significantly since the 1990s. Thus, groundwater data collected since 2006 provides an appropriate baseline for the evaluation of groundwater quality. Historical groundwater data are evaluated in this PA only when more recent groundwater data are not available.

6.2.3 Data Quality and Data Validation

An evaluation of data usability based on laboratory data validation was not conducted for this PA, and if conducted during future evaluations of historical data, may result in elimination of some historical data. However, in this PA, no data were eliminated from the dataset based on the results of data validation. Potential issues that may need to be further evaluated or addressed during a future Site characterization include those issues summarized in the following list.

- The groundwater dataset includes results analyzed by USEPA Method 200.8, which is known to have a saline matrix interference for certain metals. Because many samples are located in close proximity to the LDW Superfund Site, which is a saline estuary, saline matrix interference may be significant enough to cause elevated results and reporting limits to levels that are greater than relevant criteria. If collection of additional groundwater data is determined to be necessary for metals in a later phase, modifications to the analytical method to reduce saline matrix interference may be appropriate.
- The soil dataset includes results for total PCBs that were reported as “non-detect” in prior environmental investigation data reports without associated reporting limit information. Lack of reporting limit information limits the utility of these data with respect to comparison to screening levels.
- The soil dataset includes results for PCB Aroclors that were analyzed by several different laboratories during historical events dating between 1981 and 2015. This is expected to result in differences in laboratory quantification of individual PCB Aroclors as a consequence of the use of different laboratory standards and instrument calibration. Thus, the individual Aroclor distribution of the dataset may have limited utility for source identification via fingerprinting analysis.
- The soil and groundwater dataset includes results analyzed for TPH. Chromatograms have not been reviewed to confirm the accuracy and qualifiers of laboratory-reported data for TPH. If TPH is of concern for the Site, a more detailed evaluation of TPH data, or collection of additional data to identify the composition of TPH present at the Site, may be warranted.
- Certain historical groundwater results were qualified as rejected (R qualifier) by the laboratory. R qualified data were not included in the dataset evaluated in this PA. The appropriateness of these and other laboratory-assigned data qualifiers was not evaluated in this PA.

6.3 SUMMARY OF CURRENT PERMITS AND COMPLIANCE

Since April 2008, ConGlobal has operated on the Eastern Parcel under a NPDES ISGP (WAR-010569) and a SWPPP. The permit expires on December 31, 2019. The NPDES ISGP covers stormwater discharges from the chassis repair and equipment refueling area on the Eastern Parcel to the Duwamish/Diagonal CSO/SD system (Windward 2009a). ConGlobal is

responsible for managing all stormwater runoff at the facility and must maintain all stormwater-related structures and BMPs.

Between 2008 and 2017, ConGlobal has been issued multiple violations for effluent and benchmark exceedances. Stormwater compliance inspections completed by Ecology and the City reported that ConGlobal had poor housekeeping and several source control issues associated with the chassis storage area and vehicle/equipment maintenance areas. The 2008 Ecology stormwater compliance inspection report noted outdoor activities, such as grinding, welding, painting, and cutting of shipping containers being completed outdoors. A significant sheen was observed flowing into SDs near the repair and fabrication area. The need for protection of SD inlets from stormwater runoff from these areas and proper indoor or under cover maintenance and repair of vehicles and equipment was also noted. It was recommended that the SWPPP be updated to address source control issues observed (Ecology 2008). A 2009 City inspection report identified similar issues including hazardous materials were improperly stored and labeled, wastes used for parts washing were not properly separated, fuels and hazardous materials were not located within secondary containment, and other materials such as damaged batteries and open containers were stored outside and/or uncovered (City of Seattle 2009).

In 2010, Ecology received a complaint from Puget Soundkeeper Alliance noting a discharge originating from near the park at the end of Diagonal Avenue South resembling “chocolate milk.” An Ecology inspector found that the discharge was coming from the yard of the former Lafarge facility. A sheen was also noted in the complaint. Although the source of the sheen was not determined, Ecology reported that it may be from leaks and drips from driveways on the property, because sheen was observed in muddy puddles in the chassis storage area (Ecology 2010a). Communication between the Port and Ecology indicated that the chassis would be moved to another location.

In January 2013 stormwater effluent exceeded benchmark values for total suspended solids, turbidity, zinc, and copper, triggering a Level 3 Corrective Action, as summarized in Section 4.2.8. In March 2013, a NOV (docket number 9717) was issued for violation of permit conditions. As a follow-up, in September 2014, Farallon prepared an Engineering Design Report proposing the installation of an Enpuriion EC electrocoagulation treatment system. In April 2015, a stormwater compliance inspection was completed by Ecology noting that the facility was in the process of installing the treatment system at the Site (Ecology 2016).

According to Ecology’s Permitting and Reporting Information System (PARIS) database (Ecology 2018c), ConGlobal has exceeded benchmarks or effluent limits 60 times between 2015 and 2017 under its active ISGP. The total number of benchmark or effluent limit exceedances represents sample results from four outfall locations (001, 002, 003, and 004) for multiple parameters, including copper, zinc, turbidity, and total suspended solids. Benchmark or effluent limit exceedances have not occurred since 2017. In 2017, ConGlobal also received a reporting violation for failure to submit a required discharge monitoring report. No reporting violations or benchmark/effluent limit exceedances have occurred in 2018. Per the conditions of ConGlobal’s permit, corrective actions must be taken for stormwater benchmark and effluent limit exceedances.

7.0 Preliminary Screening Level Development and Evaluation of Existing Analytical Data

This section provides a summary of the approach used to identify the PSLs for each medium through evaluation of anticipated Applicable or Relevant and Appropriate Requirements (ARARs) and the available Site data. The primary cleanup regulations (chemical-specific ARARs) that apply to this Site are CERCLA, MTCA, Sediment Management Standards (SMS), Water Quality Standards for Surface Waters of the State of Washington (Washington Administrative Code [WAC] 173-201A), and federal surface water quality ARARs for protection of the adjacent groundwater receiving waterbody, the LDW.

Once PSLs for each medium were developed, existing data were compared against the most stringent PSL by medium, and chemicals with exceedances of PSLs were identified. The outcome of this section is a list of applicable PSLs for various pathways and preliminary COPCs for soil and groundwater that can be further refined in future Site evaluation phases.

7.1 DEVELOPMENT OF PRELIMINARY SCREENING LEVELS BY MEDIA

Based on the ARARs, PSLs have been developed that are protective of both human health and ecological receptors for soil and groundwater. Tables 7.1 and 7.2 present PSLs for soil and groundwater respectively. These PSL tables include all potential screening levels based on the following sources:

- Ecology's PCUL Workbook. Ecology has developed comprehensive PSL summary tables for soil, groundwater, sediment, and indoor air for sites near or adjacent to the LDW consistent with cleanup regulations (Ecology 2018a). Exposure pathways identified in the PCUL Workbook are included in the screening level tables. However, it is important to note that the applicability of the screening levels for chemicals in the PCUL Workbook is dependent on future evaluation of COPCs specific to the Site. For example, the PCUL Workbook includes target sediment concentrations used to develop soil and groundwater PSLs protective of sediment for chemicals that are not LDW sediment contaminants of concern. For this preliminary screening and to be conservative, all chemicals and PSLs presented in the PCUL Workbook are included.
- USEPA's RSLs. USEPA soil RSLs for soil direct contact are included in the PSL tables. Groundwater is considered nonpotable, and therefore the USEPA RSLs for the soil to potable groundwater pathway are not applicable (Floyd|Snider 2011). The highest beneficial use of groundwater at the Site is discharge to the LDW.
- MTCA Method A and C soil CULs for industrial use.

PSLs are protective of direct contact and select cross-media exposure scenarios. Cross-media protection pathways require that (1) the contaminant migrates from one medium (or location) to another and that (2) an exposure occurs between a receptor and the medium that is being protected. PSLs are inherently conservative because contaminant migration is modeled by simple equilibrium partitioning equations that are not calibrated to site-specific conditions that can limit

or eliminate contaminant migration and exposure, including natural attenuation processes and physical barriers to exposure. These two factors combine to create PSLs that are intentionally conservative, which ensures the use of analytical methods with appropriate sensitivity to assess risk, regardless of site-specific conditions.

The sections that follow identify the potentially applicable exposure pathways and corresponding regulatory criteria considered in the development of PSLs for each of the potentially impacted media, as well as the source of background data and other considerations relevant to PSL development.

7.1.1 Preliminary Screening Level Development for Soil

Table 7.1 presents the PSLs for soil for each of the potential exposure pathways for all chemicals included in the PCUL Workbook. The most stringent PSL is also identified. The complete exposure pathways considered in developing the PSLs for soil are presented below.

- **Protection of Human Health via Direct Contact.** PSLs protective of human health based on both unrestricted and industrial land uses apply to the Western and Eastern Parcels, respectively, and include the following:
 - MTCA Method B standard formula table values for unrestricted land use or MTCA Method A table values for unrestricted land use where MTCA Method B values were not available (lead and TPH)
 - MTCA Method C standard formula table values for industrial land use or MTCA Method A table values for industrial land use where MTCA Method C values were not available (lead and TPH)
 - USEPA RSLs for resident soil
 - USEPA RSLs for composite worker³
- **Protection of Groundwater Quality.** PSLs that are protective of contaminants leaching from soil to groundwater were calculated using the fixed parameter three-phase partitioning model, MTCA Equation 747-1, with parameters as described in the PCUL Workbook Supplemental Information (Ecology 2018b), and were developed separately for saturated and vadose zone soils. The basis of the groundwater PSLs used in the calculation is described in Section 7.1.2.
- **Protection of Sediment Quality.** PSLs that are protective of soil migrating to sediment or leaching to groundwater and then partitioning to sediment were also included. Target sediment concentrations are the minimum of the LDW CUL and the SMS lower tier concentration and are protective of benthic invertebrates, beach play, subsistence net fishing, and subsistence clam digging. The derivation of target sediment concentrations is described in detail in the PCUL Workbook Supplemental

³ The composite worker exposure scenario combines the most protective exposure assumptions of USEPA's outdoor and indoor worker exposures. The only difference between the outdoor worker and the composite worker is that the composite worker uses the more protective exposure frequency of 250 days per year from the indoor worker scenario.

Information (Ecology 2018b) and summarized in Table 7.1. In addition to their direct use as soil PSLs for the protection of bank erosion and stormwater pathways, target sediment concentrations were used to back-calculate a groundwater concentration protective of sediments, which was then used to back-calculate a soil concentration protective of groundwater.

- **Protection of Terrestrial Ecological Receptors.** The terrestrial ecological evaluation (TEE) PSL is the minimum of the values for protection of plants, soil biota, and wildlife in the site-specific TEE under unrestricted land use (MTCA Table 749-3).

Soil PSLs developed to protect soil and groundwater are protective of surface water via erosion of bank soils, transport of soil into a storm pipe, leaching from soil to groundwater, and leaching from soil to groundwater to sediment.

Additionally, natural background was considered as a modifying factor when establishing PSLs:

- **Natural Background.** A number of the chemicals detected at the Site are naturally occurring in the environment, and it is inappropriate to establish a PSL less than the natural background concentrations. Where the PSLs are less than the natural background value, the PSL is adjusted upward to natural background. Natural background concentrations for dioxins/furans and metals used in this PA are the Puget Sound Region 90th percentile values (Ecology 1994). Note that typical USEPA methodology for calculation of background threshold values is described in USEPA's ProUCL technical guide and includes calculation of the 95 percent upper prediction limit (95UPL), the 95 percent upper confidence level limit of the 95th percentile (UTL95-95), or the 95th percentile (USEPA 2013). These calculations are less conservative than comparison of data to background values represented by Ecology's 90th percentile values.

7.1.2 Preliminary Screening Level Development for Groundwater

As stated above, groundwater is considered nonpotable, and therefore the drinking water ARARs are not applicable (Floyd|Snider 2011). The highest beneficial use of groundwater at the Site is discharge to the LDW. Table 7.2 presents the PSLs for groundwater for each of the exposure pathways. PSLs are presented for all chemicals included in the PCUL Workbook. The exposure pathways considered potentially complete in developing PSLs for groundwater are presented below.

- **Protection of Surface Water.** Groundwater at the Site has the potential to migrate to the shoreline and discharge into the LDW. Groundwater that discharges into surface water must meet the surface water quality standards at the groundwater/surface water interface. State and federal surface water quality criteria are protective of aquatic life, designated uses of the waterbody, and human consumption of seafood. Surface water quality criteria include the following:
 - Water Quality Standards for Surface Waters of the State of Washington for protection of aquatic life and human consumption of organisms (WAC 173-201A)

- Washington Toxics Rule for Human Health for the Consumption of Organisms (40 CFR Part 131.45)
- National Toxics Rule for protection of aquatic life (40 CFR 131.36)
- National Recommended Water Quality Criteria for protection of aquatic life and human consumption of organisms (Clean Water Act Section 304)
- MTCA Method B surface water criteria calculated using Equations 730-1 and 730-2 and modified exposure factors consistent with LDW fish consumption rates and diet fractions
- **Protection of Direct Use.** Although groundwater at the Site is not potable, potable groundwater PSLs were considered for those chemicals that lack surface water criteria. Groundwater PSLs were calculated using MTCA Method B standard formula table values calculated using Equations 720-1 and 720-2 or MTCA Method A table values where MTCA Method B values were not available (TPH). It may be appropriate to develop site-specific groundwater criteria protective of the reasonable maximum exposure to groundwater in a later phase of work.
- **Protection of Sediment.** Sediment quality must be protected at the point where groundwater is discharged to sediment. In their PSL development, Ecology used a modified MTCA three-phase model to calculate the groundwater concentration protective of sediments, using assumptions about theoretical partitioning between groundwater and sediments. Target sediment concentrations protective of potential benthic and human health effects for the LDW Superfund Site were identified in the PCUL Workbook (Ecology 2018a). These target sediment concentrations were used to back-calculate a groundwater concentration protective of sediments.
- **Protection of Indoor Air.** Volatile contaminants in shallow groundwater have the potential to volatilize, rise through the soil column, and discharge into indoor air. PSLs for vapor intrusion were calculated per Ecology's guidance (2018a), as updated (Appendix B of Ecology 2018d).

As with soil, natural background was considered as a modifying factor in establishing PSLs:

- **Natural Background.** The only chemical with an established natural background concentration in groundwater is arsenic. The natural background concentration is the 90th percentile for the Puget Sound Basin, as stated in the PCUL Workbook (Ecology 2018a). The PSL for arsenic is adjusted upward to natural background.

7.2 COMPARISON OF DATA TO PRELIMINARY SCREENING LEVELS

Available soil and groundwater data were screened relative to the PSLs, which resulted in the identification of preliminary COPCs for each medium. To screen the data, Frequency of Exceedance (FOE) tables were developed, which summarize data for all chemicals that were analyzed in Site soil and groundwater. Preliminary COPCs for soil and groundwater are identified based on the exceedance information and additional rationale provided in the FOE tables.

7.2.1 Identification of Preliminary Soil Contaminants of Potential Concern

To identify preliminary COPCs, all available soil data from 1984 to present were used in the screening process. The detected chemicals identified as preliminary COPCs in soil are presented in Tables 7.3 and 7.4 for the vadose zone and saturated soil, respectively. For a number of chemicals, their PSLs are less than standard practical quantitation limits; therefore, some chemicals were not detected but have concentrations greater than the PSL. These preliminary COPCs for chemicals never detected in soil are presented in Table 7.5 (combined vadose zone and saturated soil).

Chemicals that were not detected can be considered in compliance with their PSLs if the more stringent of the conditions in WAC 173-340-707(2) are met. In this PA, this provision was used to eliminate certain chemicals as COPCs, as indicated in Table 7.5.

Additionally, certain chemicals were eliminated as soil COPCs in Tables 7.3 through 7.5 in accordance with WAC 173-340-747(9). Specifically, this provision enables use of an empirical demonstration to show that the soil concentrations present at the Site have not caused, and will not cause, the applicable groundwater criteria to be exceeded at the point of compliance for the target media. For an empirical demonstration to be used for the leaching pathway, the following conditions must be met:

- Sufficient time has elapsed for soil contamination to migrate to groundwater.
- Current and past Site characteristics (e.g., depth to groundwater and infiltration) must be representative of future Site conditions.
- Groundwater data must be of sufficient quality to determine compliance with applicable criteria.

A number of chemicals in the PCUL Workbook have not been analyzed in soil. In Table 7.6, those chemicals are considered individually. Only hexavalent chromium and tributyltin have been identified as preliminary COPCs based on historical Site activities (wastewater treatment and placement of dredged material) and may require further evaluation.

7.2.2 Identification of Preliminary Groundwater Contaminants of Potential Concern

The detected chemicals identified as preliminary COPCs in groundwater are presented in Table 7.7. Preliminary COPCs for chemicals never detected in groundwater are presented in Table 7.8.

Summaries of all available groundwater data both from 1984 to present and from 2006 to present are included in the tables. However, data collected more than 15 years ago are not considered representative of current conditions for the purposes of preliminary COPC screening. Therefore, preliminary COPCs are based on results from data collected from 2006 to present when available.

As in soil, hexavalent chromium and tributyltin have been identified as preliminary COPCs in groundwater in Table 7.6 based on historical Site activities and may require further evaluation.

8.0 Summary of Contaminants of Potential Concern and Sources

The soil and groundwater data screening performed in Section 7.0 resulted in the identification of preliminary soil and groundwater COPCs that are consistent with historical operations at the Site. This section summarizes preliminary COPCs for each medium and describes potential sources of PCBs based on the information provided in Section 4.0. These conclusions are preliminary and intended to support future phases of work at the Site.

8.1 SUMMARY OF PRELIMINARY COPCS

The preliminary COPCs identified for soil and groundwater are summarized in Table 8.1.

Table 8.1
Summary of Preliminary Contaminants of Potential Concern

Contaminant	Vadose Zone	Saturated Soil	Groundwater
Total PCBs (as Aroclors or congeners)	X	X	X
Arsenic	X	X	
Antimony ¹	X	X	
Cadmium	X	X	
Chromium (total)	X	X	X
Chromium (hexavalent) ²	X	X	X
Copper	X	X	
Lead	X	X	
Iron			X ³
Manganese			X ³
Mercury	X	X	X ¹
Nickel	X	X	X (dissolved fraction) ⁴
Silver	X	X ¹	
Thallium	X	X	
Zinc	X	X	X (dissolved fraction) ⁴
Tributyltin ²	X	X	X
cPAH TEQ	X	X	X ¹
DRO	X	X	X
ORO		X	X

Notes:

- 1 Retained as a preliminary COPC in soil or groundwater based on non-detect results.
- 2 Retained as a preliminary COPC based on historical Site activities, has never been analyzed at the Site in soil or groundwater.
- 3 Retained as a preliminary COPC in groundwater based on comparison of data to a surrogate PSL that assumes site groundwater is potable.
- 4 Retained as a preliminary COPC in groundwater based on data analyzed by a method with a known saline matrix interference.

Abbreviation:

TEQ Toxic equivalent

8.2 POTENTIAL SOURCES OF PCBs

From review of existing data, PCBs are likely to be the primary COPC, because the presence of PCBs on the Site at concentrations greater than PSLs has been confirmed by existing data and is likely associated with multiple historical operations. Also, detections have included multiple Aroclors (1242, 1248, 1254, and 1260) in soil across the Site. The likely sources of PCB contamination at the Site include use of the Site for dewatering and disposal of dredged material from the 1974 GSA PCB spill, former Diagonal Avenue STP operations, and placement of dredged material in the uplands from the mitigation area and Chiyoda's shoreline cutback activities.

The 1975 USEPA On-Scene Coordinator Report stated that "the 75 KVA transformer involved was made by Westinghouse and has an internal coolant liquid capacity of 283 total gallons. The PCB coolant according to the manufacturer's specifications tag was Enerteen, which is composed of 70% PCB (Aroclor 1254) and 30% trichlorobenzene. However, laboratory examination disclosed the coolant had been changed to 100% PCB (Aroclor 1242) probably because it would perform better in the extreme climate of the Arctic" (USEPA 1975). The 2005 Final Cleanup Study Report for the Duwamish/Diagonal CSO/SD indicated that sediments dredged in 1974 and 1976 as a result of the 1974 GSA PCB spill contained "other PCB Aroclors" in addition to Aroclor 1242 (King County et al. 2005).

Further, it was reported in a 2002 report identifying PCB sources in contaminated sediments that the relative composition of Aroclors from the former treatment plant outfall was 67 percent Aroclor 1248 and 33 percent Aroclor 1260, suggesting that these Aroclors could be attributable to the treatment plant (DMD 2002). However, a conflict was noted in laboratory reporting of Aroclor 1242 versus Aroclor 1248: USEPA reported Aroclor 1242 and King County Department of Natural Resources reported Aroclor 1248, which was noted as "a discrepancy in identifications reported by two different laboratories" (DMD 2002). This report concluded that Site (referenced as the Diagonal Avenue STP site) could be a source of PCBs to sediments. The report acknowledged that concentrations of PCBs in groundwater collected from the Site "do not appear to be sufficiently high to yield the concentrations found in the sediments of concern."

Although Aroclor 1242 was confirmed to be directly related to the 1974 GSA PCB spill, this Aroclor was not detected in recent groundwater, soil, or sediment data. In historical data, Aroclor 1242 was detected but only as a relatively minor part of total PCBs. The presence of Aroclors 1248, 1254, and 1260 in soil and groundwater are more commonly reported, as summarized:

- Aroclor 1260 was the only Aroclor detected in soil at detection limits between 32 and 33 mg/kg. Aroclor 1260 is present mostly at 4 feet bgs.
- Aroclors 1248 and 1254 were detected in groundwater at detection limits between 1 and 1.9 micrograms per liter (µg/L). Aroclor 1248 is mostly present in shallow soil.
- Aroclors 1016, 1221, and 1242 are all present in significant quantities at 8.5 feet bgs but are present at low concentrations at other depths.

Figure 8.1 presents the detected PCB Aroclor concentrations in Site soil, separated by sample depth. Figure 8.2 presents detected PCB Aroclor concentrations for sediment samples located in

the LDW, within 100 feet of the Site. PCB Aroclor concentrations have been detected in soil samples collected at the Site and in sediments in the adjacent LDW Superfund Site. Comparison of PCB Aroclors in Site soil to adjacent sediments may be conducted in a later phase of work and is not included in this PA.

9.0 Potential Contaminant Migration and Exposure Pathways

This PA conducts a preliminary identification of Site conditions and does not fully develop a conceptual site model. A future phase of work may be required to fully develop the conceptual site model, including determination of complete and incomplete exposure pathways and evaluation of receptors and exposure scenarios. In this PA, the following contaminant transport mechanisms and exposure pathways are assumed potentially active under current or future land use scenarios:

- Direct contact with soil or groundwater
- Vapor intrusion
- Bank soil erosion to surface water and sediment
- Soil leaching to groundwater
- Groundwater discharge to surface water and sediment
- Stormwater discharge to surface water and sediment
- Indirect exposure to Site-related contaminants via consumption of aquatic biota that have acquired Site-related contaminants

The sections that follow evaluate the existing dataset relative to potential contaminant migration and exposure pathways. This analysis may be used to identify additional data collection needs to identify complete and incomplete exposure pathways in a future phase of work, if required.

9.1 SOIL

Figures 9.1 through 9.5 present the PCB Aroclor concentrations detected in soils for various depths below ground surface. Existing data do not clearly delineate hot spots or indicate that contamination is limited to select historical operating areas. The existing data, although spatially distributed across the Site, do not horizontally and vertically bound the nature and extent of contamination in excess of PSLs.

9.1.1 Potential for Migration of Contaminants in Soil to Groundwater

The leaching pathway is assumed to be active for all chemicals that exceed the PSL developed for protection of groundwater in Table 7.1. However, these PSLs do not include consideration of site-specific contaminant transport factors, like the fraction of organic carbon present in soil, and are, therefore, overly conservative. MTCA offers several possibilities for evaluating compliance with the leaching pathway, including performing an empirical demonstration of groundwater quality as described in Section 7.2.1. Specifically, if a chemical was not identified as a preliminary COPC in groundwater in the shoreline wells, then it can be eliminated as a soil preliminary COPC based on the leaching pathway per WAC 173-340-747(9). If the chemical was identified as a preliminary COPC in groundwater, a more detailed evaluation of the leaching pathway is required to

determine whether soil concentrations exceeding the PSLs is present upgradient of, or collocated with, groundwater wells whose results exceed the PSL for that chemical.

The existing dataset includes collocated soil and groundwater samples for multiple chemicals, including the following:

- TPH and PCBs at sample locations C-1 through C-6. These data were collected in 1990 on the Eastern Parcel.
- Metals, VOCs, TPH, selected PAHs, and PCBs at sample locations MW-7 through MW-14. These data were collected in the early 1990s on the Eastern Parcel.
- Select metals (arsenic, cadmium, chromium, copper, lead, nickel), VOCs, TPH, PAHs, and PCBs at sample locations PGG-2, PGG-5, and PGG-6 on the Western Parcel from the mid-2000s.

These collocated data may be useful during a future COC identification process requiring an empirical demonstration of groundwater quality to determine whether the leaching pathway is complete.

9.1.2 Potential for Migration of Bank Soil to Sediment

The majority of the shoreline at the Site is armored riprap or has been stabilized during past mitigation efforts. In 1989, shoreline stabilization was completed as part of the Lafarge facility development in the central and northern portions of the shoreline, which included placement of riprap. In the mitigation area in the southern portion of the Site, clean rock and structural fill were placed to stabilize the bank.

Post-construction monitoring, and physical conditions monitoring of the regraded and stabilized slope, is conducted periodically by the Port. Armoring with riprap and placement of large woody debris and native riparian vegetation along the constructed habitat area for the purposes of physical slope protection is intended to impede erosion of bank material. The effectiveness of these measures to also restrict contaminant migration may be considered during a future phase of Site investigation.

Additionally, available bank soil data indicate a low likelihood of potential contaminant impacts from soil, if it were to erode to adjacent sediments. As described in Section 6.1, five bank soil samples were collected and analyzed for PCBs, PAHs, and metals. Results at only one location exceed soil PSLs developed for protection of sediment, which are equivalent to the target sediment concentration. At this location, total PCBs was detected at a concentration marginally exceeding its target sediment concentration, while PAHs exhibited greater concentrations. A sample collected in close proximity to the contaminated sample did not exceed the bank soil erosion PSL. These data would be considered in future phases of work to confirm contaminant migration pathways and routes of exposure.

9.1.3 Potential for Human Direct Contact Exposure to Soil

Potential impacts for human health have been evaluated in soil using PSLs identified in Table 7.1 as applicable to the direct contact exposure pathway. Because land use is different between the Eastern and Western Parcels, PSLs protective of different direct contact exposure scenarios are potentially applicable to each parcel. Potential impacts to human health were evaluated by comparing soil data (0 to 15 feet bgs, the direct contact point of compliance per WAC 173-340-740) to the industrial land use PSLs in the Eastern Parcel and to the unrestricted land use PSLs in the Western Parcel. Due to the unsecured nature of the Western Parcel and the presence of the Terminal 108 Park in the southwest corner of the property, it is assumed that application of industrial cleanup standards would likely not be acceptable for the Western Parcel under its current use and operations.

Based on the comparison of historical data to PSLs, PCBs, thallium, and GROs exceeded PSLs in the Eastern Parcel, and PCBs, cPAHs, lead, DRO, and ORO exceeded PSLs in the Western Parcel. Therefore, existing data indicate that the direct contact exposure pathway has the potential to pose risk to human health.

9.1.4 Potential for Terrestrial Receptor Exposure to Soil

In the Eastern Parcel, there are no current terrestrial ecological exposure pathways because of the industrial land use and current Site conditions with contiguous pavement and limited vegetation. These conditions represent physical barriers that prevent plants or wildlife from being exposed to contaminated soil. Therefore, the existing data and site conditions indicate that ecological exposure is not currently occurring on the Eastern Parcel.⁴

The Western Parcel includes unpaved areas, the Port-constructed mitigation area, and a public access point; therefore, exposure to terrestrial receptors is currently possible on the Western Parcel. Potential impacts to terrestrial ecological receptors were evaluated by comparing soil data (0 to 6 feet bgs, considered the biologically active soil zone per WAC 173-340-7490) on the Western Parcel to the soil TEE PSLs, which are the minimum of the values for protection of plants, soil biota, and wildlife in the site-specific TEE under unrestricted land use (MTCA Table 749-3). Based on the comparison of historical data to PSLs, PCBs, metals (arsenic, chromium, copper, lead, mercury, nickel, zinc), and DRO in the Western Parcel exceed their TEE PSLs. Additionally, selenium was not detected on the Western Parcel but had a detection limit greater than its TEE PSL. Therefore, existing data and site conditions indicate that the potential for risk to ecological receptors is present under current conditions on the Western Parcel.

9.2 GROUNDWATER

Groundwater preliminary COPCs detected at concentrations greater than the PSLs protective of surface water, sediment, and vapor intrusion in recent groundwater sampling events

⁴ During Site cleanup standards identification conducted as part of a future phase of work, institutional controls would be required to maintain the industrial land use zoning of the property, if industrial cleanup standards are selected for the Site.

(2006–2013) are presented in Figure 9.6. Review of the most recent available data indicates the following:

- In 2013, PCBs were detected (congener and Aroclors) in an area near the northwest shoreline on the Western Parcel. These detections were in wells PGG-2 and PGG-5, downgradient of the PCB disposal areas.
- In 2013, DRO and ORO were both detected at concentrations exceeding their PSLs in wells PGG-2 and PGG-5.
- Chromium was detected on both the Eastern and Western Parcels in exceedance of the PSL.
- Detections of other metals in Site groundwater are scattered and often with elevated detection limits. Exceedances do not indicate presence of a clear source area for any metals.
- VOCs were not detected.
- SVOCs were rarely detected; 1-methylnaphthalene, acenaphthene, naphthalene, and fluorine were the only SVOCs detected, and none of these chemicals were detected in more than three samples.

No groundwater data have been collected at the Site since 2013.

9.2.1 Potential for Groundwater Discharge to Surface Water and Sediment

Groundwater data were evaluated relative to the groundwater PSLs protective of surface water (surface water PSL) and protective of sediment (sediment PSL) listed in Table 7.2. The surface water PSL is protective of aquatic life and human health via consumption of seafood; the sediment PSL is the lower of the minimum ROD CUL & SMS Lower Tier value for the LDW sediments and is protective of human health and benthic invertebrates. In the recent groundwater dataset (2006–2013), SVOCs and VOCs were either not detected or were detected at concentrations in compliance with the surface water and sediment PSLs. With the exception of certain metals (mercury, antimony, silver, and thallium) and cPAHs, reporting limits are sufficient to evaluate compliance with the groundwater to surface water and sediment discharge pathway.

- Chromium results exceed the surface water PSL at four wells (PGG-1, PGG-2, PGG-4, and PGG-5).
- Nickel results exceed the surface water PSL at wells PGG-2 and PGG-3.
- One zinc result exceeds the surface water PSL at well PGG-2.
- PCBs exceed the surface water PSL at four wells (PGG-2, PGG-5, PGG-6, and MW-15).

Any future groundwater data collection may consider use of specialized methods or collection of dissolved metals data to expand the robustness of the current dataset: certain metals were

analyzed only with historical data, and only 18 samples from seven locations were analyzed for dissolved metals. Additionally, surface water PSLs have not been developed for TPH.

9.2.2 Potential for Vapor Intrusion

Groundwater data were evaluated relative to the vapor intrusion pathway PSL listed in Table 7.2. This evaluation determined that existing data reporting limits are sufficient to evaluate exposure risk associated with the vapor intrusion pathway for all chemicals, with the exception of mercury. Mercury reporting limits in groundwater data collected since 2006 range between 0.1 and 5 µg/L, which exceed the PSL of 0.025 µg/L. All other chemicals were either non-detect at concentrations less than the vapor intrusion PSL or detected at concentrations less than the vapor intrusion PSL.

9.2.3 Potential for Human Direct Contact Exposure to Groundwater

Groundwater data were evaluated relative to the PSL protective of potable groundwater use (drinking water PSL) listed in Table 7.2. This evaluation determined that existing data reporting limits are sufficient to evaluate risk associated with the drinking water pathway for all chemicals. Iron and manganese were regularly detected at concentrations exceeding the drinking water PSL. DRO and ORO both exceeded the drinking water PSL at two locations. All other chemicals were either non-detect at concentrations less than the drinking water PSL or detected at concentrations less than the drinking water PSL.

As noted previously, the highest beneficial use of groundwater is discharge to surface water; Site groundwater is nonpotable. CERCLA and MTCA provide options for establishing CULs for nonpotable groundwater, either by conducting a site-specific risk assessment to establish CULs using site-specific exposure factors, which consider current and future land uses; or by using standard MTCA potable water CULs. The latter approach was used in this PA for screening Site groundwater data; however, development of site-specific criteria may be warranted in a future phase of work if these chemicals are retained as COPCs in groundwater.

9.3 STORMWATER

The stormwater discharge to surface water pathway was not specifically evaluated in this PA: stormwater data were not evaluated relative to the surface water PSL listed in Table 7.2, nor were storm solids data evaluated relative to the stormwater discharge PSL listed in Table 7.1. Stormwater falling on the Eastern Parcel, where industrial operations occur, is managed by ConGlobal, as discussed in Sections 4.2.8 and 6.3. Stormwater quality is monitored under the NPDES program under permit number WAR-010569. Historical stormwater discharge quality data, collected prior to the start of ConGlobal operations, are not available. This pathway would be evaluated as part of a future process.

9.4 INDIRECT EXPOSURE VIA CONSUMPTION OF AQUATIC BIOTA THAT HAVE ACQUIRED SITE-RELATED CONTAMINANTS

Existing historical information suggest that the contaminants from the Site may have entered the LDW and become co-mingled with other contaminants present in the LDW. If so, aquatic biota

may have acquired T-108 Site-related contaminants that would pose human health risks to individuals consuming aquatic biota and any body burden of Site-related contaminants those biota might contain. Characterization of this exposure route would occur as part of a future process.

10.0 PA Conclusions

Following a detailed historical review, a comprehensive Site history has been developed and an evaluation of Site activities that may have resulted in releases at or from the Site has been completed. All available environmental data have been compared to PCULs and RSLs. The following findings have been developed based on the PA conducted for the Site.

- **Comprehensive Site History:** There are no PA data gaps associated with the comprehensive Site history. The historical record for the Site has been reviewed and is sufficiently complete. Historical records do not indicate the source of fill material, specific design details of the Diagonal Avenue STP, smaller entities contributing to the Diagonal Avenue STP, and certain other information relative to historical Site use; however, available data (including maps, aerial photographs, and environmental data) are sufficient to arrive at the conclusions presented herein. There are no unidentified owners, operators, or Site uses, because there are no gaps in the historical record since initial industrial development of the Site by the City in 1938.
 - Based on the historical records and existing data, this PA concludes that all historical owners and/or operators have the potential to have contributed to onsite contamination. This includes industrial facilities in the Duwamish Valley that were connected to the Diagonal Avenue STP during its operational period. This PA is not concluding that all parties would have liability; that is outside the scope of this report.
- **Presence of Contamination in Excess of PSLs:** Existing data for the Site confirm the presence of contamination in soil and groundwater at levels that exceed PSLs.
 - The existing data for the Site range in age, with some collected nearly 30 years ago. However, existing data are acceptable to determine that contamination is present in soil and groundwater in excess of PSLs (that include PCULs and RSLs as required by the Order), which means soil and groundwater are a potential threat to human health and the environment, including a potential recontamination threat to the LDW Superfund Site and the Duwamish/Diagonal EAA. The nature and extent of contamination present at the Site may be determined during a future phase of work and is outside the scope of this PA.

With the submission of this PA, the work required by Section 1(A) through (C) in the SOW is now complete. After approval of the Final Preliminary Assessment Report, USEPA will determine the next steps for investigation and management of the Site.

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**Port of Seattle
Terminal 108**

Preliminary Assessment Report

Tables

Table 4.1
Summary of Industrial Owners and Operators, Uses, and Preliminary Contaminants
of Potential Concern

Date ¹	Owner	Operator	Property Use	Potential Associated Contaminants
Eastern Parcel				
1938–1962	City of Seattle	City of Seattle	Sewage treatment plant; two clarifiers, two digesters, sludge drying beds, control house, pump house	Metals, PCBs, PAHs, SVOCs
1962–1969	City of Seattle	Metro	Same as above	Same as above
1972–1984	Chiyoda	Chiyoda ² USEPA and USACE ³	Storage of 10 million gallons of dredged sediment slurry related to 1974 GSA PCB spill, and two pits for material placement	TPH, metals, PCBs
1984–1985	Port of Seattle	Port of Seattle	Temporary storage of cargo containers	TPH, metals
1985–1992	Chevron	Chevron	Soil stockpiling, equipment storage; land farming, ⁴ gasoline station equipment (cranes/pumps) storage; automobile parking; mobile office trailers	TPH, metals, PAHs
1992–Present	Port of Seattle	ConGlobal/CCI	Container storage and chassis repair and maintenance yard; unloading cargo from barges and loading onto trucks and railcars, truck access road	TPH, metals, PAHs, VOCs, SVOCs
1992	Port of Seattle	Ness Cranes	Port assigned Chevron's lease to Ness Cranes; Ness stored equipment on the site	N/A
2003–Present	Port of Seattle	King County	Leases a small area in the southeastern part for office trailer and employee parking	N/A
2005–2007	Port of Seattle	Nuprecon/ReNu Recycling ⁵	Temporary storage for trucks and roll-off bins	TPH, metals, PAHs
Western Parcel				
1970–1984	Chiyoda	Chiyoda	Storage of 10 million gallons of dredged sediment slurry related to 1974 GSA PCB spill, and two pits for material placement	TPH, metals, PCBs
1984–Present	Port of Seattle	Port of Seattle	Vacant (1984–1985); limited container storage; public access and habitat restoration site	TPH, metals

Table 4.1
Summary of Industrial Owners and Operators, Uses, and Preliminary Contaminants
of Potential Concern

Date ¹	Owner	Operator	Property Use	Potential Associated Contaminants
Western Parcel (cont.)				
1985	Port of Seattle	Pioneer Construction Materials Co.	Temporary construction aggregate storage ⁶	TPH, metals, PAHs
1989–1999	Port of Seattle	Lafarge Cement Company	Transport bulk cement from barges to trucks and rail cars; barge moorage pier, conveyor system, product transfer tower, four cement storage silos, truck scale, truck wash-down area; prefab shed for office	TPH, metals, PAHs
1999–2009	Port of Seattle	ConGlobal/CCI	Chassis storage and lay-down area	TPH, metals, PAHs
2005–2007	Port of Seattle	Nuprecon/ReNu Recycling	Temporary storage for trucks and roll-off bins	N/A

Notes:

- 1 Ownership and operations are summarized beginning in 1938 with the first documented industrial use of the property.
- 2 Chiyoda had planned to construct a chemical manufacturing facility with a loading dock. However, the facility was never constructed due to the inability to secure necessary permits for the shore-based dock (Windward 2009a).
- 3 USEPA and USACE took control of the property in 1974 to respond to the PCB spill, and subsequent cleanup, from the electrical transformer owned by Alaska Puget United Transportation Company under contract to the U.S. Navy's Military Sea Transportation Service.
- 4 In 1990, for approximately 6 months, the northwest portion of the Eastern Parcel was used by Chevron to treat PCS via a technique known as land farming (Windward 2009a).
- 5 ReNu Recycling's lease was transferred back to ConGlobal in August 2007 (Windward 2009a).
- 6 Pioneer Construction Materials Co. leased the Western Parcel for a period of 6 months (Windward 2009a).

Abbreviations:

CCI	Container Care International	PCB	Polychlorinated biphenyl
Chevron	Chevron USA Products Company	PCS	Petroleum-contaminated soil
Chiyoda	Chiyoda Corporation International	SVOC	Semivolatile organic compound
ConGlobal	ConGlobal Industries, Inc.	TPH	Total petroleum hydrocarbon
GSA	General Services Administration	USEPA	U.S. Environmental Protection Agency
Metro	Municipality of Metropolitan Seattle	USACE	U.S. Army Corps of Engineers
N/A	Not applicable	VOC	Volatile organic compound
PAH	Polycyclic aromatic hydrocarbon		

Table 7.1
Soil Preliminary Screening Levels (mg/kg)^{1,2}

Chemical ³	CAS No.	Direct Contact Screening Levels ⁴					Leaching Screening Levels ^{5,6}				Erosion Screening Levels ⁷	Adjustment Factors	Vadose Zone Soil PSL ¹⁶	Saturated Soil PSL ¹⁷
		Unrestricted Land Use			Industrial Land Use ⁸		Vadose Zone		Saturated Zone		Protect Sediment via Bank Erosion, Stormwater Discharge (LDW PCUL/ Target Sediment Concentration)			
		USEPA RSL Residential ⁹	Lowest of MTCA Method A & B ^{10,11}	Site-Specific TEE Unrest. Land Use	USEPA RSL Composite Worker ^{9,12}	Lowest of MTCA Method A & C ¹³	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)				
Polychlorinated Biphenyls (PCBs)														
Total PCB Aroclors	1336-36-3	0.23	1	0.65	0.94	10	0.000043	0.13	0.0000022	0.0067	0.13	--	0.000043	0.0000022
Total PCB congeners	--	--	1	0.65	--	--	0.000043	0.0021	0.0000022	0.00011	0.002	--	0.000043	0.0000022
PCB TEQ ¹⁸	--	--	0.0000077	--	--	--	0.000000027	0.00000074	1.4E-09	0.000000037	0.0000007	--	0.000000027	1.4E-09
Dioxins/Furans														
2,3,7,8-TCDD	1746-01-6	0.0000048	0.000013	--	0.000022	0.0017	--	TBD	--	TBD	PQL	0.0000052	0.0000052	0.0000052
Dioxin/furan TEQ ¹⁹	--	0.0000048	0.000013	--	0.000022	0.0017	--	--	--	--	0.000002	0.0000052	0.0000052	0.0000052
Total chlorinated dioxins	--	--	--	0.000002	--	--	--	--	--	--	--	--	0.000002	0.000002
Total chlorinated furans	--	--	--	0.000002	--	--	--	--	--	--	--	--	0.000002	0.000002
Metals														
Aluminum	7429-90-5	77,000	80,000	50	1,100,000	3,500,000	--	--	--	--	220,000	33,000	33,000	33,000
Antimony	7440-36-0	31	32	5	470	1,400	81	--	4.1	--	88	--	5	4.1
Arsenic (inorganic) ²⁰	7440-38-2	0.68	0.67	7	3	20	0.082	130	0.0041	6.5	7	7	7	7
Barium	7440-39-3	15,000	16,000	100	220,000	700,000	160	690,000	8.3	34,000	44,000	--	100	8.3
Beryllium	7440-41-7	160	160	10	2,300	7,000	1,200	69	60	3.5	440	0.61	10	3.5
Cadmium	7440-43-9	71	80	4	980	3,500	1.1	0.16	0.055	0.0083	5.1	0.77	0.77	0.77
Chromium, total or trivalent (soluble salts)	7440-47-3	--	120,000	42	--	--	990,000	2,200	49,000	110	260	48	48	48
Chromium, hexavalent	18540-29-9	0.3	240	--	6.3	19	19	17,000	0.96	870	660	--	0.3	0.3
Cobalt	7440-48-4	23	24	20	350	--	--	--	--	--	66	--	20	20
Copper	7440-50-8	3,100	3,200	50	47,000	140,000	1.4	6.1	0.069	0.3	390	36	36	36
Iron	7439-89-6	55,000	56,000	--	820,000	2,500,000	--	--	--	--	150,000	36,000	55,000	55,000
Lead	7439-92-1	400	250	50	800	1,000	1,600	3,900	81	190	450	24	50	50
Manganese	7439-96-5	--	11,000	1,100	--	490,000	130	--	6.5	--	31,000	1,100	1,100	1,100
Mercury, inorganic (mercuric chloride)	7439-97-6	11	24	0.1	46	2	0.026	2.1	0.0013	0.11	0.41	0.07	0.07	0.07
Methylmercury	16056-34-1	--	8	0.4	--	--	--	--	--	--	22	--	0.4	0.4
Molybdenum	7439-98-7	390	400	2	5,800	18,000	--	--	--	--	1,100	--	2	2
Nickel (soluble salts)	7440-02-0	1,500	1,600	30	22,000	70,000	11	3,000	0.54	150	4,400	48	48	48
Selenium	7782-49-2	390	400	0.3	5,800	18,000	7.4	41,000	0.38	2,100	1,100	--	0.3	0.3
Silver	7440-22-4	390	400	2	5,800	18,000	0.32	9.4	0.016	0.47	6.1	--	0.32	0.016
Thallium (soluble salts)	7440-28-0	0.78	0.8	1	12	35	0.088	32	0.0044	1.6	2.2	--	0.088	0.0044
Tin	7440-31-5	47,000	48,000	50	700,000	2,100,000	--	--	--	--	130,000	--	50	50
Vanadium	7440-62-2	390	400	2	5,800	18,000	--	--	--	--	1,100	--	2	2
Zinc	7440-66-6	23,000	24,000	86	350,000	1,100,000	100	960	5	48	410	85	86	85
Metals - Butyltins														
Monobutyltin	78763-54-9	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Dibutyltin	1002-53-5	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Tributyltin (tributyltin oxide)	36643-28-4	--	24	--	--	--	--	--	--	--	0.0021	--	0.0021	0.0021
Tetrabutyltin	1461-25-2	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Semivolatile Organic Compounds (SVOCs) - Polycyclic Aromatic Hydrocarbons (PAHs)														
Acenaphthene	83-32-9	3,600	4,800	20	45,000	210,000	3.1	0.54	0.16	0.028	0.5	--	0.5	0.028
Acenaphthylene	208-96-8	--	--	--	--	--	--	--	--	--	1.3	--	1.3	1.3
Anthracene	120-12-7	18,000	24,000	--	230,000	1,100,000	47	1	2.4	0.051	0.96	--	0.96	0.051

Table 7.1
Soil Preliminary Screening Levels (mg/kg)^{1,2}

Chemical ³	CAS No.	Direct Contact Screening Levels ⁴					Leaching Screening Levels ^{5,6}				Erosion Screening Levels ⁷	Adjustment Factors	Vadose Zone Soil PSL ¹⁶	Saturated Soil PSL ¹⁷
		Unrestricted Land Use			Industrial Land Use ⁸		Vadose Zone		Saturated Zone		Protect Sediment via Bank Erosion, Stormwater Discharge (LDW PCUL/ Target Sediment Concentration)			
		USEPA RSL Residential ⁹	Lowest of MTCA Method A & B ^{10,11}	Site-Specific TEE Unrest. Land Use	USEPA RSL Composite Worker ^{9,12}	Lowest of MTCA Method A & C ¹³	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)				
SVOCs - PAHs (cont.)														
Benzo(a)anthracene	56-55-3	1.1	--	--	21	180	0.0011	1.4	0.000057	0.068	1.3	--	0.0011	0.000057
Benzo(b)fluoranthene	205-99-2	1.1	--	--	21	180	0.0039	--	0.0002	--	--	--	0.0039	0.0002
Benzo(k)fluoranthene	207-08-9	11	--	--	210	1,800	0.039	--	0.002	--	--	--	0.039	0.002
Total benzofluoranthenes	--	--	--	--	--	--	--	--	--	--	3.2	--	3.2	3.2
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	--	--	--	--	0.67	--	0.67	0.67
Benzo(a)pyrene	50-32-8	0.11	0.19	12	2.1	2	0.00031	1.7	0.000016	0.084	1.6	--	0.00031	0.000016
Chrysene	218-01-9	110	--	--	2,100	18,000	0.13	1.5	0.0064	0.074	1.4	--	0.13	0.0064
Dibenz(a,h)anthracene	53-70-3	0.11	--	--	2.1	18	0.00057	0.24	0.000029	0.012	0.23	--	0.00057	0.000029
Dibenzofuran	132-64-9	73	80	--	1,000	3,500	--	--	--	--	0.54	--	0.54	0.54
Fluoranthene	206-44-0	2,400	3,200	--	30,000	140,000	5.9	1.8	0.3	0.09	1.7	--	1.7	0.09
Fluorene	86-73-7	2,400	3,200	30	30,000	140,000	1.6	0.58	0.08	0.029	0.54	--	0.54	0.029
Indeno(1,2,3-c,d)pyrene	193-39-5	1.1	--	--	21	180	0.011	0.63	0.00056	0.032	0.6	--	0.011	0.00056
Methyl isopropyl phenanthrene	483-65-8	--	--	--	--	--	--	--	--	--	--	--	NE	NE
1-Methylnaphthalene	90-12-0	18	34	--	73	4,500	--	--	--	--	29	--	18	18
2-Methylnaphthalene	91-57-6	240	320	--	3,000	14,000	--	--	--	--	0.67	--	0.67	0.67
Naphthalene	91-20-3	3.8	1,600	--	17	5	0.039	2.5	0.0021	0.13	2.1	--	0.039	0.0021
Phenanthrene	85-01-8	--	--	--	--	--	--	--	--	--	1.5	--	1.5	1.5
Pyrene	129-00-0	1,800	2,400	--	23,000	110,000	11	2.7	0.55	0.14	2.6	--	2.6	0.14
Total LPAHs	--	--	--	--	--	--	--	--	--	--	5.2	--	5.2	5.2
Total HPAHs	--	--	--	--	--	--	--	--	--	--	12	--	12	12
Total PAHs	--	--	--	--	--	--	--	--	--	--	--	--	NE	NE
cPAH TEQ ^{21,22}	--	0.11	0.19	12	2.1	2	0.00031	0.095	0.000016	0.0047	0.09	--	0.09	0.09
Other SVOCs														
Aniline	62-53-3	95	180	--	400	23,000	--	--	--	--	150	--	95	95
Azobenzene	103-33-3	5.6	9.1	--	26	1,200	--	--	--	--	7.8	--	5.6	5.6
Benzidine	92-87-5	0.00053	0.0043	--	0.01	0.57	--	--	--	--	0.0037	--	0.00053	0.00053
Benzoic acid	65-85-0	250,000	320,000	--	3,300,000	14,000,000	--	2.4	--	0.17	0.65	--	0.65	0.17
Benzyl alcohol	100-51-6	6,300	8,000	--	82,000	350,000	--	--	--	--	0.057	--	0.057	0.057
Bis(2-chloroethoxy)methane	111-91-1	190	--	--	2,500	--	--	--	--	--	--	--	190	190
Bis(2-chloroethyl)ether	111-44-4	0.23	0.91	--	1	120	0.00033	2.1	0.000022	0.14	0.78	--	0.00033	0.000022
Bis(2-chloro-1-methylethyl)ether	108-60-1	3,100	14	--	47,000	1,900	--	--	--	--	12	--	12	12
2,6-Bis(1,1-dimethylethyl) phenol	128-39-2	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Bis(2-ethylhexyl) phthalate	117-81-7	39	71	--	160	9,400	0.1	1.4	0.0051	0.069	1.3	--	0.1	0.0051
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Butyl benzyl phthalate	85-68-7	290	530	--	1,200	69,000	0.0036	0.067	0.00018	0.0034	0.063	--	0.0036	0.00018
Butyl diphenyl phosphate	2752-95-6	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Carbazole	86-74-8	--	--	--	--	--	--	--	--	--	--	--	NE	NE
4-Chloroaniline	106-47-8	2.7	5	--	11	660	--	12	--	0.81	4.3	--	2.7	0.81
4-Chloro-3-methylphenol	59-50-7	6,300	--	--	82,000	--	--	--	--	--	--	--	6,300	6,300
2-Chloronaphthalene	91-58-7	4,800	6,400	--	60,000	280,000	--	--	--	--	14,000	--	4,800	4,800
2-Chlorophenol	95-57-8	390	400	--	5,800	18,000	0.2	35	0.011	2	840	--	0.2	0.011

Table 7.1
Soil Preliminary Screening Levels (mg/kg)^{1,2}

Chemical ³	CAS No.	Direct Contact Screening Levels ⁴					Leaching Screening Levels ^{5,6}				Erosion Screening Levels ⁷	Adjustment Factors	Vadose Zone Soil PSL ¹⁶	Saturated Soil PSL ¹⁷
		Unrestricted Land Use			Industrial Land Use ⁸		Vadose Zone		Saturated Zone		Protect Sediment via Bank Erosion, Stormwater Discharge (LDW PCUL/ Target Sediment Concentration)	Natural Background ^{14,15}		
		USEPA RSL Residential ⁹	Lowest of MTCA Method A & B ^{10,11}	Site-Specific TEE Unrest. Land Use	USEPA RSL Composite Worker ^{9,12}	Lowest of MTCA Method A & C ¹³	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)				
Other SVOCs (cont.)														
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Dibutyl phthalate	84-74-2	6,300	8,000	200	82,000	350,000	0.28	1.6	0.015	0.085	1.4	--	0.28	0.015
Dibutyl phenyl phosphate	2528-36-1	--	--	--	--	--	--	--	--	--	--	--	NE	NE
1,2-Dichlorobenzene	95-50-1	1,800	7,200	--	9,300	320,000	9.3	0.054	0.53	0.0031	0.036	--	0.036	0.0031
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	--	--	--	--	--	--	NE	NE
1,4-Dichlorobenzene	106-46-7	2.6	190	20	11	24,000	0.98	0.15	0.054	0.0081	0.11	--	0.11	0.0081
3,3'-Dichlorobenzidine	91-94-1	1.2	2.2	--	5.1	290	0.000061	2.4	0.0000033	0.13	1.9	--	0.000061	0.0000033
2,4-Dichlorophenol	120-83-2	190	240	--	2,500	11,000	0.069	48	0.0043	3	510	--	0.069	0.0043
Diethyl phthalate	84-66-2	51,000	64,000	100	660,000	2,800,000	1.1	0.52	0.074	0.034	0.2	--	0.2	0.034
Dimethyl phthalate	131-11-3	--	--	200	--	--	--	--	--	--	0.071	--	0.071	0.071
2,4-Dimethylphenol	105-67-9	1,300	1,600	--	16,000	70,000	0.79	0.052	0.048	0.0031	0.029	--	0.029	0.0031
4,6-Dinitro-2-methylphenol	534-52-1	5.1	--	--	66	--	--	--	--	--	--	--	5.1	5.1
2,4-Dinitrophenol	51-28-5	130	160	20	1,600	7,000	0.4	2200	0.029	160	340	--	0.4	0.029
2,4-Dinitrotoluene	121-14-2	1.7	3.2	--	7.4	420	0.0011	6.7	0.000069	0.44	2.8	--	0.0011	0.000069
2,6-Dinitrotoluene	606-20-2	0.36	0.67	--	1.5	88	--	1.6	--	0.11	0.57	--	0.36	0.11
Di-n-octyl phthalate	117-84-0	630	800	--	8,200	35,000	--	6.5	--	0.33	6.2	--	6.2	0.33
1,4-Dioxane	123-91-1	5.3	10	--	24	1,300	--	--	--	--	8.5	--	5.3	5.3
1,2-Diphenylhydrazine	122-66-7	0.68	1.3	--	2.9	160	--	--	--	--	1.1	--	0.68	0.68
Hexachlorobenzene	118-74-1	0.21	0.63	17	0.96	82	0.000008	0.023	0.0000004	0.0012	0.022	--	0.000008	0.0000004
Hexachlorobutadiene	87-68-3	1.2	13	--	5.3	1,700	0.011	0.012	0.00054	0.00058	0.011	--	0.011	0.00054
Hexachlorocyclopentadiene	77-47-4	1.8	480	10	7.5	21,000	4	1100	0.2	53	1000	--	1.8	0.2
Hexachloroethane	67-72-1	1.8	25	--	8	2,500	0.00079	25	0.000041	1.3	21	--	0.00079	0.000041
Isophorone	78-59-1	570	1,100	--	2,400	140,000	0.54	3000	0.037	200	900	--	0.54	0.037
2-Methoxynaphthalene	93-04-9	--	--	--	--	--	--	--	--	--	--	--	NE	NE
2-Methylphenol	95-48-7	3,200	4,000	--	41,000	180,000	--	0.16	--	0.01	0.063	--	0.063	0.01
4-Methylphenol	106-44-5	6,300	8,000	--	82,000	350,000	--	--	--	--	0.67	--	0.67	0.67
2-Nitroaniline	88-74-4	630	800	--	8,000	35,000	--	--	--	--	1700	--	630	630
3-Nitroaniline	99-09-2	--	--	--	--	--	--	--	--	--	--	--	NE	NE
4-Nitroaniline	100-01-6	27	--	--	110	--	--	--	--	--	--	--	27	27
Nitrobenzene	98-95-3	5.1	160	40	22	7000	0.64	750	0.041	48	340	--	0.64	0.041
2-Nitrophenol	88-75-5	--	--	--	--	--	--	--	--	--	--	--	NE	NE
4-Nitrophenol	100-02-7	--	--	7	--	--	--	--	--	--	--	--	7	7
n-Nitrosodimethylamine	62-75-9	0.002	0.02	--	0.034	2.6	--	--	--	--	0.017	--	0.002	0.002
n-Nitrosodiphenylamine	86-30-6	110	200	20	470	27,000	0.021	0.033	0.0011	0.0018	0.028	--	0.021	0.0011
n-Nitrosodi-n-propylamine	621-64-7	0.078	0.14	--	0.33	19	0.00026	0.52	0.000018	0.036	0.12	--	0.00026	0.000018
Pentachlorophenol	87-86-5	1	2.5	3	4	330	0.000032	0.014	0.0000018	0.00077	0.36	--	0.000032	0.0000018
Phenol	108-95-2	19,000	24,000	30	250,000	1,100,000	320	1.7	22	0.12	0.42	--	0.42	0.12
Pyridine	110-86-1	78	80	--	1,200	3,500	--	--	--	--	170	--	78	78
1,2,4-Trichlorobenzene	120-82-1	24	34	20	110	4,500	0.0014	0.036	0.000072	0.0019	0.031	--	0.0014	0.000072
2,4,5-Trichlorophenol	95-95-4	6,300	8,000	4	82,000	350,000	22	2000	1.1	110	17,000	--	4	1.1
2,4,6-Trichlorophenol	88-06-2	49	80	10	210	3,500	0.0033	6.9	0.00019	0.39	78	--	0.0033	0.00019

Table 7.1
Soil Preliminary Screening Levels (mg/kg)^{1,2}

Chemical ³	CAS No.	Direct Contact Screening Levels ⁴					Leaching Screening Levels ^{5,6}				Erosion Screening Levels ⁷	Adjustment Factors	Vadose Zone Soil PSL ¹⁶	Saturated Soil PSL ¹⁷
		Unrestricted Land Use			Industrial Land Use ⁸		Vadose Zone		Saturated Zone		Protect Sediment via Bank Erosion, Stormwater Discharge (LDW PCUL/ Target Sediment Concentration)	Natural Background ^{14,15}		
		USEPA RSL Residential ⁹	Lowest of MTCA Method A & B ^{10,11}	Site-Specific TEE Unrest. Land Use	USEPA RSL Composite Worker ^{9,12}	Lowest of MTCA Method A & C ¹³	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)				
Volatile Organic Compounds (VOCs)														
Acetone	67-64-1	61,000	72,000	--	670,000	3,200,000	--	--	--	--	--	--	61,000	61,000
Acrolein	107-02-8	0.14	40	--	0.6	1,800	--	--	--	--	--	--	0.14	0.14
Acrylonitrile	107-13-1	0.25	1.9	--	1.1	240	--	--	--	--	--	--	0.25	0.25
Benzaldehyde	100-52-7	170	8,000	--	820	350,000	--	--	--	--	--	--	170	170
Benzene	71-43-2	1.2	18	--	5.1	0.03	0.0088	--	0.00056	--	--	--	0.0088	0.00056
Bromobenzene	108-86-1	290	640	--	1800	--	--	--	--	--	--	--	290	290
Bromochloromethane	74-97-5	150	--	--	630	--	--	--	--	--	--	--	150	150
Bromoethane	74-96-4	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Bromoform	75-25-2	19	130	--	86	17,000	0.078	--	0.005	--	--	--	0.078	0.005
Bromomethane	74-83-9	6.8	110	--	30	4,900	1.2	--	0.079	--	--	--	1.2	0.079
2-Butoxyethanol	111-76-2	6,300	8,000	--	82,000	350,000	--	--	--	--	--	--	6,300	6,300
n-Butylbenzene	104-51-8	3,900	4,000	--	58,000	180,000	--	--	--	--	--	--	3,900	3,900
sec-Butylbenzene	135-98-8	7,800	8,000	--	120,000	350,000	--	--	--	--	--	--	7,800	7,800
tert-Butylbenzene	98-06-6	7,800	8,000	--	120,000	350,000	--	--	--	--	--	--	7,800	7,800
Carbon disulfide	75-15-0	770	8,000	--	3,500	350,000	--	--	--	--	--	--	770	770
Carbon tetrachloride	56-23-5	0.65	14	--	2.9	1,900	0.0029	--	0.00015	--	--	--	0.0029	0.00015
Chlorobenzene	108-90-7	280	1,600	40	1,300	70,000	1.7	--	0.1	--	--	--	1.7	0.1
Chloroethane	75-00-3	14,000	--	--	57,000	--	--	--	--	--	--	--	14,000	14,000
2-Chloroethyl vinyl ether	110-75-8	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Chloroform	67-66-3	0.32	32	--	1.4	4,200	0.81	--	0.052	--	--	--	0.32	0.052
Chloromethane	74-87-3	110	--	--	460	--	--	--	--	--	--	--	110	110
3-Chloro-1-propene	107-05-1	0.72	48	--	3.2	6,300	--	--	--	--	--	--	0.72	0.72
2-Chlorotoluene	95-49-8	1,600	1,600	--	23,000	70,000	--	--	--	--	--	--	1600	1600
4-Chlorotoluene	106-43-4	1,600	--	--	23,000	--	--	--	--	--	--	--	1600	1600
Dibromochloromethane	124-48-1	8.3	12	--	39	1,600	0.012	--	0.00077	--	--	--	0.012	0.00077
1,2-Dibromo-3-chloropropane	96-12-8	0.0053	1.3	--	0.064	160	--	--	--	--	--	--	0.0053	0.0053
Dibromomethane	74-95-3	24	800	--	99	35,000	--	--	--	--	--	--	24	24
Dichlorobromomethane	75-27-4	0.29	16	--	1.3	2,100	0.014	--	0.00096	--	--	--	0.014	0.00096
trans-1,4-Dichloro-2-butene	110-57-6	0.0074	--	--	0.032	--	--	--	--	--	--	--	0.0074	0.0074
Dichlorodifluoromethane	75-71-8	87	16,000	--	370	700,000	--	--	--	--	--	--	87	87
1,1-Dichloroethane	75-34-3	3.6	180	--	16	23,000	--	--	--	--	--	--	3.6	3.6
1,2-Dichloroethane	107-06-2	0.46	11	--	2	1,400	0.35	--	0.024	--	--	--	0.35	0.024
1,1-Dichloroethylene	75-35-4	230	4,000	--	1,000	180,000	25	--	1.4	--	--	--	25	1.4
cis-1,2-Dichloroethylene	156-59-2	160	160	--	2,300	7,000	--	--	--	--	--	--	160	160
trans-1,2-Dichloroethylene	156-60-5	1,600	1,600	--	23,000	70,000	5.2	--	0.32	--	--	--	5.2	0.32
1,2-Dichloroethylene (mixed isomers)	540-59-0	--	720	--	--	32,000	--	--	--	--	--	--	720	720
1,2-Dichloropropane	78-87-5	2.5	27	700	11	3,600	0.016	--	0.001	--	--	--	0.016	0.001
1,3-Dichloropropane	142-28-9	1,600	--	--	23,000	--	--	--	--	--	--	--	1,600	1,600
2,2-Dichloropropane	594-20-7	--	--	--	--	--	--	--	--	--	--	--	NE	NE
1,1-Dichloropropene	563-58-6	--	--	--	--	--	--	--	--	--	--	--	NE	NE

Table 7.1
Soil Preliminary Screening Levels (mg/kg)^{1,2}

Chemical ³	CAS No.	Direct Contact Screening Levels ⁴					Leaching Screening Levels ^{5,6}				Erosion Screening Levels ⁷	Adjustment Factors	Vadose Zone Soil PSL ¹⁶	Saturated Soil PSL ¹⁷
		Unrestricted Land Use			Industrial Land Use ⁸		Vadose Zone		Saturated Zone		Protect Sediment via Bank Erosion, Stormwater Discharge (LDW PCUL/ Target Sediment Concentration)	Natural Background ^{14,15}		
		USEPA RSL Residential ⁹	Lowest of MTCA Method A & B ^{10,11}	Site-Specific TEE Unrest. Land Use	USEPA RSL Composite Worker ^{9,12}	Lowest of MTCA Method A & C ¹³	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)				
VOCs (cont.)														
cis-1,3-Dichloropropene	10061-01-5	--	10	--	--	--	0.01	--	0.00063	--	--	--	0.01	0.00063
trans-1,3-Dichloropropene	10061-02-6	--	10	--	--	--	0.01	--	0.00063	--	--	--	0.01	0.00063
Ethane	74-84-0	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Ethylbenzene	100-41-4	5.8	8,000	--	25	6	0.26	--	0.015	--	--	--	0.26	0.015
Ethylene	74-85-1	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Ethyl ether	60-29-7	16,000	16,000	--	230,000	700,000	--	--	--	--	--	--	16,000	16,000
Ethylene dibromide	106-93-4	0.036	0.5	--	0.16	0.005	--	--	--	--	--	--	0.005	0.005
Formaldehyde	50-00-0	17	16,000	--	73	700,000	--	--	--	--	--	--	17	17
2-Hexanone	591-78-6	200	400	--	1300	--	--	--	--	--	--	--	200	200
Isopropylbenzene	98-82-8	1,900	8,000	--	9,900	350,000	--	--	--	--	--	--	1,900	1,900
4-Isopropyltoluene	99-87-6	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Methane	74-82-8	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Methyl ethyl ketone	78-93-3	27,000	48,000	--	190,000	2,100,000	--	--	--	--	--	--	27,000	27,000
Methyl iodide	74-88-4	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Methyl isobutyl ketone	108-10-1	33,000	6,400	--	140,000	280,000	--	--	--	--	--	--	6,400	6,400
Methyl tert-butyl ether	1634-04-4	47	560	--	210	0.1	--	--	--	--	--	--	0.1	0.1
Methylene chloride	75-09-2	57	480	--	1000	0.02	0.43	--	0.03	--	--	--	0.02	0.02
2-Pentanone	107-87-9	--	--	--	--	--	--	--	--	--	--	--	NE	NE
n-Propylbenzene	103-65-1	3,800	8,000	--	24,000	350,000	--	--	--	--	--	--	3,800	3,800
Styrene	100-42-5	6,000	16,000	300	35,000	700,000	--	--	--	--	--	--	300	300
1,1,1,2-Tetrachloroethane	630-20-6	2	38	--	8.8	5,000	--	--	--	--	--	--	2	2
1,1,2,2-Tetrachloroethane	79-34-5	0.6	5	--	2.7	660	0.0017	--	0.00011	--	--	--	0.0017	0.00011
Tetrachloroethylene	127-18-4	24	480	--	100	0.05	0.029	--	0.0016	--	--	--	0.029	0.0016
Toluene	108-88-3	4,900	6,400	200	47,000	7	0.92	--	0.055	--	--	--	0.92	0.055
1,2,3-Trichlorobenzene	87-61-6	63	--	20	930	--	--	--	--	--	--	--	20	20
1,1,1-Trichloroethane	71-55-6	8,100	160,000	--	36,000	2	370	--	21	--	--	--	2	2
1,1,2-Trichloroethane	79-00-5	1.1	18	--	5	2300	0.005	--	0.00033	--	--	--	0.005	0.00033
Trichloroethylene	79-01-6	0.94	12	--	6	0.03	0.0044	--	0.00027	--	--	--	0.0044	0.00027
Trichlorofluoroethane	27154-33-2	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Trichlorofluoromethane	75-69-4	23,000	24,000	--	350,000	1,100,000	--	--	--	--	--	--	23,000	23,000
1,2,3-Trichloropropane	96-18-4	0.0051	0.033	--	0.11	4.4	--	--	--	--	--	--	0.0051	0.0051
Trichlorotrifluoroethane	76-13-1	6,700	2,400,000	--	28,000	110,000,000	--	--	--	--	--	--	6,700	6,700
1,2,3-Trimethylbenzene	526-73-8	340	800	--	2,000	--	--	--	--	--	--	--	340	340
1,2,4-Trimethylbenzene	95-63-6	300	800	--	1,800	--	--	--	--	--	--	--	300	300
1,3,5-Trimethylbenzene	108-67-8	270	800	--	1,500	35,000	--	--	--	--	--	--	270	270
Vinyl acetate	108-05-4	910	80,000	--	3,800	3,500,000	--	--	--	--	--	--	910	910
Vinyl chloride	75-01-4	0.059	0.67	--	1.7	11,000	0.001	--	0.000055	--	--	--	0.001	0.000055
m-Xylene	108-38-3	550	16,000	--	2,400	700,000	--	--	--	--	--	--	550	550
m,p-Xylene	179601-23-1	--	16,000	--	--	--	--	--	--	--	--	--	16,000	16,000
o-Xylene	95-47-6	650	16,000	--	2,800	700,000	--	--	--	--	--	--	650	650
Total xylenes	1330-20-7	580	16,000	--	2,500	9	--	--	--	--	--	--	9	9

Table 7.1
Soil Preliminary Screening Levels (mg/kg)^{1,2}

Chemical ³	CAS No.	Direct Contact Screening Levels ⁴					Leaching Screening Levels ^{5,6}				Erosion Screening Levels ⁷	Adjustment Factors	Vadose Zone Soil PSL ¹⁶	Saturated Soil PSL ¹⁷
		Unrestricted Land Use			Industrial Land Use ⁸		Vadose Zone		Saturated Zone		Protect Sediment via Bank Erosion, Stormwater Discharge (LDW PCUL/ Target Sediment Concentration)			
		USEPA RSL Residential ⁹	Lowest of MTCA Method A & B ^{10,11}	Site-Specific TEE Unrest. Land Use	USEPA RSL Composite Worker ^{9,12}	Lowest of MTCA Method A & C ¹³	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)				
Petroleum Hydrocarbons														
Gasoline-range hydrocarbons ²³	--	--	30	100	--	30	--	--	--	--	--	--	30	30
Diesel-range hydrocarbons	--	--	2,000	200	--	2,000	--	--	--	--	--	--	200	200
Oil-range hydrocarbons	--	--	2,000	--	--	2,000	--	--	--	--	--	--	2,000	2,000
Pesticides														
Aldrin	309-00-2	0.039	0.059	0.1	0.18	7.7	0.00000004	0.00011	0.000000002	0.0000053	0.0001	--	0.00000004	0.000000002
alpha-BHC ²⁴	319-84-6	0.086	0.16	6	0.36	21	0.0000019	0.16	0.000000098	0.0081	0.14	--	0.0000019	0.000000098
beta-BHC ²⁴	319-85-7	0.3	0.56	6	1.3	73	0.000066	0.54	0.0000034	0.028	0.47	--	0.000066	0.0000034
delta-BHC ²⁴	319-86-8	--	--	6	--	--	--	--	--	--	--	--	6	6
gamma-BHC ²⁴	58-89-9	0.57	0.91	6	2.5	0.01	0.0039	0.92	0.00021	0.048	0.78	--	0.0039	0.00021
cis-Chlordane ²⁵	5103-71-9	--	2.9	1	--	--	0.00037	TBD	0.000019	TBD	PQL	--	0.00037	0.000019
trans-Chlordane ²⁵	5103-74-2	--	2.9	1	--	--	0.00037	TBD	0.000019	TBD	PQL	--	0.00037	0.000019
Chlordane	57-74-9	--	2.9	1	--	380	0.000023	TBD	0.0000011	TBD	PQL	--	0.000023	0.0000011
Chlorpyrifos	2921-88-2	63	80	--	820	3,500	--	--	--	--	170	--	63	63
4,4'-DDD	72-54-8	1.9	2.4	0.75	9.6	550	0.0000073	3.8	0.00000036	0.19	3.6	--	0.0000073	0.00000036
4,4'-DDE	72-55-9	2	2.9	0.75	9.3	390	0.0000015	2.6	0.000000076	0.13	2.5	--	0.0000015	0.000000076
4,4'-DDT	50-29-3	1.9	2.9	0.75	8.5	4	0.000016	0.00011	0.00000081	0.0000053	0.0001	--	0.000016	0.00000081
Total DDD ²⁶	--	1.9	4.2	0.75	9.6	--	0.00092	3.8	0.000046	0.19	3.6	--	0.00092	0.000046
Total DDE ²⁶	--	2	2.9	0.75	9.3	--	0.0017	2.6	0.000087	0.13	2.5	--	0.0017	0.000087
Total DDT ²⁶	--	1.9	2.9	0.75	8.5	--	0.014	0.00011	0.00068	0.0000053	0.0001	--	0.0001	0.0000053
Diazinon	333-41-5	44	56	--	570	2,500	--	--	--	--	120	--	44	44
Dieldrin	60-57-1	0.034	0.063	0.07	0.14	8.2	0.00000062	0.00011	0.000000031	0.0000053	0.0001	--	0.00000062	0.000000031
Endosulfan I	959-98-8	--	480	--	--	--	0.00039	1,200	0.00002	60	1,000	--	0.00039	0.00002
Endosulfan II	33213-65-9	--	480	--	--	--	0.00039	1,200	0.00002	60	1,000	--	0.00039	0.00002
Endosulfan sulfate	1031-07-8	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Endrin	72-20-8	19	24	0.2	250	1,100	0.00044	54	0.000022	2.7	51	--	0.00044	0.000022
Endrin aldehyde	7421-93-4	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Endrin ketone	53494-70-5	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Heptachlor ²⁷	76-44-8	0.13	0.22	0.4	0.63	29	0.000000066	0.00011	3.3E-09	0.0000054	0.0001	--	0.000000066	3.3E-09
Heptachlor epoxide ²⁷	1024-57-3	0.07	0.11	0.4	0.33	14	0.000004	TBD	0.0000002	TBD	PQL	--	0.000004	0.0000002
Malathion	121-75-5	1,300	1,600	--	16,000	70,000	--	--	--	--	3,400	--	1300	1300
Methoxychlor	72-43-5	320	400	--	4,100	18,000	0.032	890	0.0016	45	840	--	0.032	0.0016
Mirex	2385-85-5	0.036	0.056	--	0.17	7.3	--	--	--	--	0.047	--	0.036	0.036
Nonachlor	3734-49-4	--	--	--	--	--	--	--	--	--	--	--	NE	NE
Toxaphene	8001-35-2	0.49	0.91	--	2.1	120	0.000061	0.82	0.0000031	0.041	0.78	--	0.000061	0.0000031

Table 7.1
Soil Preliminary Screening Levels (mg/kg)^{1,2}

Chemical ³	CAS No.	Direct Contact Screening Levels ⁴					Leaching Screening Levels ^{5,6}				Erosion Screening Levels ⁷	Adjustment Factors	Vadose Zone Soil PSL ¹⁶	Saturated Soil PSL ¹⁷
		Unrestricted Land Use			Industrial Land Use ⁸		Vadose Zone		Saturated Zone		Protect Sediment	Natural Background ^{14,15}		
		USEPA RSL Residential ⁹	Lowest of MTCA Method A & B ^{10,11}	Site-Specific TEE Unrest. Land Use	USEPA RSL Composite Worker ^{9,12}	Lowest of MTCA Method A & C ¹³	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	Protect Surface Water via Ground Water (MTCA Eq. 747-1)	Protect Sediment via Ground Water (MTCA Mod. Eq. 747-1)	via Bank Erosion, Stormwater Discharge (LDW PCUL/ Target Sediment Concentration)			

Notes:

- Not available.
- NA Not applicable; the labs surveyed did not identify a PQL value for a chemical.
- NE Not established; this chemical is not regulated in groundwater, surface water, or sediment.
- PQL Consistent with Ecology 2018a, the target sediment concentration will be set to natural background, if available, or the PQL. If neither value is available, the target sediment concentration is noted as “PQL.”
- TBD When the target SMS sediment concentration is listed as “PQL,” it is not possible to calculate numerical groundwater SLs for protection of sediment. In these cases, the groundwater SL is listed as “TBD” (to be determined).
- 1 SLs presented in this table are consistent with soil PCULs presented in Ecology 2018a, with site-specific modifications as described in the footnotes to this table. Groundwater at the site is not potable; therefore, SLs developed for sites with potable groundwater (i.e., soil to protect potable groundwater) have generally been omitted in favor of SLs developed for non-potable sites (i.e., soil to protect groundwater discharging to surface water).
- 2 SLs have been rounded to two significant digits.
- 3 Not all chemicals included in this table are chemicals requiring SLs at the site. Chemicals requiring SLs will be determined in coordination with the regulating agency at a later date.
- 4 Ecology and USEPA utilize different chemical-specific parameters, toxicity factors, and exposure assumptions to calculate SLs protective of direct human contact with soil. The Ecology LDW PCUL Workbook (2018a) was modified to include RSLs calculated and used by USEPA for cleanups performed with USEPA as the lead regulatory agency.
- 5 For values for chemical properties (e.g., K_d , K_{oc} , or Henry’s Law Constant) not available from Ecology’s (2017) CLARC database were referenced from USEPA’s (1996) Soil Screening Guidance. SLs that are dependent on chemical properties (e.g., leaching) were not calculated for chemicals without values from these two sources.
- 6 Leaching SLs are based on the MTCA fixed parameter three-phase partitioning model (WAC 173-340-747, equation 747-1), using partitioning factors and calculation inputs as described in Ecology 2018a. Leaching SLs for the protection of surface water via groundwater discharge are protective of the surface water SL listed in Table 7.2.
- 7 Erosion SLs are equivalent to target sediment concentrations developed by Ecology for use in the LDW PCUL Workbook. Target sediment concentrations are the minimum of the sediment CULs in the ROD, when available. The ROD includes six different sediment CULs, which are applicable to different remedial action objectives and sediment depth horizons. For some sites, the regulating agency may determine the minimum sediment CULs in the ROD are not applicable. For chemicals not listed in the ROD, the target sediment concentrations are consistent with the SMS sediment cleanup objective, which may be expressed as a dry weight equivalent. Target sediment concentrations are protective of human contact under the scenarios defined in LDWG’s (2007) human health risk assessment.
- 8 Industrial portions of the site qualify for a Terrestrial Ecological Evaluation exclusion. Specifically, all soil contaminated with hazardous substances is, or will be, covered by buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed to the soil contamination. An institutional control shall be required to maintain this condition.
- 9 RSLs as calculated by USEPA using chemical-specific parameters and toxicity factors as found in the May 2018 RSL tables. RSLs include contributions from ingestion, inhalation, and dermal soil exposures and are protective of cancer and noncancer modes of action using a target cancer risk of 1E-6 and a hazard quotient of 1.0. Equations and exposure factors used to calculate the residential and composite worker RSLs included in this table are presented in USEPA 2018.
- 10 MTCA Method B SLs were calculated by Ecology using WAC 173-340-740, equations 740-1 and 740-2, as presented in the LDW PCUL Workbook. MTCA Method B calculations in the LDW PCUL Workbook differ from those presented in CLARC for the reasons described in Ecology 2018a. MTCA Method A soil CULs are shown for those chemicals for which Method B values are not available (e.g., petroleum hydrocarbons and lead). The MTCA Method A value for total PCBs is also included because it captures the chemical-specific level mandated in the federal Toxic Substances Control Act.
- 11 The Method B and USEPA RSL SLs certain chemicals (i.e. benzo(a)pyrene, benzo(a)pyrene TEQ, and trichloroethene) were performed using specialized calculations to account for mutagenic exposure during early life stages when children are more susceptible to exposure. For SLs based on MTCA Method B, mutagenic calculations were performed by Ecology and presented in Ecology 2018a; for SLs based on the USEPA RSL, mutagenic calculations were performed by USEPA and presented in the RSL tables (USEPA 2018b).
- 12 The regulating agency may determine that an alternative worker exposure scenario (i.e. outdoor worker or indoor worker exposure to soil) is appropriate for use at the site.
- 13 MTCA Method C SLs were calculated by Ecology using WAC-173-340-745, equations 745-1 and 745-2, as presented in the LDW PCUL Workbook. MTCA Method C calculations in the LDW PCUL Workbook differ from those presented in CLARC for the reasons described in Ecology 2018a. MTCA Method A soil cleanup levels are shown for those chemicals for which Method C values are not available (e.g., petroleum hydrocarbons and lead). The MTCA Method A value for total PCBs is also included because it captures the chemical-specific level mandated in the federal Toxic Substances Control Act.
- 14 Metals background values (Puget Sound Region 90th percentile values) are from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994) Table 7, Puget Sound Soil Background Values; except for arsenic for which MTCA established 20 mg/kg as background (WAC 173-340-900 Table 745-1).
- 15 Background for dioxins/furans from *Natural Background for Dioxins/Furans in WA Soils* (Ecology 2010b).
- 16 The PSL for vadose zone (unsaturated) soil is protective of the following pathways: direct human contact with soil; direct contact with soil by ecological receptors; leaching from vadose zone to protect surface water via groundwater; leaching from vadose zone to protect sediment; and protection of sediment via erosion. The PSL for each chemical was adjusted upward for background in accordance with WAC 173-340-705(6), as appropriate. Subsequent analysis may be performed to tailor the PSL to incorporate site-specific modifications, including restrictions on current or future land use or elimination of pathways that are not active at the site.
- 17 The PSL for saturated soil is protective of the following pathways: direct human contact with soil; direct contact with soil by ecological receptors; leaching from saturated soil to protect surface water via groundwater; leaching from saturated soil to protect sediment; and protection of sediment via erosion. The PSL for each chemical was adjusted upward for background in accordance with WAC 173-340-705(6), as appropriate. Subsequent analysis may be performed to tailor the PSL to incorporate site-specific modifications, including restrictions on current or future land use or elimination of pathways that are not active at the site.
- 18 Represents the sum of the 12 dioxin-like PCB congeners, each adjusted using its TEF (e.g., MTCA Table 708-4). SLs are derived using the toxicity values and ARARs for 2,3,7,8-TCDD.
- 19 Represents the sum of the 17 carcinogenic congeners, each adjusted using its TEF (e.g., MTCA Table 708-1). SLs are derived using the toxicity values and ARARs for 2,3,7,8-TCDD.
- 20 The TEE SLs are the minimum for arsenic(III) and arsenic(V). If site-specific data are available to determine the form of arsenic, the TEE SLs specific to that form should be used.
- 21 Represents the sum of the 7 carcinogenic PAH compounds, each adjusted using its TEF (e.g., MTCA Table 708-2).The PQL for benzo(a)pyrene is used as a surrogate. SLs are derived using the toxicity values and ARARs for benzo(a)pyrene.
- 22 Under MTCA, cPAHs are regulated individually, rather than as a sum, when evaluating compliance with the leaching pathways. Therefore, the PSL for the total cPAH TEQ in this table considers only direct contact and erosion pathways.
- 23 MTCA Method A SL for gasoline-range petroleum hydrocarbons is 30 mg/kg if benzene is present. If benzene is not present, the MTCA Method A SL (and PSL) is 100 mg/kg.
- 24 TEE SLs are from benzene hexachloride.
- 25 The chemical characteristics, toxicity data, and TEE SLs are from chlordane.
- 26 Includes 2,4’- and 4,4’-DDx isomers. SLs shown for individual forms of DDD, DDE, and DDT are applied to the total of DDD, DDE, and DDT.
- 27 TEE SLs shown for heptaclor and heptaclor epoxide should be applied to the total of the two analytes.

Abbreviations:

- ARAR Applicable or Relevant and Appropriate Requirement
- BHC Beta-hexachlorocyclohexane
- CAS Chemical Abstracts Service
- CLARC Cleanup Levels and Risk Calculation
- cPAH Carcinogenic polycyclic aromatic hydrocarbon
- CUL Cleanup level
- DDD Dichlorodiphenyldichloroethane
- DDE Dichlorodiphenyldichloroethylene
- DDT Dichlorodiphenyltrichloroethane
- DDx DDD, DDE, or DDT
- Ecology Washington State Department of Ecology
- Eq. MTCA Equations
- HPAH High molecular weight polycyclic aromatic hydrocarbon
- K_d Distribution coefficient for metals (liters per kilogram)
- K_{oc} Soil organic carbon-water partitioning coefficient (liters per kilogram)
- LDW Lower Duwamish Waterway
- LDWG Lower Duwamish Waterway Group
- LPAH Low molecular weight polycyclic aromatic hydrocarbon
- mg/kg Milligrams per kilogram
- MTCA Model Toxics Control Act
- PAH Polycyclic aromatic hydrocarbon
- PCUL Preliminary cleanup level
- PQL Practical Quantitation Limit
- PSL Preliminary Screening Level
- ROD Record of Decision
- RSL Regional Screening Level
- SCO Sediment cleanup objective
- SL Screening level
- SMS Sediment Management Standards
- TCDD Tetrachlorodibenzodioxin
- TEE Terrestrial ecological evaluation
- TEF Toxic equivalent factor
- TEQ Toxic equivalent
- USEPA U.S. Environmental Protection Agency
- WAC Washington Administrative Code

Table 7.2
Groundwater Preliminary Screening Levels (µg/L)^{1,2}

Chemical ³	CAS No.	Potable Groundwater ⁴	Protection of Marine Surface Water ^{5,6}	Protection of Sediment ⁷	Protection of Indoor Air ⁸	Adjustment Factors	Groundwater PSL ¹⁰
		Lowest of MTCA Method A & B ²	Protective of Aquatic Life and Human Health via Organism-Only Consumption	Protective of the Lower of the Minimum ROD CUL & SMS Lower Tier	Protective of Indoor Air via Vapor Intrusion using standard MTCA B Calculation	Natural Background ⁹	
Polychlorinated Biphenyls (PCBs)							
Total PCB Aroclors	1336-36-3	--	7.0E-06	2.2E-02	--	--	7.0E-06
Total PCB congeners	--	--	7.0E-06	3.4E-04	--	--	7.0E-06
PCB TEQ	--	--	4.4E-09	1.2E-07	--	--	4.4E-09
Dioxins/Furans							
2,3,7,8-TCDD	1746-01-6	--	5.1E-09	TBD	--	--	5.1E-09
Dioxin/furan TEQ ¹¹	--	--	5.1E-09	TBD	--	--	5.1E-09
Total chlorinated dioxins	--	--	--	--	--	--	NE
Total chlorinated furans	--	--	--	--	--	--	NE
Metals ¹²							
Aluminum	7429-90-5	1.6E+04	--	--	--	--	1.6E+04
Antimony	7440-36-0	--	9.0E+01	--	--	--	9.0E+01
Arsenic	7440-38-2	--	1.4E-01	2.2E+02	--	8.0E+00	8.0E+00
Barium	7440-39-3	--	2.0E+02	8.3E+05	--	--	2.0E+02
Beryllium	7440-41-7	--	7.6E+01	4.4E+00	--	--	4.4E+00
Cadmium	7440-43-9	--	7.9E+00	1.2E+00	--	--	1.2E+00
Chromium, total or trivalent (soluble salts)	7440-47-3	--	2.7E+01	6.0E-02	--	--	6.0E-02
Chromium, hexavalent	18540-29-9	--	5.0E+01	4.5E+04	--	--	5.0E+01
Cobalt	7440-48-4	4.8E+00	--	--	--	--	4.8E+00
Copper	7440-50-8	--	3.1E+00	1.4E+01	--	--	3.1E+00
Iron	7439-89-6	1.1E+04	--	--	--	--	1.1E+04
Lead	7439-92-1	--	8.1E+00	1.9E+01	--	--	8.1E+00
Manganese	7439-96-5	--	1.0E+02	--	--	--	1.0E+02
Mercury, inorganic	7439-97-6	--	2.5E-02	2.0E+00	2.9E-01	--	2.5E-02
Methylmercury	16056-34-1	--	3.0E-02	--	--	--	3.0E-02
Molybdenum	7439-98-7	8.0E+01	--	--	--	--	8.0E+01
Nickel	7440-02-0	--	8.2E+00	2.3E+03	--	--	8.2E+00
Selenium	7782-49-2	--	7.1E+01	3.9E+05	--	--	7.1E+01
Silver	7440-22-4	--	1.9E+00	5.5E+01	--	--	1.9E+00
Thallium	7440-28-0	--	6.2E-02	2.3E+01	--	--	6.2E-02
Tin	7440-31-5	9.6E+03	--	--	--	--	9.6E+03
Vanadium	7440-62-2	8.0E+01	--	--	--	--	8.0E+01
Zinc	7440-66-6	--	8.1E+01	7.7E+02	--	--	8.1E+01
Metals - Butyltins							
Monobutyltin	78763-54-9	--	--	--	--	--	NE
Dibutyltin	1002-53-5	--	--	--	--	--	NE
Tributyltin	36643-28-4	--	7.4E-03	--	--	--	7.4E-03
Tetrabutyltin	1461-25-2	--	--	--	--	--	NE
Semivolatile Organic Compounds (SVOCs) - Polycyclic Aromatic Hydrocarbons (PAHs)							
Acenaphthene	83-32-9	--	3.0E+01	5.3E+00	--	--	5.3E+00
Acenaphthylene	208-96-8	--	--	--	--	--	NE
Anthracene	120-12-7	--	1.0E+02	2.1E+00	--	--	2.1E+00
Benzo(a)anthracene	56-55-3	--	1.6E-04	1.9E-01	--	--	1.6E-04
Benzo(b)fluoranthene	205-99-2	--	1.6E-04	--	--	--	1.6E-04
Benzo(k)fluoranthene	207-08-9	--	1.6E-03	--	--	--	1.6E-03
Total benzofluoranthenes	--	--	--	--	--	--	NE
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	NE
Benzo(a)pyrene	50-32-8	--	1.6E-05	8.7E-02	--	--	1.6E-05
Chrysene	218-01-9	--	1.6E-02	1.9E-01	--	--	1.6E-02
Dibenz(a,h)anthracene	53-70-3	--	1.6E-05	6.8E-03	--	--	1.6E-05
Dibenzofuran	132-64-9	1.6E+01	--	--	--	--	1.6E+01
Fluoranthene	206-44-0	--	6.0E+00	1.8E+00	--	--	1.8E+00
Fluorene	86-73-7	--	1.0E+01	3.7E+00	--	--	3.7E+00
Indeno(1,2,3-c,d)pyrene	193-39-5	--	1.6E-04	9.1E-03	--	--	1.6E-04
Methyl isopropyl phenanthrene	483-65-8	--	--	--	--	--	NE
1-Methylnaphthalene	90-12-0	1.5E+00	--	--	--	--	1.5E+00
2-Methylnaphthalene	91-57-6	3.2E+01	--	--	--	--	3.2E+01
Naphthalene	91-20-3	--	1.4E+00	9.0E+01	8.9E+00	--	1.4E+00

Table 7.2
Groundwater Preliminary Screening Levels (µg/L)^{1,2}

		Potable Groundwater ⁴	Protection of Marine Surface Water ^{5,6}	Protection of Sediment ⁷	Protection of Indoor Air ⁸	Adjustment Factors	
		Lowest of MTCA Method A & B ²	Protective of Aquatic Life and Human Health via Organism-Only Consumption	Protective of the Lower of the Minimum ROD CUL & SMS Lower Tier	Protective of Indoor Air via Vapor Intrusion using standard MTCA B Calculation	Natural Background ⁹	
Chemical ³	CAS No.						Groundwater PSL ¹⁰
SVOCs - PAHs (cont.)							
Phenanthrene	85-01-8	--	--	--	--	--	NE
Pyrene	129-00-0	--	8.0E+00	2.0E+00	--	--	2.0E+00
Total LPAHs	--	--	--	--	--	--	NE
Total HPAHs	--	--	--	--	--	--	NE
Total PAHs	--	--	--	--	--	--	NE
cPAH TEQ ¹¹	--	--	1.6E-05	4.9E-03	--	--	1.6E-05
Other SVOCs							
Aniline	62-53-3	7.7E+00	--	--	--	--	7.7E+00
Azobenzene	103-33-3	8.0E-01	--	--	--	--	8.0E-01
Benzidine	92-87-5	--	2.3E-05	--	--	--	2.3E-05
Benzoic acid	65-85-0	6.4E+04	--	5.9E+02	--	--	5.9E+02
Benzyl alcohol	100-51-6	8.0E+02	--	--	--	--	8.0E+02
Bis(2-chloroethoxy)methane	111-91-1	--	--	--	--	--	NE
Bis(2-chloroethyl)ether	111-44-4	--	6.0E-02	3.8E+02	2.6E+01	--	6.0E-02
Bis(2-chloro-1-methylethyl)ether	108-60-1	--	1.0E+02	--	--	--	1.0E+02
2,6-Bis(1,1-dimethylethyl) phenol	128-39-2	--	--	--	--	--	NE
Bis(2-ethylhexyl) phthalate	117-81-7	--	4.6E-02	6.2E-01	--	--	4.6E-02
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	NE
Butyl benzyl phthalate	85-68-7	--	1.3E-02	2.4E-01	--	--	1.3E-02
Butyl diphenyl phosphate	2752-95-6	--	--	--	--	--	NE
Carbazole	86-74-8	--	--	--	--	--	NE
4-Chloroaniline	106-47-8	2.2E-01	--	2.3E+03	--	--	2.3E+03
4-Chloro-3-methylphenol	59-50-7	--	3.6E+01	--	--	--	3.6E+01
2-Chloronaphthalene	91-58-7	--	1.0E+02	--	--	--	1.0E+02
2-Chlorophenol	95-57-8	--	1.7E+01	2.9E+03	--	--	1.7E+01
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	NE
Dibutyl phthalate	84-74-2	--	8.0E+00	4.6E+01	--	--	8.0E+00
Dibutyl phenyl phosphate	2528-36-1	--	--	--	--	--	NE
1,2-Dichlorobenzene	95-50-1	--	8.0E+02	4.6E+00	2.6E+03	--	4.6E+00
1,3-Dichlorobenzene	541-73-1	--	2.0E+00	--	--	--	2.0E+00
1,4-Dichlorobenzene	106-46-7	--	6.0E+01	8.9E+00	4.9E+00	--	4.9E+00
3,3'-Dichlorobenzidine	91-94-1	--	3.3E-03	1.3E+02	--	--	3.3E-03
2,4-Dichlorophenol	120-83-2	--	1.0E+01	7.0E+03	--	--	1.0E+01
Diethyl phthalate	84-66-2	--	2.0E+02	9.3E+01	--	--	9.3E+01
Dimethyl phthalate	131-11-3	--	6.0E+02	--	--	--	6.0E+02
2,4-Dimethylphenol	105-67-9	--	9.7E+01	6.3E+00	--	--	6.3E+00
4,6-Dinitro-2-methylphenol	534-52-1	--	7.0E+00	--	--	--	7.0E+00
2,4-Dinitrophenol	51-28-5	--	1.0E+02	5.5E+05	--	--	1.0E+02
2,4-Dinitrotoluene	121-14-2	--	1.8E-01	1.1E+03	--	--	1.8E-01
2,6-Dinitrotoluene	606-20-2	5.8E-02	--	3.0E+02	--	--	3.0E+02
Di-n-octyl phthalate	117-84-0	1.6E+02	--	3.9E-03	--	--	3.9E-03
1,4-Dioxane	123-91-1	4.4E-01	--	--	--	--	4.4E-01
1,2-Diphenylhydrazine	122-66-7	--	2.0E-02	--	--	--	2.0E-02
Hexachlorobenzene	118-74-1	--	5.0E-06	1.4E-02	--	--	5.0E-06
Hexachlorobutadiene	87-68-3	--	1.0E-02	1.1E-02	8.1E-01	--	1.0E-02
Hexachlorocyclopentadiene	77-47-4	--	1.0E+00	2.7E+02	--	--	1.0E+00
Hexachloroethane	67-72-1	--	2.0E-02	6.2E+02	3.1E+00	--	2.0E-02
Isophorone	78-59-1	--	1.1E+02	6.0E+05	--	--	1.1E+02
2-Methoxynaphthalene	93-04-9	--	--	--	--	--	NE
2-Methylphenol	95-48-7	4.0E+02	--	2.7E+01	--	--	2.7E+01
4-Methylphenol	106-44-5	8.0E+02	--	--	--	--	8.0E+02
2-Nitroaniline	88-74-4	1.6E+02	--	--	--	--	1.6E+02
3-Nitroaniline	99-09-2	--	--	--	--	--	NE
4-Nitroaniline	100-01-6	--	--	--	--	--	NE
Nitrobenzene	98-95-3	--	1.0E+02	1.2E+05	1.6E+02	--	1.0E+02
2-Nitrophenol	88-75-5	--	--	--	--	--	NE
4-Nitrophenol	100-02-7	--	--	--	--	--	NE
n-Nitrosodimethylamine	62-75-9	--	3.4E-01	--	--	--	3.4E-01

Table 7.2
Groundwater Preliminary Screening Levels (µg/L)^{1,2}

Chemical ³	CAS No.	Potable Groundwater ⁴	Protection of Marine Surface Water ^{5,6}	Protection of Sediment ⁷	Protection of Indoor Air ⁸	Adjustment Factors	Groundwater PSL ¹⁰
		Lowest of MTCA Method A & B ²	Protective of Aquatic Life and Human Health via Organism-Only Consumption	Protective of the Lower of the Minimum ROD CUL & SMS Lower Tier	Protective of Indoor Air via Vapor Intrusion using standard MTCA B Calculation	Natural Background ⁹	
Other SVOCs (cont.)							
n-Nitrosodiphenylamine	86-30-6	--	6.9E-01	1.1E+00	--	--	6.9E-01
n-Nitrosodi-n-propylamine	621-64-7	--	5.8E-02	1.2E+02	--	--	5.8E-02
Pentachlorophenol	87-86-5	--	2.0E-03	8.8E-01	--	--	2.0E-03
Phenol	108-95-2	--	7.0E+04	3.7E+02	--	--	3.7E+02
Pyridine	110-86-1	8.0E+00	--	--	--	--	8.0E+00
1,2,4-Trichlorobenzene	120-82-1	--	3.7E-02	9.6E-01	3.9E+01	--	3.7E-02
2,4,5-Trichlorophenol	95-95-4	--	6.0E+02	5.7E+04	--	--	6.0E+02
2,4,6-Trichlorophenol	88-06-2	--	2.8E-01	5.9E+02	--	--	2.8E-01
Volatile Organic Compounds (VOCs)							
Acetone	67-64-1	7.2E+03	--	--	--	--	7.2E+03
Acrolein	107-02-8	--	1.1E+00	--	2.9E+00	--	1.1E+00
Acrylonitrile	107-13-1	--	2.8E-02	--	1.6E+01	--	2.8E-02
Benzaldehyde	100-52-7	8.0E+02	--	--	--	--	8.0E+02
Benzene	71-43-2	--	1.6E+00	--	2.4E+00	--	1.6E+00
Bromobenzene	108-86-1	6.4E+01	--	--	--	--	6.4E+01
Bromochloromethane	74-97-5	--	--	--	--	--	NE
Bromoethane	74-96-4	--	--	--	--	--	NE
Bromoform	75-25-2	--	1.2E+01	--	2.0E+02	--	1.2E+01
Bromomethane	74-83-9	--	2.7E+02	--	1.3E+01	--	1.3E+01
2-Butoxyethanol	111-76-2	8.0E+02	--	--	--	--	8.0E+02
n-Butylbenzene	104-51-8	4.0E+02	--	--	--	--	4.0E+02
sec-Butylbenzene	135-98-8	8.0E+02	--	--	--	--	8.0E+02
tert-Butylbenzene	98-06-6	8.0E+02	--	--	--	--	8.0E+02
Carbon disulfide	75-15-0	8.0E+02	--	--	4.0E+02	--	4.0E+02
Carbon tetrachloride	56-23-5	--	3.5E-01	--	5.6E-01	--	3.5E-01
Chlorobenzene	108-90-7	--	2.0E+02	--	2.9E+02	--	2.0E+02
Chloroethane	75-00-3	--	--	--	1.9E+04	--	1.9E+04
2-Chloroethyl vinyl ether	110-75-8	--	--	--	--	--	NE
Chloroform	67-66-3	--	1.5E+02	--	1.2E+00	--	1.2E+00
Chloromethane	74-87-3	--	--	--	1.5E+02	--	1.5E+02
3-Chloro-1-propene	107-05-1	2.1E+00	--	--	--	--	2.1E+00
2-Chlorotoluene	95-49-8	1.6E+02	--	--	--	--	1.6E+02
4-Chlorotoluene	106-43-4	--	--	--	--	--	NE
Dibromochloromethane	124-48-1	--	2.2E+00	--	4.5E+00	--	2.2E+00
1,2-Dibromo-3-chloropropane	96-12-8	2.0E-01	--	--	--	--	2.0E-01
Dibromomethane	74-95-3	8.0E+01	--	--	--	--	8.0E+01
Dichlorobromomethane	75-27-4	--	2.8E+00	--	1.8E+00	--	1.8E+00
trans-1,4-Dichloro-2-butene	110-57-6	--	--	--	--	--	NE
Dichlorodifluoromethane	75-71-8	--	--	--	5.6E+00	--	5.6E+00
1,1-Dichloroethane	75-34-3	--	--	--	1.1E+01	--	1.1E+01
1,2-Dichloroethane	107-06-2	--	7.3E+01	--	4.2E+00	--	4.2E+00
1,1-Dichloroethylene	75-35-4	--	4.0E+03	--	1.3E+02	--	1.3E+02
cis-1,2-Dichloroethylene	156-59-2	1.6E+01	--	--	--	--	1.6E+01
trans-1,2-Dichloroethylene	156-60-5	--	1.0E+03	--	--	--	1.0E+03
1,2-Dichloroethylene (mixed isomers)	540-59-0	7.2E+01	--	--	--	--	7.2E+01
1,2-Dichloropropane	78-87-5	--	3.1E+00	--	1.0E+00	--	1.0E+00
1,3-Dichloropropane	142-28-9	--	--	--	--	--	NE
2,2-Dichloropropane	594-20-7	--	--	--	--	--	NE
1,1-Dichloropropene	563-58-6	--	--	--	--	--	NE
cis-1,3-Dichloropropene	10061-01-5	--	2.0E+00	--	--	--	2.0E+00
trans-1,3-Dichloropropene	10061-02-6	--	2.0E+00	--	--	--	2.0E+00
Ethane	74-84-0	--	--	--	--	--	NE
Ethylbenzene	100-41-4	--	3.1E+01	--	2.8E+03	--	3.1E+01
Ethylene	74-85-1	--	--	--	--	--	NE
Ethyl ether	60-29-7	1.6E+03	--	--	--	--	1.6E+03
Ethylene dibromide	106-93-4	--	--	--	2.7E-01	--	2.7E-01
Formaldehyde	50-00-0	1.6E+03	--	--	--	--	1.6E+03

Table 7.2
Groundwater Preliminary Screening Levels (µg/L)^{1,2}

Chemical ³	CAS No.	Potable Groundwater ⁴	Protection of Marine Surface Water ^{5,6}	Protection of Sediment ⁷	Protection of Indoor Air ⁸	Adjustment Factors	Groundwater PSL ¹⁰
		Lowest of MTCA Method A & B ²	Protective of Aquatic Life and Human Health via Organism-Only Consumption	Protective of the Lower of the Minimum ROD CUL & SMS Lower Tier	Protective of Indoor Air via Vapor Intrusion using standard MTCA B Calculation	Natural Background ⁹	
VOCs (cont.)							
2-Hexanone	591-78-6	4.0E+01	--	--	--	--	4.0E+01
Isopropylbenzene	98-82-8	8.0E+02	--	--	7.2E+02	--	7.2E+02
4-Isopropyltoluene	99-87-6	--	--	--	--	--	NE
Methane	74-82-8	--	--	--	--	--	NE
Methyl ethyl ketone	78-93-3	4.8E+03	--	--	1.7E+06	--	1.7E+06
Methyl iodide	74-88-4	--	--	--	--	--	NE
Methyl isobutyl ketone	108-10-1	6.4E+02	--	--	4.7E+05	--	4.7E+05
Methyl tert-butyl ether	1634-04-4	2.0E+01	--	--	6.0E+02	--	6.0E+02
Methylene chloride	75-09-2	--	1.0E+02	--	4.4E+03	--	1.0E+02
2-Pentanone	107-87-9	--	--	--	--	--	NE
n-Propylbenzene	103-65-1	8.0E+02	--	--	--	--	8.0E+02
Styrene	100-42-5	1.6E+03	--	--	8.2E+03	--	8.2E+03
1,1,1,2-Tetrachloroethane	630-20-6	1.7E+00	--	--	7.4E+00	--	7.4E+00
1,1,2,2-Tetrachloroethane	79-34-5	--	3.0E-01	--	6.2E+00	--	3.0E-01
Tetrachloroethylene	127-18-4	--	2.9E+00	--	2.4E+01	--	2.9E+00
Toluene	108-88-3	--	1.3E+02	--	1.5E+04	--	1.3E+02
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	--	NE
1,1,1-Trichloroethane	71-55-6	--	5.0E+04	--	5.5E+03	--	5.5E+03
1,1,2-Trichloroethane	79-00-5	--	9.0E-01	--	4.6E+00	--	9.0E-01
Trichloroethylene	79-01-6	--	7.0E-01	--	1.5E+00	--	7.0E-01
Trichlorofluoroethane	27154-33-2	--	--	--	--	--	NE
Trichlorofluoromethane	75-69-4	2.4E+03	--	--	--	--	2.4E+03
1,2,3-Trichloropropane	96-18-4	1.5E-03	--	--	--	--	1.5E-03
Trichlorotrifluoroethane	76-13-1	2.4E+05	--	--	1.8E+02	--	1.8E+02
1,2,3-Trimethylbenzene	526-73-8	8.0E+01	--	--	--	--	8.0E+01
1,2,4-Trimethylbenzene	95-63-6	8.0E+01	--	--	2.4E+02	--	2.4E+02
1,3,5-Trimethylbenzene	108-67-8	8.0E+01	--	--	--	--	8.0E+01
Vinyl acetate	108-05-4	8.0E+03	--	--	7.8E+03	--	7.8E+03
Vinyl chloride	75-01-4	--	1.8E-01	--	3.5E-01	--	1.8E-01
m-Xylene	108-38-3	1.6E+03	--	--	3.0E+02	--	3.0E+02
m,p-Xylene	179601-23-1	1.6E+03	--	--	--	--	1.6E+03
o-Xylene	95-47-6	1.6E+03	--	--	4.3E+02	--	4.3E+02
Total xylenes	1330-20-7	8.0E+02	--	--	3.3E+02	--	3.3E+02
Petroleum Hydrocarbons							
Gasoline-range hydrocarbons ¹³	--	8.0E+02	--	--	--	--	8.0E+02
Diesel-range hydrocarbons	--	5.0E+02	--	--	--	--	5.0E+02
Oil-range hydrocarbons	--	5.0E+02	--	--	--	--	5.0E+02
Pesticides							
Aldrin	309-00-2	--	4.1E-08	1.1E-04	3.2E-01	--	4.1E-08
alpha-BHC	319-84-6	--	4.8E-05	4.0E+00	--	--	4.8E-05
beta-BHC	319-85-7	--	1.4E-03	1.1E+01	--	--	1.4E-03
delta-BHC	319-86-8	--	--	--	--	--	NE
gamma-BHC	58-89-9	--	1.3E-01	3.0E+01	--	--	1.3E-01
cis-Chlordane	5103-71-9	--	3.6E-04	TBD	--	--	3.6E-04
trans-Chlordane	5103-74-2	--	3.6E-04	TBD	--	--	3.6E-04
Chlordane	57-74-9	--	2.2E-05	TBD	--	--	2.2E-05
Chlorpyrifos	2921-88-2	--	5.6E-03	--	--	--	5.6E-03
4,4'-DDD	72-54-8	--	7.9E-06	4.1E+00	--	--	7.9E-06
4,4'-DDE	72-55-9	--	8.8E-07	1.5E+00	--	--	8.8E-07
4,4'-DDT	50-29-3	--	1.2E-06	7.8E-06	--	--	1.2E-06
Total DDD	--	--	1.0E-03	4.1E+00	--	--	1.0E-03
Total DDE	--	--	1.0E-03	1.5E+00	--	--	1.0E-03
Total DDT	--	--	1.0E-03	7.8E-06	--	--	7.8E-06
Diazinon	333-41-5	1.1E+01	--	--	--	--	1.1E+01
Dieldrin	60-57-1	--	1.2E-06	2.1E-04	--	--	1.2E-06
Endosulfan I	959-98-8	--	8.7E-03	2.6E+04	--	--	8.7E-03
Endosulfan II	33213-65-9	--	8.7E-03	2.6E+04	--	--	8.7E-03
Endosulfan sulfate	1031-07-8	--	1.0E+01	--	--	--	1.0E+01

Table 7.2
Groundwater Preliminary Screening Levels (µg/L)^{1,2}

Chemical ³	CAS No.	Potable Groundwater ⁴	Protection of Marine Surface Water ^{5,6}	Protection of Sediment ⁷	Protection of Indoor Air ⁸	Adjustment Factors	Groundwater PSL ¹⁰
		Lowest of MTCA Method A & B ²	Protective of Aquatic Life and Human Health via Organism-Only Consumption	Protective of the Lower of the Minimum ROD CUL & SMS Lower Tier	Protective of Indoor Air via Vapor Intrusion using standard MTCA B Calculation	Natural Background ⁹	
Pesticides (cont.)							
Endrin	72-20-8	--	2.0E-03	2.5E+02	--	--	2.0E-03
Endrin aldehyde	7421-93-4	--	3.5E-02	--	--	--	3.5E-02
Endrin ketone	53494-70-5	--	--	--	--	--	NE
Heptachlor	76-44-8	--	3.4E-07	5.5E-04	--	--	3.4E-07
Heptachlor epoxide	1024-57-3	--	2.4E-06	TBD	--	--	2.4E-06
Malathion	121-75-5	--	1.0E-01	--	--	--	1.0E-01
Methoxychlor	72-43-5	--	2.0E-02	5.6E+02	--	--	2.0E-02
Mirex	2385-85-5	--	1.0E-03	--	--	--	1.0E-03
Nonachlor	3734-49-4	--	--	--	--	--	NE
Toxaphene	8001-35-2	--	3.2E-05	4.3E-01	--	--	3.2E-05

- Notes:
- Not available.
 - NA Not applicable; the labs surveyed did not identify a PQL value for a chemical.
 - NE Not established; this chemical is not regulated in groundwater, surface water, or sediment.
 - PQL Consistent with Ecology 2018a, the target sediment concentration will be set to natural background, if available, or the PQL. If neither value is available, the target sediment concentration is noted as “PQL.”
 - TBD When the target SMS sediment concentration is listed as “PQL,” it is not possible to calculate numerical groundwater SLs for protection of sediment. In these cases, the groundwater SL is listed as “TBD” (to be determined).
 - 1 SLs presented in this table are consistent with groundwater PCULs presented in Ecology 2018a. Groundwater at the site is not potable; therefore, PCULs developed for sites with potable groundwater have generally been omitted, except as described in Note 4.
 - 2 SLs have been rounded to two significant digits.
 - 3 Not all chemicals included in this table are chemicals requiring SLs at the site. Chemicals requiring SLs will be determined in coordination with the regulating agency at a later date.
 - 4 Potable groundwater SLs are the lowest of the MTCA Method A and Method B groundwater criteria, including consideration of both carcinogenic and non-carcinogenic modes of action. Method B groundwater criteria have been adjusted for cancer effects as appropriate, as performed by Ecology in Ecology 2018a. Groundwater is not a current or future drinking water source and the highest beneficial use of groundwater is discharge to surface water. Surface water at the Site is marine water and is non-potable. Therefore, MTCA Method A and B groundwater criteria are included only for chemicals that lack SLs for surface water.
 - 5 SLs for protection of marine surface water based on MTCA Method B surface water criteria were calculated by Ecology and presented in the LDW PCUL Workbook (Ecology 2018a). MTCA Method B surface water criteria were calculated using MTCA Surface Water Equations 730-1 and 730-2 and toxicity values in the CLARC database. The fish consumption rate was adjusted to 97.5 grams per day and the fish diet fraction was adjusted to 1 (Ecology 2016), consistent with the LDW ROD.
 - 6 The SL presented in this column was developed by Ecology as presented in Ecology 2018a and is the minimum of the following criteria: (1) Washington Surface Water Quality Standards; WAC 173-201A, Surface Water Quality Criteria (2) USEPA National Recommended Water Quality Criteria, Clean Water Act Section 304 or (3) National Toxics Rule 40 CFR 131.45. SLs for protection of surface water are protective of aquatic life, considering both acute and chronic exposure in a marine waterbody. SLs are also protective of human health, considering exposure via organism-only consumption. When promulgated water quality criteria for protection of aquatic life were not available, Ecology utilized literature to estimate concentrations protective of aquatic life consistent with WAC 173-340-730(3)(b)(ii).
 - 7 SLs protective of sediment were calculated by Ecology using MTCA Equation 747-1 (three-phase equilibrium partitioning) modified for equilibrium partitioning between sediment and groundwater (Ecology 2018a). Target sediment concentrations used to calculate the groundwater SLs included in this table are the minimum of the sediment CULs in the ROD, when available. The ROD includes six different sediment CULs, which are applicable to different remedial action objectives and sediment depth horizons. For some sites, the regulating agency may determine the minimum sediment CULs in the ROD are not applicable. For chemicals not listed in the ROD, the target sediment concentrations are consistent with the SMS sediment cleanup objective, which may be expressed as a dry weight equivalent. Target sediment concentrations are protective of human contact under the scenarios defined in LDWG’s (2010)
 - 8 Groundwater SLs for vapor intrusion were calculated per Ecology’s 2018 guidance, as updated (Appendix B of Ecology 2018c).
 - 9 The natural background concentration for arsenic in ground water is the concentration of arsenic in the Puget Sound Basin (Ecology 2018a). Proposal of natural background concentrations for other chemicals may be appropriate per WAC 173-340-709.
 - 10 The PSL is based on the lowest of the ARARs for site groundwater, which include federal and state marine surface water concentrations protective of aquatic life and human health from consumption of seafood. For chemicals for which surface water criteria are not available, the PSL is based on protection of groundwater as drinking water (see Note 4).
 - 11 Representative PQLs were not provided for dioxin/furan TEQ or for total cPAH TEQ. PQLs provided for 2,3,7,8-TCDD and benzo(a)pyrene TEQ, respectively, were used as surrogates.
 - 12 Metals criteria may apply to either the dissolved metals fraction or total metals fraction. For metals for which the basis of the PSL is a promulgated surface water criterion, the applicable fraction is identified in the surface water regulation. Subsequent evaluation of groundwater data relative to the PSL will be performed relative to the fraction regulated in surface water.
 - 13 MTCA Method A SL for gasoline-range petroleum hydrocarbons is 800 µg/L if benzene is present. If benzene is not present, the MTCA Method A SL (and PSL) is 1,000 µg/L.

Abbreviations:	
ARAR Applicable or Relevant and Appropriate Requirement	MTCA Model Toxics Control Act
BHC Beta-hexachlorocyclohexane	PCUL Preliminary cleanup level
CAS Chemical Abstracts Service	PQL Practical Quantitation Limit
CFR Code of Federal Regulation	PSL Preliminary screening level
CLARC Cleanup Levels and Risk Calculation	ROD Record of Decision
cPAH Carcinogenic polycyclic aromatic hydrocarbon	SL Screening level
CUL Cleanup level	SMS Sediment Management Standards
DDD Dichlorodiphenyldichloroethane	TCDD Tetrachlorodibenzodioxin
DDE Dichlorodiphenyldichloroethylene	TEQ Toxic equivalent
DDT Dichlorodiphenyltrichloroethane	USEPA U.S. Environmental Protection Agency
HPAH High molecular weight polycyclic aromatic hydrocarb	WAC Washington Administrative Code
LDW Lower Duwamish Waterway	
LDWG Lower Duwamish Waterway Group	
LPAH Low molecular weight polycyclic aromatic hydrocarbon	
µg/L Micrograms per liter	

Table 7.3
Frequency of Exceedance for Chemicals Detected in Vadose Zone Soil (mg/kg)¹

Chemical	CAS No.	Information about Dataset: 1984 to Present						Information about Detected Exceedances			
		Number of Results	Percent Detected	Information about Maximum Detection				Vadose Zone Soil PSL ³	Percent That Exceed PSL	Exceedance Factor ⁴	Preliminary COPC?
				Result ²	Location	Date	Depth				
Polychlorinated Biphenyls (PCBs)											
PCBs (Total, Aroclors) ⁵	1336-36-3	83	54%	14	84-2	06/12/1984	1.5–3 feet bgs	0.000043	54%	330,000	Yes.
Metals											
Arsenic	7440-38-2	54	69%	15	84-1	06/12/1984	4–6 feet bgs	7	17%	2.1	Yes.
Cadmium	7440-43-9	60	72%	6.1	PGG-7	06/05/2006	0.5–2 feet bgs	0.77	32%	7.9	Yes.
Chromium	7440-47-3	60	100%	180	MW-10	10/09/1991	8.5 feet bgs	48	20%	3.8	Yes.
Copper	7440-50-8	33	100%	160	DUD_31C	08/17/2005	0–3 centimeters bgs	36	30%	4.4	Yes.
Lead	7439-92-1	60	90%	170	84-1	06/12/1984	4–6 feet bgs	50	17%	3.4	Yes.
Manganese	7439-96-5	6	100%	640	BS-4	12/03/2012	0–6 inches bgs	1,100	None	None	No; no exceedances.
Mercury	7439-97-6	51	53%	1.1	MW-10	10/09/1991	8.5 feet bgs	0.07	45%	16	Yes.
Nickel	7440-02-0	28	96%	70	MW-7	10/08/1991	8.5 feet bgs	48	3.6%	1.5	Yes.
Silver	7440-22-4	16	31%	11	MW-10	10/09/1991	8.5 feet bgs	0.32	31%	34	Yes.
Thallium	7440-28-0	13	92%	26	MW-14	10/08/1991	8.5 feet bgs	0.088	92%	300	Yes.
Zinc	7440-66-6	60	100%	460	PGG-7	06/05/2006	0.5–2 feet bgs	86	25%	5.3	Yes.
Semivolatile Organic Compounds (SVOCs) - Polycyclic Aromatic Hydrocarbons (PAHs)											
Acenaphthene	83-32-9	32	9%	0.16	BS-3	12/03/2012	0–6 inches bgs	0.5	None	None	No; no exceedances.
Acenaphthylene	208-96-8	32	3.1%	0.011	BS-3	12/03/2012	0–6 inches bgs	1.3	None	None	No; no exceedances.
Anthracene	120-12-7	32	25%	0.26	BS-3	12/03/2012	0–6 inches bgs	0.96	None	None	No; no exceedances.
Benzo(a)anthracene	56-55-3	32	53%	0.4	BS-3	12/03/2012	0–6 inches bgs	0.0011	53%	360	No; empirical groundwater data demonstration; see note 6.
Benzo(b)fluoranthene	205-99-2	26	62%	0.23	PGG-5	06/05/2006	5–6.5 feet bgs	0.0039	62%	58	
Benzo(k)fluoranthene	207-08-9	23	61%	0.23	PGG-5	06/05/2006	5–6.5 feet bgs	0.039	13%	6	
Benzofluoranthenes (total)	56832-73-6	9	56%	0.58	BS-3	12/03/2012	0–6 inches bgs	3.2	None	None	No; no exceedances.
Benzo(g,h,i)perylene	191-24-2	32	22%	0.2	BS-3	12/03/2012	0–6 inches bgs	0.67	None	None	No; no exceedances.
Benzo(a)pyrene	50-32-8	32	50%	0.4	BS-3	12/03/2012	0–6 inches bgs	0.00031	50%	1,300	No; empirical groundwater data demonstration; see note 6.
Chrysene	218-01-9	32	56%	0.54	BS-3	12/03/2012	0–6 inches bgs	0.13	9%	4.2	
Dibenzo(a,h)anthracene	53-70-3	32	9%	0.071	BS-3	12/03/2012	0–6 inches bgs	0.00057	9%	124	
Dibenzofuran	132-64-9	8	25%	0.088	BS-3	12/03/2012	0–6 inches bgs	0.54	None	None	No; no exceedances.
Fluoranthene	206-44-0	32	44%	0.8	BS-3	12/03/2012	0–6 inches bgs	1.7	None	None	No; no exceedances.
Fluorene	86-73-7	32	19%	0.18	BS-3	12/03/2012	0–6 inches bgs	0.54	None	None	No; no exceedances.
Indeno(1,2,3-c,d)pyrene	193-39-5	32	25%	0.2	BS-3	12/03/2012	0–6 inches bgs	0.011	22%	18	No; empirical groundwater data demonstration; see note 6.
1-Methylnaphthalene	90-12-0	18	11%	0.079	BS-3	12/03/2012	0–6 inches bgs	18	None	None	No; no exceedances.
2-Methylnaphthalene	91-57-6	20	15%	0.098	BS-3	12/03/2012	0–6 inches bgs	0.67	None	None	No; no exceedances.
Naphthalene	91-20-3	32	13%	0.18	BS-3	12/03/2012	0–6 inches bgs	0.039	3.1%	4.6	No; empirical groundwater data demonstration; see note 6.
Phenanthrene	85-01-8	32	44%	0.98	BS-3	12/03/2012	0–6 inches bgs	1.5	None	None	No; no exceedances.
Pyrene	129-00-0	32	53%	0.93	BS-3	12/03/2012	0–6 inches bgs	2.6	None	None	No; no exceedances.
Total LPAH ⁷	--	8	63%	1.8	BS-3	12/03/2012	0–6 inches bgs	5.2	None	None	No; no exceedances.
Total HPAH ⁸	--	8	50%	4.1	BS-3	12/03/2012	0–6 inches bgs	12	None	None	No; no exceedances.
Total PAH	--	9	44%	6.1	BS-3	12/03/2012	0–6 inches bgs	NE	NA	NA	No; no exceedances.
cPAH TEQ ⁹	--	32	63%	0.3	PGG-5	06/05/2006	5–6.5 feet bgs	0.09	59%	3.3	Yes.

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Table 7.3 Soil - Vadose Zone FOE for PA - Detections - 2018-1212.xlsx

Table 7.3
Frequency of Exceedance for Chemicals Detected in Vadose Zone Soil (mg/kg)¹

Chemical	CAS No.	Information about Dataset: 1984 to Present						Information about Detected Exceedances			
		Number of Results	Percent Detected	Information about Maximum Detection				Vadose Zone Soil PSL ³	Percent That Exceed PSL	Exceedance Factor ⁴	Preliminary COPC?
				Result ²	Location	Date	Depth				
Other SVOCs											
Benzoic acid	65-85-0	2	100%	0.85	DUD_30C	08/17/2005	0–3 centimeters bgs	0.65	50%	1.3	No; see note 10.
bis(2-ethylhexyl)phthalate	117-81-7	2	100%	0.14	DUD_30C	08/17/2005	0–3 centimeters bgs	0.1	50%	1.4	No; see note 11.
Butyl benzyl phthalate	85-68-7	2	50%	0.061	DUD_31C	08/17/2005	0–3 centimeters bgs	0.0036	50%	17	No; see note 11.
Dibutyl phthalate	84-74-2	2	100%	0.038	DUD_30C	08/17/2005	0–3 centimeters bgs	0.28	None	None	No; no exceedances.
1,2-Dichlorobenzene	95-50-1	2	50%	0.0072	DUD_30C	08/17/2005	0–3 centimeters bgs	0.036	None	None	No; no exceedances.
Phenol	108-95-2	2	100%	1.3	DUD_30C	08/17/2005	0–3 centimeters bgs	0.42	50%	3.1	No; see note 10.
Volatile Organic Compounds (VOCs)											
Ethylbenzene	100-41-4	23	17%	0.048	MW-8	10/10/1991	6 feet bgs	0.26	None	None	No; no exceedances.
Toluene	108-88-3	23	8.7%	0.01	MW-10	10/09/1991	8.5 feet bgs	0.92	None	None	No; no exceedances.
Xylene (total)	1330-20-7	23	17%	0.11	MW-8	10/10/1991	6 feet bgs	9	None	None	No; no exceedances.
Total Petroleum Hydrocarbons (TPH) ¹²											
Gasoline-range organics ¹³	--	45	6.7%	94	EP-3	06/13/1990	8 feet bgs	100	None	None	No; no exceedances.
Diesel-range organics	--	88	32%	530	C-3	08/16/1990	7.5–9 feet bgs	200	5.7%	2.7	Yes.
Oil-range organics	--	9	44%	670	PGG-7	06/05/2006	0.5–2 feet bgs	2,000	None	None	No; no exceedances.

Notes:

Bold Red	Exceeds PCUL; not likely to become a COPC.
Bold Red	May become COPC based on existing soil and groundwater data.

-- Not available.
NA Not applicable.

- 1 Only chemicals detected in vadose zone soil are included in this table. Chemicals that were not detected in vadose zone soil are presented in Table 7.5. Chemicals that were not analyzed for in vadose zone soil are presented in Table 7.8. Samples are considered vadose zone soil if the sampled depth interval is within 0 to 9 feet bgs. Samples collected at depths of 9 feet bgs are considered saturated soil samples. The five samples at exactly 9 feet bgs were not included in the vadose dataset, they are in the saturated dataset.
- 2 Results have been rounded to two significant figures.
- 3 PSLs for vadose soil were developed and presented in Table 7.1.
- 4 The exceedance factor is calculated by dividing the maximum detected value by the PSL. Only values greater than one (indicating an exceedance of the PSL) are displayed. Exceedance factors have been rounded to two significant figures.
- 5 Results are summed and compared to the total PCB PSL. If no Aroclors are detected, the summed total PCB value is the greatest detection limit.
- 6 The most stringent soil PSL is protective of groundwater. Compliance for the soil-to-groundwater pathway is empirically demonstrated in accordance with WAC 173-340-747(3)(f): individual PAHs were not identified as COPCs in groundwater (refer to Tables 7.7 and 7.8). The maximum detected result in soil is in compliance with screening levels developed for protection of sediment and protection of site receptors via direct contact. Note that for cPAHs, WAC 173-340-708(8)(e) requires that mixtures of cPAHs be considered a single hazardous substance when determining compliance with direct contact PSLs.
- 7 Total LPAH is the total of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene; 2-methylnaphthalene is not included in the sum of LPAHs.
- 8 Total HPAH is the total of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(a)fluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
- 9 Calculation of cPAH TEQ concentrations is performed using the California Environmental Protection Agency 2005 TEFs as presented in Table 708-2 of WAC 173-340-900. Calculation is performed using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.
- 10 PSLs are based on protection of sediment; however, this chemical is naturally occurring in sediment.
- 11 Not related to site activities, the CSOs nearby are likely the source to sediments and therefore not retained as a preliminary COPC.
- 12 The PSL for TPH is protective of a pathway that is not active at the site. Site-specific screening/cleanup levels may need to be developed for any TPH fraction that requires further consideration as a COPC.
- 13 Benzene was non-detect in all vadose zone soil samples (refer to Table 7.5); therefore, the PSL has been adjusted to the MTCA Method A SL of 100 mg/kg, for use when benzene is not present.

Abbreviations:

bgs	Below ground surface	MTCA	Model Toxics Control Act
CAS	Chemical Abstracts Service	PCUL	Preliminary cleanup level
COPC	Contaminant of Potential Concern	PSL	Preliminary Screening Level
cPAH	Carcinogenic polycyclic aromatic hydrocarbon	TEF	Toxic equivalent factor
CSO	Combined sewer overflow	TEQ	Toxic equivalent
HPAH	High molecular weight polycyclic aromatic hydrocarbon	WAC	Washington Administrative Code
LPAH	Low molecular weight polycyclic aromatic hydrocarbon		
mg/kg	Milligrams per kilogram		

Table 7.4
Frequency of Exceedance for Chemicals Detected in Saturated Zone Soil (mg/kg)¹

Chemical	CAS No.	Information about Dataset: 1984 to Present						Information about Detected Exceedances			
		Number of Results	Percent Detected	Information about Maximum Detection				Saturated Soil PSL ³	Percent That Exceed PSL	Exceedance Factor ⁴	Preliminary COPC?
				Result ²	Location	Date	Depth				
Polychlorinated Biphenyls (PCBs)											
Total PCBs (as Aroclors) ⁵	--	59	68%	140	B-12	11/1/2013 ¹⁰	10-13.8 feet bgs	0.0000022	67%	64,000,000	Yes.
Metals											
Arsenic	7440-38-2	58	97%	75	B-12	11/1/2013 ¹⁰	10-13.8 feet bgs	7	43%	11	Yes.
Cadmium	7440-43-9	58	97%	19	B-12	11/1/2013 ¹⁰	10-13.8 feet bgs	0.77	32%	25	Yes.
Chromium (total)	7440-47-3	58	100%	1,600	B-12	11/1/2013 ¹⁰	10-13.8 feet bgs	48	18%	33	Yes.
Copper	7440-50-8	14	100%	1,100	B-12	11/1/2013 ¹⁰	10-13.8 feet bgs	36	25%	31	Yes.
Lead	7439-92-1	58	100%	1,100	B-12	11/1/2013 ¹⁰	10-13.8 feet bgs	50	27%	22	Yes.
Mercury	7439-97-6	48	77%	3.6	B-17	11/1/2013 ¹⁰	10-11.5 feet bgs	0.07	39%	51	Yes.
Nickel	7440-02-0	14	100%	85	PGG-2	06/05/2006	9–10.5 feet bgs	48	8.3%	1.8	Yes.
Thallium	7440-28-0	4	50%	20	MW-7	10/08/1991	13 feet bgs	0.0044	100%	4,500	Yes.
Zinc	7440-66-6	58	100%	2,500	B81-1 B1	7/20/1981 6/12/1984	11 feet bgs 11 feet bgs	85	29%	29	Yes.
Semivolatile Organic Compounds (SVOCs) - Polycyclic Aromatic Hydrocarbons (PAHs)											
Acenaphthene	83-32-9	12	8.3%	0.064	MW-7	10/08/1991	13 feet bgs	0.028	8.3%	2.3	No; empirical groundwater data demonstration; see note 6.
Anthracene	120-12-7	12	25%	0.034	MW-7	10/08/1991	13 feet bgs	0.051	None	None	No; no exceedances.
Benzo(a)anthracene	56-55-3	12	42%	0.2	PGG-2	06/05/2006	9–10.5 feet bgs	0.000057	42%	3,500	No; empirical groundwater data demonstration; see note 6.
Benzo(b)fluoranthene	205-99-2	12	42%	0.31	PGG-2	06/05/2006	9–10.5 feet bgs	0.0002	42%	1,600	
Benzo(k)fluoranthene	207-08-9	12	25%	0.25	PGG-2	06/05/2006	9–10.5 feet bgs	0.002	25%	130	
Benzo(g,h,i)perylene	191-24-2	12	17%	0.021	PGG-5	06/05/2006	10–11.5 feet bgs	0.67	None	None	No; no exceedances.
Benzo(a)pyrene	50-32-8	12	42%	0.4	PGG-2	06/05/2006	9–10.5 feet bgs	0.000016	42%	25,000	No; empirical groundwater data demonstration; see note 6.
Chrysene	218-01-9	12	42%	0.48	PGG-2	06/05/2006	9–10.5 feet bgs	0.0064	42%	75	
Fluoranthene	206-44-0	12	42%	0.49	PGG-2	06/05/2006	9–10.5 feet bgs	0.09	17%	5.4	
Fluorene	86-73-7	12	17%	0.13	PGG-2	06/05/2006	9–10.5 feet bgs	0.029	17%	4.5	
Indeno(1,2,3-c,d)pyrene	193-39-5	12	33%	0.16	PGG-2	06/05/2006	9–10.5 feet bgs	0.00056	33%	290	No; no exceedances.
1-Methylnaphthalene	90-12-0	10	10%	0.12	PGG-2	06/05/2006	9–10.5 feet bgs	18	None	None	
2-Methylnaphthalene	91-57-6	10	10%	0.17	PGG-2	06/05/2006	9–10.5 feet bgs	0.67	None	None	
Naphthalene	91-20-3	12	17%	0.079	PGG-2	06/05/2006	9–10.5 feet bgs	0.0021	17%	38	No; empirical groundwater data demonstration; see note 6.
Phenanthrene	85-01-8	12	42%	0.2	PGG-2	06/05/2006	9–10.5 feet bgs	1.5	None	None	No; no exceedances.
Pyrene	129-00-0	12	50%	1.1	PGG-2	06/05/2006	9–10.5 feet bgs	0.14	8.3%	7.9	No; empirical groundwater data demonstration; see note 6.
cPAH TEQ ⁷	--	12	50%	0.5	PGG-2	06/05/2006	9–10.5 feet bgs	0.0000022	50%	230,000	Yes.
Volatile Organic Compounds (VOCs)											
Toluene	108-88-3	12	8.3%	0.006	MW-8	10/09/1991	11 feet bgs	0.055	None	None	No; no exceedances.

Table 7.4
Frequency of Exceedance for Chemicals Detected in Saturated Zone Soil (mg/kg)¹

Chemical	CAS No.	Information about Dataset: 1984 to Present						Information about Detected Exceedances			
		Number of Results	Percent Detected	Information about Maximum Detection				Saturated Soil PSL ³	Percent That Exceed PSL	Exceedance Factor ⁴	Preliminary COPC?
				Result ²	Location	Date	Depth				
Total Petroleum Hydrocarbons (TPH) ⁸											
Gasoline-range organics ⁹	--	14	14%	17	PGG-2	06/05/2006	9–10.5 feet bgs	100	None	None	No; no exceedances.
Diesel-range organics	--	18	39%	4,100	PGG-2	06/05/2006	9–10.5 feet bgs	200	11%	21	Yes.
Oil-range organics	--	10	40%	4,900	PGG-2	06/05/2006	9–10.5 feet bgs	2,000	10%	2.5	Yes.

Notes:

Bold Red	Exceeds PCUL; groundwater demonstrates compliance.
Bold Red	May become COPC based on existing soil and groundwater data.

-- Not available.

NA Not applicable.

- 1 Only chemicals detected in saturated soil are included in this table. Chemicals that were not detected in saturated soil are presented in Table 7.5. Chemicals that were not analyzed for in saturated soil are presented in Table 7.8. Samples are considered saturated soil if collected at depths of 9 feet bgs or deeper.
- 2 Results have been rounded to two significant figures.
- 3 PSLs for saturated soil were developed and presented in Table 7.1.
- 4 The exceedance factor is calculated by dividing the maximum detected value by the PSL. Only values greater than one (indicating an exceedance of the PSL) are displayed. Exceedance factors have been rounded to two significant figures.
- 5 Results are summed and compared to the total PCB PSL. If no Aroclors are detected, the summed total PCB value is the greatest detection limit.
- 6 The most stringent soil PSL is protective of groundwater. Compliance for the soil-to-groundwater pathway is empirically demonstrated in accordance with WAC 173-340-747(3)(f): individual PAHs were not identified as COPCs in groundwater (refer to Tables 7.7 and 7.8). The maximum detected result in soil is in compliance with SLs developed for protection of sediment and protection of site receptors via direct contact. Note that for cPAHs, WAC 173-340-708(8)(e) requires that mixtures of cPAHs be considered a single hazardous substance when determining compliance with direct contact PSLs.
- 7 Calculation of cPAH TEQ concentrations is performed using the California Environmental Protection Agency 2005 TEFs as presented in Table 708-2 of WAC 173-340-900. Calculation is performed using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.
- 8 The PSL for TPH is protective of a pathway that is not active at the site. Site-specific screening/cleanup levels may need to be developed for any TPH fraction that requires further consideration as a COPC.
- 9 Benzene was non-detect in all saturated soil samples (refer to Table 7.5); therefore, the PSL has been adjusted to the MTCA Method A SL of 100 mg/kg, for use when benzene is not present.
- 10 Sample locations B-12 and B-17 were collected by Farallon on behalf of ConGlobal in November 2013, the specific sample collection dates are unknown.

Abbreviations:

- bgs Below ground surface
- CAS Chemical Abstracts Service
- COPC Contaminant of Potential Concern
- cPAH Carcinogenic polycyclic aromatic hydrocarbon
- mg/kg Milligrams per kilogram
- MTCA Model Toxics Control Act
- PCUL Preliminary cleanup level
- PSL Preliminary Screening Level
- SL Screening level
- TEF Toxic equivalent factor
- TEQ Toxic equivalent
- WAC Washington Administrative Code

Table 7.5
Chemicals That Were Analyzed For but Not Detected in Soil (mg/kg)^{1,2}

Chemical	CAS No.	Information about Dataset: 1984 to Present			Vadose Zone or Saturated Soil PSL ³	Preliminary COPC?
		Number of Non Detect Results	Minimum Non Detect Value	Maximum Non Detect Value		
Vadose Zone Soil ⁴						
Metals ⁵						
Antimony	7440-36-0	12	5	7.5	5	Yes; however not likely to become a COPC based on nature of site activities.
Beryllium	7440-41-7	12	1	1.5	10	No; no exceedances.
Selenium	7782-49-2	18	0.6	7.5	0.3	No; see note 6.
Other Semivolatile Organics Compounds (SVOCs)						
Benzyl alcohol	100-51-6	2	0.0056	0.032	0.057	No; no exceedances.
1,3-Dichlorobenzene	541-73-1	2	0.00028	0.0016	--	No; no exceedances.
1,4-Dichlorobenzene	106-46-7	2	0.00028	0.0016	0.11	No; no exceedances.
Diethyl phthalate	84-66-2	2	0.0056	0.032	0.2	No; no exceedances.
Dimethyl phthalate	131-11-3	2	0.0056	0.032	0.071	No; no exceedances.
2,4-Dimethylphenol	105-67-9	2	0.0028	0.016	0.029	No; no exceedances.
Di-n-octyl phthalate	117-84-0	2	0.0056	0.032	6.2	No; no exceedances.
Hexachlorobenzene	118-74-1	2	0.00056	0.0032	0.000008	No; see note 6.
Hexachlorobutadiene	87-68-3	2	0.0014	0.0081	0.011	No; no exceedances.
2-Methylphenol	95-48-7	2	0.0056	0.032	0.063	No; no exceedances.
4-Methylphenol	106-44-5	2	0.0056	0.032	0.67	No; no exceedances.
N-Nitrosodiphenylamine	86-30-6	2	0.0056	0.032	0.021	No; see note 7.
Pentachlorophenol	87-86-5	2	0.014	0.081	0.000032	No; see note 7.
1,2,4-Trichlorobenzene	120-82-1	2	0.00028	0.0016	0.0014	No; see note 7.
Volatile Organic Compounds (VOCs)						
Benzene	71-43-2	23	0.005	0.056	0.0088	No; see note 6.
Saturated Soil ⁸						
Metals ⁵						
Antimony	7440-36-0	2	6	8.5	4.1	Yes; however not likely to become a COPC based on nature of site activities.
Beryllium	7440-41-7	2	1.2	1.7	3.5	No; no exceedances.
Selenium	7782-49-2	2	6	8.5	0.3	No; see note 6.
Silver	7440-22-4	2	3	4.2	0.016	Yes; retained because identified as a preliminary COPC in vadose zone soil.
SVOCs - Polycyclic Aromatic Hydrocarbons (PAHs)						
Acenaphthylene	208-96-8	12	0.012	0.12	1.3	No; no exceedances.
Dibenzo(a,h)anthracene	53-70-3	12	0.012	0.077	0.000029	No; see note 6.
VOCs						
Benzene	71-43-2	12	0.006	0.051	0.00056	No; see note 6.
Ethylbenzene	100-41-4	12	0.006	0.086	0.015	No; see note 6.
Xylene (total)	1330-20-7	12	0.018	0.17	9	No; no exceedances.

Notes:

Bold	Reporting limit exceeds applicable soil PSL.
Bold Red	Exceeds PSL; groundwater demonstrates compliance.
Bold Red	May become COPC based on existing soil and groundwater data.

-- Not available.

- Only analytes that were not detected in any sample within the soil zone indicated are included; results for analytes that were detected are summarized in Table 7.3 and 7.4 for vadose zone and saturated soil, respectively.
- All reporting limits are rounded to two significant figures.
- PSLs for vadose and saturated soil were developed and presented in Table 7.1.
- Vadose zone soil is defined as 0 to 9 feet bgs. To be conservative, the five samples collected at depths of exactly 9 feet bgs are included in the saturated soil dataset and are compared to the PSLs developed for saturated soil.
- Antimony, beryllium, thallium, and silver were not analyzed for in recent data collection efforts conducted after January 1, 2003. Reporting limits for these metals may be elevated as a result of limitations of historical analysis methods.
- The most stringent soil PSL is protective of groundwater. Compliance for the soil-to-groundwater pathway is empirically demonstrated in accordance with WAC 173-340-747. Groundwater data is presented in Tables 7.7 and 7.8. The maximum detected result in soil is in compliance with SLs developed for protection of sediment and protection of site receptors via direct contact.
- Chemicals may be eliminated per WAC 173-340-707(2). When results are non-detect, compliance is considered to have been attained...when the more stringent of the following conditions are met:
 - The PQL is no greater than ten times the method detection limit; or
 - The PQL for the particular hazardous substance, medium, and analytical procedure is no greater than the PQL established by the U.S. Environmental Protection Agency and used to establish requirements in 40 C.F.R. 136, 40 C.F.R. 141 through 143, or 40 C.F.R. 260 through 270.
- Saturated soil is defined as soil samples collected at depths of 9 feet bgs or deeper.

Abbreviations:

- bgs Below ground surface
- CAS Chemical Abstracts Service
- COPC Contaminant of Potential Concern
- mg/kg Milligrams per kilogram
- PCUL Preliminary cleanup level
- PSL Preliminary Screening Level
- SL Screening level
- WAC Washington Administrative Code

Table 7.6
Chemicals Never Analyzed For in Soil and/or Groundwater¹

Chemical	CAS No.	Soil Results Available?		Groundwater	Preliminary COPC?	Rationale
		Vadose Zone	Saturated	Results Available?		
Polychlorinated Biphenyls (PCBs)						
Total PCB congeners	--	No	No	Yes	No.	Existing PCB Aroclor data identifies PCBs as COPC.
Total PCB TEQ	--	No	No	Yes		
Dioxins/Furans						
2,3,7,8-TCDD	1746-01-6	No	No	No	No.	No on-site dioxin generating activities (e.g., no burning or high-temperature industrial operations).
Total dioxin/furan TEQ	--	No	No	No		
Total chlorinated dioxins	--	No	No	--		
Total chlorinated furans	--	No	No	--		
Metals						
Aluminum	7429-90-5	No	No	No	No.	Naturally occurring in soil and groundwater. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Barium	7440-39-3	No	No	Yes	No.	Rarely a risk driver; no specific site activity links this chemical to the site. Historically not a chemical of concern in Puget Sound (Tetra Tech 1988, Tetra Tech 1985). Groundwater data demonstrates compliance with soil PSL.
Chromium, hexavalent	18540-29-9	No	No	No	Yes.	Chromium(VI) was used in aerospace chromium plating operations, and chromium plating wastes from Boeing may have been sent to the wastewater treatment plant.
Cobalt	7440-48-4	No	No	No	No.	Rarely a risk driver; no specific site activity links this chemical to the site. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Iron	7439-89-6	No	No	Yes	No.	Naturally occurring in soil and groundwater. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Manganese	7439-96-5	Yes	No	Yes	No.	Naturally occurring in soil and groundwater; rarely a risk driver.
Methylmercury	16056-34-1	No	No	No	No.	Previous studies of sediment found that methylmercury represented a small fraction (0.1 to 1.4 percent) of the total mercury in sediment (King County et al. 2005).
Molybdenum	7439-98-7	No	No	No	No.	Naturally occurring in soil and groundwater. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Selenium	7782-49-2	Yes	Yes	No	No.	Rarely a risk driver; historically not found at concentrations that exceed reference levels in Puget Sound (Tetra Tech 1988, Tetra Tech 1985).
Tin	7440-31-5	No	No	No	No.	Naturally occurring in soil and groundwater. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Vanadium	7440-62-2	No	No	No	No.	
Metals - Butyltins						
Tributyltin	36643-28-4	No	No	No	Yes.	Rarely a risk driver in soil and groundwater. Common historical component of certain marine antifouling paints; only potential link to uplands would be placement of dredge spoils.
Semivolatile Organic Compounds (SVOCs)						
SVOCs - Polycyclic Aromatic Hydrocarbons (PAHs)						
Total benzofluoranthenes	--	Yes	No	--	No.	Existing soil data are sufficient to evaluate potential risk for potentially active pathways; the only soil SL is to protect the erosion pathway. This chemical does not exceed the PSL in soil, nor was it identified as a COC in sediment adjacent to the site during previous studies (for SMS SVOCs). Not of concern in wastewater or associated with other site activities.
Dibenzofuran	132-64-9	Yes	No	Yes	No.	Existing soil data are sufficient to evaluate potential risk for potentially active pathways; there are no leaching SLs for this chemical. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.

Table 7.6
Chemicals Never Analyzed For in Soil and/or Groundwater¹

Chemical	CAS No.	Soil Results Available?		Groundwater	Preliminary COPC?	Rationale
		Vadose Zone	Saturated	Results Available?		
SVOCS (cont.)						
SVOCS - PAHs (cont.)						
Total LPAHs	--	Yes	No	--	No.	Existing soil data are sufficient to evaluate potential risk for potentially active pathways; there are no leaching SLs for this chemical.
Total HPAHs	--	Yes	No	--	No.	
Phthalates						
Bis(2-ethylhexyl) phthalate	117-81-7	Yes	No	No	No.	Not related to site activities, CSOs nearby are likely the source to sediments.
Butyl benzyl phthalate	85-68-7	Yes	No	No		
Dibutyl phthalate	84-74-2	Yes	No	No		
Diethyl phthalate	84-66-2	Yes	No	No		
Dimethyl phthalate	131-11-3	Yes	No	No	No.	Existing soil data are sufficient to evaluate risk for potentially active pathways; there are no leaching SLs for this chemical. Chemical is not expected to be present in groundwater based on its chemical properties and site activities.
Di-n-octyl phthalate	117-84-0	Yes	No	No	No.	Existing soil data are sufficient to evaluate risk for potentially active pathways; there are no groundwater leaching SLs for this chemical. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Chlorinated Benzenes						
1,2-Dichlorobenzene	95-50-1	Yes	No	No	No.	Rarely a risk driver but may present concern in wastewater. Soil data indicate that leaching from soil to groundwater may be of concern for some chlorinated benzenes. Empirical data demonstrate this pathway is not active for LPAHs (e.g., naphthalene and acenaphthene), which have Koc values similar to this group of chemicals.
1,3-Dichlorobenzene	541-73-1	--	--	No		
1,4-Dichlorobenzene	106-46-7	Yes	No	No		
Hexachlorobenzene	118-74-1	Yes	No	No		
1,2,4-Trichlorobenzene	120-82-1	Yes	No	No		
Phenols						
2,4-Dimethylphenol	105-67-9	Yes	Yes	No	No.	Rarely a risk driver but may be present in wastewater. 2,4-dimethylphenol has a short half-life in the environment. Other site activities are not linked to phenols.
2-Methylphenol	95-48-7	Yes	No	No	No.	Existing soil data are sufficient to evaluate risk for potentially active pathways; there are no groundwater leaching SLs for this chemical. This chemical is not detected at levels of concern in sediment adjacent to the Site. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
4-Methylphenol	106-44-5	Yes	No	No	No.	Existing soil data are sufficient to evaluate risk for potentially active pathways; there are no leaching SLs for this chemical. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Phenol	108-95-2	Yes	No	No	No.	Rarely a risk driver but may be present in wastewater. Phenol has a short half-life in the environment and is naturally occurring in sediments (Ecology 2014; Ecology 2018a). Other site activities are not linked to phenols.
Substituted Phenols						
2-Chlorophenol	95-57-8	No	No	No	No	Substituted phenols were seldom or not reported in sediment throughout the Duwamish River/Elliott Bay (Tetra Tech 1988); other historical and more recent studies of sediment near site indicate no impacts.
4-Chloro-3-methylphenol	59-50-7	No	No	No		
2,4-Dichlorophenol	120-83-2	No	No	No		
2,4-Dinitrophenol	51-28-5	No	No	No		
4,6-Dinitro-2-methylphenol	534-52-1	No	No	No		
2,4,5-Trichlorophenol	95-95-4	No	No	No		
2,4,6-Trichlorophenol	88-06-2	No	No	No		

Table 7.6
Chemicals Never Analyzed For in Soil and/or Groundwater¹

Chemical	CAS No.	Soil Results Available?		Groundwater	Preliminary COPC?	Rationale
		Vadose Zone	Saturated	Results Available?		
SVOCS (cont.)						
Substituted Phenols (cont.)						
Pentachlorophenol	87-86-5	Yes	No	No	No.	Not detected in vadose zone soil. Pentachlorophenol has a short half-life in the environment and is not a human health COC in LDW sediments (USEPA 2014; Ecology 2018a), indicating this chemical is unlikely to be found in site soil as a result of wastewater treatment plant activities. Other site activities are not linked to pentachlorophenol.
Other SVOCs						
Aniline	62-53-3	No	No	No	No.	Not COCs in sediment adjacent to the site during previous studies (for SMS SVOCs), not regularly risk drivers in any media, and not of concern in wastewater. No onsite sources. Aniline and azobenzene are not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Azobenzene	103-33-3	No	No	No		
Benzidine	92-87-5	No	No	No		
Benzoic acid	65-85-0	Yes	No	No	No.	Rarely a risk driver. Soil and groundwater PSLs are based on protection of sediment; however, this chemical is naturally occurring in sediment. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Benzyl alcohol	100-51-6	Yes	No	No	No.	Rarely a risk driver. Soil and groundwater PSLs are based on protection of sediment; however, this chemical is naturally occurring in sediment. There are no leaching SLs for this chemical. Chemical is not regulated in surface water; groundwater PSL is based on drinking water surrogate.
Bis(2-chloroethoxy)methane	111-91-1	No	No	--	No.	No. Not COCs in sediment adjacent to the site during previous studies (for SMS SVOCs), rarely risk drivers, and not of concern in wastewater. No onsite sources.
Bis(2-chloroethyl)ether	111-44-4	No	No	No		
Bis(2-chloro-1-methylethyl)ether	108-60-1	No	No	No		
4-Chloroaniline	106-47-8	No	No	No		
2-Chloronaphthalene	91-58-7	No	No	No		
3,3'-Dichlorobenzidine	91-94-1	No	No	No		
2,4-Dinitrotoluene	121-14-2	No	No	No		
2,6-Dinitrotoluene	606-20-2	No	No	No		
1,4-Dioxane	123-91-1	No	No	No		
1,2-Diphenylhydrazine	122-66-7	No	No	No		
Hexachlorobutadiene	87-68-3	Yes	No	No	No.	Rarely a risk driver and not of concern in wastewater. Soil data indicate that leaching from soil to groundwater may be of concern. However, empirical data demonstrate this pathway is not active for LPAHs (e.g., naphthalene and acenaphthene), which have Koc values similar to this chemical.
Hexachlorocyclopentadiene	77-47-4	No	No	No	No.	Not COCs in sediment adjacent to the site during previous studies (for SMS SVOCs), not regularly risk drivers, and not of concern in wastewater. No onsite sources.
Hexachloroethane	67-72-1	No	No	No		
Isophorone	78-59-1	No	No	No		
2-Nitroaniline	88-74-4	No	No	No		
4-Nitroaniline	100-01-6	No	No	--		
Nitrobenzene	98-95-3	No	No	No		
4-Nitrophenol	100-02-7	No	No	--		
n-Nitrosodimethylamine	62-75-9	No	No	No		
n-Nitrosodiphenylamine	86-30-6	Yes	No	No	No.	Rarely a risk driver and not of concern in wastewater. The basis of the PSL is to protect groundwater from leaching. Empirical data demonstrate this pathway is not active for LPAHs (e.g., naphthalene and acenaphthene), which have Koc values similar to this chemical.
n-Nitrosodi-n-propylamine	621-64-7	No	No	No	No.	Not COCs in sediment adjacent to the site during previous studies (for SMS SVOCs), not regularly risk drivers in any media, and not of concern in wastewater. No onsite sources.
Pyridine	110-86-1	No	No	No		

Table 7.6
Chemicals Never Analyzed For in Soil and/or Groundwater¹

Chemical	CAS No.	Soil Results Available?		Groundwater	Preliminary COPC?	Rationale
		Vadose Zone	Saturated	Results Available?		
Pesticides						
Chlorinated Pesticides						
4,4'-DDD	72-54-8	No	No	No	No.	Although used historically and present at other locations along the Duwamish River in the 1980s, these chemicals were not detected at levels of concern in previous studies of sediments near the former Diagonal Avenue South Sewage Treatment Plant (Diagonal Avenue STP) outfall (e.g., Tetra Tech 1988), indicating they are unlikely to be found in site soils as a result of wastewater treatment plant activities. Current/historical site activities are not sources. These chemicals are not expected to be present in groundwater as a result of high soil partitioning coefficients.
4,4'-DDE	72-55-9	No	No	No		
4,4'-DDT	50-29-3	No	No	No		
Total DDD	--	No	No	No		
Total DDE	--	No	No	No		
Total DDT	--	No	No	No		
Aldrin	309-00-2	No	No	No		
Dieldrin	60-57-1	No	No	No		
Endrin	72-20-8	No	No	No	No.	No. These pesticides have not been previously designated as contaminants of concern in Puget Sound (Tetra Tech 1988) and have not been detected at levels of concern during historical sampling of sediment near Diagonal Avenue STP outfall, indicating they are unlikely to be found in site soils as a result of wastewater treatment plant activities. Other current/historical site activities are not sources. These chemicals are not expected to be present in groundwater as a result of high soil partitioning coefficients.
Heptachlor	76-44-8	No	No	No		
alpha-BHC	319-84-6	No	No	No		
beta-BHC	319-85-7	No	No	No		
delta-BHC	319-86-8	No	No	--		
gamma-BHC	58-89-9	No	No	No		
Other Pesticides						
cis-Chlordane	5103-71-9	No	No	No	No.	No. These pesticides have not been previously designated as contaminants of concern in Puget Sound (Tetra Tech 1988) and have not been detected at levels of concern during historical sampling of sediment near Diagonal Avenue STP outfall, indicating they are unlikely to be found in site soils as a result of wastewater treatment plant activities. Current/historical site activities are not sources. These chemicals are not expected to be present in groundwater as a result of high soil partitioning coefficients.
trans-Chlordane	5103-74-2	No	No	No		
Chlordane	57-74-9	No	No	No		
Chlorpyrifos	2921-88-2	No	No	No		
Diazinon	333-41-5	No	No	No		
Endosulfan I	959-98-8	No	No	No		
Endosulfan II	33213-65-9	No	No	No		
Endosulfan sulfate	1031-07-8	--	--	No		
Endrin aldehyde	7421-93-4	--	--	No		
Heptachlor epoxide	1024-57-3	No	No	No		
Malathion	121-75-5	No	No	No		
Methoxychlor	72-43-5	No	No	No		
Mirex	2385-85-5	No	No	No		
Toxaphene	8001-35-2	No	No	No		
Volatile Organic Compounds (VOCs)						
Benzene, Toluene, Ehtylbenzene, and Xylene (BTEX)						
m-Xylene	108-38-3	No	No	Yes	No.	Total xylene data in soil are sufficient to delineate contamination in soil; regulating xylenes as a sum is at least as conservative as regulating individual xylene isomers.
m,p-Xylene	179601-23-1	No	No	Yes		
o-Xylene	95-47-6	No	No	Yes		

Table 7.6
Chemicals Never Analyzed For in Soil and/or Groundwater¹

Chemical	CAS No.	Soil Results Available?		Groundwater	Preliminary COPC?	Rationale
		Vadose Zone	Saturated	Results Available?		
VOCs (cont.)						
Chlorinated VOCs						
cis-1,2-Dichloroethylene	156-59-2	No	No	No	No.	Chlorinated VOCs may have been present in historical wastewater discharge. VOCs have a short half-life in the environment and LDW sediments are not impacted by VOCs (USEPA 2014; Ecology 2018a), indicating they are unlikely to be found in site soil as a result of wastewater treatment plant activities. Other site activities are not linked to chlorinated VOCs.
trans-1,2-Dichloroethylene	156-60-5	No	No	No		
Tetrachloroethylene	127-18-4	No	No	No		
Trichloroethylene	79-01-6	No	No	No		
Vinyl chloride	75-01-4	No	No	No		
Other VOCs						
Acetone	67-64-1	No	No	No	No.	VOCs may have been present in historical wastewater discharge; however, these chemicals have a short half-life in the environment. LDW sediments are not impacted by VOCs (USEPA 2014; Ecology 2018a), indicating they are unlikely to be found in site soil as a result of wastewater treatment plant activities. Other site activities are not linked to VOCs. Additionally, of the least volatile VOCs, most were seldom or not reported in previous studies of sediment in the Duwamish River (e.g., Tetra Tech 1988). Therefore, other VOCs are unlikely to be present at levels exceeding soil or groundwater PSLs.
Acrolein	107-02-8	No	No	No		
Acrylonitrile	107-13-1	No	No	No		
Benzaldehyde	100-52-7	No	No	No		
Bromobenzene	108-86-1	No	No	No		
Bromochloromethane	74-97-5	No	No	--		
Bromoform	75-25-2	No	No	No		
Bromomethane	74-83-9	No	No	No		
2-Butoxyethanol	111-76-2	No	No	No		
n-Butylbenzene	104-51-8	No	No	No		
sec-Butylbenzene	135-98-8	No	No	No		
tert-Butylbenzene	98-06-6	No	No	No		
Carbon disulfide	75-15-0	No	No	No		
Carbon tetrachloride	56-23-5	No	No	No		
Chlorobenzene	108-90-7	No	No	No		
Chloroethane	75-00-3	No	No	No		
Chloroform	67-66-3	No	No	No		
Chloromethane	74-87-3	No	No	No		
3-Chloro-1-propene	107-05-1	No	No	No		
2-Chlorotoluene	95-49-8	No	No	No		
4-Chlorotoluene	106-43-4	No	No	--		
Dibromochloromethane	124-48-1	No	No	No		
1,2-Dibromo-3-chloropropane	96-12-8	No	No	No		
Dibromomethane	74-95-3	No	No	No		
Dichlorobromomethane	75-27-4	No	No	No		
trans-1,4-Dichloro-2-butene	110-57-6	No	No	--		
Dichlorodifluoromethane	75-71-8	No	No	No		
1,1-Dichloroethane	75-34-3	No	No	No		
1,2-Dichloroethane	107-06-2	No	No	No		
1,1-Dichloroethylene	75-35-4	No	No	No		
1,2-Dichloroethylene (mixed isomers)	540-59-0	No	No	No		
1,2-Dichloropropane	78-87-5	No	No	No		
1,3-Dichloropropane	142-28-9	No	No	--		

Table 7.6
Chemicals Never Analyzed For in Soil and/or Groundwater¹

Chemical	CAS No.	Soil Results Available?		Groundwater	Preliminary COPC?	Rationale
		Vadose Zone	Saturated	Results Available?		
VOCs (cont.)						
Other VOCs (cont.)						
cis-1,3-Dichloropropene	10061-01-5	No	No	No	No.	VOCs may have been present in historical wastewater discharge; however, these chemicals have a short half-life in the environment. LDW sediments are not impacted by VOCs (USEPA 2014; Ecology 2018a), indicating they are unlikely to be found in site soil as a result of wastewater treatment plant activities. Other site activities are not linked to VOCs. Additionally, of the least volatile VOCs, most were seldom or not reported in previous studies of sediment in the Duwamish River (e.g., Tetra Tech 1988). Therefore, other VOCs are unlikely to be present at levels exceeding soil or groundwater PSLs.
trans-1,3-Dichloropropene	10061-02-6	No	No	No		
Ethyl ether	60-29-7	No	No	No		
Ethylene dibromide	106-93-4	No	No	No		
Formaldehyde	50-00-0	No	No	No		
2-Hexanone	591-78-6	No	No	No		
Isopropylbenzene	98-82-8	No	No	No		
Methyl ethyl ketone	78-93-3	No	No	No		
Methyl isobutyl ketone	108-10-1	No	No	No		
Methyl tert-butyl ether	1634-04-4	No	No	No		
Methylene chloride	75-09-2	No	No	No		
n-Propylbenzene	103-65-1	No	No	No		
Styrene	100-42-5	No	No	No		
1,1,1,2-Tetrachloroethane	630-20-6	No	No	No		
1,1,2,2-Tetrachloroethane	79-34-5	No	No	No		
1,2,3-Trichlorobenzene	87-61-6	No	No	--		
1,1,1-Trichloroethane	71-55-6	No	No	No		
1,1,2-Trichloroethane	79-00-5	No	No	No		
Trichlorofluoromethane	75-69-4	No	No	No		
1,2,3-Trichloropropane	96-18-4	No	No	No		
Trichlorotrifluoroethane	76-13-1	No	No	No		
1,2,3-Trimethylbenzene	526-73-8	No	No	No		
1,2,4-Trimethylbenzene	95-63-6	No	No	No		
1,3,5-Trimethylbenzene	108-67-8	No	No	No		
Vinyl acetate	108-05-4	No	No	No		

Notes:

Bold Red Potential link to site activities; retained as preliminary COPC without existing soil or groundwater data.

-- Not applicable.

1 Only includes chemicals not analyzed in one or more media for which a PSL was developed.

- Abbreviations:
- BHC Beta-hexachlorocyclohexane

CAS Chemical Abstracts Service

Boeing The Boeing Company

COC Contaminant of Concern

COPC Contaminant of Potential Concern

CSO Combined sewer overflow

DDD Dichlorodiphenyldichloroethane

DDE Dichlorodiphenyldichloroethylene

DDT Dichlorodiphenyltrichloroethane

HPAH High molecular weight polycyclic aromatic hydrocarbon

LDW Lower Duwamish Waterway

LPAH Low molecular weight polycyclic aromatic hydrocarbon

PSL Preliminary Screening Level

Site Terminal 108 Site

SL Screening level

SMS Sediment Management Standards

TCDD Tetrachlorodibenzodioxin

TEQ Toxic equivalent

Table 7.7
Frequency of Exceedance for Chemicals Detected in Groundwater (µg/L)¹

Chemical	CAS No.	Information about Dataset: All Data 1984 to Present					Information about Dataset: All Data 2003 to Present					Information about Exceedances in Current Dataset (2003 to Present) ²			
		Number of Results	Percent Detected	Maximum Detection			Number of Results	Percent Detected	Maximum Detection			Groundwater PSL ⁴	Percent That Exceed PSL	Exceedance Factor ⁵	Preliminary COPC? ⁶
				Result ³	Location	Date			Result ³	Location	Date				
Polychlorinated Biphenyls (PCBs) ⁷															
Total PCBs (as Aroclors)	--	70	1.0%	6.9	PGG-2	09/30/2013	36	3.0%	6.9	PGG-2	09/30/2013	0.000007	3.0%	990,000	Yes.
Total PCBs (as congeners) ⁸	--	3	100%	0.11	PGG-5	09/30/2013	3	100%	0.11	PGG-5	09/30/2013	0.000007	100%	16,000	Yes.
Total Metals ⁹															
Arsenic	7440-38-2	52	40%	73	Well 84-1	06/05/1984	18	89%	11	PGG-5	06/14/2006	8	6.0%	1.4	No; data reflect natural background in groundwater for the Duwamish Valley. Historical groundwater methods subject to saline matrix interference.
Barium	7440-39-3	3	33%	49	PGG-5	02/19/2007	3	33%	49	PGG-5	02/19/2007	200	None	None	No; no exceedances.
Cadmium	7440-43-9	70	34%	38	MW-7	01/18/1992	36	25%	1.2	PGG-2 PGG-6	12/12/2012 12/12/2012	1.2	None	None	No; no exceedances.
Chromium (total)	7440-47-3	70	43%	84	MW-10	10/11/1991	36	53%	14	PGG-2 PGG-5	9/19/2006 9/19/2006	0.06	53%	230	Yes.
Iron	7439-89-6	3	100%	110,000	PGG-5	02/19/2007	3	100%	110,000	PGG-5	02/19/2007	11,000	33%	10	Yes; however, PSL is drinking water surrogate.
Manganese	7439-96-5	21	100%	4,200	PGG-5	02/19/2007	21	100%	4,200	PGG-5	02/19/2007	100	100%	42	
Mercury	7439-97-6	58	3.0%	2	Well 84-2	06/05/1984	24	0%	ND	ND	ND	0.025	ND	ND	Yes. Refer to Table 7.8.
Selenium ¹⁰	7782-49-2	28	0.0%	ND	ND	ND	NA	NA	NA	NA	NA	71	None	None	No; no exceedances.
Dissolved Metals ⁹															
Copper	7440-50-8	18	44%	2.1	PGG-6	02/19/2007	18	44%	2.1	PGG-6	02/19/2007	3.1	None	None	No; no exceedances.
Nickel	7440-02-0	18	78%	35	PGG-2	06/14/2006	18	78%	35	PGG-2	06/14/2006	8.2	11%	4.3	Yes; however, groundwater analysis method subject to saline matrix interference. Not expected to exceed PSLs in groundwater with improved analysis methods.
Zinc	7440-66-6	18	28%	440	PGG-2	06/14/2006	18	28%	440	PGG-2	06/14/2006	81	5.6%	5.4	
Semivolatile Organic Compounds (SVOCs) - Polycyclic Aromatic Hydrocarbons (PAHs)															
Acenaphthene	83-32-9	65	12%	0.21	C-2	10/11/1991	37	5%	0.14	PGG-1	06/14/2006	5.3	None	None	No; no exceedances.
Acenaphthylene	208-96-8	65	5%	7.6	C-4	10/11/1991	37	0%	ND	ND	ND	NE	NA	NA	No; no PSL.
Anthracene	120-12-7	65	17%	0.45	MW-10	10/11/1991	37	0%	ND	ND	ND	2.1	None	None	No; no exceedances.

Table 7.7
Frequency of Exceedance for Chemicals Detected in Groundwater (µg/L)¹

Chemical	CAS No.	Information about Dataset: All Data 1984 to Present					Information about Dataset: All Data 2003 to Present					Information about Exceedances in Current Dataset (2003 to Present) ²			
		Number of Results	Percent Detected	Maximum Detection			Number of Results	Percent Detected	Maximum Detection			Groundwater PSL ⁴	Percent That Exceed PSL	Exceedance Factor ⁵	Preliminary COPC? ⁶
				Result ³	Location	Date			Result ³	Location	Date				
SVOCs - PAHs (cont.)															
Benzo(a)anthracene	56-55-3	65	8%	0.28	C-1	10/11/1991	37	0%	ND	ND	ND	0.00016	ND	ND	No; not retained as an individual preliminary COPC (refer to Table 7.8). Retained as a component of cPAH TEQ.
Benzo(b)fluoranthene	205-99-2	46	17%	0.32	MW-10	10/11/1991	18	0%	ND	ND	ND	0.00016	ND	ND	
Benzo(k)fluoranthene	207-08-9	46	22%	0.3	C-3 MW-10	10/11/1991 10/11/1991	18	0%	ND	ND	ND	0.0016	ND	ND	
Benzo(g,h,i)perylene	191-24-2	65	3%	0.084	MW-14	01/18/1992	37	0%	ND	ND	ND	NE	NA	NA	No; no PSL.
Benzo(a)pyrene	50-32-8	65	5%	0.072	MW-14	01/18/1992	37	0%	ND	ND	ND	0.000016	ND	ND	No; not retained as an individual preliminary COPC (refer to Table 7.8). Retained as a component of cPAH TEQ.
Chrysene	218-01-9	65	15%	0.44	MW-10	10/11/1991	37	0%	ND	ND	ND	0.016	ND	ND	
Dibenzo(a,h)anthracene	53-70-3	64	13%	0.6	MW-9	10/11/1991	36	0%	ND	ND	ND	0.000016	ND	ND	
Fluoranthene	206-44-0	65	18%	0.95	MW-10	10/11/1991	37	0%	ND	ND	ND	1.8	ND	ND	No; no exceedances.
Fluorene	86-73-7	65	15%	0.5	C-5	10/11/1991	37	3%	0.11	PGG-2	06/14/2006	3.7	None	None	No; no exceedances.
Indeno(1,2,3-c,d)pyrene	193-39-5	64	2%	0.063	MW-14	01/18/1992	36	0%	ND	ND	ND	0.00016	ND	ND	No; not retained as an individual preliminary COPC (refer to Table 7.8). Retained as a component of cPAH TEQ.
1-Methylnaphthalene	90-12-0	37	8%	0.29	PGG-2	06/14/2006	37	8%	0.29	PGG-2	06/14/2006	1.5	None	None	No; no exceedances.
Naphthalene	91-20-3	65	6%	3	C-5	10/11/1991	37	3%	0.14	PGG-2	06/14/2006	1.4	None	None	No; no exceedances.
Phenanthrene	85-01-8	65	17%	0.72	MW-9	10/11/1991	37	0%	ND	ND	ND	NE	NA	NA	No; no PSL.
Pyrene	129-00-0	65	18%	0.81	MW-10	10/11/1991	37	0%	ND	ND	ND	2	None	None	No; no exceedances.
cPAH TEQ ¹¹	--	64	23%	0.12	MW-10	10/11/1991	36	6%	0.076	PGG-5 PGG-6	12/12/2012 12/12/2012	0.000016	5.6%	4,800	Yes; however, none of the individual cPAHs were detected.
Volatile Organic Compounds (VOCs)															
Benzene	71-43-2	49	8%	0.9	C-5	10/11/1991	18	0%	ND	ND	ND	1.6	None	None	No; no exceedances.
Ethylbenzene	100-41-4	49	10%	3	C-5 MW-9	10/11/1991 10/11/1991	18	0%	ND	ND	ND	31	None	None	No; no exceedances.
Toluene	108-88-3	49	14%	2	C-5	01/17/1992	18	0%	ND	ND	ND	130	None	None	No; no exceedances.
Xylene (total)	1330-20-7	49	12%	4	C-5	01/17/1992	18	0%	ND	ND	ND	330	None	None	No; no exceedances.

Table 7.7
Frequency of Exceedance for Chemicals Detected in Groundwater (µg/L)¹

Chemical	CAS No.	Information about Dataset: All Data 1984 to Present					Information about Dataset: All Data 2003 to Present					Information about Exceedances in Current Dataset (2003 to Present) ²			
		Number of Results	Percent Detected	Maximum Detection			Number of Results	Percent Detected	Maximum Detection			Groundwater PSL ⁴	Percent That Exceed PSL	Exceedance Factor ⁵	Preliminary COPC? ⁶
				Result ³	Location	Date			Result ³	Location	Date				
Total Petroleum Hydrocarbons (TPH) ¹²															
Gasoline-range organics ¹³	--	98	5%	120	C-5	01/17/1992	36	0%	ND	ND	ND	1,000	None	None	No; no exceedances.
Diesel-range organics	--	130	20%	1,500	PGG-5	09/30/2013	37	30%	1,500	PGG-5	09/30/2013	500	19%	3.0	Yes.
Oil-range organics	--	99	9%	1,600	PGG-2	09/30/2013	37	24%	1,600	PGG-2	09/30/2013	500	19%	3.2	Yes.

Notes:

- Bold Red**
- Exceeds PSL; unlikely to become COPC.
- Bold Red**
- May become COPC based on existing data.

-
- Not available.
- NA
- Not applicable.
- ND
- No detections.
- NE
- Not established; this chemical is not regulated in groundwater, surface water, or sediment.

- 1
- Only chemicals that were detected in groundwater during the date range specified are included in this table. Chemicals that were not detected in groundwater during the date range specified are presented in Table 7.8. Chemicals that were not analyzed for in groundwater are presented in Table 7.6.
- 2
- Data representative of current groundwater quality should be used to assess compliance. Data collected after January 1, 2003, were compared to the PSL as a conservative representation of current groundwater quality. Historical data collected prior to 2003 are not representative of current groundwater discharge quality and are subject to elevated reporting limits as a result of reduced analytical sensitivity of many historical analysis methods. For completeness, information about both historical and current groundwater data is summarized in this table.
- 3
- Results have been rounded to two significant figures.
- 4
- The groundwater PSL was developed in Table 7.2 and is protective of the highest beneficial use of site groundwater (i.e., discharge to surface water). The PSL is protective of LDW sediment, aquatic life, and human health from consumption of seafood. The PSL for each chemical was adjusted for background in accordance with WAC 173-340-705(6), as appropriate.
- 5
- The exceedance factor is calculated by dividing the maximum detected value by the PSL. Only values greater than 1 (indicating an exceedance of the PSL) are displayed. Exceedance factors have been rounded to two significant figures.
- 6
- If any detected result exceeds the PSL, the chemical was retained as a potential COPC unless otherwise noted in the chemical-specific comments in the table.
- 7
- Results are summed and compared to the total PCB PSL. If no Aroclors are detected, the summed total PCB value is the greatest detection limit.
- 8
- Total PCB results analyzed by the congener method were converted from units provided by the laboratory (pg/L) to the units presented in this table (µg/L).
- 9
- The groundwater dataset includes results analyzed by USEPA Method 200.8, which is known to have a saline matrix interference for certain metals. Saline matrix interference can be significant enough to cause elevated results and reporting limits to levels that are greater than the PSL. If additional groundwater data are collected for metals, modifications to the method to reduce saline matrix interference will be considered.
- 10
- The basis of the PSL is protection of surface water, and the regulated fraction in surface water for this chemical is the dissolved fraction. However, dissolved groundwater data are not available for certain metals (i.e., antimony, beryllium, selenium, silver, and thallium). Therefore, total selenium data are compared to the PSL.
- 11
- Calculation of cPAH TEQ concentrations is performed using the California Environmental Protection Agency 2005 TEFs as presented in Table 708-2 of WAC 173-340-900. Calculation is performed using detected cPAH concentrations plus one-half the reporting limit for cPAHs that were not detected.
- 12
- The PSL for TPH is protective of a pathway that is not active at the site. Site-specific screening/cleanup levels may need to be developed for any TPH fraction that requires further consideration as a COPC.
- 13
- MTCA Method A SL for gasoline-range petroleum hydrocarbons is 800 µg/L if benzene is present. Because benzene is not present, the MTCA Method A SL (and PSL) is 1,000 µg/L.

Abbreviations:

- CAS
- Chemical Abstracts Service
- COPC
- Contaminant of Potential Concern
- cPAH
- Carcinogenic polycyclic aromatic hydrocarbon
- LDW
- Lower Duwamish Waterway
- µg/L
- Micrograms per liter
- pg/L
- Picograms per liter
- PQL
- Practical quantitation limit
- PSL
- Preliminary screening level
- TEF
- Toxic equivalent factor
- TEQ
- Toxic equivalent
- USEPA
- U.S. Environmental Protection Agency
- WAC
- Washington Administrative Code

Table 7.8
Chemicals That Were Analyzed For but Not Detected in Groundwater (µg/L)¹

Chemical	CAS No.	Information about Dataset: 1984 to Present			Information about Current Dataset: 2003 to Present			Comparison of Reporting Limits in Current Dataset to PSL ²	
		Number of Non- Detects	Minimum Reporting Limit ³	Maximum Reporting Limit ³	Number of Non- Detects	Minimum Reporting Limit ³	Maximum Reporting Limit ³	Groundwater PSL ⁴	Preliminary COPC?
Polychlorinated Biphenyls (PCBs)									
PCB TEQ ⁵	--	3	1.3E-06	1.4E-06	3	1.3E-06	1.4E-06	4.4E-09	No; analysis using Aroclor method sufficient for site characterization.
Total Metals									
Antimony	7440-36-0	28	100	100	--	--	--	90	Elevated reporting limit in historical data. Not expected to become COPC.
Beryllium	7440-41-7	28	20	20	--	--	--	4.4	
Selenium	7782-49-2	28	100	100	--	--	--	71	
Silver ⁶	7440-22-4	28	50	50	--	--	--	1.9	
Thallium	7440-28-0	28	100	100	--	--	--	0.062	
Mercury	7439-97-6	NA	NA	NA	24	0.1	5	0.025	Yes.
Dissolved Metals									
Cadmium	7440-43-9	18	1	1	18	1	1	1.2	No; no exceedances.
Lead	7439-92-1	18	1	1	18	1	1	8.1	No; no exceedances.
Mercury	7439-97-6	6	0.2	5	6	0.2	5	0.025	Yes.
Semivolatile Organic Compounds (SVOCs) - Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthylene	208-96-8	NA	NA	NA	37	0.094	0.47	NE	No; no PSL.
Anthracene	120-12-7	NA	NA	NA	37	0.094	0.47	2.1	No; no exceedances.
Benzo(a)anthracene	56-55-3	NA	NA	NA	37	0.0094	0.1	0.00016	No; see Note 7.
Benzo(b)fluoranthene	205-99-2	NA	NA	NA	18	0.0094	0.047	0.00016	No; see Note 7.
Benzo(k)fluoranthene	207-08-9	NA	NA	NA	18	0.0094	0.047	0.0016	No; see Note 7.
Benzofluoranthenes (total)	56832-73-6	18	0.1	0.2	18	0.1	0.2	NE	No; no PSL.
Benzo(g,h,i)perylene	191-24-2	NA	NA	NA	37	0.094	0.47	NE	No; no PSL.
Benzo(a)pyrene	50-32-8	NA	NA	NA	37	0.0094	0.1	0.000016	No; see Note 7.
Chrysene	218-01-9	NA	NA	NA	37	0.0094	0.47	0.016	No; see Note 7.
Dibenzo(a,h)anthracene	53-70-3	NA	NA	NA	36	0.0094	0.1	0.000016	No; see Note 7.
Dibenzofuran	132-64-9	18	0.1	0.1	18	0.1	0.1	16	No; no exceedances.
Fluoranthene	206-44-0	NA	NA	NA	37	0.094	0.47	1.8	No; no exceedances.
Indeno(1,2,3-c,d)pyrene	193-39-5	NA	NA	NA	36	0.0094	0.1	0.00016	No; see Note 7.
2-Methylnaphthalene	91-57-6	37	0.094	0.47	37	0.094	0.47	32	No; no exceedances.
Phenanthrene	85-01-8	NA	NA	NA	37	0.094	0.47	NE	No; no PSL.
Pyrene	129-00-0	NA	NA	NA	37	0.094	0.47	2	No; no exceedances.
Total LPAH	--	18	0.1	0.1	18	0.1	0.1	NE	No; no PSL.
Total HPAH	--	18	0.1	0.2	18	0.1	0.2	NE	No; no PSL.
Total PAH	--	18	0.1	0.2	18	0.1	0.2	NE	No; no PSL.
Volatile Organic Compounds (VOCs)									
Benzene	71-43-2	NA	NA	NA	18	0.5	0.5	1.6	No; no exceedances.
Ethylbenzene	100-41-4	NA	NA	NA	18	0.5	0.5	31	No; no exceedances.
Toluene	108-88-3	NA	NA	NA	18	0.5	0.5	130	No; no exceedances.
Xylene (meta & para)	108-38-3/ 106-42-3	20	2	2	20	2	2	1,600	No; no exceedances.
Xylene (ortho)	95-47-6	20	1	1	20	1	1	430	No; no exceedances.
Xylene (total)	1330-20-7	NA	NA	NA	18	1	2	330	No; no exceedances.
Total Petroleum Hydrocarbons (TPH)									
Gasoline-range organics ⁸	--	NA	NA	NA	36	50	250	1,000	No; no exceedances.

Notes:

Bold Red	Exceeds PSL; unlikely to become COPC.
Bold Red	May become COPC based on existing data.
Bold	Reporting limit exceeds the PSL.

-- Not available; analysis was not performed.

NA Not applicable; reporting limits are only summarized in this table when all results are non-detect for the specified date range.

NE Not established; this chemical is not regulated in groundwater, surface water, or sediment.

1 Only chemicals that were not detected in any groundwater sample analyzed for the date ranges specified are included in this table.

2 Data representative of current groundwater quality should be used to assess compliance. Reporting limits for data collected after January 1, 2003, were compared to the PSL as a conservative representation of current groundwater quality. Historical data collected prior to 2003 are not representative of current groundwater discharge quality and are subject to elevated reporting limits as a result of reduced analytical sensitivity of many historical analysis methods. For completeness, information about both historical and current groundwater data is summarized in this table.

3 Reporting limits have been rounded to two significant figures.

4 The groundwater PSL was developed in Table 7.2 and is protective of the highest beneficial use of site groundwater (i.e., discharge to surface water). The PSL is protective of LDW sediment, aquatic life, and human health from consumption of seafood. The PSL for each chemical was adjusted for background in accordance with WAC 173-340-705(6), as appropriate.

5 The total PCB TEQ represents the sum of the 12 dioxin-like PCB congeners, each adjusted using its TEF. Results are calculated using TEF values from MTCA Table 708-4 and by using one-half the reporting limit as the result for any congener that was not detected.

6 The basis of the PSL is protection of surface water, and the regulated fraction in surface water for this chemical is the dissolved fraction. However, dissolved groundwater data are not available for certain metals (i.e. antimony, beryllium, selenium, silver, and thallium). Therefore, total silver data are compared to the PSL.

7 Chemicals may be eliminated per WAC 173-340-707(2). When results are non-detect, compliance is considered to have been attained . . . when the more stringent of the following conditions are met:

(a) The PQL is no greater than ten times the method detection limit; or

(b) The PQL for the particular hazardous substance, medium, and analytical procedure is no greater than the PQL established by the U.S. Environmental Protection Agency and used to establish requirements in 40 C.F.R. 136, 40 C.F.R. 141 through 143, or 40 C.F.R. 260 through 270.

8 MTCA Method A SL for gasoline-range petroleum hydrocarbons is 800 µg/L if benzene is present. Because benzene is not present, the MTCA Method A SL (and PSL) is 1,000 µg/L.

Abbreviations:

CAS Chemical Abstracts Service

COPC Contaminant of Potential Concern

HPAH High molecular weight polycyclic aromatic hydrocarbon

LDW Lower Duwamish Waterway

LPAH Low molecular weight polycyclic aromatic hydrocarbon

µg/L Micrograms per liter

MTCA Model Toxics Control Act

PQL Practical quantitation limit

PSL Preliminary screening level

TEF Toxic equivalent factor

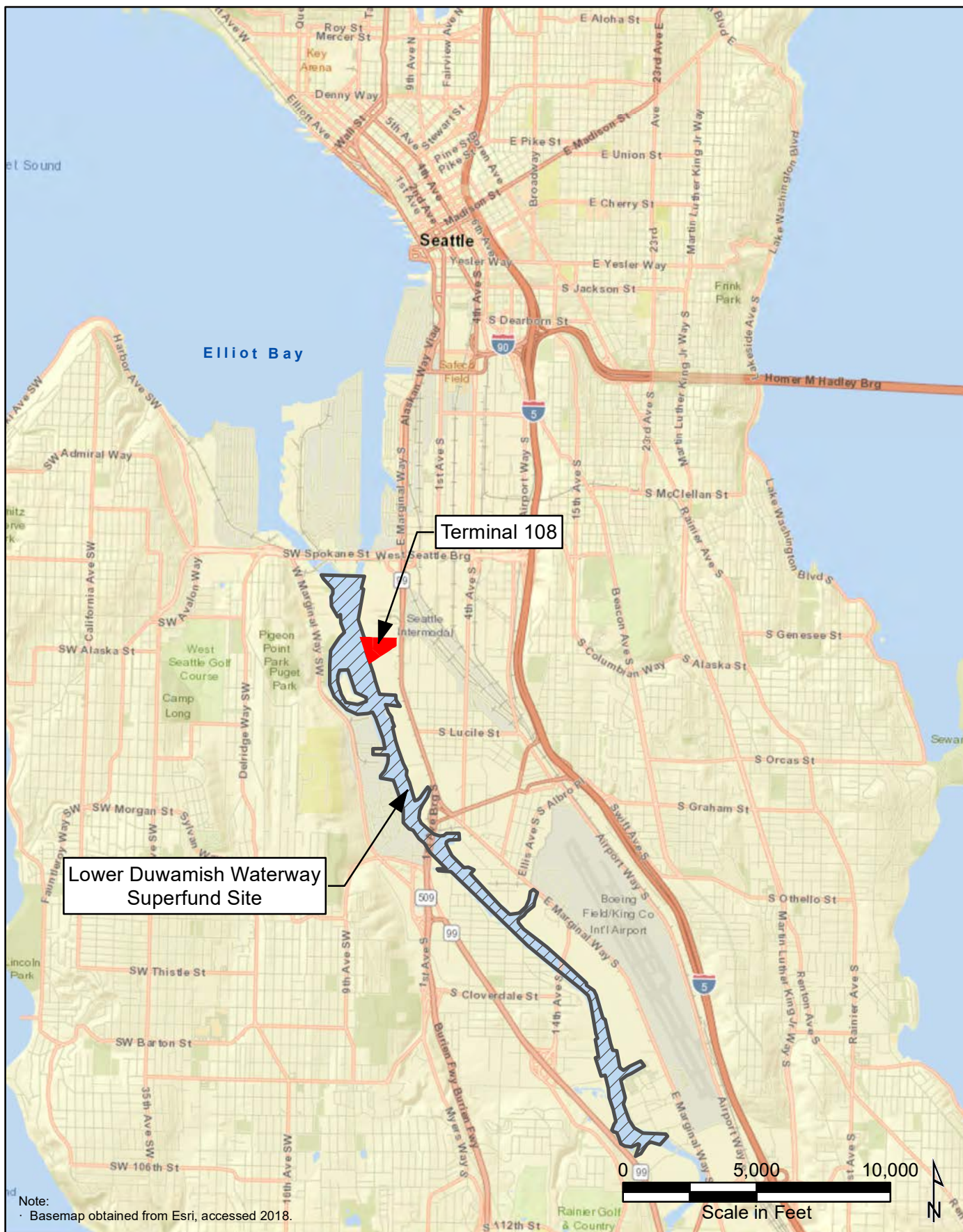
TEQ Toxic equivalent

WAC Washington Administrative Code

**Port of Seattle
Terminal 108**

Preliminary Assessment Report

Figures





Legend

- Monitoring Well
- Terminal 108 Parcel Boundary
- Port of Seattle Public Access and Habitat Mitigation Area

Historical Features

- Former Tidal Channel
- Approximate Area of STP Sludge Ponds
- Approximate PCB Disposal Area
- Sludge Drying Beds
- Chevron's Landfarming Area

Notes:

- Port of Seattle Public Access and Habitat Mitigation area obtained from the King County Parcel Viewer.
- Approximate PCB disposal area boundary obtained from Figure 4 in U.S. Army Corps of Engineers' 1976 Environmental Evaluation (USACE 1976).
- Approximate area of STP sludge ponds obtained from a 1970 aerial photograph (Appendix B of Windward 2009a).
- Sludge drying beds and Chevron USA Products Company (Chevron) landfarming area obtained from Windward's Environmental Conditions Report (2009a).
- Aerial imagery obtained from Nearmap, 2018.

Abbreviations:

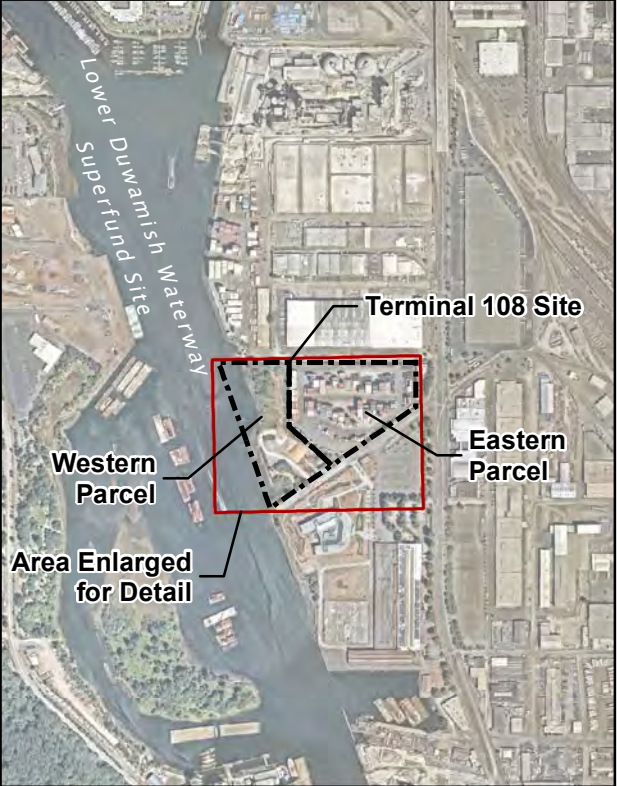
- PCB = Polychlorinated biphenyl
- STP = Sewage Treatment Plant

0 75 150 300
Scale in Feet

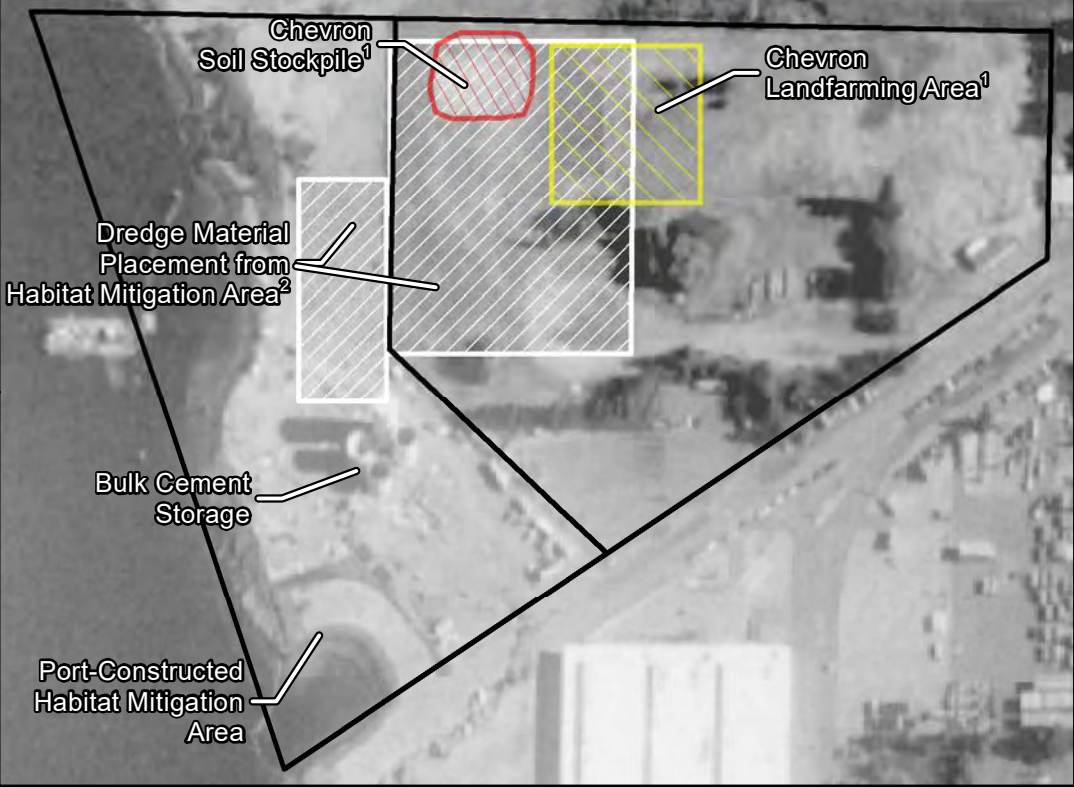
1960s: City of Seattle Ownership, Diagonal Avenue STP



1970s: Chiyoda Ownership, Site Grading, and Dredged Sediment Handling



1990s: Port of Seattle Ownership, Lafarge Operation on Western Parcel



2018: Port of Seattle Ownership, ConGlobal Container Storage



Legend

Terminal 108 Property Boundary

Notes:

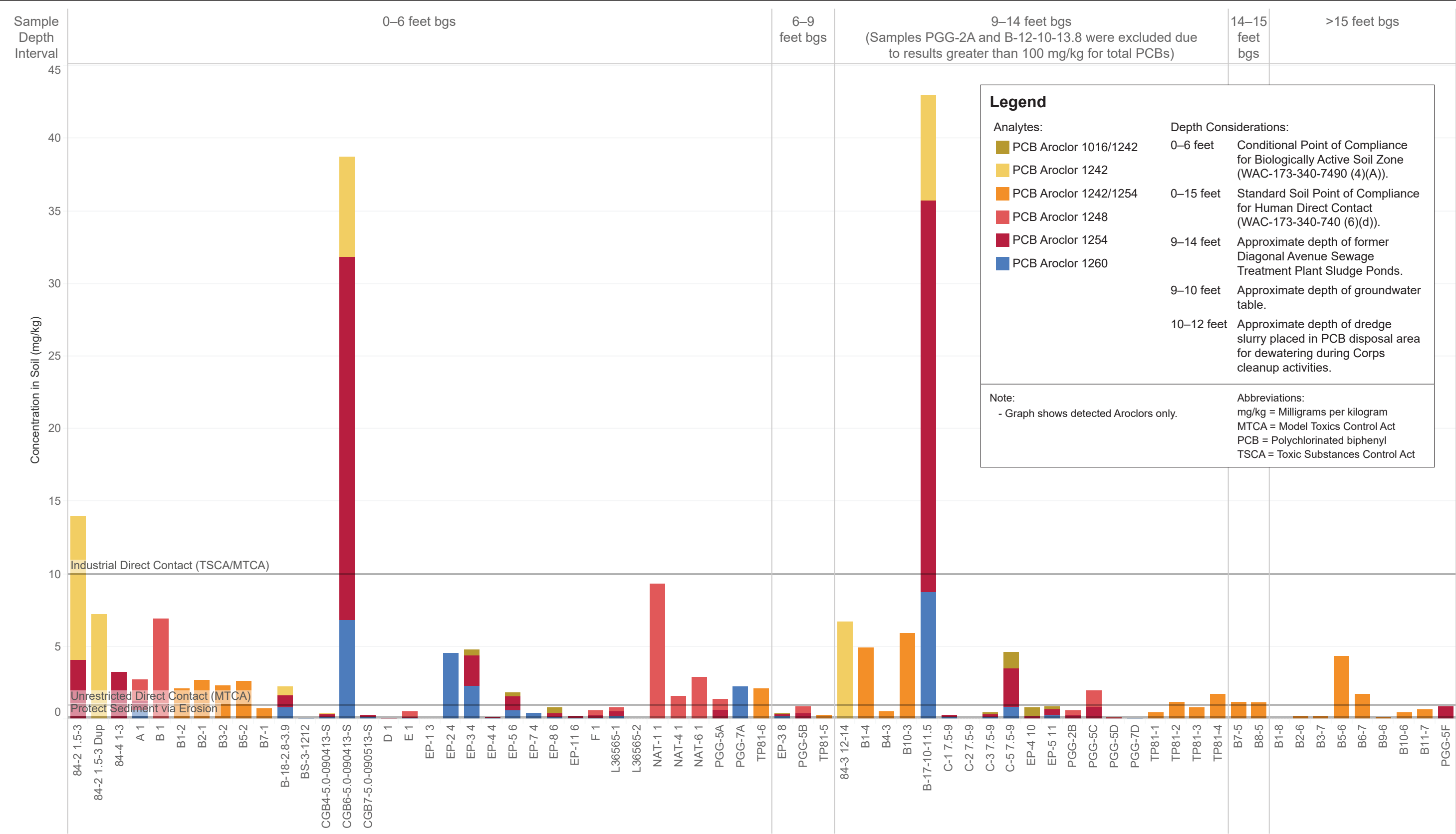
- 1. These boundaries are from the historical site features shown on Map 6 in the ECR (Windward 2009a).
- 2. These boundaries are from the 1986 Port Habitat Mitigation As-built drawing showing dredge material spread out to maximum thickness of 1 foot and seeded in both areas.
- Reference map aerial imagery obtained from Nearmap, 2018.
- 1960s, 1970s, and 1990s aerial imagery obtained from the U.S. Geological Survey.

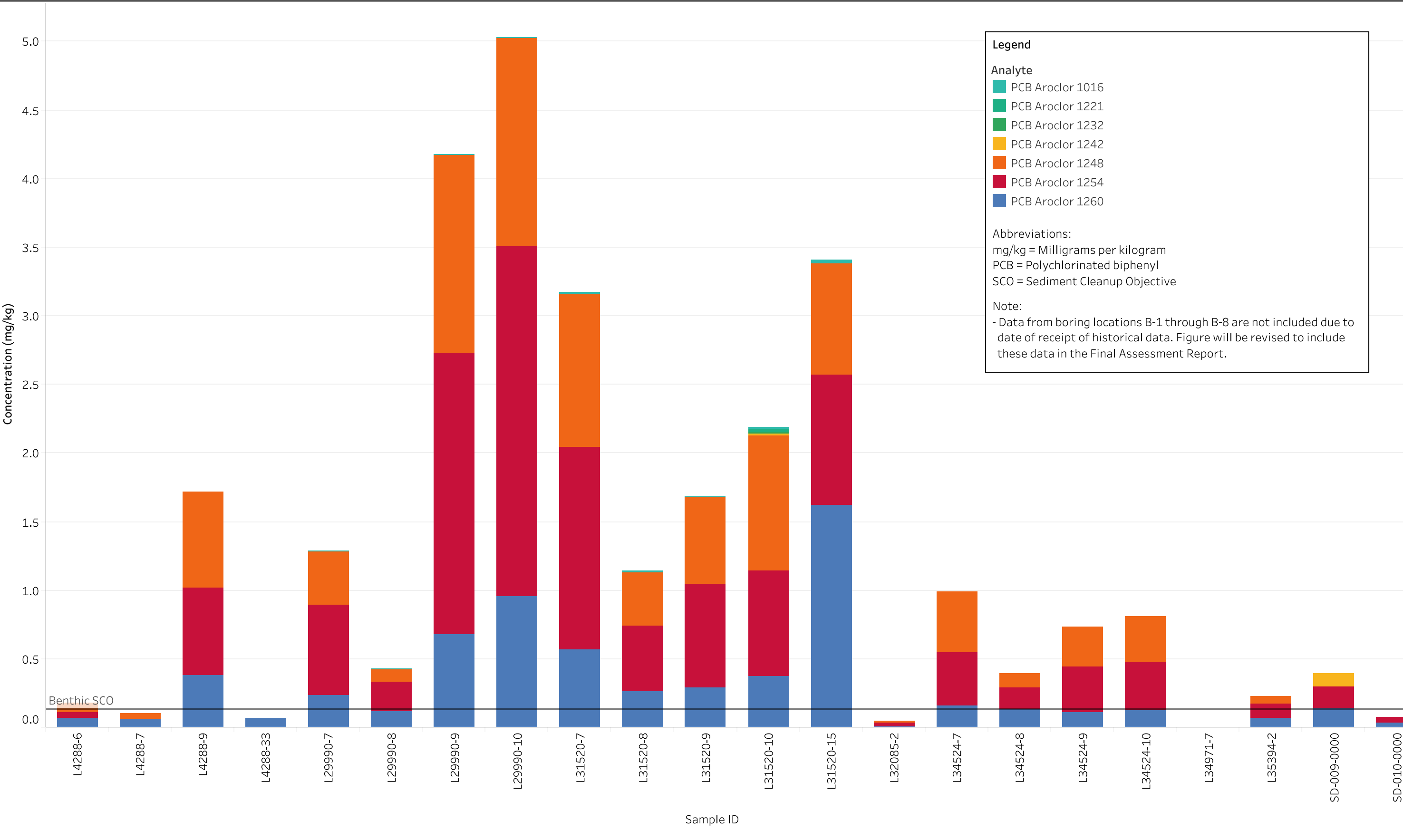
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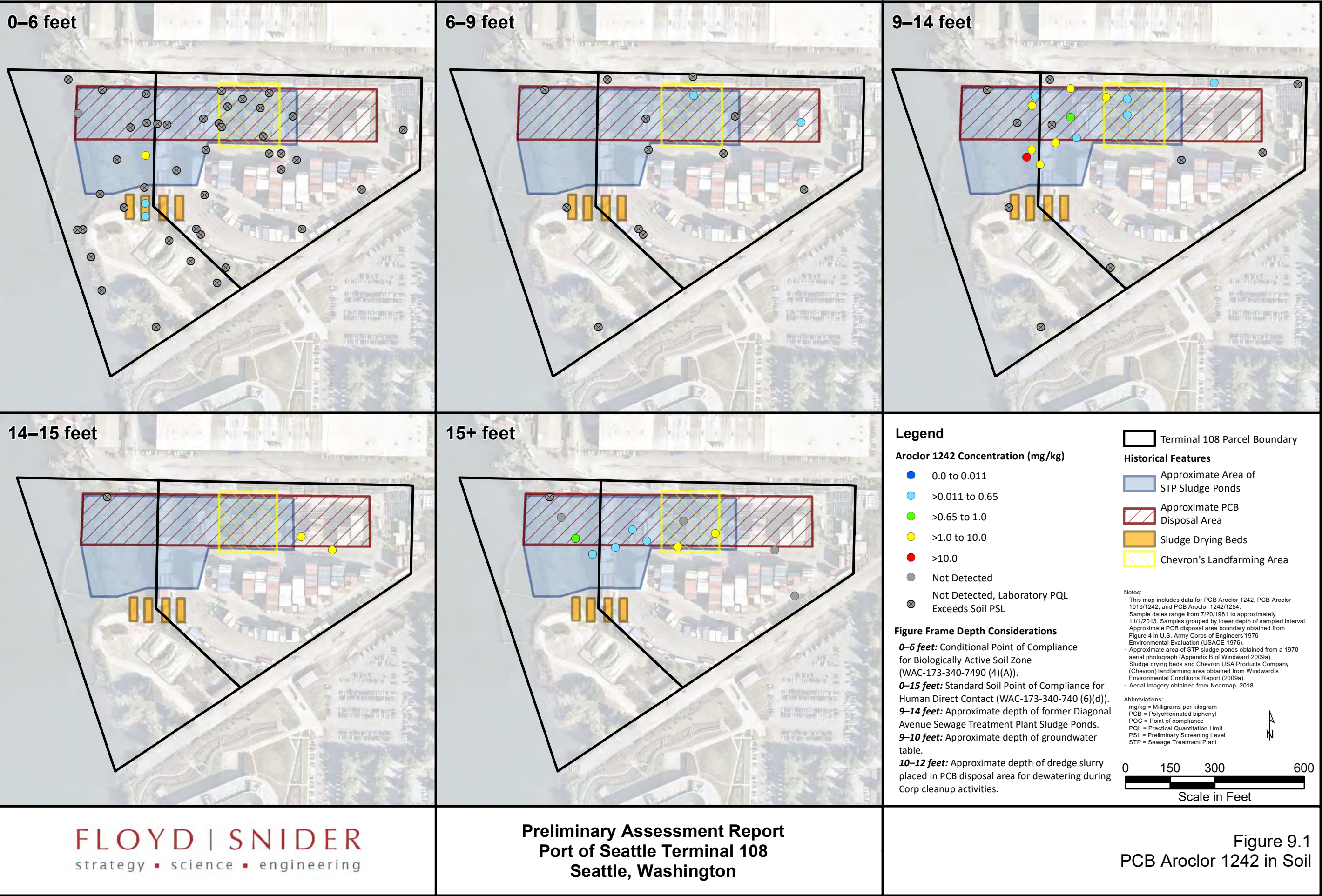
Chiyoda = Chiyoda Corporation International
ConGlobal = ConGlobal Industries, Inc.
ECR = Environmental Conditions Report
Lafarge = Lafarge Cement Company
Diagonal Avenue STP = Diagonal Avenue South Sewage Treatment Plant

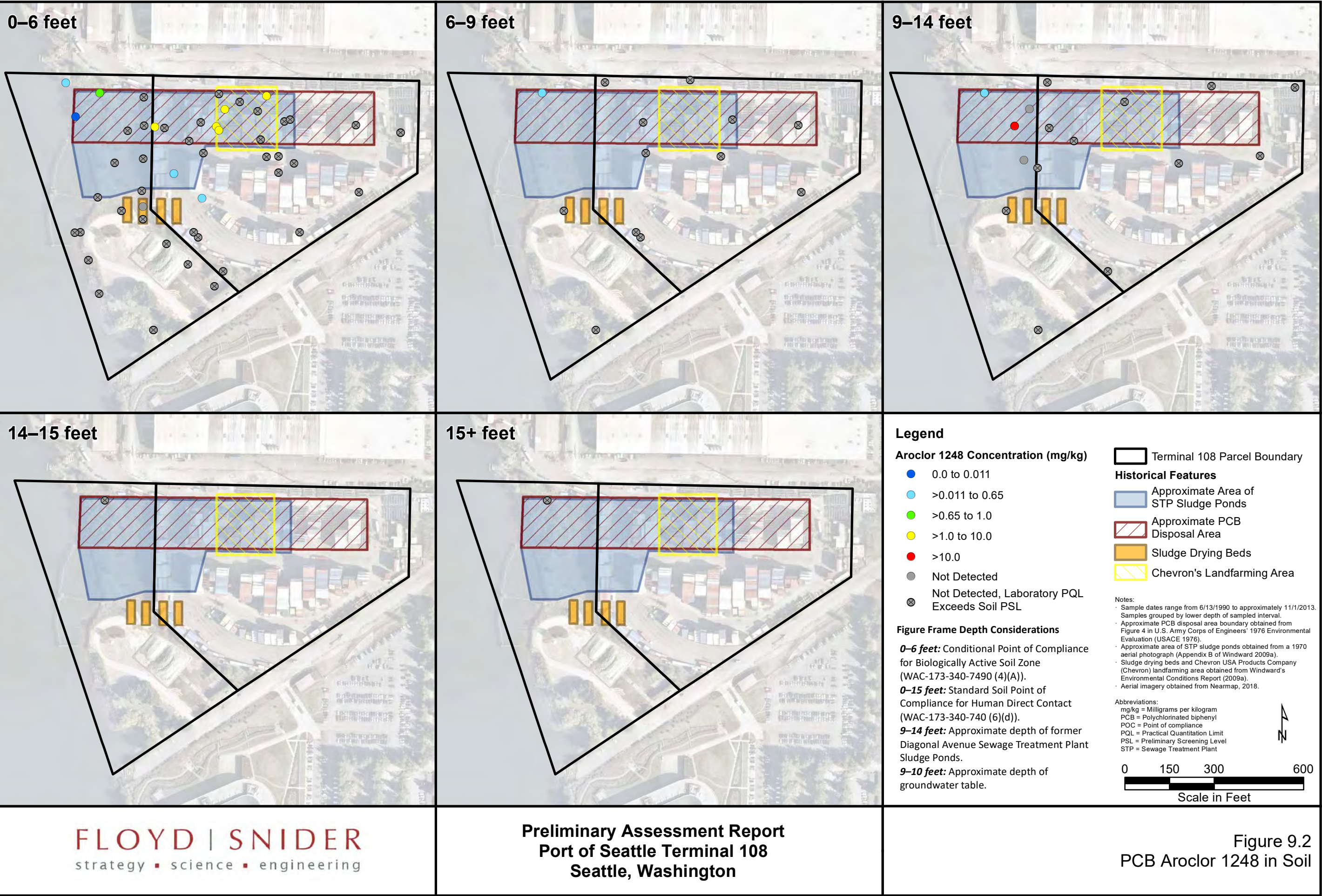
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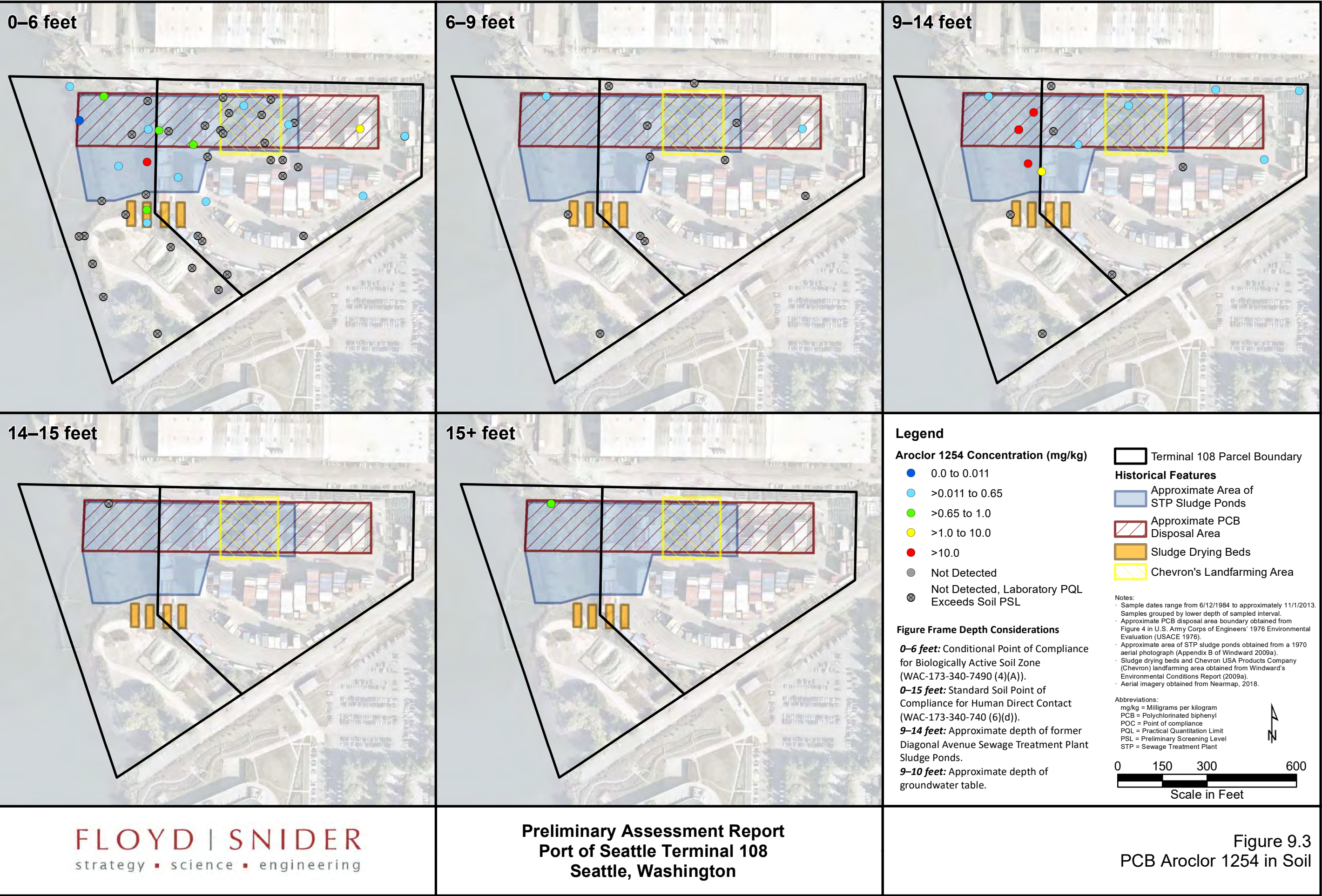


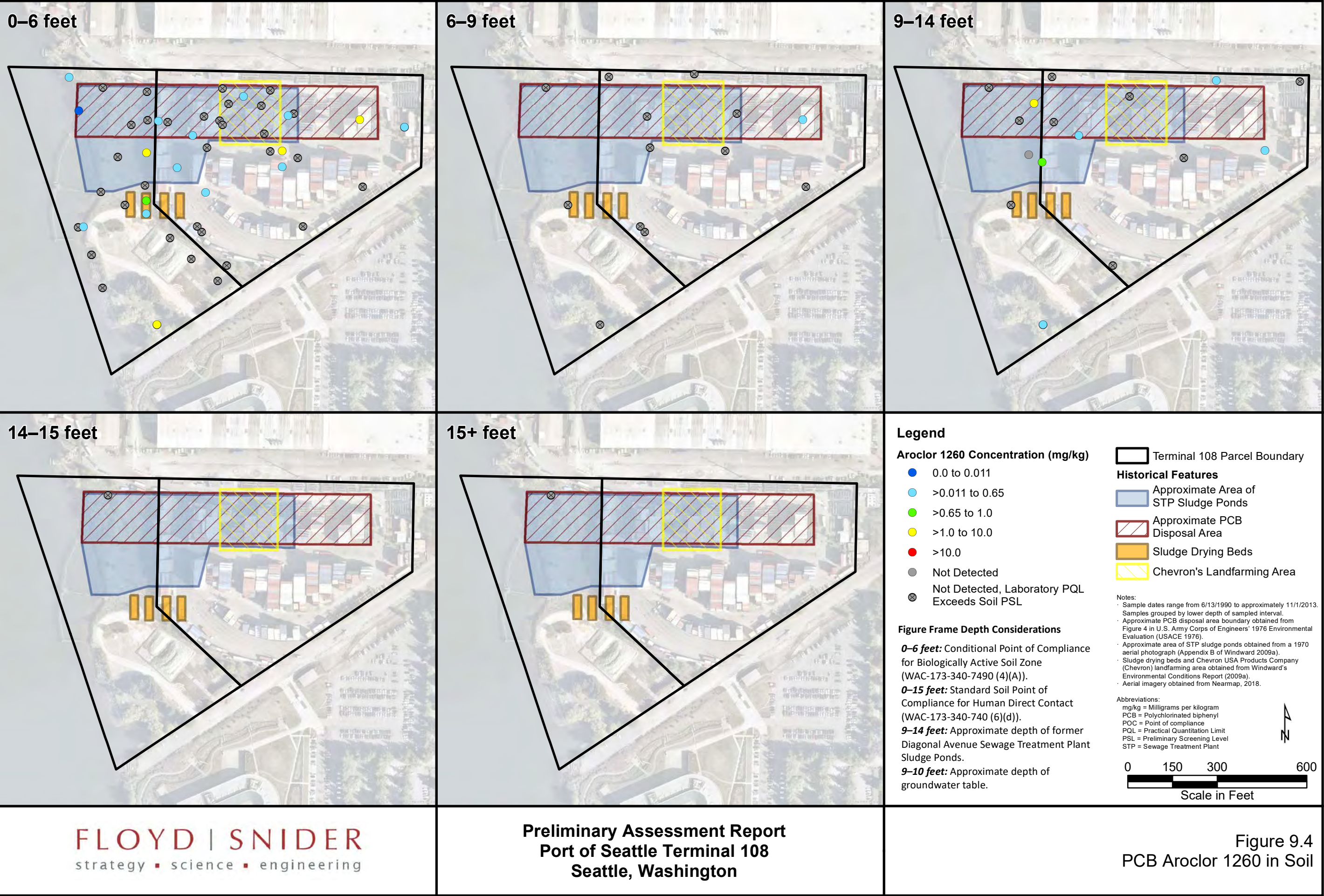


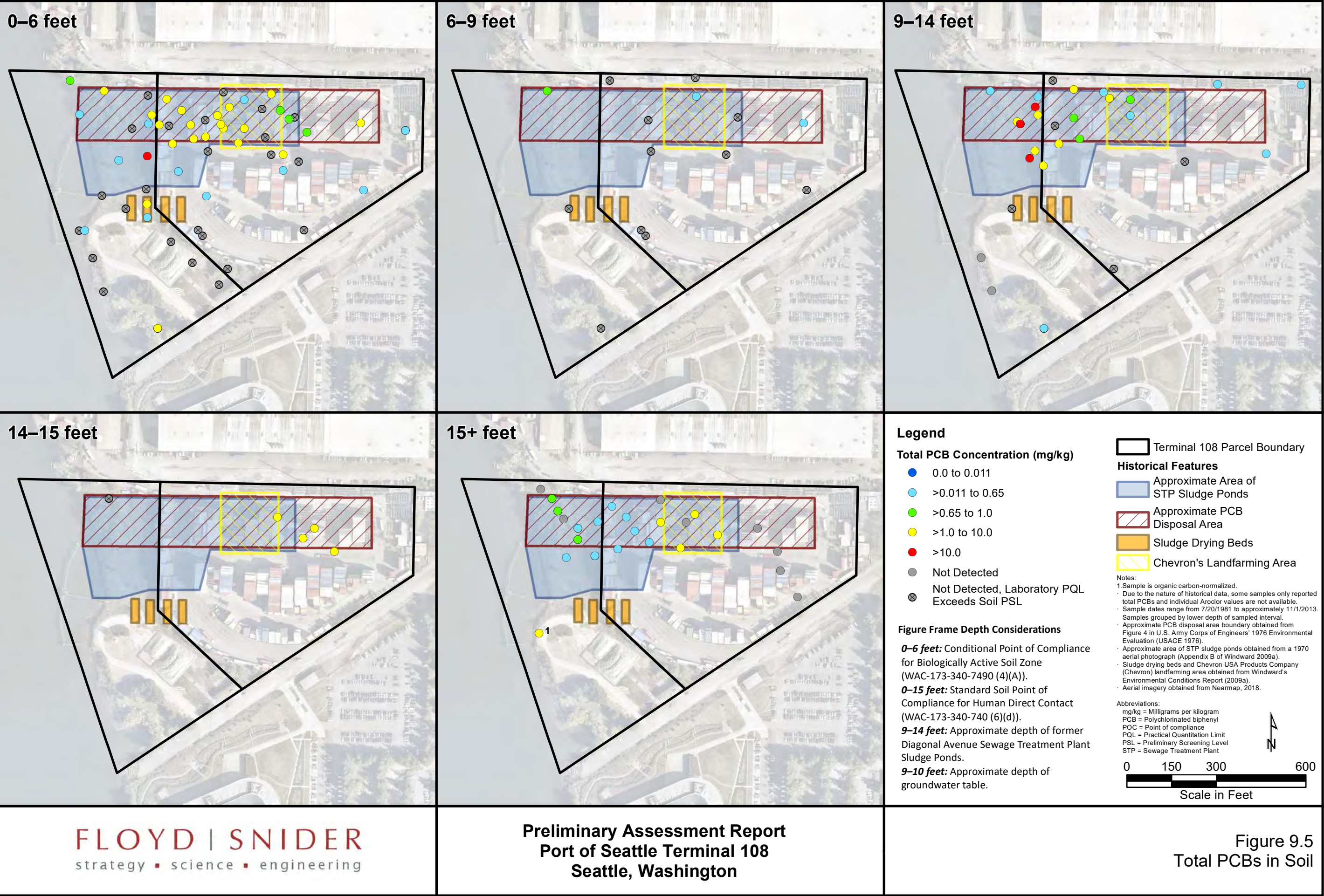


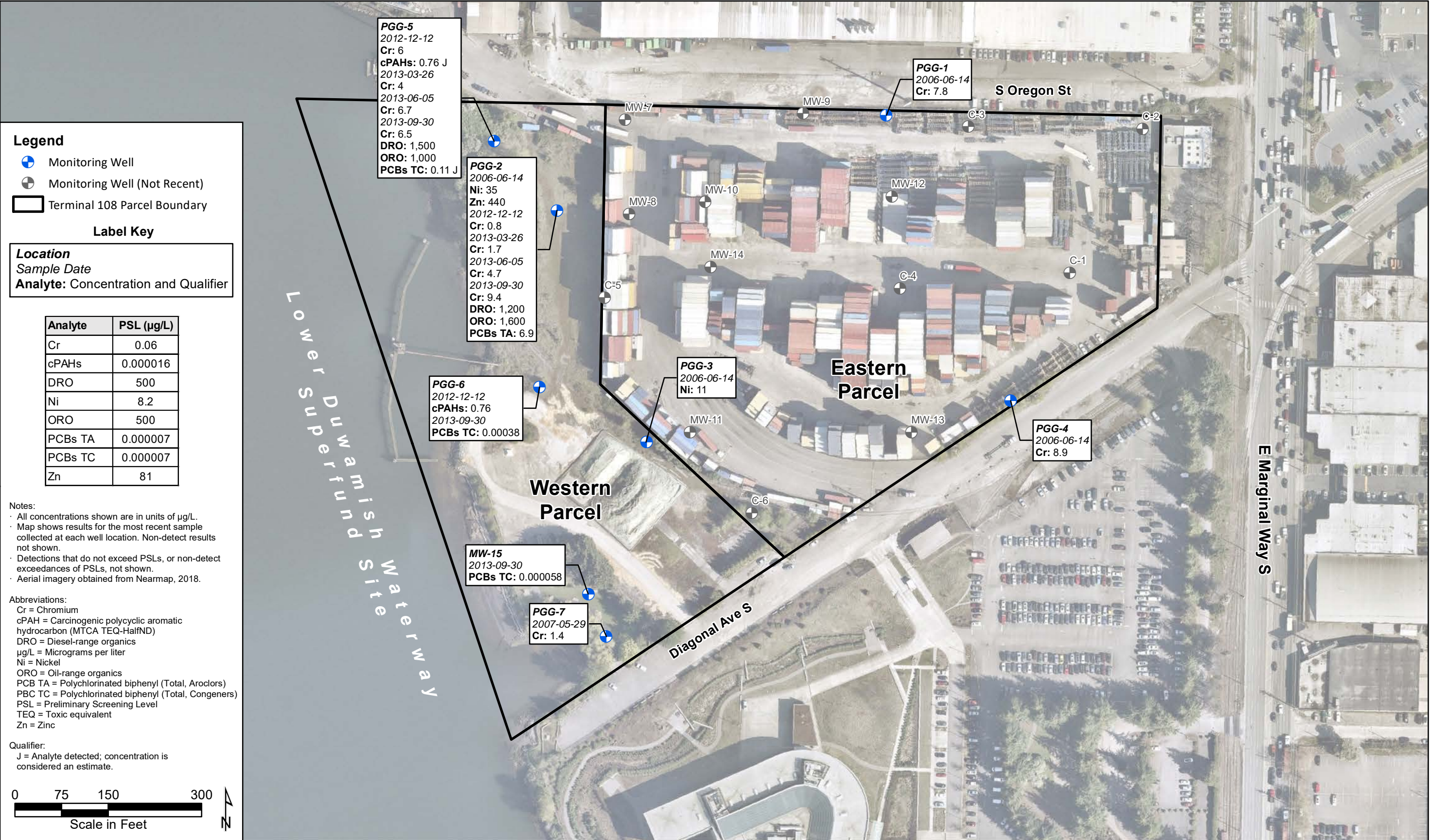












**Port of Seattle
Terminal 108**

Preliminary Assessment Report

Appendix A Environmental Conditions Report (Windward 2009a)



TERMINAL 108 – ENVIRONMENTAL CONDITIONS REPORT

FINAL

For submittal to:

Washington State Department of Ecology
3190 160th Avenue SE
Bellevue, WA 98008

January 23, 2009

Prepared by:



200 West Mercer Street, Suite 401
Seattle, Washington 98119

Table of Contents

1.0	Introduction	1
1.1	PROJECT BACKGROUND	1
1.2	PURPOSE AND ORGANIZATION OF REPORT	4
2.0	Site Description	4
2.1	GENERAL PROPERTY DESCRIPTION	4
2.2	PHYSICAL AND ECOLOGICAL FEATURES	7
2.3	GEOLOGY AND HYDROGEOLOGY	9
2.3.1	Geology	9
2.3.2	Hydrogeology	10
2.4	INFRASTRUCTURE AND CONSTRUCTED SITE FEATURES	17
3.0	Property Ownership and Operational History	21
3.1	PRE-INDUSTRIAL HISTORY	23
3.2	DIAGONAL WAY SEWAGE TREATMENT PLANT	23
3.3	CHIYODA CORPORATION INTERNATIONAL OWNERSHIP (C. 1972-1980)	28
3.4	OWNERSHIP AND OPERATIONAL HISTORY (1980-2008) – EASTERN PARCEL	29
3.4.1	Port of Seattle Ownership (1980-1984)	29
3.4.2	Chevron USA Products Company Ownership (1984-1992)	29
3.4.3	Port of Seattle Ownership – Eastern Parcel (1992-1997)	34
3.5	OWNERSHIP AND OPERATIONAL HISTORY (1980-2008) – WESTERN PARCEL	35
3.6	CURRENT OPERATIONS AT T-108	36
4.0	T-108 Environmental Conditions and Investigation Information	43
4.1	ENVIRONMENTAL DATA SUMMARY FOR T-108	43
4.1.1	T-108 soil	43
4.1.2	T-108 groundwater	44
4.1.3	T-108 bank soil	46
4.1.4	T-108 seep data	46
4.2	RELEVANT INFORMATION FOR SURROUNDING PROPERTIES, ROADWAYS, AND OUTFALL SYSTEMS	46
4.2.1	Adjacent properties	47
4.2.2	Adjacent streets	54
4.2.3	Public outfalls	58
5.0	Potential Pathways of Contamination and Source Control Management	64
5.1	POTENTIAL PATHWAYS	64
5.1.1	Atmospheric deposition	64
5.1.2	Stormwater inputs (direct discharge)	64
5.1.3	Groundwater migration	65
5.1.4	Bank erosion	65
5.2	HISTORY OF THE DUWAMISH/DIAGONAL SOURCE CONTROL AREA	65

5.3	SOURCE CONTROL MANAGEMENT TOOLS	67
5.4	T-108 ONSITE POTENTIAL PATHWAYS OF CONTAMINATION AND SOURCE CONTROL	70
5.5	OFFSITE POTENTIAL PATHWAYS OF CONTAMINATION	76
6.0	Conclusions and Recommendations	79
7.0	References	81
Appendix A	Terminal-108 and Adjacent Property Photographic Log	
Appendix B	Historical Aerial Photograph Review	
Appendix C	Groundwater Monitoring Well and Boring Logs	
Appendix D	T-108 Analytical Information	
Appendix E	Adjacent Property Analytical Information	
Appendix F	T-108 Reference Documentation	

List of Tables

Table 1.	T-108 groundwater and shoreline soil investigation monitoring well construction and water level summary	13
Table 2.	Summary of relevant information for properties adjacent to T-108	48
Table 3.	Summary of relevant information for street rights-of-way adjacent to T-108	55
Table 4.	Summary of relevant information for outfalls adjacent to T-108	59
Table 5.	Chemicals of concern in Duwamish/Diagonal SCA surface sediment (exceeding associated SMS criteria)	66
Table 6.	Potential source control management tools for the subject property	67
Table 7.	Potential onsite pathways of contamination and general source control information at T-108	72
Table 8.	Potential offsite sources of contamination and pathway information relative to T-108	77

List of Figures

Figure 1.	T-108 timeline: ownership, operations, and environmental investigations	22
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List of Maps

Map 1.	Terminal 108 location	2
Map 2.	T-108 vicinity map	5
Map 3.	Groundwater well and soil sampling locations	11
Map 4.	Groundwater contour maps, Pacific Groundwater Group wells (June and September 2006)	15
Map 5.	Stormwater drainage networks	19
Map 6.	Historical site features 1938 – c. 1970, 1970s	25
Map 7.	Historical site features 1980s, 1990s	31
Map 8.	Historical site feature overlay	39
Map 9.	Historical site feature overlay and previous sample locations	41

Acronyms

AGI	Applied Geotechnology, Inc.
APN	assessor's parcel number
AST	aboveground storage tank
BBP	butyl benzyl phthalate
BEHP	bis(2-ethylhexyl) phthalate
bgs	below ground surface
BMP	best management practice
Boeing	The Boeing Company
BTEX	benzene, toluene, ethyl benzene, and xylene
CB	catch basin
CCI	Container Care International
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
Chevron	Chevron USA Products Company
Chiyoda	Chiyoda Corporation International
City	City of Seattle
ConGlobal	ConGlobal Industries
County	King County
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
CSO	combined sewer overflow
cy	cubic yard
EAA	early action area
EBI	Elliott Bay Interceptor
Ecology	Washington State Department of Ecology
EOF	emergency overflow
EPA	US Environmental Protection Agency
ESA	environmental site assessment
FBI	Federal Bureau of Investigation
GSA	General Services Administration
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
ICR	independent cleanup report
Lafarge	Lafarge Canada, Inc.

LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
LUST	leaking underground storage tank
mgd	million gallons per day
mgy	million gallons per year
MLLW	mean lower low water
MTCA	Model Toxics Control Act
MT/yr	million tons per year
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGG	Pacific Groundwater Group
Pioneer	Pioneer Construction Materials Company
Port	Port of Seattle
ppm	parts per million
RCB	right-of-way catch basin
RCRA	Resource Conservation and Recovery Act
ROW	right-of-way
SCAP	source control action plan
SCSP	source control strategy plan
SD	storm drain
SMS	Washington State Sediment Management Standards
SPCC	spill prevention control and countermeasure
SPU	Seattle Public Utilities
SQG	small-quantity generator
SQS	sediment quality standard
STP	sewage treatment plant
SWPPP	stormwater pollution prevention plan
T-108	Terminal 108
T-106	Terminal 106
TEQ	toxic equivalent
TPH	total petroleum hydrocarbons
TPH-D	diesel-range total petroleum hydrocarbons
TPH-O	oil-range total petroleum hydrocarbons

TSCA	Toxic Substances Control Act
TSS	total suspended solids
USACE	US Army Corps of Engineers
UST	underground storage tank
VCP	voluntary cleanup program
VOC	volatile organic compound
WAC	Washington Administrative Code
WSLCB	Washington State Liquor Control Board
WWTP	wastewater treatment plant

1 Introduction

The Lower Duwamish Waterway (LDW) is an approximately 5.5-mile waterway located in Seattle, Washington. In 2001, the US Environmental Protection Agency (EPA) added the heavily used industrial waterway to the nation's Superfund list. Contaminants identified in the waterway's sediments that led to its listing include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), various metals, and phthalates. These identified contaminants may threaten both humans and wildlife.

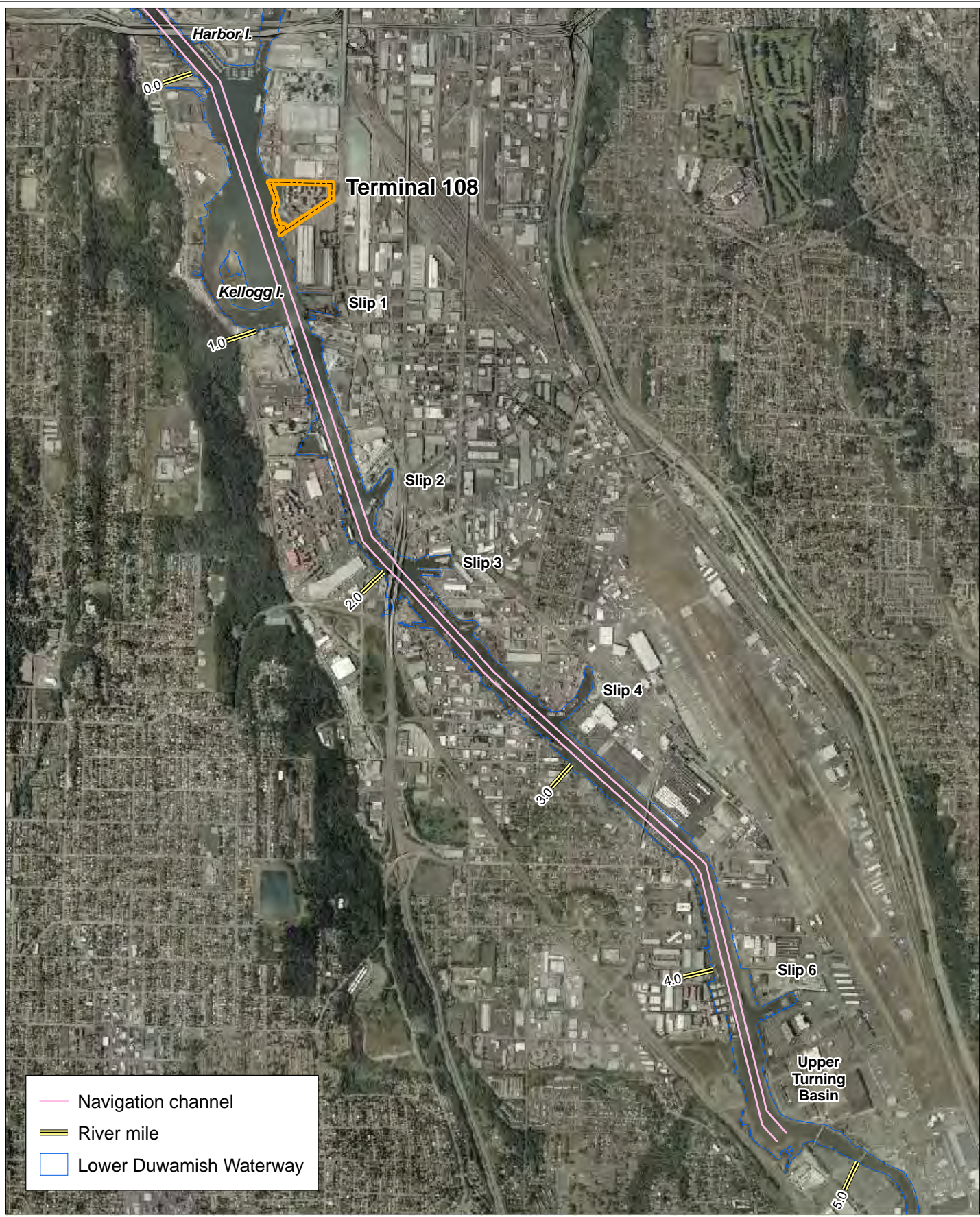
The Port of Seattle's (Port) Terminal 108 property (T-108) is located on the eastern shore of the LDW, just upstream of Harbor Island (Map 1). T-108 has been owned by or leased to various entities during its history of industrial and commercial use. For the purposes of this report, T-108 will be referred to as the subject property. During the course of recent investigations on the waterway, the subject property, along with neighboring properties, has been identified as a property of potential interest for source control with respect to the LDW.

In support of these ongoing investigation efforts, the Port is developing independently a source control strategy for the terminal property. To help develop and focus the strategy on potential source control issues at the subject property, the Port is preparing this comprehensive Environmental Conditions Report detailing property-specific investigation information along with the operational history and development of the property over the course of the last hundred years. This report's conclusions and recommendations will assist in the development of a source control strategy for the subject property, to be discussed in future documentation.

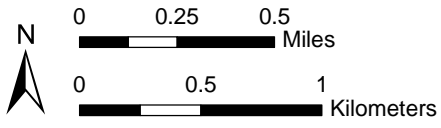
1.1 PROJECT BACKGROUND

In December 2000, EPA and the Washington State Department of Ecology (Ecology) entered into an Agreed Order on Consent with King County (County), the Port, the City of Seattle (City), and The Boeing Company (Boeing). The purpose of the order was for the completion of a remedial investigation and feasibility study (RI/FS) to address the waterway's sediment contamination. Subsequent to signing of the agreement, the County, the City, the Port, and Boeing formed the Lower Duwamish Waterway Group (LDWG) to manage and coordinate the ongoing investigation and remediation strategy efforts.

Prepared by CEH, 12/06/07, MAP #3120, W:\Projects\06-08-14\31 Marine Environmental Sources Control\Map\GIST-108



- Navigation channel
- River mile
- Lower Duwamish Waterway



Map 1. Terminal 108 location

FINAL

Preventing recontamination to levels that exceed the Washington State Sediment Management Standards (SMS) (per Washington Administrative Code [WAC] 173-204) and the LDW sediment cleanup goals is the ultimate focus of Ecology's source control strategy. The LDW source control program, under Ecology's lead, is designed to identify and manage sources of contamination to LDW sediments in coordination with sediment remediation activities. This program provides the framework for identifying source control issues and implementing effective controls, potentially including various levels of remedial action. To support this effort, Ecology is preparing source control action plans and data gaps analysis reports to establish current environmental conditions and evaluate historical and ongoing sources of contamination.

In 2003, seven candidate sediment sites for early action (subsequently referred to as early action areas [EAAs]) were identified in the LDW. One of the recommended EAAs, EAA 1, includes the adjacent Duwamish/Diagonal combined sewer overflow (CSO) and storm drain (SD) area on the east side of the LDW at the end of the Oregon Street right-of-way (ROW). The subject property borders these outfall locations to the south and directly abuts EAA 1.

In December 2004, Ecology published a Source Control Action Plan (SCAP) for the Duwamish/Diagonal Way Early Action Cleanup Area (EAA 1) which strategized the approach to ongoing evaluation and control of sources of contamination to the sediment area. In that strategy document, the subject property was included as a property of potential concern relative to identified sediment contamination associated with EAA 1 (Ecology 2004). In June 2008, Ecology published several property reviews for individual properties of potential concern relative to EAA 1, including T-108, T-106 West (T-106W), T-106 Northwest (T-106NW), T-106 East (T-106E), and Federal Center South. Relevant information from Ecology's property reviews is included in the subsequent sections of this report.

Ecology has requested that the Port provide documentation of the subject property's environmental conditions and develop a long-term Source Control Strategy Plan (SCSP). The SCSP will be implemented and managed on an independent basis. Work to be performed at the site, including any potential remedial activities or engineered mitigation measures, will be managed as outlined under the Model Toxics Control Act (MTCA), the National Pollutant Discharge Elimination System (NPDES) requirements, and other established regulations.

This Environmental Conditions Report will help establish the basis for the development, implementation, and management of the SCSPs for the subject property. The SCSPs will take into consideration current operations and the recommendations of this report. The SCSPs will also consider remedial action alternatives, if appropriate, based on the conclusions of the environmental conditions documentation and the approaches deemed to be most effective for the potential issues at the subject property. Any remedial action at the subject property will be completed as an independent

remedial action in accordance with Ecology's MTCA. However, the Port acknowledges that Ecology may consider an Agreed Order for the subject property in the future.

1.2 PURPOSE AND ORGANIZATION OF REPORT

The purpose of this report is to present and discuss the subject property's relevant operational and development history, evaluate existing environmental data, and identify potential source control issues, focusing on long-term source control strategy efforts at T-108.

This Environmental Conditions Report is organized as follows:

- ◆ Section 2.0, Site Description
- ◆ Section 3.0, Property Ownership and Operational History
- ◆ Section 4.0, Environmental Conditions and Source Information
- ◆ Section 5.0, Potential Pathways of Contamination and Source Control Management
- ◆ Section 6.0, Conclusions and Recommendations
- ◆ Section 7.0, References

2 Site Description

T-108 is located at 4525 Diagonal Avenue S in Seattle, Washington (Map 2). It is owned by the Port of Seattle and currently leased to ConGlobal Industries (ConGlobal), an international company that operates container and chassis depots. T-108 is located on the LDW which bounds the property to the west. It is bounded to the east by a King County pumping station and E Marginal Way S, to the west by the LDW, to the south by Diagonal Avenue S and the Federal Center South facility, and to the north by the Oregon Street ROW, Terminal 106 W (T-106W), and the Washington State Liquor Control Board (WSLCB) facility.

2.1 GENERAL PROPERTY DESCRIPTION

T-108 currently consists of two parcels totaling approximately 20 acres. The Western Parcel (Assessor's Parcel Number [APN] 7666700510) is approximately 9 acres in size, and the Eastern Parcel (APN 7666700515) is approximately 11 acres in size (King County 2008). Currently, ConGlobal leases both parcels of the subject property: the Eastern Parcel is used as a container storage facility and truck chassis storage and repair area, and the Western Parcel is used as a chassis lay-down area.



T-108 has been used by several parties for a variety of purposes since its development in the early 20th century. Detailed information on the subject property's ownership and operational history is discussed in Section 3.0. A timeline that provides a visual presentation of the property's ownership, operation, and environmental-related investigation history is also provided in Section 3.0.

Brief highlights of the ownership history of the T-108 property include:

- Diagonal Avenue S sewage treatment plant (STP) – Operated by the City of Seattle from 1938 to 1962 and then by King County Metro from 1962 to 1969 in the central portion of T-108 Eastern Parcel.
- Chiyoda Corporation International (Chiyoda) owned the property in the mid-1970s; EPA and the US Army Corps of Engineers (USACE) controlled the property for a portion of the Chiyoda ownership period.
- In the early 1980s, the T-108 property was subdivided for the first time when the Port acquired the property; the Port maintained ownership of the Western Parcel and sold the Eastern Parcel to Chevron in approximately 1984. The Port subsequently repurchased the Eastern Parcel in 1992.
- The Lafarge Cement Company leased the Western Parcel from 1989 to 1998; Lafarge constructed and operated a bulk cement terminal on the property.
- In the mid-1990s, the Eastern Parcel was redeveloped for use as a container storage and transfer yard by Container Care International (CCI). CCI is a predecessor to ConGlobal Industries.

Presently the majority of T-108 is operated as a container storage facility by ConGlobal Industries. The primary container storage area is located on the Eastern Parcel of the property, and portions of the Western Parcel are used for chassis lay-down and storage. A Port of Seattle public access and habitat mitigation area is located along the southern shoreline of the Western Parcel, adjacent to the LDW. The park area is one of approximately 12 habitat mitigation areas along the LDW shoreline, and public access to the site is provided in accordance with the Port's public access plan (Port of Seattle 1985a). Select photographs of the subject property used as reference for the following sections are included in Appendix A. Appendix B includes copies of historical aerial photographs of the immediate vicinity of the T-108 that were used as a resource for this discussion.

2.2 PHYSICAL AND ECOLOGICAL FEATURES

T-108 is located in what was once a tidal marsh area associated with the Duwamish River delta. Much of this marsh area was filled in the early 1900s during engineering of the LDW. The present topography of the site is generally flat with gradual slopes downward to the east and northwest, away from the central part of the site (Port of

Seattle 1992a). The average ground surface elevation is approximately 19 feet mean lower low water (MLLW).

The majority of the container yard on the Eastern Parcel of T-108 is paved, however some portions are covered with gravel (Map 2). The southern half of the Western Parcel of T-108 is paved or covered with gravel. The paved and graveled areas on the Western Parcel were formerly used as part of the Lafarge bulk cement terminal and as a parking lot associated with the Diagonal Avenue S STP (discussed in Section 3.5). Currently, a thick layer of soil covers much of the paved/graveled portion of this parcel, and ConGlobal uses some of the area for chassis lay-down and storage (Appendix A, Photos 5, 7, and 8). The majority of the northern portion of the Western Parcel is unpaved and is covered with vegetation including grass, low lying shrubs (predominantly blackberries) and trees (Appendix A, Photo 6).

The T-108 shoreline is approximately 1,200 ft (or 0.23 mi) long. The bank elevation of the northern and central portions of the shoreline varies from 0 to 10 ft (Port of Seattle Datum) (Port of Seattle 1993). The bank elevation of the southern portion of the shoreline, which includes the mitigation area, varies from approximately 4 to 18 ft (Port of Seattle Datum). The northern and central portions of the T-108 shoreline are armored with riprap, gravel, and other materials (Appendix A, Photo 15). Along the south-central portion of the shoreline, to the north of the mitigation area, the shoreline is partially armored with riprap and a wooden bulkhead which runs parallel to the shoreline. The bulkhead is not well-anchored and is slanted away from the shoreline (Appendix A, Photos 12 and 13). Within the park and mitigation area, the T-108 shoreline is primarily unarmored, with the exception of gravel (habitat mix) scattered along the perimeter (Appendix A, Photo 10).

Two outfalls points are located along the T-108 shoreline boundary. One is an active storm drain outfall that drains the southern portion of the Western Parcel (Port of Seattle outfall 2225 on Map 2), located in the vicinity of the wooden bulkhead (Appendix A, Photo 13). The second is an abandoned outfall formerly associated with the Diagonal Avenue S STP, located to the north of the active outfall (former Diagonal Avenue S STP outfall 2002 on Map 2; Appendix A, Photo 14). In addition, a wooden box frame structure in an extreme state of disrepair was observed in approximately the middle of the shoreline. The former purpose of this structure is not known.

The intertidal portion of the shoreline (ranging between elevations 5 and -10 MLLW depending on location along the subject property's shoreline) is composed predominately of mudflats that gently incline toward the navigation channel. Debris including wood, metal, brick, plastic, glass, and wiring is visible in the shoreline banks and in the mudflat area.

The T-108 public access and habitat mitigation area was constructed in the late 1980s by excavating the bank shoreline. It is approximately 1 acre in size and includes approximately 420 ft of shoreline, at an elevation ranging from 8 to 18 ft. A vegetated

buffer surrounds a U-shaped mudflat area that extends into the LDW (Appendix A, Photos 9 and 10). A buoy line is present along the mouth of the mitigation area to prevent debris from washing into the site. Vegetation within the public access and mitigation area is routinely maintained by Port maintenance crews and appears to be healthy, and the area provides fish and wildlife habitat. The public access area extends to a public parking area located at the end of Diagonal Avenue S which also includes a lawn area, picnic tables, a launch for hand-carried boats, and interpretive signage. Existing trees on the eastern perimeter of the public access area provide visual screening from the rest of T-108 and E Marginal Way S (Appendix A, Photo 9).

2.3 GEOLOGY AND HYDROGEOLOGY

The following section provides a brief overview of the subsurface conditions at the subject property and discusses the basics of the property's hydrogeological features. A more detailed discussion is available in the various site investigation reports cited as reference throughout the section.

2.3.1 Geology

T-108 is located within the Duwamish River valley which was formed approximately 15,000 years ago by the retreat of the glaciers that covered the Puget Sound region (Booth and Herman 1998). Sediment originating from the Osceola mudflow off Mt. Rainier as well as other sources from surrounding mountains and hills was carried into the valley by the ancestral White River over a period of several thousand years. Between 1913 and 1917, the LDW was created by dredging a channel for the waterway and filling adjacent floodplain areas. Fill was placed using both mechanical and hydraulic methods, and consisted primarily of dredge spoils produced during channelization of the LDW. Fill materials may have included soil and other geologic materials that were a by-product of other land development projects inland from the Duwamish River, such as re-grading projects, as well as other waste materials of the time including refuse. Glacial scouring, natural sedimentation, earthquakes, and human engineering projects have all influenced the geology of T-108 and surrounding areas. Numerous subsurface investigations have been completed which have identified the various hydrogeologic components that comprise the subject property.

A review of soil borings logged during development of monitoring wells on the property indicate that the shallow hydrostratigraphic units present at T-108 consist of fill materials underlain by tidal marsh deposits (Pacific Groundwater Group 2007a). The fill material was reported as a predominantly heterogeneous deposit extending from the ground surface approximately 10 to 15 feet to the top of the tidal marsh deposits (Pacific Groundwater Group 2007a; Dames & Moore 1988). The upland fill is described as brown to black, loose to medium dense, moist to wet, very fine to medium-grained sand and silty sand (AGI 1992a; Pacific Groundwater Group 2006c). The fill includes zones of significant organic content, localized cementation, and variations in percentage of silt and gravel content. During subsurface investigation at the property, the fill was

usually identified by the presence of significant volumes of sand and anthropogenic materials, with a lack of peaty material. The fill potentially consists of hydraulic fill, dredge spoils from the former river channel, and potentially some volume of sewage sludge (Port of Seattle 1992a).

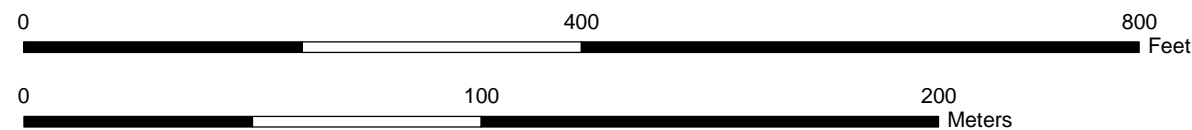
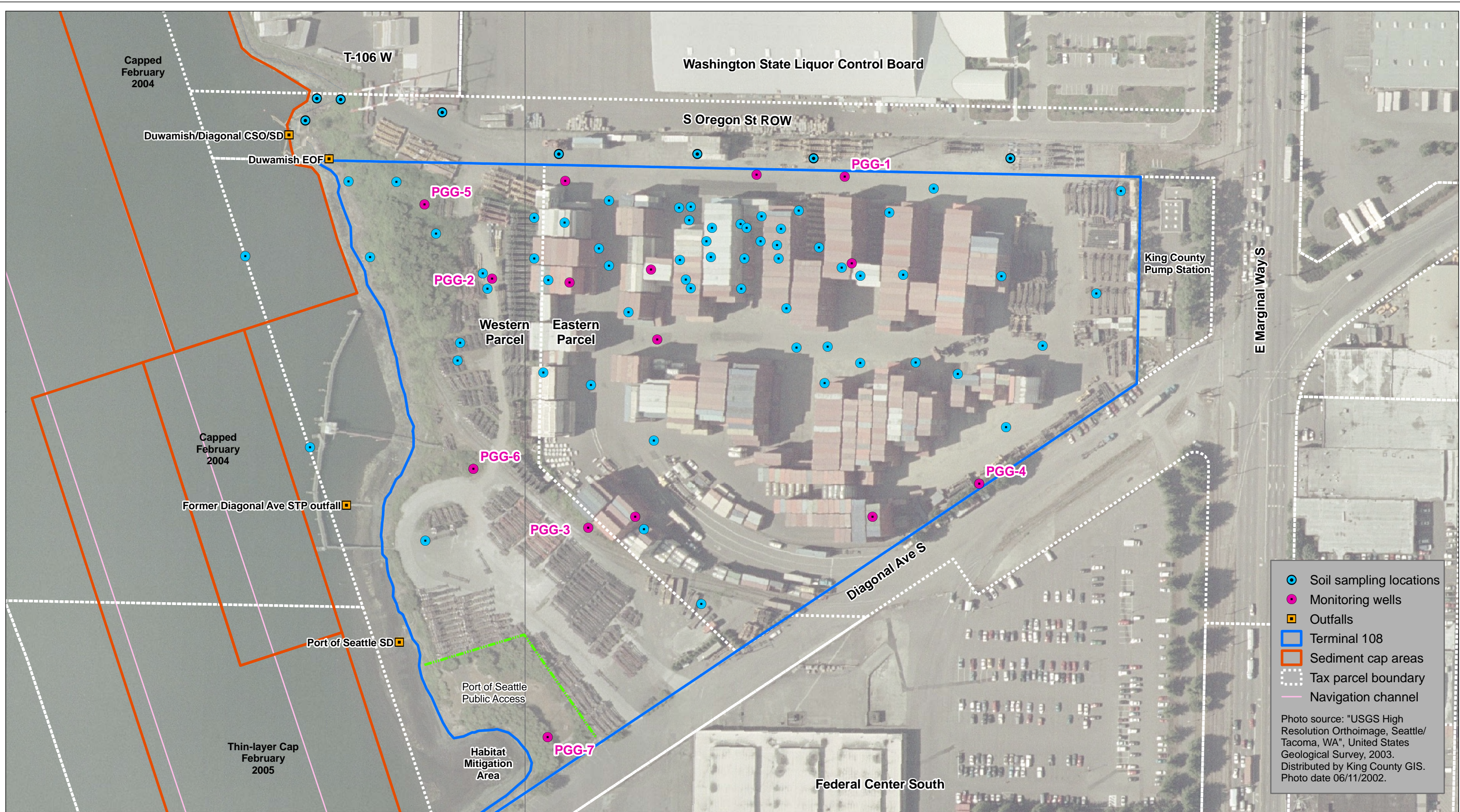
During advancement of monitoring wells on the property in 2006, tidal marsh deposits were distinctive and easily identified as compact silts intermixed with peaty grass and root materials (Pacific Groundwater Group 2006c). The tidal marsh deposits were described as compact sandy silt with peat (organic material). Outcrops of tidal marsh deposits are visible along the shoreline near mean sea level (Appendix A, Photo 14). In the observed outcroppings, the deposits consist of sandy silt with a high organic content (peat). The tidal marsh deposits underlie the fill material at T-108 from between 10 to 20 ft below ground surface (bgs). These deposits are brown to gray, very soft to soft, moist to wet, and composed of organic silts and clays.

Along the T-108 shoreline, various outcrops of fill that lacked peaty material was identified. The fill was described as silty sand predominantly gray in color containing significant amounts of sand and anthropogenic materials. Tidal marsh outcrops were also identified near mean sea level along the shoreline. These deposits are generally light brown in color and peat material is often visible. Boring logs from past subsurface investigations for the T-108 subject property are contained in Appendix C.

Several previous investigations have identified and described the alluvial deposits that underlie the marsh deposit layers. The alluvial deposits represent remnants of the former Duwamish River channel, of which the subject property was a part prior to development of the LDW. The alluvial materials range from black, loose, wet, fine grained sands to gray, medium stiff, wet, and very fine grained sandy silts (Pacific Groundwater Group 2006c).

2.3.2 Hydrogeology

The fill layer discussed in Section 2.3.1 is the uppermost water-bearing unit of the subject property. This unit is often referred to as the shallow aquifer in investigation documentation. Monitoring wells installed on T-108 have been completed in this shallow aquifer unit (Appendix A, Photo 6 is a representative groundwater well at T-108); groundwater is typically observed in this unit at approximately 10 ft bgs. Groundwater near the LDW within this shallow unit is tidally influenced. Groundwater flow patterns in the shallow aquifer have been observed over the course of several years of investigation; groundwater appears to flow radially from a relative high in the north-central portion of the subject property (roughly between groundwater monitoring wells PGG-1 and PGG-2 on Map 3).



Map 3. Groundwater well and soil sampling locations

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Table 1 provides a summary of water level measurements over time for PGG wells 01 through 07 at the subject property. These seven wells are the most recently completed wells at the property and analytical information from these well locations is considered the most representative of current conditions at the subject property relative to source control. A groundwater contour map based on levels from these wells locations is provided as Map 4. Successive mapping of the groundwater contours at the subject property derived from years of investigations have indicated that groundwater in the shallow aquifer in the Western Parcel generally flows toward the LDW. However, in the Eastern Parcel, groundwater moves from a relative high in the center of the Eastern Parcel radially in all directions, but predominately to the north and east.

Table 1. T-108 groundwater and shoreline soil investigation monitoring well construction and water level summary

PARAMETER	PGG-1	PGG-2	PGG-3	PGG-4	PGG-5	PGG-6	PGG-7
General							
Ecology unique ID	APQ 005	APQ 002	APQ 004	APQ 006	APQ 007	APQ 003	APQ 001
Installation dates	6/6/2006	6/5/2006	6/5/2006	6/6/2006	6/6/2006	6/5/2006	6/5/2006
Development volume, gallons (approx.)	1.75	6.25	35	<0.5	15	25	20
Bailed dry at, gallons (approx.)	1	3.75	NA	<0.5	NA	NA	NA
Coordinates^a							
Northing	209009.5	208857.2	208484.3	208550.9	208967.95	208572.9	208171.9
Easting	1267978	1267451	1267595	1268180	1267349.68	1267423	1267534
Elevations^b							
Monument elevation (north rim)	15.4	19.25	13.68	15.59	23.45	15.53	12.59
Measuring point (PVC) elevation	15.04	18.82	13.26	15.21	22.81	15.03	12.24
Top of screen elevation	11.9	15.8	10.2	12.1	12.6	12	8.6
Bottom of screen elevation	5.4	8.8	2.7	5.6	2.6	3	2.1
Depths							
Top of screen, feet bgs	3.5	3.5	3.5	3.5	8	3.5	4
Bottom of screen, ft bgs	10	10.5	11	10	18	12.5	10.5
Depth of borehole, ft bgs	10.5	14	13.5	10.5	20	13	14
Round 3 Water Level Snapshot – 2/19/07							
Time of measurement	9:19 a.m.	10:12 a.m.	NA	9:33 a.m.	10:22 a.m.	10:04 a.m.	9:45 a.m.
Depth to water (ft bgs)	8.84	7.39	NM	8.34	17.9	9.17	5.99
Groundwater elevation ^b	6.2	11.43	NM	6.87	4.91	5.86	6.25
Time of tide observation ^c	9:18 a.m.	10:12 a.m.	NA	9:30 a.m.	10:24 a.m.	10:06 a.m.	9:42 a.m.
Tide elevation ^{b2}	8.29	6.19	NA	7.83	5.73	6.41	7.34

Round 4 Water Level Snapshot – 5/29/07							
Time of measurement	8:54 a.m.	9:35 a.m.	NA	9:08 a.m.	9:25 a.m.	9:45 a.m.	10:01 a.m.
Depth to water (ft bgs)	9.13	9.22	NM	8.96	18.93	9.69	6.74
Groundwater elevation ^b	5.91	9.6	NM	6.25	3.88	5.34	5.5
Time of tide observation ^c	8:54 a.m.	9:36 a.m.	NA	9:06 a.m.	9:24 a.m.	9:42 a.m.	10:00 a.m.
Tide elevation ^b	0.33	-0.46	NA	0.04	-0.31	-0.54	-0.68

^a Horizontal datum: NAD 83/(91), Washington Coordinate System, North Zone, based on the published coordinate values of WSDOT Monument No. 3295 and WSDOT No. 3294 as published on the WSDOT Website during September 2006.

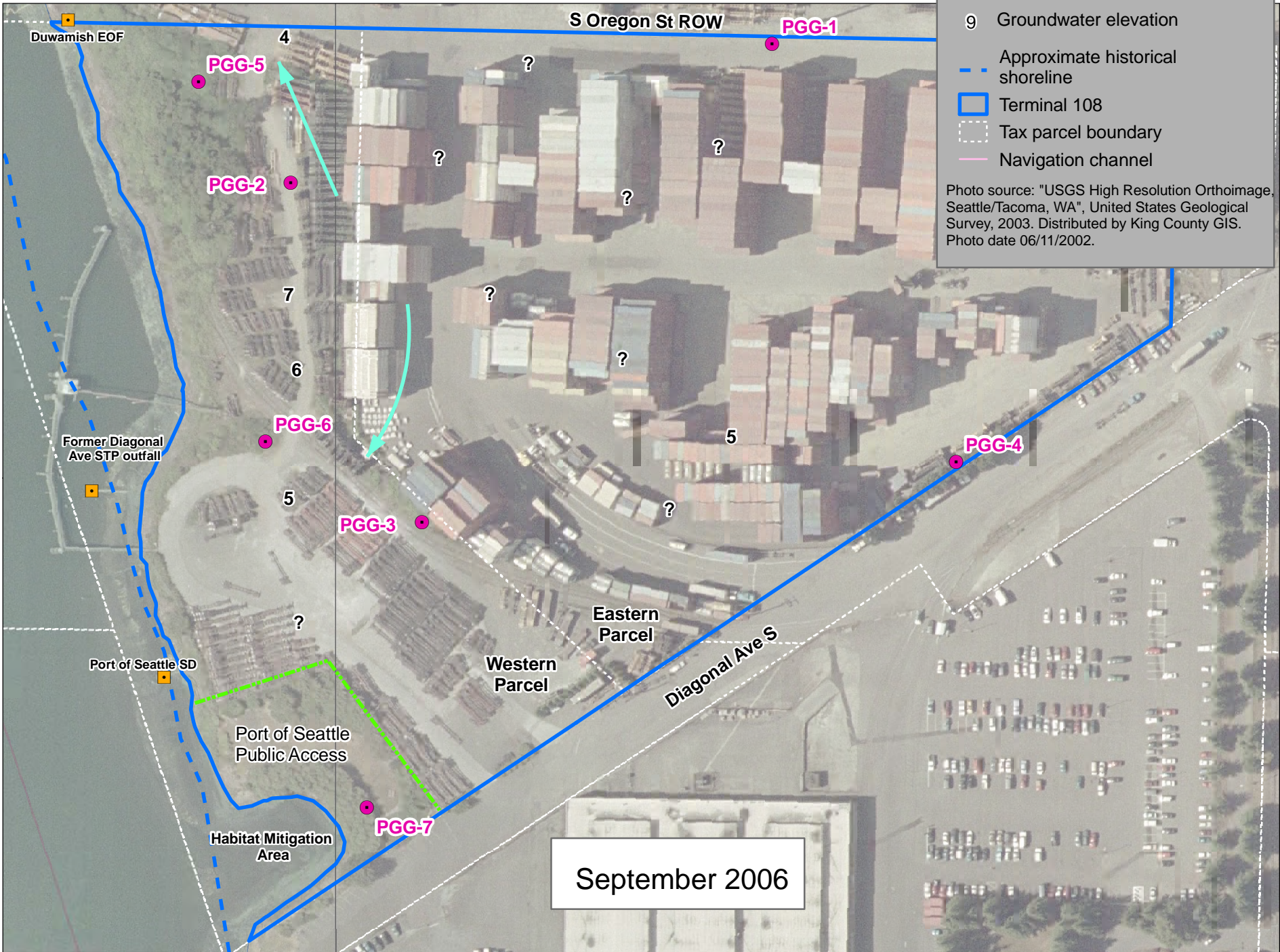
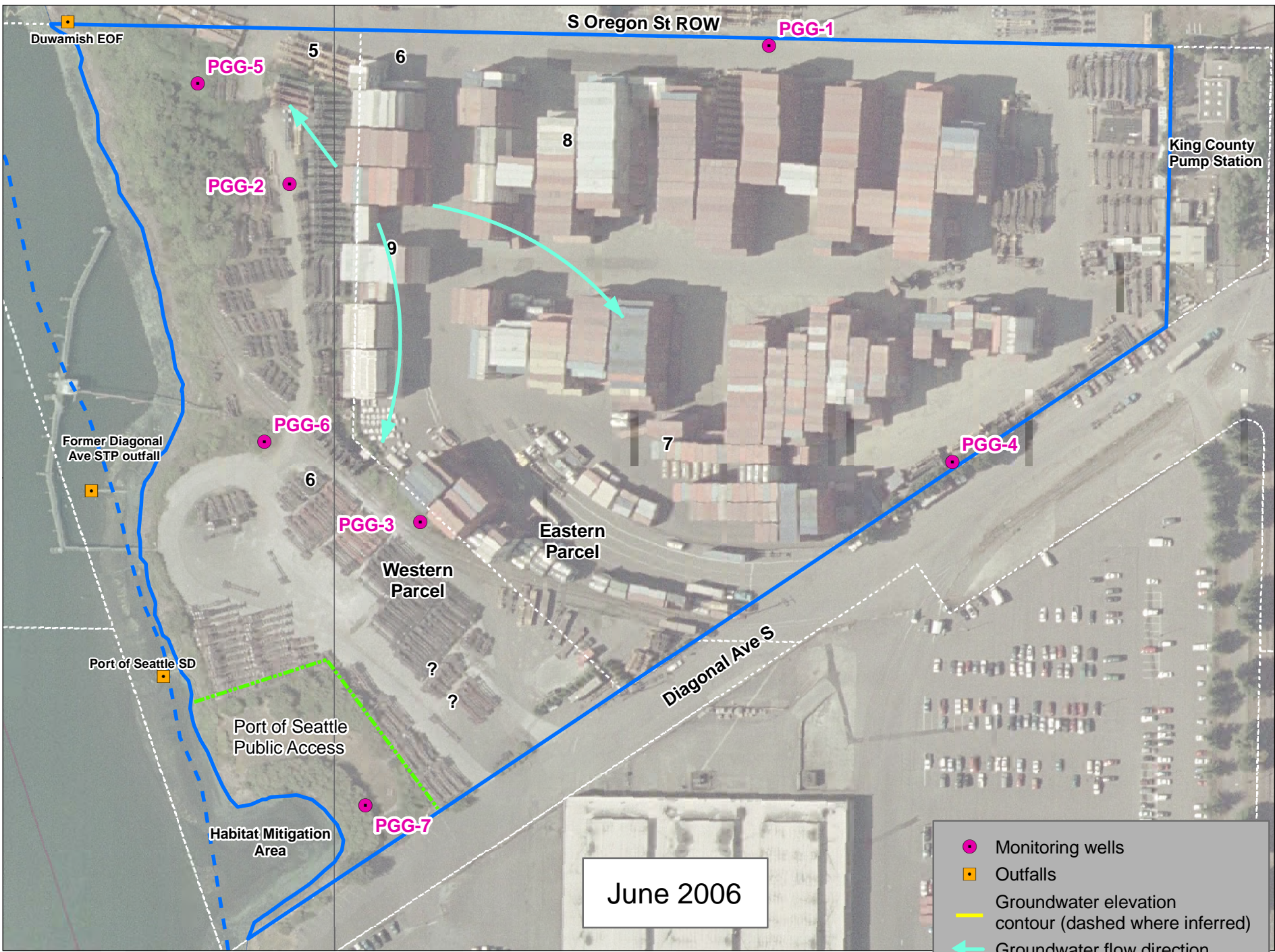
^b Vertical Datum: MLLW. Elevations (monument, measuring point, top of screen, bottom of screen) presented in this table are correctly reported to MLLW and should replace elevations incorrectly presented in the Interim Report (PGG, 2006).

^c Observed tide at Seattle Station ID 9447130 (ferry terminal) as reported by NOAA.

bgs – below ground surface; NM – not measured, PGG-3 wellhead damaged before Round 3

ID – identification

PVC – polyvinyl chloride



Historical aerial photographs of the subject property (see Appendix B) identify a former tidal channel that extended from the LDW, along or adjacent to the north of the present day S Oregon Street ROW, and into the subject property (AGI 1992a). It is unclear where the channels exact terminus existed, but some of the aerial photographs indicate it may have extended to E Marginal Way S and potentially received runoff from the street and areas farther east. One source reported that the channel received untreated sewage discharge from small sewer system that was located to the northeast of T-108 (King County et al. 2005a). The aerial photograph from 1946 (Appendix B) shows a facility located to the northeast of T-108 along Diagonal Avenue S that may represent this reported sewer system; however, this could not be confirmed during the course of this investigation.

The tidal channel entered the subject property along the eastern boundary and extended through the northeast portion of the Eastern Parcel, passing outside of the property boundary near the center of the northern boundary of the parcel (near PGG-1; see map 3 for reference). Based on available information, the channel was likely filled between 1962 and 1976 (Pacific Groundwater Group 2006a); the channel was most likely backfilled when the Duwamish/Diagonal CSO/SD stormwater and sewer lines were installed in 1966 and 1967 (King County et al. 2005a).

Assuming that coarse-grained materials were used as backfill, the relic channel may be locally influencing groundwater flow in the shallow aquifer unit by providing a preferential pathway for flow. Ultimately the discharge point for this flow path is most likely the LDW, near the present day location of the Duwamish/Diagonal CSO/SD and the Duwamish emergency overflow (EOF).

2.4 INFRASTRUCTURE AND CONSTRUCTED SITE FEATURES

Current T-108 site features are associated with the existing container storage and maintenance facility on the Eastern Parcel and a former parking lot and bulk cement terminal on the Western Parcel, plus areas of chassis and miscellaneous material storage. The container storage and maintenance facility on the Eastern Parcel includes a paved and graveled container storage yard, a paved maintenance area, and access roadways and railway spurs for loading and unloading cargo. In total, approximately nine acres of paved area are used for cargo container storage operations and approximately five acres are graveled (the nine acres of paving includes areas in the S Oregon Street ROW and T-106W not included in the acreage of the subject property).

A four-lane entry extends from Diagonal Avenue S into the southern portion of the Eastern Parcel (Map 2). Access to the northern portion of the T-108 cargo yard can be gained from the Diagonal Avenue S ROW. The T-108 container storage and maintenance facility is linked to the adjoining T-106W, located to the north, by an access roadway extending the S Oregon Street ROW. An office trailer is located in the southeast corner of the maintenance yard in the Eastern Parcel but no permanent structures have been constructed on the Eastern Parcel. The Eastern Parcel is

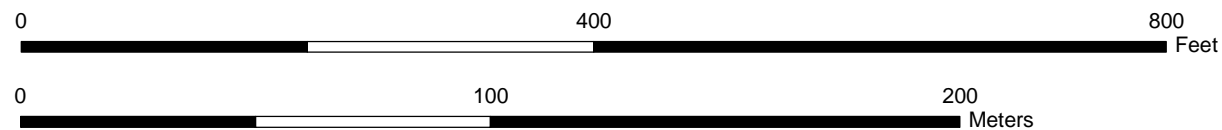
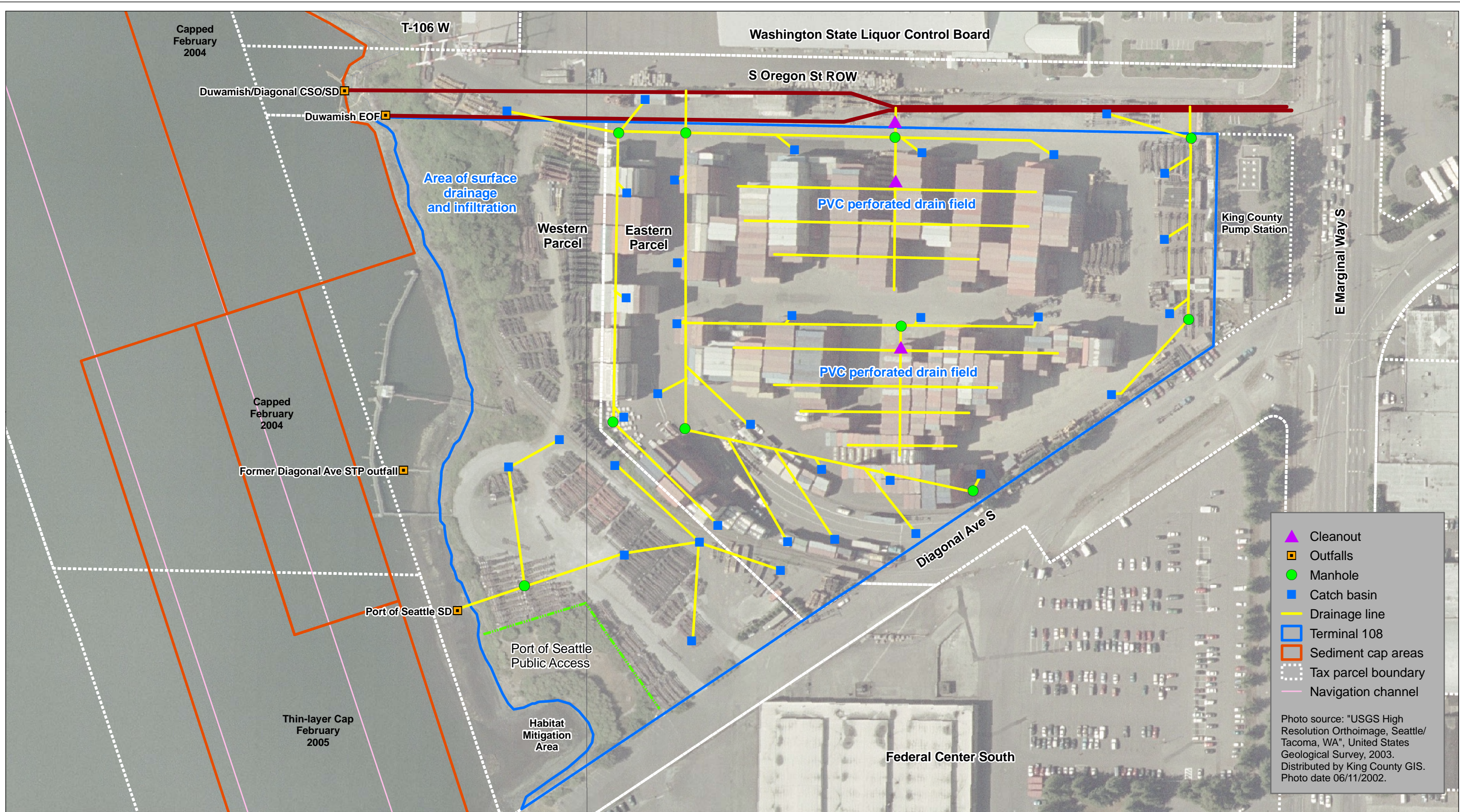
surrounded by chain-linked fencing and light posts are dispersed throughout the container yard.

A network of storm drainage lines, catch basins, manholes, and oil/water separators support drainage for the paved and graveled areas of the Eastern Parcel. The drainage system was installed in 1993 by the Port when the Port redeveloped the property for use as a container storage yard. The drainage system consists of City of Seattle-approved catch basins in a 100-ft by 150-ft grid pattern. Lines of highway grade perforated polyethylene pipe were installed beneath the areas of gravel during redevelopment of the property to collect stormwater that infiltrates in the areas where the cargo containers are stored. The perforated pipes are located approximately 2.5 ft bgs (note that the highest groundwater level measured at T-108 in 2007 was 5.99 ft bgs [Table 1]); therefore, groundwater is not expected to infiltrate the perforated piping). The perforated pipes interconnect with a combination of 18- and 24-inch-diameter pipes that collect stormwater runoff in the paved areas supported by the catch basins. All stormwater collected in the Eastern Parcel is routed through an approved oil/water separator prior to discharge into the Duwamish/Diagonal SD piping beneath the S Oregon Street ROW. This piping ultimately discharges into the LDW 100 ft northwest of the subject property. Surface runoff from the Eastern Parcel tends to collect in the eastern portion of the site (within the area of the maintenance yard) which is topographically lower than the remainder of the property (Pacific Groundwater Group 2006c).

ConGlobal maintains an industrial stormwater NPDES permit (No. SO3-010569) and has prepared a stormwater pollution prevention plan (SWPPP) to manage stormwater discharges to the Duwamish/Diagonal CSO/SD system. Additional information on the NPDES permit and SWPPP is included in Section 3.6.

Improvements on the Western Parcel of T-108 are primarily associated with its former uses. The southern portion of the Western Parcel was paved in the early 1960s for use as a parking lot (Port of Seattle 1988). A drainage system consisting of catch basins and a storm drain (Port outfall 2225) was also installed at this time to drain stormwater from the parking lot (Map 5).

In the early 1990s, Lafarge Canada, Inc. (Lafarge) installed a bulk cement terminal on the Western Parcel. The terminal was installed on existing paved areas (a former parking lot) which drained to an existing SD outfall. A catch basin was installed by Lafarge for the truck wash-down area; this catch basin was plumbed to the sanitary sewer (Port of Seattle 1988). The paved areas and catch basins, as well as remnants of the truck wash-down area, remain on the Western Parcel. In addition, Lafarge constructed a pier and pneumatic conveyor system offshore of T-108 in approximately the center of the shoreline. These features are still present although not currently in operation (Map 2).



Map 5. Stormwater drainage networks

FINAL

A railroad spur, approximately 1,100 feet long, spans both the Eastern and Western Parcels of T-108. The spur extends from the southern property boundary and crosses Diagonal Avenue S before joining the existing Union Pacific Railroad track on the south side of Diagonal Avenue S. On T-108, the spur extends west and north to a loading platform in the northwest corner of the Western Parcel. On the Eastern Parcel, the rail spur runs along the boundary between the two parcels and terminates near the northern property border. The rail spur is not currently in use. Chain link fencing borders the majority of T-108 (both the Eastern and Western Parcels).

3 Property Ownership and Operational History

The area currently comprising T-108 was created from the flood plain of the Duwamish River between 1913 and 1917, at the time of construction of the LDW; however, based on historical aerial photographs, the site was otherwise undeveloped as of 1936 (Appendix B). The first documented development and use of the site occurred in 1938 when the property was developed as the Diagonal Avenue S STP.

Over the years the property has been used for various industrial purposes and has had several different owners and operators. Since 1980, ownership and operation of the property has been split between two parcels, an Eastern Parcel and a Western Parcel (Map 2). Both parcels are currently owned by the Port. The Eastern Parcel is approximately 11 acres in size and the Western Parcel is approximately 9 acres in size.

Information in this section is derived from documents on file at Ecology and the Port, as well as historical documentation of the Diagonal Avenue S STP (Brown and Caldwell 1958), documents prepared in association with the Duwamish/Diagonal CSO/SD sediment area cleanup, and documents prepared as part of the source control strategy for the LDW. Information from documentation on site use at T-108 prior to the Port's ownership period (beginning in 1980) is included when available. Several of the documents reviewed for information on property development and use were planning documents prepared for the purposes of acquiring permits. In some cases it is unknown whether all planned development activities were completed. Several historical sources provided conflicting or incomplete information. The property ownership and operational history presented for T-108 in this report are intended to be as complete and accurate as possible; however some inaccuracies and uncertainties may be present and are identified accordingly. Figure 1 provides a visual timeline of the subject property's ownership, operational, and environmental investigation history.

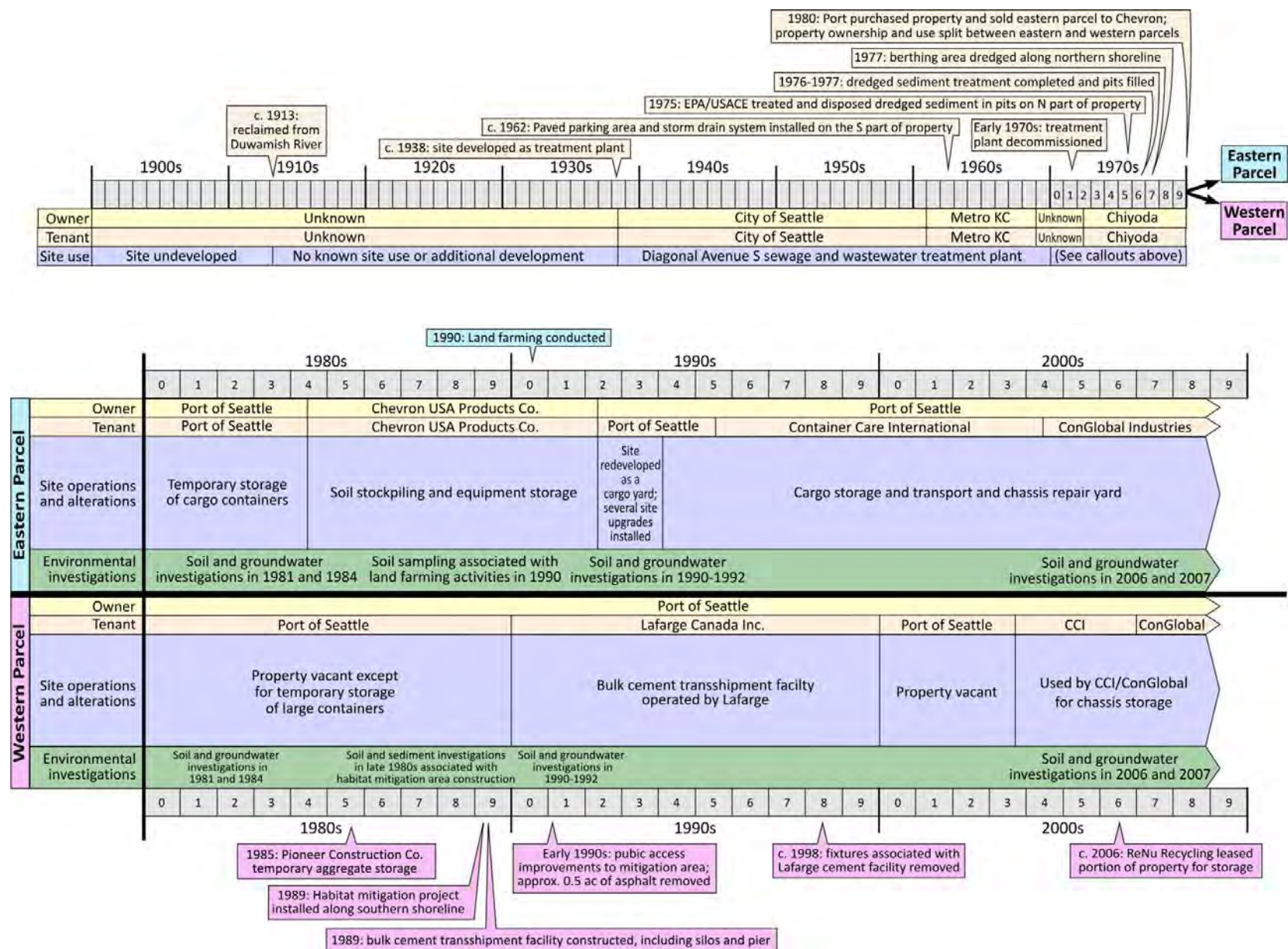


Figure 1. T-108 timeline: ownership, operations, and environmental investigations

3.1 PRE-INDUSTRIAL HISTORY

Until the 1850s, the Duwamish River and surrounding areas supported fishing, hunting, and trapping activities of various Native American Tribes. Historically, the Black, Green, and White Rivers all contributed to the flow of the Duwamish River, with the Black and Green Rivers being tributaries to the White River, which was tributary to the Duwamish. The original Duwamish drained an area of approximately 1,640 square miles as it meandered through grasslands, floodplains, wetlands, and tidal marshes prior to emptying into Elliott Bay.

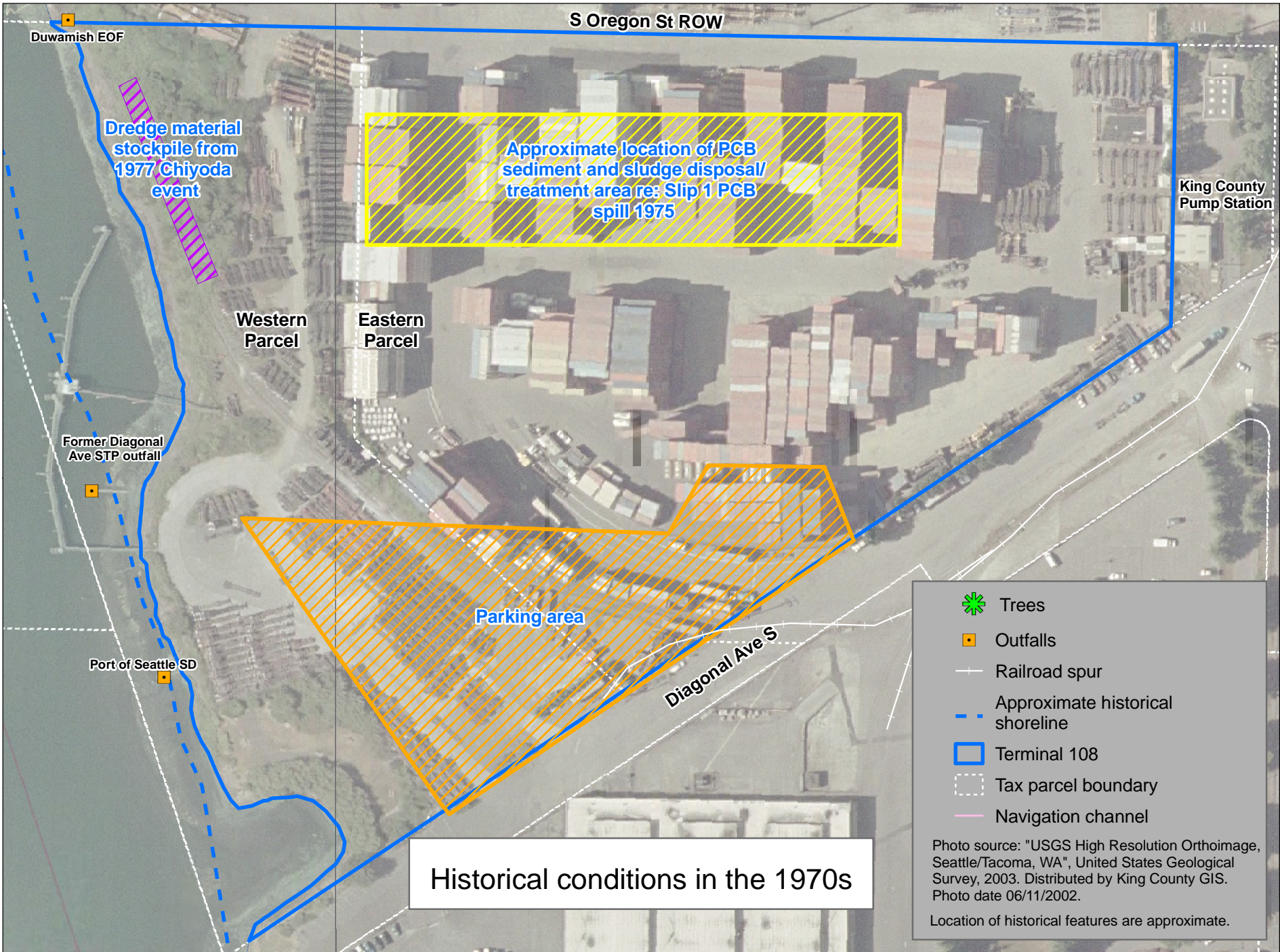
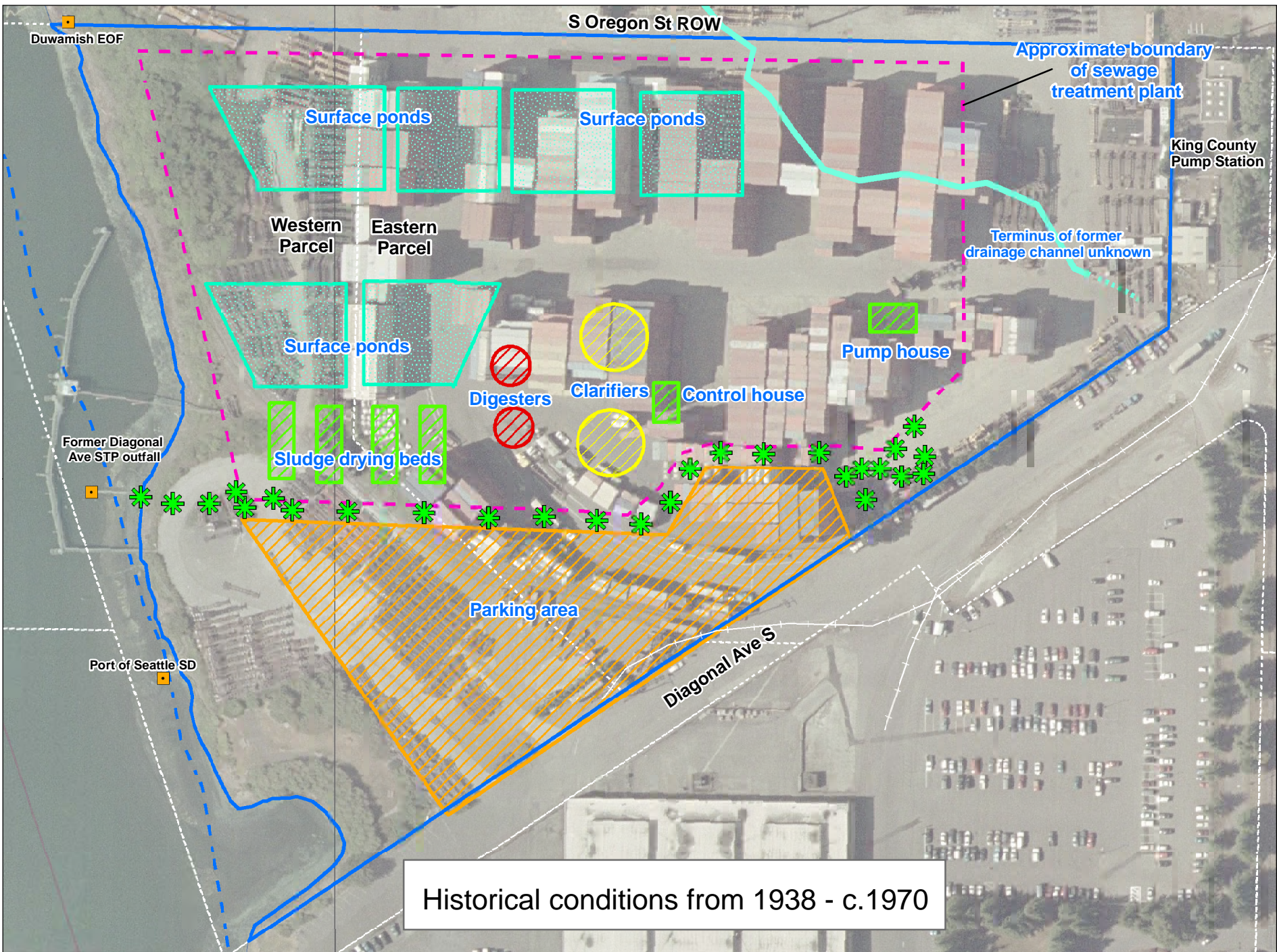
People of European descent arrived in the region in the 1850s and began clearing the shoreline and draining the adjacent freshwater and tidal marshes to facilitate farming activities. Logging emerged as a profitable venture, and docks and shipping infrastructure were built along the banks of the Duwamish. Because flooding in low-lying areas remained a concern in the early 1900s, levees and dams were installed to control water flow. Additional efforts to control river flooding led to several changes in the hydrology of the Duwamish River. The White River was diverted to the Puyallup River, the Cedar River was rerouted to flow into Lake Washington, and the Black River was reduced to a small stream with the construction of the Lake Washington Ship Canal and the resulting lowering of the water level in Lake Washington. The Green River remained as the only tributary to the Duwamish River.

Between 1913 and 1917, the Duwamish River was channelized and dredged to form the LDW. The land on which T-108 now exists was once tidal marsh that was reclaimed through the placement of fill materials during this time period (AGI 1992b, citing Dames and Moore 1981). Channelization and dredging of the river increased the levels of industrialization of the area as berthing of large ocean-going vessels became possible. Commercial interest of the waterway's shoreline expanded, and residential areas sprung up in what had been farmland adjacent to the river.

The first known use of the T-108 property was as the Diagonal Avenue S STP, owned and operated by the City of Seattle until 1962. The plant began operations in 1938 (Ecology 2004a). Documentation regarding the use of the T-108 property prior to 1938 has not been identified.

3.2 DIAGONAL WAY SEWAGE TREATMENT PLANT

From 1938 to 1962, the City of Seattle operated the Diagonal Way STP on the current location of the T-108 subject property. Between 1962 and 1969, Metro assumed operation of the facility and made improvements to the plant (King County et al. 2005a). This facility had the capacity to receive eight million gallons of sewage and stormwater per day (mgd) and was the primary sewage treatment and discharge facility for the industrialized and downtown portions of the City of Seattle. The location of the treatment plant is shown on Map 6 (approximate locations of major facility features) and in aerial photos from 1946, 1953, 1961, and 1970 (Appendix B).



Treatment facilities comprising the treatment plant included two large clarifiers and two digesters located in approximately the center of the subject property, glass-covered sludge drying beds to the west of the clarifiers and digesters, a control house adjacent to the east of the clarifiers and digesters, and a pump house on the eastern portion of the property (TAMS 1992; Brown and Caldwell 1958) (Map 6; Appendix B – 1946 aerial). The pump house associated with the Diagonal Avenue S STP is different from the current King County pumping station located adjacent to and east of present day T-108.

As mentioned previously, historical aerial photographs identify a former tidal channel that extended from the LDW, along or adjacent to the north of the present day S Oregon Street ROW, and into the subject property (AGI 1992a). According to information on the construction and operations of the Diagonal Avenue S STP, this drainage channel was not used for water intake or effluent discharge from standard plant activities. The channel may have received untreated sewage from a small sewer system located to the northeast of T-108 (King County et al. 2005a), not associated with the Diagonal Avenue S STP.

Historically, a raw sewage trunk line extending west from E Marginal Way S carried wastewater to the former control house and clarifiers. Wastewater was treated in the clarifiers and digesters and the sludge was then pumped into open ponds and drying beds on the northern portion of the property (Dames & Moore 1988). The size, location, and configuration of the sludge ponds changed over the years as observed in aerial photographs (Appendix B). Primary-treated effluent was discharged into the LDW through a 30-inch steel outfall located approximately mid-way along the property shoreline (see former Diagonal Avenue STP outfall 2002 on Maps 2 and 6; Appendix A, Photo 14; and Appendix B). A parking lot area was constructed on the southern portion of the property around 1962 (Port of Seattle 1988). A drainage system was installed in association with the parking area, including an 18-inch concrete outfall (Port outfall 2225 on Map 2).

The Diagonal Way STP was closed by 1970 when construction of the West Point Wastewater Treatment Plant (WWTP) was completed and sewage and wastewater was re-routed to that facility. As part of the construction of the West Point facility, the Duwamish Pumping Station was constructed adjacent to and east of T-108 and the Diagonal Way CSO/SD and Duwamish EOF were installed beneath the S Oregon Street ROW. The structures and above-ground clarifiers were demolished and removed in the early-1970s. The digesters were reportedly filled and left in-place (Port of Seattle 1992a). Sludge up to five feet thick was left in the sludge ponds and drying beds on the northern portion of the property and subsequently covered with fill material (Dames & Moore 1988; AGI 1992b). The source of the fill material has not been identified during the review of historical documentation.

3.3 CHIYODA CORPORATION INTERNATIONAL OWNERSHIP (c. 1972-1980)

Chiyoda acquired the T-108 subject property in the mid-1970s and planned to construct a chemical manufacturing plant with a loading dock on the site. Although shoreline dredging was conducted by Chiyoda in anticipation of the manufacturing plant, it was never constructed because the company failed to acquire the necessary permits for the shore-based dock (King County 2002).

In 1974, approximately 265 gallons of PCB oil consisting of Aroclor 1242 were spilled into Slip 1 of the LDW (upstream of T-108) when an electrical transformer owned by the United States Air Force was damaged while being loaded onto a barge owned by the Alaska Puget United Transportation Company under contract to the Navy Military Sea Transportation Service (King County et al. 2005a; EPA 1975). Neither the US government nor the Puget United Transportation Company would claim responsibility for the spill, so EPA took control as the On-scene Coordinator for the spill cleanup. The majority of the spilled PCB material (approximately 250 gallons) was dredged from the bottom of the LDW and transferred to a trailer mounted portable treatment plant stationed on the southern portion of the Federal Center South facility.

Additional dredging was conducted by EPA and USACE between 1974 and 1976 to remove LDW sediments contaminated with the residual PCB material (approximately 20 gallons not removed during the initial cleanup effort). According to the interim groundwater and shoreline soil investigation final work plan report completed for T-108 by PGG, Chiyoda agreed to allow the EPA and USACE to store and treat approximately 10 million gallons of dredged sediment slurry on the subject property (Pacific Groundwater Group 2006c). A historical record of this agreement was not identified through the course of this investigation.

To accommodate treatment and disposal of the dredged sediment, USACE excavated two pits were excavated on the northern portion of the T-108 property near the location of a large former sludge pond (see Map 6 and Appendix B). The pits were reported by the Pacific Groundwater Group (PGG) to have been excavated to depths of 10 to 12 ft deep based on a review of a 1976 topographic map (2006c). PCB-contaminated sediment slurry was pumped into the southwest corner of the western pit where solids were allowed to settle out. The liquid portion of the slurry was then decanted into the eastern pit and pumped to a holding pond and treatment unit. From there it was pumped back into the LDW. PCB Aroclor 1242 concentrations in the dredged sediment within the western pit ranged from 146 mg/kg at the slurry intake point in the southwest corner of the pit, to 33 mg/kg in the pit interior (Pacific Groundwater Group 2006c). The location of the holding pond and treatment unit are not known.

The sediment treatment process was completed and USACE filled the pits by 1977. After treatment, water was pumped back into the LDW, however the solids that had settled out within the holding pits (primarily the western pit) were left in place and the pits were subsequently covered with fill material (Pacific Groundwater Group 2006c).

The fill consisted of the material excavated during pit construction and from other sources (see paragraph that follows). It has been estimated that between 7,000 and 8,000 cy of sediment dredged during the PCB spill cleanup were buried in the holding pits, and that in total, this included approximately 170 gallons of PCBs (Pacific Groundwater Group 2006c). In 1980, Chiyoda sold the T-108 property to the Port.

In 1977, Chiyoda cut back and dredged the northern portion of the T-108 shoreline to improve berthing (see Appendix B); the new shoreline was approximately 100 ft further inland from the extent of the shoreline before dredging (King County 2002). It is estimated that 80,000 cubic yards (cy) of material was dredged from the area (King County et al. 2005a). Based on a review of historical aerial photographs, it appears that the southern extent of the dredging likely ended in the vicinity of the former Diagonal Avenue S STP outfall (Maps 2 and 6). Dredged material was stockpiled on the northern portion of the Western Parcel (see Map 6 for approximate location), and was also used to fill the dredged sediment pits, fill nearshore areas, and level the site of the former Diagonal Way STP.

3.4 OWNERSHIP AND OPERATIONAL HISTORY (1980-2008) – EASTERN PARCEL

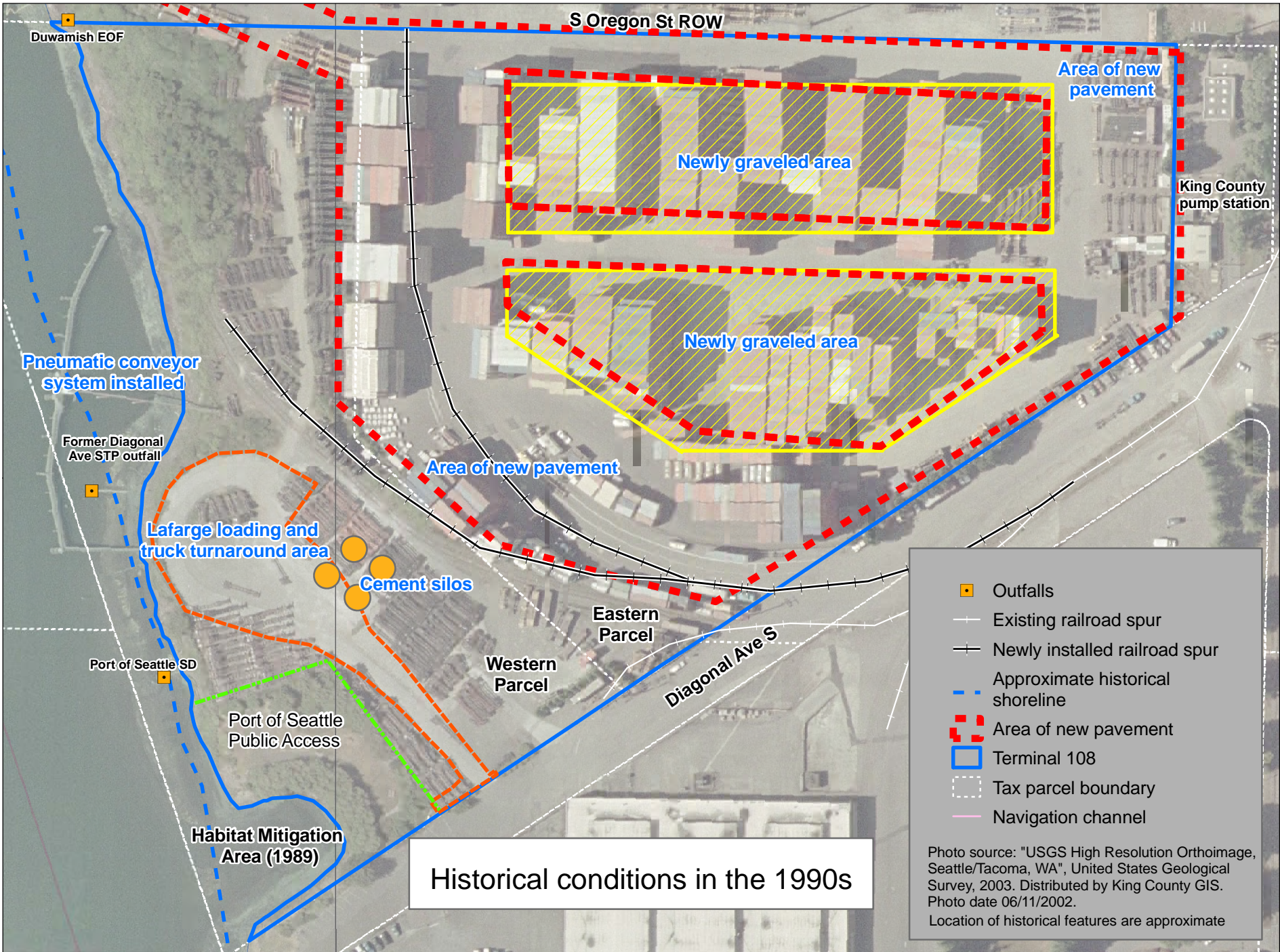
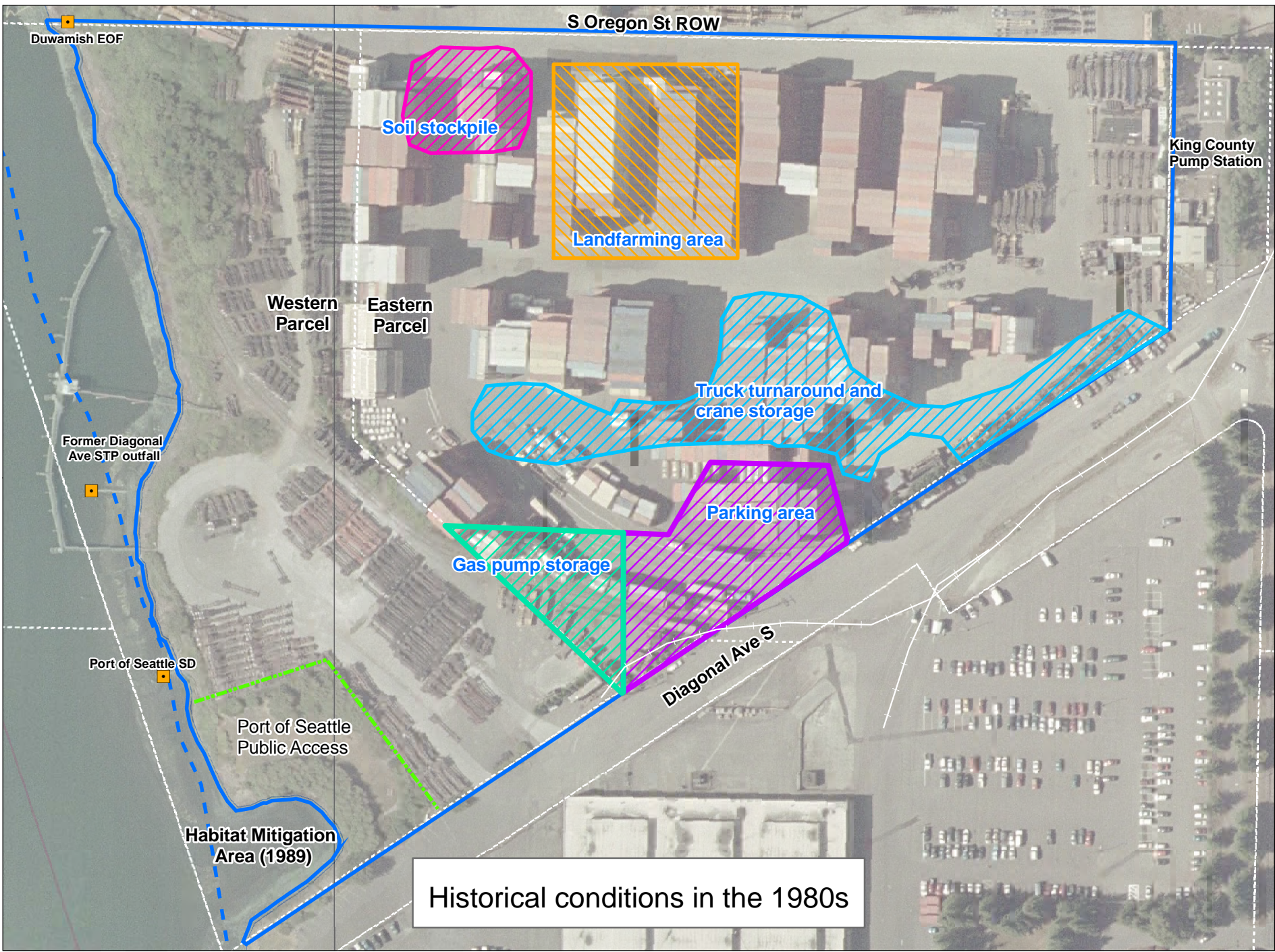
The subject property was first subdivided into the Eastern and Western Parcels in the early 1980s. Since that time, ownership of the Eastern Parcel traded between the Port and Chevron a few times in the 1980s and 1990s. Since 1992, the Eastern Parcel has been owned by the Port and leased as a container terminal.

3.4.1 Port of Seattle Ownership (1980-1984)

The Port acquired the subject property from Chiyoda in 1980. Based on a historical aerial photo from 1981, the paved southern portion of the property and a small area in the central portion of the property were used for container storage (Appendix B). No additional information regarding the use of the Eastern Parcel during this time period was identified.

3.4.2 Chevron USA Products Company Ownership (1984-1992)

In 1984, Chevron USA Products Company (Chevron) acquired the Eastern Parcel of T-108 as part of a deal in which the Port acquired Pier 32 (formerly Terminal-30/Chevron). This is the first time that property ownership was split between the Eastern and Western Parcels. Chevron used the Eastern Parcel from 1984 to 1992 to stockpile soil and store equipment. Gasoline station equipment, including cranes and gasoline pumps, were stored on the southern portion of the parcel (Map 7) (Port of Seattle 1992a). The area was also used for automobile parking. One or two mobile office trailers were located on the Eastern Parcel during Chevron's ownership. Soil stockpiles and equipment storage areas are visible in aerial photographs from 1990 (Appendix B).



The northwestern portion of the parcel was used by Chevron to treat soil contaminated with petroleum hydrocarbons using a technique called land-farming for approximately six months in 1990. Approximately 1,400 cy of soil excavated from a local service station that had been contaminated by a leaking underground fuel storage tank was treated by land-farming (Thorne Environmental 1990); the approximate location where the land-farming activity occurred is presented on Map 7 and visible on the aerial photograph from 1990 (Appendix B).

Prior to the onset of land-farming activities, analytical samples were collected from the soil stockpile and the surface soil in the proposed land farming area. Total petroleum hydrocarbons (TPH) were detected above Ecology cleanup standards of 200 parts per million (ppm) in the soil stockpile (Thorne Environmental 1990) (Appendix C). Total xylenes, ethylbenzene, barium, and cadmium were also detected in the soil stockpile; PCBs, benzene, toluene, arsenic, chromium, lead, mercury, selenium, and silver were not detected (Thorne Environmental 1990). Gasoline and benzene, toluene, ethyl benzene, and xylene (BTEX) constituents were not detected in surface soil samples collected from the proposed land-farming location; however, PCBs were detected in five out of the six samples (with a maximum total PCB concentration of 6.90 ppm) (Pacific Environmental Group 1991).

The soil was placed in a 200-square ft area located at approximately the same location as the PCB dredge sediment disposal pits that were created to treat impacted sediment from the 1975 PCB spill at Slip 1. The aerial photo from 1990 shows the land farming area in the northern portion of the parcel (see Appendix B). Prior to placing the petroleum-contaminated soils onsite, a clay cap was installed in the designated land-farming area (Map 7) to prevent the possibility of contaminating the soils to be land-farmed with other contaminants that might have been present on the property (Dames & Moore 1988). The clay cap had a surface approximately two ft thick and varied from an elevation of approximately 15 to 17.5 ft (Dames & Moore 1992). The soil was land-farmed until petroleum hydrocarbon concentrations in the soil were below MTCA Method A cleanup screening levels. TPH concentrations of the land-farmed soil ranged from 42-190 mg/kg, TPH-gasoline concentrations ranged from non-detected to 28 mg/kg, and BTEX constituents were not detected (Pacific Environmental Group 1991) (Appendix C). The stockpiled soil was distributed on the Eastern Parcel of T-108 to a thickness of approximately 1 to 2 ft (Dames & Moore 1992).

After land-farming activities were completed, soil samples were also collected beneath the treatment area to determine whether native soil conditions had been affected by land-farming activities (Appendix C). TPH concentrations ranged from 15 to 100 mg/kg, TPH-gasoline was not detected, and BTEX constituents were not detected (Pacific Environmental Group 1991). PCB 1248 was detected at concentrations ranging from 106 to 9.3 mg/kg. These results suggest that native soil was contaminated with TPH because of land-farming activities but that the contamination was below Ecology cleanup levels.

In 1992, the Port purchased the Eastern Parcel of T-108 back from Chevron and redeveloped the property for use as a container terminal. Permitting documentation for development of the container terminal indicated that the land-farmed soils would be removed and disposed of at an approved off-site facility prior to redevelopment (Port of Seattle 1992a); therefore, it is assumed at this time that the land-farmed material is no longer present on the T-108 property.

3.4.3 Port of Seattle Ownership – Eastern Parcel (1992-1997)

In the early 1990s, the Port redeveloped the Eastern Parcel of T-108 for use as a container storage and chassis repair yard to accommodate CCI in expanding their operations from T-106W (located adjacent to the northwest of T-108). The redevelopment involved construction of a paved access road across the S Oregon Street ROW to connect the two Port properties, construction of a 4-lane truck access road extending from Diagonal Avenue S onto the southern portion of the Eastern Parcel, construction of a rail spur extending from the rail line along the south side of Diagonal Avenue S to the northwest corner of the container terminal, and re-surfacing much of the parcel with asphalt pavement and gravel for container storage and transport (Port of Seattle 1992a). These improvements are visible on aerial photographs from 1995 and subsequent years (Appendix B). Improvements were also made to the stormwater drainage system including installation of an oil-water separator, catch basins, and new subsurface piping; this drainage system is discussed in Section 2.4.

In order to ensure subsurface materials would be geotechnically suitable to support future land use as a cargo container storage and transport yard, approximately 5,000 cubic yards (cy) of soil and fill material, including the soil land-farmed during Chevron's ownership of the property, was removed from the property between 1992 and 1993 (as indicated by the permit for the effort), and replaced with newly-imported fill material (Port of Seattle 1992a).

Development of the container terminal was completed by 1995. CCI's operations included unloading cargo from barges and loading it onto trucks and railcars for transport. In addition, chassis repair and maintenance operations also occurred at the eastern portion of the Eastern Parcel during CCI's occupation of the property. Hazardous substances handled on the property in association with these activities included (but were not necessarily limited to) chlorofluorocarbon (CFC) 11/12, Freon 12, paint, paint thinner, oils, lubricants, and fuel products (Container Care International 1993).

In 2004, CCI merged with another depot operator called Global Intermodal Systems to form ConGlobal Industries (ConGlobal). ConGlobal assumed operation of both T-108 and T-106W at this time. For a brief period, ReNu recycling also leased approximately 2 acres of the southern portion of the Eastern Parcel of T-108 for use as temporary storage for trucks and roll-off bins (Pacific Groundwater Group 2007a). The ReNu lease was transferred to ConGlobal in August 2007.

3.5 OWNERSHIP AND OPERATIONAL HISTORY (1980-2008) – WESTERN PARCEL

The Port purchased the Western Parcel of T-108 from Chiyoda in 1980 and has maintained ownership of the property since that time. Between 1980 and 1985, the parcel remained vacant, with the exception of some container storage limited to the southern, paved portion of the parcel in the early 1980s. In 1985, the Pioneer Construction Materials Co. (Pioneer) was permitted to use the site as a temporary construction aggregate storage area for a period of approximately six months (Taylor 1985). The aggregate was unloaded from barges using a portable stacker/conveyer system and subsequently loaded onto trucks for transport to a construction site along I-90. The aggregate originated from Pioneer's gravel pit in Steilacoom, Washington and is assumed to have been free of contaminants when brought to the site.

In the late 1980s, a habitat project was constructed along the southern portion of the T-108 shoreline to mitigate for loss of habitat at another Port property (T-30). Approximately 12,400 cy of sediment and soil were cut out of the existing shoreline bank to create the 12,300 square foot (SF) intertidal shoreline habitat area located immediately north of Diagonal Avenue S (Port of Seattle 1985b) (Map 7). The majority of the soil and sediment removed during construction of the mitigation site was approved for open-water disposal in Elliott Bay. Approximately 200 cy of the excavated material was found to be contaminated and required disposal at an approved upland site (Ecology 1987). According to Port staff, contaminants in the soil were primarily metals and PAHs and were thought to be related trash (cans, broken glass, and other debris) dumped at the Diagonal Avenue S street end. Additional details (including the analytical results) of the sampling conducted in the mitigation area prior to its construction are not currently available. After the soil and sediment excavation was completed, approximately 1,500 cy of clean rock and structural fill were installed at the mitigation area to stabilize the bank.

Between 1989 and 1998, Lafarge leased the Western Parcel from the Port for use as a bulk cement transshipment facility. The facility was constructed in the early 1990s and was located on the southern half of the Western Parcel of T-108 (Map 7). Lafarge used the facility to transport bulk cement from barges to trucks and rail cars for distribution.

Several site improvements were made during development of the Lafarge facility. A barge moorage pier and pneumatic conveyor system were constructed offshore in the LDW, approximately in the center of the parcel shoreline (see Map 7 and Appendix B). A product transfer tower, four dry cement storage silos, a truck scale, and a truck wash-down area were all constructed according to permitting documentation (Port of Seattle 1988). The truck wash-down area was constructed on a concrete pad that drained to a catch basin and ultimately to the sanitary sewer. A prefabricated shed was placed on a paved area on the southwest portion of the parcel for use as an office building.

Public access improvements to the shoreline mitigation area and Diagonal Avenue S street end were also planned as part of the project. These improvements were in

accordance with the Port's public access plan (Port of Seattle 1985a) and included a trail and hand-boat launch area. The wooden bulkhead observed along the property shoreline in March 2008 were associated with the public access trail (Blomberg 2008) (Appendix A, Photos 12 and 13).

Paved roadways, a rail spur, and associated loading areas were also constructed as part of the Lafarge facility improvements. According to Port staff, a covered loading area was located adjacent to the storage silos and was used to load trucks and railcars. The loading area was a shallow pit excavated beneath the rail line. Dry bulk cement that arrived to the facility by rail was unloaded into the pit and then loaded into the silos via an additional pneumatic conveyor system (Blomberg 2008). Plans for the terminal also called for construction of office and warehouse buildings, however according to Port staff and based on a review of historical aerial photographs, it does not appear that these buildings were ever constructed.

Grading and shoreline modifications were made as part of the Lafarge facility development. In order to stabilize eroding shoreline in the central and northern portions of the property, the bank was cut back above 11.5 ft MLLW and stabilized with riprap (Port of Seattle 1988, 1989). Excavated bank sediments, as well as dredge spoils along the northern portion of the shoreline (likely remaining from Chiyoda's 1977 dredging project) were graded across the northern portion of the parcel (Port of Seattle 1988). The area was then seeded/planted with vegetation to help control erosion.

Additional public access improvements were made to the mitigation area in the early-1990s. These improvements were made to compensate for public access restrictions to the S Oregon Street ROW implemented during development of the container storage facility on the Eastern Parcel of T-108 (Port of Seattle 1992a). Public access enhancements included removal of approximately a half acre of asphalt near the mitigation area, installation of additional native plantings, and installation of other human-use features such as picnic tables and interpretive signage (Port of Seattle 1992a).

In the late 1990s, Lafarge removed the bulk cement facility fixtures and transported them for use in Eastern Washington. The fixtures removed included the storage silos, office shed, truck scale and wash-down area, and rail car loading equipment (Port of Seattle 1999). Beginning around 2002 or 2003, CCI used a portion of the parcel as a chassis storage area.

3.6 CURRENT OPERATIONS AT T-108

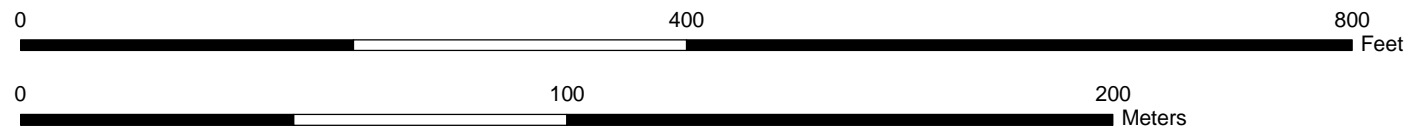
ConGlobal is currently the only tenant at T-108, and the company continues to operate a container terminal on the Eastern Parcel. Containers are stored throughout the Eastern Parcel and maintenance is conducted on the eastern end of the parcel (Appendix A, Photo 2). A fueling area, which includes two aboveground storage tanks (AST) containing diesel (one 300-gallons and one 600-gallons) is located on the southern portion of the Eastern Parcel. An additional 1,200-gallon AST is also located in this area.

ASTs are regulated based on the requirements outlined in the Code of Federal Regulations (CFR) (40 CFR 112 – Spill Prevention, Control, and Countermeasure Plans).

ConGlobal also leases the majority of the Western Parcel for use as a chassis storage and lay-down area (Appendix A, Photos 7 and 8). The public access park and mitigation area remain on the southern portion of the Western Parcel and are not included in the ConGlobal lease area (Appendix A, Photos 9 and 10). For reference purposes, Map 8 provides a comprehensive presentation of the historical site features (presented on Maps 6 and 7) overlying the current conditions of the T-108 subject property. Map 9 expands this comprehensive presentation to include the locations of previous soil and groundwater sample locations.

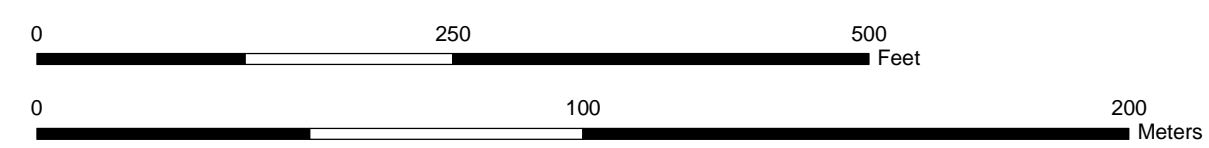
As of April 2008, ConGlobal maintains an industrial NPDES stormwater permit (No. SO3-010569) and a SWPPP for management of stormwater discharges from the container terminal to the Duwamish/Diagonal CSO/SD system has been prepared. ConGlobal also maintains an SPCC plan to be implemented in the case of a hazardous materials release. The purpose of the NPDES permit, SWPPP, and SPCC plan is to reduce the potential for stormwater contamination resulting from industrial activities conducted at the facility. Ecology conducted a stormwater compliance inspection at the facility on June 5, 2008. Several modifications to the SWPPP were required after the inspection.

Best management practices (BMPs) are implemented to reduce stormwater pollution, and inspections and stormwater sampling are conducted as required under the NPDES permit and associated SWPPP. Stormwater samples are analyzed for total zinc, oil and grease, turbidity, total suspended solids (TSS), and pH. In addition, total copper and total lead are analyzed if the benchmark for zinc is exceeded during two consecutive sampling events. The chassis repair area and equipment fueling areas on the Eastern Parcel are covered by the NPDES permit and SWPPP; the portions of T-108 used only for storage, office space, and parking are not covered.



Map 8. Historical Site Features Overlay

FINAL



Map 9. Historical site feature overlay, previous sample locations, and current drainage features

FINAL

4 T-108 Environmental Conditions and Investigation Information

Since the early 1980s, numerous environmental investigations have been completed at the subject property and at properties within its immediate vicinity. Environmental investigations have included sampling and analyses of soil, groundwater, seep water, bank soil, and nearshore sediment. Although samples have been collected over the majority of T-108, much of the investigation work has concentrated on the northern portion of the subject property, in the vicinity of the former landfarming and PCB sludge disposal and treatment areas.

The following sections provide an overview of previous sampling events completed at the subject and adjacent properties. The information in the section has been presented to assist with overall evaluation of the subject property, in order to develop an effective, long-term source control strategy. The particular data discussed in the follow sections are provided in more detail in Appendix D (T-108 related data) and Appendix E (relevant adjacent property data). This section and Appendix E also provide information on the rights-of-way surrounding the subject property and the stormwater outfalls within the vicinity of T-108.

4.1 ENVIRONMENTAL DATA SUMMARY FOR T-108

In 2006, PGG completed a review and summary of historical soil and groundwater data for T-108 as part of their work plan for additional soil and groundwater sampling to be conducted on the property in 2006 and 2007 (Pacific Groundwater Group 2006c). The following soil and groundwater data summaries are based on the PGG work plan and the data reports summarizing PGG's recent environmental investigations at T-108 (Pacific Groundwater Group 2006b, 2007a).

4.1.1 T-108 soil

Several soil and groundwater investigations have been conducted on T-108 since the 1980s. Data are available from several historical investigations including Dames and Moore investigations from 1981 and 1984, PEG investigations from 1990, and an investigation by Applied Geotechnology, Inc. (AGI) in 1991 (Appendix D). PCBs, TPH (gasoline and diesel), toluene, ethylbenzene, and xylenes, thirteen individual PAHs, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, thallium, and zinc have historically been detected in soils at T-108. Of these chemicals, only cadmium was detected above MTCA industrial cleanup levels.

Soil conditions at T-108 were recently investigated by PGG (Pacific Groundwater Group 2006b). The locations sampled, PGG-2, PGG-5, PGG-6, and PGG-7, are shown on Map 3. PCBs (Aroclors 1248, 1254, and 1260), petroleum hydrocarbons (gasoline, diesel, and lube oil), 17 individual PAHs, arsenic, cadmium, chromium, copper, lead, nickel, and zinc were all detected. Of these, only diesel-range hydrocarbons, lube oil-range

hydrocarbons, and cadmium were detected above MTCA Method A industrial soil cleanup levels. Sample location PGG-2, located adjacent to the west of the PCB sediment disposal area, exceeded MTCA Method A industrial cleanup levels for diesel-range hydrocarbons and cadmium in the 9-10.5 ft bgs interval. The other exceedance (for cadmium) occurred in the 0.5-2 ft bgs interval in sampling location PGG-7, located at the southern portion of the Western Parcel near the mitigation area (Map 3).

4.1.2 T-108 groundwater

Historical groundwater investigations were conducted on T-108 by Dames and Moore in 1981 and 1984 (Dames & Moore 1984) and by AGI in 1991 and 1992 (AGI 1992a, 1992b). Groundwater data from the Dames and Moore reports were not included in the PGG work plan, but data from the 1984 investigation are included along with other historical data in Appendix D of this report. Groundwater data from the 1981 Dames and Moore investigation were not identified during the course of this investigation; however, according to a site assessment summary report completed for Chevron in 1992, PCB Aroclor 1242 was detected at 0.9 µg/L in one of six groundwater monitoring wells sampled by Dames and Moore in 1981 (AGI 1992a). The well in which Aroclor 1242 was detected was located in the south-central portion of the approximate PCB sludge disposal area. Groundwater samples collected by Dames and Moore in 1984 did not contain PCBs at concentrations above the 1 µg/L detection limit (Dames & Moore 1984); the locations of these historical groundwater wells were not identified during the course of this investigation. PCBs were not detected in groundwater samples collected from T-108 by AGI in 1991 or 1992 (Appendix D).

Groundwater monitoring results from the AGI investigations in the early 1990s identified petroleum hydrocarbons (diesel and gasoline) in wells located on the northern portion of the property. Gasoline-range hydrocarbons did not exceed MTCA Method A cleanup levels; diesel-range hydrocarbons did exceed MTCA Method C cleanup levels in one well located approximately 100 ft south of the sediment disposal pit area. BTEX constituents were also detected in groundwater samples collected within or near the sediment disposal pits; however, concentrations were below MTCA Method C industrial cleanup levels.

PAHs were historically detected in groundwater samples collected from wells on the northern portion of T-108. Total carcinogenic PAH (cPAH) toxic equivalents (TEQs) exceeded the MTCA Method C cleanup level in three wells located to the east and south of the sediment disposal pit area, and one well within the disposal pit area in 1991. Total cPAH TEQs were below MTCA Method C in all wells when re-sampled in 1992 (Pacific Groundwater Group 2006c).

Arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc were detected in historical T-108 groundwater samples. Arsenic and cadmium were each detected above MTCA Method C cleanup levels; arsenic exceeded MTCA in a well near the northeast corner of the Eastern Parcel, and cadmium exceeded MTCA in two wells, one located

approximately 100 ft south of the sediment disposal pit area, and one located along the northern boundary of the sediment disposal pit area. In addition, arsenic exceeded the MTCA Method C cleanup level in three historical wells sampled by Dames and Moore in 1984 (Dames & Moore 1984); the locations of these wells are not known. In their work plan, PGG stated that historical groundwater samples collected at T-108 were likely unfiltered and therefore biased high (Pacific Groundwater Group 2006c). In addition, historical samples were not collected with the low flow method and therefore likely contained entrained soils which could also biased analytical results.

In 2006 and 2007, PGG installed seven new monitoring wells and sampled groundwater during four monitoring rounds. The data from these sampling events are presented in Appendix D. PCBs were not detected in any of the wells during all four sampling rounds with the exception of Aroclor 1016, which was detected above MTCA Method A cleanup levels in one well in the second sampling round (PGG-2 on Map 3). This sample result was rejected due to poor sample quality (Pacific Groundwater Group 2006b). The sample was considered to be of poor quality because the well pumped dry several times during sampling, and it was concluded that soil particulates were likely introduced into the sample. In addition, due to a lab/chain-of-custody error, the sample was analyzed after its holding time had elapsed.

Petroleum hydrocarbons and BTEX constituents were not detected in any of the wells sampled during the four sampling rounds. Non-carcinogenic PAHs were detected in two wells in the first round of sampling but were not detected in the following three rounds. Carcinogenic PAHs were detected in two wells (PGG-2 and PGG-5) during the second round of sampling. The results from well PGG-2 were rejected due to poor sample quality for the reasons discussed above (Pacific Groundwater Group 2006b).

Total and dissolved arsenic, chromium, copper, nickel, and zinc were detected in multiple monitoring wells during all four sampling rounds. Within the first two rounds of sampling, total and dissolved arsenic were detected above MTCA Method A cleanup levels in wells PGG-1 and PGG-2 (Map 3). Total arsenic was also detected above MTCA Method A in well PGG-5 in the first sampling round. Total lead was detected above MTCA Method A in well PGG-1 in the first round of sampling. All detected metals concentrations in rounds three and four were below both MTCA Method A cleanup levels and the groundwater screening levels developed by Ecology for the protection of LDW sediments (Pacific Groundwater Group 2007a). Based on the 2006 and 2007 groundwater monitoring results, PGG recommended that groundwater monitoring be discontinued and that the groundwater pathway be considered closed as a source to LDW sediments (Pacific Groundwater Group 2007a). Ecology recently acknowledged that groundwater at the subject property was not considered a potential source of contamination to LDW sediments (Pacific Groundwater Group 2007a).

4.1.3 T-108 bank soil

In 2005, King County collected two bank soil samples (DUD-30C and DUD-31C) from the northern portion of the T-108 shoreline (Anchor 2007) (see Appendix D, Tables D-8 and D-9). No information was provided regarding the tidal elevation at the time of sampling, or the condition of the bank where samples were collected. PCBs (Aroclors 1248, 1254, and 1260) were detected in both samples; however, the dry weight (dw) concentrations were below the MTCA Method A cleanup level for unrestricted land use. The OC-normalized concentration of total PCBs was greater than the CSL in one of the samples. The total organic carbon content of this sample was 1.05%.

One individual low-molecular-weight PAH (LPAH) (i.e., phenanthrene) and all nine individual high-molecular-weight PAHs (HPAHs) analyzed for were detected; however, total LPAH and HPAH concentrations were below the SQS concentrations. Arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc were all detected in bank soil; however, only mercury was detected above the SQS (in one sample). Bis(2-ethylhexyl) phthalate (BEHP), butyl benzyl phthalate (BBP), and di-n-butylphthalate were detected but were below the SQS. Phenol and benzoic acid were both detected above the CSL, and 1,2-dichlorobenzene was detected in one of the two bank samples at a concentrations below the SQS.

4.1.4 T-108 seep data

Dames and Moore collected two seep samples from the T-108 shoreline in 1984 (Dames & Moore 1984). One of the maps was missing from this report; therefore, the sampling locations are not known. PCBs were not detected in either seep; however, the detection limit (1 µg/L) was above the MTCA Method A cleanup level of 0.1 µg/L. Cadmium, chromium, lead, mercury, and zinc were each detected in at least one of the seep samples. Arsenic was detected at 10 µg/L, which is above the MTCA Method C cleanup level. Lead was detected at 6 µg/L in one seep and at 5 µg/L in the other seep, and mercury was detected in one seep at 2 µg/L (no MTCA groundwater cleanup levels are available for lead for comparison). Cadmium, chromium and zinc were all detected below MTCA Method C cleanup levels. Details on how the seep samples were collected (e.g., filtered or unfiltered samples) were not available.

4.2 RELEVANT INFORMATION FOR SURROUNDING PROPERTIES, ROADWAYS, AND OUTFALL SYSTEMS

The following sections discuss relevant information pertaining to the adjacent properties, streets, and outfall networks in the immediate vicinity of the T-108 subject property. The surrounding area chosen for discussion in this section focus on those properties or facilities that may directly affect source control concerns at the subject property.

4.2.1 Adjacent properties

Environmental investigations have been conducted on several of the properties adjacent to T-108. Surrounding properties include T-106W and the WSLCB facility to the north, a King County pumping station and E Marginal Way S to the east, and the General Services Administration's (GSA's) Federal Center South facility to the south. The following section briefly discusses the operational and environmental investigation history of these adjacent properties.

4.2.1.1 Terminal 106 West – southern portion of property

Terminal 106 West (T-106W) is located across the S Oregon Street ROW to the north of T-108. It is approximately 31 acres in size. The southern portion of the property, currently operated as a container storage facility, is applicable to T-108 source control because of its proximity. T-106W includes a container repair and wash area, container lifts and stackers. The majority of the facility is covered with gravel (Port of Seattle 1992b). A portion of the northern end of the container terminal drains to the S Nevada Street storm drain system (Ecology 2004a). Available information for this property is summarized in Table 2.

4.2.1.2 Washington State Liquor Control Board

The WSLCB property is approximately 11 acres in size and is located across the S Oregon Street ROW to the north of T-108. There are two warehouse buildings on the property used for storage and distribution of alcoholic beverages and other unspecified items (King County 2008). Very little information was available regarding the past and current uses of the property, property ownership history, and environmental conditions on the property; however, according to a 1992 business letter from Barbara Hinkle, Port of Seattle Environmental Management Specialist to Barbara Ritchie, Ecology, past practices on the property, including steam cleaning of batteries and equipment may have caused contamination along S Oregon Street ROW (Port of Seattle 1992b). Available information for this property is summarized in Table 2.

Table 2. Summary of relevant information for properties adjacent to T-108

TIME PERIOD	OWNERSHIP, OPERATIONAL HISTORY, AND CHANGES IN SITE FEATURES	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN SAMPLED ENVIRONMENTAL MEDIA	REMEDIAL ACTIONS AND SOURCE CONTROL ACTIVITIES	REFERENCES
Terminal 106 W (southern portion of property). Regulatory Listings: RCRA SQG, LUST/UST, ICR					
Late 1960s	property developed by reclaiming land from LDW; no ownership information available	unknown	na	unknown	Pinnacle Geosciences (2005)
1970	property purchased by Port of Seattle; much of site reclaimed from LDW when rock bulkhead installed and area backfilled to create approximately 900 linear ft of additional upland shoreline	unknown	na	unknown	Pinnacle Geosciences (2005), King County et al. (2005a)
1975 to 1990	Coastal Trailer Repair, Inc. leased the southern portion of the property for use as cargo container storage, repair and cleaning yard	RCRA compliance inspection by Ecology (1985) noted storage of waste oil drums and flammable solvents; generator reports dated between 1982-1990 identified wastes including lacquer thinner, oil, and waste solvent; waste handling practices at the facility were unclear	na	Coastal Trailer Repair received guidance from Ecology on cleanup of the waste oil and solvent storage areas	Pinnacle Geosciences (2005)
		soil and groundwater investigation of a compressor area and a steam-cleaning area (1990)	oil and PCBs identified in soil; lead, arsenic, PCBs, and oil identified in groundwater	soil removed from compressor area (1992)	Envirotech (1991) as cited in Pinnacle Geosciences (2005)

TIME PERIOD	OWNERSHIP, OPERATIONAL HISTORY, AND CHANGES IN SITE FEATURES	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN SAMPLED ENVIRONMENTAL MEDIA	REMEDIAL ACTIONS AND SOURCE CONTROL ACTIVITIES	REFERENCES
1990 to 2007	Container Care International (CCI) leased property for use as a container terminal; activities included storage, cleaning, repair, and transport of cargo containers and chassis	soil and groundwater investigation related to UST removal (1992)	petroleum identified in soil and groundwater	two USTs and associated petroleum-contaminated soil removed (1991)	Applied GeoTechnology (1992) as cited in Pinnacle Geosciences (2005)
		joint site inspection by the City of Seattle and Ecology (2001) noted poor housekeeping practices associated with used oil, antifreeze, and other waster materials	no sampling conducted	unknown	Ecology (2004a)
		facility inspection by Ecology (2002)	no sampling conducted	unknown	Ecology (2004a)
		catch basin solids sample collected along the boundary of T-106W and the WSCLB property by SPU (2003) ^a	copper (30 mg/kg dw), lead (10 mg/kg dw), zinc (55 mg/kg dw), TPH-D (15 mg/kg dw), TPH-O (52 mg/kg dw), BEHP (130 µg/kg dw), and BBP (20 µg/kg dw) detected in solids sample	unknown	Schmoyer (2008)
2007 to present	ConGlobal Industries leases property for use as a container storage and repair yard	none	na	established a SWPPP and acquired a general stormwater NPDES permit from Ecology	Pinnacle Geosciences (2005)
Washington State Liquor Control Board. Regulatory Listings: None					
Unknown to 2008	property owned by the SWLCB; warehouses used for storage and distribution	catch basin solids sample collected along the boundary of T-106W and the WSCLB property by SPU (2003) ^a	copper (30 mg/kg dw), lead (10 mg/kg dw), zinc (55 mg/kg dw), TPH-D (15 mg/kg dw), TPH-O (52 mg/kg dw), BEHP (130 µg/kg dw), and BBP (20 µg/kg dw) detected in solids sample	unknown	Pinnacle Geosciences (2005), King County Parcel Viewer (online)

TIME PERIOD	OWNERSHIP, OPERATIONAL HISTORY, AND CHANGES IN SITE FEATURES	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN SAMPLED ENVIRONMENTAL MEDIA	REMEDIAL ACTIONS AND SOURCE CONTROL ACTIVITIES	REFERENCES
1950s	warehouse building constructed	unknown	na	unknown	Pinnacle Geosciences (2005), King County Parcel Viewer (online)
1999	warehouse building demolished and reconstructed	unknown	na	unknown	Pinnacle Geosciences (2005), King County Parcel Viewer (online)
2007	second warehouse building constructed	unknown	na	unknown	Pinnacle Geosciences (2005), King County Parcel Viewer (online)
King County/METRO Duwamish Pump Station. Regulatory Listings: RCRA SQG					
1946 to late 1960s	site undeveloped, owner not known; southern boundary may have been used as a parking area	unknown	na	unknown	Aerial Photo Publishers (1946), Photographer unknown (1953), Pacific Aerial Surveys (1961), WDNR (1970)
Late 1960s to present	facility owned and operated by King County (formerly Metro) as a pumping station associated with the Elliott Bay Interceptor (part of the larger West Point WWTP system,) and the Duwamish Siphon	unknown	na	unknown	Pinnacle Geosciences (2005), King County et al. (2005a), Pacific Aerial Surveys (1961), WDNR (1970)
Federal Center South/US General Services Administration: Regulatory Listings: CSCSL, Spills, VCP, LUST/UST, ICR					
c. 1931 to c. 1941	property first developed and operated as a Ford automobile production plant	unknown	na	unknown	Herrera (2001)

TIME PERIOD	OWNERSHIP, OPERATIONAL HISTORY, AND CHANGES IN SITE FEATURES	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN SAMPLED ENVIRONMENTAL MEDIA	REMEDIAL ACTIONS AND SOURCE CONTROL ACTIVITIES	REFERENCES
c. 1937 to present	U. S. government acquired property and leased space in numerous buildings on the property for use as warehouse storage, office space, vehicle maintenance, and parking; materials were loaded onto barges and other vessels at Slip 1	na	na	na	Herrera (2001)
1974 to 1976	southern portion of property adjacent to Slip 1 and the LDW used as a treatment facility to remove spilled PCBs from Slip 1 and the LDW; treatment facility consisted of dredge pumps, a mobile treatment plant, dredged material receiving and holding tanks, and a clarifier; 215 barrels of contaminated sludge temporarily stored in the Air Force warehouse (Building 1202 on Map 2) during treatment operations	environmental investigations and cleanup related to a 265-gallon PCB spill into Slip 1 caused when a PCB-containing electrical transformer owned by the US Air Force was damaged while being loaded onto a private barge under contract to the Navy	PCBs (Aroclor 1242)	an initial spill cleanup was conducted by EPA in 1974; additional cleanup of PCB-contaminated sediments was conducted by EPA/USACE from 1974 and 1976	EPA (1975)
1993	property owned by US government and leased to various tenants by GSA	hazardous waste inspection by Ecology noted boiler water was treated with algaecides, biocides, and fungicides and discharged into a drain (the discharge location of this drain was not specified); also chemically-treated coolant was discharged to a floor drain that discharged to the LDW and a drum storage area drained to the LDW	na	na	Ecology (2004a)

TIME PERIOD	OWNERSHIP, OPERATIONAL HISTORY, AND CHANGES IN SITE FEATURES	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN SAMPLED ENVIRONMENTAL MEDIA	REMEDIAL ACTIONS AND SOURCE CONTROL ACTIVITIES	REFERENCES
1997 to 1999	property owned by US government and managed by GSA	soil and groundwater investigations associated with the removal of USTs	diesel-range hydrocarbons (up to 4,700 mg/kg), heavy oil-range hydrocarbons (up to 960 mg/kg), gasoline-range hydrocarbons (up to 700 mg/kg), xylenes (up to 66 mg/kg), and metals (including lead) identified in soil; petroleum (gasoline plume and heavy hydrocarbons) and BTEX identified in groundwater; PCBs and VOCs not detected in soil samples ^b	USTs and associated contaminated soil removed	Herrera (2001); Glacier Environmental (1997), Herrera (1999), and Herrera (2003) as cited in Ecology (2004a)
2001	building on the western portion of property (Building 1203 on Map 2) used by the FBI as a maintenance area for motor pool vehicles	Phase I ESA conducted by Herrera; recognized environmental conditions identified included soil and groundwater contamination from removed USTs, the presence of five remaining USTs, and historical uses of the property	no sampling conducted in association with the Phase I ESA	unknown	Herrera (2001)
2008	GSA continues to manage the property; warehouse storage and office space is leased to various government agencies and other tenants, and the site is also used for vehicle maintenance and parking	unknown	na	unknown	Ecology (2004a; 2008)

^a The same sample is discussed for both T-106W and the WSLCB property.

^b The analytical data collected in association with UST removals was not available; however, maximum concentrations were reported in source documents.

BBP – butyl benzyl phthalate

BEHP – bis(2-ethylhexyl) phthalate

BTEX – benzene, toluene, ethylbenzene, xylene

CSL – cleanup screening level

PCB – polychlorinated biphenyls

RCRA – Resource Conservation and Recovery Act

SQG – small-quantity generator

SQS – sediment quality standard

Ecology – Washington State Department of Ecology
ESA – Environmental Site Assessment
FBI – Federal Bureau of Investigation
GSA – General Services Administration
ICR – Independent Cleanup Report
LDW – Lower Duwamish Waterway
LUST – leaking underground storage tank
mg/kg – milligrams per kilogram
na – not applicable

SWPPP – stormwater pollution prevention plan
TPH-D – diesel-range total petroleum hydrocarbons
TPH-O – oil-range total petroleum hydrocarbons
UST – underground storage tank
VCP – voluntary cleanup program
VOC – volatile organic compound
WSLCB – Washington State Liquor Control Board
WWTP – wastewater treatment plant
µg/kg – micrograms per kilogram

4.2.1.3 King County Pumping Station

King County operates a pumping station on the 0.7-acre parcel of land adjacent and to the east of T-108. The pumping station has been in operation as part of the Elliott Bay Interceptor (EBI) system since the late-1960s (Pinnacle Geosciences 2005; WDNR 1970). The EBI system carries sewage and wastewater from the LDW basin and parts of West Seattle to the West Point WWTP. No additional information was available for this property beyond what is summarized in Table 2.

4.2.1.4 GSA's Federal Center South – northern portion

The Federal Center South is located on a 33-ac parcel of land across Diagonal Avenue S to the south of T-108 (Map 2). The Federal Center South facility is owned by the US government and managed by the GSA which leases space within the center to various government agencies and other tenants. The property was operated as a Ford Motor plant from approximately 1931 to 1941 (Herrera 2001), and a significant historical PCB spill occurred directly offshore of the property in 1974. Additional a information available for this property is summarized in Table 2.

4.2.2 Adjacent streets

Two street ROWs are located adjacent to T-108. The S Oregon Street ROW is located adjacent and to the north and the Diagonal Avenue S ROW is adjacent and to the south. These ROWs are applicable to environmental conditions on T-108 because of their proximity to the property. If contamination were present within the ROWs, the possibility would exist for these contaminants to migrate to T-108 or the LDW. Information about these two ROWs is presented in the sections that follow and is summarized in Table 3.

4.2.2.1 S Oregon Street ROW

The S Oregon Street ROW extends westward from E Marginal Way S and terminates at the LDW. The ROW is owned by the City and is used for commercial operations by ConGlobal Industries and the WSLCB. The ROW has both paved and graveled portions. Power transmission lines are also located within the S Oregon Street ROW; public access to the roadway is restricted. The Duwamish/Diagonal CSO/SD and Duwamish EOF piping networks underlay the S Oregon Street ROW.

Table 3. Summary of relevant information for street rights-of-way adjacent to T-108

TIME PERIOD	SITE USE	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN ENVIRONMENTAL MEDIA	REMEDIAL ACTIONS AND SOURCE CONTROL ACTIVITIES	CITATIONS ^a	AVAILABLE ANALYTICAL DATA AND DATA LOCATION ^b
S Oregon Street ROW						
Pre-1940 to late 1960s	area included tidal/drainage channel that likely received stormwater and wastewater discharges from surrounding industrial properties	unknown	na	unknown	Pacific Groundwater Group (2007a); Aerial Photo Publisher (1946); Photographer unknown (1953); Pacific Aerial Surveys (1961); WDNR (1970)	na
Late 1960s	underground piping associated with Metro's West Point sanitary sewer system and the Duwamish Siphon (the Duwamish/Diagonal CSO/SD, and the Duwamish EOF) laid adjacent to or within channel and channel filled	unknown	na	unknown	Pacific Groundwater Group (2007b); Pacific Aerial Surveys (1961); WDNR (1970)	na
1970s	high-power electrical transmission lines installed within ROW	unknown	na	unknown	cleanup study report	na
1970s to 1993	ROW; specific uses unknown	unknown	na	unknown	WDNR (1970); WDNR (1981); Metro Aerial (1991)	na

TIME PERIOD	SITE USE	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN ENVIRONMENTAL MEDIA	REMEDIAL ACTIONS AND SOURCE CONTROL ACTIVITIES	CITATIONS ^a	AVAILABLE ANALYTICAL DATA AND DATA LOCATION ^b
1993 to 2008	portions of ROW used by the Port as an access roadway between T-108 and T-106W. Also used by WSLCB operations; public access restricted; the Duwamish/Diagonal CSO/SD and the Duwamish EOF discharge at end of ROW	Phase II ESA to investigate soil, groundwater, and adjacent intertidal sediment conditions (2007)	PAHs, diesel, and lube oil detected above MTCA Method A cleanup levels in soil, PCBs, cadmium, copper, lead, nickel, and zinc also detected in soil; gasoline, BTEX, and arsenic not detected in soil; cPAHs, lube oil, and dissolved arsenic detected above MTCA Method A in groundwater, PCBs also detected in groundwater; PAHs, diesel, lube oil, and metals detected in intertidal sediment	unknown	Pacific Groundwater Group (2007b)	soil, groundwater, and intertidal sediment data presented in Appendix E
Diagonal Avenue S ROW						
Pre-1944 to early 1960s	road ROW extending from E Marginal Way S to LDW with railroad spur crossing	unknown	na	unknown	Aerial Photo Publisher (1946); Photographer unknown (1953); Pacific Aerial Surveys (1961)	na
c. 1961 to mid-1980s	southwestern half of ROW incorporated into a large parking area for the Diagonal Avenue S STP and Federal Center South facility; street-end may have been used as an unofficial dump site	unknown	na	unknown	Pacific Aerial Surveys (1961); WDNR (1970); WDNR (1981); Metro Aerial (1991)	na
Mid-1980s to 2008	road ROW extending from E Marginal Way S to LDW with railroad spur crossing; Diagonal Avenue S storm drain line present beneath ROW	unknown	na	unknown	Ecology (2004a); Metro Aerial (1991); WDNR (1995)	na

^a Historical aerial photographs cited are presented in Appendix B.

^b Data associated with the drainage lines buried within these rights-of-way are presented in Table 4.

BTEX – benzene, toluene, ethylbenzene, xylene

MTCA – Model Toxics Control Act

cPAH – carcinogenic polycyclic aromatic hydrocarbon
CSO – combined sewer overflow
Ecology – Washington State Department of Ecology
EOF – emergency overflow
ESA – Environmental Site Assessment
na – not applicable

PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
ROW – right-of-way
SD – storm drain
STP – sewage treatment plant
WSLCB – Washington State Liquor Control Board

4.2.2.2 Diagonal Avenue S ROW

The Diagonal Avenue S ROW extends southeastward from E Marginal Way S and terminates at the LDW. It is owned by the City, and public access is allowed. The ROW has been present since at least the 1940s based on review of historical aerial photos (Appendix B). The exact date that the ROW was developed is not known. The street-end is currently used as a hand-boat launch area and park. The Diagonal Avenue S street end may have been used as a trash dumping area until the late 1980s according to Port staff. Cans, broken glass, and other debris were observed in the soil when the area was excavated during installation of the public access area and adjacent T-108 mitigation area. The Diagonal Avenue S SD line is located beneath the ROW, and discharges to the south of the ROW's terminus. This drainage line is discussed further in Section 4.2.3.3. Four source-tracing solids samples have been collected within the SD system; data for these samples are discussed in Table 4 and presented in Appendix E.

4.2.3 Public outfalls

Four public outfalls discharging to the LDW are located in the vicinity of T-108 (Map 2). The Diagonal Avenue S SD is located near the terminus of the Diagonal Avenue S ROW, and the S Nevada Street SD is located on the northern portion of T-106W. Two public outfalls discharge from the terminus of the S Oregon Street ROW: the Duwamish/Diagonal CSO/SD, (owned jointly by the City and the County), and the Duwamish EOF associated with the County-owned Duwamish siphon and pump station.

4.2.3.1 Duwamish/Diagonal CSO/SD and associated drainage basin

The Duwamish/Diagonal CSO/SD outfall discharges at the terminus of the S Oregon Street ROW at RM 0.45, approximately 50 ft from the northern portion of T-108. The system has a combined sewer service area of 4,900 ac and the storm drain basin encompasses about 2,620 acres (King County and SPU 2005). The drainage basin includes a 3.6-mi portion of I-5, parts of the Central District, the Duwamish industrial area, Rainier Valley, and Beacon Hill. The stormwater network in the Eastern Parcel of T-108 discharges to this drainage system. The estimated medium-range stormwater runoff from the Duwamish/Diagonal drainage basin is 1,045 million gallons per year (mgd) (King County 2002). Recent source control sampling efforts indicate that the average TSS values for the discharge is approximately 80 mg/L with the TSS loading range from 241 to 414 million tons per year (MT/yr).

Between 2002 and 2006, Seattle Public Utilities (SPU) collected in-line sediment from the Diagonal Avenue CSO/SD network in association with the Duwamish/Diagonal sediment remediation effort. During this timeframe, portions of the overall network were cleaned, including the Diagonal Avenue S CSO/SD mainline, the S Dakota Street lateral, and the downstream sections of the 1st Avenue S lateral and the Denver

Table 4. Summary of relevant information for outfalls adjacent to T-108

OWNERSHIP AND OPERATIONAL HISTORY	DRAINAGE BASIN INFORMATION	DISCHARGE INFORMATION	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN ENVIRONMENTAL MEDIA	SOURCE CONTROL ACTIVITIES	CITATIONS	AVAILABLE ANALYTICAL DATA AND DATA LOCATION
Duwamish/Diagonal CSO/SD							
System installed in the late 1960s in association with the West Point WWTP; the City owns and operates the storm drain system and the County owns and operates the CSO system	CSO service area is 4,900 ac in size and includes portions of the Diagonal and Hanford drainage basins, SD basin is 2,600 ac in size; SD basin includes a portion of I-5, and parts of the Central District of Seattle, the Duwamish industrial area; Rainier Valley, and Beacon Hill; outfall located at the S Oregon Street street-end	discharges to the LDW via a 144-in concrete outfall; average stormwater discharge of 1,100 mgd (King County 2002); average untreated CSO/EOF event frequency is 0.17 events/yr, with average annual discharge volume of 0.67 mgd (Nairn 2007; King County 2006)	two source-tracing sediment samples collected (1985)	four individual PAHs detected above the CSL and seven detected above the SQS, total HPAHs and total LPAHs detected above the SQS, 1,2-dichlorobenzene, 1,4-dichlorobenzene, dimethyl phthalate, dibenzofuran, phenol, and 4-methylphenol detected above the CSL, and zinc detected above the SQS	unknown	Ecology (2004a) citing Tetra Tech (1988)	Appendix E
			whole-water stormwater effluent samples collected at two locations (1995)	arsenic, cadmium, chromium, copper, lead, mercury, zinc, fluoranthene, pyrene, and phthalates	unknown	Ecology (2004a)	stormwater effluent data presented in Appendix E
			multiple rounds of in-line sediment solids sampling (2002-2006)	PCBs, TPH, arsenic, lead, mercury, copper, zinc, BEHP, BBP, and PAHs	system drainage lines being cleaned periodically; business inspections in drainage basin (2000-present)s	King County and SPU (2005)	inline sediment solids data presented in Appendix E

OWNERSHIP AND OPERATIONAL HISTORY	DRAINAGE BASIN INFORMATION	DISCHARGE INFORMATION	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN ENVIRONMENTAL MEDIA	SOURCE CONTROL ACTIVITIES	CITATIONS	AVAILABLE ANALYTICAL DATA AND DATA LOCATION
			source-tracing sediment sampling was conducted within the CSO/SD basin by SPU; onsite catch basins, right-of-way catch basins, inline sediment trap, and inline sediment grab samples were collected (2002-2007)	arsenic, copper, lead, mercury, zinc, diesel-range hydrocarbons, oil-range hydrocarbons, BEHP, BBP, total PCBs, HPAHs, and LPAHs	source-tracing efforts within the CSO/SD drainage basin	Schmoyer (2008)	Appendix E
Duwamish EOF							
Installed in the late-1960s as part of the EBI system; owned and operated by the County; EOF is connected to the Duwamish Siphon and pump station	has the potential to discharge storm-water and combined sewage from the sanitary sewer system if flows from the Duwamish Siphon are too high; outfall located at the S Oregon Street street-end	overflows to the LDW only in emergency by-pass situations; has not overflowed since 1989; outfall is 36-in in diameter	unknown	na	unknown	Ecology (2004a)	na

OWNERSHIP AND OPERATIONAL HISTORY	DRAINAGE BASIN INFORMATION	DISCHARGE INFORMATION	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN ENVIRONMENTAL MEDIA	SOURCE CONTROL ACTIVITIES	CITATIONS	AVAILABLE ANALYTICAL DATA AND DATA LOCATION
S Nevada Street SD							
Owned and operated by the City; date of installation not identified	drains the northern portion of T-106W, including the northern end of the ConGlobal Industries container terminal	discharges to the LDW via a 24-in SD outfall located at the S Nevada Street street-end	source-tracing solids sampling within Nevada Street storm drain line (1985); SPU also attempted to sample manholes in the system but either solids were not present in the manholes or manholes were inaccessible	cadmium, chromium, and lead detected at concentrations above the CSL, and zinc detected above the SQS in storm drain solids	source-tracing solids sampling	Ecology (2004a) citing Tetra Tech (1988); Ecology (2004a); King County and SPU (2005)	storm drain solids data presented in Appendix E
Federal Center South Private Outfall (located on the northern portion of property)							
Owned and operated by USACE; date of installation not identified	drainage basin not identified; based on location, assumed to collect drainage from parking areas and roof drains on the northern portion of Federal Center South including parking areas and rooftops	discharges to the LDW via a 12-in metal outfall located to the west of Building 1203 (Map 2)	unknown	na	unknown	Herrera (2004)	na

OWNERSHIP AND OPERATIONAL HISTORY	DRAINAGE BASIN INFORMATION	DISCHARGE INFORMATION	ENVIRONMENTAL INVESTIGATIONS	CHEMICALS IDENTIFIED IN ENVIRONMENTAL MEDIA	SOURCE CONTROL ACTIVITIES	CITATIONS	AVAILABLE ANALYTICAL DATA AND DATA LOCATION
Diagonal Avenue SD							
Owned and operated by City; date of installation not identified	system drains approximately 12 ac, including the Diagonal Avenue S roadway west of E Marginal Way S	discharges to the LDW via a 12-in. diameter steel outfall located on the northern portion of the Federal Center South property, adjacent to the south of the Diagonal Avenue S ROW	source-tracing solids sample collected (1985)	chromium detected above the CSL, zinc, di-n-octyl phthalate, and indeno(1,2,3-c,d)pyrene detected above SQS	unknown	Ecology (2004a) citing Tetra Tech (1988)	Appendix E
			sediment samples collected offshore of outfall location	BEHP and BBP exceeded the SQS	unknown	(King County 2002); Ecology (2004a)	Appendix E
			City attempted to collect manhole solids from system but manhole locations were inaccessible (2005)	na	unknown	King County and SPU (2005)	na

BBP – butyl benzyl phthalate

BEHP – bis(2-ethylhexyl) phthalate

CB – catch basin

CSL – cleanup screening level

CSO – combined sewer overflow

EBI – Elliott Bay Interceptor

Ecology – Washington State Department of Ecology

EOF – emergency overflow

HPAH – high-molecular-weight polycyclic aromatic hydrocarbon

LDW – Lower Duwamish Waterway

LPAH- low-molecular-weight polycyclic aromatic hydrocarbon

mg/y – million gallons per year

na – not applicable

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

RCB – right-of-way catch basin

ROW – right-of-way

SD – storm drain

SPU – Seattle Public Utilities

STP – sewage treatment plant

SQS – sediment quality standard

USACE – United States Army Corps of Engineers

WSLCB – Washington State Liquor Control Board

WWTP – wastewater treatment plant

Avenue S lateral. A total of 168 samples were collected from the system's mainline and contributing lateral lines (as of December 2007), and several of the lines were cleaned out.

4.2.3.2 Duwamish EOF (pump station emergency bypass)

The Duwamish EOF is located at the terminus of S Oregon Street ROW approximately 100 ft upstream of the Diagonal Avenue S CSO/SD, and approximately at the northwest corner of T-108. It operates as the emergency overflow for the Duwamish siphon and pump station associated with the King County interceptor system. The Duwamish EOF has not overflowed since 1989, and therefore, Ecology does not consider it a significant source of recontamination to the LDW (Ecology 2004b).

4.2.3.3 Diagonal Avenue storm drain

The Diagonal Avenue SD is a 12-in.-diameter steel outfall located adjacent to the south of the terminus of the Diagonal Avenue S ROW, approximately 100 ft from the southern end of T-108. The system drains stormwater from approximately 12 acres, including the Diagonal Avenue S roadway west of E Marginal Way S. Most of the area drained by this outfall is paved and used for general roadway access and miscellaneous storage by surrounding property tenants.

4.2.3.4 S Nevada Street storm drain

The S Nevada Street SD is a 24-in.-diameter outfall located at the S Nevada Street street end in approximately the center of the T-106W shoreline. The system is owned and operated by the City, and drains stormwater from the northern portion of T-106W, including the northern portion of the ConGlobal container yard. Most of the area drained by this outfall is paved or covered with buildings and is used for storage and transport of cargo and other goods.

5 Potential Pathways of Contamination and Source Control Management

The following section briefly highlights the various pathways through which contaminants can migrate and potentially enter the LDW; sources of contamination can often migrate through more than one potential pathway. This section also provides information on the source control measures and procedures that are either in place or can be incorporated at T-108 to aid in the management of these potential contaminant pathways. The section presents this data in a tabularized discussion with respect to the subject property's specific concerns relative to source control.

5.1 POTENTIAL PATHWAYS

Chemicals released to media such as air, soil, groundwater, or stormwater can migrate within the subject property and potentially to the LDW through various pathways. With respect to the subject property, the pathways of potential concern include atmospheric deposition; stormwater inputs (i.e., direct discharge); groundwater migration, and bank erosion. The following sections briefly discuss the potential pathways of concern at the subject property.

5.1.1 Atmospheric deposition

Chemicals have the potential to be emitted to the atmosphere from both point and non-point sources. Point sources include various industrial facilities and operations within the greater LDW basin (EPA 2001). T-108 is not currently regulated as a point-source of air emissions (Thomas 2008). Non-point sources include emissions from motor vehicles, marine vessels, and trains, as well as common materials (e.g., plastics) through off-gassing. Chemicals emitted to the air may be transported over long distances, generally in the direction of the area's prevailing winds.

Air pollutants can be deposited through either direct or indirect deposition. Direct deposition occurs when contaminated particulates are deposited directly onto the land surface or the surface of a water body. Indirect deposition to water bodies occurs when chemicals are first deposited on land or other water bodies and then transported to the receiving water body via stormwater runoff. Contaminants can adhere to solids on the ground or in stormwater runoff and potentially be transported to LDW sediment. The latter process is a major concern when considering source control within the greater Duwamish Valley; however, it is not expected to play a major role in environmental conditions at T-108.

5.1.2 Stormwater inputs (direct discharge)

Contaminants carried in stormwater have the potential to discharge directly into the LDW through public or private outfalls. Several outfalls serve the subject property,

including connection with the City and County owned Duwamish/Diagonal CSO/SD network. Stormwater traversing across impervious surfaces can pick up chemicals originating from accidental spills (vehicle fueling, maintenance, etc.); leaking equipment or storage tanks; particulates deposited on the subject property through atmospheric deposition; and general commercial/industrial operations. Stormwater runoff in unpaved areas (surface runoff) can also collect materials (soil, debris, etc.) in the flow stream and transport them to other parts of the subject property and potentially into the LDW.

5.1.3 Groundwater migration

Groundwater flow in the greater Duwamish Basin is generally towards the LDW, although the direction varies locally depending on the nature of subsurface materials, hydrostratigraphy, local affects of tidal fluctuations, and relative proximity to the waterway. At the subject property, groundwater has been shown to flow radially from a relative high near the center of the site in all directions (pending time of year and tidal stage). Contaminants in groundwater have the potential to migrate directly into the LDW (seeps, shoreline discharge) or through other pathways (infiltration into underground stormwater piping). Leaking or spilled chemicals, as discussed above, can also infiltrate into groundwater in areas without pervious surfaces (western parcel). The determination of whether a chemical identified in groundwater will reach sediment and surface water is a complex process. In this case however, Ecology has acknowledged that recent monitoring has shown that groundwater at the subject property is not considered a potential source of contamination to LDW sediment.

5.1.4 Bank erosion

Soil in unprotected shoreline banks is susceptible to erosion by disturbances from human activities, wind, surface water runoff, tidal exchange, and groundwater discharge. Shoreline armoring and vegetation significantly reduce bank erosion, and steeper banks are particularly susceptible. Much of the subject property's shoreline is armored and covered with vegetation; however, some areas remain susceptible to bank erosion. Contaminants in the subject property's surficial and subsurface soil (originating from non-native fill or historical site operations, etc.) may exist at elevated concentrations in the shoreline bank. This contaminated material does have the potential to migrate to the waterway.

5.2 HISTORY OF THE DUWAMISH/DIAGONAL SOURCE CONTROL AREA

As mentioned in the previous sections, T-108 has been identified as a property of potential concern for source control with respect to the greater Duwamish/Diagonal Source Control Area (SCA). The sediments near the Duwamish/Diagonal outfalls were originally identified as a priority cleanup area by the Elliott Bay/Duwamish Restoration Program in the mid-1990s because of contamination associated with the Duwamish EOF and Duwamish/Diagonal CSO/SD outfalls. The area was identified again through the

LDW Remedial Investigation as an early action area. Dredging and capping actions were implemented through the Elliott Bay/Duwamish Restoration Program beginning in November 2003. Ecology prepared a SCAP for the Duwamish/Diagonal SCA in December 2004. A sediment remediation project closure report was prepared in 2005 (King County et al. 2005b).

Studies conducted in 1994 and 1996 identified PCBs, mercury, BEHP, and BBP as the principal chemicals of concern for the Duwamish/Diagonal SCA area near the outfalls (Ecology 2004a; King County 1997). Table 5 presents the chemicals that have been identified in surface sediment within the Duwamish/Diagonal SCA in-water boundary during the LDW Remedial Investigation effort. The chemicals included on this table had at least one exceedance of its associated SMS criteria for surface sediment, as applicable, prior to sediment removal and capping activities.

Table 5. Chemicals of concern in Duwamish/Diagonal SCA surface sediment (exceeding associated SMS criteria)

CHEMICAL	CHEMICAL	CHEMICAL
1,2,4-Trichlorobenzene	Bis(2-ethylhexyl)phthalate	Mercury
1,2-Dichlorobenzene	Butyl benzyl phthalate	Naphthalene
1,4-Dichlorobenzene	Cadmium	N-Nitrosodiphenylamine
2,4-Dimethylphenol	Chromium	PCBs (total calc'd)
2-Methylnaphthalene	Chrysene	Pentachlorophenol
2-Methylphenol	Dibenzo(a,h)anthracene	Phenanthrene
4-Methylphenol	Dibenzofuran	Phenol
Acenaphthene	Dimethyl phthalate	Pyrene
Benzo(a)anthracene	Fluoranthene	Silver
Benzo(a)pyrene	Fluorene	Total HPAH (calc'd)
Benzo(g,h,i)perylene	Hexachlorobenzene	Total LPAH (calc'd)
Benzo(a)fluoranthene (total-calc'd)	Hexachlorobutadiene	Zinc
Benzoic acid	Indeno(1,2,3-cd)pyrene	
Benzyl alcohol	Lead	

Note: Exceedances of the chemicals listed in this table were detected before sediment removal and capping activities were conducted at the Duwamish/Diagonal cleanup area.

The Duwamish/Diagonal sediment cleanup project began in 1994; remedial actions occurred in late 2003 and early 2004. Sediment remediation included dredging contaminated sediments from a 7-ac area in the LDW and placing an engineered cap over the remaining sediment. The dredging was conducted between November 2003 and January 2004; the sediment cap was installed between January and March 2004 (see Map 2). A follow-up action was conducted in February 2005 involving the placement of a thin layer of sand around the dredged area in response to elevated chemical concentrations resulting from the previous dredging activity (Ecology 2004a) (Map 2).

Long-term sediment monitoring began in the summer of 2004 and is currently scheduled to continue until 2014. In samples collected as part of the monitoring program between June 2004 and April 2007, BEHP, BBP, fluoranthene, dimethyl phthalate, benzyl alcohol, benzoic acid, and total PCBs exceeded the SQS, and BEHP, total PCBs, benzyl alcohol, and benzoic acid also exceeded the CSL.

5.3 SOURCE CONTROL MANAGEMENT TOOLS

A wide variety of source control management tools are available for use at the subject property. These tools vary greatly in management and application, but all are aimed to help reduce or eliminate the potential impact from contaminant sources and their associated pathways on the subject property. In many instances, the components of these tools and source control measures overlap with one another in their intent or physical application. An effective long-term source control strategy will require incorporation of a mixture of these options, with specific focus on the operations at the subject property and types of contamination and pathways of concern. Some of these tools are already in place at the subject property; nevertheless, further consideration of additional application of these tools would continue to promote the goal of an effective, long-term source control strategy at the subject property. This strategy would include the compliance monitoring necessary to determine the effectiveness and performance of these tools.

Regulatory and compliance programs overseen by federal, state, and local jurisdictions offer numerous possible tools that could be implemented at the subject property under various circumstances. Table 6 presents a list of some of the available and relevant tools and source control measures that will be combined to establish and promote effective source control at the subject property. Many other source control tools exist and may be applicable to the site, especially with changes in operations or future development activities. For example, programs managed under the Toxic Substance Control Act (TSCA) could be applicable if hazardous waste associated with the former PCB disposal pits is encountered during site improvement work. Additionally, if future operations generated wastewater requiring off-site treatment, King County's Industrial Waste pre-treatment authorizations would represent an additional source control tool. Table 6 is not meant to be a comprehensive list of all tools available but those most appropriate for the current conditions and operations at the subject property.

Table 6. Potential source control management tools for the subject property

SOURCE CONTROL TOOLS	TOOL COMPONENTS	ADDITIONAL INFORMATION ON POTENTIAL USE OR APPLICATION
Regulatory and Compliance Programs	NDPES Permit Programs	Municipal Permit - Port of Seattle. Includes Stormwater Management Planning, tenant education and oversight, and O&M programs.
		General Industrial Permit – ConGlobal. Includes requirements for preparation and management of a SWPPP and SPCC for operational areas.

SOURCE CONTROL TOOLS	TOOL COMPONENTS	ADDITIONAL INFORMATION ON POTENTIAL USE OR APPLICATION
	Port of Seattle Compliance Programs and Tenant Lease Arrangements	Port's internal compliance unit inspects for environmental compliance based on environmental regulations and lease agreements.
	LDW Source Control Work Group (SCWG) Coordination	Coordination with long-term strategy of SCWG and associated programs (Puget Sound Initiative, Urban Waters Initiative, etc.).
Environmental investigation	Multi-media characterization	Additional media information (subsurface, bank soil, etc.) to fulfill data gaps and focus effective environmental strategy.
Remediation Programs	Independent removal action (excavation, etc.)	Soil excavation with performance sampling in coordination with voluntary cleanup program
	Containment	Capping for in-place containment of impacted media
	In-situ treatments	In-situ treatment of areas of impacted subsurface soil
	Monitored natural attenuation	Monitoring of existing environmental conditions to satisfy cleanup goals
Operational/ Behavioral Best Management Practices (BMPs)	Public Involvement/Education	Education and communication of source control concerns with tenants and public users to support compliance and promote overall environmental stewardship.
	Good housekeeping practices	Promote environmentally-friendly operational and behavioral practices of those using the subject property.
Physical BMPs	Construction BMPs (permanent and temporary)	Erosion and runoff controls, sediment controls (vegetative buffer, drainage swales), grading improvements, hay bale buffers, catch basin filter socks, etc.
	Redevelopment BMPs	Habitat restoration, porous pavement, green roof technologies.
Capital Improvements	Utility upgrades and improvements	Upgrades to stormwater collection networks and other underground utility systems, upgrades to onsite pre-treatment, etc.
	Infrastructure improvements	Paving, grading, access concerns, bank/shoreline stabilization, etc.
	Tenant-driven improvements	Improvements in tenant areas (either operational or compliance driven)
	Restoration opportunities	Construction of restoration/mitigation areas along shoreline; with potential link to existing habitat area
Engineering Controls	Operation and Maintenance programs	Proper operation and maintenance of equipment used on property can greatly reduce the potential for accidentally spills and leaks.
	Upgrades to newer "greener" equipment	Use of newer, "greener" equipment technologies could greatly reduce the potential impact from onsite operations.
Institutional Controls	Property deed restrictions	Restriction of long-term use of property to help ensure environmental stewardship.
	Tenant restrictions	Restrictions on operational use of tenant lease areas

Again, the tools highlighted in Table 6 are not inclusive of all of the options available for approaches to source control management, but are focused to a relative extent on measures that can be implemented at the subject property. Depending on the specific aspects of the contaminant and/or pathway of concern, different components of the tools mentioned may be more appropriate for evaluation and implementation. This

evaluation process will be an important aspect of the SCSPs that will be prepared after finalization of this documentation.

One of the major tools available to help assess and manage stormwater concerns at the subject property is the NPDES permit program. As discussed in previous sections, stormwater discharges at T-108 are regulated under two NPDES permits: the Municipal Stormwater permit, under which the Port of Seattle is a secondary permittee, and the industrial stormwater general permit recently obtained by the tenant, ConGlobal Industries, in April 2008.

As required under the permit, the Port of Seattle has implemented a Stormwater Management Program (SWMP) that includes:

- an education program, including training on Best Management Practices (BMPs), for tenants and Port employees aimed at reducing behaviors and practices that can adversely affect stormwater quality
- a program to identify, eliminate, and prevent illicit discharges and spills to the stormwater system
- a program of information gathering that allows for adequate stormwater management planning, priority setting, and program evaluation including maps of properties, drainage basins, stormwater conveyance lines, and outfalls
- a program for documenting operation and maintenance activities for stormwater facilities
- field inspections to inspect for illicit discharges at all known outfalls covered under the permit; at least one third of all outfalls should be inspected each year
- procedures for removing illicit discharges and documenting activities associated with monitoring these discharges
- a spill response plan
- a program for management of construction site stormwater runoff and post-construction stormwater management for new development and redevelopment
- an operation and maintenance program for all catch basins, stormwater treatment, and flow control facilities
- a long-term monitoring program to characterize stormwater runoff at a limited number of locations¹, evaluate stormwater management practices, and evaluate BMPs

¹ The facility selected for monitoring under the Port's SWMP is used for different operational purposes than T-108 and is not located in the LDW; monitoring data from this facility will most likely not be directly applicable to conditions at T-108.

These elements of the Port's SWMP are aimed to help in the protection of stormwater quality at all Port terminals and facilities, including T-108.

As of April 2008, ConGlobal has maintained a general industrial NPDES stormwater permit (No. SO3-010569) and a SWPPP for management of stormwater discharges from the container terminal to the Duwamish/Diagonal CSO/SD system. The chassis repair area and equipment fueling areas on the Eastern Parcel are covered by the NPDES permit and SWPPP; the portions of T-108 used only for storage, office space, and parking are not covered.

As part of the general industrial stormwater permit, ConGlobal:

- maintains an SPCC plan to be implemented in the case of a hazardous materials release
- implements BMPs to reduce stormwater pollution
- inspects the stormwater system infrastructure
- samples stormwater and analyzes samples for total zinc, oil and grease, turbidity, total suspended solids (TSS), and pH, as well as total copper and total lead if the benchmark for zinc is exceeded during two consecutive sampling events
- provides discharge monitoring reports to Ecology to report the results of the inspection and sampling program

As with the Port's program, ConGlobal's NPDES permit, SWPPP, and SPCC plan are in place to reduce the potential for stormwater contamination resulting from industrial activities conducted at the facility. While the permit and plans limit and control the discharge of a number of pollutants, they do not necessarily control contaminants that pose a threat to LDW sediments, such as PCBs, phthalates, arsenic, mercury, and PAHs (Thomas 2008). The combinations of these established regulatory and compliance requirements with the other "grab bag" of tools presented in Table 6 (BMPs, remediation programs, capital improvements, institutional controls, etc.) will be further evaluated in the following sections with respect to their potential application and use at the subject property to lessen or potentially eliminate the threat from the potential pathways of contamination.

5.4 T-108 ONSITE POTENTIAL PATHWAYS OF CONTAMINATION AND SOURCE CONTROL

Several potential onsite contaminant migration pathways were identified at the subject property through the completion of the environmental conditions review effort. Controlling these potential pathways and sources can decrease the potential for them to impact other media on the property or ultimately the LDW. Many of these identified pathways and their associated contaminant sources can be either eliminated entirely or controlled to some degree through implementation of various source control tools and

procedures and adherence to the requirements of regulatory programs currently governing operations at the subject property.

Table 7 provides information on the potential pathways and sources of contamination identified on the T-108 property, and briefly identifies the various source control tools (with reference to those discussed in Table 6) that are either in place or that can be implemented to help control each pathway. Not all pathways and corresponding chemical sources have the same relative potential for impact to area media and the LDW. The table provides general information on chemicals that can be potentially associated with each source type.

Information on the table takes into consideration both historical source areas and potential ongoing sources based on the current conditions of the property, and expected long-term tenant operations (cargo container storage, chassis storage and repair, miscellaneous maintenance). The table also provides general information on data gaps related to these potential pathways and sources. Fulfilling these data gaps may require further study or characterization to more fully understand their potential for contributing contaminants to the LDW, as well as options for controlling them.

Table 7. Potential onsite pathways of contamination and general source control information at T-108

POTENTIAL PATHWAY	POTENTIAL SOURCES	POTENTIAL CONTAMINANTS	DETAILS	DATA GAP	GENERAL OPTIONS AND TOOLS FOR ADDITIONAL PATHWAY CHARACTERIZATION OR SOURCE CONTROL (REFER TO TABLE 6)	
					WESTERN PARCEL	EASTERN PARCEL
Air	Emissions from operational equipment	Metals, phthalates, dioxins/furans, particulates	Equipment and machinery used by the current tenants are of similar use as most commercial operations in the greater Duwamish Valley (trucks, etc.).	Data on air emissions in the greater Duwamish Valley are very limited; additional data would be helpful in further assessing pathway but difficult to associate directly with T-108 concerns.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Stormwater monitoring results can help assess impact from atmospheric deposition. • Operational BMPs – Good housekeeping and environmental stewardship education can help limit impact from air emissions. • Engineering Controls – Newer “greener” machinery can help reduce onsite emissions. 	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Stormwater monitoring results can help assess impact from atmospheric deposition. • Operational BMPs – Good housekeeping and environmental stewardship education can help limit impact from air emissions. • Engineering Controls – Newer “greener” machinery can help reduce onsite emissions; effective operation and maintenance of equipment can also reduce emissions. • Institutional Controls – Deed and tenant restrictions can limit operations that produce harmful emissions.
Stormwater	Spills, leaks, and accidental discharges; onsite dust and debris	Metals, PAHs, PCBs, TPH, VOCs, SVOCs	Operations include chassis and miscellaneous maintenance; chemicals have the potential to enter stormwater system and discharge to LDW via the Duwamish/Diagonal CSO/SD (Eastern Parcel) and Port private storm drains (Western Parcel).	Current information on stormwater quality limited. ConGlobal's NDPES sampling requirements will provide some additional information to assist in ongoing assessment of this potential contaminant pathway.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Stormwater monitoring results, although limited for this area, can help assess impact from stormwater runoff. • Operational BMPs – Good housekeeping and environmental stewardship education can help reduce introduction of contaminants to stormwater. • Physical BMPs – Erosion and runoff control, and vegetative barriers can help limit transport of contaminants in stormwater. • Capital Improvements – Paving and utility upgrades (installation of stormwater infrastructure) would help management stormwater issues in this area. 	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Adherence to requirements of the Port's and ConGlobal's permit (proper materials storage/handling, inspection and oversight, etc.) will help manage stormwater concerns in this area. • Operational BMPs – Good housekeeping and environmental stewardship education can help reduce introduction of contaminants to stormwater. • Physical BMPs – Hay bale buffers, catch basin filter socks, etc., can help prevent accidental spills from affecting stormwater. • Institutional Controls – Deed and tenant restrictions can limit potential operations in this area.

Table 7, cont.

Potential onsite pathways of contamination and general source control information at T-108

POTENTIAL PATHWAY	POTENTIAL SOURCES	POTENTIAL CONTAMINANTS	DETAILS	DATA GAP	GENERAL OPTIONS AND TOOLS FOR ADDITIONAL PATHWAY CHARACTERIZATION OR SOURCE CONTROL (REFER TO TABLE 6)	
					WESTERN PARCEL	EASTERN PARCEL
Stormwater	Contaminants in fill material	Miscellaneous	Large portions of the subject property have been filled over time, using both native and non-native materials. These fill materials can infiltrate into underground piping.	Soil data available for site; additional soil data would provide little new information relevant to the tools used to manage this potential contaminant pathway.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Stormwater monitoring results, although limited for this area, can help assess impact from impacted fill material. • Environmental Investigation – Additional characterization could assess volume and potential impact from contaminated fill in this area. • Remediation Programs – Soil excavation, containment, or in-situ treatment could help manage contaminants in fill material. • Physical BMPs – Erosion and runoff controls, sediment controls, and vegetative buffers would aid in management of this pathway. • Capital Improvements – Paving and utility upgrades (installation of stormwater infrastructure) would help management potential impact to stormwater in this area. 	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Stormwater monitoring results could help assess impact from contaminated fill materials in this area; however, upgraded stormwater network at higher elevation than areas of suspected fill; potential impact from this pathway is unlikely. • Environmental Investigation – Additional characterization in this area could assess volume and potential impact from contaminated fill in this area; however, investigation would greatly affect ongoing operations and would not likely provide information useful for practical management of this potential pathway.
Stormwater	Sludges and general STP-related materials and PCB-contaminated materials from the 1974 spill remain in place	TPH, PCBs, metals, household/ industrial chemicals	Much of the area comprising the former treatment plant and PCB-material treatment/disposal area is covered by pavement. Areas in the western parcel that overlay former STP units are unpaved.	Additional soil data would provide further understanding of where STP-or PCB spill-related materials remain on site; however, this additional information will add little to support the tools available for managing these lingering materials.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Stormwater monitoring results, although limited for this area, could help assess impact from remaining impacted materials. • Environmental Investigation – Additional characterization could assess volume and potential impact from remaining contaminated materials in this area. • Remediation Programs – Soil excavation, containment, or in-situ treatment could help manage remaining contaminants in these materials. • Physical BMPs – Erosion and runoff controls, sediment controls, and vegetative buffers would aid in management of this pathway. • Capital Improvements – Paving and utility upgrades (installation of stormwater infrastructure) would help management potential impact to stormwater in this area. 	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Stormwater monitoring results could help assess impact from remaining contaminated materials in this area; however, upgraded stormwater structure at higher elevation than suspected materials; potential impact from this pathway is unlikely. • Environmental Investigation – Additional characterization in this area could assess volume and potential impact from STP/PCB-treatment related contamination in this area; however, investigation would greatly affect ongoing operations and would not likely provide information useful for practical management of this potential source concern.

Table 7, cont.

Potential onsite pathways of contamination and general source control information at T-108

POTENTIAL PATHWAY	POTENTIAL SOURCES	POTENTIAL CONTAMINANTS	DETAILS	DATA GAP	GENERAL OPTIONS AND TOOLS FOR ADDITIONAL PATHWAY CHARACTERIZATION OR SOURCE CONTROL (REFER TO TABLE 6)	
					WESTERN PARCEL	EASTERN PARCEL
Groundwater migration	Contaminants in groundwater on the subject property have the potential to migrate directly to the LDW or via underground piping/infiltration.	TPH compounds, metals	Sampling results indicated that TPH, metals, PCBs, and PAHs were present at some level in onsite groundwater, however at levels below MTCA standards.	Recent groundwater sampling has been conducted; available data establishes that pathway is not of impact concern at the subject property; additional data not required.	Recent groundwater investigations have allowed Ecology to determine that groundwater at the subject property is not a pathway for recontamination of LDW sediment. Nevertheless, capital improvements to address other potential pathways (i.e., stormwater) will greatly reduce infiltration and migration potential.	Recent groundwater investigations have allowed Ecology to determine that groundwater at the subject property is not currently a pathway for recontamination of LDW sediment.
Groundwater migration	Chemicals spilled or leaked on impervious areas have the potential to infiltrate into migrating groundwater	TPH compounds, metals, PCBs, PAHs, and SVOCs	Operations being completed in areas currently unpaved (storage) do not indicate a major threat for accidental spills and leaked chemicals that could enter groundwater.	Given conditions of areas of operation, impact from these sources would likely affect stormwater prior to any influence over area groundwater; additional groundwater data not required.	<ul style="list-style-type: none"> • Operational BMPs – Good housekeeping and environmental stewardship education could help reduce the potential future introduction of contaminants to groundwater. • Capital Improvements –Paving, grading, and utility improvements (stormwater network installation) would greatly limit future infiltration of stormwater into subsurface groundwater and prevent these spilled materials from being transported via groundwater. 	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Adherence to requirements of the Port's and ConGlobal's permit (proper materials storage/handling, inspection and oversight, etc.) will help limit potential future impact to groundwater; although the majority of this area is paved and managed by an updated stormwater network installed above the water table. • Operational BMPs – Good housekeeping and environmental stewardship education can help reduce the potential for future introduction of contaminants from spills and leaks. • Engineering Controls – Proper operation and maintenance of machinery can limit accidental spills and leaks. • Institutional Controls – Deed and tenant restrictions can limit potential operations in this area.
Groundwater migration	Contaminated fill material beneath subject property or in former tidal drainage channel	Miscellaneous sewage and industrial wastes	Large portions of the subject property have been filled over time including the former drainage channel, using both native and non-native materials. These fill materials can infiltrate into migrating groundwater	Additional soil information gathered to ascertain location and quality of fill materials would be helpful; however, the information would add little to implementation of the tools most effective to address potential lingering contamination.	<ul style="list-style-type: none"> • Remediation Programs –Containment or in-situ treatment could help manage potential future impact to groundwater from contaminants in fill material. • Capital Improvements – Paving and utility upgrades (installation of stormwater infrastructure) would help prevent future infiltration of stormwater into impacted fill material which may mobilize contaminants to groundwater. 	<ul style="list-style-type: none"> • Environmental Investigation – Additional characterization in this area could assess volume and potential future impact to groundwater from contaminated fill in this area; however, investigation would greatly affect ongoing operations and provide little information for a pathway previously determined to be of minimal concern.

Table 7, cont.

Potential onsite pathways of contamination and general source control information at T-108

POTENTIAL PATHWAY	POTENTIAL SOURCES	POTENTIAL CONTAMINANTS	DETAILS	DATA GAP	GENERAL OPTIONS AND TOOLS FOR ADDITIONAL PATHWAY CHARACTERIZATION OR SOURCE CONTROL (REFER TO TABLE 6)	
					WESTERN PARCEL	EASTERN PARCEL
Groundwater migration	Sludge materials remaining in place from historical STP or PCB spill treatment operations	TPH, PCBs, metals, household/ industrial chemicals	Much of the area comprising the former STP and PCB-spill treatment areas is covered by pavement. Areas in the Western Parcel that overly former STP units are unpaved.	Additional groundwater data would provide further understanding of STP- and PCB treatment-related materials; however, groundwater determined not to be a potential source at the subject property and additional data would not benefit application of practical tools to address lingering contamination.	<ul style="list-style-type: none"> • Environmental Investigation – Additional characterization in this area could assess volume and potential future impact to groundwater from contaminated materials in this area. • Remediation Programs – Containment or in-situ treatment could help prevent future stormwater infiltration that may mobilize contaminants remaining in these materials into groundwater. • Capital Improvements – Paving and utility upgrades (installation of stormwater infrastructure) would help prevent future infiltration of stormwater that may mobilize contaminants in these materials into local groundwater. 	<ul style="list-style-type: none"> • Environmental Investigation – Additional characterization in this area could assess volume and potential future impact to groundwater from STP/PCB spill treatment related contamination in this area; however, investigation would greatly affect ongoing operations and would not likely provide information useful for practical management of this pathway already determined to be of minimal concern.
Bank erosion	Contaminated bank sediment can erode directly into the LDW (surface water runoff, tidal exchanges, etc.)	PCBs, metals, TPH compounds, PAHs, phthalates, phenol, benzoic acid, 1,2-dichlorobenzene	Areas of the subject property shoreline are unarmored, or existing armoring/vegetation are not providing stability as designed.	Little shoreline bank data are available; further sampling of the bank would provide useful information and help focus long-term environmental strategy.	<ul style="list-style-type: none"> • Environmental Investigation – Additional characterization of bank soil is necessary to provide information to formulate an effective strategy for this area. • Remediation Programs – Soil removal and/or containment would greatly reduce the potential impact from this pathway. • Physical BMPs – Erosion and runoff controls and vegetative buffers would help reduce potential impact from this pathway to LDW sediment. • Capital Improvements – Infrastructure improvements (paving, grading, containment, and shoreline stabilization, etc.) would greatly reduce potential impact from this pathway. Restoration opportunities along the shoreline would promote long-term environmental stewardship. 	Not applicable

BMP – best management practice

CSO – combined sewer overflow

LDW – Lower Duwamish Waterway

NPDES – National Pollutant Discharge Elimination System

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

SD – storm drain

STP – sewage treatment plant

SWPPP – stormwater pollution prevention plan

TPH – total petroleum hydrocarbons

VOC – volatile organic compound

The potential pathways and associated source information in Table 7 provide a general overview of the contaminant dynamics currently of potential issue at the subject property. Planning and management of ongoing and future source control programs at the subject property will be discussed in greater length in the subsequent SCSP documentation to be completed upon finalization of this Environmental Conditions Report.

5.5 OFFSITE POTENTIAL PATHWAYS OF CONTAMINATION

Contamination documented at adjacent properties also has the potential to migrate into and through the subject property. Some of this documented environmental contamination was discussed in Section 4.2; data summaries for many of these facilities are provided in Appendix E.

Since these pathways are outside of the T-108 property boundary, options for control or elimination of these sources and pathways are highly limited. However, source control management practices, standard operating procedures, and existing permit monitoring requirements can be utilized to greatly reduce the potential impact from these offsite sources.

Table 8 highlights some of the potential offsite sources and the routes of migration onto the subject property. As with the information included in Table 7, the information in this table will be used to assist in the planning and management of ongoing and future source control programs at the subject property to be discussed in the upcoming SCSP documentation.

Table 8. Potential offsite sources of contamination and pathway information relative to T-108

POTENTIAL PATHWAY	POTENTIAL SOURCES	POTENTIAL CONTAMINANTS	DETAILS	DATA GAP	GENERAL OPTIONS AND TOOLS FOR ADDITIONAL PATHWAY CHARACTERIZATION OR SOURCE CONTROL (REFER TO TABLE 6)
Air	Emission from neighboring industrial facilities depositing on site	Metals, phthalates, dioxins/furans, particulates	Subject property located in large industrial area; neighboring facilities (e.g., Ash Grove Cement) have documented releases to the atmosphere above regulatory standards; emissions can migrate through stormwater and groundwater pathways.	Data on air emissions in the greater Duwamish Valley are very limited; additional data would be helpful in further assessing pathway but difficult to associate directly with T-108 concerns.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Review and consideration of greater Duwamish Valley stormwater monitoring results can provide insight as to the level of impact from atmospheric deposition. Ongoing coordination with the SCWG can provide valuable information on strategies within the greater Duwamish Valley to assess and manage impacts from atmospheric deposition. • Operational BMPs – Good housekeeping and environmental stewardship education can aid in the identification by subject property workers of potential offsite air emissions issues.
Stormwater	Spills, leaks, and accidental discharges from neighboring facilities	Metals, PAHs, PCBs, TPH, VOCs, miscellaneous chemicals	Contaminants from operations at adjacent terminal properties, truck traffic, and general ROW activities have the potential to migrate through stormwater runoff or sheet flow and into the drainage networks serving the subject property.	Monitoring information from adjacent Port properties (as applicable to their permit) and other potential monitoring data from local property owners (as available) can be assessed for potential impacts to the subject property; however, available data will likely be very limited.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Coordination with other NPDES permittees and with the efforts of the SCWG can provide useful information on assessing potential for impact to the subject property from contaminated stormwater originating offsite. • Operational BMPs – Good housekeeping and environmental stewardship education can help subject property workers identify concerns in advance of potential impact to the site. • Physical BMPs – Hay bale buffers, catch basin filter socks, silt screens, etc., can help limit the introduction of contaminants transported to the site from offsite stormwater. Regular cleaning of the catch basin and the stormwater networks can prevent impacted materials from entering the LDW through the stormwater pathway.
Stormwater	Contaminants from indirect atmospheric deposition, dust and particulates	Metals, phthalates, dioxins/furans, particulates	As mentioned above, contaminants deposited via indirect atmospheric deposition onto the subject property can be transported to the LDW through the stormwater pathway.	Data on air emissions in the greater Duwamish Valley are very limited; additional data would be helpful in further assessing pathway but difficult to associate directly with T-108 concerns.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Review and consideration of greater Duwamish Valley stormwater monitoring results can provide insight as to the level of impact from atmospheric deposition. Ongoing coordination with the SCWG can provide valuable information on strategies within the greater Duwamish Valley to assess and manage impacts from atmospheric deposition. • Operational BMPs – Good housekeeping practices (pavement sweeping, catch basin cleanout, etc.) can help prevent contaminants in atmospheric materials from entering the stormwater network.

POTENTIAL PATHWAY	POTENTIAL SOURCES	POTENTIAL CONTAMINANTS	DETAILS	DATA GAP	GENERAL OPTIONS AND TOOLS FOR ADDITIONAL PATHWAY CHARACTERIZATION OR SOURCE CONTROL (REFER TO TABLE 6)
Stormwater	Contaminants carried to the subject property from offsite by trucks, miscellaneous equipment, and in cargo containers, etc.	Metals, PAHs, PCBs, TPH, miscellaneous chemicals	Tenant operations involve management of trucks, chassis, and cargo containers that could potentially introduce contaminants to the subject property from other locations.	Information on potential contaminants that can be brought to the site via truck traffic, etc. is very limited. Additional data would be helpful but would be difficult to assign specifically to potential T-108 concerns.	<ul style="list-style-type: none"> • Regulatory and Compliance Programs – Permit required monitoring could be used to assess potential impact from offsite materials deposited on the subject property and transported into the stormwater pathway. However, differentiation between onsite contributions and those introduced by offsite equipment would be very difficult to ascertain. • Operational BMPs – Good housekeeping practices (pavement sweeping, catch basin cleanout, etc.) and an established equipment/truck washing program in a dedicated area at the subject property (with appropriate wash-water collection systems) would be the most practical way of addressing this potential contaminant pathway at the subject property.
Groundwater migration	Contaminants in groundwater in properties outside the T-108 subject property (i.e., S Oregon Street ROW) have the potential to migrate onto the subject property	TPH compounds, metals, miscellaneous chemicals	Results of sampling in the S Oregon Street ROW indicated soil and/or groundwater impacted with PCBs, metals, TPH compounds, and PAHs	Additional coordination and assessment of neighboring groundwater monitoring programs will provide necessary, if likely limited, information on overall groundwater quality in the area of the subject property.	<ul style="list-style-type: none"> • Environmental Investigation – Additional characterization of groundwater conditions around the perimeter of the subject property would provide useful information on the quality of groundwater potentially entering the property; however, groundwater flow patterns in many areas of the subject property have been shown to be existing the subject property toward neighboring facilities. • Remediation Programs – In-situ treatment of groundwater at the property boundary, or potential containment pumping of impacted groundwater would limit its influence on subsurface groundwater conditions at the site; however, given the level of contamination identified to date, this is an expensive and relatively impractical approach to address this potential pathway of concern.

BMP – best management practice

LDW – Lower Duwamish Waterway

NPDES – National Pollutant Discharge Elimination System

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

ROW – right-of-way

SWPPP – stormwater pollution prevention plan

TPH – total petroleum hydrocarbons

VOC – volatile organic compound

6 Conclusions and Recommendations

Terminal 108 has had numerous owners and operators over the course of the last hundred years. Operations have included wastewater/stormwater treatment, materials storage and transfer, PCB-contaminated sediment treatment and disposal, and most recently container and chassis storage and miscellaneous maintenance efforts. Upgrades and improvements to subject property infrastructure have occurred with each change of operation at the site and have greatly influenced the overall shape and layout of the subject property.

This diverse operational history has created a complex list of potential environmental concerns that must be considered in the formulation and implementation of an effective long-term source control strategy. Numerous source control tools and management procedures are available for consideration and incorporation into an effective strategy for the subject property. Requirements of a variety of regulatory and compliance programs, many already applicable to operations at the subject property (NPDES permits, etc.), can be utilized to reduce and potentially eliminate contaminants from impacting the subject property while at the same time assessing potential impacts from other onsite and offsite sources. Focused characterization efforts and remediation programs can potentially remove or contain impacted media at the subject property while operational and physical BMPs (good housekeeping practices, worker education, erosion control, etc.) can be incorporated as standard operating procedure at the subject property. Most importantly capital improvement initiatives (utility upgrades, paving, infrastructure improvements, etc.) can greatly reduce the potential for impact from upland sources to LDW sediment.

Environmental media at the subject property (i.e., surface and subsurface soil, groundwater) have been sampled and analyzed for the last three decades. Impacted soil at the subject property may have originated from past onsite operations (wastewater treatment, PCB-impacted sediment treatment and disposal) or may have been brought to the site during filling and grading historically associated with the construction of the LDW. Although the continued characterization and potential remediation (i.e., excavation) of these impacted materials should be considered for the site (especially in consideration of bank soil in the Western Parcel), current and long-term operational use at the subject property makes this approach practical for only small portions of the site. With these considerations, ongoing infrastructure improvements and applicable engineering controls (paving, containment, etc.) are a more practical and effective strategy for the subject property.

Recent groundwater investigation reports for the subject property (Pacific Groundwater Group 2006b, 2007a) have indicated that low concentrations of contaminants have been identified in samples, but at reporting levels below relevant regulatory cleanup standards. Subsequent to this reporting, Ecology acknowledged that groundwater at T-

108 is not currently considered as a potential source for impact to neighboring LDW sediment. Nevertheless, groundwater migration potential (from onsite and offsite) must be considered if a long-term source control strategy implemented at the site is to be effective.

The stormwater pathway's potential to transport contaminants across the subject property and to the LDW will need to be a chief focus during development and implementation of an effective source control strategy. Stormwater has the potential to transport a wide array of contaminants whose origins are from both onsite (spills, leaks, accidental discharges, etc.) and offsite (atmospheric deposition, runoff from adjacent properties, etc.). Numerous options are available to help reduce this pathway's potential of impact including the aspects of the existing NPDES programs (education, spill prevention, proper materials handling and storage, and inspection and oversight). Adherence to the requirements of the Port's and tenant's NPDES permits will reduce the potential for chemicals to leave the property and impact the LDW.

Nevertheless, source control programs will only be effective if they consider the "big picture," including understanding potential future uses of the property (both by its tenants and owner), and the potential for outside sources and pathways to impact the subject property. The understanding of the current conditions of the subject property provided in this documentation, including (but not limited to) the property's geology, hydrogeology, historical operations and practices, environmental investigation history, and future development plans (as applicable) will have to be considered in order to develop an effective strategy for the site.

The SCSPs that will now be completed will expand upon the information included in this documentation (particularly concerning potential pathways and selected source control measures/tools) and provide an overall strategy for continued source control management at the subject property. The plans will take into consideration the regulatory requirements already established as well as other measures and techniques that can be used to ensure that the strategies are proactive and can adjust to the potential changing operational and environmental conditions of the subject property.

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Appendix A. Photolog



Photo 1: ConGlobal Industries container terminal operations on the eastern parcel of T-108.



Photo 2: View (looking north) of the maintenance area located on the eastern portion of the ConGlobal Industries container terminal.



Photo 3: A catch basin on the northern portion of the ConGlobal Industries container terminal located near the maintenance area (eastern parcel).



Photo 4: View (looking northwest from Diagonal Ave S) of the railway crossing the southern portion of the eastern parcel onto the eastern and central portions of the western parcel of T-108.



Photo 5: View (looking south) of the northern portion of the western parcel of T-108. Container chassis are stored on portions of this parcel. The containers in the background are located on the eastern parcel.



Photo 6: Vegetation, chassis parts storage, and a groundwater monitoring well (PGG-5) located on the northern portion of the western parcel of T-108.



Photo 7: View (looking west) of the chassis storage area located on the paved, central portion of the western parcel of T-108.



Photo 8: View (looking north) from the interior of the western parcel of T-108. High-power transmission lines located along the S Oregon St ROW are visible in the background.



Photo 9: View (looking north from the Diagonal Ave S street-end) of the T-108 mitigation area and shoreline; protective buoy line visible at center of image.



Photo 10: Close-up view (looking north) of the T-108 mitigation area.



Photo 11: View (looking south toward the mitigation area) of the southern portion of the T-108 shoreline.



Photo 12: A portion of the wooden bulkhead located on the south-central portion of the T-108 shoreline.



Photo 13: Wooden bulkhead and the Port storm drain outfall (2225) located on the south-central portion of the T-108 shoreline.



Photo 14: View (looking northwest) of the abandoned Diagonal Ave STP outfall and the pipeline dock (installed by Lafarge) located on the north-central portion of the T-108 shoreline. Note the native intertidal substrate.



Photo 15: View (looking north) of the north-central and northern portions of the T-108 shoreline; the bank in this area is armored with rip-rap.



Photo 16: View (looking south from the S Oregon St ROW end) of the northern portion of the T-108 shoreline. The Duwamish/Diagonal CSO/SD and EOF outfalls are nearby, and the location of the Duwamish Siphon is indicated by the sign.



Photo 17: View (looking east) of the S Oregon St ROW. T-108 is on the right-hand side of the photograph, and the WSLCB property is to the left.



Photo 18: View (looking northeast from Diagonal Ave S) of the King County pumping station located adjacent and to the east of T-108.



Photo 19: View (looking northeast) of Diagonal Ave S. T-108 is located to the left (north) of the roadway, and the GSA's Federal Center South is visible to the right (south).



Photo 20: View (looking southeast from Diagonal Ave S) of the northern portion of the Federal Center South property.

Appendix B. Historical Aerial Photograph Review

A historical aerial photo review was conducted to document changes in site use and layout at T-108 over time. Photos from 1936 (King County 2008), 1946 (Aerial Photo Publishers), 1953 (Photographer unknown), 1961 (Pacific Aerial Surveys), 1970 (WDNR), 1981 (WDNR), 1990 (Metro Aerial 1991), and 1995 (WDNR) were available. The parcel boundaries for both the Eastern and Western Parcels of T-108 and the outline of the present-day shoreline are overlaid on the aerial photographs for reference. In addition to the aerial photos collected for this investigation, photos from 1976 and 1977 showing the central and western portions of the property were also available from an existing report by King County (King County et al. 2005).

The 1936 aerial photograph shows the property undeveloped with a tidal channel located on the eastern and northern portions of the Eastern Parcel. The shoreline extends further into the LDW than the present-day shoreline. By 1946, the Diagonal Way STP had been developed. Two large, round clarifiers are visible in the photograph, with two smaller round digesters to the west, and three or four rectangular-shaped sludge-drying beds to the west of the digesters. A control house is located to the east of the clarifiers. The STP outfall is visible approximately midway along the property shoreline, and lumber is being stored offshore within the LDW.

A report by King County indicated that the tidal channel on the north end of the property received untreated sewage from a small sewer system located to the northeast of the Diagonal Way STP (King County et al. 2005). What appears to be a small structure is visible along the eastern boundary of the Eastern Parcel in the aerial photograph from 1946. This may represent the small sewer system, however this could not be confirmed during the course of this investigation.

The site layout observed in the 1953 photograph appears similar to the 1946 layout. In the 1961 photo, a large sludge pond is visible to the west of the clarifiers and digesters; additional sludge ponds may be present to the north of the treatment plant. A large parking lot has been installed on the southern portion of the property.

In the aerial photograph from 1970, an additional structure has been added to the northeast corner of the Eastern Parcel. According to a historical map by the Kroll Map Co. contained in a historical report of site conditions conducted for Chevron by TAMS (1992), this may have been a pump house. Other changes from 1961 apparent on the 1970 photograph include filling of the tidal channel, clearing and grading on the northern and eastern portions of the site, and a reduction in the size of the open sludge pond located to the west of the clarifiers and digesters.

In the 1981 aerial photograph, the STP has been removed and the shoreline along the northern portion of the property has been dredged. It appears that the paved parking area on the southern portion of the property and an area in the center of

the Eastern Parcel are being used to store shipping containers or similar large objects.

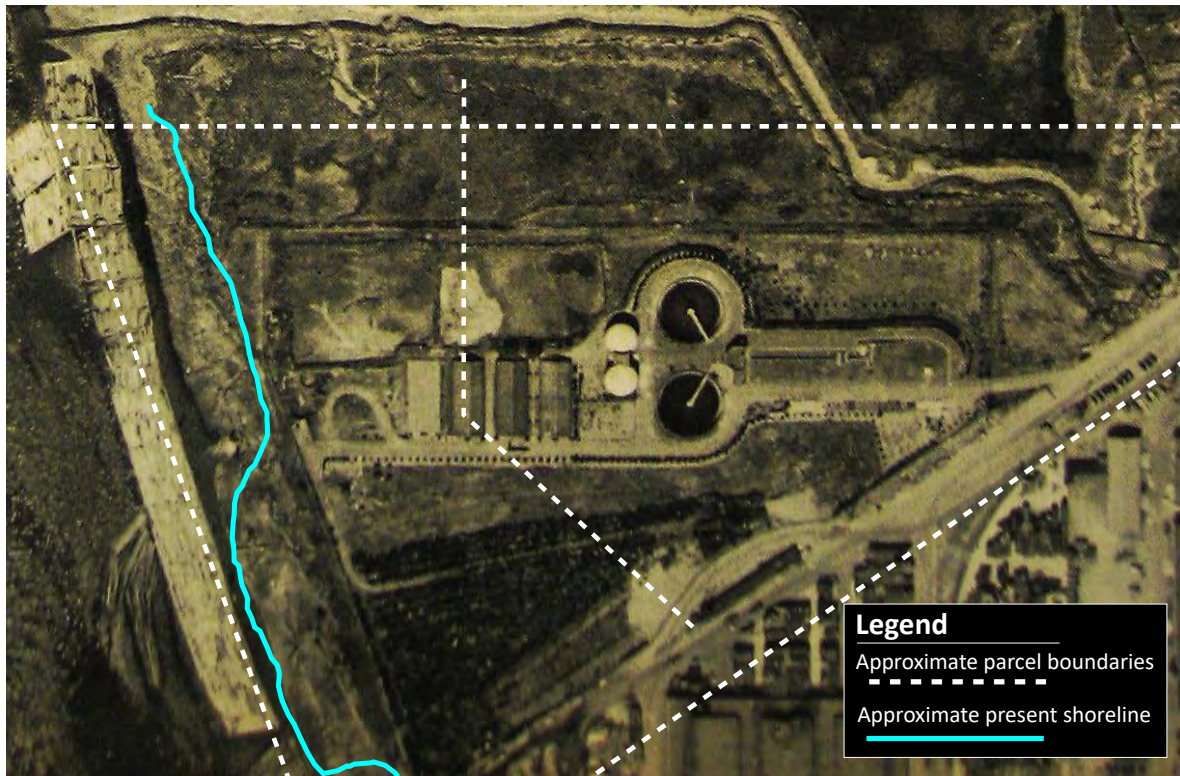
The Lafarge facility is apparent on the Western Parcel of the property in the aerial photograph from 1990. The pipeline dock, cement silos, and truck turn-around area are all distinguishable. The Eastern Parcel appears to be primarily vacant except for a few equipment storage areas visible on the central and southern portions of the parcel. The shape of the mitigation area on the southern portion of the shoreline is also apparent, and lumber is no longer being stored offshore of the property.

In the 1995 aerial photograph, the T-108 container terminal is visible on the Eastern Parcel of the property, while the Lafarge facility remains on the Western Parcel. The mitigation area appears to be more fully developed than in the 1990 photo as vegetation is now visible.

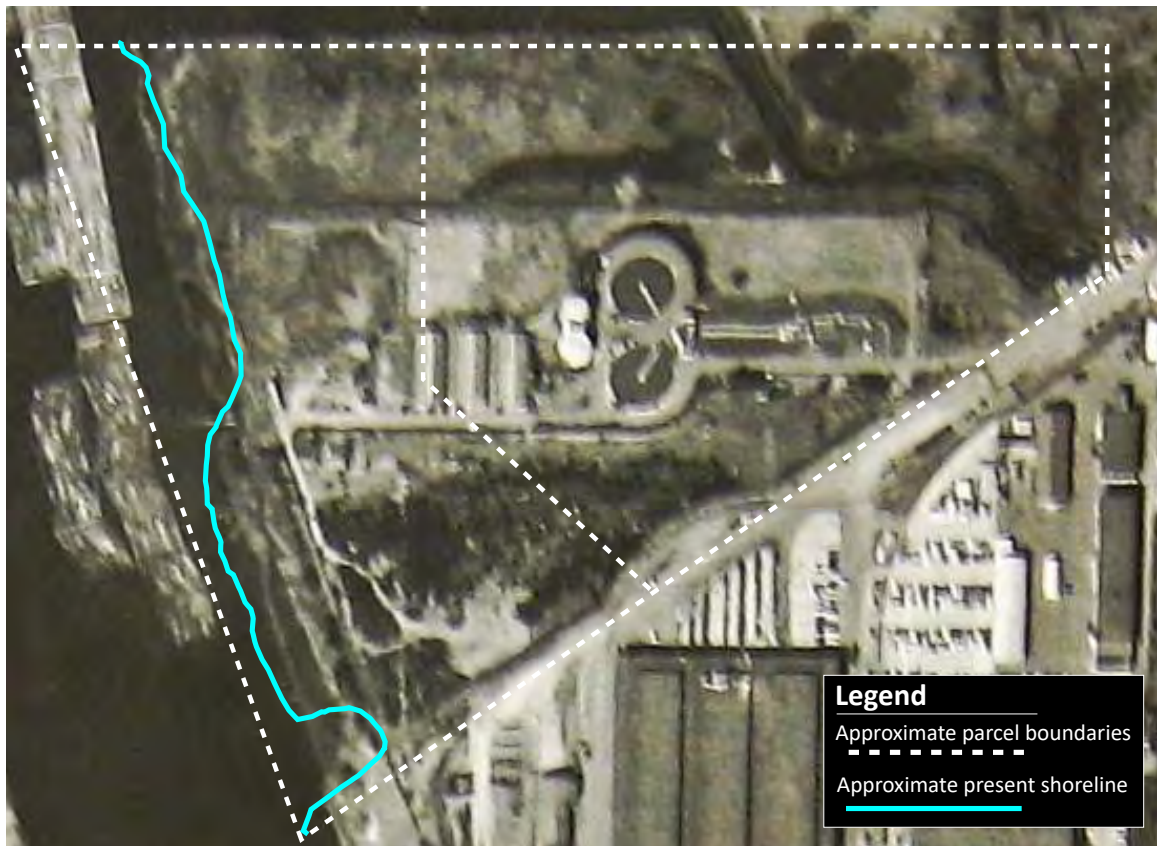
The aerial photographs with coverage of the western portion of the property acquired from the Duwamish/Diagonal CSO/SD Cleanup Study Report (King County et al. 2005) provides information on site conditions at T-108 in the mid-1970s. It was during this time period that the Diagonal Way STP was decommissioned, and also that two pits were excavated on the property to store and treat PCB-contaminated sediment dredged from the LDW. Based on these photographs, it is known that the sediment pits were present on the property in 1976 but had been filled by 1977. The Diagonal Way STP appears to have been decommissioned either in the latter half of 1976 or in 1977. The newly-dredged shoreline along the northern portion of the property is also clearly visible in the 1977 photograph. Overall, the historical aerial photographs reviewed during this investigation support the accounts of the property history reviewed in other reports and records.



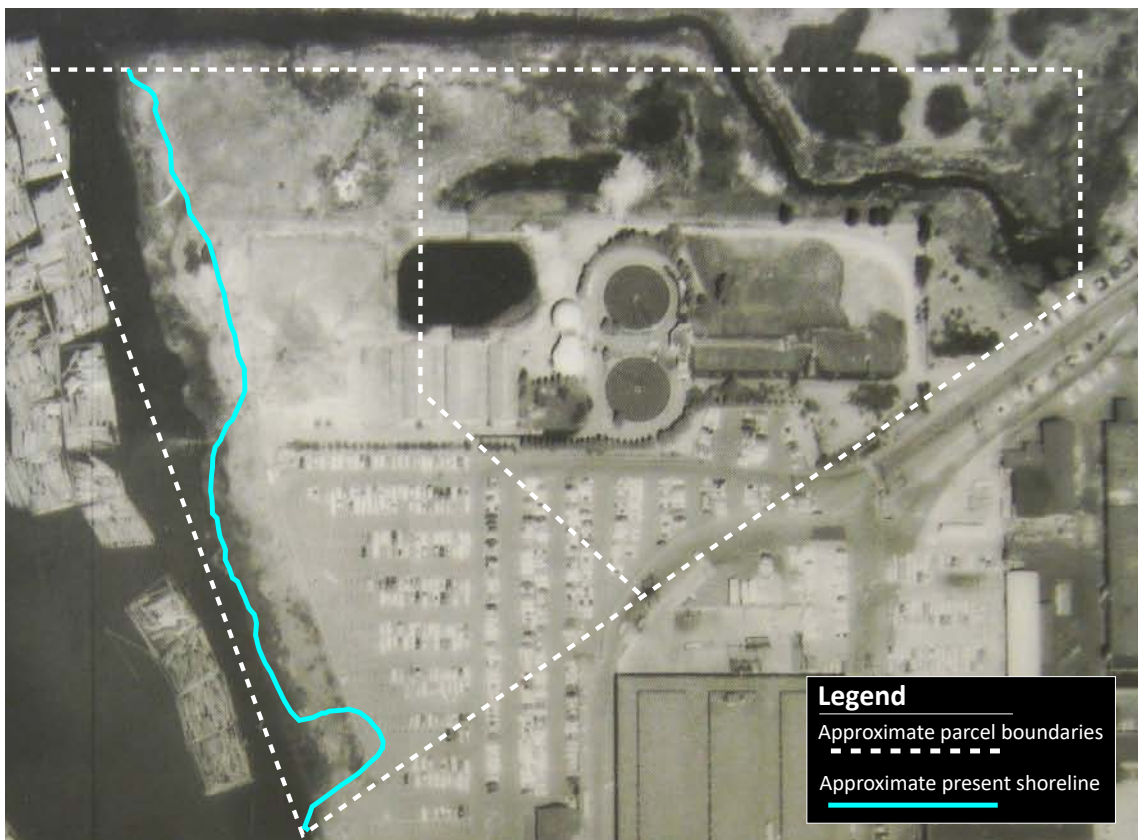
1936 aerial photograph (King County 2008)



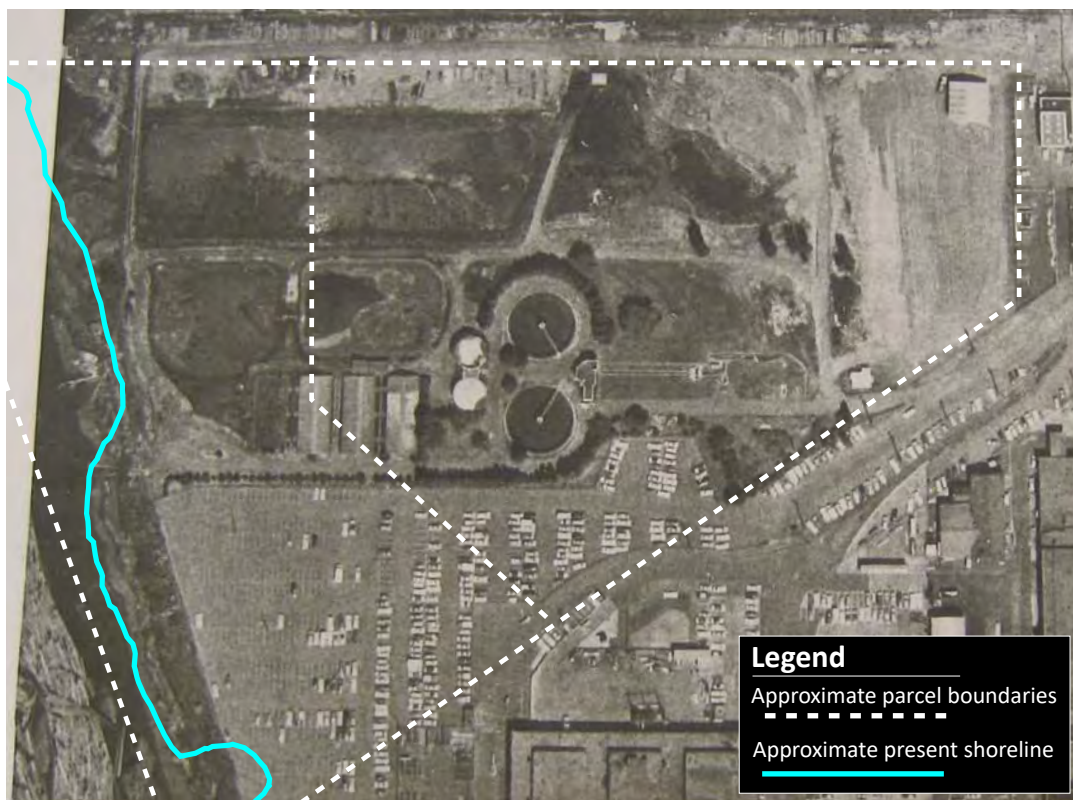
1946 aerial photograph (Aerial Photo Publishers 1946)



1953 aerial photograph (Source not reported)



1961 aerial photograph (Pacific Aerial Surveys 1961)



1970 aerial photograph (Washington Department of Natural Resources 1970)



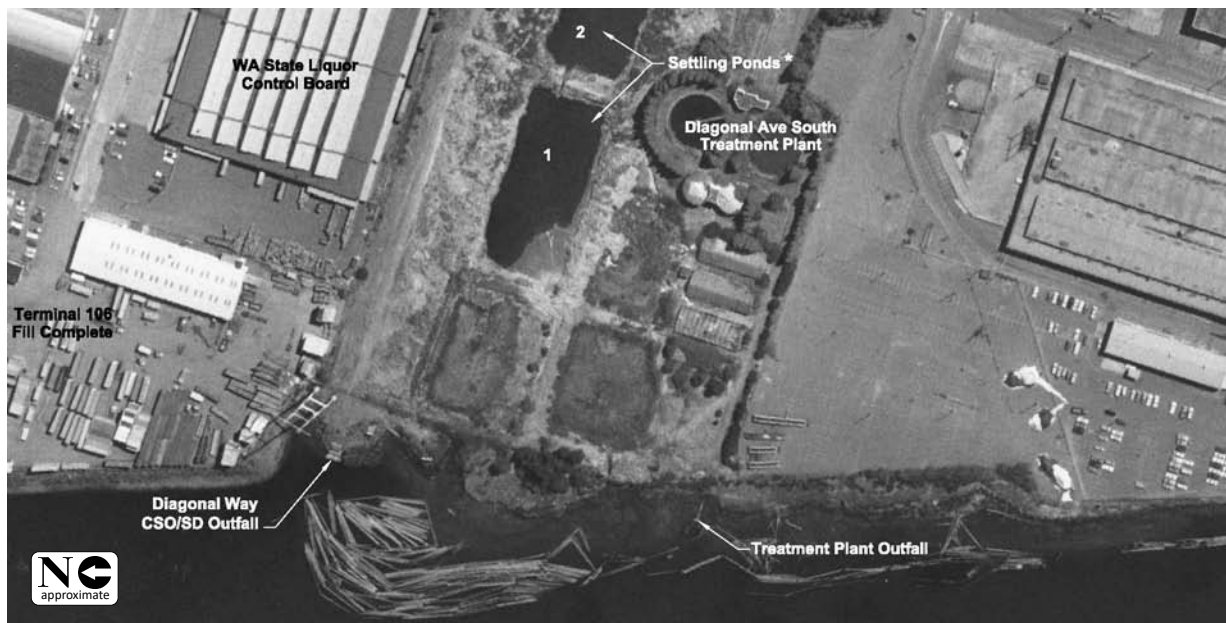
1981 aerial photograph (Washington Department of Natural Resources 1981)



1990 aerial photograph (Metro Aerial 1991)



1995 aerial photograph (Washington Department of Natural Resources 1995)



1976 aerial photograph showing settling holding pits (KCDNR et al. 2005; photograph provided by US Army Corps of Engineers, Seattle District, dated July 28, 1976)



1977 aerial photograph showing settling holding pits filled (KCDNR et al. 2005; photograph provided by US Army Corps of Engineers, Seattle District, dated October 4, 1977)

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Appendix C Groundwater Monitoring Well and Boring Logs

BORING AND WELL LOG INFORMATION

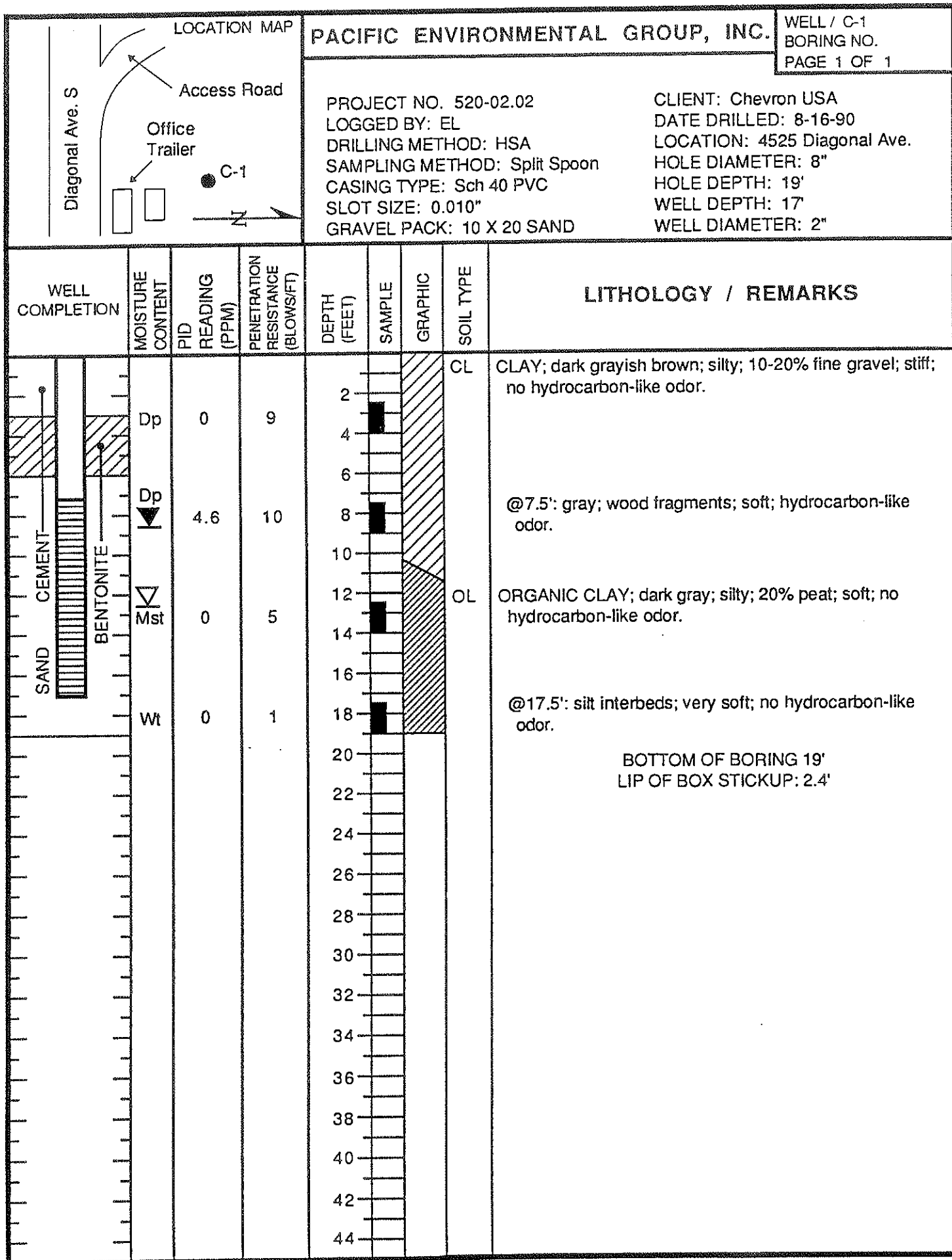
BORING CORE ID	COMPLETED AS A WELL?	OBTAINED LOG?	ENDNOTE CITATION	NOTES
C-1	Y	Y	AGI (1992)	
C-2	Y	Y	AGI (1992)	
C-3	Y	Y	AGI (1992)	
C-4	Y	Y	AGI (1992)	
C-5	Y	Y	AGI (1992)	
C-6	Y	Y	AGI (1992)	
MW-7	Y	Y	AGI (1992)	
MW-8	Y	Y	AGI (1992)	
MW-9	Y	Y	AGI (1992)	
MW-10	Y	Y	AGI (1992)	
MW-11	Y	Y	AGI (1992)	
MW-12	Y	Y	AGI (1992)	
MW-13	Y	Y	AGI (1992)	
MW-14	Y	Y	AGI (1992)	
PGG-1	Y	Y	Pacific Groundwater Group (2007)	
PGG-2	Y	Y	Pacific Groundwater Group (2007)	
PGG-3	Y	Y	Pacific Groundwater Group (2007)	
PGG-4	Y	Y	Pacific Groundwater Group (2007)	
PGG-5	Y	Y	Pacific Groundwater Group (2007)	
PGG-6	Y	Y	Pacific Groundwater Group (2007)	
PGG-7	Y	Y	Pacific Groundwater Group (2007)	
A	N	Y	AGI (AGI 1992)	D&M - diff locations from PEG A-F
B	N	Y	AGI (AGI 1992)	D&M - diff locations from PEG A-F
C	N	Y	AGI (AGI 1992)	D&M - diff locations from PEG A-F
D	N	Y	AGI (AGI 1992)	D&M - diff locations from PEG A-F
E	N	Y	AGI (AGI 1992)	D&M - diff locations from PEG A-F
F	N	Y	AGI (AGI 1992)	D&M - diff locations from PEG A-F
B88-1	N	Y	Dames & Moore (1989)	
B88-2	N	Y	Dames & Moore (1989)	
B88-3	N	Y	Dames & Moore (1989)	
B81-1	N	Y	Dames & Moore (1981)	Boring log label is 1
B81-2	N	Y	Dames & Moore (1981)	Boring log label is 2
B81-3	N	Y	Dames & Moore (1981)	Boring log label is 3
B81-4	N	Y	Dames & Moore (1981)	Boring log label is 4
B81-5	N	Y	Dames & Moore (1981)	Boring log label is 5

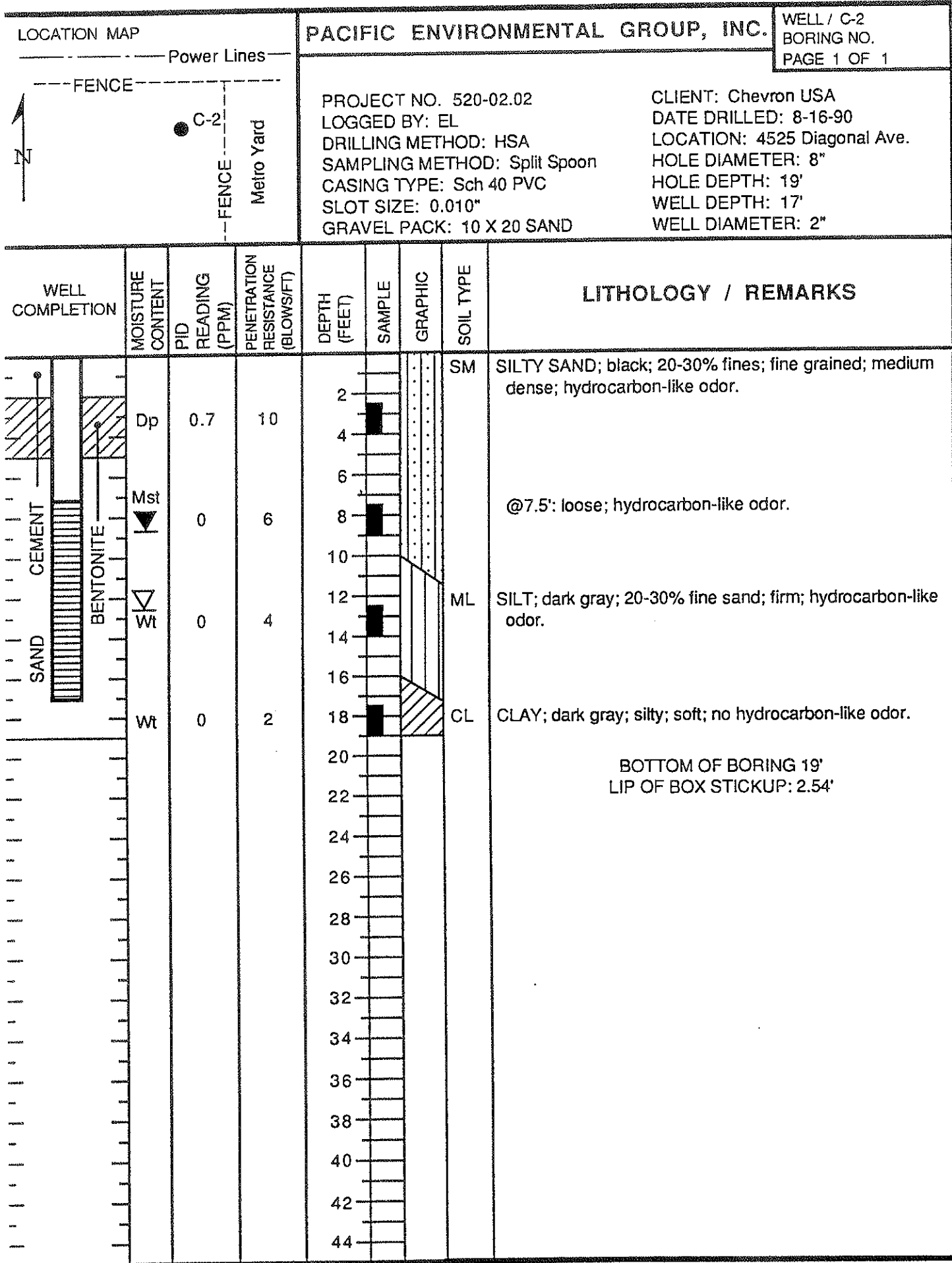
BORING CORE ID	COMPLETED AS A WELL?	OBTAINED LOG?	ENDNOTE CITATION	NOTES
B81-6	N	Y	Dames & Moore (1981)	Boring log label is 6
B81-7	N	Y	Dames & Moore (1981)	Boring log label is 7
B81-8	N	Y	Dames & Moore (1981)	Boring log label is 8
B81-9	N	Y	Dames & Moore (1981)	Boring log label is 9
B81-10	N	Y	Dames & Moore (1981)	Boring log label is 10
B81-11	N	Y	Dames & Moore (1981)	Boring log label is 11
B81-12	N	Y	Dames & Moore (1981)	Boring log label is 12
B81-13	N	Y	Dames & Moore (1981)	Boring log label is 13
A	N	N	Pacific Environmental Group (1991)*	PEG - diff locations from D&M A-F
B	N	N	Pacific Environmental Group (1991)*	PEG - diff locations from D&M A-F
C	N	N	Pacific Environmental Group (1991)*	PEG - diff locations from D&M A-F
D	N	N	Pacific Environmental Group (1991)*	PEG - diff locations from D&M A-F
E	N	N	Pacific Environmental Group (1991)*	PEG - diff locations from D&M A-F
F	N	N	Pacific Environmental Group (1991)*	PEG - diff locations from D&M A-F
NAT-1	N	N	Pacific Groundwater Group (2006)*	
NAT-2	N	N	Pacific Groundwater Group (2006)*	
NAT-3	N	N	Pacific Groundwater Group (2006)*	
NAT-4	N	N	Pacific Groundwater Group (2006)*	
NAT-5	N	N	Pacific Groundwater Group (2006)*	
NAT-6	N	N	Pacific Groundwater Group (2006)*	
EP-1	N	N	Pacific Groundwater Group (2006)*	Should be in PEG 1991 Environmental Investigation but boring logs are missing from Appendix
EP-2	N	N	Pacific Groundwater Group (2006)*	
EP-3	N	N	Pacific Groundwater Group (2006)*	
EP-4	N	N	Pacific Groundwater Group (2006)*	
EP-5	N	N	Pacific Groundwater Group (2006)*	
EP-6	N	N	Pacific Groundwater Group (2006)*	
EP-7	N	N	Pacific Groundwater Group (2006)*	
EP-8	N	N	Pacific Groundwater Group (2006)*	
EP-9	N	N	Pacific Groundwater Group (2006)*	
EP-10	N	N	Pacific Groundwater Group (2006)*	
EP-11	N	N	Pacific Groundwater Group (2006)*	
DUD_30C	N	N	Anchor (2007)*	
DUD_31C	N	N	Anchor (2007)*	

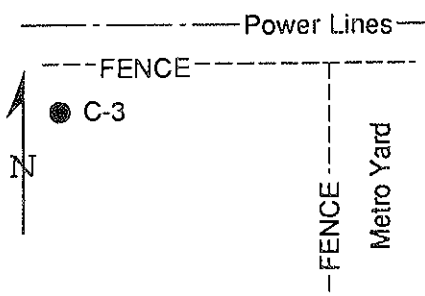
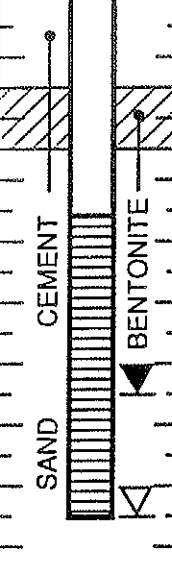
* – Could not find boring log, but found analytical data associated with the location

REFERENCES

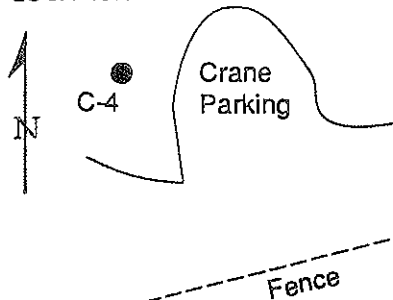
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LOCATION MAP 				PACIFIC ENVIRONMENTAL GROUP, INC.				WELL / C-3 BORING NO. PAGE 1 OF 1	
PROJECT NO. 520-02.02 LOGGED BY: EL DRILLING METHOD: HSA SAMPLING METHOD: Split Spoon CASING TYPE: Sch 40 PVC SLOT SIZE: 0.010" GRAVEL PACK: 10 X 20 SAND				CLIENT: Chevron USA DATE DRILLED: 8-16-90 LOCATION: 4525 Diagonal Ave. HOLE DIAMETER: 8" HOLE DEPTH: 19' WELL DEPTH: 17' WELL DIAMETER: 2"					
WELL COMPLETION	MOISTURE CONTENT	PID READING (PPM)	PENETRATION RESISTANCE (BLOWS/FT)	DEPTH (FEET)	SAMPLE	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS	
	Dp	0	10	2			SM	SILTY SAND; dark gray; 30-40% fines; fine grained; trace gravel; medium dense; hydrocarbon-like odor.	
	Dp	10.5	2	4					
				6					
				8				@7.5': wood fragments; loose; hydrocarbon-like odor.	
				10					
				12				@12.5': abundant wood fragments; loose; hydrocarbon-like odor.	
	Mst	0	1	14			CL	CLAY; gray; silty; peaty; very soft; no hydrocarbon-like odor.	
				16					
				18				@17.5': no hydrocarbon-like odor.	
	Wt	0	1	20					
				22					
				24					
				26					
				28					
				30					
				32					
				34					
				36					
				38					
			40						
			42						
			44						
BOTTOM OF BORING 19' LIP OF BOX STICKUP: 1.63'									

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

WELL / C-4
BORING NO.
PAGE 1 OF 1

PROJECT NO. 520-02.02
LOGGED BY: EL
DRILLING METHOD: HSA
SAMPLING METHOD: Split Spoon
CASING TYPE: Sch 40 PVC
SLOT SIZE: 0.010"
GRAVEL PACK: 10 X 20 SAND

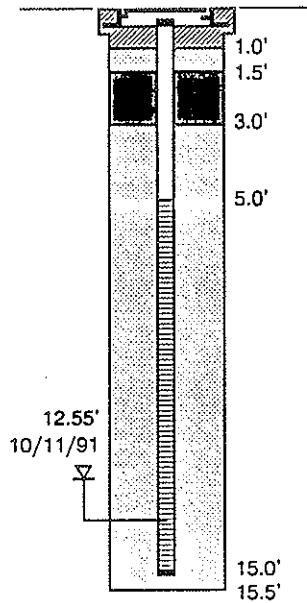
CLIENT: Chevron USA
DATE DRILLED: 8-16-90
LOCATION: 4525 Diagonal Ave.
HOLE DIAMETER: 8"
HOLE DEPTH: 15'
WELL DEPTH: 15'
WELL DIAMETER: 2"

WELL COMPLETION	MOISTURE CONTENT	PID	READING (PPM)	PENETRATION RESISTANCE (BLOWS/FT)	DEPTH (FEET)	SAMPLE	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
	Dp		0	3	2			SM	SILTY SAND; grayish brown; 15% fines; fine grained; loose; no hydrocarbon-like odor.
	Wt		0	6	8				@7.5': fine to coarse grained; no hydrocarbon-like odor.
	Wt		0	2	12			Pt	PEAT; brown; very soft; no hydrocarbon-like odor.
					14				
					16				
					18				
					20				
					22				
					24				
					26				
					28				
					30				
					32				
					34				
					36				
					38				
					40				
					42				
					44				

BOTTOM OF BORING 15'
LIP OF BOX STICKUP: 0.83'

<p>LOCATION MAP</p>		<p>PACIFIC ENVIRONMENTAL GROUP, INC.</p>			<p>WELL / C-6 BORING NO. PAGE 1 OF 1</p>			
<p>PROJECT NO. 520-02.02 LOGGED BY: EL DRILLING METHOD: HSA SAMPLING METHOD: Split Spoon CASING TYPE: Sch 40 PVC SLOT SIZE: 0.010" GRAVEL PACK: 10 X 20 SAND</p>		<p>CLIENT: Chevron USA DATE DRILLED: 8-16-90 LOCATION: 4525 Diagonal Ave. HOLE DIAMETER: 8" HOLE DEPTH: 15' WELL DEPTH: 15' WELL DIAMETER: 2"</p>						
WELL COMPLETION	MOISTURE CONTENT	PID READING (PPM)	PENETRATION RESISTANCE (BLOWS/FT)	DEPTH (FEET)	SAMPLE	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
	Dp	0	4	2			SM	SILTY SAND; black; 20-30% fines; fine to medium grained; loose; no hydrocarbon-like odor.
	Wt	0	1	8				@7.5': very loose; no hydrocarbon-like odor.
	Wt	0	2	12			OL	ORGANIC CLAY; dark gray; trace silt; abundant peat; very soft; hydrogen sulfide odor; no hydrocarbon-like odor.
				14				BOTTOM OF BORING 15'
				16				
				18				
				20				
				22				
				24				
				26				
				28				
				30				
				32				
				34				
				36				
				38				
				40				
				42				
				44				

Well Construction
Summary



*Temporary Benchmark = 8.35 feet

Equipment Mobile B-61

Land Surface ~ 8.8 feet * Date 10/8/91
Elevation

OVM (ppm)

Blows per
Foot

Depth

Sample

0

5

10

15

20

25

30

35

40

BROWN SAND (SP) loose, moist; fine grained.

Becomes black, wet at 9 feet.

GRAY CLAY (OL) soft, wet; with a trace of organic debris.

Groundwater not encountered during drilling.



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

Log of Monitoring Well 7
Chevron/Site 64534097
Seattle, Washington

PLATE

B3

JOB NUMBER
15,582.022

DRAWN
SES

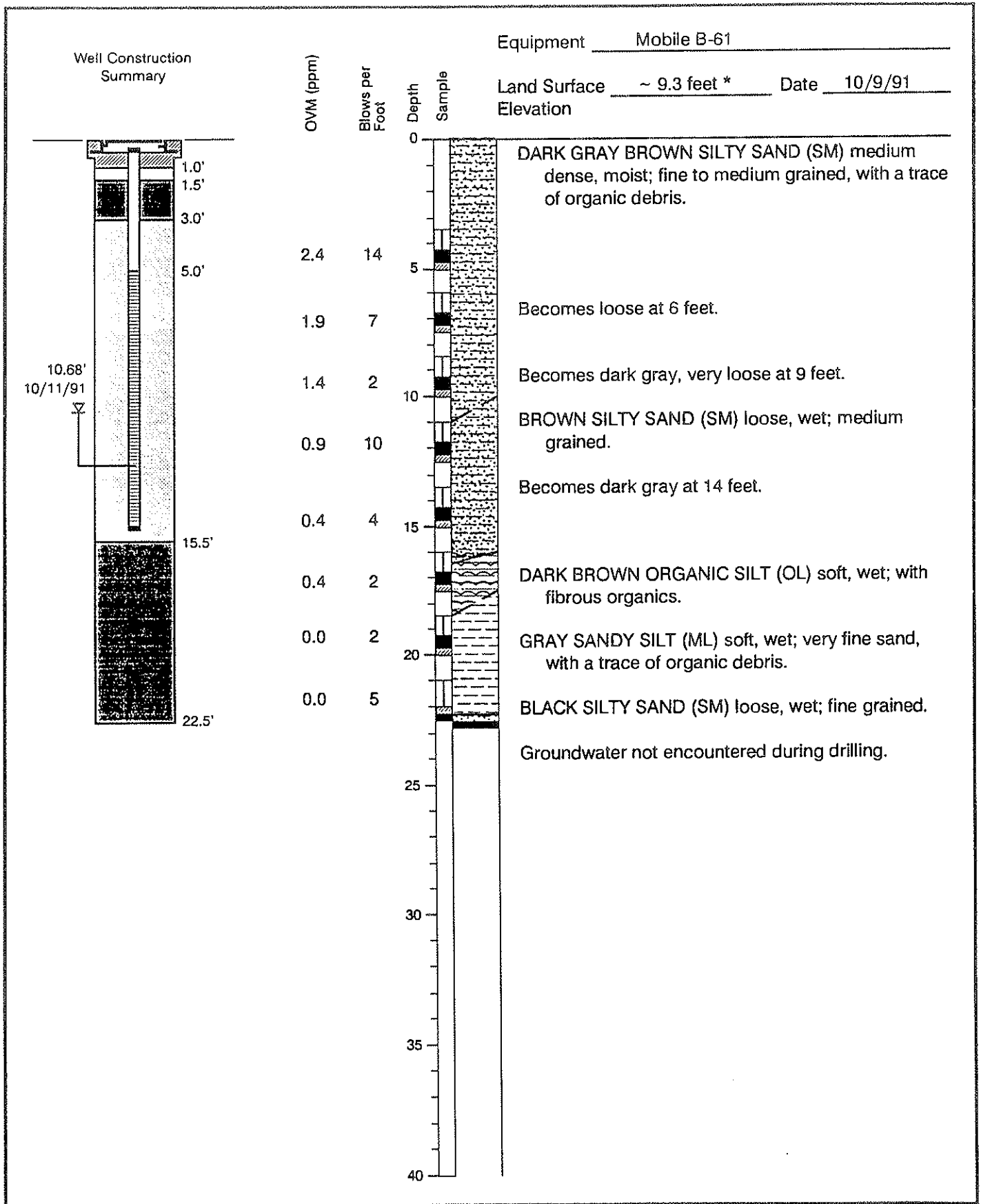
APPROVED
GCC

DATE
10 Aug 92

REVISED

DATE

Appendix C



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

Log of Monitoring Well 8

Chevron/Site 64534097
Seattle, Washington

PLATE

B4

JOB NUMBER
15,582.022

DRAWN
SES

APPROVED
GEC

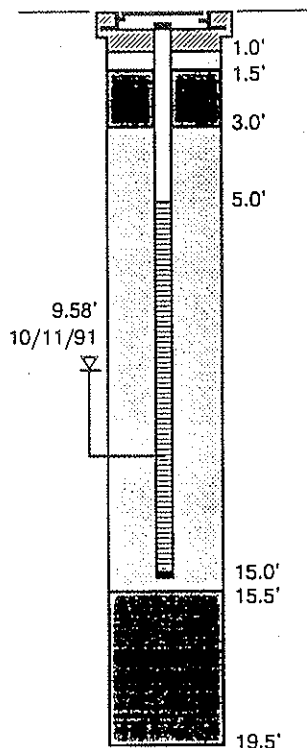
DATE
10 Aug 92

REVISED

DATE

Appendix C

Well Construction
Summary



OVM (ppm)

Blows per
Foot

Depth
Sample

Equipment Mobile B-61

Land Surface ~7.3 feet * Date 10/8/91
Elevation

0.4

5

5

BROWN SILTY SAND (SM) loose, moist; fine to medium grained.

0.4

9

10

BROWN SAND (SP) loose, moist; medium grained.

0.4

4

15

GRAY BROWN SILT (ML) soft, moist; with a trace of root and wood debris.

2.2

2

15

0.4

2

15

Becomes wet at 19 feet.

0.0

2

20

Groundwater not encountered during drilling.

20

25

30

35

40



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

Log of Monitoring Well 9

Chevron/Site 64534097
Seattle, Washington

PLATE

B5

JOB NUMBER
15,582.022

DRAWN
SES

APPROVED
GCC

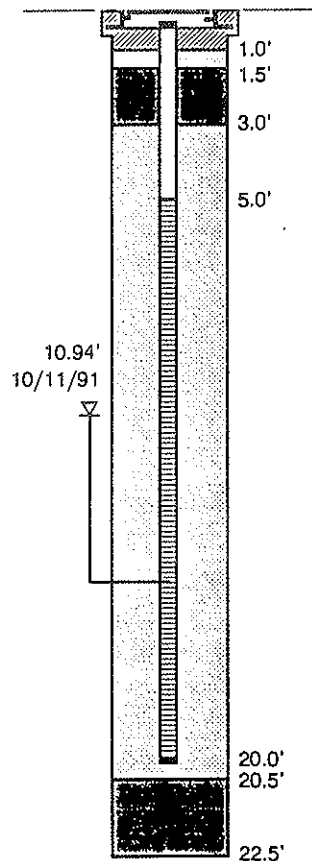
DATE
10 Aug 92

REVISED

DATE

Appendix C

Well Construction
Summary



OVM (ppm)

Blows per
Foot

Depth

Sample

Equipment Mobile B-61

Land Surface ~ 10.1 feet * Date 10/9/91
Elevation

BROWN SILTY SAND (SM) loose, moist; fine to medium grained.

DARK GRAY SANDY SILT (ML) medium stiff, moist.

Becomes black, with a trace of organics at 9.5 feet.

Becomes wet at 12 feet.

DARK BROWN BLACK SAND (SP) very loose, wet; medium grained, with some silt.

GRAY SANDY SILT (ML) medium stiff, wet; very fine sand.

Groundwater not encountered during drilling.



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Log of Monitoring Well 10

Chevron/Site 64534097
Seattle, Washington

PLATE

B6

JOB NUMBER
15,582.022

DRAWN
SES

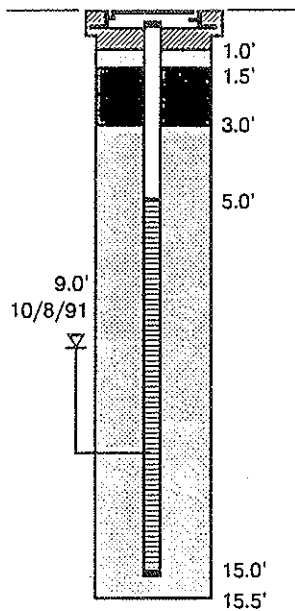
APPROVED
GEC

DATE
10 Aug 92

REVISED

DATE
Appendix C

Well Construction
Summary



OWM (ppm)

Blows per
Foot

Depth

Sample

Equipment Mobile B-61

Land Surface
Elevation

~7.5 feet *

Date 10/8/91

BROWN SILTY SAND (SM) loose, moist; fine to medium grained.

Becomes black, saturated at 9.5 feet.

GRAY CLAY (CL) very soft, saturated; with a trace of organics.

Groundwater encountered at 9 feet during drilling.

20

25

30

35

40



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Log of Monitoring Well 11

Chevron/Site 64534097
Seattle, Washington

PLATE

B7

JOB NUMBER
15,582.022

DRAWN
SES

APPROVED
GCC

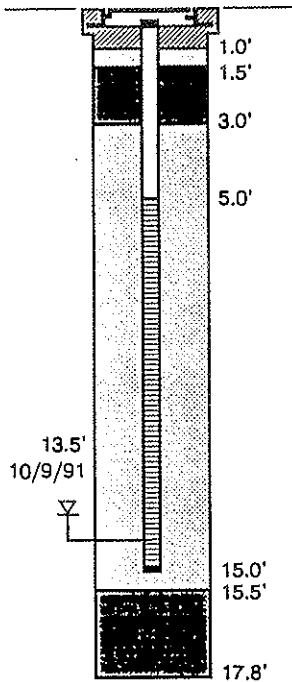
DATE
10 Aug 92

REVISED

DATE

Appendix C

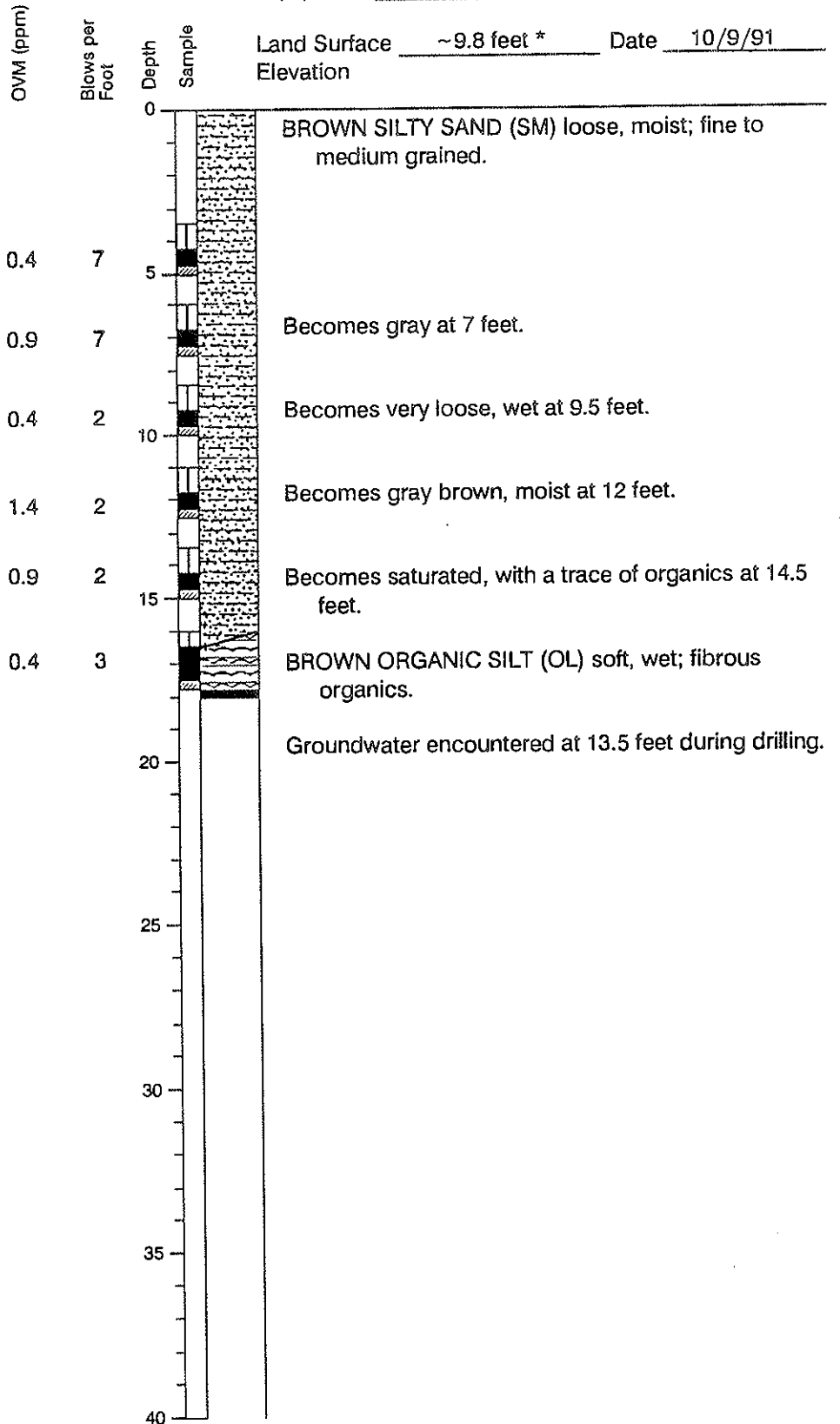
Well Construction
Summary



Equipment Mobile B-61

Land Surface ~9.8 feet *
Elevation

Date 10/9/91



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Log of Monitoring Well 12

Chevron/Site 64534097
Seattle, Washington

PLATE

B8

JOB NUMBER
15,582.022

DRAWN
SES

APPROVED
GCC

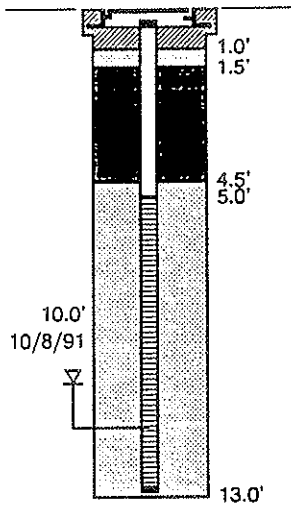
DATE
10 Aug 92

REVISED

DATE

Appendix C

Well Construction
Summary



Equipment Mobile B-61

Land Surface ~6.0 feet *

Date 10/8/91

Elevation

OVM (ppm)

Blows per
Foot

Depth

Sample

0

5

10

15

20

25

30

35

40

DARK BROWN SAND (SP) loose, moist; fine grained,
with a trace of fine gravel and silt.

BLACK SILTY SAND (SM) loose, saturated; fine
grained, with some fine gravel.

DARK BROWN ORGANIC SILT (OL) stiff, saturated;
with a trace of very fine sand.

Groundwater encountered at 10 feet during drilling.



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Log of Monitoring Well 13

Chevron/Site 64534097
Seattle, Washington

PLATE

B9

JOB NUMBER
15,582.022

DRAWN
SES

APPROVED
gpc

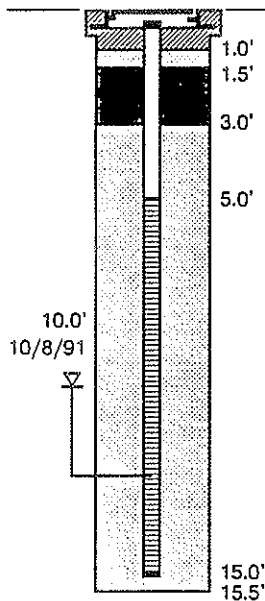
DATE
10 Aug 92

REVISED

DATE

Appendix C

Well Construction
Summary



Equipment Mobile B-61

Land Surface ~9.8 feet
Elevation

Date 10/8/91

OVM (ppm)

Blows per
Foot

Depth
Sample

2.3

27

5

0.4

9

10

0.0

2

15

20

25

30

35

40

BROWN SILTY SAND (SM) medium dense, moist;
fine to medium grained, with a trace of fine gravel.

Becomes dark gray, very fine to fine grained at 9.5
feet.

BLACK SAND (SP) loose, saturated; medium
grained.

DARK GRAY SANDY SILT (ML) soft, saturated; fine
sand, with a trace of organics.

Groundwater encountered at 10 feet during drilling.



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Log of Monitoring Well 14

Chevron/Site 64534097
Seattle, Washington

PLATE

B10

JOB NUMBER
15,582.022

DRAWN
SES

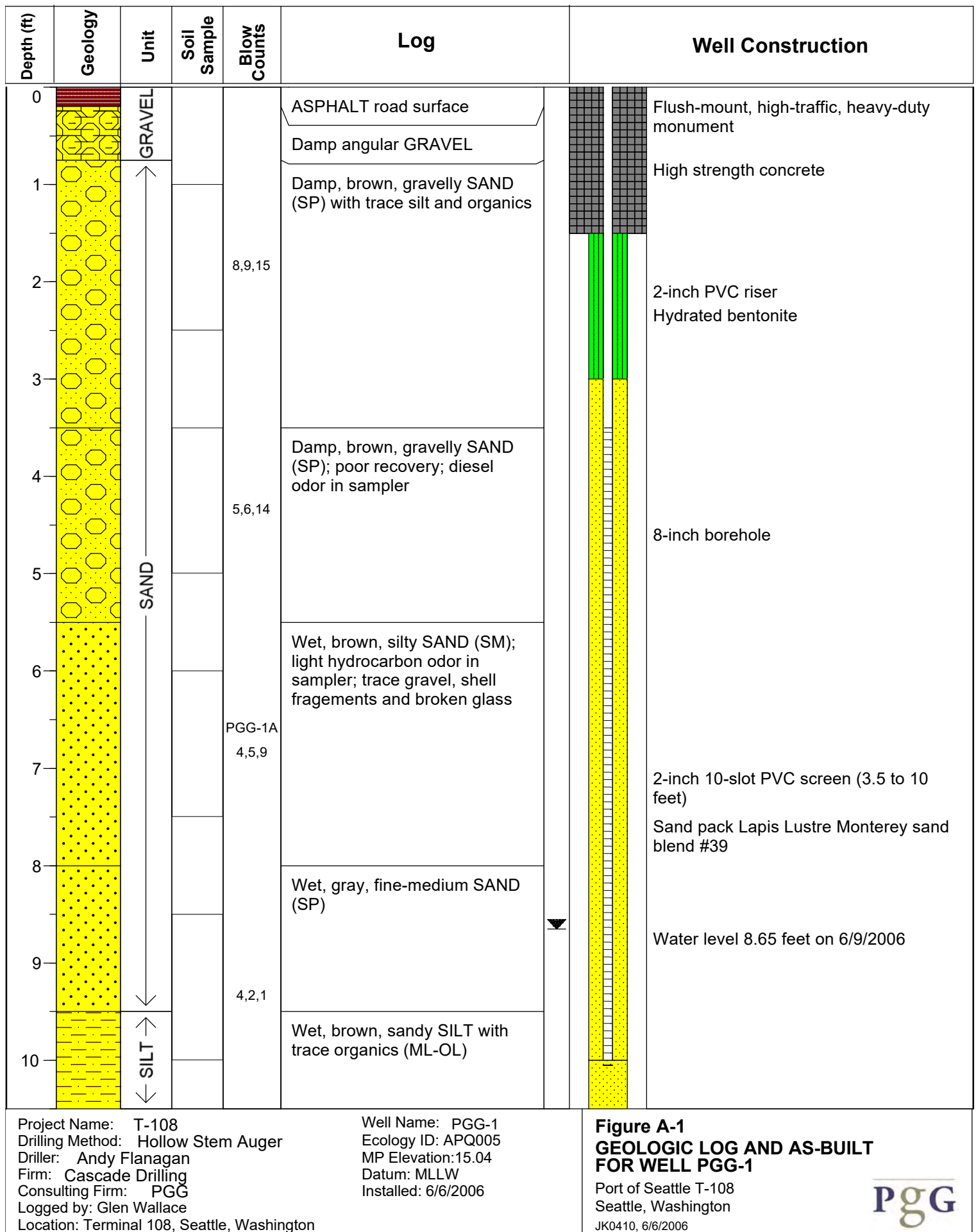
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GCC

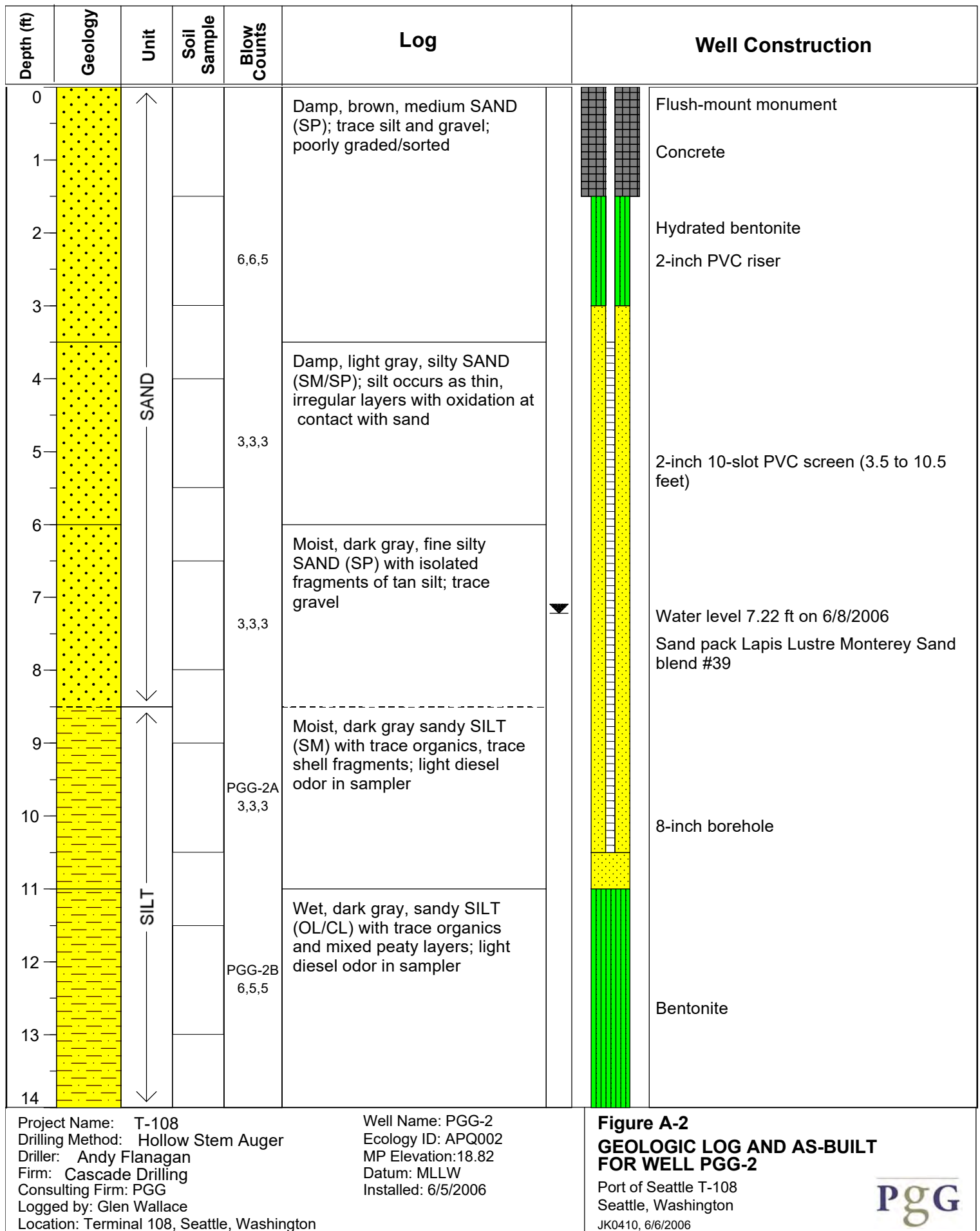
DATE
10 Aug 92

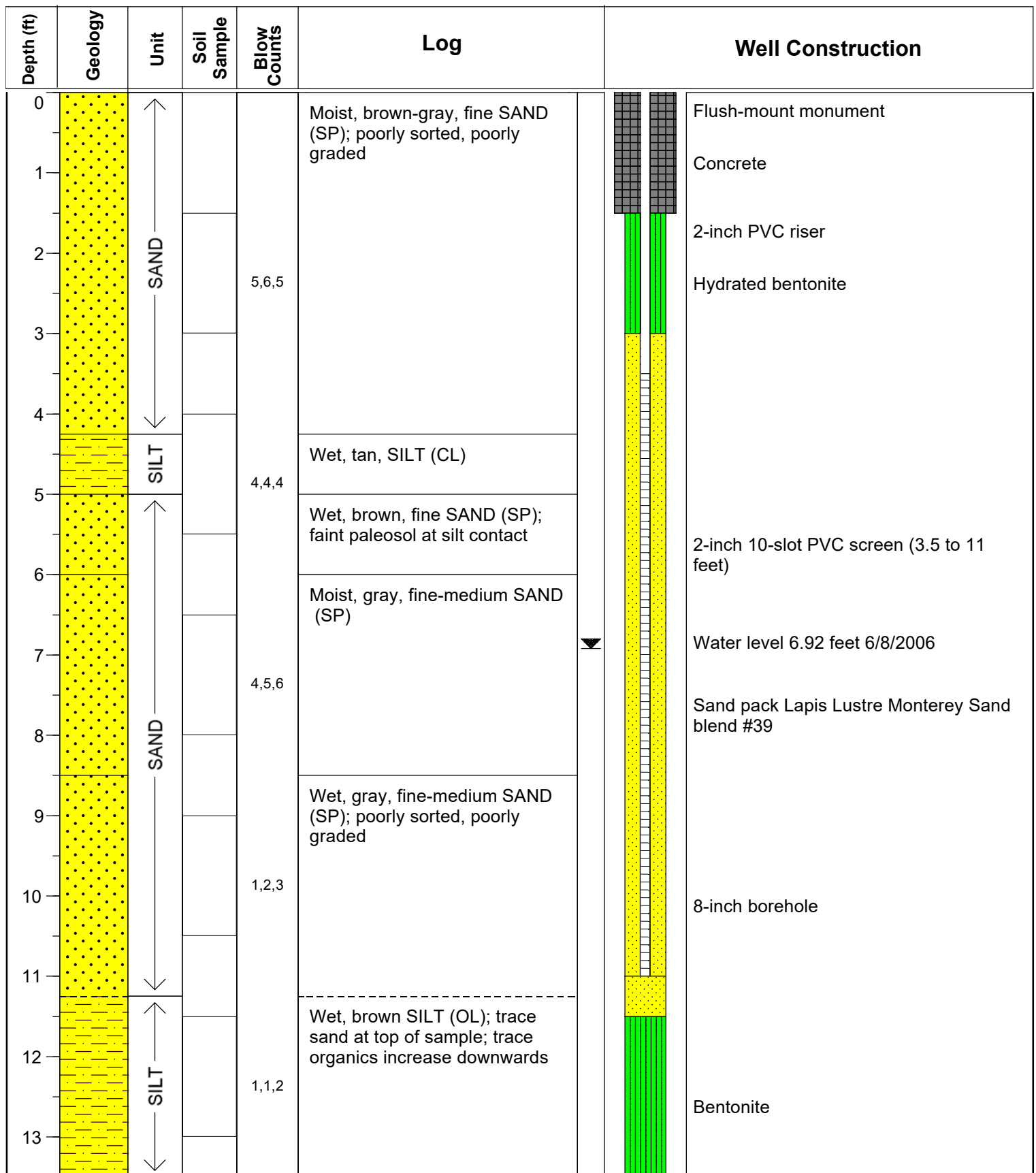
REVISED

DATE

Appendix C







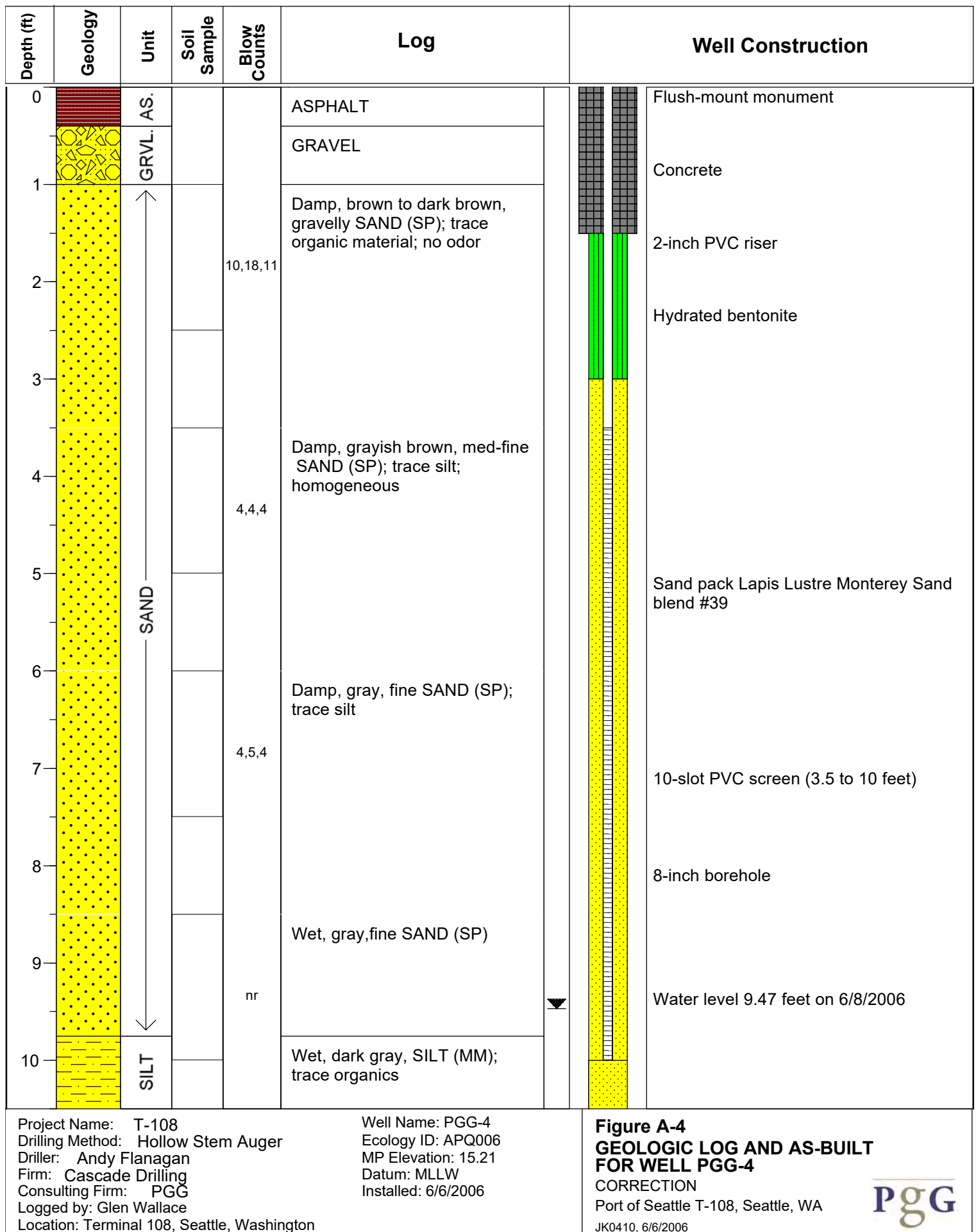
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 Drilling Method: Hollow Stem Auger
 Driller: Andy Flanagan
 Firm: Cascade Drilling
 Consulting Firm: PGG
 Logged by: Glen Wallace
 Location: Terminal 108, Seattle, Washington

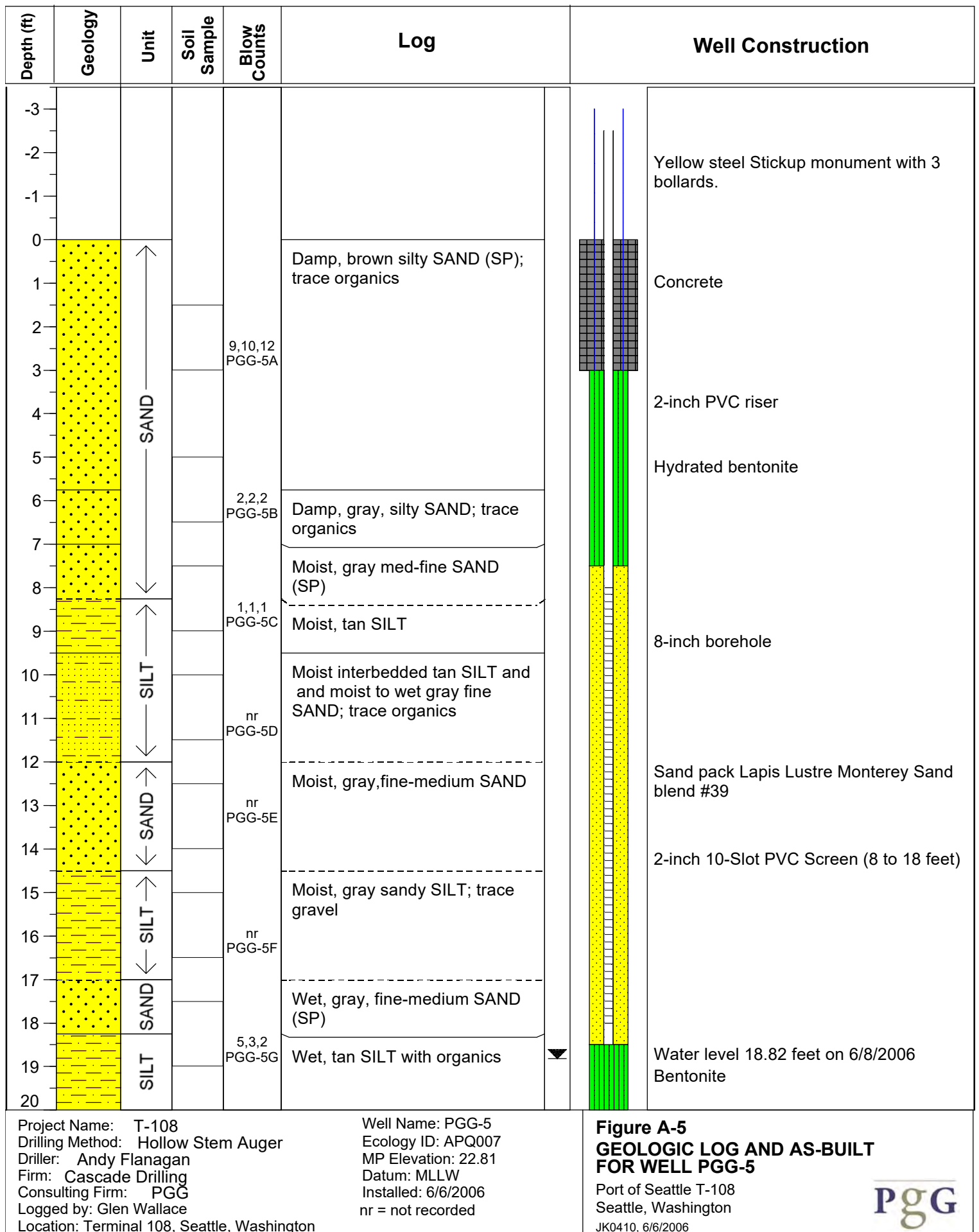
Well Name: PGG-3
 Ecology ID: APQ004
 MP Elevation: 13.26
 Datum: MLLW
 Installed: 6/5/2006

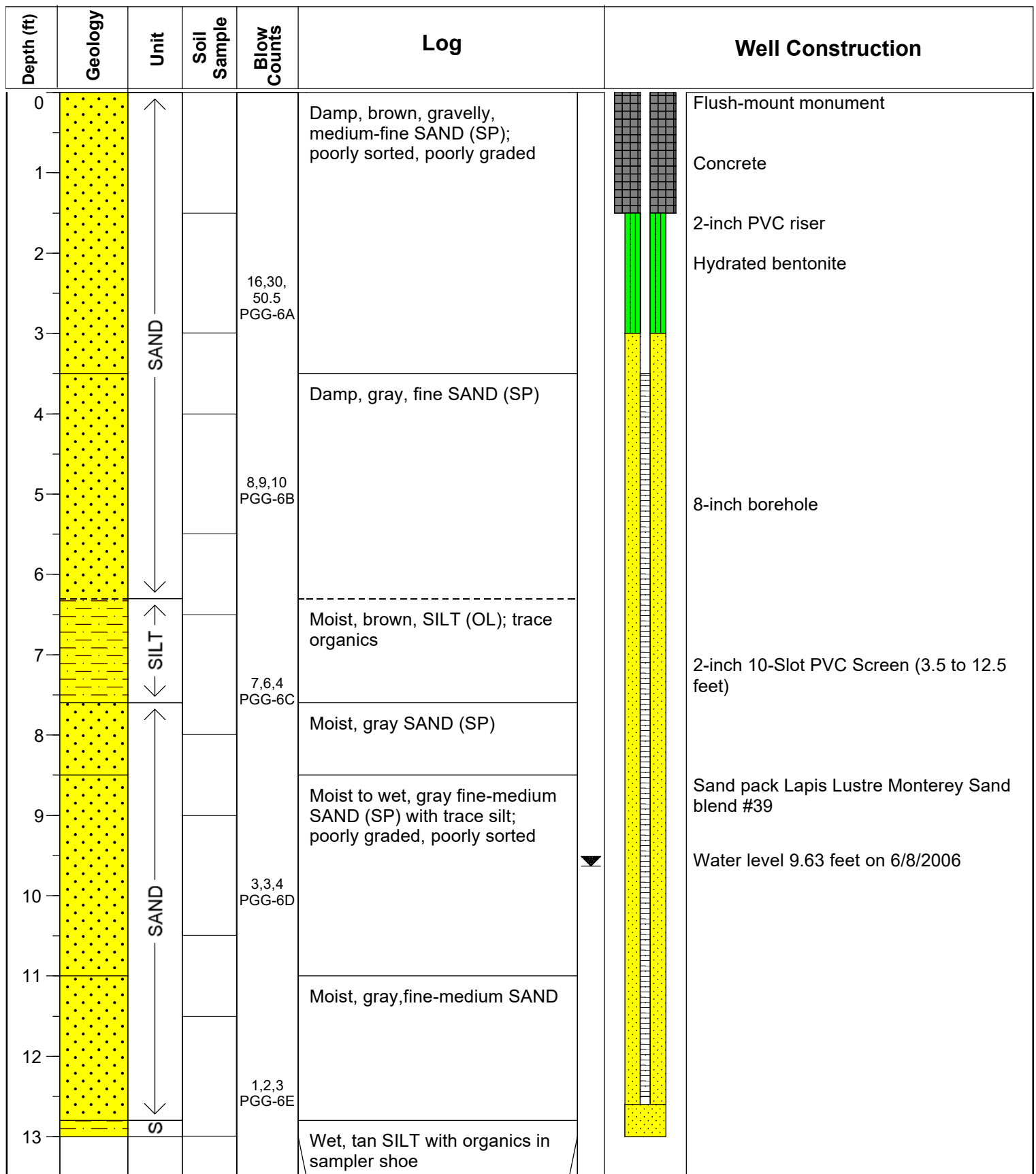
Figure A-3 GEOLOGIC LOG AND AS-BUILT FOR WELL PGG-3

Port of Seattle T-108
 Seattle, Washington
 JK0410, 6/6/2006









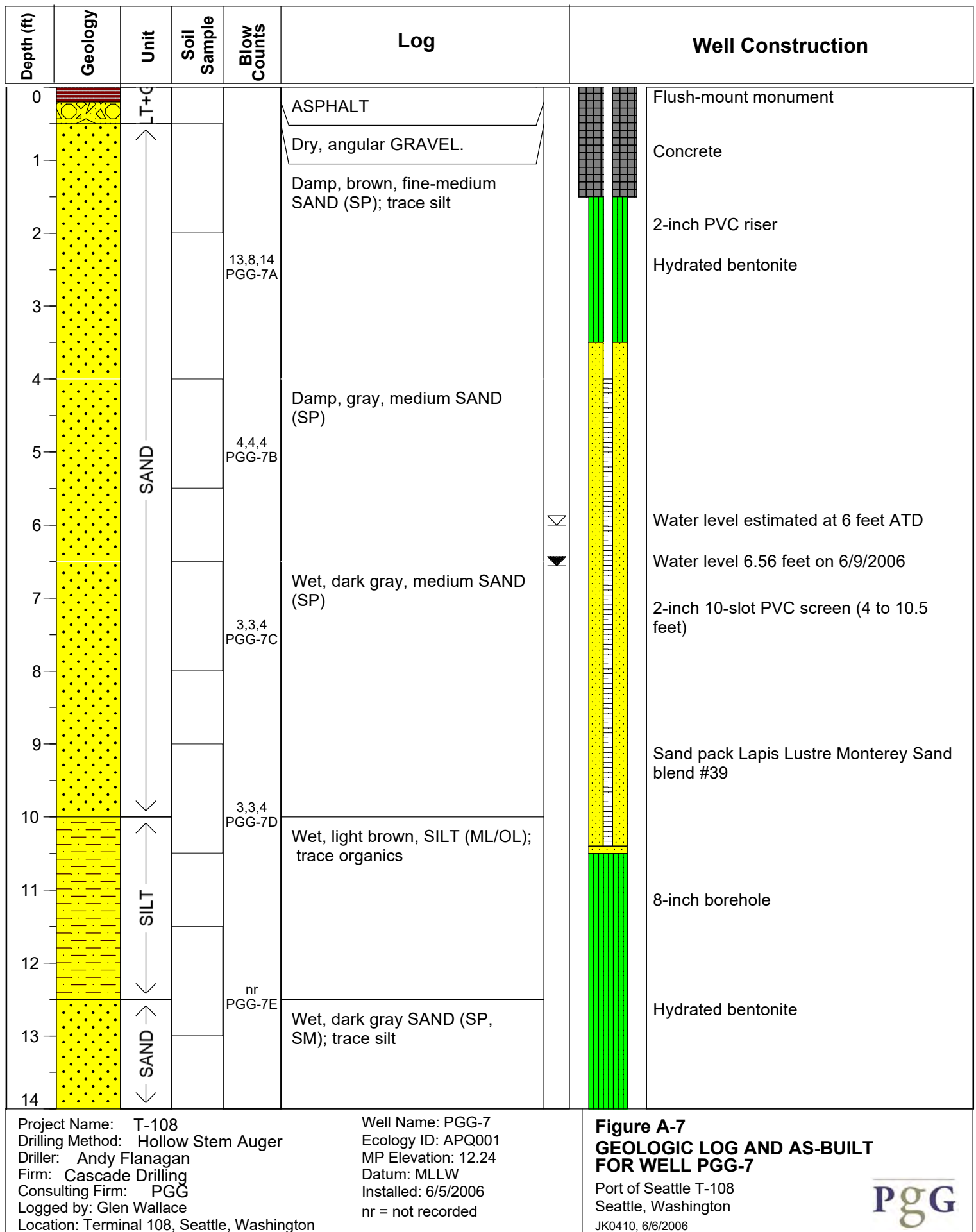
Project Name: T-108
 Drilling Method: Hollow Stem Auger
 Driller: Andy Flanagan
 Firm: Cascade Drilling
 Consulting Firm: PGG
 Logged by: Glen Wallace
 Location: Terminal 108, Seattle, Washington

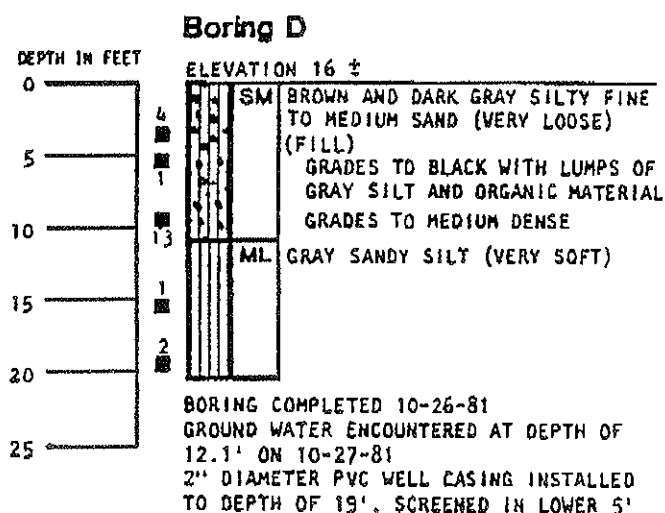
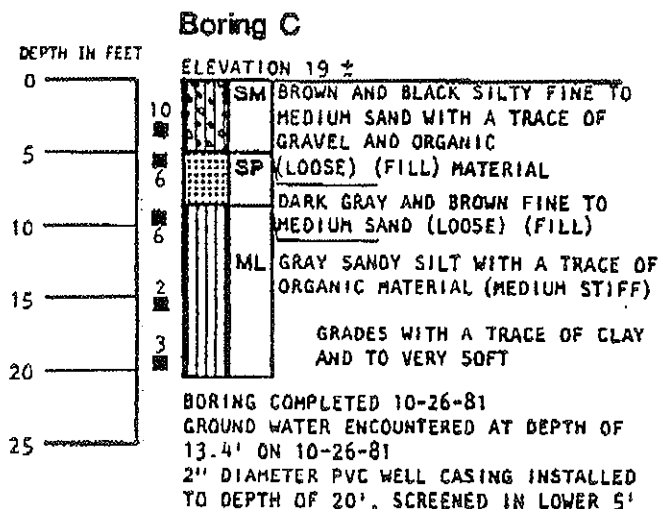
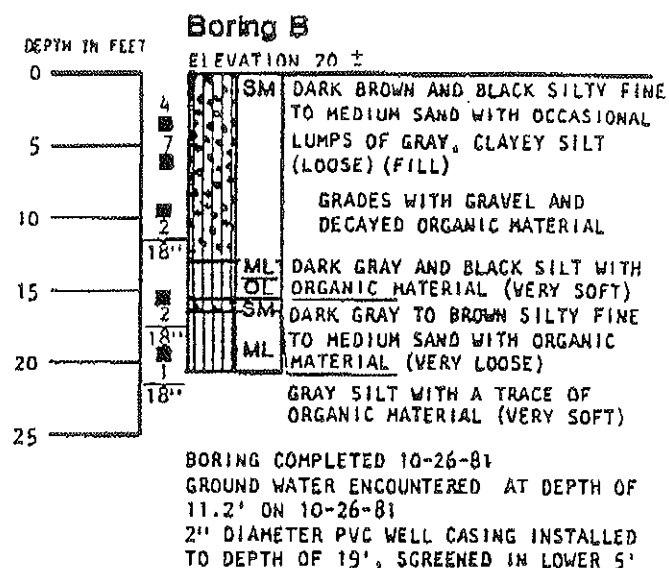
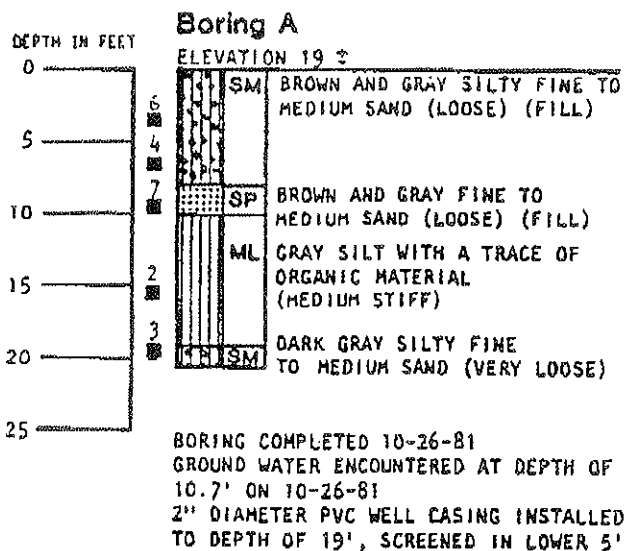
Well Name: PGG-6
 Ecology ID: APQ003
 MP Elevation: 15.03
 Datum: MLLW
 Installed: 6/5/2006

Figure A-6 GEOLOGIC LOG AND AS-BUILT FOR WELL PGG-6

Port of Seattle T-108
 Seattle, Washington
 JK0410, 6/6/2006







Key:

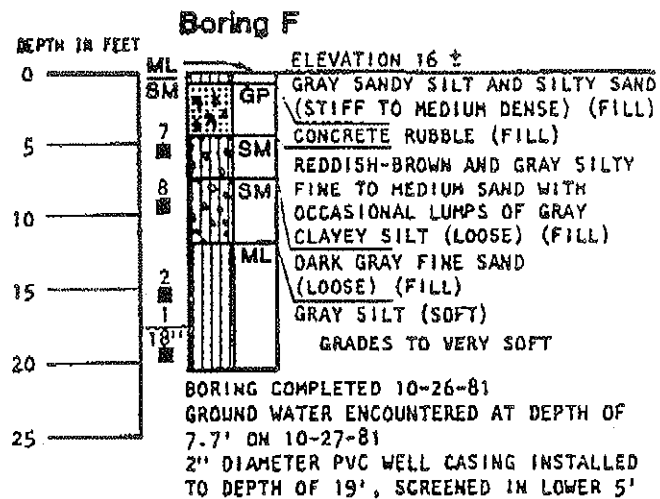
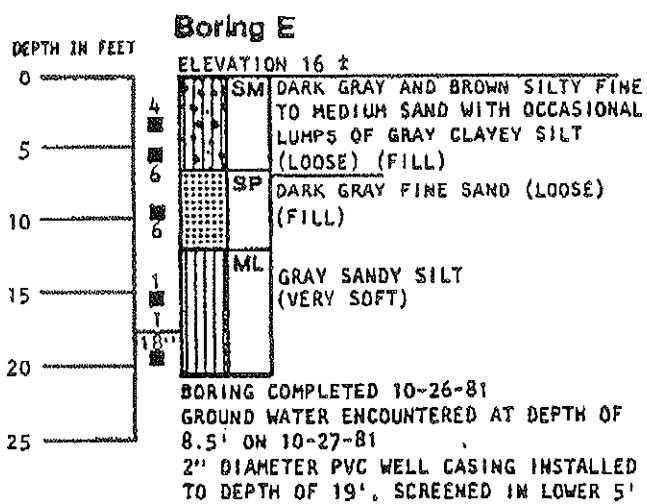
- ↓ BLOWS REQUIRED TO DRIVE DAMES & MOORE SAMPLER ONE FOOT WITH A HAMMER WEIGHT OF 325 LBS. AND A STROKE OF 30 INCHES.
- INDICATES DEPTH AT WHICH UNDISTURBED DAMES & MOORE SAMPLE WAS EXTRACTED.
- INDICATES DEPTH AT WHICH DISTURBED DAMES & MOORE SAMPLE WAS EXTRACTED.

Notes:

1. THE DISCUSSION IN THE TEXT OF THIS REPORT IS NECESSARY FOR A PROPER UNDERSTANDING OF THE NATURE OF THE SUBSURFACE MATERIAL.
2. THE ELEVATIONS SHOWN HAVE BEEN ESTIMATED FROM MAPS AND SHOULD BE CONSIDERED APPROXIMATE; DATUM IS MLLW.

LOG OF BORINGS

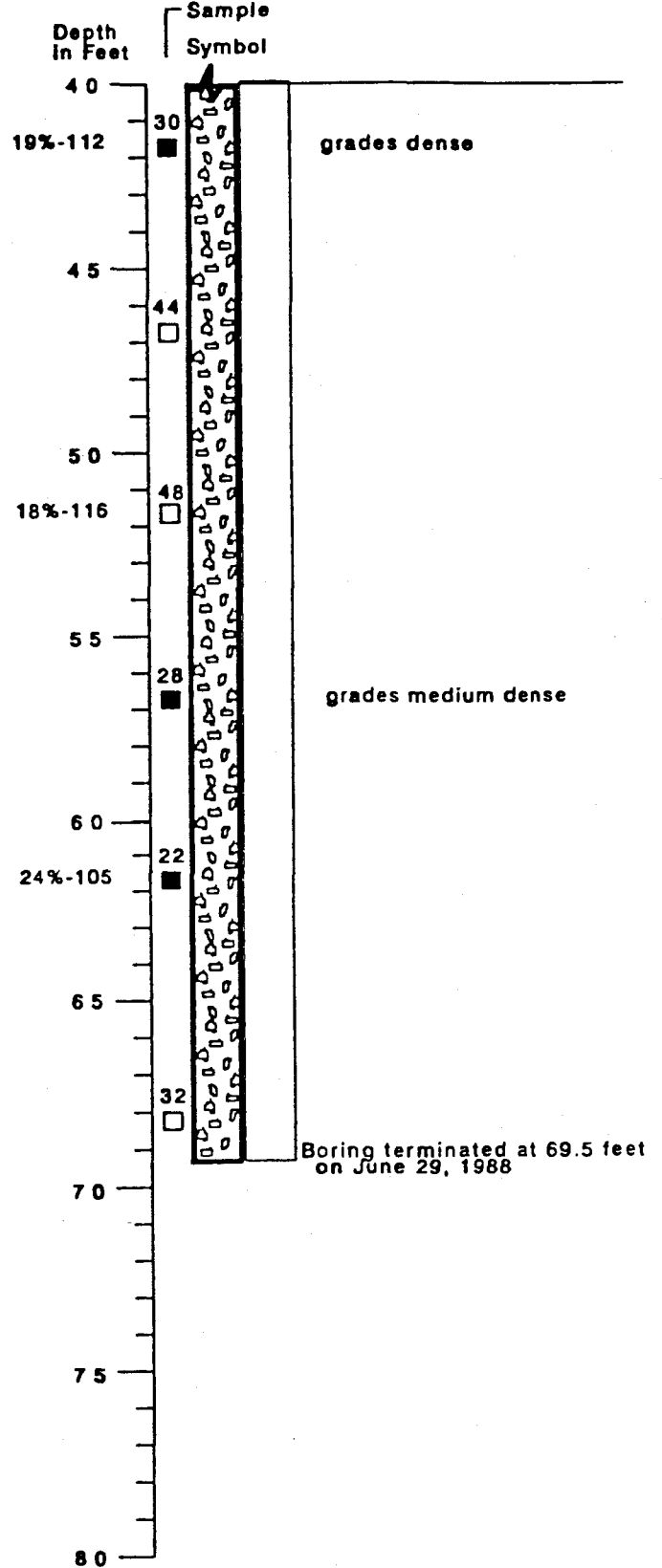
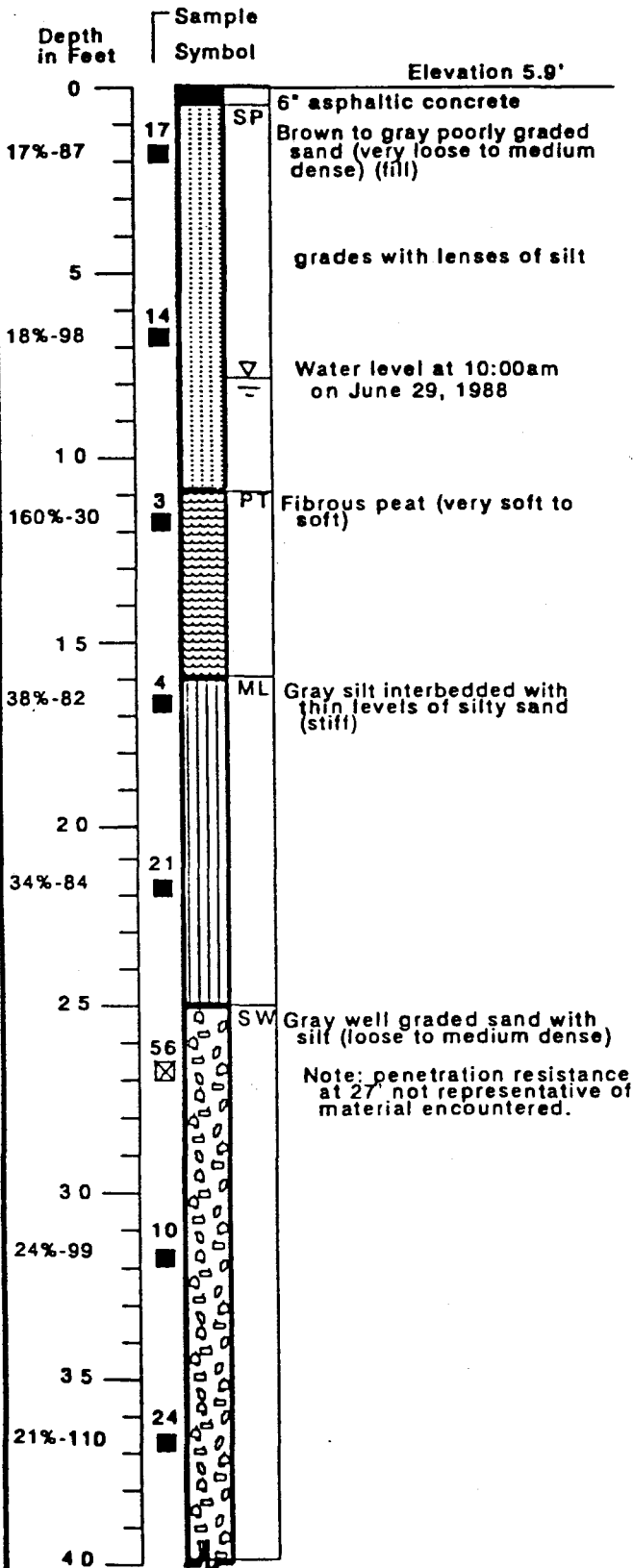
Dames & Moore



LOG OF BORINGS

Dames & Moore

Boring 88-1



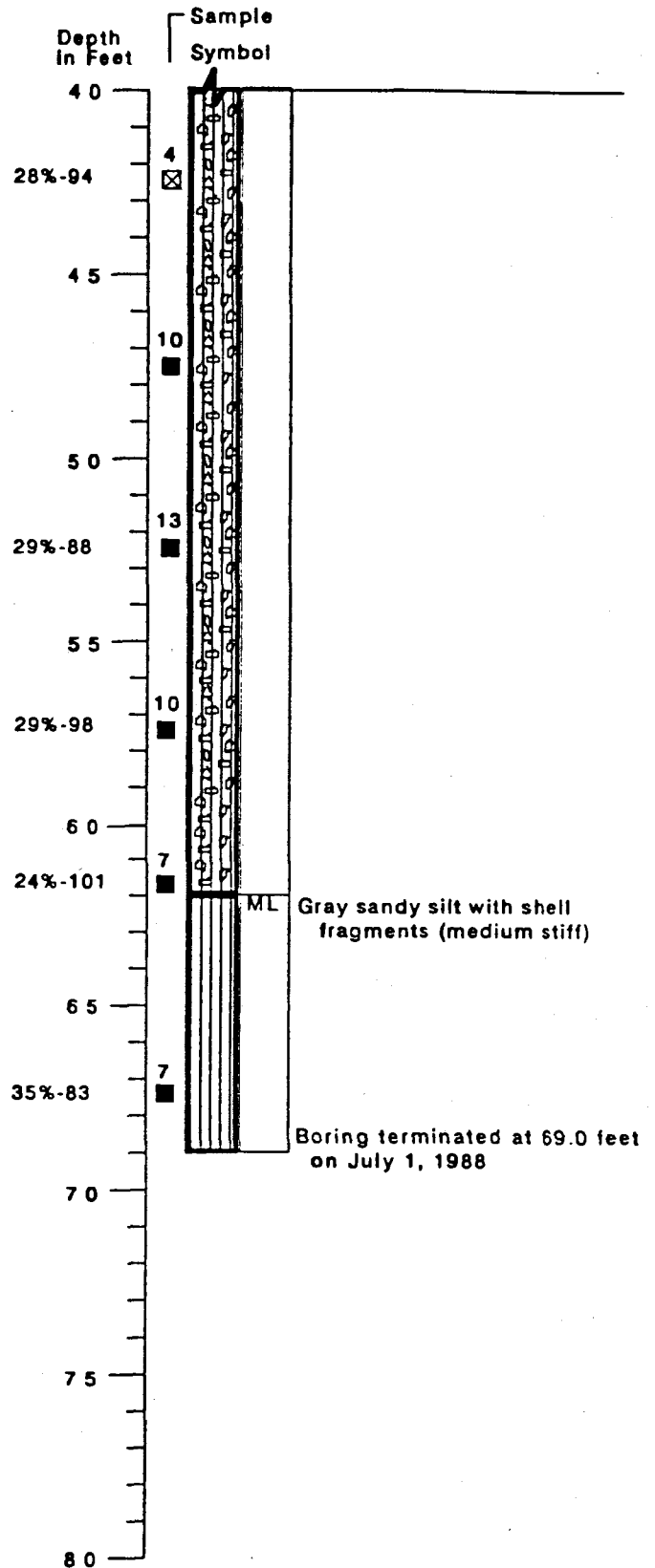
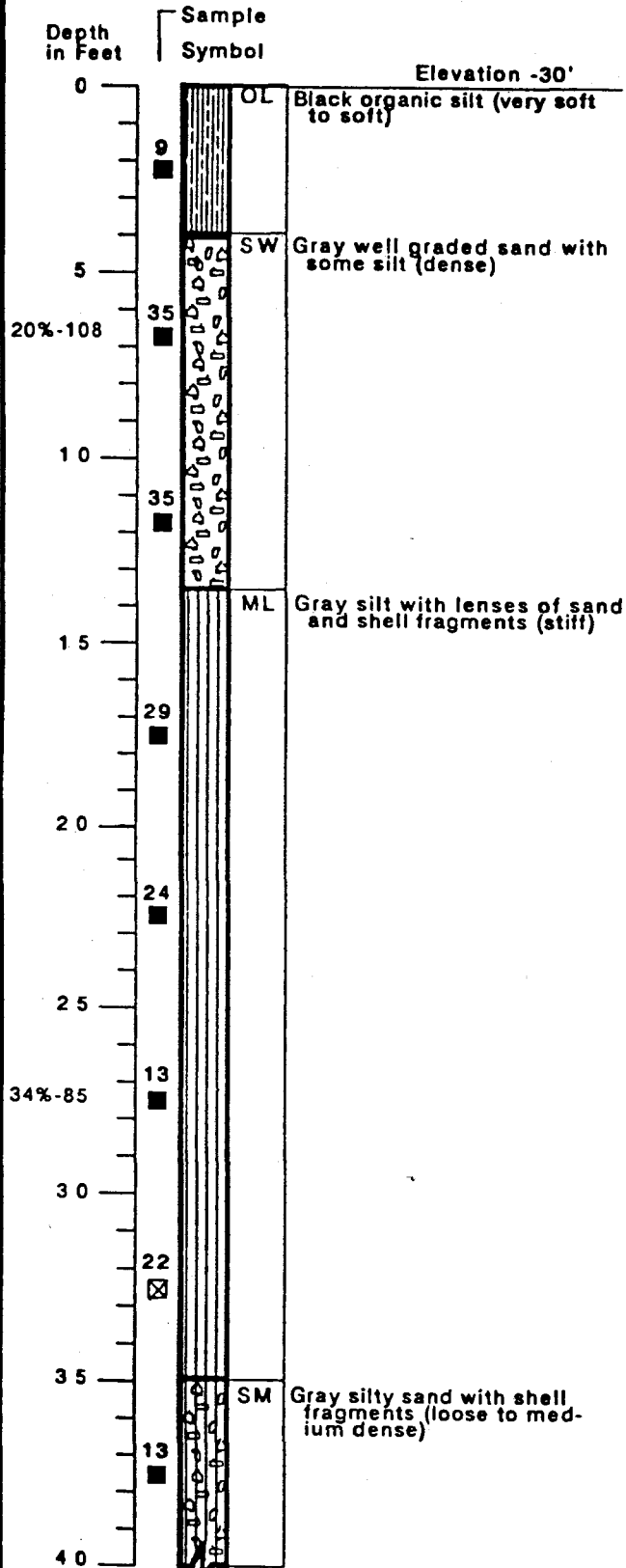
Log of Borings

Dames & Moore

Appendix C

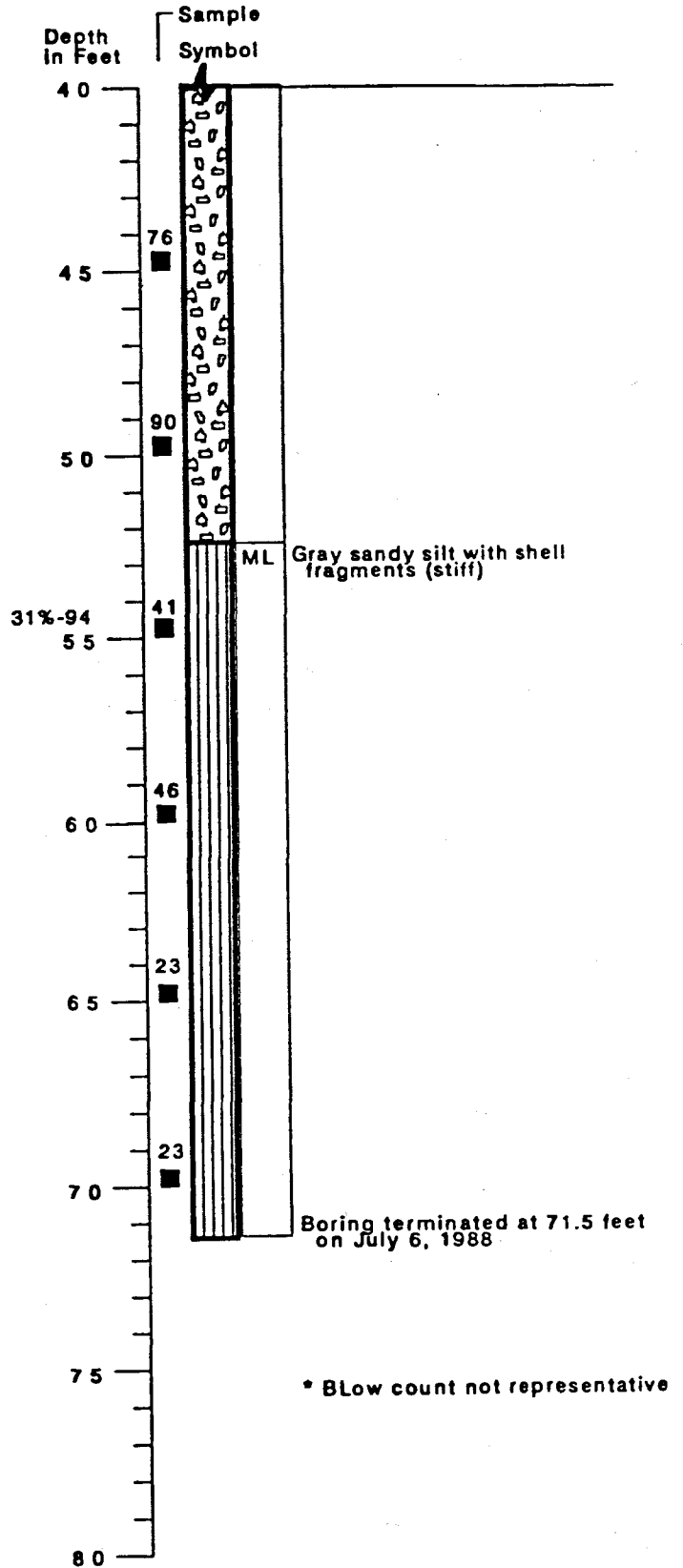
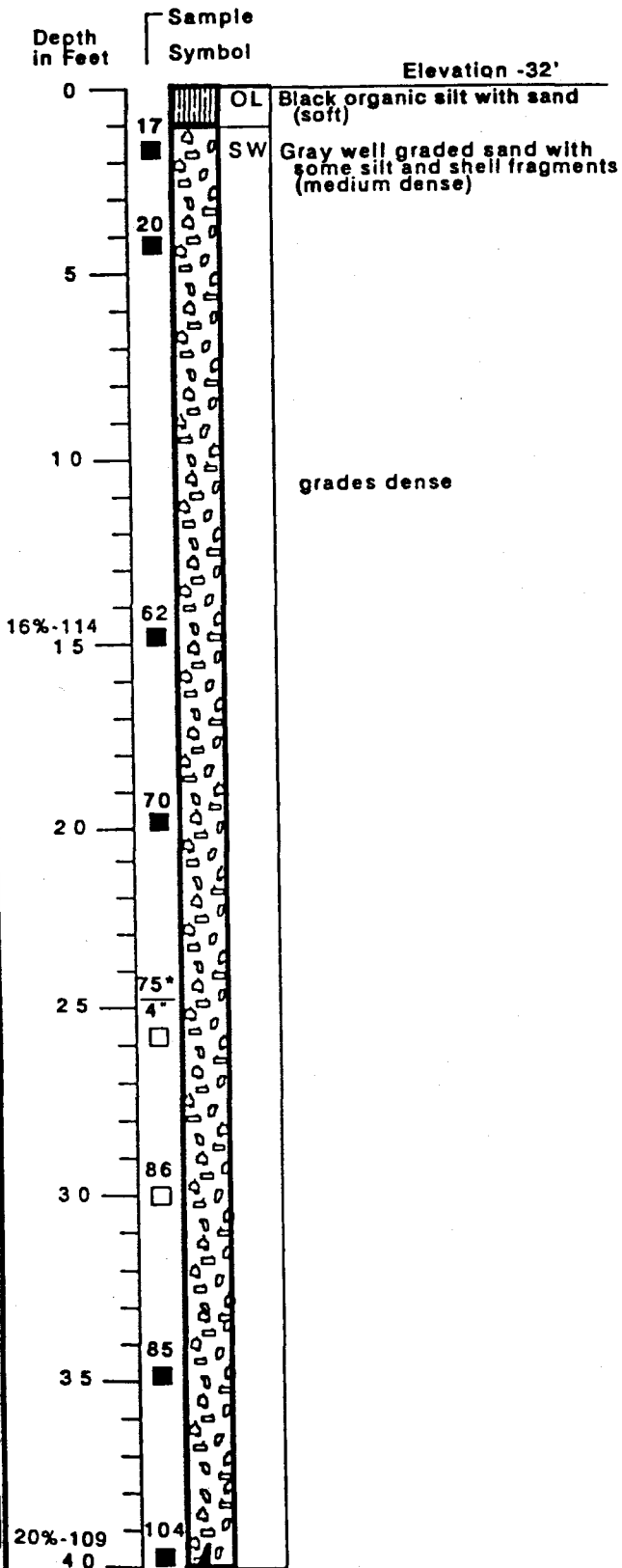
Plate 27A-1

Boring 88-2



Log of Borings

Boring 88-3



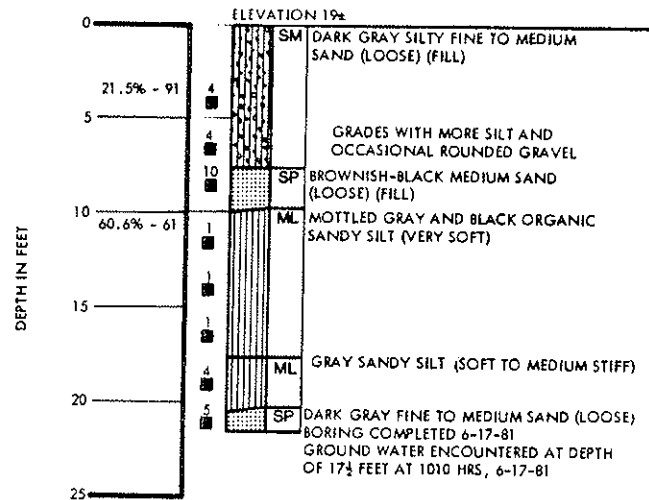
Log of Borings

Dames & Moore

Appendix C

Plate 29 A-3

BORING 1



KEY:

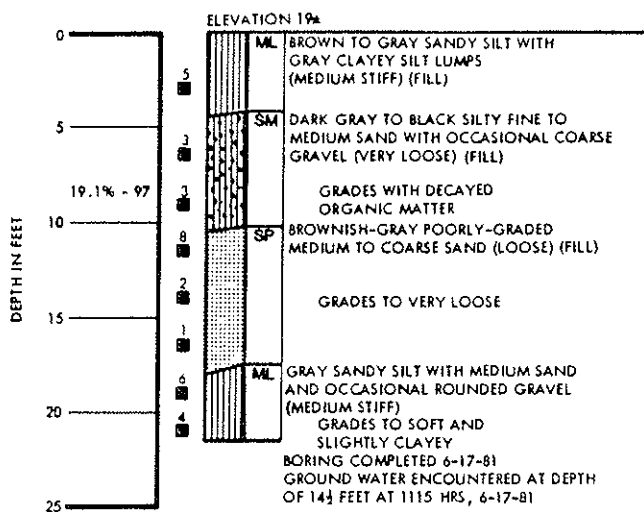
- MOISTURE CONTENT 21.5% - 91
DRY DENSITY IN PCF 60.6% - 61
- BLOWS REQUIRED TO DRIVE DAMES AND MOORE SAMPLER ONE FOOT WITH A HAMMER WEIGHT OF 325 LBS., AND A STROKE OF 18 INCHES.
- INDICATES DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED.
- ▣ INDICATES DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED.
- INDICATES SAMPLING ATTEMPT WITH NO RECOVERY.

NOTES:

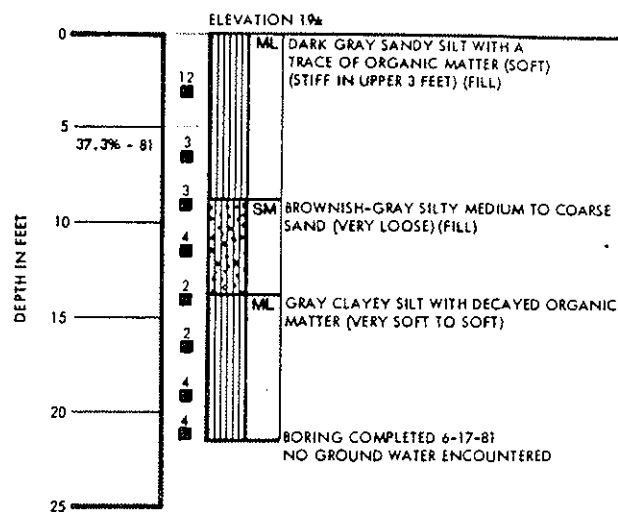
1. THE DISCUSSION IN THE TEXT OF THIS REPORT IS NECESSARY FOR A PROPER UNDERSTANDING OF THE NATURE OF THE SUBSURFACE MATERIALS.
2. THE ELEVATIONS SHOWN HAVE BEEN ESTIMATED FROM MAPS AND SHOULD BE CONSIDERED APPROXIMATE; DATUM IS MLLW.

LOG OF BORINGS

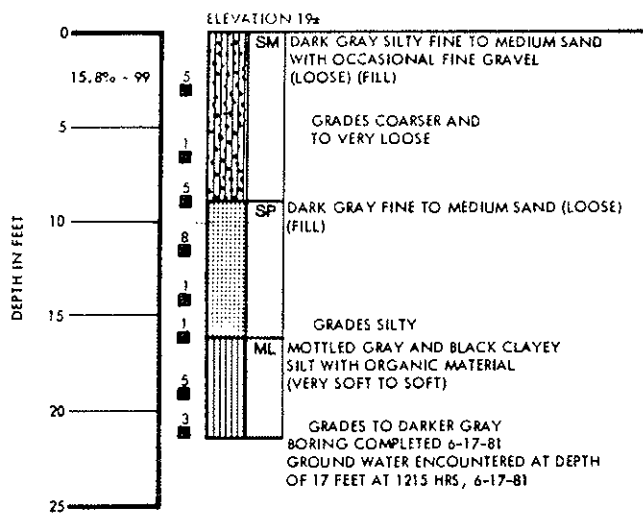
BORING 2



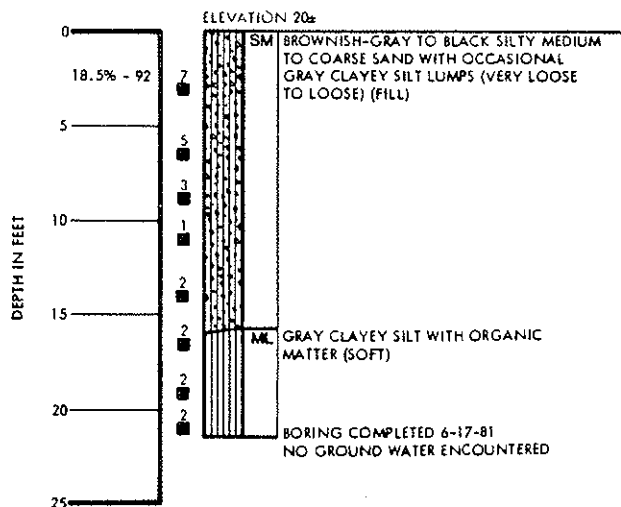
BORING 4



BORING 3

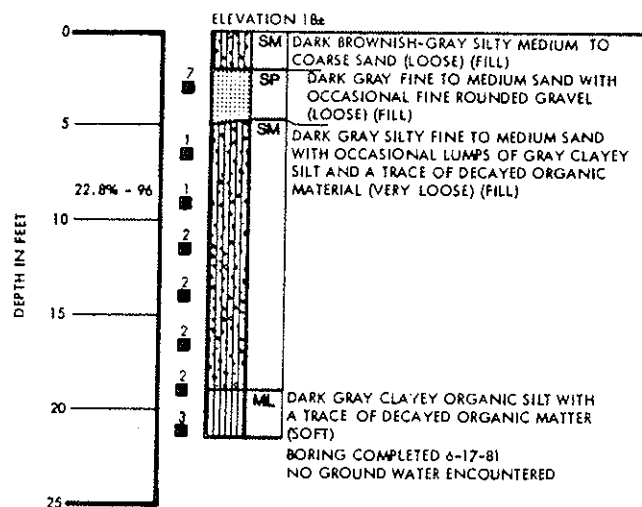


BORING 5

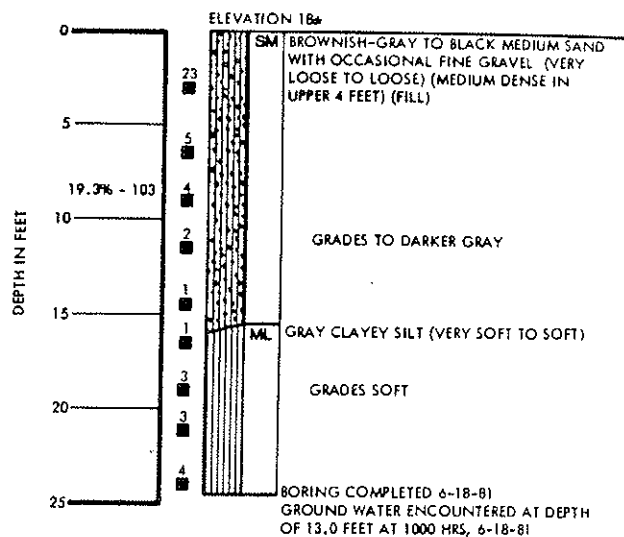


LOG OF BORINGS

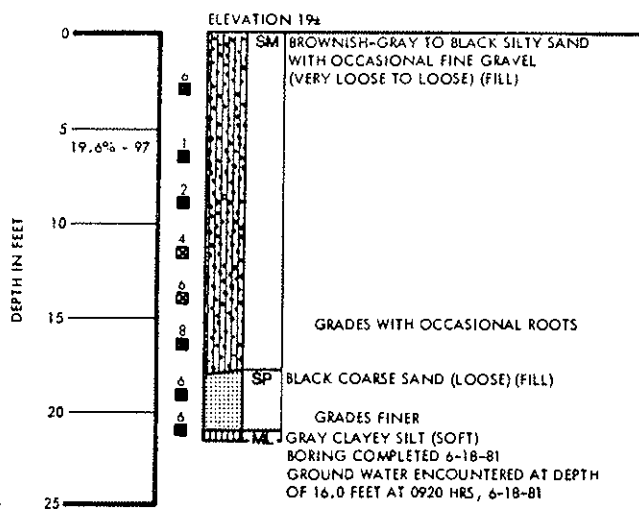
BORING 6



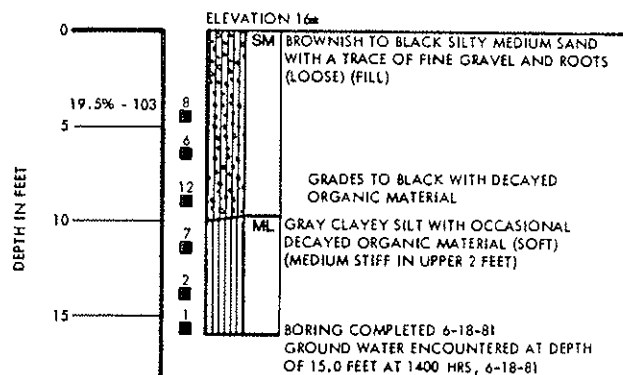
BORING 8



BORING 7

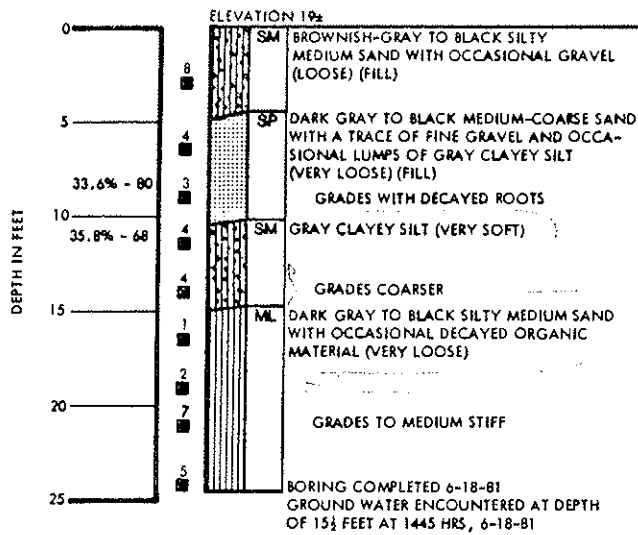


BORING 9

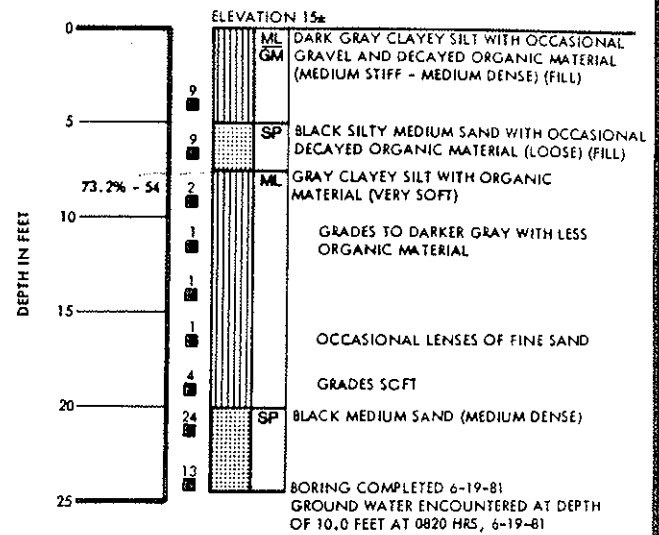


LOG OF BORINGS

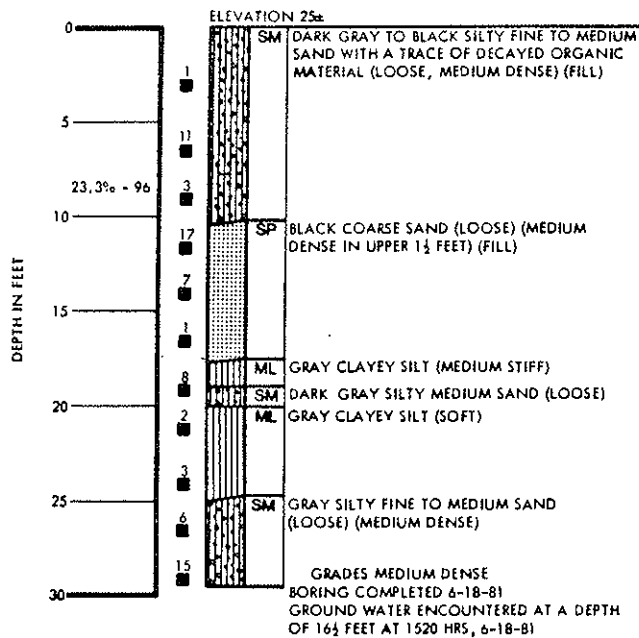
BORING 10



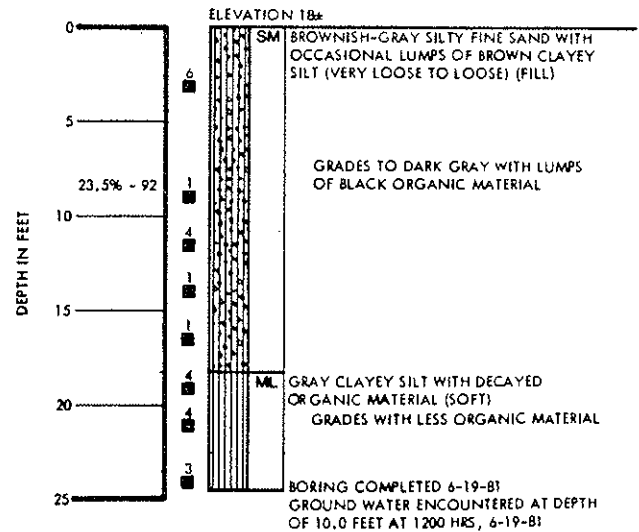
BORING 12



BORING 11



BORING 13



LOG OF BORINGS

Appendix D T-108 Analytical Information

<i>Summary Table</i>	<i>iii</i>
<i>Table D-1a. Analytical summary of soil sampling conducted June 5 and 6, 2006: PGG-2A through PGG-6A</i>	<i>1</i>
<i>Table D-1b. Analytical summary of soil sampling conducted June 5 and 6, 2006: PGG-6B through PGG-7E</i>	<i>4</i>
<i>Table D-2. Historical soil sample results for PCBs conducted July 20, 1981, June 13, August 16 and September 28, 1990, and October 1991</i>	<i>7</i>
<i>Table D-3. Historical soil sample results for TPH samples conducted June 13, July 19, and August 16, 1990 and September 28, October 8, 9, and 10, 1991</i>	<i>11</i>
<i>Table D-4. Historical soil sample results for PAH conducted October 1992</i>	<i>14</i>
<i>Table D-5. Historical soil sample results for metals conducted July 20, 1981 and October 1991</i>	<i>16</i>
<i>Table D-6. Historical soil sample results for PCBs and metals conducted June 12, 1984</i>	<i>18</i>
<i>Table D-7. Historical soil sample results for metals conducted June 12, 1984</i>	<i>19</i>
<i>Table D-8. Summary of bank soil analytical chemistry (dry weight)—AET screening^a conducted on August 17, 2005</i>	<i>20</i>
<i>Table D-9. Summary of bank soil analytical chemistry (organic carbon normalized) – SMS screening conducted on August 17, 2005</i>	<i>23</i>
<i>Table D-10. Historical test pit soil sample results conducted on July 20, 1981</i>	<i>25</i>
<i>Table D-11. Historical soil sample results prior to land-farming, conducted July 19, 1990</i>	<i>26</i>
<i>Table D-12. Historical stockpile soil sample results after land-farming, conducted September 28, 1990</i>	<i>27</i>
<i>Table D-13. Historical stockpile soil sample results after land-farming, conducted November 6, 1990</i>	<i>28</i>
<i>Table D-14. Historical stockpile soil sample results at the former Chiyoda site conducted June 21, 1989 and March 19, 1990</i>	<i>29</i>
<i>Table D-15a. Analytical summary of groundwater sampling, round 1, conducted June 13 and 14, 2006, PGG-1 through PGG-5</i>	<i>30</i>
<i>Table D-15b. Analytical summary of groundwater sampling, round 1, conducted June 13 and 14, 2006, PGG-6 through PGG-7</i>	<i>34</i>
<i>Table D-16. Analytical summary of groundwater sampling, round 2, conducted September 19 and 20, 2006</i>	<i>38</i>
<i>Table D-17. Analytical summary of groundwater sampling, round 3, conducted February 19 and 20, 2007</i>	<i>43</i>
<i>Table D-18. Analytical summary of groundwater sampling, round 4, conducted May 29 and 30, 2007</i>	<i>47</i>

<i>Table D-19.</i>	<i>Historical groundwater sample results for PCBs conducted October 11, 1991 and January 18, 1992</i>	<i>51</i>
<i>Table D-20a.</i>	<i>Historical groundwater sample results for PAHs conducted October 11 and 12, 1991: C-1 through C-6</i>	<i>53</i>
<i>Table D-20b.</i>	<i>Historical groundwater sample results for PAHs conducted October 11 and 12, 1991: Sample locations MW-7 through MW-14</i>	<i>55</i>
<i>Table D-21a.</i>	<i>Historical groundwater sample results for PAHs conducted January 17 and 18, 1992: Sample locations C-1 through C-6</i>	<i>57</i>
<i>Table D-21b.</i>	<i>Historical groundwater sample results for PAHs conducted January 17 and 18, 1992: Sample locations MW-7 through MW-14</i>	<i>59</i>
<i>Table D-22.</i>	<i>Historical groundwater sample results for TPHs conducted October 11, 1991 and January 18, 1992</i>	<i>61</i>
<i>Table D-23.</i>	<i>Historical groundwater sample results for metals conducted October 11, 1991 and January 17, 1992</i>	<i>63</i>
<i>Table D-24.</i>	<i>Historical groundwater sample results for metals and PCBs conducted June 5, 1984</i>	<i>65</i>
<i>Table D-25.</i>	<i>Historical seep sample results for metals and PCBs conducted June 5, 1984</i>	<i>66</i>
<i>References</i>		<i>67</i>

Summary Table

TABLE	MEDIA	CHEMICALS ANALYZED	LOCATION SAMPLED
Table D-1. Analytical Summary of Soil Sampling conducted June 5 and 6 th 2006.	Soil	Petroleum hydrocarbons, total metals, PCBs, PAH, toxicity equivalent concentrations	PGG-1 to 7
Table D-2. Historical Soil Sample Results for PCBs conducted July 20, 1981, June 13, August 16 and September 28, 1990, and October 1991	Soil	PCBs	B81-1 to 13, EP-1 to 11, A-F, C-1 to 6, NAT-1 to 6, MW-7 to 14
Table D-3. Historical Soil Sample Results for TPH samples conducted June 13, July 19, and August 16, 1990 and September 28, October 8, 9, and 10, 1991	Soil	TPH	EP-1 to 11, A-F, C-1 to 6, NAT-1 to 6, MW-7 to 14
Table D-4. Historical Soil Sample Results for PAH conducted October 1992	Soil	PAH	MW-7 to 14
Table D-5. Historical Soil Sample Results for Metals conducted July 20, 1981 and October 1991	Soil	Metals	B81-1 to 13, MW-7 to 14
Table D-6. Historical Soil Sample Results PCB and Metals conducted June 12, 1984	Soil	PCB, metals	B81-1 to 13
Table D-7. Historical Soil Sample Results for Metals conducted June 12, 1984	Soil	metals	B84-1 to 11
Table D-8. Summary of Analytical Chemistry (dry weight) - AET Screening conducted on August 17, 2005	Soil	Metals, PCBs, LPAH, HPAH, chlorinated hydrocarbons, phthalates, phenols, misc extractables	DUD_30C and DUD_31C
Table D-9. Summary of Analytical Chemistry (organic carbon normalized) – SMS Screening conducted on August 17, 2005	Soil	Metals, PCBs, .LPAH, HPAH, chlorinated hydrocarbons, phthalates, phenols, misc extractables	DUD_30C and DUD_31C
Table D-10. Historical test pit soil sample results conducted on July 20, 1981	Soil (Test Pit)	PCB, metals	TP81-1 to 6
Table D-11. Historical soil sample results prior to land-farming, conducted July 19, 1990	Soil	TPH, BTEX compounds	A-F
Table D-12. Historical stockpile soil sample results after land-farming, conducted September 28, 1990	Soil (stockpile)	TPH, BTEX compounds	SP-1 to SP-3
Table D-13. Historical stockpile soil sample results after land-farming, conducted November 6, 1990	Soil (stockpile)	TPH, BTEX compounds	SP-1 to SP-12

TABLE	MEDIA	CHEMICALS ANALYZED	LOCATION SAMPLED
Table D-14. Historical stockpile soil sample results at former Chiyoda site conducted June 21, 1989 and March 19, 1990	Soil (stockpile)	TPH, BTEX compounds, barium, cadmium, fuel hydrocarbons	WS-1, ES-1, SP-N1 to SP-N4, SP-S1 to SP-S4
Table D-15. Analytical Summary of Groundwater Sampling Round 1 Conducted June 13 and 14, 2006	Groundwater	Petroleum hydrocarbons, total metals, dissolved metals, PCBs, PAH	PGG-1 to 7
Table D-16. Analytical Summary of Groundwater Sampling Round 2 Conducted September 19 and 20, 2006	Groundwater	Petroleum hydrocarbons, total metals, dissolved metals, PCBs, PAH	PGG-1 to 7
Table D-17. Analytical Summary of Groundwater Sampling Round 3 Conducted February 19 and 20 2007	Groundwater	Petroleum hydrocarbons, total metals, dissolved metals, PCBs, polycyclic aromatic compounds	PGG-5 to 7
Table D-18. Analytical Summary of Groundwater Sampling Round 4 Conducted May 29 and 30 th 2007	Groundwater	Petroleum hydrocarbons, total metals, dissolved metals, PCBs, polycyclic aromatic compounds	PGG-5 to 7
Table D-19. Historical Groundwater Sample Results for PCB Conducted October 11, 1991 and January 18, 1992	Groundwater	PCBs	C-1 to 6, MW-7 to 14
Table D-20. Historical Groundwater Sample Results for PAH Conducted October 11 and 12, 1991	Groundwater	PAH	C-1 to 6, MW-7 to 14
Table D-21. Historical Groundwater Sample Results for PAH Conducted January 17 and 18, 1992	Groundwater	PAH	C-1 to 6, MW-7 to 14
Table D-22. Historical Groundwater Sample Results for TPH Conducted October 11, 1991 and January 18, 1992	Groundwater	TPH	C-1 to 6, MW-7 to 14
Table D-23. Historical Groundwater Sample Results for Metals Conducted October 11, 1991 and January 17, 1992	Groundwater	Metals	C-1 to 6, MW-7 to 14
Table D-24. Historical groundwater sample results for metals and PCBs conducted June 5, 1984	Groundwater	Metals and PCBs	Well 84-1 to 84-2, Well A
Table D-25. Historical seep sample results for metals and PCBs conducted June 5, 1984	Groundwater (Seep)	Metals and PCBs	Seep N and Seep S

Table D-1a. Analytical summary of soil sampling conducted June 5 and 6, 2006: PGG-2A through PGG-6A

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	MTCA METHOD A	PGG-2A	PGG-2B	PGG-5A	PGG-5B	PGG-5C	PGG-5D	PGG-5E	PGG-5F	PGG-5G	PGG-6A
Depth		feet bgs		9-10.5	11.5-13	1.5-3	5-6.5	7.5-9	10-11.5	12.5-14	15-16.5	17.5-19	1.5-3
Total Organic Carbon	EPA 9060 mod	mg/kg		140000	14000	11500	9170	13400	11400	1950	24700	2350	4700
Dry Weight	BSOPSPL003R08	%		64.9	77.7	85.4	80.7	71.4	86.5	82.1	66.9	83.8	95.8
Petroleum Hydrocarbons													
Gasoline Range HC	NWTPH-Gx/8021B	mg/kg	100*	17	5.69 U	5.87 U	5.04 U	12.8	4.88 U	6.53 U	8.4 U	6.4 U	5.12 U
Benzene	NWTPH-Gx/8021B	mg/kg	0.03	0.036 U	0.0342 U	0.0352 U	0.0302 U	0.0461 U	0.0293 U	0.0392 U	0.0504 U	0.0384 U	0.0307 U
Toluene	NWTPH-Gx/8021B	mg/kg	7	0.06 U	0.0569 U	0.0587 U	0.0504 U	0.0768 U	0.0488 U	0.0653 U	0.084 U	0.064 U	0.0512 U
Ethylbenzene	NWTPH-Gx/8021B	mg/kg	6	0.06 U	0.0569 U	0.0587 U	0.0504 U	0.0768 U	0.0488 U	0.0653 U	0.084 U	0.064 U	0.0512 U
Xylenes (total)	NWTPH-Gx/8021B	mg/kg	9	0.12 U	0.114 U	0.117 U	0.101 U	0.154 U	0.0976 U	0.131 U	0.168 U	0.128 U	0.102 U
Diesel Range HC	NWTPH-Dx	mg/kg	2,000	4120 T	53.4 T	105 T	72.5 T	136 T	64.7 T	12.7 T	203 T	11.9 U	10.5 U
Lube Oil Range HC	NWTPH-Dx	mg/kg	2,000	4910	57.5	179	153	173	106	30.5 U	510	29.7 U	26.4 U
Total Metals													
Arsenic	EPA 6020	mg/kg	20	15.1	3.69	5.36	3.76	9.92	2.85	2.21	11.4	2.05	2.73
Cadmium	EPA 6020	mg/kg	2	13.9	0.644	0.585	0.632	1.15	0.545	0.648	0.951	1.7	0.522
Chromium	EPA 6020	mg/kg	2,000	1260	27.1	32.4	30	84	16.9	13.9	200	12.8	20.7
Copper	EPA 6020	mg/kg		594	18.3	22.9	21.9	68.4	23.1	32	74.7	10.5	14.9
Lead	EPA 6020	mg/kg	1,000	625	14.9	31.6	30	24.3	74.7	8.49	202	3.01	2.83
Nickel	EPA 6020	mg/kg		84.5	9.82	7.51	6.53	29.3	11	10	21.7	7.43	25.9
Zinc	EPA 6020	mg/kg		1460	39.6	35.8	34.7	163	51.8	62.1	149	64.7	46.3
PCBs													
Aroclor 1016	EPA 8082	µg/kg	10,000	3840 U	32.6 U	297 U	158 U	35.6 U	28.7 U	30.9 U	186 U	29.9 U	26.3 U
Aroclor 1221	EPA 8082	µg/kg	10,000	7680 U	65.2 U	593 U	315 U	71.2 U	57.4 U	61.7 U	371 U	59.9 U	52.5 U
Aroclor 1232	EPA 8082	µg/kg	10,000	3840 U	32.6 U	297 U	158 U	35.6 U	28.7 U	30.9 U	186 U	29.9 U	26.3 U
Aroclor 1242	EPA 8082	µg/kg	10,000	3840 U	32.6 U	297 U	158 U	35.6 U	28.7 U	30.9 U	186 U	29.9 U	26.3 U
Aroclor 1248	EPA 8082	µg/kg	10,000	56200 P	325 Q	737	464	1090	89	30.9 U	186 U	29.9 U	26.3 U
Aroclor 1254	EPA 8082	µg/kg	10,000	44600 P	248 Q	655	406	864	73.6	30.9 U	876	29.9 U	26.3 U
Aroclor 1260	EPA 8082	µg/kg	10,000	3840 U	32.6 U	297 U	158 U	35.6 U	28.7 U	30.9 U	186 U	29.9 U	26.3 U
Aroclor 1262	EPA 8082	µg/kg	10,000	3840 U	32.6 U	297 U	158 U	35.6 U	28.7 U	30.9 U	186 U	29.9 U	26.3 U
Aroclor 1268	EPA 8082	µg/kg	10,000	3840 U	32.6 U	297 U	158 U	35.6 U	28.7 U	30.9 U	186 U	29.9 U	26.3 U
Total PCB (U as O)	EPA 8082	µg/kg	10,000	100,800	573	1,392	870	1,954	163	0	876	0	0
PAHs													
1-Methylnaphthalene	EPA 8270-SIM	mg/kg	2	0.118	0.013 U	0.0118 U	0.0125 U	0.0142 U	0.0117 U	0.012 U	0.0151 U	0.0119 U	0.0106 U

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	MTCA METHOD A	PGG-2A	PGG-2B	PGG-5A	PGG-5B	PGG-5C	PGG-5D	PGG-5E	PGG-5F	PGG-5G	PGG-6A
2-Methylnaphthalene	EPA 8270-SIM	mg/kg	2	0.169	0.013 U	0.0118 U	0.0125 U	0.0142 U	0.0117 U	0.012 U	0.0151 U	0.0119 U	0.0106 U
Acenaphthene	EPA 8270-SIM	mg/kg	2	0.0768 U	0.013 U	0.0118 U	0.0235	0.0142 U	0.0117 U	0.012 U	0.0151 U	0.0119 U	0.0106 U
Acenaphthylene	EPA 8270-SIM	mg/kg	2	0.0768 U	0.013 U	0.0118 U	0.0125 U	0.0142 U	0.0117 U	0.012 U	0.0151 U	0.0119 U	0.0106 U
Anthracene	EPA 8270-SIM	mg/kg	2	0.0768 U	0.0136	0.0118 U	0.0487	0.0185	0.0117 U	0.012 U	0.016	0.0119 U	0.0106 U
Benzo(ghi)perylene	EPA 8270-SIM	mg/kg	2	0.0768 U	0.013 U	0.0118 U	0.115	0.0142 U	0.0208	0.012 U	0.0196	0.0119 U	0.0106 U
Fluoranthene	EPA 8270-SIM	mg/kg	2	0.49	0.0225	0.0386	0.493	0.0818	0.037	0.012 U	0.0817	0.0119 U	0.0106 U
Fluorene	EPA 8270-SIM	mg/kg	2	0.134	0.013 U	0.0118 U	0.0186	0.0142 U	0.0117 U	0.012 U	0.0151 U	0.0119 U	0.0106 U
Naphthalene	EPA 8270-SIM	mg/kg	2	0.0788	0.013 U	0.0118 U	0.0125 U	0.0142 U	0.0117 U	0.012 U	0.0155	0.0119 U	0.0106 U
Phenanthrene	EPA 8270-SIM	mg/kg	2	0.195	0.013 U	0.0259	0.28	0.027	0.0138	0.012 U	0.0475	0.0119 U	0.0106 U
Pyrene	EPA 8270-SIM	mg/kg	2	1.06	0.025	0.0466	0.467	0.128	0.05	0.012 U	0.109	0.0119 U	0.0106 U
Benzo(a)anthracene	EPA 8270-SIM	mg/kg	2	0.202	0.013 U	0.0165	0.184	0.0255	0.0184	0.012 U	0.0354	0.0119 U	0.0106 U
Benzo(a)pyrene	EPA 8270-SIM	mg/kg	2	0.4	0.0339	0.0181	0.219	0.0256	0.0364	0.012 U	0.0524	0.0119 U	0.0106 U
Benzo(b)fluoranthene	EPA 8270-SIM	mg/kg	2	0.305	0.013 U	0.0281	0.226	0.0344	0.0339	0.012 U	0.0515	0.0119 U	0.0106 U
Benzo(k)fluoranthene	EPA 8270-SIM	mg/kg	2	0.25	0.013 U	0.0236	0.233	0.027	0.0396	0.012 U	0.0576	0.0119 U	0.0106 U
Chrysene	EPA 8270-SIM	mg/kg	2	0.478	0.013 U	0.0334	0.28	0.0409	0.0277	0.012 U	0.058	0.0119 U	0.0106 U
Dibenz(a,h)anthracene	EPA 8270-SIM	mg/kg	2	0.0768 U	0.013 U	0.0118 U	0.0517	0.0142 U	0.0117 U	0.012 U	0.0151 U	0.0119 U	0.0106 U
Indeno(1,2,3-cd)pyrene	EPA 8270-SIM	mg/kg	2	0.162	0.0222	0.0118 U	0.117	0.0142 U	0.0197	0.012 U	0.0153	0.0119 U	0.0106 U
Toxicity Equivalent Concentrations	TEF												
Benzo(a)anthracene	0.1	mg/kg	2	0.0202	0	0.00165	0.0184	0.00255	0.00184	0	0.00354	0	0
Benzo(a)pyrene	1	mg/kg	2	0.4	0.0339	0.0181	0.219	0.0256	0.0364	0	0.0524	0	0
Benzo(b)fluoranthene	0.1	mg/kg	2	0.0305	0	0.00281	0.0226	0.00344	0.00339	0	0.00515	0	0
Benzo(k)fluoranthene	0.1	mg/kg	2	0.025	0	0.00236	0.0233	0.0027	0.00396	0	0.00576	0	0
Chrysene	0.01	mg/kg	2	0.00478	0	0.000334	0.0028	0.000409	0.000277	0	0.00058	0	0
Dibenzo(a,h)anthracene	0.4	mg/kg	2	0	0	0	0.02068	0	0	0	0	0	0
Indeno(1,2,3-cd)pyrene	0.1	mg/kg	2	0.0162	0.00222	0	0.0117	0	0.00197	0	0.00153	0	0
Sum of TEF			2	0.5	0.04	0.03	0.32	0.03	0.05	0	0.07	0	0

Source: (Pacific Groundwater Group 2007)

Green highlight – concentration exceeds MTCA Method A for soil (for Industrial Properties)

Yellow highlight – parameter detected

bgs – below ground surface

EPA – US Environmental Protection Agency

HC - hydrocarbons

J – parameter detected at the reported concentration; result qualifies as "estimated" due to unacceptable QA results

µg/kg – micrograms per kilogram

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

P – Results for 500x dilution

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

PGG – Pacific Groundwater Group

Q – results for 5x dilution

R – analytical result rejected based on unrepresentative sample quality and poor data quality, as the sample did not meet Standard Operating Procedures.

S – lab analyst note: results reported for the gas range are primarily due to overlap from diesel range hydrocarbons

SIM – Simultaneous Ion Monitoring

T – lab analyst note: results reported for the gas range are primarily due to overlap from heavy oil range product

TEF – Toxic Equivalency Factor

U – parameter not detected, associated # is the lab reporting limit

UJ – parameter not detected at the associated reporting limit; analysis performed 44 days outside holding time

Table D-1b. Analytical summary of soil sampling conducted June 5 and 6, 2006: PGG-6B through PGG-7E

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	MTCA METHOD A	PGG-6B	PGG-6C	PGG-6D	PGG-6E	PGG-7A	PGG-7B	PGG-7C	PGG-7D	PGG-7E
Depth		feet bgs		4-5.5	6.5-8	9-10.5	11.5-13	0.5-2	4-5.5	6.5-8	9-10.5	11.5-13
Total Organic Carbon	EPA 9060 mod	mg/kg		839	18000	785	14400	52300	2050	645	10200	46000
Dry Weight	BSOPSPL003R08	%		95.4	64.2	80	66.9	85	93.6	78.8	74.1	59.1
Petroleum Hydrocarbons												
Gasoline Range HC	NWTPH-Gx/8021B	mg/kg	100*	5.6 U	6.74 U	5.47 U	6.31 U	6.7 U	9.34 U	5.41 U	6 U	8.55 U
Benzene	NWTPH-Gx/8021B	mg/kg	0.03	0.0336 U	0.0405 U	0.0328 U	0.0378 U	0.0402 U	0.056 U	0.0325 U	0.036 U	0.0513 U
Toluene	NWTPH-Gx/8021B	mg/kg	7	0.056 U	0.0674 U	0.0547 U	0.0631 U	0.067 U	0.0934 U	0.0541 U	0.06 U	0.0855 U
Ethylbenzene	NWTPH-Gx/8021B	mg/kg	6	0.056 U	0.0674 U	0.0547 U	0.0631 U	0.067 U	0.0934 U	0.0541 U	0.06 U	0.0855 U
Xylenes (total)	NWTPH-Gx/8021B	mg/kg	9	0.112 U	0.135 U	0.109 U	0.126 U	0.134 U	0.187 U	0.108 U	0.12 U	0.171 U
Diesel Range HC	NWTPH-Dx	mg/kg	2,000	10.3 U	15.8 U	12.5 U	15 U	285 T	10.6 U	12.6 U	13.5 U	16.7 U
Lube Oil Range HC	NWTPH-Dx	mg/kg	2,000	25.8 U	39.6 U	31.2 U	37.6 U	670	26.4 U	31.4 U	33.7 U	41.7 U
Total Metals												
Arsenic	EPA 6020	mg/kg	20	1.11	7.67	1.68	4.93	12.2	1.13	0.641	3.41	7.72
Cadmium	EPA 6020	mg/kg	2	0.524	0.779	0.625	0.747	6.12	0.534	1.2	0.675	0.846
Chromium	EPA 6020	mg/kg	2,000	9.45	26	6.98	17.8	91.6	8	10.3	12.6	18.1
Copper	EPA 6020	mg/kg		10.1	47.3	6.59	26.5	71.8	7.48	14.3	16.4	26.9
Lead	EPA 6020	mg/kg	1,000	2.05	7.8	0.8	4.54	130	1.08	1.26	6.15	4.82
Nickel	EPA 6020	mg/kg		4.6	24.3	4.89	12.8	37.4	4.16	8.36	8.8	12.4
Zinc	EPA 6020	mg/kg		26.8	66.3	18.5	36.1	460	35.8	99	33	31.3
PCBs												
Aroclor 1016	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	29.9 U	26.8 U	32.2 U	33.7 U	42.9 U
Aroclor 1221	EPA 8082	µg/kg	10,000	52.6 U	78.4 U	62.9 U	74.5 U	59.8 U	53.6 U	64.3 U	67.5 U	85.7 U
Aroclor 1232	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	29.9 U	26.8 U	32.2 U	33.7 U	42.9 U
Aroclor 1242	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	29.9 U	26.8 U	32.2 U	33.7 U	42.9 U
Aroclor 1248	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	29.9 U	26.8 U	32.2 U	33.7 U	42.9 U
Aroclor 1254	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	29.9 U	26.8 U	32.2 U	33.7 U	42.9 U
Aroclor 1260	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	2190	26.8 U	32.2 U	42.2	42.9 U
Aroclor 1262	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	29.9 U	26.8 U	32.2 U	33.7 U	42.9 U
Aroclor 1268	EPA 8082	µg/kg	10,000	26.3 U	39.2 U	31.5 U	37.2 U	29.9 U	26.8 U	32.2 U	33.7 U	42.9 U
Total PCB (U as O)	EPA 8082	µg/kg	10,000	0	0	0	0	2,190	0	0	42	0
PAHs												
1-Methylnaphthalene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	MTCA METHOD A	PGG-6B	PGG-6C	PGG-6D	PGG-6E	PGG-7A	PGG-7B	PGG-7C	PGG-7D	PGG-7E
2-Methylnaphthalene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Acenaphthene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Acenaphthylene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Anthracene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Benzo(ghi)perylene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Fluoranthene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0438	0.0124 U	0.0148 U	0.205	0.0105 U	0.0125 U	0.0133 U	0.017 U
Fluorene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Naphthalene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Phenanthrene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0304	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Pyrene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.067	0.0124 U	0.0148 U	0.252	0.0105 U	0.0125 U	0.0133 U	0.017 U
Benzo(a)anthracene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.019	0.0124 U	0.0148 U	0.116	0.0105 U	0.0125 U	0.0133 U	0.017 U
Benzo(a)pyrene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0199	0.0124 U	0.0148 U	0.178	0.0105 U	0.0125 U	0.0133 U	0.017 U
Benzo(b)fluoranthene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.202	0.0105 U	0.0125 U	0.0133 U	0.017 U
Benzo(k)fluoranthene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.024	0.0124 U	0.0148 U	0.182	0.0105 U	0.0125 U	0.0133 U	0.017 U
Chrysene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0284	0.0124 U	0.0148 U	0.215	0.0105 U	0.0125 U	0.0133 U	0.017 U
Dibenz(a,h)anthracene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Indeno(1,2,3-cd)pyrene	EPA 8270-SIM	mg/kg	2	0.0106 U	0.0155 U	0.0124 U	0.0148 U	0.116 U	0.0105 U	0.0125 U	0.0133 U	0.017 U
Toxicity Equivalent Concentrations (TEF)												
Benzo(a)anthracene	0.1	mg/kg	2	0	0.0019	0	0	0.0116	0	0	0	0
Benzo(a)pyrene	1	mg/kg	2	0	0.0199	0	0	0.178	0	0	0	0
Benzo(b)fluoranthene	0.1	mg/kg	2	0	0	0	0	0.0202	0	0	0	0
Benzo(k)fluoranthene	0.1	mg/kg	2	0	0.0024	0	0	0.0182	0	0	0	0
Chrysene	0.01	mg/kg	2	0	0.000284	0	0	0.00215	0	0	0	0
Dibenzo(a,h)anthracene	0.4	mg/kg	2	0	0	0	0	0	0	0	0	0
Indeno(1,2,3-cd)pyrene	0.1	mg/kg	2	0	0	0	0	0	0	0	0	0
Sum of TEF			2	0	0.02	0	0	0.23	0	0	0	0

Source: (Pacific Groundwater Group 2007)

Green highlight – concentration exceeds MTCA Method A for soil (for Industrial Properties)

Yellow highlight – parameter detected

bgs – below ground surface

EPA – US Environmental Protection Agency

HC - hydrocarbons

J – parameter detected at the reported concentration; result qualifies as "estimated" due to unacceptable QA results

µg/kg – micrograms per kilogram

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

P – Results for 500x dilution

PAH – Polycyclic Aromatic Hydrocarbon

PCB – Polychlorinated Biphenyls

PGG – Pacific Groundwater Group

Q – Results for 5x dilution

R – analytical result rejected based on unrepresentative sample quality and poor data quality, as the sample did not meet Standard Operating Procedures.

S – lab analyst note: results reported for the gas range are primarily due to overlap from diesel range hydrocarbons

SIM – Simultaneous Ion Monitoring

T – lab analyst note: results reported for the gas range are primarily due to overlap from heavy oil range product

TEF – Toxic Equivalency Factor

U – parameter not detected, associated # is the lab reporting limit

UJ – parameter not detected at the associated reporting limit; analysis performed 44 days outside holding time

Table D-2. Historical soil sample results for PCBs conducted July 20, 1981, June 13, August 16 and September 28, 1990, and October 1991

SAMPLE ID	INVESTIGATION	DATE	DEPTH (feet bgs)	WITHIN SLUDGE FOOTPRINT	AROCLOR 8080 (mg/kg)	AROCLOR 1016/1242 8080 (mg/kg)	AROCLOR 1016 8080 (mg/kg)	AROCLOR 1221 8080 (mg/kg)	AROCLOR 1232 8080 (mg/kg)	AROCLOR 1242 8080 (mg/kg)	AROCLOR 1248 8080 (mg/kg)	AROCLOR 1254 8080 (mg/kg)	AROCLOR 1260 8080 (mg/kg)
B81-1	D&M	7/20/1981	6	Yes	2.06								
B81-1	D&M	7/20/1981	11	Yes	4.89								
B81-1	D&M	7/20/1981	21	Yes	0.013								
B81-10	D&M	7/20/1981	9	No	5.91								
B81-10	D&M	7/20/1981	16	No	0.443								
B81-10	D&M	7/20/1981	24	No	0.01 U								
B81-11	D&M	7/20/1981	19	No	0.661								
B81-11	D&M	7/20/1981	26.5	No	0.01 U								
B81-12	D&M	7/20/1981	15.5	No	0.01 U								
B81-13	D&M	7/20/1981	24	No	0.01 U								
B81-2	D&M	7/20/1981	2.5	Yes	2.73								
B81-2	D&M	7/20/1981	16	Yes	0.169								
B81-3	D&M	7/20/1981	6	Yes	2.29								
B81-3	D&M	7/20/1981	19	Yes	0.171								
B81-4	D&M	7/20/1981	9	Yes	0.512								
B81-4	D&M	7/20/1981	21	Yes	0.01 U								
B81-5	D&M	7/20/1981	6	Yes	2.6								
B81-5	D&M	7/20/1981	16	Yes	4.27								
B81-6	D&M	7/20/1981	19	Yes	1.71								
B81-7	D&M	7/20/1981	2.5	Yes	0.709								
B81-7	D&M	7/20/1981	14	Yes	1.21								
B81-8	D&M	7/20/1981	14.5	Yes	1.13								
B81-8	D&M	7/20/1981	24	Yes	0.01 U								
B81-9	D&M	7/20/1981	15.5	No	0.102								

SAMPLE ID	INVESTIGATION	DATE	DEPTH (feet bgs)	WITHIN SLUDGE FOOTPRINT	AROCLOR 8080 (mg/kg)	AROCLOR 1016/1242 8080 (mg/kg)	AROCLOR 1016 8080 (mg/kg)	AROCLOR 1221 8080 (mg/kg)	AROCLOR 1232 8080 (mg/kg)	AROCLOR 1242 8080 (mg/kg)	AROCLOR 1248 8080 (mg/kg)	AROCLOR 1254 8080 (mg/kg)	AROCLOR 1260 8080 (mg/kg)
EP-1	PEG	6/13/1990	3	No		0.05 U					0.05 U	0.021	0.05 U
EP-1	PEG	6/13/1990	8	No		0.05 U					0.05 U	0.05 U	0.05 U
EP-10	PEG	6/13/1990	6	No		0.05 U					0.05 U	0.05 U	0.05 U
EP-11	PEG	6/13/1990	6	No		0.05 U					0.05 U	0.14	0.035
EP-2	PEG	6/13/1990	4	No		0.05 U					0.05 U	0.05 U	4.5
EP-2	PEG	6/13/1990	8	No		0.05 U					0.05 U	0.05 U	0.05 U
EP-3	PEG	6/13/1990	4	No		0.4					0.05 U	2.1	2.3
EP-3	PEG	6/13/1990	8	No		0.031					0.05 U	0.19	0.19
EP-4	PEG	6/13/1990	4	Yes		0.05 U					0.05 U	0.093	0.06
EP-4	PEG	6/13/1990	10	Yes		0.54					0.05 U	0.22	0.05 U
EP-5	PEG	6/13/1990	6	No		0.26					0.05 U	0.97	0.6
EP-5	PEG	6/13/1990	11	No		0.17					0.05 U	0.42	0.26
EP-6	PEG	6/13/1990	4	No		0.05 U					0.05 U	0.05 U	0.05 U
EP-6	PEG	6/13/1990	8	No		0.05 U					0.05 U	0.05 U	0.05 U
EP-7	PEG	6/13/1990	4	No		0.05 U					0.05 U	0.05 U	0.42
EP-8	PEG	6/13/1990	6	Yes		0.42					0.05 U	0.29	0.11
EP-9	PEG	6/13/1990	4	No		0.05 U					0.05 U	0.05 U	0.05 U
A	PEG	8/16/1990	1	Yes		0.05 U					1.4	0.66	0.61
B	PEG	8/16/1990	1	Yes		<0.500					6.9	<0.500	<0.500
C	PEG	8/16/1990	1	Yes		0.05 U					0.05 U	0.05 U	0.05 U
D	PEG	8/16/1990	1	Yes		0.05 U					0.05 U	0.081	0.05 U
E	PEG	8/16/1990	1	Yes		0.05 U					0.36	0.1	0.063
F	PEG	8/16/1990	1	Yes		0.05 U					0.297	0.21	0.08
C-1	PEG	8/16/1990	7.5-9	No		0.05 U					0.05 U	0.14	0.12
C-2	PEG	8/16/1990	7.5-9	No		0.05 U					0.05 U	0.025	0.05 U
C-3	PEG	8/16/1990	7.5-9	No		0.12					0.05 U	0.18	0.13
C-4	PEG	8/16/1990	2.5-4	No		0.05 U					0.05 U	0.05 U	0.05 U

SAMPLE ID	INVESTIGATION	DATE	DEPTH (feet bgs)	WITHIN SLUDGE FOOTPRINT	AROCLOR 8080 (mg/kg)	AROCLOR 1016/1242 8080 (mg/kg)	AROCLOR 1016 8080 (mg/kg)	AROCLOR 1221 8080 (mg/kg)	AROCLOR 1232 8080 (mg/kg)	AROCLOR 1242 8080 (mg/kg)	AROCLOR 1248 8080 (mg/kg)	AROCLOR 1254 8080 (mg/kg)	AROCLOR 1260 8080 (mg/kg)
C-4	PEG	8/16/1990	7.5-9	No		0.05 U					0.05 U	0.05 U	0.05 U
C-5	PEG	8/16/1990	7.5-9	No		1.1					0.05 U	2.6	0.87
C-6	PEG	8/16/1990	2.5-4	No		0.05 U					0.05 U	0.05 U	0.05 U
C-6	PEG	8/16/1990	7.5-9	No		0.05 U					0.05 U	0.05 U	0.05 U
NAT-1	PEG	9/28/1990	1	Yes			0.05 U	0.05 U	0.05 U	0.05 U	9.3	0.05 U	0.05 U
NAT-2	PEG	9/28/1990	1	No			0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
NAT-3	PEG	9/28/1990	1	Yes			0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
NAT-4	PEG	9/28/1990	1	Yes			0.05 U	0.05 U	0.05 U	0.05 U	1.6	0.05 U	0.05 U
NAT-5	PEG	9/28/1990	1	Yes			0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
NAT-6	PEG	9/28/1990	1	Yes			0.05 U	0.05 U	0.05 U	0.05 U	2.9	0.05 U	0.05 U
MW-10	AGI	October 1991	6	Yes			0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
MW-10	AGI	October 1991	8.5	Yes			1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
MW-11	AGI	October 1991	3.5	No			0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
MW-11	AGI	October 1991	8.5	No			0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
MW-12	AGI	October 1991	6	Yes			0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
MW-12	AGI	October 1991	8.5	Yes			0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
MW-13	AGI	October 1991	3.5	No			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-14	AGI	October 1991	3.5	No			0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
MW-14	AGI	October 1991	8.5	No			0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
MW-7	AGI	October 1991	8.5	Yes			0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
MW-7	AGI	October 1991	13	Yes			0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U
MW-8	AGI	October 1991	6	Yes			0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
MW-8	AGI	October 1991	11	Yes			0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
MW-9	AGI	October 1991	8.5	No			0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method A for soil

Yellow highlight – parameter detected

AGI – Applied Geotechnology Inc.

bgs – below ground surface

D&M – Dames and Moore

mg/kg – milligram per kilogram

PCB – Polychlorinated Biphenyls

PEG –Pacific Environmental Group

U – parameter not detected; associated number is laboratory detection limit

Table D-3. Historical soil sample results for TPH samples conducted June 13, July 19, and August 16, 1990 and September 28, October 8, 9, and 10, 1991

SAMPLE ID	INVESTIGATION	DATE	DEPTH (feet bgs)	WITHIN SLUDGE FOOTPRINT	TPH 418.1 (mg/kg)	GASOLINE 8015 (mg/kg)	MINERAL SPIRITS (mg/kg)	KEROSENE (mg/kg)	JET FUEL (mg/kg)	DIESEL 8015 (mg/kg)	BENZENE 8020 (mg/kg)	ETHYL- BENZENE GC-FID (mg/kg)	TOLUENE GC-FID (mg/kg)	TOTAL XYLENES GC-FID (mg/kg)
EP-1	PEG	6/13/1990	3	No	10 U									
EP-1	PEG	6/13/1990	8	No	10 U									
EP-2	PEG	6/13/1990	4	No	130									
EP-2	PEG	6/13/1990	8	No	10 U									
EP-3	PEG	6/13/1990	4	No	210	88				80				
EP-3	PEG	6/13/1990	8	No	240	94				25 U				
EP-4	PEG	6/13/1990	4	Yes	20									
EP-4	PEG	6/13/1990	10	Yes	67									
EP-5	PEG	6/13/1990	6	No	140									
EP-5	PEG	6/13/1990	11	No	59									
EP-6	PEG	6/13/1990	4	No	10 U									
EP-6	PEG	6/13/1990	8	No	10 U									
EP-7	PEG	6/13/1990	4	No	10 U									
EP-8	PEG	6/13/1990	6	Yes	75									
EP-9	PEG	6/13/1990	4	No	26									
EP-10	PEG	6/13/1990	6	No	93									
EP-11	PEG	6/13/1990	6	No	10 U									
A	PEG	7/19/1990	1	Yes	25 U									
B	PEG	7/19/1990	1	Yes	25 U									
C	PEG	7/19/1990	1	Yes	25 U									
D	PEG	7/19/1990	1	Yes	25 U									
E	PEG	7/19/1990	1	Yes	25 U									

SAMPLE ID	INVESTIGATION	DATE	DEPTH (feet bgs)	WITHIN SLUDGE FOOTPRINT	TPH 418.1 (mg/kg)	GASOLINE 8015 (mg/kg)	MINERAL SPIRITS (mg/kg)	KEROSENE (mg/kg)	JET FUEL (mg/kg)	DIESEL 8015 (mg/kg)	BENZENE 8020 (mg/kg)	ETHYL- BENZENE GC-FID (mg/kg)	TOLUENE GC-FID (mg/kg)	TOTAL XYLENES GC-FID (mg/kg)
F	PEG	7/19/1990	1	Yes	25 U									
NAT-1	PEG	9/28/1991	1	Yes	68	1 U								
NAT-2	PEG	9/28/1991	1	No	44	1 U								
NAT-3	PEG	9/28/1991	1	Yes	15	1 U								
NAT-4	PEG	9/28/1991	1	Yes	33	1 U								
NAT-5	PEG	9/28/1991	1	Yes	31	1 U								
NAT-6	PEG	9/28/1991	1	Yes	100	1 U								
C-1	PEG	8/16/1990	7.5-9	No	88									
C-2	PEG	8/16/1990	7.5-9	No	16									
C-3	PEG	8/16/1990	7.5-9	No	530									
C-4	PEG	8/16/1990	2.5-4	No	10 U									
C-4	PEG	8/16/1990	7.5-9	No	10 U									
C-5	PEG	8/16/1990	7.5-9	No	260									
C-6	PEG	8/16/1990	2.5-4	No	10 U									
C-6	PEG	8/16/1990	7.5-9	No	10 U									
MW-7	AGI	10/8/1991	8.5	Yes		13 U	13 U	13 U	13 U	13 U	0.006 U	0.013	0.006 U	0.052
MW-7	AGI	10/8/1991	13	Yes		17 U	17 U	17 U	17 U	17 U	0.008 U	0.008 U	0.008 U	0.026 U
MW-8	AGI	10/9/1991	6	Yes		12 U	12 U	12 U	12 U	18	0.006 U	0.024	0.006 U	0.026 U
MW-8 Dup ^a	AGI	10/10/1991	6	Yes		12 U	12 U	12 U	12 U	68	0.006 U	0.048	0.006 U	0.11
MW-8	AGI	10/9/1991	11	Yes		12 U	12 U	12 U	12 U	12 U	0.006 U	0.006 U	0.006	0.018 U
MW-9	AGI	10/9/1991	8.5	No		12 U	12 U	12 U	12 U	12 U	0.006 U	0.006 U	0.006 U	0.018 U
MW-10	AGI	10/9/1991	6	Yes		13 U	13 U	13 U	13 U	14	0.006 U	0.006 U	0.006 U	0.02 U
MW-10 Dup ^b	AGI	10/10/1991	6	Yes		19 U	19 U	19 U	19 U	170	0.01 U	0.01 U	0.01 U	0.028 U
MW-10	AGI	10/9/1991	8.5	Yes		15 U	15 U	15 U	15 U	24	0.008 U	0.008 U	0.01	0.022 U
MW-11	AGI	10/9/1991	3.5	No		11 U	11 U	11 U	11 U	11 U	0.006 U	0.006 U	0.006 U	0.016 U

SAMPLE ID	INVESTIGATION	DATE	DEPTH (feet bgs)	WITHIN SLUDGE FOOTPRINT	TPH 418.1 (mg/kg)	GASOLINE 8015 (mg/kg)	MINERAL SPIRITS (mg/kg)	KEROSENE (mg/kg)	JET FUEL (mg/kg)	DIESEL 8015 (mg/kg)	BENZENE 8020 (mg/kg)	ETHYL- BENZENE GC-FID (mg/kg)	TOLUENE GC-FID (mg/kg)	TOTAL XYLENES GC-FID (mg/kg)
MW-11	AGI	10/9/1991	8.5	No		14 U	14 U	14 U	14 U	14 U	0.007 U	0.007 U	0.007 U	0.021 U
MW-12	AGI	10/9/1991	6	Yes		12 U	12 U	12 U	12 U	12 U	0.006 U	0.006 U	0.007	0.018 U
MW-12	AGI	10/9/1991	8.5	Yes		13 U	13 U	13 U	13 U	13 U	0.006 U	0.006	0.006 U	0.021
MW-13	AGI	10/8/1991	3.5	No		11 U	11 U	11 U	11 U	11 U	0.005 U	0.005 U	0.005 U	0.02
MW-14	AGI	10/8/1991	3.5	No		11 U	11 U	11 U	11 U	11 U	0.006 U	0.006 U	0.006 U	0.016 U
MW-14	AGI	10/8/1991	8.5	No		15 U	15 U	15 U	15 U	15 U	0.008 U	0.008 U	0.008 U	0.022 U
MTCA Method A - Industrial						100				2000	0.03	6	7	9

Source: (Pacific Groundwater Group 2006)

^aMW-8 Dup is sample MW-15

^bMW-10 Dup is Sample MW-1

yellow highlight – parameter detected

Green highlight – concentration exceeds MTCA Method A for soil

AGI – Applied Geotechnology Inc.

bgs – below ground surface

D&M – Dames and Moore

Dupl. – Duplicate

GC-FID – Gas Chromatograph – Flame Ionization Detector

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

PEG – Pacific Environmental Group

TPH – Total Petroleum Hydrocarbons

U – parameter not detected; associated # is laboratory detection limit

Table D-4. Historical soil sample results for PAH conducted October 1992

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	MW-7 (mg/kg)	MW-7 (mg/kg)	MW-8 (mg/kg)	MW-8 (mg/kg)	MW-9 (mg/kg)	MW-10 (mg/kg)	MW-10 (mg/kg)	MW-11 (mg/kg)	MW-11 (mg/kg)	MW-12 (mg/kg)	MW-12 (mg/kg)	MW-13 (mg/kg)	MW-14 (mg/kg)	MW-14 (mg/kg)
Depth (feet bgs):		8.5	13	6	11	8.5	6	8.5	3.5	8.5	6	8.5	3.5	3.5	8.5
Within Sludge Footprint:		Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	No	No	No
Naphthalene ^a	8310	0.18 U	0.24 U	0.17 U	0.17 U	0.17 U	0.18 U	0.21 U	0.15 U	0.2 U	0.17 U	0.17 U	0.14 U	0.15 U	0.21 U
Acenaphthylene	8310	0.09 U	0.12 U	0.083 U	0.083 U	0.083 U	0.09 U	0.1 U	0.076 U	0.097 U	0.83 U	0.083 U	0.069 U	0.76 U	0.1 U
Acenaphthene	8310	0.026 U	0.064	0.054	0.024 U	0.024 U	0.026 U	0.03 U	0.022 U	0.28 U	0.24 U	0.024 U	0.02 U	0.022 U	0.03 U
Fluorene	8310	0.021	0.039	0.038	0.016 U	0.016 U	0.022	0.02 U	0.014 U	0.08 U	0.016 U	0.013 U	0.013 U	0.014 U	0.02 U
Phenanthrene	8310	0.19	0.15	0.13	0.055	0.023 U	0.025 U	0.028 U	0.021 U	0.027 U	0.026	0.059	0.019 U	0.11	0.028 U
Anthracene	8310	0.045	0.034	0.026	0.017 U	0.017 U	0.018 U	0.021 U	0.015 U	0.02 U	0.017 U	0.029	0.014 U	0.015 U	0.021 U
Fluoranthene	8310	0.17	0.14	0.094	0.03 U	0.03 U	0.032 U	0.038 U	0.028 U	0.035 U	0.03 U	0.051	0.025 U	0.071	0.038 U
Pyrene	8310	0.21	0.11	0.077	0.042	0.018	0.11	0.17	0.015 U	0.02 U	0.049	0.1	0.014 U	0.094	0.021 U
Benzo(a)anthracene	8310	0.095	0.022	0.023	0.015	0.013 U	0.039	0.081	0.012 U	0.015 U	0.026	0.058	0.011 U	0.042	0.016 U
Chrysene	8310	0.01	0.046	0.055	0.081	0.018	0.049	0.11	0.014 U	0.018 U	0.028	0.069	0.013 U	0.067	0.012 U
Benzo(b)fluoranthene	8310	0.087	0.052	0.05	0.026	0.037	0.072	0.17	0.014 U	0.018 U	0.038	0.073	0.013 U	0.064	0.032
Benzo(k)fluoranthene	8310	0.014	0.019 U	0.018	0.013 U	0.013 U	0.022	0.033	0.012 U	0.015 U	0.013 U	0.03	0.011 U	0.018	0.021
Benzo(a)pyrene	8310	0.091	0.024	0.014 U	0.014 U	0.014 U	0.029	0.079	0.013 U	0.017 U	0.022	0.051	0.012 U	0.026	0.018 U
Dibenzo(a,h)anthracene	8310	0.014 U	0.019 U	0.013 U	0.013 U	0.013 U	0.014 U	0.016 U	0.012 U	0.015 U	0.013 U	0.013 U	0.011 U	0.011 U	0.016 U
Benzo(g,h,i)perylene	8310	0.049	0.051 U	0.036 U	0.036 U	0.036 U	0.039 U	0.045 U	0.033 U	0.042 U	0.036 U	0.036 U	0.03 U	0.03 U	0.045 U
Indeno(1,2,3-cd)pyrene	8310	0.029	0.02 U	0.014 U	0.014 U	0.014 U	0.016 U	0.025	0.013 U	0.017 U	0.014 U	0.014 U	0.012 U	0.012 U	0.018 U
Toxicity Equivalent Concentrations	TEF														
Benzo(a)anthracene	0.1	0.0095	0.0022	0.0023	0.0015	0.0013	0.0039	0.0081	0.0006	0.00075	0.0026	0.0058	0.00055	0.0042	0.0016
Benzo(a)pyrene	1	0.091	0.024	0.007	0.007	0.007	0.029	0.079	0.0065	0.0085	0.022	0.051	0.006	0.026	0.009
Benzo(b)fluoranthene	0.1	0.0087	0.0052	0.005	0.0026	0.0037	0.0072	0.017	0.0007	0.0009	0.0038	0.0073	0.00065	0.0064	0.0032
Benzo(k)fluoranthene	0.1	0.0014	0.00095	0.0018	0.00065	0.00065	0.0022	0.0033	0.0006	0.00075	0.00065	0.003	0.00055	0.0018	0.00105
Chrysene	0.01	0.0001	0.00046	0.00055	0.00081	0.00018	0.00049	0.0011	0.00007	0.00009	0.00028	0.00069	0.000065	0.00067	0.00006
Dibenzo(a,h)anthracene	0.4	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028	0.0028	0.0024	0.003	0.0028	0.0028	0.0022	0.0028	0.0028
Indeno(1,2,3-cd)pyrene	0.1	0.0029	0.001	0.0007	0.0007	0.0007	0.0008	0.0025	0.00065	0.00085	0.0007	0.0007	0.0006	0.0006	0.0009
Total cPAH Toxicity Equivalent Concentrations		0.116	0.037	0.02	0.016	0.016	0.046	0.114	0.012	0.015	0.033	0.071	0.011	0.042	0.019

Source: (Pacific Groundwater Group 2006)

^a MTCA Method A - Industrial cleanup level for naphthalene – 5 mg/kg. Individual cleanup levels for remaining PAHs not established under MTCA Method A - Industrial

Green highlight – concentration exceeds MTCA Method A for soil

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

bgs – below ground surface

cPAH – carcinogenic Polycyclic Aromatic Hydrocarbon

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

MW – Monitoring Well

Non-detect cPAH results considered 50% of the reporting limit in the TEF calculations

TEF – toxic equivalency factor

U – parameter not detected; associated # is laboratory detection limit

Table D-5. Historical soil sample results for metals conducted July 20, 1981 and October 1991

SAMPLE ID	DATE	DEPTH (ft bgs)	ANTIMONY 6010/7000 (mg/kg)	ARSENIC 6010/ 7000 (mg/kg)	BERYLLIUM 6010/7000 (mg/kg)	CADMIUM 6010/7000 (mg/kg)	CHROMIUM 6010/7000 (mg/kg)	COPPER 6010/7000 (mg/kg)	LEAD 7240 (mg/kg)	MERCURY 6010/ 7000 (mg/kg)	NICKEL 6010/ 7000 (mg/kg)	SELENIUM 6010/ 7000 (mg/kg)	SILVER 6010/ 7000 (mg/kg)	THALLIUM 6010/ 7000 (mg/kg)	ZINC 6010/ 7000 (mg/kg)
B81-1-2	7/20/1981	6	na	8	na	1.4	39	na	41	0.24	na	na	na	na	86
B81-1-4	7/20/1981	11	na	19	na	15	64	na	240	0.17	na	na	na	na	2500
B81-1-8	7/20/1981	21	na	7	na	0.31	10	na	4	0.02 U	na	na	na	na	22
B81-2-1	7/20/1981	2.5	na	6	na	1.4	39	na	72	0.13	na	na	na	na	91
B81-2-6	7/20/1981	16	na	1.5	na	0.22	3.9	na	4	0.06	na	na	na	na	19
B81-3-2	7/20/1981	6	na	5.2	na	1.4	42	na	88	0.15	na	na	na	na	110
B81-3-7	7/20/1981	19	na	4.7	na	0.32	11	na	6	0.15	na	na	na	na	24
B81-4-3	7/20/1981	9	na	9	na	0.85	24	na	39	0.07	na	na	na	na	88
B81-4-8	7/20/1981	21	na	4.1	na	0.37	11	na	4	0.04	na	na	na	na	24
B81-5-2	7/20/1981	6	na	7	na	2	85	na	45	0.23	na	na	na	na	140
B81-5-6	7/20/1981	16	na	10	na	3.1	150	na	130	0.32	na	na	na	na	320
B81-6-7	7/20/1981	19	na	4.9	na	2	62	na	140	0.13	na	na	na	na	140
B81-7-1	7/20/1981	2.5	na	4.8	na	1.4	13	na	14	0.02 U	na	na	na	na	43
B81-7-5	7/20/1981	14	na	9	na	1.7	25	na	350	0.11	na	na	na	na	130
B81-8-5	7/20/1981	14.5	na	5.5	na	0.85	19	na	57	0.1	na	na	na	na	54
B81-8-9	7/20/1981	24	na	6.1	na	0.32	11	na	6	0.02 U	na	na	na	na	25
B81-9-6	7/20/1981	15.5	na	8.2	na	0.47	11	na	6	0.05	na	na	na	na	28
B81-10-3	7/20/1981	9	na	17	na	3.3	380	na	240	0.4	na	na	na	na	280
B81-10-6	7/20/1981	16	na	7.2	na	0.46	11	na	6	0.02 U	na	na	na	na	25
B81-10-9	7/20/1981	24	na	6	na	0.35	10	na	6	0.02 U	na	na	na	na	23
B81-11-7	7/20/1981	19	na	8	na	0.53	12	na	11	0.03	na	na	na	na	35
B81-11-20	7/20/1981	26.5	na	3.4	na	0.27	7.5	na	3	0.05	na	na	na	na	21
B81-12-9	7/20/1981	15.5	na	1.7	na	0.19	5.9	na	2	0.04	na	na	na	na	14

SAMPLE ID	DATE	DEPTH (ft bgs)	ANTIMONY 6010/7000 (mg/kg)	ARSENIC 6010/ 7000 (mg/kg)	BERYLLIUM 6010/7000 (mg/kg)	CADMIUM 6010/7000 (mg/kg)	CHROMIUM 6010/7000 (mg/kg)	COPPER 6010/7000 (mg/kg)	LEAD 7240 (mg/kg)	MERCURY 6010/ 7000 (mg/kg)	NICKEL 6010/ 7000 (mg/kg)	SELENIUM 6010/ 7000 (mg/kg)	SILVER 6010/ 7000 (mg/kg)	THALLIUM 6010/ 7000 (mg/kg)	ZINC 6010/ 7000 (mg/kg)
B81-13-8	7/20/1981	24	na	7.2	na	0.39	12	na	7	0.05	na	na	na	na	28
MW-7	Oct-91	8.5	6.5 U	6.5 U	1.3 U	1.3 U	56	21	18	0.06 U	70	6.5 U	3.4 U	10	75
MW-7	Oct-91	13	8.5 U	8.5 U	1.7 U	1.7 U	46	48	34	0.24	48	8.5 U	4.2 U	20	88
MW-8	Oct-91	6	6 U	6 U	1.2 U	1.9	65	40	44	0.97	12	6 U	7.1	13	120
MW-8	Oct-91	11	6 U	6 U	1.2 U	1.2 U	17	19	8.5	0.06 U	16	6 U	3 U	18	62
MW-9	Oct-91	8.5	6 U	6 U	1.2 U	1.2 U	13	13	<6	0.06 U	7.1	6 U	3 U	24	25
MW-10	Oct-91	6	6.5 U	6.5 U	1.3 U	1.3 U	23	26	20	0.1	10	6.5 U	4.7	10	51
MW-10	Oct-91	8.5	7.5 U	7.5 U	1.5 U	3	180	100	150	1.1	16	7.5 U	11	22	340
MW-11	Oct-91	3.5	5.5 U	5.5 U	1.1 U	1.1 U	9.2	11	5.5 U	0.06 U	5.5 U	5.5 U	2.8 U	19	20
MW-11	Oct-91	8.5	6 U	6 U	1.2 U	1.2 U	8.3	10	6 U	0.06 U	7.4	6 U	3 U	14	16
MW-12	Oct-91	6	6 U	6 U	1.2 U	1.2 U	14	22	7.6	0.06 U	7.8	6 U	3 U	11	31
MW-12	Oct-91	8.5	6.5 U	6.5 U	1.3 U	1.3 U	34	22	21	0.13	9.8	6.5 U	3.4 U	18	66
MW-13	Oct-91	3.5	5 U	5 U	1 U	1 U	5.8	3.3	5 U	0.05 U	5 U	5 U	2.5 U	10	21
MW-14	Oct-91	3.5	5.5 U	5.5 U	1.1 U	1.1 U	32	20	31	0.37	8.2	5.5 U	2.8 U	15	42
MW-14	Oct-91	8.5	7.5 U	7.5 U	1.5 U	1.5 U	12	22	10	0.08 U	9.4	7.5 U	3.8 U	26	54
MTCA Method A - Industrial				20		2	2000		1000	2					

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method A for soil

Yellow highlight – parameter detected

Investigation – D&M

bgs – below ground surface

D&M – Dames and Moore

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

na – not applicable

U – parameter not detected; associated # is laboratory detection limit

Table D-6. Historical soil sample results for PCBs and metals conducted June 12, 1984

SAMPLE ID	DEPTH (ft bgs)	AROCOR (1242 & 1254) (mg/kg)	ARSENIC (mg/kg)	CADMIUM (mg/kg)	CHROMIUM (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	ZINC (mg/kg)	TOTAL SOLIDS (mg/kg)
B1-2	6	2.06	8	1.4	39	41	0.24	86	71.4
B1-4	11	4.89	19	15	64	240	0.17	2500	59.1
B1-8	21	0.013	7	0.31	10	4	< 0.02	22	72.6
B2-1	2.5	2.73	6	1.4	39	72	0.13	91	80.1
B2-6	16	0.169	1.5	0.22	3.9	4	0.06	19	7
B3-2	6	2.29	5.2	1.4	42	88	0.15	110	73.9
B3-7	19	0.171	4.7	0.32	11	6	0.15	24	58.9
B4-3	9	0.512	9	0.85	24	0.9	0.07	88	73.7
B4-8	21	< 0.01	4.1	0.37	11	4	0.04	24	73.4
B5-2	6	2.6	7	2	85	45	0.23	140	69.7
B5-6	16	4.27	10	3.1	150	130	0.32	320	50.5
B6-7	19	1.71	4.9	2	62	140	0.13	140	55.3
B7-1	2.5	0.709	4.8	1.4	13	14	< 0.02	43	88.8
B7-5	14	1.21	9	1.7	25	350	0.11	130	79.3
B8-5	14.5	1.13	5.5	0.85	19	57	0.1	54	77.9
B8-9	24	< 0.01	6.1	0.32	11	6	< 0.02	25	73.5
B9-6	15.5	0.102	8.2	0.47	11	6	0.05	28	69.5
B10-3	9	5.91	17	3.3	360	240	0.4	280	69.7
B10-6	16	0.443	7.2	0.46	11	6	< 0.02	25	67.4
B10-9	24	< 0.01	6	0.35	10	6	< 0.02	23	73.6
B11-7	19	0.661	8	0.53	12	11	0.03	35	73.5
B11-10	26.5	< 0.01	3.4	0.27	7.5	3	0.05	21	81.9
B12-9	15.5	< 0.01	1.7	0.19	5.9	2	0.04	14	81.7
B13-8	24	< 0.01	7.2	0.39	12	7	0.05	28	71.9

Source: (Dames & Moore 1984)

bgs – below ground surface

mg/kg – milligram per kilogram

PCB – polychlorinated biphenyl

Table D-7. Historical soil sample results for metals conducted June 12, 1984

SAMPLE ID	DEPTH (ft bgs)	AROCLOR 1242 (µg/g)	AROCLOR 1254 (µg/g)	ARSENIC (mg/kg)	CADMIUM (mg/kg)	CHROMIUM (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	ZINC (mg/kg)	% SOLIDS
84-1	1.5-3	--	--	8.5	0.25	19	7.8	0.12	53	86
84-1	4-6	--	--	15	4.6	50	170	0.25	280	76
84-2	1.5-3	7.2	--	7.5	0.6	100	11	0.55	83	73
84-2	1.5-3	9.9	4.1 ^a	7.8	0.55	120	140	0.81	58	72
84-3	4.5-7	--	--	6	0.55	43	29	0.2	75	85
84-3	9-10.5	--	--	6.8	0.32	19	17	0.2	71	83
84-3	12-14	6.7	--	8.4	0.52	34	22	0.14	100	69
84-4	1-3		3.2	6	0.081	21	18	0.14	27	80
84-5	1-2.5	--	--	5.2	0.35	17	9.3	<0.1	52	86
84-6	4-5.5	--	--	6.5	0.38	9.8	2.9	<0.1	25	78
84-7	1.5-3	--	--	4.1	0.1	11	9.7	<0.1	19	91
84-8	1-2.5	--	--	4.8	0.31	13	5.5	<0.1	31	85
84-9	1.5-3	--	--	5	0.4	17	5	0.12	39	88
84-10	1.5-3	--	--	4.5	0.074	6.1	1.3	<0.1	17	7
84-10	4-6	--	--	4.2	3.1	28	41	0.28	110	87
84-11	1-2	--	--	3.8	0.11	6.2	3.8	<0.1	16	82
84-11	3.5-5	--	--	3.9	0.07	7.3	1.9	<0.1	24	78

Source: (Dames & Moore 1984)

^a Duplicate samples were tested for quality control check.

-- PCB concentration is less than the detection limit of 1 ppm (mg/kg)

bgs – below ground surface

Dupl. – Duplicate

µg/g – micrograms per gram

mg/kg – milligram per kilogram

PCB – polychlorinated biphenyl

Table D-8. Summary of bank soil analytical chemistry (dry weight)—AET screening^a conducted on August 17, 2005

CHEMICAL / SAMPLE INFORMATION	SQS-AET	CSL-AET	DUD_30C	DUD_31C
Sample ID			L36565-1	L36565-2
Depth Interval			0-3 cm	0-3 cm
Conventionals (%)				
Total solids	--	--	83.2	95.3
Total Organic Carbon	--	--	1.05	0.377
Metals (mg/kg)				
Arsenic	57	93	6 JL	2.6 U
Cadmium	5.1	6.7	0.18 U	0.28
Chromium	260	270	55.9	31
Copper	390	530	61.8	158
Lead	450	530	94.4	7.8
Mercury	0.41	0.59	0.468*	0.031
Zinc	410	960	61.9 J	85.8
PCBs (µg/kg)				
Aroclor 1016	--	--	170U	1.4U
Aroclor 1221	--	--	30U	2.6U
Aroclor 1232	--	--	470U	2.6U
Aroclor 1242	--	--	400U	1.4U
Aroclor 1248	--	--	315	2
Aroclor 1254	--	--	303	5.22
Aroclor 1260	--	--	197	9.32
Total PCBs (SMS)	130	1000	815*	16.5
LPAH (µg/kg)				
Naphthalene	2100	2400	16U	2.8U
Acenaphthylene	1300	1300	16U	2.8U
Acenaphthene	500	730	16U	2.8U
Fluorene	540	1000	16U	2.8U
Phenanthrene	1500	5400	43.8	8.84
Anthracene	960	4400	16U	2.8U
2-Methylnaphthalene	670	1400	16U	2.8U
Total LPAH (SMS)	5200	13000	43.8	8.84
HPAH (µg/kg)				
Fluoranthene	1700	2500	112	22.6
Pyrene	2600	3300	98.8	19.5

CHEMICAL / SAMPLE INFORMATION	SQS-AET	CSL-AET	DUD_30C	DUD_31C
Benzo(a)anthracene	1300	1600	41	8.36
Chrysene	1400	2800	55	14.8
Benzo(b)fluoranthene	--	--	53	13.6
Benzo(k)fluoranthene	--	--	54.9	15.5
Benzo(a)pyrene	1600	3000	47.4	13.7
Indeno(1,2,3-cd)pyrene	600	690	38.9	10.9
Dibenzo(a,h)anthracene	230	540	16U	3.3
Benzo(g,h,i)perylene	670	720	45.8	13.2
Total benzofluoranthenes (SMS)	3200	3600	107.9	29.1
Total HPAH (SMS)	12000	17000	546.8	135.46
Chlorinated Hydrocarbons (µg/kg)				
1,3-Dichlorobenzene	--	--	1.6U	0.28U
1,4-Dichlorobenzene	110	120	1.6U	0.28U
1,2-Dichlorobenzene	35	50	7.21	0.28U
1,2,4-Trichlorobenzene	31	51	1.6U	0.28U
Hexachlorobenzene	22	70	3.2U	0.56U
Phthalates (µg/kg)				
Dimethylphthalate	71	160	32U	5.6U
Diethylphthalate	200	1200	32U	5.6U
Di-n-butylphthalate	1400	5100	38J	9.1
Butylbenzylphthalate	63	900	32U	61.1
bis(2-Ethylhexyl)phthalate	1300	1900	138	39.3
Di-n-octylphthalate	6200	--	32U	5.6U
Phenols (µg/kg)				
Phenol	420	1200	1300J*#	14.7
2-Methylphenol	63	72	32U	5.6U
4-Methylphenol	670	1800	32U	5.6U
2,4-Dimethylphenol	29	72	16U	2.8U
Pentachlorophenol	360	690	81U	14U
Misc Extractables (µg/kg)				
Benzyl alcohol	57	73	32U	5.6U
Benzoic acid	650	650	846J*	116
Dibenzofuran	540	700	16U	2.8U
Hexachlorobutadiene	11	120	8.1U	1.4U
n-Nitrosodiphenylamine	28	40	32U	5.6U

Source: (Anchor 2007)

a. Note chemicals are compared to dry weight AETs when TOC is <0.5% or >3% (except for metals, phenols and some miscellaneous extractable organics which are always compared to dry weight AETs).

Yellow Highlight – parameter detected

Italics – TOC <0.5% or >3%.

* – Exceeds SQS-AET dry weight criteria.

– Exceeds CSL-AET dry weigh criteria

AET – apparent effects threshold

CSL – cleanup screening level

HPAH – high-molecular-weight Polycyclic Aromatic
Hydrocarbon

µg/kg – micrograms per kilogram

mg/kg – milligram per kilogram

PAH – Polycyclic Aromatic Hydrocarbon

PCB – Polychlorinated Biphenyls

SQS – sediment quality standard

SMS – Washington State Sediment Management Standards

Table D-9. Summary of bank soil analytical chemistry (organic carbon normalized) – SMS screening conducted on August 17, 2005

CHEMICAL / SAMPLE INFORMATION			DUD_30C	DUD_31C
Sample ID			L36565-1	L36565-2
Depth Interval			0-3 cm	0-3 cm
	SMS SQS	SMS CSL		
Conventionals (%)				
Total solids	--	--	83.2	95.3
Total Organic Carbon	--	--	1.05	0.377
Metals (mg/kg)				
Arsenic	57	93	6 JL	2.6 U
Cadmium	5.1	6.7	0.18 U	0.28
Chromium	260	270	55.9	31
Copper	390	390	61.8	158
Lead	450	530	94.4	7.8
Mercury	0.41	0.59	0.468*	0.031
Silver	6.1	6.1	2.62JG	0.79
Zinc	410	960	61.9J	85.8
PCBs (mg/kg-OC)				
Total PCBs (SMS)	12	65	77.6*#	4.39
LPAH (mg/kg-OC)				
Naphthalene	99	170	1.52U	0.743U
Acenaphthylene	66	66	1.52U	0.743U
Acenaphthene	16	57	1.52U	0.743U
Fluorene	23	79	1.52U	0.743U
Phenanthrene	100	480	4.17	2.34
Anthracene	220	1200	1.52U	0.743U
2-Methylnaphthalene	38	64	1.52U	0.743U
Total LPAH (SMS)	370	780	4.17	2.34
HPAH (mg/kg-OC)				
Fluoranthene	160	1200	10.7	5.99
Pyrene	1000	1400	9.41	5.17
Benzo(a)anthracene	110	270	3.9	2.22
Chrysene	110	460	5.24	3.93
Benzo(a)pyrene	99	210	4.51	3.63
Indeno(1,2,3-cd)pyrene	34	88	3.7	2.89
Dibenzo(a,h)anthracene	12	33	1.52U	0.875
Benzo(g,h,i)perylene	31	78	4.36	3.5

CHEMICAL / SAMPLE INFORMATION			DUD_30C	DUD_31C
Total benzofluoranthenes (SMS)	230	450	10.3	7.72
Total HPAH (SMS)	960	5300	52.1	35.9
Chlorinated Hydrocarbons (mg/kg-OC)				
1,4-Dichlorobenzene	3.1	9	0.152U	0.0743U
1,2-Dichlorobenzene	2.3	2.3	0.687	0.0743U
1,2,4-Trichlorobenzene	0.81	1.8	0.152U	0.0743U
Hexachlorobenzene	0.38	2.3	0.305U	0.149U
Phthalates (mg/kg-OC)				
Dimethylphthalate	53	53	3.05U	1.49U
Diethylphthalate	61	110	3.05U	1.49U
Di-n-butylphthalate	220	1700	3.62J	2.41
Butylbenzylphthalate	4.9	64	3.05U	16.2*
bis(2-Ethylhexyl)phthalate	47	78	13.1	10.4
Di-n-octylphthalate	58	4500	3.05U	1.49U
Phenols (µg/kg)				
Phenol	420	1200	1300J*#	14.7
2-Methylphenol	63	63	32U	5.6U
4-Methylphenol	670	670	32U	5.6U
2,4-Dimethylphenol	29	29	16U	2.8U
Pentachlorophenol	360	690	81U	14U
Misc Extractables (mg/kg-OC)				
Dibenzofuran	15	58	1.52U	0.743U
Hexachloroethane	3.9	6.2	0.771U	0.371U
n-Nitrosodiphenylamine	11	11	3.05U	1.49U
Misc Extractables (µg/kg)				
Benzyl alcohol	57	73	32U	5.6U
Benzoic acid	650	650	846J*#	116

Source: (Anchor 2007)

Note: metals, phenols and some miscellaneous extractable organics are not compared to organic carbon normalized values but only to dry weight AETs regardless of the organic carbon value.

Green Highlight – Exceeds TOC applicable criteria.

Yellow Highlight – parameter detected

* – Exceeds SQS-AET dry weight criteria.

– Exceeds CSL-AET dry weight criteria.

Italics – TOC <0.5% or >3%.

-- TOC undetected; not normalized

AET – apparent effects threshold

cm – centimeters

CSL – cleanup screening level

µg/kg – micrograms per kilogram

mg/kg – milligrams per kilogram OC – organic carbon

PCB – Polychlorinated Biphenyls

PAH – Polycyclic Aromatic Hydrocarbon

SQS – sediment quality standard

SMS – Washington State Sediment Management Standards

Table D-10. Historical test pit soil sample results conducted on July 20, 1981

CHEMICAL	ANALYTICAL METHOD	TP81-1 (mg/kg)	TP81-2 (mg/kg)	TP81-3 (mg/kg)	TP81-4 (mg/kg)	TP81-5 (mg/kg)	TP81-6 (mg/kg)
Depth (feet bgs)		9.5	10	10	9	8	5.5
Aroclors (1242 & 1254)		0.432	1.19	0.803	1.72	0.225	2.11
Arsenic	6010/7000	6.3	12	9	5.2	4.4	4.2
Cadmium	6010/7000	0.63	0.54	0.54	0.64	0.58	0.69
Chromium	6010/7000	17	13	16	27	14	16
Lead	7240	16	14	17	33	16	18
Mercury	6010/7000	0.02 U	0.02 U	0.04	0.19	0.02 U	0.02 U
Zinc	6010/7000	49	50	46	63	34	36
Total Solids		82.6	86.5	84.1	81.2	83	83.9

Source: (Pacific Groundwater Group 2006)

Green Highlight – Exceeds TOC applicable criteria.

Yellow Highlight – parameter detected

Investigation – Dames and Moore

bgs – below ground surface

mg/kg – milligram per kilogram

PCB – Polychlorinated Biphenyls

TP – test pit

Table D-11. Historical soil sample results prior to land-farming, conducted July 19, 1990

CHEMICAL	ANALYTICAL METHOD	A (MG/KG)	B (MG/KG)	C (MG/KG)	D (MG/KG)	E (MG/KG)	F (MG/KG)	DETECTION LIMIT
TPH-Gasoline	EPA 8015	nd	nd	nd	nd	nd	nd	25
Benzene	EPA 8020	nd	nd	nd	nd	nd	nd	0.05 – 0.062
Toluene	EPA 8020	nd	nd	nd	nd	nd	nd	0.05 – 0.062
Ethyl-Benzene	EPA 8020	nd	nd	nd	nd	nd	nd	0.05 – 0.062
Total Xylenes	EPA 8020	nd	nd	nd	nd	nd	nd	0.05 – 0.062

Source: (Pacific Environmental Group 1991)

Yellow Highlight – parameter detected

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

nd – not detected

TPH – total petroleum hydrocarbons

Table D-12. Historical stockpile soil sample results after land-farming, conducted September 28, 1990

CHEMICAL	ANALYTICAL METHOD	SP-1 (COMPOSITE) (mg/kg)	SP-2 (COMPOSITE) (mg/kg)	SP-3 (COMPOSITE) (mg/kg)	DETECTION LIMIT
TPH-EPA 418.1	EPA 418.1	110	110	130	5
TPH-Gasoline	EPA 8015	28	nd	10	1
Benzene	EPA 8020	nd	nd	nd	0.05
Toluene	EPA 8020	nd	nd	nd	0.1
Ethyl-Benzene	EPA 8020	nd	nd	nd	0.1
Total Xylenes	EPA 8020	nd	nd	nd	0.1

Source: (Pacific Environmental Group 1991)

Note: This soil has reportedly been removed

Yellow Highlight – parameter detected

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

nd – not detected

TPH – Total Petroleum Hydrocarbons

Table D-13. Historical stockpile soil sample results after land-farming, conducted November 6, 1990

SAMPLE ID	TPH-EPA 418.1 (mg/kg)	TPH-GASOLINE (mg/kg)	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYL-BENZENE (mg/kg)	TOTAL XYLENES (mg/kg)
Analytical Method	EPA 418.1	EPA 8015	EPA 8020	EPA 8020	EPA 8020	EPA 8020
SP-1	110	nd	nd	nd	nd	nd
SP-2	130	nd	nd	nd	nd	nd
SP-3	150	nd	nd	nd	nd	nd
SP-3A	150	nd	nd	nd	nd	nd
SP-4	96	nd	nd	nd	nd	nd
SP-5	73	nd	nd	nd	nd	nd
SP-6	160	nd	nd	nd	nd	nd
SP-7	120	nd	nd	nd	nd	nd
SP-8	170	nd	nd	nd	nd	nd
SP-9	79	nd	nd	nd	nd	nd
SP-10	83	nd	nd	nd	nd	nd
SP-11	42	nd	nd	nd	nd	nd
SP-12	190	nd	nd	nd	nd	nd
Detection Limit	5	1	0.05	0.1	0.1	0.1

Source: (Pacific Environmental Group 1991)

Note: This soil has reportedly been removed

Yellow Highlight – parameter detected

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

nd – not detected

TPH – Total Petroleum Hydrocarbons

Table D-14. Historical stockpile soil sample results at the former Chiyoda site conducted June 21, 1989 and March 19, 1990

SAMPLE ID	DATE SAMPLED	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYL-BENZENE (mg/kg)	TOTAL XYLENES (mg/kg)	TPH (mg/kg)	BARIUM (mg/L)	CADMIUM (mg/L)	FUEL HYDROCARBONS (mg/kg)	FUEL TYPE ^a
WS-1 ^b	6/21/1989	nd	nd	nd	0.011 ^c	212	nd	nd	63 / 110	Diesel #2/turpentine
ES-1 ^b	6/21/1989	nd	nd	0.017	0.107 ^c	344	nd	nd	53 / 670	Diesel #2/turpentine
SP-N1	3/19/1990	nd	nd	nd	0.27	200	0.032	0.002	60	Gasoline
SP-N2	3/19/1990	nd	nd	nd	0.14	180	0.077	0.003	nd	
SP-N3	3/19/1990	nd	nd	nd	1.2	230	0.046	nd	48	Gasoline
SP-N4	3/19/1990	nd	nd	nd	nd	260	0.061	nd	nd	
SP-S1	3/19/1990	nd	nd	nd	0.056	410	0.061	nd	200	Gasoline
SP-S1 ^d	3/19/1990	nd	nd	nd	0.57	na	na	na	na	
SP-S2	3/19/1990	nd	nd	nd	0.49	360	0.071	nd	150	Gasoline
SP-S2 ^d	3/19/1990	nd	nd	nd	0.51	na	na	na	na	
SP-S3	3/19/1990	nd	nd	nd	0.18	810	0.044	nd	84	Gasoline
SP-S4	3/19/1990	nd	nd	nd	0.14	200	0.049	nd	nd	
SP-4A ^e	3/19/1990	nd	nd	nd	0.15	230	0.062	nd	nd	

Source: (Thorne Environmental 1990)

^a Identified only if analyte detected

^b Samples taken from stockpile at service station site prior to being exported to the Chiyoda site

^c Individual isomers have been combined into a total xylene result

^d Sample analyzed twice by laboratory

^e Duplicate of sample S4

Yellow Highlight – parameter detected

Analytical Method – EPA 8015

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

na – not analyzed

nd – not detected at the analytical detection limit of 25 mg/kg

Table D-15a. Analytical summary of groundwater sampling, round 1, conducted June 13 and 14, 2006, PGG-1 through PGG-5

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-1 ^a (6/13/06)	PGG-1 ^a (6/14/06)	PGG-2	PGG-3	PGG-4	PGG-5	MTCA METHOD A
Coordinates			N: 209009.53 E: 1267978.45	N: 209009.53 E: 1267978.45	N: 208857.20 E: 1267450.88	N: 208484.34 E: 1267594.69	N: 208550.85 E: 1268179.67	N: 208967.95 E: 1267349.68	
pH				6.88	5.92	6.03	6.36	7.10	
Temp		°C		16.83	15.2	13.44	15.36	13.48	
Dissolved Oxygen		mg/L		0.5	1.74	1.36	2.32	0.47	
Electrical Conductivity		mS/cm		4.96	1.357	0.591	1.172	1.868	
Oxidation Reduction Potential		mV		-290.2	84.5	-338.3	-210.4	-295.2	
Petroleum Hydrocarbons									
Gasoline Range HC	NWTPH-Gx/8021B	µg/L	50.0 U		50.0 U	50.0 U	50.0 U	50.0 U	1000
Benzene	NWTPH-Gx/8021B	µg/L	0.500 U		0.500 U	0.500 U	0.500 U	0.500 U	5
Toluene	NWTPH-Gx/8021B	µg/L	0.500 U		0.500 U	0.500 U	0.500 U	0.500 U	1000
Ethylbenzene	NWTPH-Gx/8021B	µg/L	0.500 U		0.500 U	0.500 U	0.500 U	0.500 U	700
Xylenes (total)	NWTPH-Gx/8021B	µg/L	1.000 U		1.000 U	1.000 U	1.000 U	1.000 U	1000
Diesel Range HC	NWTPH-Dx	mg/L	0.255 U	0.272 U	0.250 U	0.250 U	0.253 U	0.250 U	500
Lube Oil Range HC	NWTPH-Dx	mg/L	0.51 U	0.543 U	0.500 U	0.500 U	0.505 U	0.500 U	500
Total Metals									
Arsenic	EPA 6020	mg/L	na	0.00628	0.00381	0.001 U	0.005	0.0107	0.005
Cadmium	EPA 6020	mg/L	na	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.005
Chromium	EPA 6020	mg/L	na	0.0078	0.00622	0.001 U	0.00538	0.00985	0.05
Copper	EPA 6020	mg/L	na	0.011	0.00316	0.00198	0.00791	0.00205	na

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-1 ^a (6/13/06)	PGG-1 ^a (6/14/06)	PGG-2	PGG-3	PGG-4	PGG-5	MTCA METHOD A
Lead	EPA 6020	mg/L	na	0.0168	0.00249	0.001 U	0.00324	0.001 U	0.015
Nickel	EPA 6020	mg/L	na	0.00598	0.0381	0.0134	0.00816	0.00247	na
Zinc	EPA 6020	mg/L	na	0.0747	0.36	0.0446	0.049	0.001 U	na
Dissolved Metals									
Arsenic	EPA 6020-Diss	mg/L	na	0.00577	0.00378	0.00103	0.0104	0.0104	0.005
Cadmium	EPA 6020-Diss	mg/L	na	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.005
Chromium	EPA 6020-Diss	mg/L	na	0.00246	0.00455	0.00108	0.00892	0.00892	0.05
Copper	EPA 6020-Diss	mg/L	na	0.001 U	0.00173	0.00155	0.00138	0.00138	
Lead	EPA 6020-Diss	mg/L	na	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.015
Nickel	EPA 6020-Diss	mg/L	na	0.0031	0.0347	0.0111	0.0029	0.0029	na
Zinc	EPA 6020-Diss	mg/L	na	0.0249	0.435	0.0436	0.069	0.001 U	na
Polychlorinated Biphenyls									
Aroclor 1016	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1221	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1232	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1242	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1248	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1254	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1260	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1262	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Aroclor 1268	EPA 8082 Mod	µg/L	na	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	na
Polycyclic Aromatic Hydrocarbons									
1-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.286	0.0943 U	0.0952 U	0.0943 U	na
2-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na
Acenaphthene	EPA 8270C-HVI	µg/L	0.115	0.138	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-1 ^a (6/13/06)	PGG-1 ^a (6/14/06)	PGG-2	PGG-3	PGG-4	PGG-5	MTCA METHOD A
Acenaphthylene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na
Anthracene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na
Benzo(ghi)perylene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na
Fluoranthene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na
Fluorene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.111	0.0943 U	0.0952 U	0.0943 U	na
Naphthalene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.136	0.0943 U	0.0952 U	0.0943 U	na
Phenanthrene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na
Pyrene	EPA 8270C-HVI	µg/L	0.105 U	0.0952 U	0.0943 U	0.0943 U	0.0952 U	0.0943 U	na
Benzo(a)anthracene	EPA 8270C-HVI	µg/L	0.0105 U	0.00952 U	0.00943 U	0.00943 U	0.00952 U	0.00943 U	na
Benzo(a)pyrene	EPA 8270C-HVI	µg/L	0.0105 U	0.00952 U	0.00943 U	0.00943 U	0.00952 U	0.00943 U	na
Benzo(b)fluoranthene	EPA 8270C-HVI	µg/L	0.0105 U	0.00952 U	0.00943 U	0.00943 U	0.00952 U	0.00943 U	na
Benzo(k)fluoranthene	EPA 8270C-HVI	µg/L	0.0105 U	0.00952 U	0.00943 U	0.00943 U	0.00952 U	0.00943 U	na
Chrysene	EPA 8270C-HVI	µg/L	0.0105 U	0.00952 U	0.00943 U	0.00943 U	0.00952 U	0.00943 U	na
Dibenz(a,h)anthracene	EPA 8270C-HVI	µg/L	0.0105 U	0.00952 U	0.00943 U	0.00943 U	0.00952 U	0.00943 U	na
Indeno(1,2,3-cd)pyrene	EPA 8270C-HVI	µg/L	0.0105 U	0.00952 U	0.00943 U	0.00943 U	0.00952 U	0.00943 U	na

Source: (Pacific Groundwater Group 2007)

^a PGG-1 sampled on 6/13 and 6/14 to collect volume requested by laboratory.

Green highlight – concentration exceeds MTCA Method A for groundwater

Yellow highlight – parameter detected

CSL – cleanup screening level

EPA – US Environmental Protection Agency

HC – hydrocarbons

HVI – high volume injection

J – parameter detected at the reported concentration; result qualifies as "estimated" due to unacceptable QA results

µg/L – micrograms per liter

mg/L – milligram per liter

na – not applicable

NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable

NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable
SQS – sediment quality standard
SAIC – Science Applications International Corporation
U – parameter not detected, associated number is the lab reporting limit

Table D-15b. Analytical summary of groundwater sampling, round 1, conducted June 13 and 14, 2006, PGG-6 through PGG-7

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Coordinates			N: 208572.89 E: 1267423.01	N: 208171.87 E: 1267534.03			
pH			6.87	6.44			
Temp		°C	13.21	14.34			
Dissolved Oxygen		mg/L	0.36	1.56			
Electrical Conductivity		mS/cm	0.496	0.457			
Oxidation Reduction Potential		mV	-117.6	-432.1			
Petroleum Hydrocarbons							
Gasoline Range HC	NWTPH-Gx/8021B	µg/L	50.0 U	50.0 U	na	na	1000
Benzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	na	na	5
Toluene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	na	na	1000
Ethylbenzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	na	na	700
Xylenes (total)	NWTPH-Gx/8021B	µg/L	1.000 U	1.000 U	na	na	1000
Diesel Range HC	NWTPH-Dx	mg/L	0.253 U	0.250 U	na	na	500
Lube Oil Range HC	NWTPH-Dx	mg/L	0.505 U	0.500 U	na	na	500
Total Metals							
Arsenic	EPA 6020	mg/L	0.00166	0.00206	0.37	0.227	0.005
Cadmium	EPA 6020	mg/L	0.001 U	0.001 U	0.0034	0.0026	0.005
Chromium	EPA 6020	mg/L	0.001 U	0.00127	0.318	0.306	0.05

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Copper	EPA 6020	mg/L	0.00112	0.00104	0.123	0.123	
Lead	EPA 6020	mg/L	0.001 U	0.001 U	0.013	0.011	0.015
Nickel	EPA 6020	mg/L	0.00255	0.00242	na	na	na
Zinc	EPA 6020	mg/L	0.001 U	0.001 U	0.076	0.033	na
Dissolved Metals							
Arsenic	EPA 6020-Diss	mg/L	0.00207	0.00234	0.37	0.227	0.005
Cadmium	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.0034	0.0026	0.005
Chromium	EPA 6020-Diss	mg/L	0.00149	0.00156	0.318	0.306	0.05
Copper	EPA 6020-Diss	mg/L	0.001	0.001 U	0.123	0.123	na
Lead	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.013	0.011	0.015
Nickel	EPA 6020-Diss	mg/L	0.00268	0.00213	na	na	na
Zinc	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.076	0.033	na
Polychlorinated Biphenyls							
Aroclor 1016	EPA 8082 Mod	µg/L	0.100 U	0.100 U	2.4	0.44	na
Aroclor 1221	EPA 8082 Mod	µg/L	0.100 U	0.100 U	na	na	na
Aroclor 1232	EPA 8082 Mod	µg/L	0.100 U	0.100 U	na	na	na
Aroclor 1242	EPA 8082 Mod	µg/L	0.100 U	0.100 U	na	na	na
Aroclor 1248	EPA 8082 Mod	µg/L	0.100 U	0.100 U	1.5	0.27	na
Aroclor 1254	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.86	0.16	na
Aroclor 1260	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.31	0.058	na
Aroclor 1262	EPA 8082 Mod	µg/L	0.100 U	0.100 U	na	na	na

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Aroclor 1268	EPA 8082 Mod	µg/L	0.100 U	0.100 U	na	na	na
PAHs							
1-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	na	na	na
2-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	7.1	7.1	na
Acenaphthene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	9.3	2.6	na
Acenaphthylene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	11	11	na
Anthracene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	59	11	na
Benzo(ghi)perylene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	0.029	0.012	na
Fluoranthene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	17	2.3	na
Fluorene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	7	2	na
Naphthalene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	92	54	na
Phenanthrene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	23	4.8	na
Pyrene	EPA 8270C-HVI	µg/L	0.0943 U	0.0943 U	20	14	na
Benzo(a)anthracene	EPA 8270C-HVI	µg/L	0.00943 U	0.00943 U	0.63	0.26	na
Benzo(a)pyrene	EPA 8270C-HVI	µg/L	0.00943 U	0.00943 U	0.27	0.13	na
Benzo(b)fluoranthene	EPA 8270C-HVI	µg/L	0.00943 U	0.00943 U	0.56	0.29	na
Benzo(k)fluoranthene	EPA 8270C-HVI	µg/L	0.00943 U	0.00943 U	0.57	0.29	na
Chrysene	EPA 8270C-HVI	µg/L	0.00943 U	0.00943 U	1.9	0.47	na
Dibenz(a,h)anthracene	EPA 8270C-HVI	µg/L	0.00943 U	0.00943 U	0.013	0.0046	na
Indeno(1,2,3-cd)pyrene	EPA 8270C-HVI	µg/L	0.00943 U	0.00943 U	0.033	0.013	na

Source: (Pacific Groundwater Group 2007)

Green highlight – concentration exceeds MTCA Method A for groundwater

Yellow highlight – parameter detected

CSL – cleanup screening level
EPA – US Environmental Protection Agency
HC – hydrocarbons
HVI – high volume injection
J – parameter detected at the reported concentration; result qualifies as "estimated" due to unacceptable QA results
µg/L – micrograms per liter
mg/L – milligram per liter
MTCA – Model Toxics Control Act
na – not applicable
NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable
NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable
PAH – Polycyclic Aromatic Hydrocarbon
SQS – sediment quality standard
SAIC – Science Applications International Corporation
U – parameter not detected, associated number is the lab reporting limit

Table D-16. Analytical summary of groundwater sampling, round 2, conducted September 19 and 20, 2006

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-2	PGG-3	PGG-5	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Coordinates			N: 208857.20 E: 1267450.88	N: 208484.34 E: 1267594.69	N: 208967.95 E: 1267349.68	N: 208572.89 E: 1267423.01	N: 08171.87 E:1267534.03			
pH			6.33	6.34	6.70	6.48	6.56			
Temp		°C	16.63	16.57	12.83	15.79	16.17			
Dissolved Oxygen		mg/L	0.9	0.53	0.56	0.92	0.47			
Electrical Conductivity		mS/cm	1.682	1.697	1.841	1.714	1.717			
Oxidation Reduction Potential		mV	-72.8	47.2	-154.5	19.3	-47.9			
Petroleum Hydrocarbons										
Gasoline Range HC	NWTPH-Gx/8021B	µg/L	80.0 U	80.0 U	80.0 U	80.0 U	80.0 U	na	na	1000
Benzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	na	na	5
Toluene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	na	na	1000
Ethylbenzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	na	na	700
Xylenes (total)	NWTPH-Gx/8021B	µg/L	1.000 U	1.000 U	1.000 U	1.000 U	1.000 U	na	na	1000
Diesel Range HC	NWTPH-Dx	mg/L	0.284 U	0.269 U	0.240 U	0.243 U	0.269 U	na	na	500
Lube Oil Range HC	NWTPH-Dx	mg/L	0.568 U	0.472 U	0.481 U	0.485 U	0.472 U	na	na	500
Total Metals										
Arsenic	EPA 6020	mg/L	0.00538	0.00156	0.00205	0.00228	0.00168	0.37	0.227	0.005
Cadmium	EPA 6020	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0034	0.0026	0.005

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-2	PGG-3	PGG-5	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Chromium	EPA 6020	mg/L	0.0135	0.001 U	0.0135	0.001 U	0.001 U	0.318	0.306	0.05
Copper	EPA 6020	mg/L	0.00533	0.001 U	0.00204	0.001 U	0.001 U	0.123	0.123	
Lead	EPA 6020	mg/L	0.0073	0.001 U	0.001 U	0.001 U	0.001 U	0.013	0.011	0.015
Nickel	EPA 6020	mg/L	0.00948	0.00698	0.00637	0.00237	0.00144	na	na	
Zinc	EPA 6020	mg/L	0.0692	0.0101	0.0155	0.001 U	0.001 U	0.076	0.033	
Dissolved Metals										
Arsenic	EPA 6020-Diss	mg/L	0.00611	0.00188	0.00194	0.00208	0.00149	0.37	0.227	0.005
Cadmium	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0034	0.0026	0.005
Chromium	EPA 6020-Diss	mg/L	0.0111	0.00166	0.0143	0.001 U	0.001 U	0.318	0.306	0.05
Copper	EPA 6020-Diss	mg/L	0.00136	0.001 U	0.00149	0.001 U	0.001 U	0.123	0.123	
Lead	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.013	0.011	0.015
Nickel	EPA 6020-Diss	mg/L	0.0062	0.0059	0.0043	0.00221	0.001 U	na	na	
Zinc	EPA 6020-Diss	mg/L	0.0129	0.001 U	0.001 U	0.001 U	0.001 U	0.076	0.033	
Polychlorinated Biphenyls										
Aroclor 1016	EPA 8082 Mod	µg/L	0.638 R	0.100 U	0.100 U	0.100 U	0.100 U	2.4	0.44	0.1
Aroclor 1221	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	na	na	0.1
Aroclor 1232	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	na	na	0.1

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-2	PGG-3	PGG-5	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Aroclor 1242	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	na	na	0.1
Aroclor 1248	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	1.5	0.27	0.1
Aroclor 1254	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	0.86	0.16	0.1
Aroclor 1260	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	0.31	0.058	0.1
Aroclor 1262	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	na	na	0.1
Aroclor 1268	EPA 8082 Mod	µg/L	0.100 UJ	0.100 U	0.100 U	0.100 U	0.100 U	na	na	0.1
PAHs										
1-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	na	na	
2-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	7.1	7.1	
Acenaphthene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	9.3	2.6	
Acenaphthylene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	11	11	
Anthracene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	59	11	
Benzo(ghi)perylene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.029	0.012	
Fluoranthene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	17	2.3	
Fluorene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	7	2	

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-2	PGG-3	PGG-5	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Naphthalene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	92	54	
Phenanthrene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	23	4.8	
Pyrene	EPA 8270C-HVI	µg/L	0.204 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	20	14	
Benzo(a)anthracene	EPA 8270C-HVI	µg/L	0.0204 U	0.00943 U	0.00943 U	0.00943 U	0.00943 U	0.63	0.26	
Benzo(a)pyrene	EPA 8270C-HVI	µg/L	0.0204 U	0.00943 U	0.00943 U	0.00943 U	0.00943 U	0.27	0.13	
Benzo(b)fluoranthene	EPA 8270C-HVI	µg/L	0.171 R	0.00943 U	0.00943 U	0.00943 U	0.00943 U	0.56	0.29	
Benzo(k)fluoranthene	EPA 8270C-HVI	µg/L	0.129 R	0.00943 U	0.00943 U	0.00943 U	0.00943 U	0.57	0.29	
Chrysene	EPA 8270C-HVI	µg/L	0.0204 U	0.00943 U	0.00943 U	0.00943 U	0.00943 U	1.9	0.47	
Dibenz(a,h)anthracene	EPA 8270C-HVI	µg/L	0.177 R	0.00943 U	0.00943 U	0.00943 U	0.00943 U	0.013	0.0046	
Indeno(1,2,3-cd)pyrene	EPA 8270C-HVI	µg/L	0.16 R	0.00943 U	0.00943 U	0.00943 U	0.00943 U	0.033	0.013	
Toxicity Equivalency Calculations	Factor									
Benzo(a)anthracene	0.1	µg/L	0.00	0.00	0.00	0.00	0.00	na	na	
Benzo(a)pyrene	1	µg/L	0.00	0.00	0.00	0.00	0.00	na	na	
Benzo(b)fluoranthene	0.1	µg/L	0.017 R	0.00	0.00	0.00	0.00	na	na	
Benzo(k)fluoranthene	0.1	µg/L	0.0129 R	0.00	0.00	0.00	0.00	na	na	
Chrysene	0.01	µg/L	0.00	0.00	0.00	0.00	0.00	na	na	
Dibenz(a,h)anthracene	0.4	µg/L	0.0708 R	0.00	0.0620	0.00	0.00	na	na	

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-2	PGG-3	PGG-5	PGG-6	PGG-7	SAIC GROUND-WATER BASED ON CSL	SCREENING LEVELS BASED ON SQS	MTCA METHOD A
Indeno(1,2,3-cd)pyrene	0.1	µg/L	0.016 R	0.00	0.0132	0.00	0.00	na	na	
Total Toxicity Equivalency Concentrations (µg/L)			0.1167 R	0.00	0.0756	0.00	0.00	na	na	

Source: (Pacific Groundwater Group 2007)

PGG-1: coordinates N: 209009.53 E: 1267978.45, sample was dry, sampled on 6/13 and 6/14 to collect volume requested by lab.

PGG-4: coordinates N: 208550.85 E: 1268179.67, sample was dry

Green highlight – concentration exceeds MTCA Method A for groundwater

Yellow highlight – parameter detected

CSL – cleanup screening level

EPA – US Environmental Protection Agency

HC – hydrocarbons

HVI – high volume injection

J – parameter detected at the reported concentration; result qualifies as "estimated" due to unacceptable QA results

µg/L – micrograms per liter

mg/L – milligram per liter

mS/cm – milliSiemens per centimeter

MTCA – Model Toxics Control Act

mV – millivolts

PGG – Pacific Groundwater Group

R – analytical result rejected based on unrepresentative sample quality and poor data quality, as the sample did not meet Standard Operating Procedures.

SAIC – Science Applications International Corporation

SQS – sediment quality standard

NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable

NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable

U – parameter not detected, associated # is the lab reporting limit

UJ – parameter not detected at the associated reporting limit; analysis performed 44 days outside holding time

Table D-17. Analytical summary of groundwater sampling, round 3, conducted February 19 and 20, 2007

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-5	PGG-6	PGG-7	SAIC GROUNDWATER BASED ON CSL	SCREENING LEVELS BASED ON SQS
Coordinates			N: 208967.95 E:1267349.68	N: 208572.89 E:1267423.01	N: 208171.87 E: 1267534.03		
pH			6.44	6.43	6.24		
Temp		°C	12.33	11.76	10.78		
Dissolved Oxygen		mg/L	0.55	0.66	0.56		
Electrical Conductivity		mS/cm	3.486	1.505	0.646		
Oxidation Reduction Potential		mV	-130.6	-177	-90.6		
Petroleum Hydrocarbons							
Gasoline Range	NWTPH-Gx/8021B	µg/L	50.0 U	50.0 U	50.0 U	na	na
Benzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	na	na
Toluene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	na	na
Ethylbenzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	na	na
Xylenes (total)	NWTPH-Gx/8021B	µg/L	1.000 U	1.000 U	1.000 U	na	na
Diesel Range	NWTPH-Dx	mg/L	0.236 U	0.248 U	0.243 U	na	na
Lube Oil Range	NWTPH-Dx	mg/L	0.472 U	0.495 U	0.485 U	na	na
Total Metals							
Arsenic	EPA 6020	mg/L	0.00172	0.00100 U	0.00115	0.37	0.227
Barium	EPA 6020	mg/L	0.04900	0.01000 U	0.01000 U	na	na
Cadmium	EPA 6020	mg/L	0.00100 U	0.00100 U	0.00100 U	0.0034	0.0026
Chromium	EPA 6020	mg/L	0.00884	0.00100 U	0.00149	0.318	0.306
Copper	EPA 6020	mg/L	0.00158	0.00322	0.00100 U	0.123	0.123
Iron	EPA 6010B	mg/L	105.0 J	9.37000 J	10.6 J	na	na
Lead	EPA 6020	mg/L	0.00100 U	0.00100 U	0.00100 U	0.013	0.011

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-5	PGG-6	PGG-7	SAIC GROUNDWATER BASED ON CSL	SCREENING LEVELS BASED ON SQS
Manganese	EPA 6020	mg/L	4.21 J	0.40800 J	0.291 J	na	na
Nickel	EPA 6020	mg/L	0.00100 U	0.00324	0.00133	na	na
Zinc	EPA 6020	mg/L	0.01000 U	0.01110	0.01000 U	0.076	0.033
Mercury	EPA 7470A	mg/L	0.00020 U	0.00020 U	0.00020 U	0.0000074	0.0000052
Dissolved Metals							
Arsenic	EPA 6020-Diss	mg/L	0.00157	0.00100	0.00118	0.37	0.227
Barium	EPA 6020-Diss	mg/L	0.0400	0.01000 U	0.01000 U	na	na
Cadmium	EPA 6020-Diss	mg/L	0.00100 U	0.00100 U	0.00100 U	0.0034	0.0026
Chromium	EPA 6020-Diss	mg/L	0.0105	0.00215	0.00177	0.318	0.306
Copper	EPA 6020-Diss	mg/L	0.00100 U	0.00209	0.00100 U	0.123	0.123
Iron	EPA 6010B-Diss	mg/L	37.8 J	9.07 J	11.8 J	na	na
Lead	EPA 6020-Diss	mg/L	0.00100 U	0.00100 U	0.00100 U	0.013	0.011
Manganese	EPA 6020-Diss	mg/L	4.01 J	0.43000	0.272	na	na
Nickel	EPA 6020-Diss	mg/L	0.00100 U	0.00304	0.00119	na	na
Zinc	EPA 6020-Diss	mg/L	0.01000 U	0.01000 U	0.01000 U	0.076	0.033
Mercury	EPA 7470A-Diss	mg/L	0.00020 U	0.00020 U	0.00020 U	0.0000074	0.0000052
Polychlorinated Biphenyls							
Aroclor 1016	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	2.4	0.44
Aroclor 1221	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Aroclor 1232	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Aroclor 1242	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Aroclor 1248	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	1.5	0.27
Aroclor 1254	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	0.86	0.16
Aroclor 1260	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	0.31	0.058
Aroclor 1262	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-5	PGG-6	PGG-7	SAIC GROUNDWATER BASED ON CSL	SCREENING LEVELS BASED ON SQS
Aroclor 1268	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Polycyclic Aromatic Compounds							
Acenaphthene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	9.3	2.6
Acenaphthylene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	11	11
Anthracene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	59	11
Benzo(a)anthracene	EPA 8270C-HVI	µg/L	0.0099 U	0.0098 U	0.0099 U	0.63	0.26
Benzo(a)pyrene	EPA 8270C-HVI	µg/L	0.0099 U	0.0098 U	0.0099 U	0.27	0.13
Benzo(b)fluoranthene	EPA 8270C-HVI	µg/L	0.0099 U	0.0098 U	0.0099 U	0.56	0.29
Benzo(k)fluoranthene	EPA 8270C-HVI	µg/L	0.0099 U	0.0098 U	0.0099 U	0.57	0.29
Benzo(ghi)perylene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	0.029	0.012
Chrysene	EPA 8270C-HVI	µg/L	0.0099 U	0.0098 U	0.0099 U	1.9	0.47
Dibenz(a,h)anthracene	EPA 8270C-HVI	µg/L	0.0099 U	0.0098 U	0.0099 U	0.013	0.0046
Fluoranthene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	17	2.3
Fluorene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	7	2
Indeno(1,2,3-cd)pyrene	EPA 8270C-HVI	µg/L	0.0099 U	0.0980 U	0.0099 U	0.033	0.013
1-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	na	na
2-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	31	18
Naphthalene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	92	54
Phenanthrene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	23	4.8
Pyrene	EPA 8270C-HVI	µg/L	0.0990 U	0.0980 U	0.0990 U	20	14

Source: (Pacific Groundwater Group 2007)

Green highlight – concentration exceeds MTCA Method A for groundwater

Yellow highlight – parameter detected

CSL – cleanup screening level

EPA – US Environmental Protection Agency

J – parameter detected at the reported concentration; result qualifies as "estimated" due to unacceptable QA results

µg/L – micrograms per liter

mg/L – milligram per liter

mS/cm – milliSiemens per centimeter

MTCA – Model Toxics Control Act

mV – millivolts

NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable

NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable

PGG – Pacific Groundwater Group

SQS – sediment quality standard

SAIC – Science Applications International Corporation

U – parameter not detected, associated # is the lab reporting limit

Table D-18. Analytical summary of groundwater sampling, round 4, conducted May 29 and 30, 2007

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-5	PGG-6	PGG-7	SAIC GROUNDWATER BASED ON CSL	SCREENING LEVELS BASED ON SQS
Coordinates			N: 208967.95 E: 1267349.68	N: 208572.89 E: 1267423.01	N: 208171.87 E: 1267534.03	na	na
pH			6.14	6.13	6.00	na	na
Temp		°C	12.94	13.33	14.15	na	na
Dissolved Oxygen		mg/L	1.73	1.22	1.13	na	na
Electrical Conductivity		mS/cm	2.352	0.7	0.318	na	na
Oxidation Reduction Potential		mV	-151.9	-52.2	-77.6	na	na
Petroleum Hydrocarbons						na	na
Gasoline Range	NWTPH-Gx/8021B	µg/L	50.0 U	50.0 U	50.0 U	na	na
Benzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	na	na
Toluene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	na	na
Ethylbenzene	NWTPH-Gx/8021B	µg/L	0.500 U	0.500 U	0.500 U	na	na
Xylenes (total)	NWTPH-Gx/8021B	µg/L	1.000 U	1.000 U	1.000 U	na	na
Diesel Range	NWTPH-Dx	mg/L	0.236 U	0.236 U	0.236 U	na	na
Lube Oil Range	NWTPH-Dx	mg/L	0.472 U	0.472 U	0.472 U	na	na
Total Metals						na	na
Arsenic	EPA 6020	mg/L	0.00164	0.0012	0.0015	0.37	0.227
Cadmium	EPA 6020	mg/L	0.001 U	0.001 U	0.001 U	0.0034	0.0026
Chromium	EPA 6020	mg/L	0.012	0.001 U	0.001 U	0.318	0.306
Copper	EPA 6020	mg/L	0.00136	0.00122	0.001 U	0.123	0.123
Lead	EPA 6020	mg/L	0.001 U	0.001 U	0.001 U	0.013	0.011
Nickel	EPA 6020	mg/L	0.00119	0.00159	0.001 U	na	na
Zinc	EPA 6020	mg/L	0.01 U	0.01 U	0.01 U	0.076	0.033

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-5	PGG-6	PGG-7	SAIC GROUNDWATER BASED ON CSL	SCREENING LEVELS BASED ON SQS
Mercury	EPA 7470A	mg/L	0.005 U	0.005 U	0.005 U	0.0074	0.0052
Dissolved Metals							
Arsenic	EPA 6020-Diss	mg/L	0.00161	0.00132	0.00107	0.37	0.227
Cadmium	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.001 U	0.0034	0.0026
Chromium	EPA 6020-Diss	mg/L	0.0118	0.00161	0.00138	0.318	0.306
Copper	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.001 U	0.123	0.123
Lead	EPA 6020-Diss	mg/L	0.001 U	0.001 U	0.001 U	0.013	0.011
Nickel	EPA 6020-Diss	mg/L	0.001 U	0.00136	0.001 U	na	na
Zinc	EPA 6020-Diss	mg/L	0.01 U	0.01 U	0.01 U	0.076	0.033
Mercury	EPA 7470A-Diss	mg/L	0.005 U	0.005 U	0.005 U	0.0074	0.0052
Polychlorinated Biphenyls							
Aroclor 1016	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	2.4	0.44
Aroclor 1221	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Aroclor 1232	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Aroclor 1242	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Aroclor 1248	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	1.5	0.27
Aroclor 1254	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	0.86	0.16
Aroclor 1260	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	0.31	0.058
Aroclor 1262	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Aroclor 1268	EPA 8082 Mod	µg/L	0.100 U	0.100 U	0.100 U	na	na
Polynuclear Aromatic Compounds							
Acenaphthene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	9.3	2.6
Acenaphthylene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	11	11
Anthracene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	59	11

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	UNIT	PGG-5	PGG-6	PGG-7	SAIC GROUNDWATER BASED ON CSL	SCREENING LEVELS BASED ON SQS
Benzo(a)anthracene	EPA 8270C-HVI	µg/L	0.0472 U	0.00943 U	0.00943 U	0.63	0.26
Benzo(a)pyrene	EPA 8270C-HVI	µg/L	0.0472 U	0.00943 U	0.00943 U	0.27	0.13
Benzo(b)fluoranthene	EPA 8270C-HVI	µg/L	0.0472 U	0.00943 U	0.00943 U	0.56	0.29
Benzo(k)fluoranthene	EPA 8270C-HVI	µg/L	0.0472 U	0.00943 U	0.00943 U	0.57	0.29
Benzo(ghi)perylene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	0.029	0.012
Chrysene	EPA 8270C-HVI	µg/L	0.472 U	0.00943 U	0.00943 U	1.9	0.47
Dibenz(a,h)anthracene	EPA 8270C-HVI	µg/L	0.0472 U	0.00943 U	0.00943 U	0.013	0.0046
Fluoranthene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	17	2.3
Fluorene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	7	2
Indeno(1,2,3-cd)pyrene	EPA 8270C-HVI	µg/L	0.0472 U	0.00943 U	0.00943 U	0.033	0.013
1-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.472 U	0.0943	0.0943	na	na
2-Methylnaphthalene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	31	18
Naphthalene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	92	54
Phenanthrene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	23	4.8
Pyrene	EPA 8270C-HVI	µg/L	0.472 U	0.0943 U	0.0943 U	20	14

Source: (Pacific Groundwater Group 2007)

Green highlight – concentration exceeds MTCA Method A for groundwater

Yellow highlight – parameter detected

CSL – cleanup screening level

EPA – US Environmental Protection Agency

J – parameter detected at the reported concentration; result qualifies as "estimated" due to unacceptable QA results

HVI – high volume injected

µg/L – micrograms per liter

mg/L – milligrams per liter

mS/cm – milliSiemens per centimeter

MTCA – Model Toxics Control Act

mV – millivolts

na – not applicable

NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable

NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable

PGG – Pacific Groundwater Group

SAIC – Science Applications International Corporation

SIM – Simultaneous Ion Monitoring

SQS – sediment quality standard

U – parameter not detected, associated # is the lab reporting limit

Table D-19. Historical groundwater sample results for PCBs conducted October 11, 1991 and January 18, 1992

SAMPLE ID	DATE	AROCLOR 1016 8080 (µg/L)	AROCLOR 1221 8080 (µg/L)	AROCLOR 1232 8080 (µg/L)	AROCLOR 1242 8080 (µg/L)	AROCLOR 1248 8080 (µg/L)	AROCLOR 1254 8080 (µg/L)	AROCLOR 1260 8080 (µg/L)
C-1	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-1	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-2	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-2	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-3	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-3	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-4	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-4	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-5	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-5	1/17/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-6	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
C-6	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-7	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-7	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-8	10/12/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-8	1/17/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-9	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-9	1/17/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-10	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-10	1/17/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-11	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-11	1/17/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-12	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U

SAMPLE ID	DATE	AROCLOR 1016 8080 (µg/L)	AROCLOR 1221 8080 (µg/L)	AROCLOR 1232 8080 (µg/L)	AROCLOR 1242 8080 (µg/L)	AROCLOR 1248 8080 (µg/L)	AROCLOR 1254 8080 (µg/L)	AROCLOR 1260 8080 (µg/L)
MW-12	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-13	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-13	1/17/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-14	10/11/1991	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
MW-14	1/18/1992	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method A Unrestricted and/or Industrial Cleanup Level (WAC-173-340)

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

µg/L – micrograms per liter

MTCA Method A: 0.1

MW – monitoring well

U – parameter not detected; associated # is laboratory detection limit

PCB –Polychlorinated Biphenyls

Table D-20a. Historical groundwater sample results for PAHs conducted October 11 and 12, 1991: C-1 through C-6

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	C-1 (µG/L)	C-2 (µG/L)	C-3 (µG/L)	C-4 (µG/L)	C-5 (µG/L)	C-6 (µG/L)
Naphthalene	8310	1.6 U	1.6 U	1.6 U	1.6 U	3	1.6 U
Acenaphthylene	8310	1.3	0.25 U	0.25 U	7.6	0.25 U	0.25 U
Acenaphthene	8310	0.17 U	0.21	0.17 U	0.17	0.17 U	0.17 U
Fluorene	8310	0.09 U	0.09 U	0.09 U	0.09 U	0.5	0.09 U
Phenanthrene	8310	0.66	0.13	0.2	0.12 U	0.16	0.12 U
Anthracene	8310	0.19	0.11	0.38	0.1 U	0.28	0.1 U
Fluoranthene	8310	0.6	0.22	0.38	0.16 U	0.16 U	0.16 U
Pyrene	8310	0.65	0.14	0.37	0.14 U	0.14 U	0.14 U
Benzo(a)anthracene	8310	0.28	0.12	0.25	0.057 U	0.057 U	0.057 U
Chrysene	8310	0.42	0.16	0.3	0.051 U	0.051 U	0.051 U
Benzo(b)fluoranthene	8310	0.099	0.16	0.3	0.072 U	0.072 U	0.072 U
Benzo(k)fluoranthene	8310	0.2	0.12	0.3	0.068 U	0.068 U	0.068 U
Benzo(a)pyrene	8310	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U
Dibenzo(a,h)anthracene	8310	0.27	0.21	0.12	0.084 U	0.084 U	0.084 U
Benzo(g,h,i)perylene	8310	0.084 U	0.084 U	0.084 U	0.084 U	0.084 U	0.084 U
Indeno(1,2,3-cd)pyrene	8310	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U
Toxicity Equivalent Concentrations	TEF						
Benzo(a)anthracene	0.1	0.042	0.016	0.03	0.00255	0.00255	0.00255
Benzo(a)pyrene	1	0.099	0.16	0.3	0.036	0.036	0.036
Benzo(b)fluoranthene	0.1	0.02	0.012	0.03	0.0034	0.0034	0.0034
Benzo(k)fluoranthene	0.1	0.00075	0.00075	0.00075	0.00075	0.00075	0.00075

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	C-1 (µG/L)	C-2 (µG/L)	C-3 (µG/L)	C-4 (µG/L)	C-5 (µG/L)	C-6 (µG/L)
Chrysene	0.01	0.0027	0.0021	0.0012	0.00042	0.00042	0.00042
Dibenzo(a,h)anthracene	0.4	0.0168	0.0168	0.0168	0.0168	0.0168	0.0168
Indeno(1,2,3-cd)pyrene	0.1	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
Total cPAH Toxicity Equivalent Concentrations (TEQ)		0.19	0.21	0.38	0.06	0.06	0.06
MTCA Method C Total cPAH Cleanup Level (µg/L):		0.12	0.12	0.12	0.12	0.12	0.12

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method C for groundwater

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

cPAH – carcinogenic Polycyclic Aromatic Hydrocarbon

µg/L – micrograms per liter

TEF – Toxicity Equivalency Factor

TEQ – toxic equivalent

U – parameter not detected; associated # is laboratory detection limit

**Table D-20b. Historical groundwater sample results for PAHs conducted October 11 and 12, 1991:
Sample locations MW-7 through MW-14**

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	MW-7 (µg/L)	MW-8 (µg/L)	MW-9 (µg/L)	MW-10 (µg/L)	MW-11 (µg/L)	MW-12 (µg/L)	MW-13 (µg/L)	MW-14 (µg/L)	MTCA METHOD C INDIVIDUAL NON-CARCINOGENIC CLEANUP LEVEL
Naphthalene100	8310	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	350
Acenaphthylene	8310	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	na
Acenaphthene	8310	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	2100
Fluorene	8310	0.09 U	0.09 U	0.29	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	1400
Phenanthrene	8310	0.12 U	0.12 U	0.72	0.5	0.12 U	0.12 U	0.12 U	0.12 U	na
Anthracene	8310	0.1 U	0.1 U	0.26	0.45	0.1 U	0.1 U	0.1 U	0.1 U	5250
Fluoranthene	8310	0.16 U	0.16 U	0.21	0.95	0.16 U	0.16 U	0.16 U	0.16 U	1400
Pyrene	8310	0.14 U	0.14 U	0.15	0.81	0.14 U	0.14 U	0.14 U	0.14 U	1050
Benzo(a)anthracene	8310	0.057 U	0.057 U	0.057 U	0.21	0.057 U	0.057 U	0.057 U	0.057 U	na
Chrysene	8310	0.051 U	0.051 U	0.051 U	0.44	0.051 U	0.051 U	0.051 U	0.054	na
Benzo(b)fluoranthene	8310	0.072 U	0.072 U	0.072 U	0.32	0.072 U	0.072 U	0.072 U	0.072 U	na
Benzo(k)fluoranthene	8310	0.068 U	0.068 U	0.068 U	0.3	0.068 U	0.068 U	0.068 U	0.068 U	na
Benzo(a)pyrene	8310	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	na
Dibenzo(a,h)anthracene	8310	0.084 U	0.084 U	0.6	0.21	0.084 U	0.084 U	0.084 U	0.084 U	na
Benzo(g,h,i)perylene	8310	0.084 U	0.084 U	0.084 U	0.084 U	0.084 U	0.084 U	0.084 U	0.084 U	na
Indeno(1,2,3-cd)pyrene	8310	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	0.096 U	na
Toxicity Equivalent Concentrations	TEF									
Benzo(a)anthracene	0.1	0.00255	0.00255	0.00255	0.044	0.00255	0.00255	0.00255	0.0054	na
Benzo(a)pyrene	1	0.036	0.036	0.036	0.32	0.036	0.036	0.036	0.036	na

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	MW-7 (µg/L)	MW-8 (µg/L)	MW-9 (µg/L)	MW-10 (µg/L)	MW-11 (µg/L)	MW-12 (µg/L)	MW-13 (µg/L)	MW-14 (µg/L)	MTCA METHOD C INDIVIDUAL NON-CARCINOGENIC CLEANUP LEVEL
Benzo(b)fluoranthene	0.1	0.0034	0.0034	0.0034	0.03	0.0034	0.0034	0.0034	0.0034	na
Benzo(k)fluoranthene	0.1	0.00075	0.00075	0.00075	0.00075	0.00075	0.00075	0.00075	0.00075	na
Chrysene	0.01	0.00042	0.00042	0.006	0.0021	0.00042	0.00042	0.00042	0.00042	na
Dibenzo(a,h)anthracene	0.4	0.0168	0.0168	0.0168	0.0168	0.0168	0.0168	0.0168	0.0168	na
Indeno(1,2,3-cd)pyrene	0.1	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	na
Total cPAH Toxicity Equivalent Concentrations (TEQ)		0.06	0.06	0.07	0.42	0.06	0.06	0.06	0.07	na
MTCA Method C Total cPAH Cleanup Level (µg/L):		0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	na

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method C for groundwater

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

cPAH – carcinogenic Polycyclic Aromatic Hydrocarbon

µg/L – micrograms per liter

MTCA – Model Toxics Control Act

na – not applicable

PAH – Polycyclic Aromatic Hydrocarbon

TEF – Toxicity Equivalency Factor

TEQ – toxic equivalent

U – parameter not detected; associated # is laboratory detection limit

Table D-21a. Historical groundwater sample results for PAHs conducted January 17 and 18, 1992: Sample locations C-1 through C-6

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	C-1 (µg/L)	C-2 (µg/L)	C-3 (µg/L)	C-4 (µg/L)	C-5 (µg/L)	C-6 (µg/L)
Naphthalene	8310	0.14 U	0.14 U	0.14 U	0.14 U	1.3	0.14 U
Acenaphthylene	8310	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U
Acenaphthene	8310	0.02 U	0.02 U	0.16	0.02 U	0.02 U	0.02 U
Fluorene	8310	0.013 U	0.013 U	0.026	0.013 U	0.22	0.013 U
Phenanthrene	8310	0.019 U	0.019 U	0.019 U	0.019 U	0.019 U	0.019 U
Anthracene	8310	0.014 U	0.014 U	0.027	0.014 U	0.03	0.014 U
Fluoranthene	8310	0.025 U	0.046	0.06	0.025 U	0.055	0.025 U
Pyrene	8310	0.014 U	0.084	0.11	0.014 U	0.041	0.014 U
Benzo(a)anthracene	8310	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Chrysene	8310	0.011 U	0.016	0.035	0.011 U	0.011 U	0.011 U
Benzo(b)fluoranthene	8310	0.012 U	0.02	0.02	0.012 U	0.012 U	0.012 U
Benzo(k)fluoranthene	8310	0.013 U	0.038	0.013 U	0.013 U	0.013 U	0.013 U
Benzo(a)pyrene	8310	0.011 U	0.015	0.011 U	0.011 U	0.011 U	0.011 U
Dibenzo(a,h)anthracene	8310	0.013 U	0.013 U	0.023	0.013 U	0.013 U	0.013 U
Benzo(g,h,i)perylene	8310	0.011 U	0.028	0.011 U	0.011 U	0.011 U	0.011 U
Indeno(1,2,3-cd)pyrene	8310	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U
Toxicity Equivalent Concentrations	TEF						
Benzo(a)anthracene	0.1	0.00055	0.0016	0.0035	0.00055	0.00055	0.00055
Benzo(a)pyrene	1	0.006	0.02	0.02	0.006	0.006	0.006
Benzo(b)fluoranthene	0.1	0.00065	0.0038	0.00065	0.00065	0.00065	0.00065
Benzo(k)fluoranthene	0.1	0.00055	0.0015	0.00055	0.00055	0.00055	0.00055

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	C-1 (µg/L)	C-2 (µg/L)	C-3 (µg/L)	C-4 (µg/L)	C-5 (µg/L)	C-6 (µg/L)
Chrysene	0.01	0.000065	0.000065	0.00023	0.000065	0.000065	0.000065
Dibenzo(a,h)anthracene	0.4	0.0022	0.0112	0.0022	0.0022	0.0022	0.0022
Indeno(1,2,3-cd)pyrene	0.1	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
Total cPAH Toxicity Equivalent Concentrations		0.01	0.04	0.03	0.01	0.01	0.01
MTCA Method C Total cPAH Cleanup Level (µg/L):		0.12	0.12	0.12	0.12	0.12	0.12

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method C for groundwater

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

cPAH – carcinogenic Polycyclic Aromatic Hydrocarbon

µg/L – micrograms per liter

MTCA – Model Toxics Control Act

na – not applicable

PAH – Polycyclic Aromatic Hydrocarbon

TEF – Toxicity Equivalency Factor

U – parameter not detected; associated # is laboratory detection limit

Table D-21b. Historical groundwater sample results for PAHs conducted January 17 and 18, 1992: Sample locations MW-7 through MW-14

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	MW-7 (µG/L)	MW-8 (µG/L)	MW-9 (µG/L)	MW-10 (µG/L)	MW-11 (µG/L)	MW-12 (µG/L)	MW-13 (µG/L)	MW-14 (µG/L)	MTCA METHOD C INDIVIDUAL NON-CARCINOGENIC CLEANUP LEVEL
Naphthalene	8310	0.14 U	0.14 U	0.56	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	350
Acenaphthylene	8310	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.9	na
Acenaphthene	8310	0.041	0.09	0.02 U	0.02 U	0.02 U	0.17	0.02 U	0.02 U	2100
Fluorene	8310	0.028	0.049	0.13	0.013 U	0.013 U	0.057	0.013 U	0.029	1400
Phenanthrene	8310	0.022	0.065	0.13	0.019 U	0.019 U	0.041	0.019 U	0.022	na
Anthracene	8310	0.014 U	0.015	0.014 U	0.014 U	0.014 U	0.019	0.014 U	0.017	5250
Fluoranthene	8310	0.025 U	0.035	0.025 U	0.027	0.025 U	0.029	0.025 U	0.046	1400
Pyrene	8310	0.014 U	0.036	0.014 U	0.022	0.014 U	0.04	0.014 U	0.033	1050
Benzo(a)anthracene	8310	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.068	na
Chrysene	8310	0.011 U	0.016	0.011 U	0.011 U	0.011 U	0.012	0.011 U	0.035	na
Benzo(b)fluoranthene	8310	0.012 U	0.012	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.029	na
Benzo(k)fluoranthene	8310	0.017	0.015	0.013 U	0.013 U	0.013 U	0.014	0.029	0.058	na
Benzo(a)pyrene	8310	0.011 U	0.013	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.072	na
Dibenzo(a,h)anthracene	8310	0.013 U	0.016	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.054	na
Benzo(g,h,i)perylene	8310	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.084	na
Indeno(1,2,3-cd)pyrene	8310	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.063	na
Toxicity Equivalent Concentrations	TEF									
Benzo(a)anthracene	0.1	0.00055	0.0016	0.00055	0.00055	0.00055	0.0012	0.00055	0.0035	na
Benzo(a)pyrene	1	0.006	0.012	0.006	0.006	0.006	0.006	0.006	0.029	na
Benzo(b)fluoranthene	0.1	0.0017	0.0015	0.00065	0.0015	0.00065	0.0014	0.0029	0.0058	na
Benzo(k)fluoranthene	0.1	0.00055	0.0013	0.00055	0.00055	0.00055	0.00055	0.00055	0.0072	na

CHEMICAL/SAMPLE INFORMATION	ANALYTICAL METHOD	MW-7 (µG/L)	MW-8 (µG/L)	MW-9 (µG/L)	MW-10 (µG/L)	MW-11 (µG/L)	MW-12 (µG/L)	MW-13 (µG/L)	MW-14 (µG/L)	MTCA METHOD C INDIVIDUAL NON-CARCINOGENIC CLEANUP LEVEL
Chrysene	0.01	0.000065	0.00016	0.000065	0.000065	0.000065	0.000065	0.000065	0.00054	na
Dibenzo(a,h)anthracene	0.4	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	0.0022	0.0336	na
Indeno(1,2,3-cd)pyrene	0.1	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0063	na
Total cPAH Toxicity Equivalent Concentrations		0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	na
MTCA Method C Total cPAH Cleanup Level (µg/L):		0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	na

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method C for groundwater

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

cPAH – carcinogenic Polycyclic Aromatic Hydrocarbon

µg/L – micrograms per liter

MTCA – Model Toxics Control Act

na – not applicable

PAH – Polycyclic Aromatic Hydrocarbon

TEF – Toxicity Equivalency Factor

U – parameter not detected; associated # is laboratory detection limit

Table D-22. Historical groundwater sample results for TPHs conducted October 11, 1991 and January 18, 1992

SAMPLE ID	DATE	GASOLINE (µg/L)	MINERAL SPIRITS (µg/L)	KEROSENE (µg/L)	JET FUEL (µg/L)	DIESEL (µg/L)	FUEL OIL #6 (µg/L)	LUBRICATING OIL (µg/L)	BENZENE (µg/L)	ETHYL BENZENE (µg/L)	TOLUENE (µg/L)	TOTAL XYLENES (µg/L)
C-1	10/11/1991	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-2	10/11/1991	10 U	10 U	10 U	10 U	160	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-3	10/11/1991	10 U	10 U	10 U	10 U	40	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-4	10/11/1991	10 U	10 U	10 U	10 U	53	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-5	10/11/1991	57	10 U	10 U	10 U	130	10 U	100 U	0.9	3	0.6	3
C-6	10/11/1991	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-7	10/11/1991	27	10 U	10 U	10 U	53	10 U	100 U	0.3 U	0.3 U	0.6	0.7
MW-8	10/11/1991	39	10 U	10 U	10 U	140	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-9	10/11/1991	10 U	10 U	10 U	10 U	490	10 U	100 U	0.5	3	0.6	3
MW-10	10/11/1991	10 U	10 U	10 U	10 U	67	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-10 Dup ^a	10/11/1991	10 U	10 U	10 U	10 U	39	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-11	10/11/1991	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-12	10/11/1991	10 U	10 U	10 U	10 U	150	10 U	100 U	0.3 U	0.3 U	0.9	0.5 U
MW-13	10/11/1991	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-14	10/11/1991	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-14 Dup ^b	10/11/1991	10 U	10 U	10 U	10 U	38	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-1	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-2	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-3	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-4	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
C-5	1/18/1992	120	10 U	10 U	10 U	530	10 U	100 U	0.6	0.4	0.9	1
C-5 Dup ^c	1/18/1992	10 U	10 U	10 U	10 U	590	10 U	100 U	0.6	2	2	4
C-6	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-7	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-8	1/18/1992	10 U	10 U	10 U	10 U	150	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U

SAMPLE ID	DATE	GASOLINE (µg/L)	MINERAL SPIRITS (µg/L)	KEROSENE (µg/L)	JET FUEL (µg/L)	DIESEL (µg/L)	FUEL OIL #6 (µg/L)	LUBRICATING OIL (µg/L)	BENZENE (µg/L)	ETHYL BENZENE (µg/L)	TOLUENE (µg/L)	TOTAL XYLENES (µg/L)
MW-9	1/18/1992	40	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	1	0.7	2
MW-10	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-11	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-12	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-13	1/18/1992	10 U	10 U	10 U	10 U	10 U	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MW-14	1/18/1992	10 U	10 U	10 U	10 U	230	10 U	100 U	0.3 U	0.3 U	0.3 U	0.5 U
MTCA Method A Cleanup Level		na	na	na	na	500	500	na	5	700	1000	1000
MTCA Method C Cleanup Level		800	na	na	na	na	na	na	7.95	1750	3500	35000

Source: (Pacific Groundwater Group 2006)

^a MW-10 Dup is sample MW-15;

^b MW-14 Dup is Sample MW-16 for October 1991 sampling round.

^c C-5 Dup is Sample MW-15 for January 1992 sampling round.

Green highlight – concentration exceeds MTCA Method C Industrial Cleanup Level (WAC-173-340)

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

Dup – duplicate

MTCA – Model Toxics Control Act

TPH = Total Petroleum Hydrocarbons

U – parameter not detected; associated # is laboratory detection limit

Table D-23. Historical groundwater sample results for metals conducted October 11, 1991 and January 17, 1992

CHEMICAL/ SAMPLE INFORMATION	DATE	ANALYTICAL METHOD	MTCA METHOD C	C-1 (µg/L)	C-2 (µg/L)	C-3 (µg/L)	C-4 (µg/L)	C-5 (µg/L)	C-6 (µg/L)	MW-7 (µg/L)	MW-8 (µg/L)	MW-9 (µg/L)	MW-10 (µg/L)	MW-11 (µg/L)	MW-12 (µg/L)	MW-13 (µg/L)	MW-14 (µg/L)	MW-14 (Dup) (µg/L)
Antimony	10/11/1991	6010/7000		100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Arsenic	10/11/1991	6010/7000	5.25	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Beryllium	10/11/1991	6010/7000		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Cadmium	10/11/1991	6010/7000	17.5	20 U	20 U	20 U	28	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Chromium	10/11/1991	6010/7000	105 (CrVI)	26	65	20 U	20 U	53	38	20 U	20 U	20 U	84	20 U	20 U	20 U	35	39
Copper	10/11/1991	6010/7000	1300	42	100	41	20 U	45	84	20 U	20 U	54	130	20 U	22	30	77	75
Lead	10/11/1991	7240		50 U	130	94	50 U	50 U	50 U	50 U	50 U	50 U	91	50 U	50 U	50 U	50 U	260
Mercury	10/11/1991	6010/7000		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	10/11/1991	6010/7000	700	50 U	50 U	50 U	59	50 U	50 U	50 U	50 U	50 U	55	50 U	50 U	50 U	52	50 U
Selenium	10/11/1991	6010/7000		100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Silver	10/11/1991	6010/7000		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Thallium	10/11/1991	6010/7000		100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Zinc	10/11/1991	6010/7000	10500	140	230	120	1600	160	210	91	50 U	86	480	90	150	130	210	270
Antimony	1/17/1992	6010/7000		100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Arsenic	1/17/1992	6010/7000	5.25	5 U	7	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Beryllium	1/17/1992	6010/7000		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Cadmium	1/17/1992	6010/7000	17.5	0.25 U	0.47	0.25 U	7.5	0.43	0.25 U	38	0.25 U	5.7	3.4	0.27	1.6	0.93	1.5	0.25 U
Chromium	1/17/1992	6010/7000	105 (CrVI)	20 U	50	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Copper	1/17/1992	6010/7000	1300	20 U	66	20 U	20 U	20 U	20 U	200	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Lead	1/17/1992	7240		17	67	6	18	5 U	5	7	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Mercury	1/17/1992	6010/7000		0.2 U	0.3	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

CHEMICAL/ SAMPLE INFORMATION	DATE	ANALYTICAL METHOD	MTCA METHOD C	C-1 (µg/L)	C-2 (µg/L)	C-3 (µg/L)	C-4 (µg/L)	C-5 (µg/L)	C-6 (µg/L)	MW-7 (µg/L)	MW-8 (µg/L)	MW-9 (µg/L)	MW-10 (µg/L)	MW-11 (µg/L)	MW-12 (µg/L)	MW-13 (µg/L)	MW-14 (µg/L)	MW-14 (Dup) (µg/L)
Nickel	1/17/1992	6010/7000	700	50 U	50 U	50 U	120	50 U	50 U	380	50 U	170	98	50 U	110	50 U	50 U	50 U
Selenium	1/17/1992	6010/7000		100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Silver	1/17/1992	6010/7000		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Thallium	1/17/1992	6010/7000		100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Zinc	1/17/1992	6010/7000	10500	50 U	130	50 U	1200	50 U	50 U	6200	50 U	1300	430	50 U	490	89	140	50 U

Source: (Pacific Groundwater Group 2006)

Green highlight – concentration exceeds MTCA Method C Industrial Cleanup Level (WAC-173-340)

Yellow highlight – parameter detected

Investigation: AGI (Applied Geotechnology, Inc.)

– Data appears to be total metals analyses, although AGI (1992) report does not explicitly state that samples were not filtered.

U – parameter not detected; # is laboratory detection limit

CrVI – chromium six

Dup – duplicate

MTCA – Model Toxics Control Act

WAC – Washington Administrative Code

Table D-24. Historical groundwater sample results for metals and PCBs conducted June 5, 1984

CHEMICAL/SAMPLE INFORMATION	UNITS	WELL 84-1	WELL 84-1 (DUPL) ^A	WELL 84-2	WELL 84-2 (DUPL) ^A	WELL A ^B	DETECTION LIMIT
PCB	µg/L	–		–	–	–	1.0
Arsenic	mg/L	0.073	0.073	0.05		0.018	0.01
Cadmium	mg/L	0.0015	0.0018	0.0012		–	0.001
Chromium	mg/L	0.053	0.066	0.057		0.022	0.01
Lead	mg/L	0.048	0.045	0.15		0.016	0.005
Mercury	mg/L	–	–	0.002		–	0.002
Zinc	mg/L	0.22	0.27	0.28		0.14	
Total Dissolved Solids	mg/L	750	780	1400		11000	

Source: (Dames & Moore 1984; Pacific Groundwater Group 2006)

^aDuplicate samples were tested for quality control check. 84-1 duplicate tested for metals only, 84-2 duplicated tested for PCB only.

^b Detection limit for water sample from Well A is 10 ppb

– concentration is less than detection limit

Blank – no test was performed

Dupl – duplicate

Table D-25. Historical seep sample results for metals and PCBs conducted June 5, 1984

CHEMICAL/SAMPLE INFORMATION	UNITS	SEEP N	SEEP S	DETECTION LIMIT
PCB	µg/L	–	–	1.0
Arsenic	mg/L	–	–	0.01
Cadmium	mg/L	0.0012	<0.001	0.001
Chromium	mg/L	–	–	0.01
Lead	mg/L	0.006	–	0.005
Mercury	mg/L	–	–	0.002
Zinc	mg/L	0.1	0.035	
Total Dissolved Solids	mg/L	6400	7300	

Source: (Dames & Moore 1984; Pacific Groundwater Group 2006)

– concentration is less than detection limit

Blank – no test was performed

Dupl – duplicate

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Appendix E Adjacent Property Analytical Information

<i>Table E-1.</i>	<i>1985 S Nevada St storm drain sediment solid sample results</i>	<i>1</i>
<i>Table E-2.</i>	<i>Summary of PAH compounds in S Oregon St soil samples</i>	<i>2</i>
<i>Table E-3.</i>	<i>Summary of PCBs Results in S Oregon St soil samples</i>	<i>4</i>
<i>Table E-4.</i>	<i>Summary of petroleum hydrocarbon compounds in S Oregon St soil samples</i>	<i>5</i>
<i>Table E-5.</i>	<i>Summary of metals in S Oregon St soil samples</i>	<i>6</i>
<i>Table E-6.</i>	<i>Summary of PAH compounds in Oregon Street intertidal sediment samples</i>	<i>7</i>
<i>Table E-7.</i>	<i>Summary of PCBs in S Oregon St intertidal sediment samples</i>	<i>9</i>
<i>Table E-8.</i>	<i>Summary of petroleum hydrocarbon compounds in S Oregon St intertidal sediment samples</i>	<i>10</i>
<i>Table E-9.</i>	<i>Summary of metals in S Oregon St intertidal sediment samples</i>	<i>11</i>
<i>Table E-10.</i>	<i>Summary of PAH compounds in S Oregon St groundwater samples</i>	<i>12</i>
<i>Table E-11.</i>	<i>Summary of PCBs in S Oregon St groundwater samples</i>	<i>13</i>
<i>Table E-12.</i>	<i>Summary of petroleum hydrocarbon compounds and metals in S Oregon St</i>	<i>14</i>
<i>Table E-13.</i>	<i>Summary of Duwamish/Diagonal CSO/SD source-tracing sediment data (metals and TPH)</i>	<i>15</i>
<i>Table E-14.</i>	<i>Summary of Duwamish/Diagonal CSO/SD source-tracing sediment data (Phthalates, PCBs, and PAHs)</i>	<i>16</i>
<i>Table E-15.</i>	<i>Detection frequencies and concentration ranges for pollutants in Duwamish/Diagonal CSO/SD stormwater, 1995</i>	<i>17</i>
<i>Table E-16.</i>	<i>Storm drain sediment samples in Duwamish/ Diagonal CSO/SD system, 1985</i>	<i>18</i>
<i>Table E-17.</i>	<i>Storm drain sediments in Duwamish/Diagonal SD, 1985</i>	<i>19</i>
REFERENCES		19

Table E-1. 1985 S Nevada St storm drain sediment solid sample results

CHEMICAL (mg/kg)	MEASURED CONCENTRATION	SQS	CSL
Cadmium	12.3	5.1	6.7
Chromium	1,790E	260	270
Lead	1,330	450	530
Zinc	654E	410	960

Source: Ecology (2004)

CSL – cleanup screening level

E – estimated value

mg/kg – milligram per kilogram

SQS – sediment quality standard

Table E-2. Summary of PAH compounds in S Oregon St soil samples

PAH COMPOUND ^a	UNIT	CARC/ NON CARC	SAMPLE IDENTIFICATIONS										
			B06-1-1	B06-2-5	B06-2-7.5	B06-3-2.5	B06-3-5	B06-3-7.5	B06-4-1	B06-4-10	B06-4-12.5	B06-5-2.5	B06-5-5
1-Methylnaphthalene	mg/kg	nc	0.0075 U	0.0088 U	24	4.2	0.0087	0.0083 U	0.019	0.0081 U	0.0072 U	0.092	0.0077 U
2-Methylnaphthalene	mg/kg	nc	0.0075 U	0.0088 U	35	4.8	0.010	0.0083 U	0.026	0.0081 U	0.0072 U	0.13	0.0077 U
Acenaphthene	mg/kg	nc	0.021	0.0088 U	39	0.15	0.0098	0.0083 U	0.0075	0.0081 U	0.0072 U	0.015	0.0077 U
Acenaphthylene	mg/kg	nc	0.0075 U	0.0088 U	0.93	0.045	0.0081 U	0.0083 U	0.017	0.0081 U	0.0072 U	0.0092	0.12
Anthracene	mg/kg	nc	0.031	0.0088 U	60	0.022	0.022	0.019	0.015	0.0081 U	0.0072 U	0.014	0.052
Benzo(g,h,i)perylene	mg/kg	nc	0.062	0.024	51	0.057	0.089	0.13	0.046	0.0081 U	0.0072 U	0.086	0.24
Fluoranthene	mg/kg	nc	0.16	0.049	210	0.12	0.14	0.25	0.11	0.0081 U	0.0072 U	0.13	0.22
Fluorene	mg/kg	nc	0.015	0.0088 U	40	0.17	0.0090	0.0083 U	0.0092	0.0081 U	0.0072 U	0.013	0.011
Naphthalene ^b	mg/kg	nc	0.0075 U	0.0088 U	72	0.97	0.012	0.012	0.027	0.0081 U	0.0072 U	0.025	0.0077 U
Phenanthrene	mg/kg	nc	0.11	0.027	260	0.22	0.11	0.045	0.086	0.0081 U	0.0072 U	0.31	0.038
Pyrene	mg/kg	nc	0.16	0.058	220	0.12	0.17	0.40	0.16	0.0083	0.0087	0.17	0.32
Benzo(a)anthracene	mg/kg	c	0.080	0.023	80	0.064	0.077	0.23	0.068	0.0081 U	0.0072 U	0.086	0.32
Benzo(a)pyrene	mg/kg	c	0.089	0.030	83	0.066	0.12	0.29	0.053	0.0081 U	0.0072 U	0.075 U	0.39
Benzo(b)fluoranthene	mg/kg	c	0.11	0.035	80	0.090	0.12	0.25	0.077	0.0081 U	0.0072 U	0.13	0.46
Benzo(k)fluoranthene	mg/kg	c	0.039	0.012	25	0.019	0.042	0.081	0.023	0.0081 U	0.0072 U	0.075 U	0.15
Chrysene	mg/kg	c	0.13	0.038	110	0.20	0.13	0.31	0.14	0.0081 U	0.0072 U	0.40	0.51
Dibenz(a,h)anthracene	mg/kg	c	0.023	0.0088 U	12	0.023	0.024	0.039	0.017	0.0081 U	0.0072 U	0.075 U	0.089
Indeno(1,2,3-c,d)pyrene	mg/kg	c	0.059	0.019	43	0.039	0.076	0.11	0.035	0.0081 U	0.0072 U	0.075 U	0.22
Toxicity Equivalency Evaluation													
Benzo(a)anthracene	TEF	0.1	0.008	0.002	8	0.006	0.008	0.02	0.007	0	0	0.009	0.03
Benzo(a)pyrene	TEF	1	0.089	0.030	83	0.066	0.12	0.29	0.053	0	0	0	0.39
Benzo(b)fluoranthene	TEF	0.1	0.01	0.004	8	0.009	0.01	0.03	0.008	0	0	0.01	0.05
Benzo(k)fluoranthene	TEF	0.1	0.004	0.001	2.5	0.002	0.004	0.008	0.002	0	0	0	0.02

PAH COMPOUND ^a	UNIT	CARC/ NON CARC	SAMPLE IDENTIFICATIONS										
			B06-1-1	B06-2-5	B06-2-7.5	B06-3-2.5	B06-3-5	B06-3-7.5	B06-4-1	B06-4-10	B06-4-12.5	B06-5-2.5	B06-5-5
Chrysene	TEF	0.01	0.001	0.000	1.1	0.002	0.001	0.003	0.001	0	0	0.004	0.01
Dibenz(a,h)anthracene	TEF	0.4	0.009	0	4.8	0.009	0.010	0.016	0.007	0	0	0	0.036
Indeno(1,2,3-c,d)pyrene	TEF	0.1	0.006	0.002	4.3	0.004	0.008	0.01	0.004	0	0	0	0.02
SUM			0.13	0.039	111.7	0.10	0.16	0.38	0.08	0	0	0.03	0.55
MTCA Method A Soil (Industrial)			2	2	2	2	2	2	2	2	2	2	2

Source: (Pacific Groundwater Group 2007)

^a Analytical method: EPA 8270C/SIM

^b Naphthalenes cleanup levels for MTCA Method A Soil (Unrestricted) and (Industrial) are 5 mg/kg

Green highlight – sum of toxic equivalents exceeds MTCA Method A Soil (Industrial)

U – parameter not detected; # – laboratory practical quantitation limit

C – carcinogen

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

NC – non-carcinogen

PAH – Polycyclic Aromatic Hydrocarbon

ppm – parts per million

SIM – Simultaneous Ion Monitoring

TEF – toxic equivalency factor

Table E-3. Summary of PCBs Results in S Oregon St soil samples

SAMPLE LOCATION	SAMPLE (MG/KG)	AROCLOR 1016	AROCLOR 1221	AROCLOR 1232	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	AROCLOR 1260	AROCLOR 1262	AROCLOR 1268	TOTAL PCBs
B06-1	B06-1-1	0.056 U	0.056 U	0.056 U	0.056 U	0.056 U	0.28	0.20	0.056 U	0.056 U	0.48
	B06-1-5	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	ND
	B06-1-12.5	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	ND
	B06-1-20	0.068 U	0.068 U	0.068 U	0.068 U	0.068 U	0.068 U	0.068 U	0.068 U	0.068 U	ND
B06-2	B06-2-5	0.066 U	0.066 U	0.066 U	0.12	0.066 U	0.37	0.30	0.066 U	0.066 U	0.79
	B06-2-7.5	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	ND
	B06-2-10	0.058 U	0.058 U	0.058 U	0.058 U	0.058 U	0.058 U	0.058 U	0.058 U	0.058 U	ND
	B06-2-12.5	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	0.060 U	ND
B06-3	B06-3-1	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.28	0.13	0.057 U	0.057 U	0.41
	B06-3-2.5	0.054 U	0.054 U	0.054 U	0.054 U	0.054 U	0.054 U	0.054 U	0.054 U	0.054 U	ND
	B06-3-5	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	ND
	B06-3-7.5	0.063 U	0.063 U	0.063 U	0.063 U	0.063 U	0.063 U	0.063 U	0.063 U	0.063 U	ND
B06-4	B06-4-1	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	ND
	B06-4-2.5	0.054 U	0.054 U	0.054 U	0.054 U	0.054 U	0.26	0.054 U	0.054 U	0.054 U	0.26
	B06-4-10	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	ND
	B06-4-12.5	0.054 U	0.054 U	0.054 U	0.054 U	0.054 U	0.075	0.054 U	0.054 U	0.054 U	0.075
B06-5	B06-5-1	0.057 U	0.057 U	0.057 U	0.20	0.057 U	0.74	0.31	0.057 U	0.057 U	1.25
	B06-5-2	0.056 U	0.056 U	0.056 U	0.056 U	0.056 U	0.056 U	0.50	0.056 U	0.056 U	0.50
	B06-5-5	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	0.057 U	ND
	B06-5-15	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	0.061 U	ND
MTCA Method A Soil (Industrial)											10

Source: (Pacific Groundwater Group 2007)

Green highlight – sum of PCBs exceeds MTCA Method A Soil (Industrial)

Analytical method: EPA 8082

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

ND – non detect

PAH – polycyclic aromatic hydrocarbon

PQL – practical quantitation limit

TEF – toxic equivalency factor

U – parameter not detected; laboratory practical quantitation limit

Table E-4. Summary of petroleum hydrocarbon compounds in S Oregon St soil samples

SAMPLE LOCATION	SAMPLE IDENTIFICATION (mg/kg)	NWTPH-Gx/BTEX						NWTPH-Dx	
		BENZENE	TOLUENE	ETHYL BENZENE	M,P-XYLENE	O-XYLENE	TPH-GAS	DIESEL RANGE	LUBE OIL
B06-1	B06-1-1	0.020 U	0.044 U	0.044 U	0.044 U	0.044 U	4.4 U	28 U	760
	B06-1-5	—	—	—	—	—	—	150 U	4900
	B06-1-12.5	—	—	—	—	—	—	30 U	170
	B06-1-20	—	—	—	—	—	—	34 U	100
B06-2	B06-2-5	0.020 U	0.063 U	0.063 U	0.063 U	0.063 U	6.3 U	62	580
	B06-2-7.5	0.020 U	0.055 U	0.055 U	0.055 U	0.055 U	5.5 U	310	580
	B06-2-10	0.020 U	0.044 U	0.044 U	0.044 U	0.044 U	4.4 U	29 U	100
	B06-2-12.5	—	—	—	—	—	—	30 U	60 U
B06-3	B06-3-1	0.020 U	0.048 U	0.048 U	0.048 U	0.048 U	4.8 U	28 U	170
	B06-3-2.5	0.020 U	0.045 U	0.045 U	0.045 U	0.045 U	4.5 U	4500	5400
	B06-3-5	0.020 U	0.054 U	0.054 U	0.054 U	0.054 U	5.4 U	31 U	160
	B06-3-7.5	0.020 U	0.047 U	0.047 U	0.047 U	0.047 U	4.7 U	31 U	90
B06-4	B06-4-1	0.020 U	0.050 U	0.050 U	0.050 U	0.050 U	5.0 U	28 U	190
	B06-4-2.5	0.020 U	0.099 U	0.099 U	0.099 U	0.099 U	9.9 U	27 U	95
	B06-4-10	0.020 U	0.053 U	0.053 U	0.053 U	0.053 U	5.3 U	170	630
	B06-4-12.5	0.020 U	0.042 U	0.042 U	0.042 U	0.042 U	4.2 U	27 U	100
B06-5	B06-5-1	0.020 U	0.050 U	0.050 U	0.050 U	0.050 U	5.0 U	200	610
	B06-5-2.5	0.020 U	0.049 U	0.049 U	0.049 U	0.049 U	4.9 U	28 U	500
	B06-5-5	0.020 U	0.044 U	0.044 U	0.044 U	0.044 U	4.4 U	29 U	87
	B06-5-15	0.020 U	0.053 U	0.053 U	0.053 U	0.053 U	5.3 U	31 U	61 U
MTCA Method A Soil (Industrial)		0.03	7	6	9	9	100	2000	2000

Source: (Pacific Groundwater Group 2007)

Green highlight – sum of PCBs exceeds MTCA Method A Soil (Industrial)

U – parameter not detected; # – laboratory practical quantitation limit

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable

NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable

TPH – total petroleum hydrocarbons

Table E-5. Summary of metals in S Oregon St soil samples

SAMPLE LOCATION	SAMPLE IDENTIFICATION	ARSENIC (mg/kg)	CADMIUM (mg/kg)	COPPER (mg/kg)	LEAD (mg/kg)	NICKEL (mg/kg)	ZINC (mg/kg)
B06-1	B06-1-1	11 U	0.63	27	24	13	49
	B06-1-5	12 U	0.61 U	52	91	18	65
	B06-1-12.5	12 U	0.60 U	13	6.0 U	8.6	24
	B06-1-20	14 U	0.68 U	23	6.8 U	9.0	29
B06-2	B06-2-5	13 U	0.66 U	19	6.6 U	4.4	20
	B06-2-7.5	11 U	1.5	100	160	26	180
	B06-2-10	12 U	0.58 U	22	13	10	30
	B06-2-12.5	12 U	0.60 U	15	8.4	15	38
B06-3	B06-3-1	11 U	1.9	25	25	11	120
	B06-3-2.5	11 U	0.54 U	28	5.9	17	36
	B06-3-5	12 U	1.4	110	180	29	310
	B06-3-7.5	13 U	0.95	16	10	9.2	30
B06-4	B06-4-1	11 U	0.82	64	46	33	2800
	B06-4-2.5	11 U	0.54 U	35	33	11	60
	B06-4-10	12 U	0.61 U	21	6.1 U	13	68
	B06-4-12.5	11 U	0.54 U	12	5.4 U	7.5	26
B06-5	B06-5-1	11 U	0.90	40	36	12	74
	B06-5-2.5	11 U	0.56 U	36	33	30	110
	B06-5-5	11 U	0.57 U	26	34	11	35
	B06-5-15	12 U	0.61 U	10	6.1 U	9.1	19
MTCA Method A Soil (Industrial)		20	2		1000		

Source: (Pacific Groundwater Group 2007)

Green highlight – concentration exceeds MTCA Method A Soil (Industrial)

mg/kg – milligram per kilogram

MTCA – Model Toxics Control Act

U – parameter not detected; # – laboratory practical quantitation limit

Table E-6. Summary of PAH compounds in Oregon Street intertidal sediment samples

PAH COMPOUND	PAH CONCENTRATIONS - DRY WEIGHT (mg/kg)					PAH CONCENTRATIONS – TOC-NORMALIZED (mg/kg-OC)					SQS
	IT-1-6	IT-2-6	IT-2-16	IT-3-6	IT-3-12	IT-1-6	IT-2-6	IT-2-16	IT-3-6	IT-3-12	
1-Methylnaphthalene	0.0083 U	0.0063 U	0.081	0.0087 U	0.0088 U	—	—	3	—	—	
2-Methylnaphthalene	0.0083 U	0.0063 U	0.13	0.0087 U	0.0088 U	—	—	5	—	—	38
Acenaphthene	0.0083 U	0.0063 U	0.046	0.0087 U	0.0088 U	—	—	2	—	—	16
Acenaphthylene	0.0083 U	0.0063 U	0.0078 U	0.0087 U	0.0088 U	—	—	—	—	—	66
Anthracene	0.0083 U	0.0063 U	0.0078 U	0.0098	0.023	—	—	—	0	1	220
Benzo(g,h,i)perylene	0.019	0.0063 U	0.0078 U	0.042	0.081	2	—	—	2	3	31
Fluoranthene	0.020	0.0063 U	0.0078 U	0.069	0.14	2	—	—	3	6	160
Fluorene	0.0083 U	0.0063 U	0.0098	0.0087 U	0.010	—	—	0	—	0	23
Naphthalene	0.0083 U	0.0063 U	0.22	0.0087 U	0.0088 U	—	—	9	—	—	99
Phenanthrene	0.0083 U	0.0063 U	0.0078 U	0.036	0.10	—	—	—	1	4	100
Pyrene	0.021	0.0063 U	0.0078 U	0.083	0.16	2	—	—	3	6	1000
Benzo(a)anthracene	0.014	0.0063 U	0.0078 U	0.050	0.078	1	—	—	2	3	110
Benzo(a)pyrene	0.022	0.0063 U	0.0078 U	0.051	0.095	2	—	—	2	4	99
Benzo(b)fluoranthene	0.032	0.0063 U	0.0078 U	0.068	0.11	3	—	—	3	4	230 (total)
Benzo(k)fluoranthene	0.012	0.0063 U	0.0078 U	0.023	0.041	1	—	—	1	2	
Chrysene	0.031	0.0063 U	0.0078 U	0.071	0.12	3	—	—	3	5	110
Dibenz(a,h)anthracene	0.0083 U	0.0063 U	0.0078 U	0.013	0.026	—	—	—	1	1	12
Indeno(1,2,3-c,d)pyrene	0.016	0.0063 U	0.0078 U	0.036	0.068	1	—	—	1	3	34
Estimated total organic content from PGG-5 and PGG-6 analytical results and grain size (%) ^a						1.15	0.47	2.47	2.47	2.47	

Source: (Pacific Groundwater Group 2007)

^a Intertidal sediment samples not analyzed for TOC. Soil samples from boreholes PGG-5 (200 feet southeast of intertidal samples) and PGG-6 (500 feet southeast of intertidal samples) analyzed for TOC. Estimated TOC for IT samples from PGG-5 and PGG-6 results based on comparable soil/sediment description.

Green highlight – exceeds SQS

Analytical method: EPA 8270C/SIM

EPA – US Environmental Protection Agency

mg/kg-OC – mg/kg organic carbon (total organic carbon normalized)

mg/kg – milligram per kilogram

PAH –Polycyclic Aromatic Hydrocarbon

PGG – Pacific Groundwater Group

SIM – Simultaneous Ion Monitoring

SQS – Sediment Quality Standards (WAC 173-204-320)

TOC – total organic carbon

U – parameter not detected; # – laboratory practical quantitation limit

WAC – Washington Administrative Code

— not calculated, PAH not detected

Sample descriptions:

IT-1-6: Brown silt with roots and organic material

IT-1-12: Brown silt with organic material

IT-2-6: Wet, gray, sand and gravel

IT-2-16: Dark gray, wet, slightly sandy, organic smelling silt

IT-3-6: Brown, sandy silt with trace gravel

IT-3-12: Dark gray, moist, slightly sandy silt.

Table E-7. Summary of PCBs in S Oregon St intertidal sediment samples

CHEMICAL (mg/kg)	IT-1-6	IT-1-12	IT-2-6	IT-2-16	IT-3-6	IT-3-12
Aroclor 1016	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1221	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1232	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1242	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1248	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1254	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1260	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1262	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Aroclor 1268	0.063 U	0.066 U	0.052 U	0.058 U	0.065 U	0.066 U
Total PCBs	ND	ND	ND	ND	ND	ND

Source: (Pacific Groundwater Group 2007)

Analytical method: EPA 8082

EPA – US Environmental Protection Agency

mg/kg – milligram per kilogram

ND – non detect

PCB - polychlorinated biphenyl

U – parameter not detected; # – laboratory practical quantitation limit

Table E-8. Summary of petroleum hydrocarbon compounds in S Oregon St intertidal sediment samples

SAMPLE LOCATION	SAMPLE (mg/kg)	NWTPH-Gx/BTEX						NWTPH-Dx	
		BENZENE	TOLUENE	ETHYL BENZENE	M,P-XYLENE	O-XYLENE	TPH-GAS	DIESEL RANGE	LUBE OIL
Intertidal	IT-1-6	—	—	—	—	—	—	31 U	63 U
	IT-1-12	—	—	—	—	—	—	33 U	66 U
	IT-2-6	—	—	—	—	—	—	26 U	52 U
	IT-2-16	—	—	—	—	—	—	40 ^a	110
	IT-3-6	—	—	—	—	—	—	33 U	170
	IT-3-12	—	—	—	—	—	—	38	150
SQS not established under WAC 173-204 for diesel or lube oil									

Source: (Pacific Groundwater Group 2007)

^a Identified diesel fuel #2 by lab

— parameter not analyzed

NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable

NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable

SQS – Sediment Quality Standards (WAC 173-204-320)

TPH – total petroleum hydrocarbons

U – parameter not detected; # – laboratory practical quantitation limit

WAC – Washington Administrative Code

Table E-9. Summary of metals in S Oregon St intertidal sediment samples

SAMPLE LOCATION	SAMPLE (mg/kg)	ARSENIC	CADMIUM	COPPER	LEAD	NICKEL	ZINC
Intertidal	IT-1-6	13 U	0.63 U	29	53	14	48
	IT-1-12	13 U	0.66 U	13	6.6 U	4.7	12
	IT-2-6	10 U	0.52 U	120	5.2 U	22	77
	IT-2-16	12 U	0.58 U	55	100	18	95
	IT-3-6	13 U	0.65 U	84	190	22	150
	IT-3-12	13 U	0.66 U	110	330	29	180
SQS		57	5.1	390	450	na	410

Source: (Pacific Groundwater Group 2007)

na – not applicable

SQS – Sediment Quality Standards (WAC 173-204-320)

U – parameter not detected; # – laboratory practical quantitation limit

WAC – Washington Administrative Code

Table E-10. Summary of PAH compounds in S Oregon St groundwater samples

PAH COMPOUND	UNIT	CARC./NON CARC.	B06-2	B06-5
1-Methylnaphthalene	µg/L	nc	0.18	0.095 U
2-Methylnaphthalene	µg/L	nc	0.27	0.095 U
Acenaphthene	µg/L	nc	0.18	0.095 U
Acenaphthylene	µg/L	nc	0.097 U	0.095 U
Anthracene	µg/L	nc	0.12	0.095 U
Benzo(g,h,i)perylene	µg/L	nc	0.095	0.018
Fluoranthene	µg/L	nc	0.37	0.095 U
Fluorene	µg/L	nc	0.12	0.095 U
Naphthalene ^a	µg/L	nc	1.1	0.095 U
Phenanthrene	µg/L	nc	0.48	0.095 U
Pyrene	µg/L	nc	0.41	0.095 U
Benzo(a)anthracene	µg/L	c	0.12	0.018
Benzo(a)pyrene	µg/L	c	0.14	0.019
Benzo(b)fluoranthene	µg/L	c	0.14	0.026
Benzo(k)fluoranthene	µg/L	c	0.048	0.0095 U
Chrysene	µg/L	c	0.17	0.023
Dibenz(a,h)anthracene	µg/L	c	0.022	0.0095 U
Indeno(1,2,3-c,d)pyrene	µg/L	c	0.076	0.013
Toxicity Equivalency Evaluation				
Benzo(a)anthracene	TEF	0.1	0.01	0.002
Benzo(a)pyrene	TEF	1	0.14	0.019
Benzo(b)fluoranthene	TEF	0.1	0.01	0.003
Benzo(k)fluoranthene	TEF	0.1	0.005	0
Chrysene	TEF	0.01	0.002	0.0002
Dibenz(a,h)anthracene	TEF	0.4	0.009	0
Indeno(1,2,3-c,d)pyrene	TEF	0.1	0.008	0.001
SUM:			0.19	0.02
MTCA Method A Groundwater			0.1	0.1

Source: (Pacific Groundwater Group 2007)

Analytical method: EPA 8270C/SIM

^a Naphthalenes cleanup level for MTCA Method A Groundwater is 160 µg/L

Green highlight – sum of toxic equivalents exceeds MTCA Method A Groundwater

c – carcinogen

Carc. – carcinogen

EPA – US Environmental Protection Agency

µg/L – micrograms per liter

MTCA – Model Toxics Control Act

nc – non-carcinogen

PAH – Polycyclic Aromatic Hydrocarbon

TEF: toxicity equivalency factor

U – parameter not detected; # – laboratory practical quantitation limit

Table E-11. Summary of PCBs in S Oregon St groundwater samples

PCB	UNITS	B06-2	B06-5
Aroclor 1016	µg/L (ppb)	0.048 U	0.048 U
Aroclor 1221	µg/L (ppb)	0.048 U	0.048 U
Aroclor 1232	µg/L (ppb)	0.048 U	0.048 U
Aroclor 1242	µg/L (ppb)	0.048 U	0.048 U
Aroclor 1248	µg/L (ppb)	0.048 U	0.048 U
Aroclor 1254	µg/L (ppb)	0.053	0.070
Aroclor 1260	µg/L (ppb)	0.048 U	0.048 U
Aroclor 1262	µg/L (ppb)	0.048 U	0.048 U
Aroclor 1268	µg/L (ppb)	0.048 U	0.048 U
Total PCBs		0.053	0.070
MTCA Method A Groundwater		0.1	0.1

Source: (Pacific Groundwater Group 2007)

Analytical method: EPA 8082

µg/L – micrograms per liter

MTCA – Model Toxics Control Act

PCB – polychlorinated biphenyl

ppb – part per billion

PQL – practical quantitation limit

U – parameter not detected; # – laboratory practical quantitation limit

Table E-12. Summary of petroleum hydrocarbon compounds and metals in S Oregon St

CHEMICAL	UNIT	MTCA METHOD A - GROUNDWATER	B06-2	B06-5
NWTPH-Gx/BTEX				
Benzene	µg/L	5	1.0 U	1.0 U
Toluene	µg/L	1,000	1.0 U	1.0 U
Ethyl Benzene	µg/L	700	1.0 U	1.0 U
m,p-Xylene	µg/L	1,000	1.0 U	1.0 U
o-Xylene	µg/L	1,000	1.0 U	1.0 U
TPH-Gas	µg/L	1,000	100 U	100 U
NWTPH-Dx				
Diesel Range	mg/L	0.5	0.27 U	0.26 U
Lube Oil	mg/L	0.5	1.5	0.41 U
Dissolved Metals (EPA 200.8)				
Arsenic	µg/L	5	5.7	3.0 U
Cadmium	µg/L	5	4.0 U	4.0 U
Copper	µg/L		10 U	10 U
Lead	µg/L	15	1.0 U	1.0 U
Nickel	µg/L		20 U	20 U
Zinc	µg/L		25 U	25 U

Source: (Pacific Groundwater Group 2007)

Green highlight – sum of toxic equivalents exceeds MTCA Method A Groundwater

EPA – US Environmental Protection Agency

µg/L – micrograms per liter

mg/L – milligrams per liter

MTCA – Model Toxics Control Act

NWTPH-Dx – Northwest total petroleum hydrocarbons - diesel extractable

NWTPH-Gx – Northwest total petroleum hydrocarbons - gasoline extractable

ppb – parts per billion

PQL – practical quantitation limit

TPH – total petroleum hydrocarbons

U – parameter not detected; # – laboratory practical quantitation limit

Table E-13. Summary of Duwamish/Diagonal CSO/SD source-tracing sediment data (metals and TPH)

TYPE	COUNT		METALS (mg/kg dw)					TPHs (mg/kg dw)	
			ARSENIC	COPPER	LEAD	MERCURY	ZINC	TPH - DIESEL	TPH - OIL
Catch Basin	44	Mean	11	230	410	0.28	696	4160	15,200
		Range	(3 – 40)	(29.6 – 1520)	(10 – 5,830)	(0.02 – 2.05)	(54.9 – 3,940)	(0 – 46,000)	(0 – 250,000)
Right-of-way Catch Basin	36	Mean	7.4	115	161	0.15	349	1120	4,150
		Range	(2.5 – 30)	(38.4 – 751)	(19 – 1,370)	(0.02 – 1.17)	(84.7 – 966)	(130 – 6,400)	(480 – 14,000)
In-line sediment grab	33	Mean	7.3	89	254	0.26	273		1,630
		Range	(2.5 – 23)	(22.4 – 340)	(15 – 4,910)	(0.01 – 3.3)	(85 – 718)	56,300)	(0 – 13,000)
In-line sediment trap	45	Mean	7.0	138	116	0.20	508	605	2570
		Range	(3 – 25)	(6.6 – 597)	(29 – 360)	(0.025 – 2.8)	(162 – 1,930)	(0 – 1,900)	(0 – 7,500)

Source: (Schmoyer 2008)

Note: Summary statistics were calculated using one half the detection limit for non-detected values.

CSO – combined sewer overflow

dw – dry weight

mg/kg – milligrams per kilogram

SD – storm drain

TPH – total petroleum hydrocarbons

Table E-14. Summary of Duwamish/Diagonal CSO/SD source-tracing sediment data (Phthalates, PCBs, and PAHs)

TYPE	COUNT	PHTHALATES, PCBs AND PAHs (µg/kg dw)				
		BEP	BBP	TOTAL PCBs	HPAH	LPAH
Catch Basin	44	Mean	37,300	3,110	261	19,700
		Range	(130 – 200,000)	(19.5 – 18,000)	(8.5 – 3,200)	(95 – 256,800)
Right-of-way Catch Basin	36	Mean	9,570	1,720	90	5390
		Range	(740 – 48,000)	(19.5 – 37,000)	(9.5 – 670)	(461.5 – 24,290)
In-line sediment grab	33	Mean	1,960	156	123	3,120
		Range	(0 – 8,900)	(0 – 900)	(0 – 1,000)	(0 – 17,850)
In-line sediment trap	45	Mean	11,000	663	298	12,300
		Range	(0 – 67,000)	(0 – 3,400)	(22 – 3,250)	(0 – 127,580)

Source: (Schmoyer 2008)

Note: Summary statistics were calculated using one half the detection limit for non-detected values.

BEP – bis(2-ethylhexyl)phthalate

BBP – butylbenzylphthalate

CSO – combined sewer overflow

dw – dry weight

HPAA – high-molecular-weight polycyclic aromatic hydrocarbon

LPAH – low-molecular-weight polycyclic aromatic hydrocarbon

µg/L – micrograms per liter

SD – storm drain

PCB – polychlorinated biphenyl

Table E-15. Detection frequencies and concentration ranges for pollutants in Duwamish/Diagonal CSO/SD stormwater, 1995

PARAMETER	DETECTION FREQUENCY	CONCENTRATION (µg/L)
Arsenic (total)	10/10	2 – 4
Cadmium (total)	10/10	0.4 – 1.3
Chromium (total)	10/10	2 – 22
Copper (total)	10/10	2 – 119
Lead (total)	10/10	9 – 68
Mercury (total)	1/10	0.3
Zinc (total)	10/10	50 – 225
Bis(2-ethylhexyl) phthalate	9/10	0.9 – 14.7
Butyl benzyl phthalate	5/10	0.79 – 1
Dimethyl phthalate	1/10	0.825
Di-n-butyl phthalate	1/10	9.13
Fluoranthene	1/10	0.84
PCBs	0/10	<0.26 – <0.5
Pyrene	1/10	0.998

Source: Ecology (2004)

CSO – combined sewer overflow

mg/kg – milligrams per kilogram

PCB – polychlorinated biphenyl

SD – storm drain

Table E-16. Storm drain sediment samples in Duwamish/ Diagonal CSO/SD system, 1985

CHEMICAL	MEASURED CONCENTRATION		SQS	CSL
	SAMPLE MH1	SAMPLE MHU		
Zinc (mg/kg)	293E	419E	410	960
Organic compounds (mg/kg TOC)				
Acenaphthene	83E	63U	16	57
Fluorene	65E	54U	23	79
Phenanthrene	270E	49E	100	480
Total LPAH	574	379	370	780
Fluoranthene	230E	74E	160	1,200
Benzo(a)anthracene	210E	12E	110	270
Chrysene	240E	29E	110	460
Total benzo(a)fluoranthenes	350E	66E	230	450
Benzo(a)pyrene	140E	3.4E	99	210
Indeno(1,2,3-c,d)pyrene	170E	220U	34	88
Dibenzo(a,h)anthracene	47E	340U	12	33
Benzo(g,h,i)perylene	130E	200U	31	78
Total HPAH	1,697	1,001	960	5,300
1,2-Dichlorobenzene	39XE	270U	2.3	2.3
1,4-Dichlorobenzene	5,200XE	7,100X	3.1	9
Dimethyl phthalate	56E	40U	53	53
Dibenzofuran	45E	69E	15	58
Phenol	1,500E	75B	420	1,200
4-Methylphenol	5,900E	870E	670	670

Source: Tetra Tech as cited in Ecology (2004)

B – compound detected in method blank – possible laboratory contamination

CSO – combined sewer overflow

E – estimated value

HPAH– high-molecular-weight polycyclic aromatic hydrocarbon

LPAH – low-molecular-weight polycyclic aromatic hydrocarbon

mg/kg – milligrams per kilogram

SD – storm drain

TOC – total organic carbon

U – Compound not detected at value shown

X – Standard recovery <10 %

Table E-17. Storm drain sediments in Duwamish/Diagonal SD, 1985

CHEMICAL	UNITS	MEASURED CONCENTRATION	SQS	CSL
Chromium	mg/kg	287E	260	270
Zinc	mg/kg	675E	410	960
Di-n-octyl phthalate	mg/kg TOC	560ZE	58	4,500
Indeno (1,2,3-c,d)pyrene	mg/kg TOC	85E	34	88

Source: Tetra Tech as cited in (Ecology 2004)

CSL – cleanup screening level

E – Estimated value

mg/kg – milligrams per kilogram

SD – storm drain

SQS – sediment quality standard

TOC – total organic carbon

Z – Concentration corrected for blank contribution. Value still exceeds detection limit.

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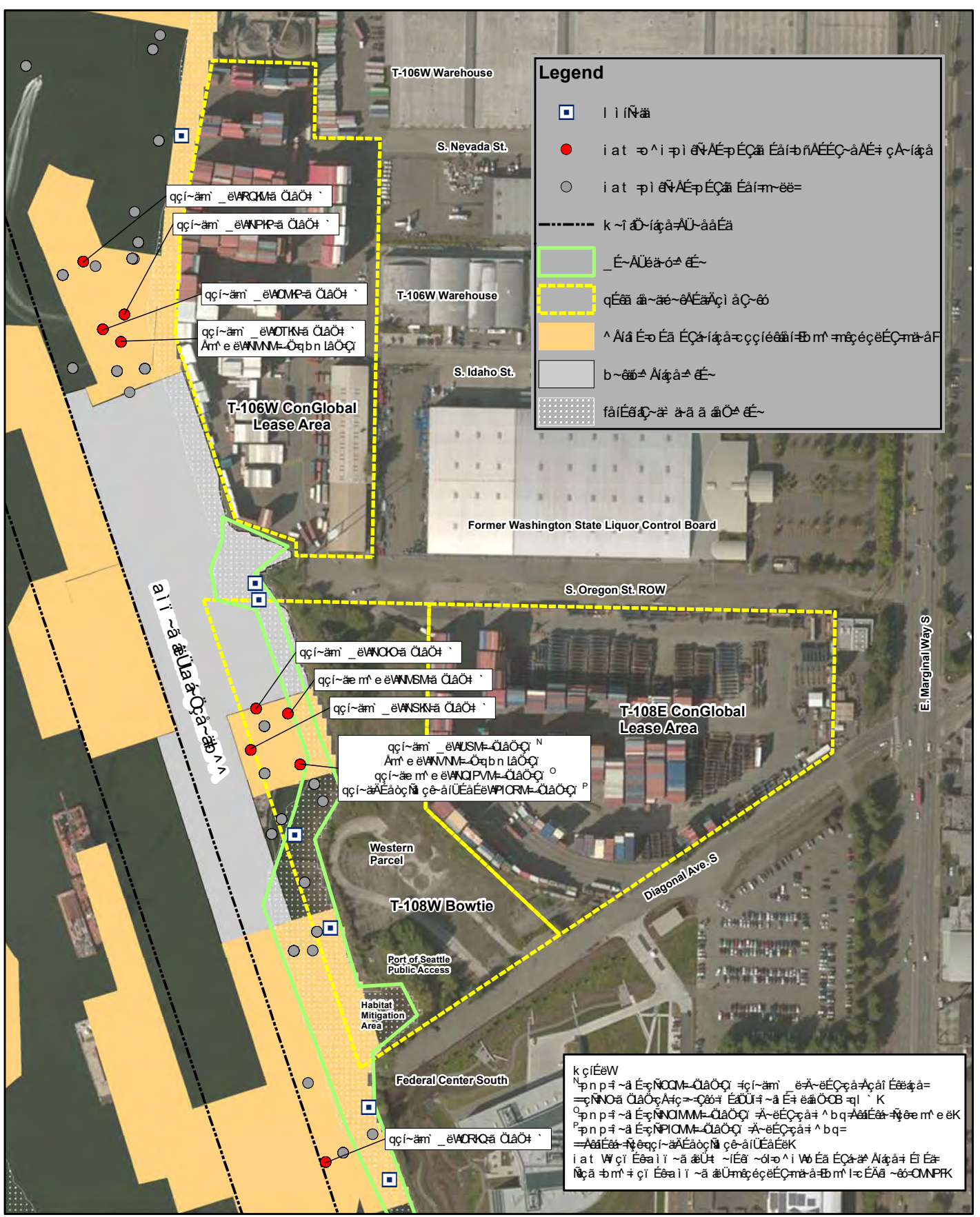
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**Port of Seattle
Terminal 108**

Preliminary Assessment Report

**Appendix B
Figure 1-2
Source Control Data Evaluation Report
(AECOM 2014)**

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**Port of Seattle
Terminal 108**

Preliminary Assessment Report

Appendix C Historical Documentation

CIVIL ENGINEERING

*Published by the
American Society of Civil Engineers*



FIRST OF A SERIES OF IMPROVEMENTS PLANNED TO RELIEVE TRAFFIC CONGESTION IN PITTSBURGH'S GOLDEN TRIANGLE
New Water Street Project, to Be Completed This Fall, Will Replace a 35-Ft Pavement with a Modern Highway of Ten Lanes

Volume 10



Number 9

SEPTEMBER 1940

S4009579

Seattle's Henderson Street Sewage Treatment Plant

By M. O. SYLLIAASEN

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSULTING ENGINEER, SEATTLE, WASH.

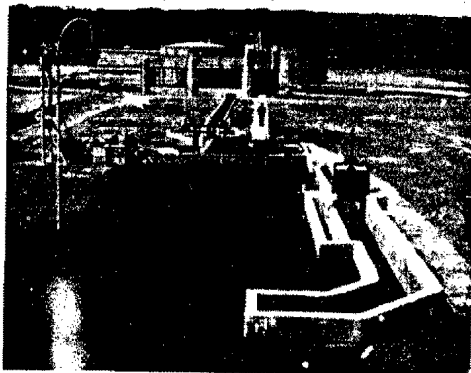
A SEWAGE treatment plant serving a small portion of the city of Seattle has recently been completed and placed in operation. It is the first such plant in the city except for three small Imhoff installations, two of which are no longer in operation.

Seattle lies between Lake Washington and Puget Sound (Fig. 1). The city is sewered by a combined storm and sanitary system, designed in the residential areas to care for 1 in. of rainfall per hour with 25% runoff. During periods of maximum runoff a portion of the flow in the trunk sewers is allowed to overflow into various lakes and waterways at convenient locations.

Approximately the north half of the city is served by the North Trunk Sewer (Fig. 1), which has an outfall at an excellent location on Puget Sound, where the currents are offshore regardless of wind or tide. Treatment of this sewage will probably never be necessary. The remainder of the city is served by many smaller sewers, also with outfalls along the shore of Puget Sound and in the Duwamish River Waterway which is tributary to the Sound. The flow from these sewers will require other disposition in the future and the new Henderson Street treatment plant is the first step in this direction. The plant is located on a tract of 17 acres on the Duwamish Waterway and handles the bulk of the flow which previously reached the waterway untreated.

Prior to 1926, thirty-two small sewers had their outfalls in Lake Washington. A bond issue of \$2,125,000 was then voted to divert all sewage flow from the lake. From time to time interceptors have been built and pumping plants installed, diverting part of the flow to the North Trunk Sewer and the Hanford Street Trunk Sewer and the remainder to the Henderson Street Trunk Sewer, which has its outfall in the Duwamish River. The 1926 bond ordinance spe-

THERE has just been completed and placed in operation a sewage treatment plant serving a population of 30,000 in the southern part of the city of Seattle. Primary treatment only is attempted, with discharge into tide-water. Provisions for enlargement, as required by future demands, have been included. Mr. Sylliaasen here describes the development of the project, its arrangement, and mode of operation.



GENERAL VIEW OF PLANT FROM PUMP CHAMBER ROOF

cified that the sewage brought to the river from the Lake Washington basin be treated before discharge. The Henderson Street plant fulfills this mandate and in addition cares for most of the flow from the Duwamish River basin.

The treatment plant is designed to serve a population of 32,000 and a flow of 8,000,000 mgd from a sparsely populated area. As the Duwamish River water is not used for drinking, bathing, or industrial purposes, and as the plant is intended merely to eliminate visible nuisance and odor, and to protect commercial and game fish, it was determined that primary treatment only was required at the present time. Ease and economy in operation, certainty of results, and opportunity for ready disposal of dried sludge pointed to the selection of a plant providing grit removal, plain sedimentation, two-stage sludge digestion, and sludge drying beds.

A high ground-water level at the site made it advisable to select a type of plant utilizing tanks that would not extend to great depths into the ground. The plant site is of sufficient size to accommodate additional units and a more complete treatment as required. The location is such that intercepting sewers diverting all sewage from the main waterfront on Elliot Bay can reach the plant.

Sewage follows the paths shown diagrammatically in Fig. 2. It enters through an overflow chamber, where excess flow, or the entire flow if need be, can be diverted through a 30-in. sewer to the river. Passing the overflow chamber, it next enters the pumping plant, where three 2,800-gpm float-controlled pumps lift it 29 ft. Thence it flows by gravity through the plant. One pump is intended for standby use only. From the pump discharge a concrete flume leads past an emergency overflow weir to a Parshall measuring flume, which is con-

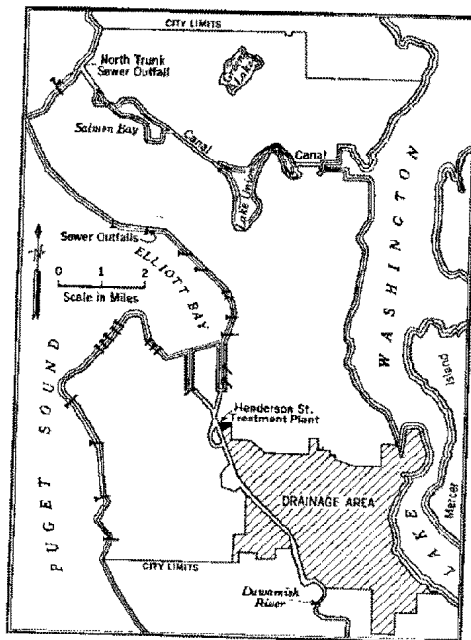
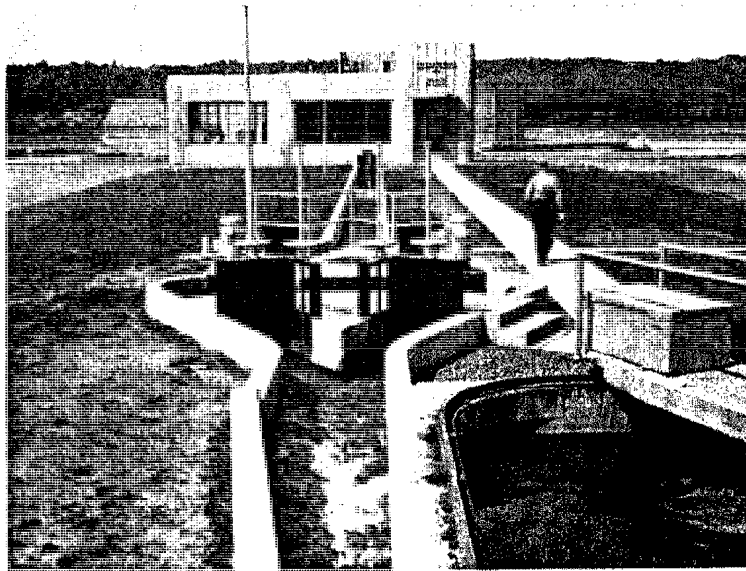


FIG. 1. MAP OF SEATTLE SHOWING LOCATION OF HENDERSON STREET TREATMENT PLANT



DETRICTOR AND COMMINUTORS—PLANT CONTROL HOUSE BEYOND

needed to a flow-recording gage in the control house. These arrangements are shown in Fig. 2.

Grit is removed by a detritor with a 13-ft width of weir, a 2-ft water depth, and an inclined trough up which the grit is raked and washed, thereby eliminating the odor and nuisance so often present in such material. The rake deposits the grit in a steel bucket equipped with a chain hoist for direct loading into a truck. Ultimate disposal of the grit is by filling on the site, much of which is low ground.

From the detritor the sewage flows through two 25-in. comminutors. These devices consist of vertical-axis, motor-driven cylinders suspended in the flow channels. The sewage flows through $3/8$ -in. horizontal slots in the cylinders. Particles not passing through are ground up against vertical cutters with teeth engaging the horizontal slots. The screening and grinding of screenings are both performed under the surface of the sewage flow without nuisance. Each comminutor will pass 4 mgd with a head loss of 4 in.; or 8 mgd with a head loss of 10 in.

FUNCTIONS OF CONTROL HOUSE

Open concrete channels carry the flow into the control house, from which it goes to either or both of the sedimentation basins. On the main floor of the control house are a laboratory room, a wash room, a locker room, an operation control room, and a chlorine room equipped with two vacuum, solution-feed, manual-controlled chlorinators, each with a capacity of 500 lb per day. Chlorine may be applied to the clarifier influent or effluent and will be used only during periods of low flow in the river. Adjoining the chlorine room is a rack for five one-ton

chlorine cylinders and a scale showing the amount and rate of flow. In the basement of the control house are a gas-fired water heater burning digester gas or commercial gas, two 4,200-gal per hr sludge pumps, and one de-watering pump.

The two sedimentation basins are radial-flow clarifiers, 85 ft in diameter by 11 ft 3 in. deep, with sludge rakes and surface skimmers. They are designed for 2-hour detention and provide 1 sq ft of surface area per 700 gal per day of flow. The effluent flowing over the circular weir is carried to the main plant by-pass and discharges into the waterway. The scum is washed from the scum trough to a scum sump in the control house and pumped at intervals to the digesters.

Next in sequence are the digesters. The primary digester is 40 ft in diameter, 20 ft high, and is equipped with a heat diffuser with heat control up to 90° and a turbo-mixer for intimate mixing and circulation of the contents. The mixer quickly seeds incoming sludge with digested sludge, aids in maintaining a uniform temperature by circulating the sludge around the heat exchanger, and prevents the formation of heavy scum. The more rapid digestion produced by these ideal conditions increases the gas production. The primary digester is designed to allow for 20-day storage of sludge containing 95% water. The partially digested sludge flows by gravity to the secondary digester.

PROCESSES IN DIGESTION

This secondary digester is of the same size and is of the non-mechanical, non-heated type. The contents become stratified into two layers, an upper layer of supernatant liquor which is clear and well settled, and a lower layer of dense, well-thickened sludge which can be drawn off with a minimum of water content. The secondary digester is equipped with a floating steel dome serving as a gas holder, and is designed to provide for 70-day storage of sludge with an average water content of 89%. The supernatant liquor flows back to the sewage channel entering the plant control house.

Joining the two digesters together is a digester control house, in which are located gas piping, gas meters and safety devices, sludge piping, sludge observation sumps, and sampling pipes. Exterior insulation walls on the

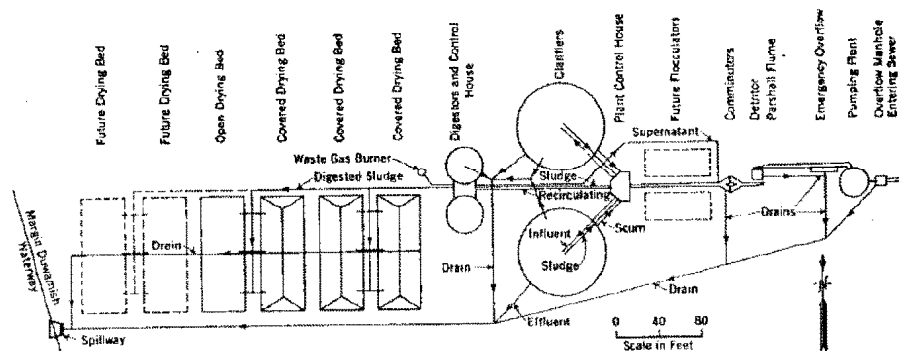


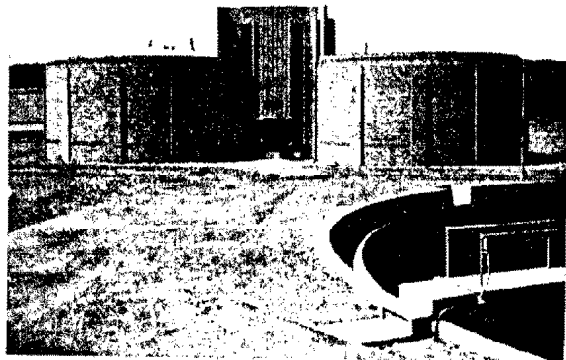
FIG. 2. SKETCH PLAN OF ENTIRE PROJECT FOR SEWAGE TREATMENT

S4009581

two digesters are of concrete brick separated from the main tank walls by a $1\frac{1}{2}$ -in. air space.

Digester gas is used for heating the primary digester, the plant control house, and the digester control house. The excess is burned in a waste gas burner located just outside the digester control house.

The digested sludge will be drawn off by gravity to four sand beds 40 by 100 ft, three of which are glass covered, to facilitate drying during periods of inclement weather. As the flow approaches the design quantity,

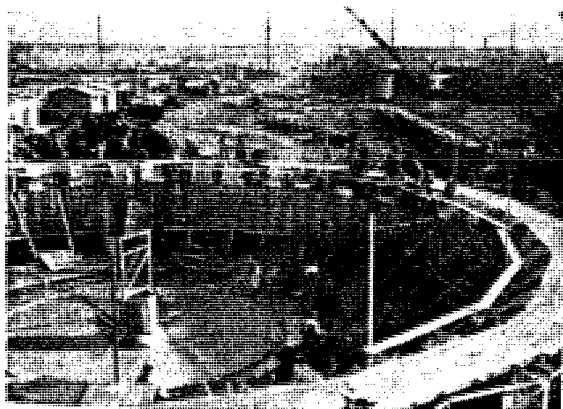


DIGESTER GROUP, AND PART OF CLARIFIER AT RIGHT

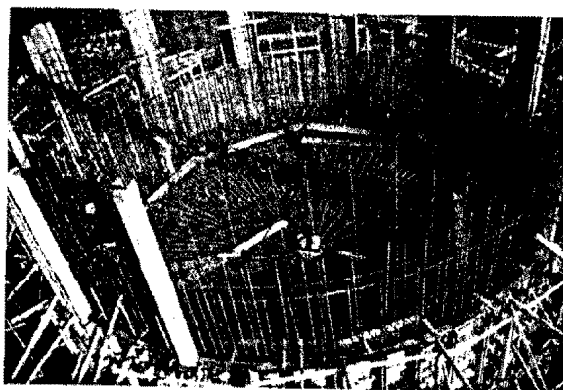
it is expected that two sand beds will be added and all will be glass covered. Provision is made for mechanical ventilation of sludge-drying houses if this is found to be necessary. Dried sludge will be loaded by hand onto a caterpillar tractor with side saddles and used for fill on the site or as a soil conditioner.

Provision was made in the design for two 21-ft by 53-ft flocculator tanks, which when built will greatly increase the percentage of removal of suspended and semi-colloidal solids by the clarifiers.

As the photographs indicate, considerable thought was given to pleasing appearance in laying out the plant, it being felt that everything possible should be done to engender a friendly attitude on the part of the public. The two highest structures—the plant control house and the digester group—are on the plant center line and are given modernistic architectural treatment.



CLARIFIER FORMS AND CONCRETING



DIGESTER FORMS AND REINFORCING

The site was developed by hydraulic fill overlying uncertain river-bottom mud, with a ground-water level as high as EL. +2.0, or just 6 ft below the clarifier weirs. All structures are of reinforced concrete, and all are supported on timber piling except the pump chamber, which because of its greater depth bears on a firm stratum at that level. All structures extending below EL. +2.0 are designed for uplift, with the excess over dead weight taken by the piling.

For all liquid containers the maximum concrete stress in bending was limited to 750 lb per sq in.; the steel stress in bending, to 12,000 lb per sq in.; and the steel stress in direct tension, to 10,000 lb per sq in. For all other structures the permissible concrete stress was 1,000 lb per sq in. and the steel stress, 10,000 lb per sq in.

SOME CONSTRUCTION FEATURES

All concrete surfaces above ground and all surfaces in contact with liquor were poured against plywood forms, care being taken to obtain smooth surfaces and dense concrete. The mortar finish on the sloping floors of the clarifiers was spread accurately by means of the sweeping mechanism with temporary screeds attached.

Total cost of the plant, including engineering charges, was \$323,000. In this total is also included the cost of 400 ft of 60-in. sewer leading in from the adjoining street, 2,200 ft of 12-in. water main, and 500 ft of 8-in. water main, a permanent fence around the property, and the necessary fill on the site. The funds came from a sewer bond issue augmented by a PWA grant.

The plant design and detailed designs were checked and approved by Roy M. Harris, Assoc. M. Am. Soc. C.E., chief engineer of the State Department of Health, and by C. C. Hockley, Assoc. M. Am. Soc. C.E., regional director of the PWA. The work was instituted under N. A. Carle, M. Am. Soc. C.E., city engineer, and built and brought into operation under C. L. Wartelle, city engineer. The design drawings and specifications were made under the direction of J. H. Quense, chief draftsman in the city engineer's office, and the writer served as consulting engineer. The General Construction Company, with C. W. Fitton in charge, built the entire plant, and their painstaking care, together with that of the equipment manufacturers and the city inspectors, resulted in an excellent piece of work.

The plant is being operated under the supervision of W. P. McNamara, sewer maintenance engineer under the city engineer. All equipment is operating in a satisfactory manner, but since the present load is far below the design flow the sludge is building up slowly and the secondary digester is not yet filled.

S4009582

C I T Y O F S E A T T L E

ENGINEERING DEPARTMENT

Sewer Division

REPORT ON OPERATION, WITH SUGGESTIONS FOR IMPROVEMENT
OF
MAINTENANCE OF SEWAGE TREATMENT PLANTS
AND
SEWAGE PUMPING STATIONS

Henry M. Fitch
Junior Engineer

Report MSDD No. 3

September, 1945

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TABLE OF CONTENTS

Introduction	Page	1, 2
Sewage Treatment Plant		3 - 7
Starting Operation		3
Subsequent Difficulties		4
Automatic Controls		4, 5
Present Operating Schedule, 1945		5
Summary of Operation - 1942-45		5, 6
Cost of Operation		6
Operation Results - 1944-45		7
Sewage Pumping Stations		8 - 10
Maintenance Necessary		9
Cost Operation - 1942-45		10
Plants Operating Personnel - 1945		11
Analysis Past Operation		11, 12
Suggestions for Improvement		12, 13
Summary and Conclusion		13

SYNOPSIS

This report summarizes the result of two years and eleven months of operation - October, 1942, to August, 1945, inclusive, of the Sewage Disposal Division of the Engineering Department, by the writer, in charge of operation and maintenance under the general supervision of Mr. W. P. McNamara, Senior Engineer.

REPORT ON MAINTENANCE WITH SUGGESTIONS FOR IMPROVEMENTS
FOR
MAINTENANCE OF SEWAGE TREATMENT PLANT
AND
SEWAGE PUMPING STATIONS

The purpose of this report is to acquaint the department with the facts pertaining to operation and maintenance of a sewage disposal division, consisting of the following:

One large sewage treatment plant, located at 4545 East Marginal Way, completed in 1939, at a cost of \$316,000.00.

Sixteen sewage interceptor pumping stations, located in various parts of the city, twelve along the shoreline of Lake Washington, to safeguard from pollution by sewage wastes this body of water used for recreational purposes. The cost of these pumping stations totals \$160,000.00.

One sewage ejector plant, located in the exclusive Broadmoor Addition, constructed privately and given to the city for maintenance.

A large septic tank, situated at 21st Avenue Southwest and Dumar Way, to relieve pollution of Longfellow Creek of sanitary wastes from approximately 3,000 persons served by sewers south of West Myrtle Street, constructed by the WPA during 1940-41.

These facilities comprise a modern and new method for disposal of sanitary wastes in the City.

The first units, consisting of two sewage pumping stations (East Pine Street and Charles Street) were placed in operation January, 1931. In the following ten years additional plants mushroomed to the system above, including the Sewage Treatment Plant. During that time (1931-40) the policy adopted toward their maintenance had been hampered by a depression; the combining of two City departments in 1937; a reclassification of City employees during 1938; all contributing to inefficient operation of the system.

The writer, a Junior Engineer, under the supervision of Mr. W. P. McNamara, Senior Engineer, was assigned the problem of operation and maintenance of the facilities in October, 1942.

This report inaugurates the first to be prepared as to the results of their operation. To make clear and to insure accuracy as to source of information to solve existing problems, it has been divided into two sections; namely,
(1) Sewage Treatment Plant and (2) Sewage Pumping Stations

pumping stations is not being presented, because of
involved to prepare.

operation of the facilities requires a new classification
employees. With this in mind, attention will be called
the subject matter presented to the present unethical
practice of operating sanitary engineering equipment by
personnel classified under Civil Service as "Auto Mechanics"
"Truck Drivers."

Seattle is a city entering metropolitan status, and
also a new era for sanitation facilities. The past decade
has been troubled. However, it is now possible, with the
pace again established, city finances not in the red, and
experience described in this report, to achieve efficient
operation.

sewage pumping stations is not being presented, because of work involved to prepare.

Operation of the facilities requires a new classification for employees. With this in mind, attention will be called to the subject matter presented to the present unethical practice of operating sanitary engineering equipment by personnel classified under Civil Service as "Auto Mechanics" or "Truck Drivers."

Seattle is a city entering metropolitan status, and also a new era for sanitation facilities. The past decade has been troubled. However, it is now possible, with the peace again established, city finances not in the red, and experience described in this report, to achieve efficient operation.

(1)

SEWAGE TREATMENT PLANT

The sewage treatment plant, located at 4545 East Marginal Way, was constructed as unit number 10 of the Henderson Street Trunk Sewer System during 1938-39, at a cost of \$316,992.24. Design of the plant is for primary treatment of sewage, using sedimentation, chlorination, and sludge digestion. The purpose of the plant is removal of settleable and floating sanitary wastes carried in sewage before it is discharged into the Duwamish River. The area serviced is all that served by the Michigan Street Trunk Sewer, Henderson Street Trunk Sewer, up to and including the Sewage Pumping Station, Henderson Street, Grattan Street and Holly Street, located on the shoreline of Lake Washington. The population served is not known exactly, but is estimated at 45,000. The capacity of the plant is 8.0 MGD, approximately 5,500 GPM. The plant facilities, pumping plant to digestors, are shown in Figure 1. Glass covered drying beds for dewatering residue of plant operation are not shown. There are three covered and one open air beds. The plant was given to the Maintenance Division for operation in January, 1940. Its operation since then to October, 1942, was intermittent and unsatisfactory. No record of results was taken.

As stated in the introduction, this report covers the period since October, 1942, to August, 1945, inclusive.

Starting Operation In October, 1942, the treatment plant was not operating, as designed. Investigation revealed that facilities, clarifiers and digestors were working, except that the contents tested Ph 5.2 minus, stale sludge.

With this condition existing, plant operation was unsatisfactory and no sewage gas suitable for use in plant heating equipment possible. Stale sludge, when digesting, gives off principally CO₂, carbon dioxide gas.

To correct the situation in the digestors, the clarifiers were drained and the inflow of fresh sewage to the plant stopped. Lime was then added to the digestors while circulating contents by pumping. After adding 1,100 pounds of lime over a period of days, a Ph 6.8 was obtained, suitable for operations, accompanied by violent foaming and high gas production. This condition prevailed for several days before gassing and foaming subsided to normal.

Before reopening the plant to receive sewage flow, all equipment was accurately calibrated for operation results. Plant operation was resumed November 15, 1942. Gas obtained subsequently was suitable for use in plant heating facilities.

Subsequent Difficulties and Operation

After resuming operation of the plant November 15, 1942, trouble was encountered with breaking of connection pipes between units, clarifiers, digestors, and control buildings (Figure 1).

Plant buildings and facilities are supported on piling, and connecting pipes layed in ground between units were not supported. Settlement of the ground caused breaking of pipes.

This trouble occurred three times after the plant was operating, and a shutdown was necessary to make repairs. When it happened the fourth time the plant was closed down from April 26 to October 22, 1943, to make a permanent repair. This permanent repair involved the construction of a pipe gallery tunnel between the units involved into which all piping has been placed.

After making this repair plant operation was periodical for a number of reasons, principally a labor shortage. During 1944 automatic controls were installed to help relieve this situation. Since their installation in September, 1944, it has been possible to operate the plant continuously up to the present time. The results obtained are shown graphically by Figures II, III and IV. Figures II and III show the amount of sludge pumped to the digestors, gas obtained and used for heating the plant facilities and also the excess gas burned off - wasted, not used for a useful purpose.

Sewage flow through plant, digester operation temperatures, outdoor temperature at 8:00 A. M. and precipitation for the year 1945 to date of report are recorded in Figure IV.

Automatic Controls The following automatic controls have been installed to relieve the labor shortage, and the technical and mechanical hazards incident to operating the plant. They function as safety features to prevent damage to equipment, and also to pump sludge from clarifiers to digestors, formerly a task requiring labor.

(1) Automatic control of sludge pumping to digestors, using time clock controls. With time clock control, any combination of pumping schedules can be had continuously or for definite periods of the day, depending on conditions.

(2) Automatic control of re-circulation of sludge in digestors to facilitate elutriation of raw sludge entering digester from clarifiers. This is also a time clock control with all the advantages as above for sludge pumping.

(3) Automatic control of inflow to digester so that overflowing of incoming sludge cannot occur in digester control building. This is a mercury switch control to pump control circuits, float operated.

(4) Automatic control to stop inflowing sewage to plant facilities in the advent of a power failure. This control is also designed to protect pumping plant from damage should a mechanical failure of pumps occur. Should this happen, inflow is stopped to plant and an emergency stand-by pump is cut in to dewater water rising to flood equipment.

In conjunction with the above controls, Bristle telltales have been connected into circuits to log operation. With these four controls, operation of plant equipment up to digestors is had mechanically - robot control - protecting plant from damage in the absence of personel attention.

Present Operating Practice - 1945 With automatic controls, plant operation is had; however, if this practice is not supplemented by maintenance upkeep, requiring qualified personnel, it cannot be continued. The present schedule is as follows:

Monday to Friday, inclusive, from 8:00 A. M. to 4:00 P. M., an attendant (Utility Laborer) is present at the plant for maintenance. From 4:30 P. M. to 8:00 A. M. next day, plant is on robot control - automatic - 16 hours.

On holidays, week-ends, etc., plant operates 24 hours on robot control, inspection visits being made by the writer to check operation and set controls to sewage flow conditions.

With the above operating schedule, no provision is made for mechanical maintenance, labor necessary for disposal of residue of plant sludge digestion, upkeep of plant appearance, and allowing vacations for employees.

The present disposal of residue is: lagooning on plant grounds, by opening and closing a valve when necessary. This method of disposal can be used for approximately 2 years before abandonment.

When emergencies arise, facilities of the Water Department, City Light Department and the Charles Street Shops are called upon for their correction. This is very unsatisfactory at present, especially with respect to the Charles Street shops. Delays result because of volume of work handled there for other departments of the city. With the labor situation as it is for operating the plants, delays in shop work result in delayed maintenance for other facilities.

SUMMARY OF PLANT OPERATION - 1942-45

During 1942-43 when the plant operated it was not possible to keep an accurate record of results. The many problems encountered, with work necessary in the supervising and engineering of plant repairs, with troubles had at the sewage pumping stations, did not permit the writer to accumulate data for an operation record.

With reconstruction of facilities and plant operation resumed, it was not until 1944 that time was available and a tabulation of results started. The summation of this data is now presented.

COST OF OPERATION OF SEWAGE TREATMENT PLANT
OCTOBER, 1942, TO AUGUST, 1945, INCLUSIVE

	<u>Oct., 1942 to Dec., 1942, inclusive</u>	<u>1943</u>	<u>1944</u>	<u>Jan. to Aug. 1945</u>	<u>Total</u>
<u>Engineering:</u>	1,678.91	7,948.18	6,757.81	5,657.70	22,042.11
Supervision					
Labor					
<u>City Light:</u>	-	165.33	89.78	-	255.11
Service					
Labor, Materials					
<u>Water Dept.:</u>	121.48	695.70	130.30	714.91	1,662.39
Service					
Labor, Materials					
<u>Charles St. Shops:</u>	5.79	165.01	1,040.22	805.48	2,016.50
Labor,					
Materials					
<u>Gas, Oil, Tires, Automotive Service</u>	86.76	1,049.76	458.30	388.56	1,983.38
<u>City Light:</u>	478.12	1,381.80	2,040.90	1,544.18	5,445.00
Power and					
Lighting					
Charges					
<u>Seattle Gas Co.</u>	134.78	341.40	456.95	167.76	1,100.98
Gas Use,					
Charges					
<u>Telephone Co.</u>	25.85	84.40	81.30	54.00	245.55
Charges					
<u>Materials, Supplies, Equipment</u>	342.27	1,418.00	883.18	1,111.87	3,755.32
	\$ 2,873.96	13,249.58	11,938.74	10,444.46	38,506.74

Operation Results 1944-45

During 1944, the treatment plant was in operation 241 days, not in operation 125 days, as indicated on Figure II. A summary of results is as follows:

Normal operation	209 days	
Minimum flow operation (raining)	32 "	
Plant not operating	125 "	
	<u>366 "</u>	
Sewage flow through plant	995.6 ⁶	Gallons
Average " " " per day	9,956 x 10 ⁶	M.G.D.
Sludge pumped to digestors	131,600	Cu.Ft.
Residue dried cake from sludge	3,948	" "
Sewage gas obtained	4,259,000	" "
" " used for heating	2,330,000	" "
" " wasted - burned off	1,928,000	" "

For the 125 days plant was idle gas was purchased from the Seattle Gas Co., amounting to 1,065,000 Cu. Ft.

- - - - -

For 1945, January to August, inclusive - 243 days:

Normal operation	209 days	
Minimum flow operation	34 "	
Plant not operating	0 "	
	<u>243 "</u>	
Sewage flow through plant	10,556 ⁶	Gallons
Average " " " per day	4.4	M.G.D.
Sludge pumped to digestors	83,675	Cu.Ft.
Residue dried cake from sludge #	--	
Sewage gas obtained	5,465,700	" "
" " used for heating	1,701,000	" "
" " wasted - burned off	3,764,700	" "
Purchased from Seattle Gas Co.	210,500	" "

Operation during 1944 was part manual and part automatic. Since October, 1944, to the present, 1945, it has been entirely automatic control. Labor available has been used to do cleaning and essential mechanical maintenance - greasing, for instance.

Digested sludge cake not taken as plant is now operated - lagooning sludge on plant grounds. See page 5.

(1)

SEWAGE PUMPING STATIONS

There are sixteen sewage pumping stations, twelve along Lake Washington. The plant names identify the locations. For instance, East Pine Street plant is located where East Pine Street fronts on the lake. Pumping stations not located on the lake shoreline are indicated by an "x" in front of plant name. A list of plants, in order of their installation, is given below.

<u>Name</u>	<u>Began</u>	<u>No. of</u>	<u>Total</u>	<u>Overhauled</u>
	<u>Opera-</u>	<u>Pumps</u>	<u>Capacity</u>	
	<u>tion</u>			
1 E. Pine St.	1931	2	3,000 GPM	1943-44
2 Charles St.	1931	1	1,030 GPM	--
3 E. Lynn St.	1932	2	2,000 GPM	1944-45 #
4 E. Lee St.	1932	2	3,000 GPM	1943-44
5 46th Ave. S.	1932	2	2,000 GPM	1944-45
6 Alaska St.	1932	1	360 GPM	--
x 7 Rainier	1932	3	8,200 GPM	1943-44
x 8 Dakota St.	1933	1	2,000 GPM	1945
9 Grattan St.	1935	2	2,250 GPM	--
10 Holly St.	1935	2	1,500 GPM	1945 #
x 11 30th Ave. N. E.	1936	2	8,000 GPM	1943-44 #
12 Belvoir	1936	2	6,000 GPM	1944
13 Montlake	1936	1	600 GPM	--
14 Henderson St.	1937	2	5,000 GPM	--
x 15 E. Marginal Way	1938	2	6,000 GPM	1944
x 16 W. Webster St.	1945	2	200 GPM	--

x Not located on shoreline of Lake Washington

Plants flooded, motors submerged in sewage water

Of the 16 plants, 10 have been overhauled during the last two years. Three of the 10 were flooded with sewage when mechanical failures occurred. The failures were traceable to poor maintenance.

All the stations contain a variety of electrical equipment to control the operation of sewage pumps and for protection of motors. Mechanical operation of the plants is comparatively simple. They operate automatically and require service only occasionally if kept clean and inspected regularly. Counter-weighted floats in wet wells of plants operating between set limits control pumping periods.

Maintenance Necessary Principal maintenance attention to plants in dry wells where electrical equipment, motors and pumps are located is to keep equipment dry, and to adjust packing glands of pumps. All pumps in stations with associated driving motors - except two, number 8 and 16 (Dakota Street and West Webster Street) - are below sewage level in suction well, so that an internal pressure exists, tending to force sewage water along pump shaft. Unless packing glands are tightened to exclude gritty material in sewage, scoring of wearing sleeves will occur. Also, sewage may gain access and flood equipment.

Suction wells - wet wells - of plants require constant attention for cleaning. Sewage solids, scum and the like collect here, causing odors and fouling of floats controlling pumping schedule.

Electrical equipment requires a minimum of labor attention. Replacements for stage starting relays for slip ring motors need attention occasionally. Collection rings on motors require smoothing and facing to brushes about once a year. Motors are oiled once a year.

The amount of attention depends on the actual operating time of the plant. Some plants operate an average of 10 to 12 hours per day. However, the majority of them average in the vicinity of 2 to 4 hours per day.

COST MAINTENANCE SEWAGE PUMPING STATIONS
OCTOBER, 1942, TO AUGUST, 1945, INCLUSIVE

<u>Name</u>	<u>Equipment and Mtls.</u>	<u>Supervision Labor</u>	<u>Services City Light</u>	<u>Services Water Dept.</u>	<u>Services Charles St.</u>	<u>Power & Light</u>	<u>Total</u>
E. Pine St.	130.63	935.88	175.79	-	144.49	6,377.00	7,763.79
Charles St.	119.06	863.10	38.62	-	5.40	708.40	1,734.58
E. Lynn St.	233.78	746.87	55.27	5.54	90.19	619.68	1,751.33
E. Lee St.	157.82	1,180.91	150.82	10.69	128.24	3,560.59	5,189.07
46th Ave. S.	152.83	950.22	18.97	-	22.00	729.51	1,873.53
Alaska St.	114.66	935.88	-	-	49.40	179.42	1,279.36
x Rainier	162.71	1,150.90	109.46	9.00	647.03	3,694.24	5,773.34
x Dakota St.	161.69	645.67	21.87	-	332.74	591.73	1,753.70
Grattan St.	114.67	599.10	2.69	44.03	-	678.78	1,439.27
Holly St.	185.53	991.90	8.06	-	2.70	395.17	1,583.36
30th Ave. N.E.	463.02	1,210.00	383.25	10.00	310.38	4,641.97	7,018.62
Belvoir	149.08	935.50	45.22	-	545.43	2,492.17	4,167.40
Montlake	114.66	896.70	-	-	-	695.62	1,706.98
Henderson St.	152.32	950.90	85.29	-	2.70	2,032.58	3,223.74
x E. Marginal Wy.	133.54	1,040.67	23.18	-	188.00	4,123.87	5,509.26
x W. Webster	-	4.02	-	-	-	34.52	38.54
Totals	2,546.00	14,038.22	1,118.49	79.26	2,468.70	31,555.20	51,805.87

PERSONNEL FOR OPERATING PLANTS

To operate the facilities described in this report, including the sewage treatment plant, the following operating personnel was available in October, 1942.

Actual plants operating personnel:

1	Civil Service Classification	Common Lab.	at	145.00	per	mo.
2	"	"	Utility	"	155.00	" "
2	"	"	Maint.	"	180.00	" "
1	"	"	Auto Mech.	"	200.00	" "

Total per month, no overtime \$1,015.00 " "

In Central Office, County-City Building:

1 Civ. Serv. Classif. Senior Engineer 1/3 116.67 " "

Grand TOTAL \$1,131.67 " "

At the present time, October, 1945, 3 years later, the operating personnel is as follows:

Actual plants operating personnel:

2	Civ. Serv. Classif.	Utility Laborer	at	170.00	per	mo.
1	"	"	Truck Driver	"	205.00	" "
1	"	"	Junior Engineer	"	225.00	" "

Total per month, no overtime 770.00 " "

In Central Office, County-City Building:

1 Civ. Serv. Classif. Senior Engineer 1/3 121.67 " "

GRAND TOTAL \$ 891.67 " "

In the paragraph entitled "Present Operating Practice," page 5, was described how this personnel was used in the Treatment Plant Operation. The "Truck Driver" and "Utility Laborer" of the 1945 personnel are used to give maintenance at the sewage pumping stations 3 days a week and the other 2 days are spent at the treatment plant to do essential tasks. It is not possible to give full maintenance coverage of facilities with this arrangement and it will have to be corrected if operation is to be continued.

ANALYSIS PAST OPERATION

A study of this report will show that the prime cause for the failure to operate a sewage treatment plant efficiently, according to design, was insufficient and poor selection of employees.

As indicated above, 5 men were available in October, 1942, to maintain the facilities. Their Civil Service Classifications were "Laborer" or "Auto Mechanic." In this case the auto mechanic was the supervisor in charge of 4 laborers of different grades. They were the actual plants operating personnel."

With this breakdown in mind, to operate sanitary engineering equipment installed at the sewage treatment plant, a \$316,992.24 unit, as well as maintain 15 sewage pumping stations located in various parts of the city, required supervision qualified to direct this type of work. The record is not consistent with respect to labor, in this case, when viewed in the light that it existed under a City Engineer's office maintained by a city as large as Seattle.

As shown for 1945, 2 "Laborers" and a "Truck Driver" now are charged with operation and maintenance under the direction of a "Junior Engineer." The ratio in this case is 6 to 4, two-thirds the 1942 personnel. At the present time, 1945, all plants are operating. In 1942 they were not. As the Engineering Department policy now stands, with respect to operating personnel, the "Truck Driver" is intended to act as a foreman to direct labor for sanitary work involved. The reason given is that truck drivers are paid the same rating that would apply to a Foreman for sewage plant operation.

This is probably correct. However, to assign Truck Drivers now employed by the city to fill this position throws the burden of educating the person selected upon the Junior Engineer. From experience, they are lacking in educational background.

The Junior Engineer has found no relief in his duties of supervising, engineering and cost accounting because of work he is called upon to do that a Foreman qualified for this type of work should do.

SUGGESTIONS FOR IMPROVING OPERATION:

Suggested operation personnel, with titles, is given below to correct conditions now existing.

To operate Sewage Treatment Plant:

- 2 Sewage Plant Operators (High School Education)
- 2 Stationary Engineers (License required)
- 1 Painter
- 2 Maintenance Laborers
- 4 Laborers (Utility and Common)

To inspect, clean, 16 Sewage Pumping Plants, 1 Sewage Ejector Station at Broadmoor and Septic Tank:

- 1 Sewage Plant Inspector (High School Education)
- 1 Maintenance Laborer

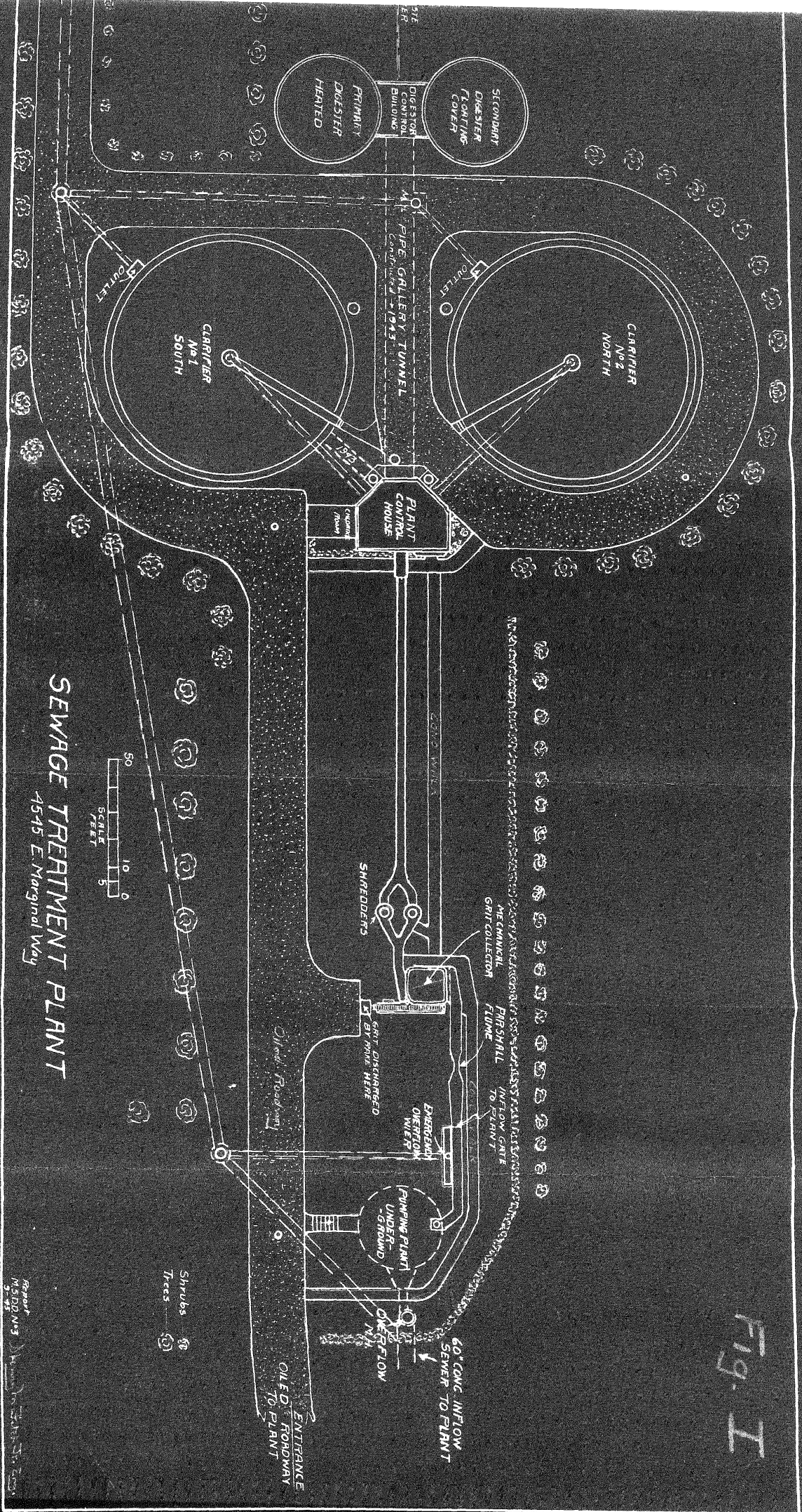
With the above personnel to maintain the Sewage Treatment Plant, and 16 pumping stations, along with the facilities available for overhauling and repairing equipment at the City's Charles Street Shops, the efficient operation of all units of the Sewage Disposal Division can be maintained and improved on to achieve a more efficient working unit. Ultimate efficiency and results achieved will depend on ability of superintendent to direct work.

SUMMARY AND CONCLUSION:

As plants and facilities grow older, more maintenance is needed. The efficiency of the pumps is less, requiring more power. Repairs and renewals for all equipment are more frequently needed.

The skill with which plants are managed influences maintenance costs. Wages paid for skilled and unskilled labor, as well as that paid the technical staff, are reflected in the operating costs.

Since the writer was assigned to the operation of sewage plants in 1942, he has never been able to work a 40-hour week, and enjoy holidays and week-ends, without being burdened with responsibilities not in line with that called for under a Junior Engineer's title. During this time operating efficiency never matched by previous personnel has been attained. The question is - will the interest and effort put forth by the writer, under the supervision of Mr. McNamara, Senior Engineer, to achieve what has been done to date, at the sacrifice of so much personal effort, bear fruit in this post war period?



SEWAGE TREATMENT PLANT

4545 E. Marginal Way

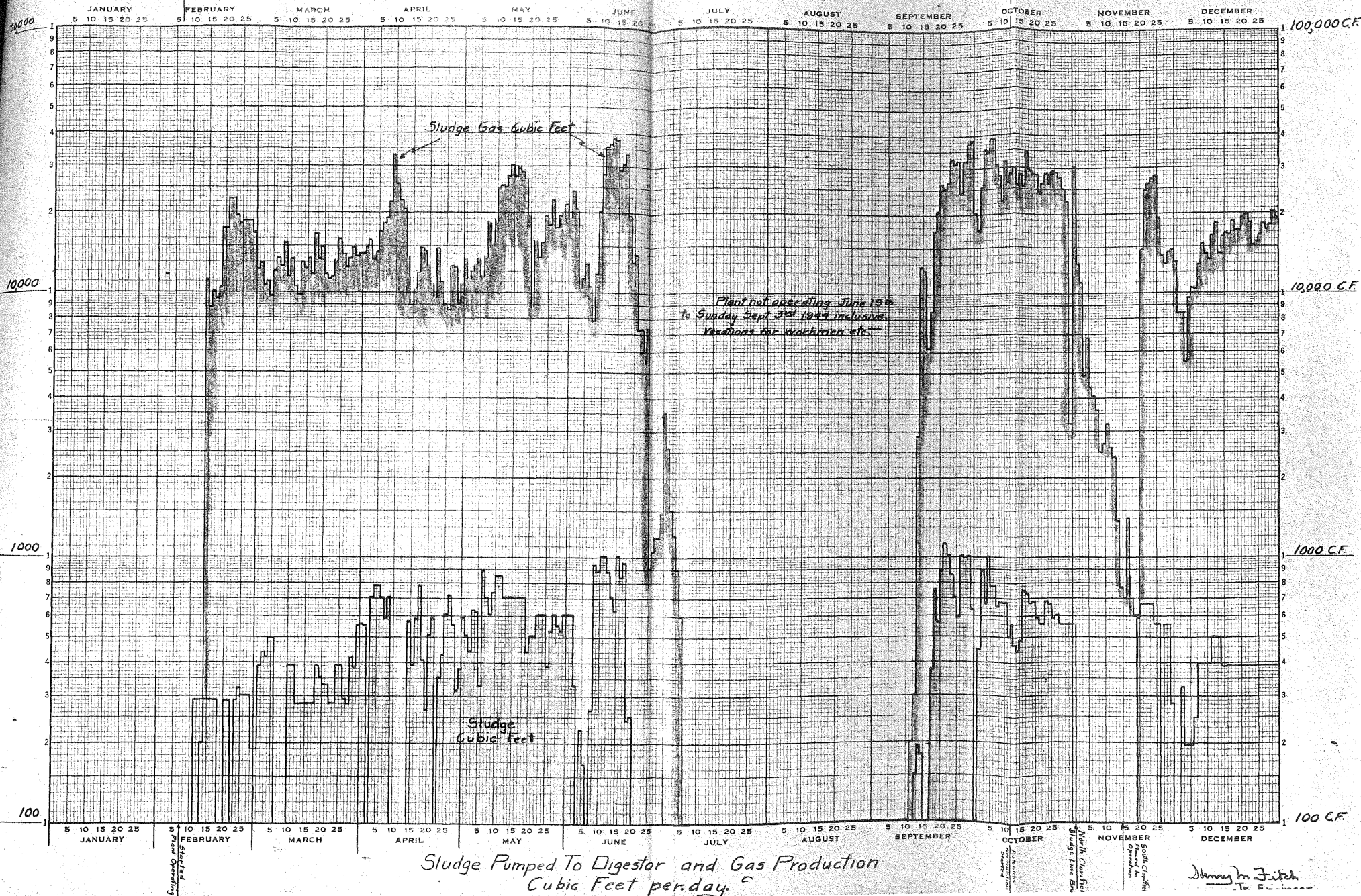
Fig. I

Shirley J. Smith
Jr. Engineer

Report
1950-51
S. 12

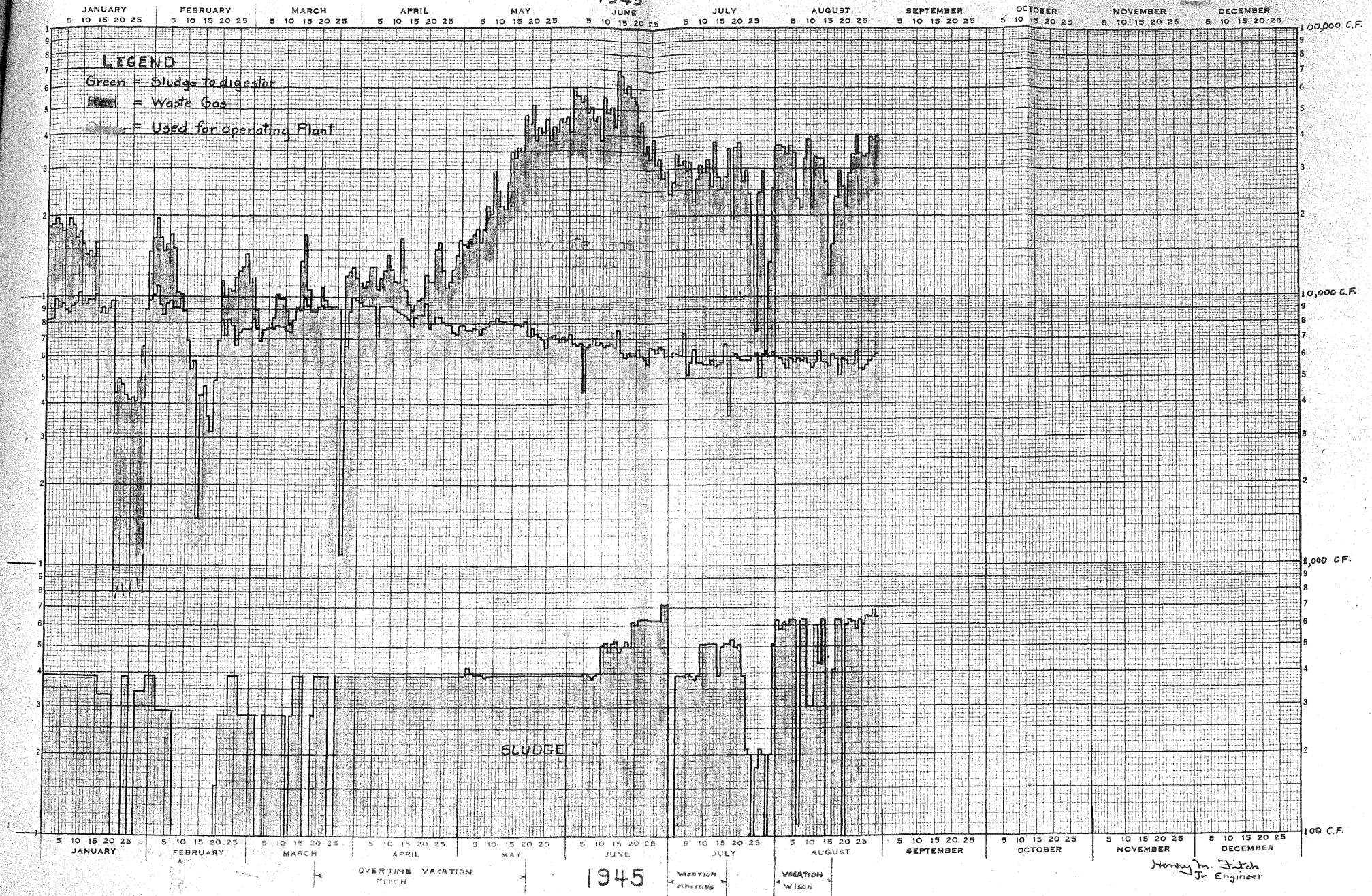
1944

Fig II



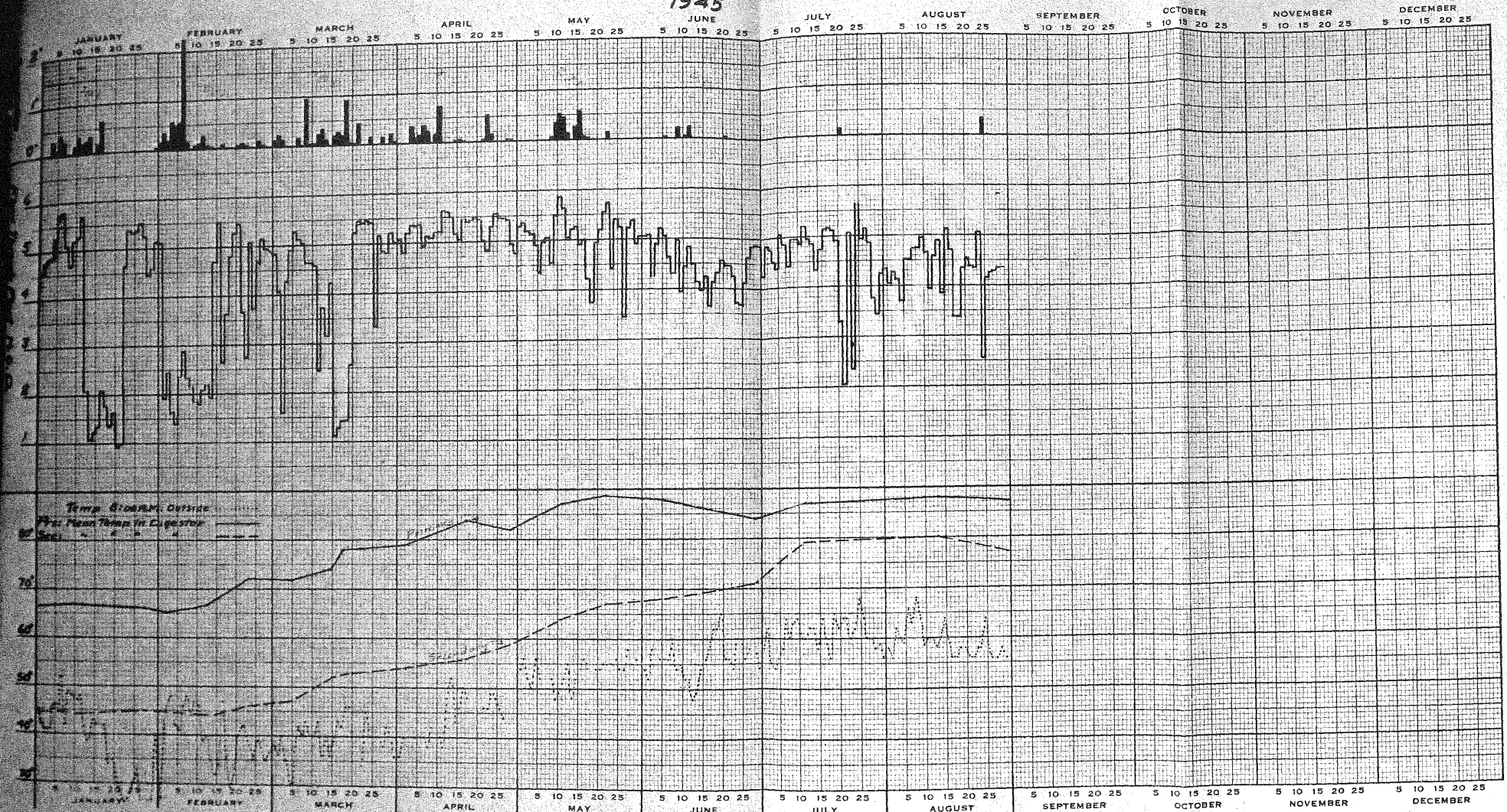
Sewage Treatment Plant 1945

Fig III



Sewage Treatment Plant 1945

Fig IV



1945

Henry M. Fitch
Jr. Engineer

NOV 18 1975

10PP

PCB spill and its removal--Federal Center South, Seattle, WA

The Record

The Air Material Command has accepted responsibility for the transformer oil spill (PCB) that occurred September 13, 1974, at Federal Center South. The COE has been charged with the responsibility for the removal of the contaminated PCB from the Duwamish waterway. They had intended to dredge the waterway and remove the material during the month of December 1975, and the total time to accomplish the work would last no longer than 30 days. The site planned to be used for disposal of the PCB is now not available and consequently until this problem can be resolved, no immediate action is planned for the removal of the material.

Prior to this happening, arrangements were being worked out with BIA, the Captain of the North Star, etc., for the vessel not to return to Federal Center South the weekend before Thanksgiving but to berth at another location until the project was completed. Mr. Barnes of Real Property Division was going to attempt to have the vessel North Star III tie up at pier 90-91 pending the removal of the PCB spill. However, all such action is to be suspended and the BIA has been advised to utilize Federal Center South for their vessel.

Should action to initiate this project get underway again and a firm schedule developed, the BIA has been advised that their vessel will have to be moved at that time. We will then require the assistance of Real Property Division to help us find a berthing site. Mr. Hal Lesmeister of the COE has been advised that we will make no further plans at this time but will require two or three weeks of leadtime to complete all necessary arrangements.

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W. R. BARRICK
Special Projects Officer
Public Buildings Service

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✓	(b) (6)	✓	(b) (6)	Team DH	
✓	(b) (6)	✓	(b) (6)	Team DI	
✓	(b) (6)	✓	(b) (6)	Team DJ	
✓	(b) (6)	✓	(b) (6)	Team DK	
✓	(b) (6)	✓	(b) (6)	Team DL	
✓	(b) (6)	✓	(b) (6)	Team DM	
✓	(b) (6)	✓	(b) (6)	Team DN	
✓	(b) (6)	✓	(b) (6)	Team DO	
✓	(b) (6)	✓	(b) (6)	Team DP	
✓	(b) (6)	✓	(b) (6)	Team DQ	
✓	(b) (6)	✓	(b) (6)	Team DR	
✓	(b) (6)	✓	(b) (6)	Team DS	
✓	(b) (6)	✓	(b) (6)	Team DT	
✓	(b) (6)	✓	(b) (6)	Team DU	
✓	(b) (6)	✓	(b) (6)	Team DV	
✓	(b) (6)	✓	(b) (6)	Team DW	
✓	(b) (6)	✓	(b) (6)	Team DX	
✓	(b) (6)	✓	(b) (6)	Team DY	
✓	(b) (6)	✓	(b) (6)	Team DZ	
✓	(b) (6)	✓	(b) (6)	Team EA	
✓	(b) (6)	✓	(b) (6)	Team EB	
✓	(b) (6)	✓	(b) (6)	Team EC	
✓	(b) (6)	✓	(b) (6)	Team ED	
✓	(b) (6)	✓	(b) (6)	Team EE	
✓	(b) (6)	✓	(b) (6)	Team EF	
✓	(b) (6)	✓	(b) (6)	Team EG	
✓	(b) (6)	✓	(b) (6)	Team EH	
✓	(b) (6)	✓	(b) (6)	Team EI	
✓	(b) (6)	✓	(b) (6)	Team EJ	
✓	(b) (6)	✓	(b) (6)	Team EK	
✓	(b) (6)	✓	(b) (6)	Team EL	
✓	(b) (6)	✓	(b) (6)	Team EM	
✓	(b) (6)	✓	(b) (6)	Team EN	
✓	(b) (6)	✓	(b) (6)	Team EO	
✓	(b) (6)	✓	(b) (6)	Team EP	
✓	(b) (6)	✓	(b) (6)	Team EQ	
✓	(b) (6)	✓	(b) (6)	Team ER	
✓	(b) (6)	✓	(b) (6)	Team ES	
✓	(b) (6)	✓	(b) (6)	Team ET	
✓	(b) (6)	✓	(b) (6)	Team EU	
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✓	(b) (6)	✓	(b) (6)	Team EX	
✓	(b) (6)	✓	(b) (6)	Team EY	
✓	(b) (6)	✓	(b) (6)	Team EZ	
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✓	(b) (6)	✓	(b) (6)	Team FB	
✓	(b) (6)	✓	(b) (6)	Team FC	
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✓	(b) (6)	✓	(b) (6)	Team FF	
✓	(b) (6)	✓	(b) (6)	Team FG	
✓	(b) (6)	✓	(b) (6)	Team FH	
✓	(b) (6)	✓	(b) (6)	Team FI	
✓	(b) (6)	✓	(b) (6)	Team FJ	
✓	(b) (6)	✓	(b) (6)	Team FK	
✓	(b) (6)	✓	(b) (6)	Team FL	
✓	(b) (6)	✓	(b) (6)	Team FM	
✓	(b) (6)	✓	(b) (6)	Team FN	
✓	(b) (6)	✓	(b) (6)	Team FO	
✓	(b) (6)	✓	(b) (6)	Team FP	
✓	(b) (6)	✓	(b) (6)	Team FQ	
✓	(b) (6)	✓	(b) (6)	Team FR	
✓	(b) (6)	✓	(b) (6)	Team FS	
✓	(b) (6)	✓	(b) (6)	Team FT	
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✓	(b) (6)	✓	(b) (6)	Team FV	
✓	(b) (6)	✓	(b) (6)	Team FW	
✓	(b) (6)	✓	(b) (6)	Team FX	
✓	(b) (6)	✓	(b) (6)	Team FY	
✓	(b) (6)	✓	(b) (6)	Team FZ	
✓	(b) (6)	✓	(b) (6)	Team GA	
✓	(b) (6)	✓	(b) (6)	Team GB	
✓	(b) (6)	✓	(b) (6)	Team GC	
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✓	(b) (6)	✓	(b) (6)	Team GI	
✓	(b) (6)	✓	(b) (6)	Team GJ	
✓	(b) (6)	✓	(b) (6)	Team GK	
✓	(b) (6)	✓	(b) (6)	Team GL	
✓	(b) (6)	✓	(b) (6)	Team GM	
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✓	(b) (6)	✓	(b) (6)	Team GS	
✓	(b) (6)	✓	(b) (6)	Team GT	
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✓	(b) (6)	✓	(b) (6)	Team HA	
✓	(b) (6)	✓	(b) (6)	Team HB	
✓	(b) (6)	✓	(b) (6)	Team HC	
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✓	(b) (6)	✓	(b) (6)	Team HK	
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✓	(b) (6)	✓	(b) (6)	Team HQ	
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✓	(b) (6)	✓	(b) (6)	Team HU	
✓	(b) (6)	✓	(b) (6)	Team HV	
✓	(b) (6)	✓	(b) (6)	Team HW	
✓	(b) (6)	✓	(b) (6)	Team HX	
✓	(b) (6)	✓	(b) (6)	Team HY	
✓	(b) (6)	✓	(b) (6)	Team HZ	
✓	(b) (6)	✓	(b) (6)	Team IA	
✓	(b) (6)	✓	(b) (6)	Team IB	
✓	(b) (6)	✓	(b) (6)	Team IC	
✓	(b) (6)	✓	(b) (6)	Team ID	
✓	(b) (6)	✓	(b) (6)	Team IE	
✓	(b) (6)	✓	(b) (6)	Team IF	
✓	(b) (6)	✓	(b) (6)	Team IG	
✓	(b) (6)	✓	(b) (6)	Team IH	
✓	(b) (6)	✓	(b) (6)	Team II	
✓	(b) (6)	✓	(b) (6)	Team IJ	
✓	(b) (6)	✓	(b) (6)	Team IK	
✓	(b) (6)	✓	(b) (6)	Team IL	
✓	(b) (6)	✓	(b) (6)	Team IM	
✓	(b) (6)	✓	(b) (6)	Team IN	
✓	(b) (6)	✓	(b) (6)	Team IO	
✓	(b) (6)	✓	(b) (6)	Team IP	
✓	(b) (6)	✓	(b) (6)	Team IQ	
✓	(b) (6)	✓	(b) (6)	Team IR	
✓	(b) (6)	✓	(b) (6)	Team IS	
✓	(b) (6)	✓	(b) (6)	Team IT	