Lower Duwamish Waterway Source Control Sufficiency Evaluation Report Upper Reach

Prepared for: U.S. Environmental Protection Agency

Prepared By

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DEPARTMENT OF ECOLOGY
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This report is available on the Department of Ecology's website at: https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Cleanup-sites/Lower-Duwamish-Waterway/Source-control

Cover photo credit: Photo of the Lower Duwamish Waterway at the turning basin, taken by Anthony Wenke on behalf of Ecology, 2023.

Related Information

- Publication 22-09-166: Focus on: LDW Source Control Sufficiency[1]
- Publication 16-09-339: LDW Source Control Strategy[2]
- Ecology's LDW Project Library and Webpage[3]
- EPA's LDW Project Webpage[4]
- LDWG Superfund Cleanup Library[5]

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[1] https://apps.ecology.wa.gov/publications/SummaryPages/2209166.html
[2] https://apps.ecology.wa.gov/cleanupsearch/document/56204
[3] https://apps.ecology.wa.gov/cleanupsearch/site/1643#site-documents
[4] https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=1002020
[5] https://ldwg.org/project-library/

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ACRONYMS AND ABBREVIATIONS

AC	Activated Carbon
the Agencies	Washington State Department of Ecology and the U.S. Environmental Protection Agency
AO	Agreed Order or Administrative Order
BDC	Boeing Developmental Center
BMP	best management practice(s)
Boeing	Boeing Company
CAP	Cleanup Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	contaminants of concern
CSCSL	Confirmed and Suspected Contaminated Sites List
CSM	Conceptual Site Model
CSO	combined sewer overflow
CSWGP	Construction Stormwater General Permit
CWA	Clean Water Act
EAA	Early Action Area
Ecology	Washington State Department of Ecology
EF	exceedance factor
ENR	Enhanced Natural Recovery
EOF	Emergency Overflow
EPA	U.S. Environmental Protection Agency
FNC	Federal Navigation Channel
FS	Feasibility Study
ft	feet
HPAH	High-molecular-weight Polycyclic Aromatic Hydrocarbon
IAWP	Interim Action Work Plan
ISGP	Industrial Stormwater General Permit
KCIA	King County International Airport
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
mg/kg	milligrams per kilogram
MS4	Municipal Separate Storm Sewer System
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCUL	Preliminary Cleanup Levels
PLP(s)	Potentially Liable Person(s)
RAL	Remedial Action Level
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation

RM	River Mile
ROD	Record of Decision
SCA	Source Control Area
SCAP	Source Control Action Plan
SCIP	Source Control Implementation Plan
SD	Storm Drain(age)
SPU	Seattle Public Utilities
SWMU	Sediment Waste Management Unit
T-117	Terminal 117
TEQ	Toxic Equivalency Quotient
WQ	Water Quality
WQP	Ecology's Water Quality Program

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- King County
- City of Seattle
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EXECUTIVE SUMMARY

The Washington State Department of Ecology (Ecology) prepared this Source Control Sufficiency Evaluation Report (SER) of the Upper Reach of the Lower Duwamish Waterway (LDW) Superfund site for the U.S. Environmental Protection Agency (EPA). EPA is the lead agency for the LDW sediment cleanup. Ecology is the lead agency for coordinating and implementing source control in the LDW.

The purpose of this SER is to document the source control sufficiency evaluation and Ecology's recommendations regarding if potential sources of contamination to the Upper Reach in-waterway areas are sufficiently controlled for the EPA to proceed with the scheduled in-water sediment remedial activities.

Ecology evaluated source control sufficiency for in-waterway cleanup areas that are scheduled for active remediation. In this report, we refer to these active in-waterway cleanup areas as Remedial Action Level (RAL) exceedance areas, corresponding to the design terminology used by LDWG and EPA at the time sufficiency was evaluated.

Source control sufficiency is the point at which sources of contaminants of concern (COCs) to the LDW are controlled enough for the EPA's active in-water sediment remediation to proceed with a minimal risk that the surface sediments will recontaminate above the Record of Decision (ROD) RALs (EPA, 2014).

In this SER, Ecology summarized the geographic and chemical scope of the source control evaluation, the types of information evaluated, basin-wide source control information for the Upper Reach, and sufficiency recommendation categories.

Ecology's source control sufficiency recommendations are organized in the following categories:

- Sources are sufficiently controlled: we recommend the area of sediment cleanup proceed. The risk of recontamination above RALs is minimal.
- Sources are conditionally controlled: we recommend the area of sediment cleanup proceed, with the condition that certain additional controls or oversight should be implemented in the near future.
- Sources are controlled with qualifications: we recommend the area of sediment cleanup proceed if there are substantial information gaps in the area evaluated.
- Sources are not sufficiently controlled: we recommend the sediment cleanup in the area does not proceed until additional controls have been implemented and assessed for effectiveness.

The findings of this report include:

- A summary of the upland areas and source control features.
- A summary of RAL exceedance areas, chemical drivers, and proximity to the shoreline areas.
- Sufficiency findings for incomplete action items.
- Source Control Work Group (SCWG) Source Control program sufficiency findings.

- Ecology's Water Quality Program (WQP) sufficiency findings.
- Ecology's sufficiency findings for upland contaminated site cleanups.

Ecology identified one cleanup site where the sources are not sufficiently controlled. Boeing Isaacson Thompson Site is located on the east bank of the LDW at River Mile 3.8. Sources identified on the northern portion of this site are associated with RAL exceedance area 18. The sources at this Site are not sufficiently controlled to prevent recontamination above the ROD RALs. The current cleanup schedule requires completion of a Feasibility Study (FS) and preparing a Cleanup Action Plan (CAP).

Ecology cannot determine when sources to RAL exceedance area 18 will be sufficiently controlled, but the schedule of upland remediation at the Boeing Isaacson Thompson site will likely extend beyond the EPA's October 2024 timeframe to begin sediment remediation. Ecology recommends that EPA does not proceed with in-waterway remediation for area 18.

Ecology's source control sufficiency recommendations for the Upper Reach of the LDW are summarized below (Table ES-1).

Table ES-1: Upper Reach Sufficiency Recommendation Summary

Recommendation Outcome to EPA	Sufficiency Recommendation Category	Remedial Action Level (RAL) Exceedance Areas	Associated Source Control Areas
Not applicable, and not evaluated	Not applicable	1[a], 6[ab], 7[a], 8[a], 9[b], 10[a]	Riverside Drive
Proceed with sediment cleanup	Sources are sufficiently controlled (some recommendations may include minor qualifications or conditions)	2, 3, 4, 5, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 25, 26, 27, 30, 31	Early Action EAA-4: Boeing Plant 2 to Jorgensen Forge, Boeing Isaacson/Central KCIA, EAA-5: Terminal 117, Sea King Industrial Park, Restoration Areas
Proceed with sediment cleanup, noting significant information gaps[c]	Sources are conditionally controlled; Sources are controlled with qualifications	22, 28, 29, 32, 33, 34, 35	Boeing Isaacson/Central KCIA, Slip 6, Boeing Developmental Center, EAA-7: Norfolk CSO/SD
Do not proceed with sediment cleanup	Sources are not sufficiently controlled	18	Boeing Isaacson/Central KCIA

[a]RAL exceedance areas associated with the Middle Reach (Riverside Drive SCA) are not evaluated in this SER.

[b] RAL exceedance area 6 is an artifact from the interpolation process and LDWG is collecting additional data during Phase III pre-design investigations to confirm whether to assign an active remedial technology. RAL exceedance area 9 is an artifact from the interpolation process and EPA expects no active in-water remedy to occur.

[c] RAL exceedance areas that correspond to shoreline areas where there are significant information gaps in our understanding of soil and/or groundwater sources to the river and where additional sampling and analysis is planned in the near term. Ecology qualifies our recommendation that the EPA proceed with these RAL exceedance areas considering the existing substantial information gaps and the additional data collection planned to occur prior to the EPA's in-waterway cleanup.

1 INTRODUCTION

The Washington State Department of Ecology (Ecology) prepared this Source Control Sufficiency Evaluation Report (SER) of the Upper Reach of the Lower Duwamish Waterway (LDW) Superfund site for the U.S. Environmental Protection Agency (EPA).

1.0 Lower Duwamish Waterway Superfund Site

The LDW Superfund site is in Seattle and Tukwila, Washington. EPA added the LDW to the National Priorities List under its Superfund cleanup program in 2001. The LDW Superfund site is approximately 5 miles long represents the downstream portion of the Duwamish River. The site extends from the southern tip of Harbor Island in Seattle, to just south of the upper turning basin near South 102nd Street in Tukwila.

EPA is the lead agency for the LDW sediment investigation and Ecology is the lead agency for coordinating and implementing source control in the LDW. The Lower Duwamish Waterway Group (LDWG), composed of the City of Seattle, King County, the Port of Seattle, and the Boeing Company (Boeing), entered an Administrative Order on Consent for a Remedial Investigation/Feasibility Study (RI/FS). LDWG completed the RI in July 2010 and the FS in October 2012.

The source area is defined by the combined stormwater/sanitary sewer service area and the separated stormwater drainage basins. The total area that discharges to the LDW encompasses 20,400 acres, or approximately 32 square miles (Figure 1).

Figure 1: Lower Duwamish Waterway Source Area

Contaminants of concern (COCs) in the waterway that pose a health risk to humans, the benthic community, and/or wildlife in the LDW include:

- Metals,
- Polycyclic aromatic hydrocarbons (PAHs),
- Polychlorinated biphenyls (PCBs),
- Dioxins/furans,
- Phthalates, and
- Other organic compounds.

1.1 Source Control Implementation

Ecology developed a Source Control Strategy (Strategy) for the LDW in 2004 and revised the Strategy in 2016 (Ecology, 2016a). The goals and objectives for Ecology's LDW Source Control program are described in the Strategy. The first goal is a near-term goal to allow the start of active in-waterway cleanup. The second goal is a long-term goal to minimize the risk of recontaminating sediments above the sediment cleanup standards established in the Record of Decision (ROD).

Ecology, the City of Seattle, King County, the Port of Seattle, the City of Tukwila, the Puget Sound Clean Air Agency, the Washington State Department of Transportation, and EPA have been active participates in coordinating source control work in the LDW. Together, they are known as the Source Control Work Group (SCWG).

As part of source control efforts in the LDW, Ecology worked with members of the SCWG to divide the LDW into 24 sub-basins, referred to as Source Control Areas (SCAs) (Figure 2).

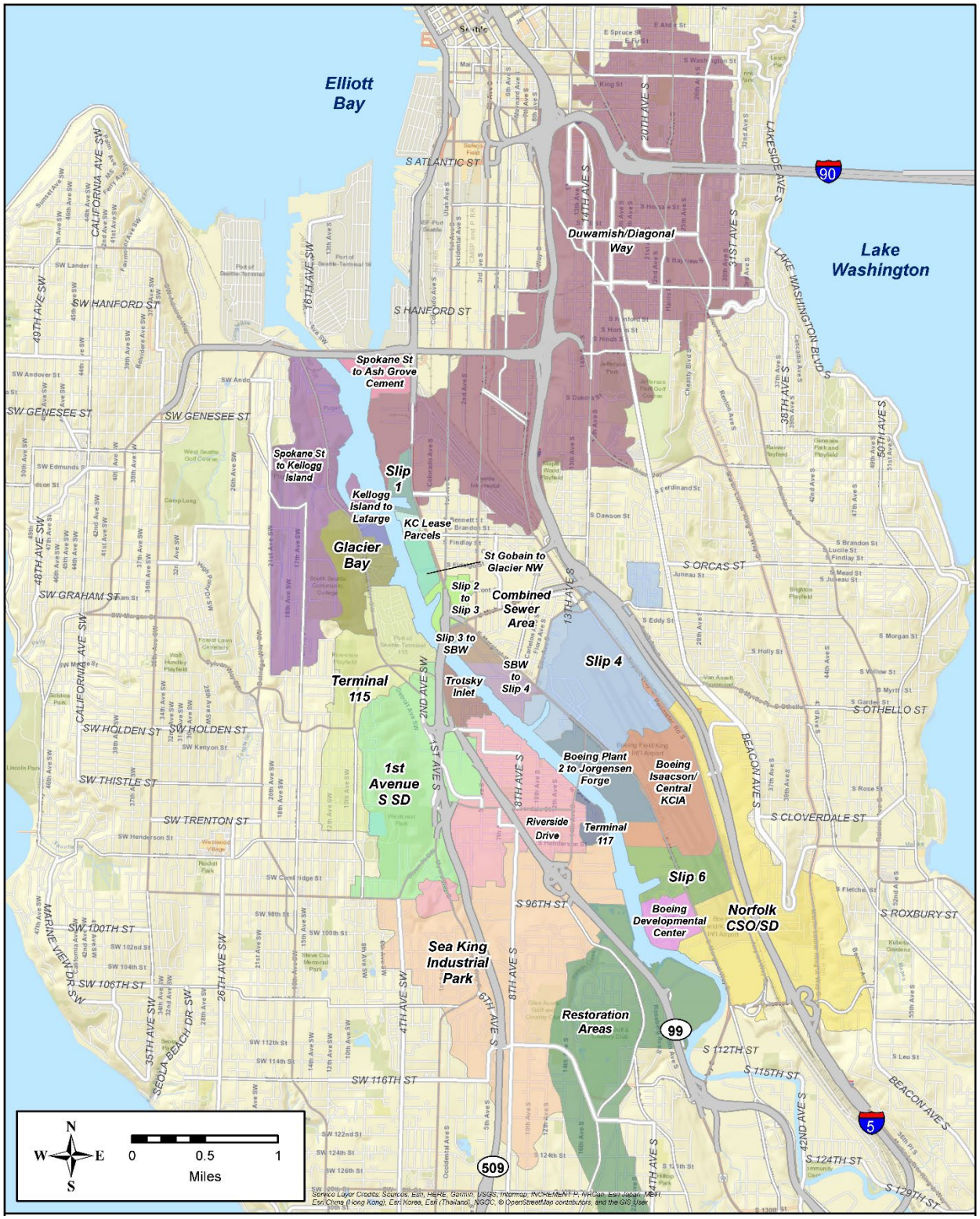

Figure 2: Lower Duwamish Waterway Source Control Areas

Ecology developed Source Control Action Plans (SCAPs) for each of the SCAs in the LDW. The SCAPs includes an initial list of source control action items needed to identify and control contaminant sources. Ecology prioritized the action items as high, medium, and low.

High-priority action items need to be completed prior to sediment cleanup actions. Medium-priority action items can be completed prior to, or concurrent with, sediment cleanup actions. Low-priority action items are either ongoing or are actions that can be completed as resources become available.

Ecology organized the 24 SCAs as the Upper Reach, Middle Reach, and Lower Reach of the LDW (Figure 3). Ecology uses an upstream-to-downstream approach to source control.

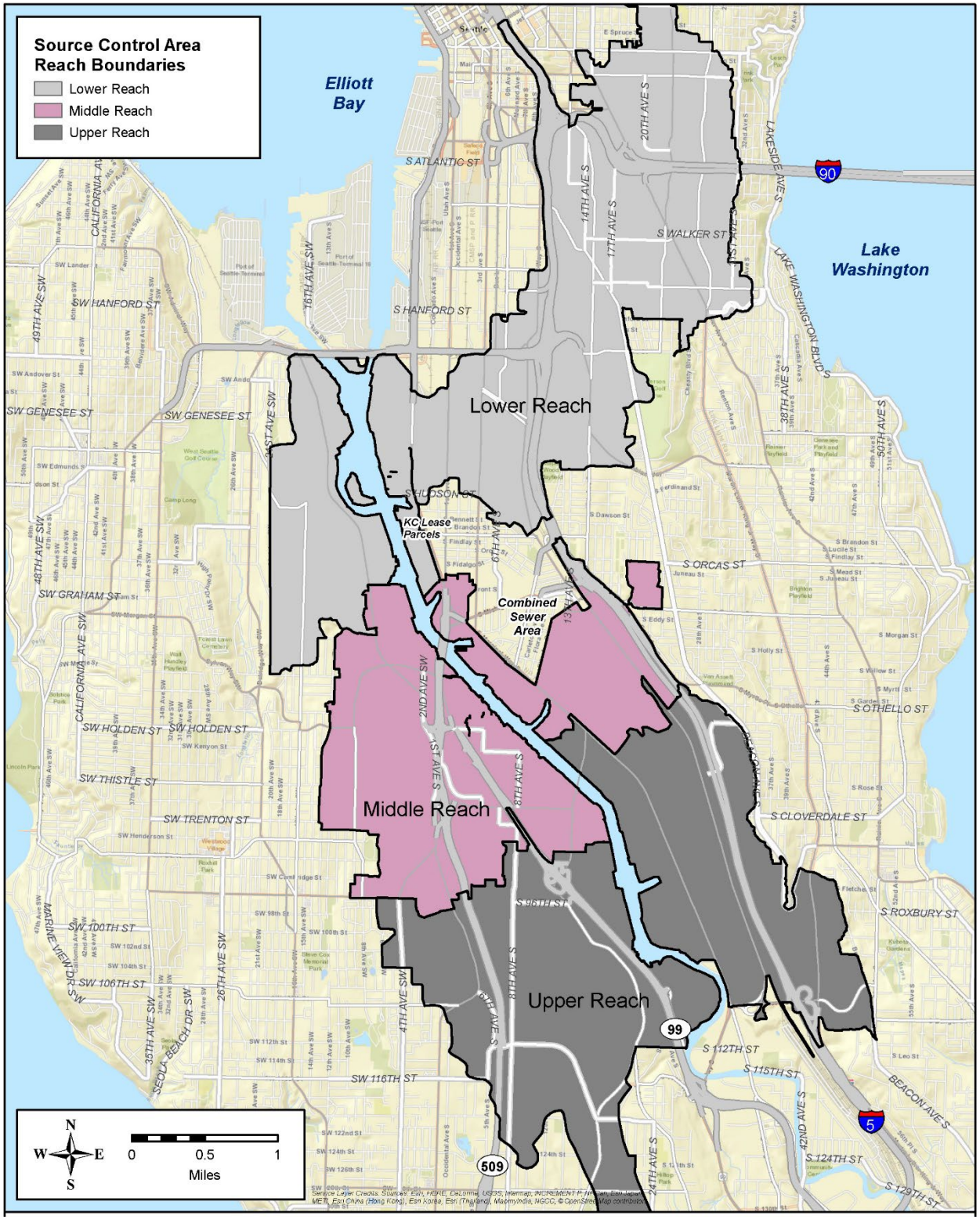

Figure 3: Lower Duwamish Waterway Reach Boundaries

1.2 Source Control Sufficiency

Ecology is responsible for evaluating source control and providing source control sufficiency recommendations to EPA. The purpose of this SER is to document Ecology's source control sufficiency evaluation for the Upper Reach of the LDW and to provide EPA with recommendations.

Ecology has defined source control sufficiency as the point at which sources of COCs to the LDW are controlled enough for the EPA's active in-water sediment remediation to proceed with a minimal risk that the surface sediments will recontaminate above the ROD Remedial Action Levels (RALs). Refer to the Strategy for additional information.

Ecology evaluated source control for in-waterway cleanup areas that the EPA and LDWG scheduled for active remediation. Ecology conducted source control evaluations for dredging, capping, and Enhanced Natural Recovery (ENR) remediation. Ecology did not evaluate source control for the Monitored Natural Recovery areas since the sediments already meet the RALs.

1.3 Report Organization

This SER is organized as follows:

Section 1—INTRODUCTION: Summarizes the LDW and the Superfund Selected Remedy; and presents the goals, purpose, objectives, and organization of this SER.

Section 2—SOURCE CONTROL SUFFICIENCY EVALUATION: Describes the sufficiency evaluation process, including the geographic and chemical scope of the Upper Reach evaluations, the types of information evaluated, and Upper Reach metrics for each type of information.

Section 3—SUFFICIENCY EVALUATION FINDINGS: Documents the findings of the source control evaluation, organized by each of the eight SCAs within the Upper Reach.

Section 4—SUFFICIENCY RECOMMENDATIONS: Summarizes recommendation outcomes for each RAL exceedance area associated with the eight SCAs.

Section 5—REFERENCES: Includes a list of References.

APPENDICES—Appendix A summarizes the remaining high-and medium-priority action items and includes a summary table of the high- and medium-priority action items in the Upper Reach. Appendix B provides a folio with map figures.

Ecology organized this SER into sections for each SCA in the Upper Reach. The SCAs are reported from east bank to west bank and from north to south, starting from the Boeing Isaacson/Central King County International Airport (KCIA) SCA and ending at the Restoration Areas SCA.

2 SOURCE CONTROL SUFFICIENCY EVALUATION

This section describes the geographic and chemical scope of Ecology's source control evaluation, describes the types of information Ecology evaluated, summarizes basin-wide source control information for the Upper Reach, and defines the sufficiency recommendation categories.

2.0 Upper Reach Geographic Scope

The geographic scope of Ecology's source control evaluation for the Upper Reach is driven by the LDW Source Control program upstream-to-downstream approach and by the scale and location of the EPA's planned in-waterway sediment cleanup for the Upper Reach. The Upper Reach SCA sub-area is comprised of the eight SCAs listed in Table 1 and Figure 4.

Table 1: Source Control Areas in the Upper Reach

SCAs – East Side of LDW	SCAs – West Side of LDW
River Mile (RM) 3.7-3.9: Boeing Isaacson/Central King County International Airport (KCIA)	RM 2.8-3.7: EAA-4: Boeing Plant 2/Jorgensen Forge
RM 3.9-4.3: Slip 6	RM 3.4-3.8: EAA-5: Terminal 117
RM 4.3-4.9: Boeing Developmental Center [BDC])	RM 3.8-4.2: Sea King Industrial Park
RM 4.9: EAA-7: Norfolk Combined Sewer Overflow (CSO)/Storm Drain (SD)	RM 4.2-5.8: Restoration Areas

A total of 35 RAL exceedance areas were identified during the pre-design investigation of the Upper Reach (LDWG, 2022b) and later refined these areas during the 30% design phase (LDWG, 2022c). Ecology used the geographic extent of the RAL exceedance areas to identify the upland geographic areas for the source control sufficiency evaluations. Some RAL exceedance areas are associated with one or more SCAs (refer to Section 2.1 Table 2 to view the relationship between RAL exceedance areas and SCAs).

This SER does not provide source control evaluation or recommendations for RAL exceedance areas 1, 6, 7, 8, and 10 (Figure B-1a). These areas are associated with the Riverside Drive SCA in the Middle Reach.

Ecology reviewed available information associated with RAL exceedance areas 2 through 5 and 14 through 17 (Figure B-1). Our evaluation of the recontamination potential for areas 2 through 5 (adjacent to the Boeing Plant 2 Early Action Areas (EAAs) and 14 through 17 (adjacent to the Terminal 117 [T-117] and Jorgensen EAAs) is limited in scope due to information gaps in EAA surface sediment characterization and the distance between the shoreline and the RAL exceedance areas.

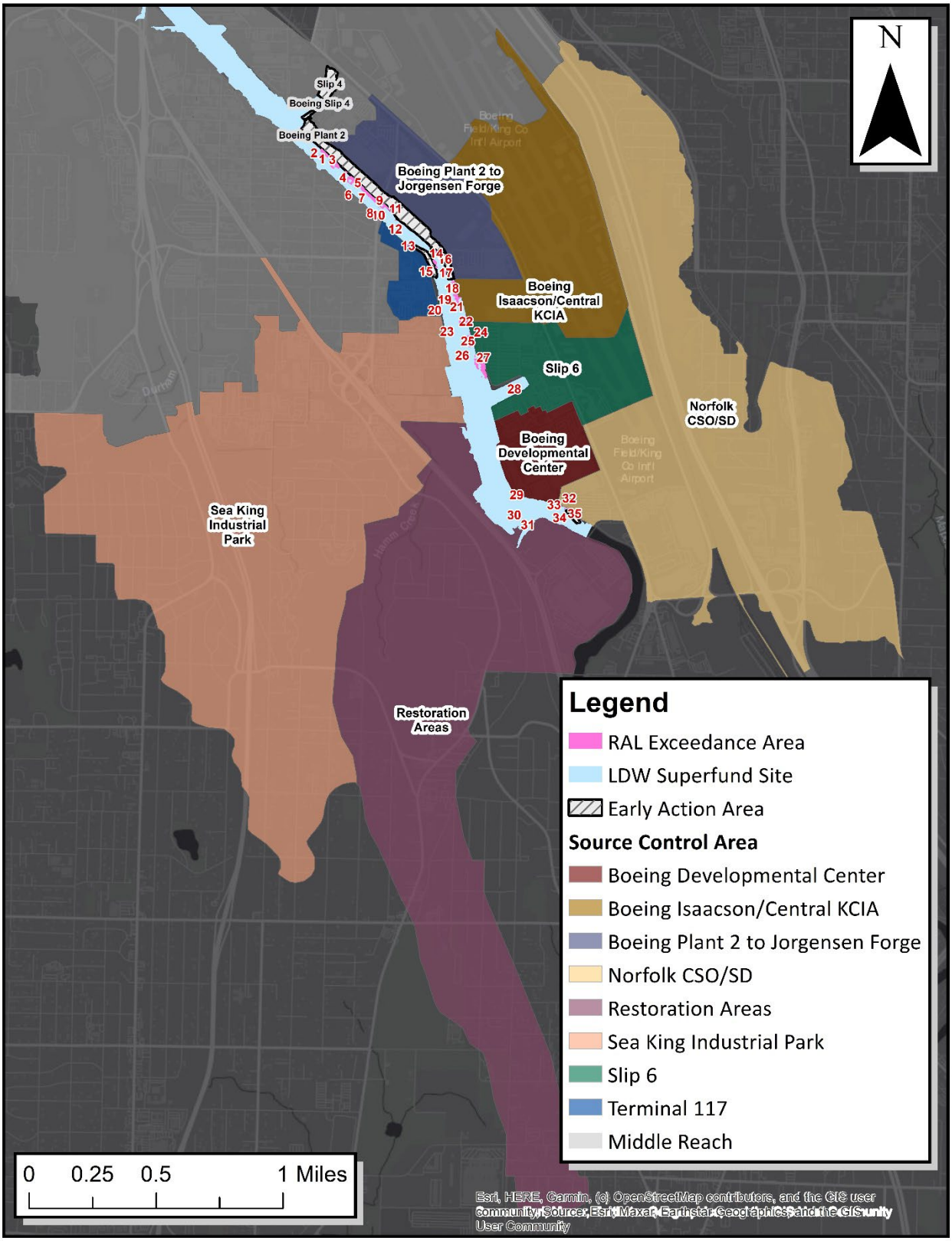

Figure 4: Upper Reach Source Control Areas and Numbered RAL Exceedance Areas

2.1 Upper Reach Chemical Scope

Ecology determined the chemical scope of this SER by evaluating COCs that are driving the planned sediment remedy during the design phase (Table 2). Of the 43 COCs listed in the ROD, 26 chemicals are driving the EPA's selection of active sediment remedy areas in the Upper Reach. We evaluated these 26 COCs in the corresponding RAL exceedance areas and SCAs. For more information on how we used sediment data as the geographic basis for this SER, refer to Section 2.4.0.

Table 2: Source Control Areas by RAL Exceedance Areas and Upper Reach Contaminants of Concern

Source Control Area	RAL Exceedance Areas	LDW Contaminants of Concern (RAL exceedance factor > 0.9)
SCAs in the Middle Reach Sub-basin	**1**[a], **6**[b], **7**[e], **8**[e], **10**[e]	total PCBs
EAA-4: Boeing Plant 2/Jorgensen Forge	**2**[a], **3**[a], **4**[a], **5,** 9[b], **14**[a]	total PCBs
EAA-4: Boeing Plant 2/Jorgensen Forge	**17**	total PCBs, mercury
EAA-5: Terminal 117	**11**[ae]	mercury, fluoranthene
EAA-5: Terminal 117	12[e], **15, 16**[ae]	total PCBs
EAA-5: Terminal 117	13	total PCBs, 4-methylphenol
EAA-5: Terminal 117	19[ce], 20[ae]	total PCBs
Boeing Isaacson/Central KCIA	18	arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, butyl benzyl phthalate, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, total high-molecular-weight PAHs[d], total PCBs, total benzofluoranthenes, zinc[d], carcinogenic PAHs (cPAHs)
Boeing Isaacson/Central KCIA	21	total PCBs (vertical core exceedances only)[d]
Boeing Isaacson/Central KCIA	22	butyl benzyl phthalate, lead, mercury, total PCBs, zinc
Slip 6	22	butyl benzyl phthalate, lead, mercury, total PCBs, zinc
Slip 6	24, 25[e]	total PCBs
Slip 6	26	butyl benzyl phthalate, dioxin/furan, total PCBs
Slip 6	27	dioxin/furan, mercury, phenol, total PCBs
Slip 6	28[a]	total PCBs
Sea King Industrial Park	23	total PCBs
Boeing Developmental Center	29[e]	acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, total HPAHs, total low-molecular-weight PAHs, total benzofluoranthenes, 1,2,4-trichlorobenzene[d]
Restoration Areas	30, 31[ae]	total PCBs

Source Control Area	RAL Exceedance Areas	LDW Contaminants of Concern (RAL exceedance factor > 0.9)
EAA-7: Norfolk CSO/SD	32, 33, 35	total PCBs
EAA-7: Norfolk CSO/SD	34[e]	benzoic acid, total PCBs

Underline RAL exceedance areas associated with the Middle Reach (Riverside Drive SCA) are not evaluated in this SER.
Bold RAL exceedance area is within the Federal Navigation Channel or is separated from potential upland sources by EAAs.
[a] RAL exceedance area is defined by subsurface (0-60cm) or intertidal (0-45cm) sediment sampling results only; surface sediment sampling (0-10cm) results are below RAL exceedance factor 0.9.
[b] RAL exceedance area is not defined by surface or subsurface sediment data and RAL exceedances are not defined.
[c] RAL exceedance area is defined by subsurface (0-60cm) or intertidal (0-45cm) sediment sampling results only; surface sediment samples (0-10cm) were not collected or analyzed.
[d] COC is included with the RAL exceedance area based upon RAL exceedance factors between 0.9 and 1.0.
[e] RAL exceedances in one sample location only within the exceedance area.

2.2 Pathways Evaluated

Ecology evaluated source control sufficiency using a line-of-evidence approach, building upon previous activities, existing conditions, and new or emerging information.

Our source control sufficiency evaluation focused on the following source pathways:

- **Direct discharges**: evaluated using National Pollutant Discharge Elimination System (NPDES) permitting compliance and corrective action information, and an evaluation of available storm drain solids data. Direct discharges refer to industrial and municipal stormwater, combined sewer overflows (CSOs) and industrial wastewater.
- **Soil erosion and/or leaching**: evaluated using bank and shoreline soil data from contaminated sites abutting the LDW. Soil erosion into stormwater conveyance systems (as a secondary source pathway) is evaluated as part of the direct discharge pathway using storm drain solids data available for contaminated sites.
- **Groundwater migration via bank seeps or subsurface mixing:** evaluated using groundwater and soil data from contaminated sites along the LDW. Groundwater migration into creeks or infrastructure pipes (stormwater and sanitary sewer) was not evaluated for this SER.

2.3 Evaluation of Principal Criteria

The principal criteria evaluated in this SER include:

- Status of high- and medium-priority action items.
- Information gathered from the SCWG members: investigations, business and spill inspections and response, source tracing studies and line cleaning activities.
- Status of water quality (WQ) permit compliance, where applicable.
- Status of upland site cleanups, where applicable.

The principal criteria is routinely updated and reported in the LDW Source Control Status Reports. These reports present a compilation and evaluation of information from entities conducting LDW source control activities. The principal criteria for each of the Upper Reach SCAs (Table 1) is presented in Section 3 of this report.

2.3.0 High- and Medium-Priority Action Item Status

Ecology evaluated the status of high-priority and medium-priority action items. There are 150 high- and medium-priority action items in the Upper Reach. 141 of these action items (94%) have been resolved (completed or cancelled) (Appendix A, Table A-2):

- 58 of 59 high-priority action items (99%) are resolved. One is currently underway at the Boeing Isaacson Thompson cleanup site (Section 3.1.2).
- 83 of 91 medium-priority action items (91%) are resolved. Eight are currently underway.

The status of remaining action items in the Upper Reach is described in Section 3 and Appendix A. The remaining actions represent ongoing sources to be controlled or suspected sources requiring further investigation.

2.3.1 Source Control Work Group Source Control Programs

The SCWG members work together to control sources to the LDW. In this document, the specific activities that four of the SCWG members (King County, City of Seattle, City of Tukwila and Port of Seattle) conduct in the LDW SCAs are generally referred to as Source Control Programs. These entities own or operate stormwater and/or wastewater systems with discharges that are regulated under WQ permits. They report on their relevant source control activities as requirements of their Municipal Separate Storm Sewer System (MS4) permits each spring. King County and the City of Seattle also report relevant CSO activities under their municipal wastewater permits.

King County and the City of Seattle have agency-specific Source Control Implementation Plans (SCIPs) that describe how that agency conducts its source control work and how it is working to meet LDW source control objectives. The SCIPs include a description of how each agency conducts its various programs to address source control for the LDW, describes each agency's priorities for source control on a near-term (five-year) and long -term basis, and includes a description of intra-departmental coordination with the agency and interagency coordination through the SCWG. The SCIPs include activities that are required by WQ permits and reported under those permits. In addition, King County reports on their activities in a source control annual report each October.

King County

King County's LDW SCIP for 2019–2023 identifies actions within the County's authority that are supportive of LDW Source Control (King County, 2019). King County's Source Control Program consists of activities to manage CSOs and municipal stormwater.

- King County is responsible for regulating industrial wastewater discharged into the sanitary sewer system from industrial facilities; this is known as a pretreatment program. According to King County, there are no Significant Industrial Users within the Upper Reach SCAs. There are three industrial wastewater dischargers to the sanitary sewer with low-level authorization and one major discharge authorization located within the Norfolk CSO basin.

- The Norfolk CSO basin includes both a CSO and a wet weather treatment station that treats combined sewer discharges from the basin before they are discharged.
- The King County International Airport (KCIA) municipal stormwater system discharges to the former Slip 5, Slip 6, and Norfolk CSO/Storm Drain (SD) outfalls (King County, 2019).
- The municipal stormwater system in the unincorporated area that includes some industrial uses is the South 96th Street stormwater basin, which drains to the North Fork of Hamm Creek (King County, 2019).

King County has not identified any source issues for County-managed municipal stormwater systems that discharge into the LDW Upper Reach. In support of this SER, King County prepared a memo with current information for their LDW Source Control activities (King County, 2023).

City of Seattle

The City of Seattle's 2021–2026 SCIP describes specific activities required for their LDW discharges in Appendix 13 of their MS4 permit as well as City-wide MS4 programs that are supportive of LDW Source Control (City of Seattle, 2020). The City of Seattle's Source Control Program consists primarily of activities to manage municipal stormwater, including business inspections and stormwater infrastructure maintenance.

Within the Upper Reach, the City of Seattle's LDW Source Control Program has identified and controlled numerous potential pollution sources since its inception (City of Seattle, 2020). The City of Seattle is aware of only two ongoing source control challenges within the Upper Reach, in the S Norfolk Street CSO/SD and 17th Avenue S SD basins (City of Seattle, 2023a). These source concerns and the plans to address them are discussed in their 2022 annual report dated March 31, 2023. Beyond these challenges, the City of Seattle is not aware of any ongoing issues within the Upper Reach.

City of Tukwila

The City of Tukwila's Source Control Program consists of their municipal stormwater management activities. They sent Ecology an update on their LDW Source Control efforts in 2022 (City of Tukwila, 2022b). Recent MS4 permit requirements have resulted in the City of Tukwila adopting local code language and best management practices (BMPs) in August 2022 to establish authority and technical expectations for pollution-generating sources from existing land uses and activities. On January 1, 2023, the City of Tukwila started their MS4 permit-required business inspection program. The boundary of the City of Tukwila does not extend into all SCAs within the Upper Reach, and accordingly Ecology reported activities by the City of Tukwila in Section 3 only for SCAs that are within the city limits.

Port of Seattle

The Port of Seattle's Source Control Program consists of their municipal stormwater management activities. The Port of Seattle has a relatively small presence in the Upper Reach. For the Upper Reach in 2022, the Port of Seattle did not have any reported illicit discharges and there were not any outstanding permit violations from leased tenants within their jurisdiction (Port of Seattle, 2023).

Relevant Studies to the LDW

Ecology and SCWG members have conducted numerous studies since 2000 to support LDW Source Control. The SCAPs (Ecology, 2013a) (Ecology, 2013a) were produced by Ecology to improve the understanding of sources throughout the LDW Source Control area. Other studies were produced on a watershed level, such as the Green-Duwamish River Watershed PCB Congener Study (Ecology, 2016) (Ecology, 2017a) (Ecology, 2016b; Ecology, 2017a); or are particular to a source pollutant, such as the PCB Chemical Action Plan (Ecology, 2015a) (Ecology, 2015a) or Phthalate Source Studies (King County, 2021). These studies augmented the SCWG's understanding of sources and contamination to the LDW. Additional studies describe hydrodynamic and sediment transport processes within the LDW, such as LDWG's 2008 LDW Sediment Transport Model Report (LDWG, 2008), USGS's Sediment Transport to the Lower Duwamish Waterway Report (USGS, 2018), and Margaret McKeon's Dissertation on Hydrodynamics and Sediment Transport in the Duwamish River Estuary (McKeon, 2020).

There have been several relevant studies conducted for specific geographic areas, such as stormwater system source tracing studies and line cleaning activities, that provide details about efforts to find and fix pollution sources. These studies can be found online in the project libraries of King County (King County, 2021) and City of Seattle (City of Seattle, 2023b).

Where relevant, Ecology used findings from these studies and investigations to evaluate sources by area, by pathway, or by COC. For the purposes of this source control sufficiency evaluation, it was not necessary to conduct additional studies.

2.3.2 Status of Permit Compliance (direct discharge pathway only)

As stated in the Strategy, a regulated direct discharge pathway provides the basis for determining that it is sufficiently controlled to allow active in-waterway remediation to begin. Many permits contain adaptive management requirements that trigger improved BMPs and/or corrective actions based on site-specific data. Ecology conducts inspections and reviews reported information to verify compliance with WQ permit conditions and/or WQ Administrative Orders (AO). Ecology issues enforcement actions when non-compliance is identified. NPDES and State Waste Discharge Permits are reviewed and reissued every 5 years to respond to changing conditions, such as improved control technologies, changes to applicable standards, and available data.

For the Upper Reach sufficiency evaluation, we reviewed compliance of 26 permitted facilities by verifying that the direct discharge has the appropriate permit type and/or conditions (including AO requirements), and conducting compliance assurance activities (i.e., inspections, data review) to confirm compliance with permit conditions (Table 3).

Permitted facilities within the Upper Reach SCAs have an appropriate permit type and/or conditions. Our review identified 19 permitted facilities (Table 3) that are implementing improved BMPs and/or corrective actions. Additional information is provided in Section 3 where notable and relevant to the source control sufficiency evaluation. Overall, the current state of permitted direct discharges to the Upper Reach is unlikely to recontaminate sediments

above the RALs and thus the direct discharge pathway in the Upper Reach is sufficiently controlled.

Table 3: Overview of Permitted Facilities Recently Implementing Improved BMPs and/or Corrective Actions

Source Control Area	Water Quality Program (WQP) Facility	Permit Number
EAA-4: Boeing Plant 2/Jorgensen Forge	Boeing Plant 2	WAR000482
EAA-4: Boeing Plant 2/Jorgensen Forge	Jorgensen Forge Corp	WAR003231
Boeing Isaacson/Central KCIA	Boeing Thompson Site	WAR000148
Boeing Isaacson/Central KCIA	KCIA	WAR000343
Slip 6	Charles Air Hangar – Starbucks	WAR127177
Slip 6	[1]Boeing Developmental Center	WAR000146
Slip 6	Shippers Transport Express	WAR312158
BDC	[1]Boeing Developmental Center	WAR000146
EAA-7: Norfolk CSO/SD	[1]Boeing Developmental Center	WAR000146
EAA-7: Norfolk CSO/SD	MacDonald Miller Facility Solutions Fab Shop	WAR125005
EAA-7: Norfolk CSO/SD	Nelson Trucking Co 9777	WAR125421
EAA-5: Terminal 117	[2]South Park Marina	WAG030045
EAA-5: Terminal 117	Boeing South Park	WAR001009
Sea King Industrial Park	[2]Delta Marine Industries Inc	WAG030091
Sea King Industrial Park	Industrial Automation Inc	WAR001949
Sea King Industrial Park	North American Auto Transportation Inc	WAR000650
Sea King Industrial Park	Old Dominion Freight Line Inc	WAR301509
Sea King Industrial Park	Pacific Industrial Supply Co Inc	WAR125474
Sea King Industrial Park	PSF Mechanical Inc	WAR000264
Sea King Industrial Park	Puget Sound Coatings	WAR002142
Restoration Areas	Amazon.com Services LLC – DWA2	WAR310157

[1]Boeing Developmental Center is one permitted facility that spans three SCAs.
[2]Facilities with Boatyard General Permits. All other facilities have Industrial Stormwater General Permits.

2.3.3 Status of Upland Contaminated Site Cleanups

For each SCA, Ecology reviewed information from upland cleanup sites to determine whether the identified sources of contamination to the LDW have been or will be reduced to a level where ongoing releases are not expected to contaminate sediment above ROD RALs.

We used a two-tier approach to review current and historical upland cleanup sites, within the Upper Reach SCAs. Our review is based on whether sources are confirmed or suspected, as informed by available in contaminated site records.

In tier one of the review, we applied exclusion criteria to information for contaminated sites within the Upper Reach. This process created a subset list of sites with confirmed or suspected sources to the LDW.

In tier two, we reviewed cleanup information in greater detail for each site retained after the tier 1 review process. We considered cleanup history, information gaps, investigatory findings about current known or suspected sources, and ongoing or planned source control activities. Our two-tiered review did not include cleanups under oversight by the EPA (Table 4). EPA evaluated sufficiency for these cleanups and reported the findings to Ecology for this SER.

Table 4: Cleanup Sites Under EPA Formal Oversight

Source Control Area	Facility Name	Regulatory Authority
EAA-4: Boeing Plant 2/ Jorgensen Forge	Boeing Former Electronics Manufacturing Facility	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
EAA-4: Boeing Plant 2/ Jorgensen Forge	Boeing Plant 2[a]	Resource Conservation and Recovery Act (RCRA)
EAA-4: Boeing Plant 2/ Jorgensen Forge	Jorgensen Forge, Outfall Site (Time Critical Removal Action) (completed in 2018)[a]	CERCLA
EAA-4: Boeing Plant 2/ Jorgensen Forge	Jorgensen Forge, Sediment Site	CERCLA
Slip 6	Rhone-Poulenc	RCRA
EAA-5: Terminal 117	Terminal 117 and Adjacent Streets and Yards	CERCLA

Company names are used only to designate SCA locations; SCA names are not intended to assign responsibility for contamination or to identify properties that may need remediation.

[a] Sediments were remediated in 2013–2014 as part of the EAA projects adjacent to Boeing Plant 2 and Jorgensen Forge upland cleanup Sites. Recontamination of adjacent sediments, should they occur, will be addressed separately from the Upper Reach sediment cleanup.

Ecology reviewed 76 cleanup sites in tier one. Of those, 36 cleanup sites are complete with a No Further Action status and are not suspected to present sources to the LDW. The remaining 40 sites are active cleanups that are in process. Of the ongoing 40 cleanups, one is under the Voluntary Cleanup Program and is not suspected to present sources to the LDW, seven are under Ecology oversight via Enforcement/Agreed Order (AO) (Table 5).

Table 5: Cleanup Sites Under Ecology Formal Oversight

Source Control Area	Site Name	Regulatory Authority
EAA-4: Boeing Plant 2/Jorgensen Forge	Jorgensen Forge Corp	MTCA Agreed Order (Jul 2007, Amended Jul 2013), Enforcement Order (Mar 2015), MTCA Agreed Order (Jul 2017), MTCA Agreed Order (in process)
Boeing Isaacson/Central KCIA	Boeing Isaacson Thompson	MTCA Agreed Order (Apr 2010)

Source Control Area	Site Name	Regulatory Authority
Slip 6	8801 E Marginal Way S	MTCA Agreed Order (Jul 2006) MTCA Agreed Order (Nov 2008, Amended Aug 2017)
BDC	Boeing Developmental Center	MTCA Agreed Order (July 2019)
EAA-7: Norfolk CSO/SD	Emerald Gateway	MTCA Agreed Order (Jan 2020)
EAA-5: Terminal 117	South Park Marina	MTCA Agreed Order (April 2019)
Sea King Industrial Park	Precision Engineering	MTCA Agreed Order (Dec 2020)

Boeing Field Chevron formal cleanup Site (Ecology's Cleanup Site Identification Number 7030) is excluded from Sufficiency evaluations because the geographic scope and cleanup is outside of Ecology's LDW Source Control program. The Site is associated above River Mile (RM) 5 outside of the Superfund boundary and the COCs driving the cleanup are petroleum-based only (not a LDW ROD COC). Source control and any impacts to the LDW above RM 5 will be addressed separately from the CERCLA cleanup under MTCA regulation.

[a] Sediments were remediated in 2013–2014 as part of the EAA projects adjacent to Boeing Plant 2 and Jorgensen Forge upland cleanup Sites. Recontamination of adjacent sediments, should they occur, will be addressed separate process that is beyond the scope of this SER.

Ecology applied exclusion criteria during the tier one review, which resulted in a list of 10 contaminated site cleanups that we evaluated in greater detail during tier two (Table 6). Source control sufficiency findings for the site cleanups listed in Table 6 are discussed in Section 3.

Table 6: Status of Ecology Cleanup Sites Included in Tier 2 Review

Site Name	Type of Cleanup	Agreed Order	Remedial Investigation	Feasibility Study	Cleanup Action Plan	Interim Action
Former Jorgensen Forge/Star Forge[a]	MTCA	2007, 2015, 2017 (cleanup related), 2022 (In progress)	Draft submitted to Ecology; in review			2014
Boeing Isaacson Thompson	MTCA	2010	2014	Draft submitted to Ecology; in review		
8801 Site	MTCA	2006, 2008	2011	2020	In progress	In progress
Boeing Developmental Center	MTCA	2019	In progress			
Affordable Auto Wrecking	Independent					
Emerald Gateway	MTCA	2020	In progress			In progress
Basin Oil Dallas Ave	Independent					2006–2007, 2010, 2017[b]

Site Name	Type of Cleanup	Agreed Order	Remedial Investigation	Feasibility Study	Cleanup Action Plan	Interim Action
Basin Oil Drum Storage	Independent					2017[b]
South Park Marina	MTCA	2019	In progress			
Precision Engineering	MTCA	2020	In progress			

[a] Sediments were remediated in 2014 as part of the Jorgensen Forge EAA project. Recontamination of adjacent sediments, should they occur, will be addressed separately from the Upper Reach cleanup and are beyond the scope of this report.
[b] Independent actions taken by the owners and SPU.

2.4 Assessment of Environmental Data

Ecology compared chemical concentrations in soil, groundwater, storm drain solids, and/or sediments to the following screening criteria:

- Cleanup site-specific criteria based upon Sediment Management Standards,
- August 2022 version of Preliminary Cleanup Levels (PCULs) for the LDW (Ecology, 2022a), or
- RALs defined in the ROD (EPA, 2014).

Empirical findings from cleanup reports, source tracing studies, and source investigations, were used as the basis for identifying potential sources when possible. We evaluated environmental data (comparing screening chemical concentration to sediment criteria) in cases where an upland cleanup is in the early stages of investigation and sources are uncharacterized.

2.4.0 Upper Reach Surface Sediment Data

EPA provided Ecology with surface sediment data and associated sediment cleanup remedial design information. Ecology used the sediment data to identify the LDW COCs to use for the source control sufficiency evaluations in each SCA of the Upper Reach. We compared COC concentrations in surface sediments with COC concentrations in shoreline soils, groundwater, and storm system solids.

Upper Reach Design Dataset

LDWG prepared and provided the Upper Reach surface sediment datasets to Ecology in June 2022. The dataset represents surface sediment conditions during the Phase II sediment design. The data incorporates a series of revisions to the Initial Upper Reach design dataset that was created on January 21, 2022, with revisions to the dataset leading up to June 15, 2022. The June 2022 dataset serves as the geographic and chemical basis for this SER.

LDWG completed the Data Evaluation Report—Upper Reach Design Dataset on August 22, 2022, in support of the 30% Remedial Design completed on August 29, 2022.[6] These documents can be found on LDWG's project library webpage.

2.4.1 Groundwater

Ecology evaluated available groundwater concentration data for situations where groundwater migrates to the LDW through seeps or sediment pore water. We did not evaluate groundwater infiltrating into stormwater conveyance systems unless a secondary source at a contaminated site cleanup was identified or if source control was being implemented under Clean Water Act (CWA) or Model Toxics Control Act (MTCA)/Resource Conservation and Recovery Act (RCRA) regulations.

We did not evaluate groundwater migration to creeks, unless it was demonstrated that the discharges from the creek mouth were impacting LDW sediments. The only creek discharges to the LDW in the Upper Reach are the north and south forks of Hamm Creek (Figure B-10). We did not evaluate these creek discharges because COCs were not identified in the sediments at the mouths of these forks.

We evaluated groundwater at several contaminated site cleanups that are adjacent to the LDW where contaminated groundwater is undergoing characterization and/or remediation, as discussed in Section 3.

2.4.2 Soils

Waterway bank soil, contaminated fill, waste piles, landfills, and surface impoundments proximate to the banks may release contaminants directly to the LDW through erosion, or by leaching to groundwater or surface water. Ecology evaluated contaminants in soils along the banks of the Upper Reach that could be released directly to sediments via erosion or leaching. We evaluated soil analytical data from samples collected proximate to the banks of the LDW, where available. In addition, proximate shoreline cleanup sites, as discussed in Section 3.

2.4.3 Storm System Solids

Ecology evaluated stormwater that enters the LDW via a combination of storm drains, pipes, ditches, or creeks, and directly from properties adjacent to the LDW. Contaminated solids that collect in storm drains and ditches may be carried to the waterway by stormwater. We did not evaluate stormwater discharging from creeks or ditches for source control sufficiency.

We compared the most-recently available storm solids data to screening levels. SCWG members compare storm drain solids concentrations to Sediment Management Standards-based criteria. When findings were not available for a particular discharge area, we compared available storm drain solids data by making dry-weight comparisons between sediment trap data nearest the outfall and the receiving sediments in the immediate proximity to the outfall.

[6] LDWG's final 30% design surface sediment dataset was finalized two months after Ecology started evaluating the Upper Reach for source control sufficiency.

Stormwater concentration data was not evaluated for source control sufficiency. Storm drain solids, particularly sediment trap solids, provide a more direct measure of potential risks to sediment quality than stormwater. This is particularly true with PCBs that tend to attach to particles present in stormwater (King County, 2016).

There are several outfalls discharging to the Upper Reach that have stormwater systems that are being characterized, reconfigured, or remediated. This includes the Norfolk drainage basin, 17th Avenue SD basin, and outfalls along Boeing Developmental Center (BDC) (City of Seattle, 2022a; City of Seattle, 2022b; City of Seattle, 2022c; City of Seattle, 2023a).

2.5 Sufficiency Recommendation Categories

Ecology's source control sufficiency recommendations fall into the following evaluation categories:

- Sources are sufficiently controlled: we recommend the area of sediment cleanup proceed. The risk of recontamination above RALs is minimal.
- Sources are conditionally controlled: we recommend the area of sediment cleanup proceed, with the condition that certain additional controls or oversight should be implemented in the near future.
- Sources are controlled with qualifications: we recommend the area of sediment cleanup proceed if there are substantial information gaps in the area evaluated.
- Sources are not sufficiently controlled: we recommend the sediment cleanup in the area does not proceed until additional controls have been implemented and assessed for effectiveness.

2.5.0 Areas of Uncertainty

The intent of Ecology's source control efforts is to reduce or eliminate sources to the LDW. However, there will always remain some uncertainty in the status of source control, particularly prior to in-water cleanup. The nature of source control in the LDW is dynamic. Information presented in this SER is intended for decision making regarding source control sufficiency evaluations and recommendations. Areas of uncertainty in our source control sufficiency recommendations include:

- Pathways that are not evaluated for source control sufficiency.
- Regional air pollution issues that are beyond the scope of LDW source control efforts.
- Information gaps resulting from the nature of the source control evaluation process.
- New sources or a new understanding of existing sources in the future.

3 SUFFICIENCY EVALUATION FINDINGS

Ecology's source control sufficiency evaluation findings are presented in this section. This section is organized by SCA, in order of north-to-south (downstream at approximately River Mile [RM] 3 to upstream at RM 5) from the east side to west banks of the LDW.

For each SCA, this section includes:

- A Summary of Area Features: the extent of the area, upland properties, outfalls and drainage basins, shoreline structures and EAAs.
- Associated Sediment Remedy Areas: a summary of RAL exceedance areas, chemical drivers, and proximity to the shoreline areas.
- Incomplete High- and Medium-priority Action Items: a summary of Ecology's sufficiency findings for incomplete action items.
- Source Control Program Sufficiency Findings: a summary of SCWG Source Control program activities relevant to source control sufficiency.
- Water Quality Permit Sufficiency Findings: a summary of WQP sufficiency findings for facilities with discharge permits.
- Upland Contaminated Site Cleanup Sufficiency Findings: a summary Ecology's sufficiency findings for upland contaminated site cleanups.

3.0 Early Action Area 4: Boeing Plant 2/Jorgensen Forge

3.0.0 Summary of Area Features

The EAA-4: Boeing Plant 2 to Jorgensen Forge SCA is located on the eastern side of the LDW between RM 2.8-3.7, and includes several upland properties associated with Boeing Plant 2 and Jorgensen Forge Corp (formerly owned by Earl M. Jorgensen, now owned by Star Forge LLC) (Figure 2, B-1). Cleanup and habitat restoration efforts were completed by Boeing and the Earl M. Jorgensen Company along the shorelines within this SCA. The associated Data Gaps Report (Ecology, 2007a) and SCAP (Ecology, 2007b) include detailed information about this SCA.

Nine private outfalls (P2B-P2G, P26, P33, P36) are located along the shoreline of the Boeing Plant 2 facility (Figure B-1). One private outfall (2065) is located along the shoreline of the Former Jorgensen/Star Forge facility. Three public outfalls are located along the shoreline (King County SD, 16th Avenue SD (W), and the Z outfall).

The shoreline of the SCA contains an array of structure types, ranging from bulkheads located along the northern portion of Boeing Plant 2 and the southern shoreline of the former Jorgensen Forge, armored slopes in the northern portion of Jorgensen Forge and underneath the South Park Bridge, and unarmored slopes along the shoreline of Boeing Plant 2 (LDWG, 2022a).

The Boeing Plant 2 and Jorgensen Forge EAAs are located adjacent to the shoreline and areas of discharge. These EAAs extend from the shoreline, between 100-200 feet, to the eastern boundaries of the FNC. The EAAs geographically separate potential upland sources located at

Boeing Plant 2 and Jorgensen Forge Corp from RAL exceedance areas within the waterway (Figure B-1).

3.0.1 Associated Sediment Remedy Areas

RAL exceedance areas 2, 3, 4, 5, 9, 14, and 17 are associated with the Boeing Plant 2/Jorgensen Forge SCA include (Table 2). These areas are all located within the Federal Navigation Channel (FNC), in subtidal areas that are immediately adjacent to the Boeing Plant 2 EAA (areas 2, 3, 4, 5, 9, and 14) and Jorgensen Forge EAA (area 17). These areas are not close to shoreline areas with direct discharges, groundwater migration and soil bank erosion features (Figure B-1a).

These RAL exceedance areas are defined by surface and subsurface exceedances of total PCBs, except for area 17 that is defined by both total PCBs and mercury exceedances. LDWG did not assign a remedy technology to area 9 because concentrations of LDW COCs in sediments are below ROD RALs; for these reasons Ecology did not further evaluate source control sufficiency for area 9. LDWG and EPA assigned dredging remedial technologies for areas 2, 3, 4, 14, and 17, and dredging with ENR for area 5.

3.0.2 Incomplete High- and Medium-Priority Action Items

27 out of the 29 high- and medium-priority action items are resolved for the Boeing Plant 2/Jorgensen Forge SCA. Two medium-priority action items are incomplete (Appendix A, Table A-2).

Boeing Plant 2 Action Item A10.09.01

This action item involves obtaining additional hydrogeologic data at the boundary of the Boeing Plant 2/Jorgensen Forge facilities. Characterization activities at Plant 2 are completed, and the property boundary groundwater monitoring will be conducted under Boeing Plant 2 Final Corrective Action Decision and Response to Comments issued by the EPA on July 21, 2022. Ecology defers to the EPA to consider whether this action item is resolved for the purposes of source control in the near term.

Our source control sufficiency finding for this action item is that it is not necessary to complete this action item prior to the EPA initiating the sediment cleanup of RAL exceedance areas 2, 3, 4, and 5.

Former Jorgensen Forge Action Item A10.33.00

This action item involves completing an RI/FS of the upland cleanup site to improve Ecology's understanding of this potential upland source to the LDW. The former owner, Earl M. Jorgensen, was directed to conduct an RI and FS under as part of the July 2017 AO (DE-14143) (Ecology, 2017b). Ecology received the draft RI on June 30, 2022; the report is under review. This action item will be complete after the RI and FS are both approved by Ecology.

Our source control sufficiency finding for this action item is that it is not necessary to complete this action item for sediment cleanup to start in RAL exceedance areas 14 and 17.

3.0.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing issues within the Boeing Plant 2/Jorgensen Forge SCA that would impact source control sufficiency (King County, 2023).

City of Seattle

The City of Seattle did not identify any ongoing issues within the Boeing Plant 2/Jorgensen Forge SCA that would impact source control sufficiency (City of Seattle, 2022a).

City of Tukwila

The City of Tukwila reported that there are no unmanaged sources to the Upper Reach sediments from illicit discharges or site operations and maintenance (O&M) discharging to their MS4 storm systems (City of Tukwila, 2022b). In addition, the City of Tukwila recently installed stormwater treatment technologies for approximately 2.8 acres associated with the East Marginal Way South Stormwater Outfalls Project (City of Tukwila, 2022c).

Port of Seattle

The Port of Seattle did not identify any ongoing issues within the Boeing Plant 2/Jorgensen Forge SCA that would impact source control sufficiency (Port of Seattle, 2023).

3.0.4 Water Quality Permit Sufficiency Findings

Two facilities with ISGP permits are within the Boeing Plant 2/Jorgensen Forge SCA. Notable information is provided below.

Boeing Plant 2

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities. Boeing installed bioswales for stormwater treatment in their North basin drainage area in 2021 and is routing additional stormwater to that treatment system in 2023 (Boeing 2022b). Given the status of treatment, Ecology's source control sufficiency evaluation of Boeing Plant 2 found that sources in the stormwater system discharge pathway at this facility have a low likelihood of recontaminating sediments above the RALs.

Jorgensen Forge Corp (also referred to as Star Forge)

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities. Prompted by a detection of PCBs in stormwater in January 2020, Ecology issued an Administrative Order (AO #18074) to require stormwater treatment (Ecology, 2020a).

This facility is undergoing formal cleanup through the MTCA process and PCBs are one contaminant of concern at the site (Section 3.0.5). Stormwater from areas where PCBs are located is directed to a Chemical Enhanced Sand Filtration treatment system. Any interim or final actions related to the MTCA cleanup should ensure that PCB-impacted soils, groundwater, or materials are not in contact with precipitation or the stormwater system.

Given the status of treatment, Ecology's source control evaluation of Jorgensen Forge found that sources in the stormwater system discharge pathway have a low likelihood of recontaminating sediments above the RALs.

3.0.5 Upland Contaminated Site Cleanups Sufficiency Findings

There are three upland facilities within the Boeing Plant 2/Jorgensen Forge SCA that are on the Confirmed and Suspected Contaminated Sites List (CSCSL). Ecology evaluated the Boeing Plant 2, Jorgensen Forge Corp, and Airco contaminated site cleanups for source control sufficiency. Ecology evaluated the Jorgensen Forge Corp site in greater detail during the tier two review and presented the findings below.

Former Jorgensen Forge Corp/Star Forge

In 2017 Ecology issued AO DE-14143 to the prior owner, Earl M. Jorgensen, to conduct an RI, FS, Cleanup Action Plan (CAP), and any necessary interim actions at the upland site. In 2022, the current owner of the property (Star Forge LLC) negotiated AO DE-21034 with Ecology for UST, exposed soil, and Dangerous Waste removal. Ecology reviewed the draft RI characterization results and the site conceptual model (Shannon & Wilson, 2022a). Ecology found that sources of LDW COCs from the upland cleanup site may be transported through soil bank erosion and groundwater migration pathways and potentially impact EAA sediments near the shoreline. However, it seems as though the relative risk of EAA sediments becoming recontaminated above RALs by upland sources is low, based on prior cleanup actions completed along the shoreline and the distribution and severity of the remaining groundwater contamination along the shoreline.

RAL exceedance areas 14 and 17 are separated by 120 to 150 feet (ft) from the upland cleanup by two EAAs (Jorgensen Forge and Boeing Plant 2) (LDWG, 2022a). These EAA sediments were remedied under the EPA, and they are undergoing long-term monitoring. The Agencies will address recontamination of the EAA sediments, should they occur, in a separate process from the active in-waterway remedy planned for RAL exceedance areas 14 and 17.

3.1 Boeing Isaacson/Central King County International Airport

3.1.0 Summary of Area Features

The Boeing Isaacson/Central KCIA SCA is located on the eastern side of the LDW between RM 3.7-3.9 (Figure 2, Figure B-2). The associated Data Gaps Report (SAIC, 2008) and SCAP include detailed information about this SCA (Ecology, 2009b). Properties located within this SCA that are of interest to Ecology include the Boeing Isaacson and Boeing Thompson properties adjacent to the LDW (also referred to as the Boeing Isaacson Thompson upland cleanup Site in Section 3.1.5), and the north-central portion of KCIA.

3.1.1 Associated Sediment Remedy Areas

Ecology associated RAL exceedance areas 18, 21, and 22 with the Boeing Isaacson/Central KCIA SCA (Table 2). Areas 18 and 22 are defined by exceedances of various LDW COCs (LDWG, 2022a). Area 18 includes total PCBs, arsenic, and PAHs. Area 22 includes total PCBs, lead, mercury, zinc, and BBP.

These RAL exceedance areas are primarily located in intertidal areas immediately adjacent to the shoreline and upland cleanups (Figure B-2). Area 18 is adjacent to the port sliver property in the northern of the Boeing Isaacson Thompson site cleanup. Area 22 is located between ENR/AC sub plots, straddling two SCAs and upland properties Boeing Isaacson Thompson and 8801 E Marginal Way S. Area 22 encompasses an area of debris piling at the property boundary lines between Boeing Isaacson Thompson and 8801 E Marginal Way.

LDWG and the EPA assigned dredging as the remedial technology for RAL exceedance area 22 (LDWG, 2022c). Remedial technologies assigned for area 18 include dredging, partial dredging, and engineered capping, and ENR.

RAL exceedance area 21 is an artifact area generated from the interpolation process used by LDWG during the 30% sediment remedy design. There are no surface (0-45 cm) or subsurface (0-60 cm) sample locations with RAL exceedances within area 21, based upon the 30% design Upper Reach Design dataset. LDWG utilized the preliminary phase III design data (LDWG, 2023a) to verify whether area 21 is selected for in-waterway cleanup (LDWG, 2023b). Based upon Ecology's review of the preliminary phase III unvalidated data, there are subsurface exceedances of total PCBs in the vertical core intervals at sampling location 800, indicating LDWG may select this area for in-waterway cleanup. For these reasons, Ecology retained area 21 in this report.

3.1.2 Incomplete High- and Medium-Priority Action Items

22 out of the 23 high- and medium-priority action items are resolved for the Boeing Isaacson/Central KCIA SCA. One high-priority action item is incomplete (Appendix A, Table A-2).

Boeing Isaacson Thompson Action Item A11.16.00

This action item involves identifying sources in upland media and developing a plan for controlling them (Ecology, 2009b). Boeing completed the RI in 2014 as part of AO No. DE-7088 (Ecology, 2010a). Boeing is in the process of revising the FS. Ecology identified several sources to LDW sediments in soil and groundwater for arsenic and other LDW COCs. As part of AO No. DE-7088, Boeing must develop and implement remedial actions at the Boeing Isaacson Thompson site to control known sources of LDW COCs in soil and groundwater.

Ecology's source control sufficiency finding for this action item is that it is necessary to complete this action item before sediment cleanup to starts in RAL exceedance area 18. Boeing's completion of the action item is expected to coincide with the completion of upland cleanup for the Boeing Isaacson Thompson Site.

3.1.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing issues within the Boeing Isaacson/Central KCIA SCA that would impact source control sufficiency (King County, 2023).

City of Seattle

The City of Seattle did not identify any ongoing issues within the Boeing Isaacson/Central KCIA SCA that would impact source control sufficiency (City of Seattle, 2022a).

City of Tukwila

The City of Tukwila reported that there are no unmanaged sources to the Upper Reach sediments from illicit discharges or site O&M discharging to their municipal stormwater system (City of Tukwila, 2022b).

Port of Seattle

The Port of Seattle does not have any leased tenants within the Upper Reach. The Port of Seattle did not identify any ongoing issues within the Boeing Isaacson/Central KCIA SCA that would impact source control sufficiency (Port of Seattle, 2023).

3.1.4 Water Quality Permit Sufficiency Findings

Four facilities with ISGP permits are located within the Boeing Isaacson/Central KCIA SCA. Notable information is provided below.

Boeing Isaacson Thompson Site

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities. Boeing has cleaned and removed solids from the stormwater system in 2019 and again in 2022. In 2019 and 2020, Boeing installed catch basin filtration and bagged units in the following areas: the Isaacson yard, the tub-skid and dumpster storage area, the 14-01 parking area and 14-03 building area (Boeing, 2020). Based on ongoing and potential future stormwater management actions, Ecology's source control sufficiency evaluation of the Boeing Isaacson Thompson stormwater discharge pathway found that sources at this facility have a low likelihood of recontaminating sediments above the RALs. This is conditional provided any onsite PCB source to the stormwater system that may be identified in the future is addressed under the existing CWA compliance and enforcement tools, and the relevant site cleanup activities protect the direct discharge pathway.

King County International Airport (KCIA)

This facility is subject to an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities as well as the King County MS4 permit. One of the four drainage basins at the KCIA is located within the Boeing Isaacson/Central KCIA SCA (referred to as the KCIA Central drainage basin). The drainage basin conveys stormwater to the KCIA SD#2 outfall (formerly the Slip 5 outfall). King County collected storm solid samples in 2021 within the KCIA Central drainage basin (King County, 2022). In 2021, King County started stormwater line cleaning in accordance with KCIA ISGP requirements. King County cleaned lines within the

eastern portions of KCIA in 2021, lines within the central portion of the KCIA in 2022 (King County, 2022). King County is planning to clean the lines within western portions of KCIA in 2023. King County and the City of Seattle are also working to address the potential discharge of sanitary sewer wastewater overflows from a City of Seattle pump station (referred to as PS45 EOF) through the KCIA SD#2 by implementing BMPs and infrastructure improvements.

Based on ongoing and potential future stormwater management actions, Ecology's source control sufficiency evaluation of the KCIA stormwater discharge pathway found that sources at this facility have a low likelihood of recontaminating sediments above the RALs.

3.1.5 Upland Contaminated Site Cleanup Sufficiency Findings

Ecology identified three upland facilities within the Boeing Isaacson/Central KCIA SCA that are on the CSCSL. Ecology evaluated the Boeing Isaacson Thompson, Hangar Holdings Inc, and Galvin Quad Lease Area Remediation contaminated cleanup sites for source control sufficiency. Ecology evaluated the Boeing Isaacson Thompson Site in greater detail during the tier two review and presented the findings below.

Boeing Isaacson Thompson Site

Ecology identified sources of PCBs, arsenic, mercury, and PAHs that are present at the northern and central shoreline areas of this site. The FS for this Site states that the source of arsenic in groundwater is likely to recontaminate sediments above ROD RALs (Figures BS-1, -2, -3) (Landau, 2022).

Ecology reviewed the draft FS. Ecology asked Boeing to address concerns with the long-term protectiveness of the proposed remedial alternatives in the draft FS (Ecology, 2023). The range of alternatives will fully address soil bank erosion and groundwater migration pathways and will incorporate the following actions: shoreline stabilization and removal of the Port of Seattle sliver area, removal of shoreline contaminated soils, and effective treatment or containment of contaminated groundwater. Ecology expects the selected remedy alternative will reduce concentrations of upland sources to below PCULs for protection of sediments.

Ecology's source control evaluation of this Site found that the sources in the southern portion of the Site that are associated with RAL exceedance areas 21 and 22 are sufficiently controlled and recontamination above ROD RALs is unlikely to occur in the near future. RAL exceedance area 21 represents a relatively small area removed from the shoreline and sources by approximately 140 ft. RAL exceedance area 22 corresponds with adjacent shoreline areas where upland soils are between PCULs and ROD RALs.

There are substantial information gaps regarding source characterization in the southern shoreline area of the Boeing Isaacson Thompson site. Groundwater concentrations of metals were increasing beyond PCULs screening levels in sampling collected quarterly in 2011–2012 (Landau, 2022), and groundwater has not been sampled since. Contaminated soils in the southern shoreline area are above PCULs that are protective of sediments, yet concentrations are well below the ROD RALs. Considering the extent of information gaps, Ecology is currently coordinating with Boeing to conduct additional characterization work prior to the EPA's planned in-waterway cleanup.

Ecology's source control evaluation of this Site found that the sources identified at the northern portion of this Site that are associated with RAL exceedance area 18 are not sufficiently controlled to prevent recontamination above the ROD RAL. Source control under the current cleanup schedule and plan will require Boeing to complete the FS and develop and implement the CAP.

Ecology cannot determine when sources to RAL exceedance area 18 will be sufficiently controlled, but it is likely that the schedule of upland remediation at the Boeing Isaacson Thompson Site will extend beyond the EPA's October 2024 timeframe to begin sediment remediation.

3.2 Slip 6

3.2.0 Summary of Area Features

The Slip 6 SCA is located on the eastern side of the LDW between RM 3.9-4.3 (Figure 2, Figure B-3). Slip 6, which is owned by Boeing and is at the north end of the BDC property, is one of the remnants of the river prior to channelization in the early 1900s. The associated Data Gaps report (Ecology & Environment, 2008) and SCAP (Ecology, 2008a) include detailed information about this SCA.

The SCA includes several upland properties with shoreline features: the CenterPoint Tukwila property (also known as the former PACCAR Site or 8801 East Marginal Way S Site, occupied by Insurance Auto Auctions until late 2019), the former Rhone-Poulenc Site (also known as Container Properties and currently occupied by Shippers Transport Express), and the northern portion of Boeing Developmental Center (BDC-North).

Two active private storm drain outfalls (2073 and 2075, called the Central and North outfalls respectively) are located on the CenterPoint Tukwila property (refer to Section 3.2.4). The Central and North outfalls (2073 and 2075) are adjacent to RAL exceedance areas 22 and 26 respectively. One County-owned outfall, known as KCIA SD#1, discharges stormwater from the south-central portion of KCIA to the eastern shoreline of Slip 6, and receives some discharge from City of Seattle stormwater/wastewater collection systems (City of Seattle, 2020). Two additional private outfalls are located along the BDC-North property (DC14 and DC15 outfalls) on the southern shoreline of Slip 6 and are associated with drainage Areas 14 and 15 (Boeing, 2022a). Drainage Area 14 conveys stormwater from non-industrial areas of the facility (Geosyntec, 2023a) whereas Area 15 conveys stormwater from industrial areas (Boeing, 2022c).

The shoreline structures vary within the SCA. On the north end of the SCA adjacent to the CenterPoint Tukwila property, the shoreline contains a bulkhead structure. The shoreline is armored on the north end of BDC and along Slip 6. In the southern portion of Rhone-Poulenc, the shoreline is armored. The shoreline is unarmored near RAL exceedance area 27 in the northern portion of the Rhone-Poulenc contaminated Site (LDWG, 2022a).

Between 2016 and 2019, Boeing surveyed existing bank stabilization infrastructure, generated riverbank stabilization alternatives and infrastructure for shoreline segments of the BDC and Boeing Thompson properties (Boeing, 2021). These designs were reviewed by agency

stakeholders for adherence with MTCA and CERCLA, and Boeing selected a sheet pile wall as the preferred alternative to minimize work activities in the LDW and the footprint of the existing bank stabilization (Boeing, 2021). Relevant to the Slip 6 SCA, Boeing proposed installation of 248 ft of sheet pile wall and associated project impacts to impervious surfaces and earth. As of spring 2023, the Agencies are coordinating with Boeing to better understand the role and schedule of the proposed shoreline infrastructure activities with planned sediment remedy and upland cleanups.

In 2014, LDWG conducted a study implementing the ENR AC pilot plots under the request of the Agencies (EPA, 2021). Known as the "Intertidal Plot", one ENR sub plot was conducted along the shoreline of the Slip 6 SCA, located among RAL exceedance areas 22 and 24 (LDWG, 2022a).

3.2.1 Associated Sediment Remedy Areas

Ecology associated RAL exceedance areas 22, 24, 25, 26, 27, and 28 with the Slip 6 SCA (Table 2). All RAL exceedance areas are in intertidal sediments adjacent to the shoreline, except for area 28 that is in Slip 6 approximately 40 to 100 ft away from the shoreline of BDC (Figure B-3). Within the RAL exceedance areas, there are exceedances of various LDW COCs, with exceptions for areas 24 and 25 (surface exceedances of total PCBs) and area 28 (two subsurface exceedances of total PCBs) (LDWG, Basis of Design Report (30%) Figures 5-13, 2022a). LDWG and the EPA assigned dredging remedial technology to areas 22, 27, and 28; areas 24 and 26 were assigned dredging and ENR, and area 25 was assigned ENR exclusively (LDWG, 2022c).

3.2.2 Incomplete High- and Medium-Priority Action Items

18 out of the 20 high- and medium-priority action items are resolved for the Slip 6 SCA. Two medium-priority action items are incomplete (Appendix A, Table A-2).

Container Properties (Former Rhone-Poulenc) A12.13.00

This action item involves investigating and addressing shoreline bank contamination from historical Site operations and releases (Appendix A). In 2012, the EPA led an investigation of shoreline bank contamination. The Shoreline Area will be addressed as part of the future Compliance Monitoring Strategy and cleanup under RCRA with oversight by the EPA.

A CO_2 Injection Pilot Study to investigate a technique to address high pH was completed in 2020. Soil and groundwater contamination will be addressed either during sediment dredging and bank sloping, or during upland corrective measures anticipated to begin by 2026.

Ecology's source control sufficiency finding for this action item is that it is not necessary to complete this action item for sediment cleanup to start.

8801 East Marginal Way S A12.09.00

This action item involves reviewing future NPDES compliance monitoring results to ensure sources are controlled as planned and to determine whether future source control actions are necessary (Appendix A). This is discussed in more detail in Section 3.2.4 below.

Ecology's source control sufficiency finding for this action item is that it is not necessary to complete this action item for sediment cleanup to start.

3.2.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing issues within the Slip 6 SCA that would impact source control sufficiency.

City of Seattle

The City of Seattle did not identify any ongoing sources within the Slip 6 SCA that would impact source control sufficiency (City of Seattle, 2023a).

City of Tukwila

The City of Tukwila reported no currently known unmanaged sources to the LDW Upper Reach sediments from illicit discharges or site O&M discharging to City of Tukwila's MS4 storm systems (City of Tukwila, 2022b).

Port of Seattle

The Port of Seattle does not have any leased tenants within the Upper Reach, and they did not identify any ongoing issues within the Slip 6 SCA that would impact source control sufficiency (Port of Seattle, 2023).

3.2.4 Water Quality Permit Sufficiency Findings

There are five WQ-permitted facilities that are associated with the Slip 6 SCA. Ecology identified notable information for three of these facilities as described below.

8801 East Marginal Way S (also known as CenterPoint Tukwila)

This property has been undergoing redevelopment activities. Therefore, the most recent NPDES permit, for the CenterPoint Tukwila project, conditionally authorizes stormwater discharges associated with construction activities. Ecology issued a companion order (AO #20358) to require sampling and treatment for site-specific COCs, including PCBs, to ensure construction stormwater discharges meet indicator levels for these pollutants.

Ecology's source control evaluation of the permitted activities at the 8801 Marginal Way S Site found that contaminated soil or groundwater is unlikely to be entering the stormwater system, and that current construction activities are unlikely to impact source control sufficiency. Potential future industrial stormwater discharges associated with the redeveloped property will be subject to the ISGP or other appropriate WQ permit.

Boeing Developmental Center, Northern Portion

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities. In the northern portion of BDC, only one drainage basin area conveys industrial stormwater to the LDW (DC-15 and outfall DC15). Boeing cleaned the DC-15 stormwater system in 2021. Boeing continues to review, conduct, and document PCB abatement/removal actions, as required by AO 19427 (Ecology, 2020c). Ecology's source control evaluation of the northern area of BDC found that it is not likely to impact source control sufficiency for Slip 6.

King County International Airport (KCIA)

One of the four drainage basins of the KCIA is located within the Slip 6 SCA (referred to as the KCIA South-Central Drainage Basin). The drainage basin conveys stormwater to the KCIA SD#1 outfall (also referred to as the Slip 6 outfall). Refer to Section 3.1.3 for notable information regarding source control activities at the KCIA. Based on ongoing and potential future stormwater management actions, Ecology's source control sufficiency evaluation of the KCIA stormwater discharge pathway found that sources at this facility have a low likelihood of recontaminating sediments above the RALs.

3.2.5 Upland Contaminated Site Cleanup Sufficiency Findings

Ecology identified three upland facilities within the Slip 6 SCA on the CSCSL. In 2022, Ecology reviewed the status of cleanup for the 8801 E Marginal Way S, BDC, and Container Properties (Formerly Rhone-Poulenc) contaminated sites and presented the findings in this section.

8801 E Marginal Way S

Cleanup-related source control action items for this Site are complete (Appendix A, Table A-2). Ecology does not think that the soil bank erosion pathway to the LDW exists, since the sheet pile wall and rip rap armored shoreline prevent erosion of soil into the LDW (Shannon & Wilson, 2020a). Ecology suspects that groundwater migration via seepage into the LDW occurs in the central (seeps 1-4) and southern (seep 6) shoreline areas of the property (Shannon & Wilson, 2020b). Ecology anticipates the remaining sources at the Site will be controlled once remaining cleanup actions and concurrent property development are completed in 2023.

Ecology approved a remedy for the Site that was designed to lower arsenic, PAH, PCB, and dioxin/furans below levels in soil and groundwater that are protective of sediments. The Potentially Liable Persons (PLPs) documented various source control actions in the Interim Action Work Plan (IAWP) (Shannon & Wilson, 2020c) and the Compliance Monitoring Plan (CMP) (Shannon & Wilson, 2022b).

Ecology approved the interim actions identified in the IAWP. These interim actions include the removal of PCB-containing joint compound between concrete slabs that historically impacted groundwater and excavation of various Areas of Concern (Shannon & Wilson, 2020b) and revised in the Addendum to the FS and IAWP (Shannon & Wilson, 2020a), several of these are based on very few sample locations where LDW COCs are exceeding the most stringent site-specific screening criteria.

Of the remedial actions relevant to source control sufficiency, the following have been completed as of December 2022:

- removal of the PCB-containing caulk believed to be the only source of PCBs in groundwater,
- hotspot soil excavations affecting the LDW via stormwater infiltration and leaching to groundwater pathways,
- and soil PCB excavation and removal at Area 4 (Shannon & Wilson, 2022c).

Ongoing remedial actions conducted by the PLPs include development-driven soil PCB hotspot excavations above the site's remediation level (0.5 mg/kg dry weight) (Shannon & Wilson,

2022d). The pavement will be replaced across the facility. Ecology anticipates that surface activities will not contaminate soil or groundwater.

The status of the remedy effectiveness will be reported in the CMRs that are due from Centerpoint Properties in 2023. Ecology's source control evaluation finds that sources documented at this Site are sufficiently controlled, under the conditions that remaining interim actions are completed and implemented remedies are effective.

Boeing Developmental Center, Northern Portion

Boeing is currently conducting an RI for this contaminated Site cleanup and shoreline contamination characterization is ongoing. Based on a synthesis of findings from the RI Work Plan (Landau, 2021) and the Draft Phase I RI Summary Report (Boeing, 2022a), Ecology suspects there are sources of LDW COCs to sediments through contaminated groundwater migration and bank erosion pathways. While Phase I RI results for LDW COCs in soil and groundwater are generally below sufficiency screening criteria, Ecology found several sample-specific exceedances of LDW COCs in media along the shoreline. In addition, Ecology found that site-wide contamination characterization remains a considerable information gap. Ecology cannot confirm whether sources are present from these areas requiring further investigation in Phase II of the RI. Ecology notes the source characterization information gaps in the shoreline soil and groundwater located within the Sediment Waste Management Unit-43 (SWMU-43) area (Figure BS-4).

Ecology's source control sufficiency evaluation found that Ecology needs more information about sources from the areas of BDC that require further investigation in phase II of the RI. This includes the upland shoreline areas corresponding to RAL exceedance area 28. Boeing will complete shoreline characterization during phase II of the RI. Ecology expects to receive the shoreline characterization information in late 2023.

Container Properties (Formerly Rhone-Poulenc, currently occupied by Shippers Transport Express)

This is a RCRA cleanup under EPA oversight. EPA evaluated sufficiency for this cleanup using Ecology's tier two approach and reported the findings to Ecology.

Ecology notes that there are current characterization information gaps for several LDW COCs in soil bank media (PCBs, dioxins/furans, mercury, phenol) based on EPA's evaluation of the Rhone-Poulenc cleanup for source control.

EPA was planning to receive a revised Pre-CMS Conditions Report in February 2023 that would present current levels of COCs, areas of contamination, exposure pathways, and preliminary screening of potential technologies. If EPA identified any additional data gaps in this report, the EPA expects they will be addressed later in the cleanup process during the upcoming CMS or design.

Based upon the source control evaluation conducted by EPA for this site, Ecology concludes that sources are controlled through restriction of the soil and groundwater pathways, although information gaps exist for COC concentrations in soil bank media.

3.3 Boeing Developmental Center

3.3.0 Summary of Area Features

The BDC SCA is located on the eastern side of the LDW and is defined by the drainage basins of the BDC property that directly discharge to the LDW between RMs 4.3-4.9 (Figure 2, Figure B-4). The BDC SCA comprises approximately 86 acres of the 174-acres of the BDC property. The BDC property and contaminated Site overlaps with three SCAs. Ecology reported findings for BDC-North in Section 3.2 (Slip 6 SCA) and BDC-South in Section 3.4 (Norfolk CSO/SD SCA). Ecology reported findings for the central portion of the BDC in this section. The associated Data Gaps report (SAIC, 2010) and SCAP (Ecology, 2010b) include detailed information about this SCA.

Located within the central portion of BDC are the drainage areas 5-13, and 19 and their respective outfalls DC5-DC13, and DC19 (Boeing, 2022a). Boeing is reconfiguring several of these drainage areas to consolidate drainage basins and reroute stormwater to treatment systems before discharging to the LDW (Section 3.3.4).

The shoreline structures of this SCA are varied. On the north end, downstream from RAL exceedance area 29, the shoreline has armored and unarmored slopes. Shoreline adjacent to area 29 is unarmored. South and upstream of area 29, the shoreline contains a mixture of structures (Figure B-4) (LDWG, 2022a). Several shoreline areas have failing wooden bulkheads corresponding with Boeing's proposed shoreline infrastructure project.

From 2016 to 2019, Boeing surveyed existing bank stabilization infrastructure, developed stabilization alternatives for riverbank areas and proposed infrastructure additions for segments of the BDC and Boeing Thompson shorelines (Boeing, 2021). Agency stakeholders reviewed Boeing's proposed designs for adherence with MTCA, RCRA and CERCLA, and Boeing selected a sheet pile wall design as the preferred alternative. Boeing reports that the proposed sheet pile wall will minimize disturbance in the LDW and stabilize the existing bank (Boeing, 2021)(Boeing, 2021). Ecology considers these proposed activities constitute as interim actions under MTCA particularly the removal of Range Track Docks, concrete decking piles and crane rails, and penetration of storm drains associated with the DC-5 outfall. As of spring 2023, the Agencies are coordinating with Boeing to better understand the impacts of the proposed shoreline infrastructure on current upland Site cleanup and planned active in-waterway sediment remedy.

3.3.1 Associated Sediment Remedy Areas

Ecology associated the RAL exceedance area 29 with the BDC SCA. Area 29 is located along the shoreline of the BDC contaminated site, in both sub- and intertidal zones of the LDW and is located within the Turning Basin area of the Upper Reach (Figure B-4). Area 29 is located approximately 100 ft downstream of outfall DC8, near a series of dock pilings (Range Track Dock 4) and collocated with Boeing's proposed shoreline infrastructure project (Boeing, 2021). Area 29 is defined by one sample location with surface sediment concentration exceedances of various PAHs (LDWG, 2022a) above RALs. LDWG and the EPA assigned dredging remedial technology to RAL exceedance area 29 (LDWG, 2022c).

3.3.2 Incomplete High- and Medium-Priority Action Items

Six out of the eight high- and medium-priority action items are resolved for the BDC SCA. Two medium-priority action items are incomplete (Appendix A, Table A-2).

Boeing Developmental Center, Central Portion Action Item A13.09.00

This action item involves further characterization of upland groundwater, notably for groundwater seeps along the shoreline. Groundwater sampling will be conducted as part of the phase II of the RI investigation in 2023. Shoreline banks will be sampled to characterize contaminated soils that may impact LDW sediments through soil bank erosion.

Ecology expects Boeing will complete phase II sampling for the RI and present the findings to Ecology in 2023. Once site characterization is complete, Boeing will provide Ecology with an updated Conceptual Site Model (CSM).

Ecology concludes that there is not enough contamination characterization information to fully understand upland sources to the LDW from this site. Based on the limited available characterization information, Ecology suspects there to be groundwater migration and soil bank erosion pathways to the LDW. The closest available shoreline data indicate the potential for upland sources to impact sediments along the shoreline of BDC.

Considering the extent of upland media data gaps, Ecology recommends re-evaluating these pathways for source control sufficiency after receiving the phase II RI data from the spring 2023 sampling. Ecology expects to receive this data in late 2023.

Boeing Developmental Center, Central Portion Action Item A13.10.01

This action item involves implementation of the remedial actions required under the AO No. DE-16275 (Ecology, 2019a), including preparation of an RI, FS, draft CAP and any necessary interim actions. This action item is related to A13.09.00 (described above). This action item is designed to ensure that Boeing develops a CSM for preparation of the RI.

Boeing is currently conducting phase II sampling activities that include soil and groundwater in the shoreline areas of the Site corresponding to SWMU-43. Ecology expects that Boeing will complete characterization and develop a CSM in 2023 as part of phase II of the RI.

Considering the extent of upland media data gaps, Ecology recommends re-evaluating this shoreline characterization and CSM for source control sufficiency after receiving the phase II RI data from sampling in spring 2023. Ecology expects to receive this data in late 2023.

3.3.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing issues within the BDC SCA that would impact source control sufficiency (King County, 2023).

City of Seattle

The City of Seattle did not identify any ongoing issues within the BDC SCA that would impact source control sufficiency (City of Seattle, 2023a).

City of Tukwila

The City of Tukwila reported that there are no unmanaged sources to the Upper Reach sediments from illicit discharges or site O&M discharging to their municipal stormwater system (City of Tukwila, 2022b).

Port of Seattle

The Port of Seattle does not have any leased tenants within the Upper Reach. The Port of Seattle did not identify any ongoing issues within the BDC SCA that would impact source control sufficiency (Port of Seattle, 2023).

3.3.4 Water Quality Permit Sufficiency Findings

The BDC is the only WQ-permitted facility that is associated with the BDC SCA. Notable information is provided below.

Boeing Developmental Center, Central Portion

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities. Boeing triggered requirements to install stormwater treatment and is installing treatment that will also minimize PCB concentrations in the discharge. Boeing designed three advanced stormwater treatment systems to treat most of the facility's stormwater in accordance with AO 15600 (Ecology, 2018) and subsequent amendments (Ecology, 2020c; Ecology, 2022b). Table 7 provides an overview of the BDC stormwater system changes and treatment installation completion dates. Stormwater monitoring following the installation of the DC-5N system has shown no PCB detections.

Table 7: Boeing Developmental Center Stormwater Basin and Reconfiguration Work

RAL Exceedance Area	Stormwater Treatment System	Basins Consolidated	Outfalls	Installation Completion Date
Not applicable	DC-9N	C10, DC11, DC-18[a], DC9 (west)	DC10, DC11, DC18, DC9	Planned August 1, 2023 (system and conveyance)
Not applicable	DC-12N	DC-12, DC-13[a]	DC12, DC13	Planned August 1, 2024 (system and conveyance)
29[b]	DC-5N	DC-5, DC-6[a], DC-7[a], DC-8[a], DC-19, DC-9 (east)	DC5, DC6[b], DC7[b], DC8[b], D19[b]	Completed: January 10, 2022 (treatment system) December 31, 2022 (remaining conveyance)

[a] Drainage area without industrial activity.
[b] RAL exceedance area is approximately 80 ft downstream of the nearest outfall location (DC8), and upstream approximately 290 ft from DC9.
[c] Outfall has been plugged or capped and is no longer discharging stormwater to the LDW.
Table compiled using information from 2022 Stormwater Pollution Prevention Plan for Boeing Developmental Center (Boeing, 2022c).

Historically, the highest PCB concentrations in stormwater at this facility were in the DC-19 drainage basin. Boeing directed this stormwater to the DC-5N treatment system. Ecology noted

detections of PCBs in stormwater collected from the drainage areas DC-10 (1st quarter of 2022) and DC-13 (2nd quarter of 2022). Stormwater from DC-10 will be rerouted and treated by the DC-9N system once Boeing completes the installation of the system in August 2023. Stormwater from DC-13 will be treated by end of 2024. Ecology anticipates that the concentrations of total PCBs in stormwater discharges will be consistently below laboratory reporting limits after Boeing completes installation of the remaining treatment systems.

Because data has shown that PCB sources to stormwater are present at BDC, Boeing continues to conduct and document PCB abatement and removal actions, as required by AO 19427 (Ecology, 2020c). Boeing cleaned all stormwater system lines, catch basins, manholes, vaults, and oil-water separators in all the drainage areas within this SCA during the 2nd and 3rd quarters of 2021.

Based on ongoing and planned stormwater management actions, Ecology's source control sufficiency evaluation of the BDC stormwater discharge pathway found that sources at this facility have a low likelihood of recontaminating sediments above the RALs. This is conditional provided the two additional advanced stormwater treatment systems are operational by the start of nearby in-water sediment cleanup work.

3.3.5 Upland Contaminated Site Cleanup Sufficiency Findings

The central portion of the BDC Site spans across the BDC SCA. Ecology reviewed the status of the cleanup for the contaminated Site in 2022 and 2023, and Ecology presented the findings below.

Boeing Developmental Center, Central Portion

Boeing is currently conducting an RI for the contaminated cleanup. Shoreline contamination characterization at this Site is ongoing. Ecology reviewed the BDC RI Work Plan (Landau, 2021) and the Draft Phase I RI Summary Report (Boeing, 2022a). Ecology believes that there may be sources of LDW COCs to sediments through the contaminated groundwater migration and bank erosion pathways.

Phase I RI results for LDW COCs in soil and groundwater are generally below sufficiency screening criteria, however Ecology found several sample-specific exceedances of LDW COCs in media. In addition, site-wide contamination characterization remains a considerable information gap in Ecology's source control sufficiency evaluation. Ecology cannot confirm whether sources are present from these areas requiring further investigation in Phase II of the RI. Ecology identified source characterization information gaps in the shoreline soil and groundwater located within the SWMU-43 area (Figure BS-5).

Ecology's source control sufficiency evaluation found that Ecology needs more information about sources from the areas of BDC that require further investigation in phase II of the RI. This includes the upland shoreline areas corresponding to RAL exceedance area 29. Boeing will complete shoreline characterization during phase II of the RI. Ecology expects to receive the shoreline characterization information in late 2023.

3.4 Early Action Area 7: Norfolk Combined Sewer Overflow/Storm Drain

3.4.0 Summary of Area Features

The Norfolk CSO/SD SCA is located on the eastern side of the LDW between RMs 4.9-5.0 (Figure 2, Figure B-5). The associated Data Gaps report (Ecology & Environment, 2007) and SCAP (Ecology, 2007c) include detailed information about this SCA. Located within the SCA there are Boeing parcels adjacent to the LDW, the southern portion of KCIA, and upland properties in the Norfolk and I-5 (Ryan Street) SD basins. At the southern end of the SCA, the Norfolk EAA was completed by the EPA and is collocated with RAL exceedance areas 34 and 35.

The Norfolk CSO/PS17 EOF/SD as well as the Henderson/MLK Wet Weather Treatment Station discharge to the LDW within this SCA. The Norfolk CSO/PS17 EOF/SD receives some discharges from City of Seattle- owned stormwater/wastewater collection systems (City of Seattle, 2020). There are several drainage basins of interest to Ecology located in the southern portion of the BDC cleanup Site (areas 1-4, 16, and 17). Drainage basin areas 1-4, 16, and 17 historically conveyed stormwater to several outfalls adjacent to RAL exceedance areas 32-35. Boeing is reconfiguring these stormwater systems to consolidate drainage basins and reroute stormwater to the DC-2N treatment system prior to discharge to the LDW (Section 3.4.4).

On the north end of the SCA, downstream from RAL exceedance area 32, the shoreline bank is armored. Shoreline adjacent to areas 32-35 is unarmored (collocated with Boeing's proposed shoreline infrastructure project). South and upstream of area 35 and the Norfolk EAA, the shoreline has a bulkhead wall (Figure B-5) (LDWG, 2022a).

From 2016 to 2019, Boeing surveyed existing bank stabilization infrastructure, generated stabilization alternatives for riverbank features and infrastructure for shoreline segments of the BDC and Boeing Thompson properties. Agency stakeholders reviewed Boeing's designs for adherence with MTCA, RCRA and CERCLA, and Boeing proposed a sheet pile wall as the preferred alternative to minimize disruption to the LDW and the footprint of the existing bank. As part of the proposed alternative, Boeing included installation of ~360 ft of sheet pile wall in the Developmental Center East (Area 4) location. Boeing's plan to install the sheet pile wall requires land disturbances that replace impervious surfaces, excavation, and fill soil bank areas. As of spring 2023, the Agencies are coordinating with Boeing to better understand the intent and schedule of the proposed shoreline infrastructure impacts to current upland cleanup and planned active in-waterway sediment remedy.

3.4.1 Associated Sediment Remedy Areas

Ecology associated RAL exceedance areas 32, 33, 34, and 35 with the Norfolk CSO/SD SCA. All areas are in intertidal areas bordering the shoreline and various infrastructures of the LDW (Figure B-5). Area 35 differs from the others in that it overlaps with the Norfolk EAA (LDWG, 2022a) and the DC2 outfall. These RAL exceedance areas are defined by surface sediment exceedances of total PCBs, except for area 34 that also is defined by exceedances of benzoic

acid. LDWG and the EPA assigned the dredging remedial technology to areas 32, 34, and 35, and ENR to area 33 (LDWG, 2022c).

3.4.2 Incomplete High- and Medium-Priority Action Items

18 out of the 20 high- and medium-priority action items are resolved for the EAA7 SCA. Two medium-priority action items are incomplete, and activities are currently underway (Appendix A, Table A-2).

Boeing Developmental Center, Southern Portion Action Item A14.08.00

This action item involves finding PCB sources in building materials that may be impacting the LDW sediments contributing through the stormwater direct discharge pathway, and to then address those PCB sources through abatement and treatment of stormwater and NPDES compliance measures. This work is underway. Refer to Section 3.3.4 for more information.

Boeing Military Flight Center Action Item A14.15.00

This action item involves monitoring stormwater for PCBs at discharge points to assess potential ongoing sources. This facility has an NPDES permit (under the name of Military Delivery Center) that conditionally authorizes stormwater discharges associated with industrial activities. Boeing has conducted multiple rounds of removal of caulk containing PCBs from the tarmac and buildings at this facility. In 2017, Ecology issued a WQ Administrative Order (AO #13932) requiring Boeing to design and install stormwater treatment to address metals and PCBs in runoff from the facility (Ecology, 2017). Stormwater treatment systems are now in place.

As part of an effort to identify PCB sources to the S Norfolk Street CSO/EOG/SD outfall, described in the following section, a 42-inch pipe underneath the Military Flight Center is targeted for cleaning due to the potential of PCBs remaining in storm solids in the pipe likely due to historical discharges. The City of Seattle will be conducting the cleaning.

Given the status of treatment and PCB source removal actions, coupled with the fact that this facility is regulated under a WQ permit, Ecology's source control sufficiency finding is that the stormwater discharge pathway has a low likelihood of recontaminating the sediments above the RALs, under the condition that the line cleaning occurs before sediment remedy implementation in late 2024.

3.4.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing sources with the EAA 7 SCA that would impact source control sufficiency (King County, 2023).

The KCIA South Drainage basin discharges stormwater to Norfolk SCA via the Norfolk CSO/PS17 EOF/SD outfall. King County does not expect any source control issues in this basin, based on 2022 storm solids data and the status of KCIA's stormwater BMPs.

King County has one CSO and one wet weather treatment station (WWTS) that discharge to the LDW Upper Reach in the EAA 7 SCA. These are Norfolk Street CSO (DSN 044a) and

Henderson/MLK Jr Way WWTS (DSN 044b). Both discharge into the LDW through the Norfolk CSO/SD outfall. Both are subject to WQ permit requirements that conditionally authorize these combined sanitary sewer and stormwater discharges (permit number WA0029181).

- The Norfolk Street CSO is a controlled CSO per Washington State CSO performance standards with an average of one untreated discharge per year. The Norfolk Street CSO had one discharge event in December 2022 for approximately 15 minutes. Prior to this event, there had only been one discharge event in the last 20 years.
- The Henderson/MLK Jr Way WWTS became operational in 2005. Since 2010, the Henderson/MLK Jr Way WWTS has ranged from zero to three treated discharge events per year. In 2022, there were three treated discharge events. For more information on the Henderson/MLK Jr Way WWTS, refer to King County's memo (King County, 2023) and online at King County's CSO report library.

Because of the intermittent and brief nature of discharges from this controlled CSO outfall and associated wet weather treatment station, Ecology's source control sufficiency evaluation of the King County CSO infrastructure discharges found that combined sewer sources at this location have a low likelihood of recontaminating sediments above the RALs.

City of Seattle

The City of Seattle did not identify any ongoing issues from businesses they inspected within the S Norfolk St CSO/EOF/SD that would impact source control sufficiency (City of Seattle, 2023a).

In 2021, Ecology requested assistance from Seattle Public Utilities (SPU) with source tracing PCBs that were discovered to have increased in waterway sediment samples near the S Norfolk Street CSO/EOG/SD outfall and Norfolk EAA. The discharge area is approximately 100 ft upstream from RAL exceedance area 35 and Boeing's DC2 outfall. SPU's existing sediment traps upstream of the outfall did not indicate a PCB source within the SPU-owned drainage system. SPU started targeted sampling for source tracing in the lower section of the basin, including in areas not owned by SPU. In 2021 and 2022, SPU and Ecology continued storm system solids sampling in the lower S Norfolk Street CSO/EOF/SD basin in areas adjacent to the BDC and Military Flight Center facilities and the Prologis construction Site (also known as Emerald Gateway contaminated site cleanup). This effort did not identify a specific ongoing source.

Ecology and SPU coordinated with King County, the City of Tukwila, Boeing, and Prologis to determine next steps. The parties selected targeted line cleaning within the basin to reduce PCBs within the stormwater system and prevent solids contaminated with PCBs from discharging to the LDW via the S Norfolk Street CSO/EOG/SD outfall. SPU determined they had jurisdiction and the expertise to conduct this line cleaning operation. In consultation with Boeing, SPU agreed to jet and clean the drainage mainlines. SPU started cleaning the drainage system in late November 2022 at the southern end of the KCIA. Due to seasonal rainfall and heavy baseflow, SPU was unable to clean several sections and plans to complete their line cleaning work during the dry season in 2023. Boeing will complete the line cleaning once SPU has completed their sections, as there is a downgradient portion of the line located on Boeing

property. In 2023, SPU plans to reclean the sections they cleaned in 2022, to ensure all potential contamination has been removed.

Ecology's source control sufficiency finding is that the identified sources within the stormwater systems of the Norfolk drainage basin are controlled, under the condition that remaining line cleaning occurs before sediment remedy implementation in late 2024.

City of Tukwila

The City of Tukwila reported that there are no unmanaged sources to the Upper Reach sediments from illicit discharges or site O&M discharging to their municipal stormwater system (City of Tukwila, 2022b). The City of Tukwila is participating in the ongoing coordinated work of the SCWG regarding the Norfolk line cleaning that started in 2021.

Port of Seattle

The Port of Seattle does not have any leased tenants within the Upper Reach. The Port of Seattle did not identify any ongoing issues within the EAA 7 SCA that would impact source control sufficiency (Port of Seattle, 2023).

3.4.4 Water Quality Permit Sufficiency Findings

There are currently four WQ-permitted industrial facilities that are associated with the Norfolk CSO/SD SCA. Notable information is described below.

Boeing Developmental Center, Southern Portion

Section 3.3.4 provided details regarding the stormwater management actions underway and planned at BDC. The planned reconfigured drainage to the DC-2N treatment system is relevant to the Early Action Area 7: Norfolk Combined Sewer Overflow/Storm Drain SCA (Table 8).

Table 8: Boeing Developmental Center Stormwater Basin and Reconfiguration Work

RAL Exceedance Area(s)	Stormwater Treatment System	Basins Consolidated	Outfalls	Installation Completion Date
32 (DC4), 33 (DC16), 34 (DC3[b]), 35 (DC2)	DC-2N	DC-2, DC-3, DC-4, DC-16[a], DC-17[a]	DC2, DC3[b], DC4, DC16, DC17	Planned August 1, 2024 (system and conveyance)

[a] Drainage area without industrial activity.
[b] Outfall has been capped and is no longer discharging stormwater to the LDW. Stormwater is treated on site and discharged to vegetation areas for infiltration to soil.
Table compiled using information from 2022 Stormwater Pollution Prevention Plan for Boeing Developmental Center (Boeing, 2022c).

Boeing continues to conduct and document PCB abatement/removal actions, as required by AO 19427 (Ecology, 2020c). During the fourth quarter of 2022, Landau Associates completed the DC-2N drainage area assessment for potential PCB sources. PCBs were detected in drain sediments and catch basin samples in the DC-2N drainage area with concentrations ranging from 0.119 mg/kg to 7.03 mg/kg. Boeing is currently evaluating next steps and actions to

address PCB sources to the stormwater system (Geosyntec, 2023a), in addition to installing stormwater treatment for DC-2N.

Based on ongoing and planned stormwater management actions, Ecology's source control sufficiency evaluation of the BDC stormwater discharge pathway found that sources at this facility have a minimal likelihood of recontaminating sediments above the RALs. This finding is conditional provided the two additional advanced stormwater treatment systems are operational by the start of nearby in-water sediment cleanup.

3.4.5 Upland Contaminated Site Cleanup Sufficiency Findings

Ecology identified six upland facilities within the Norfolk CSO/SD SCA that are on the CSCSL. In 2022, Ecology reviewed the status of the BDC, Emerald Gateway, Affordable Auto Wrecking, Boeing Military Flight Center, BNSF Locomotive Spill, and Easteys ARCO cleanup sites. Ecology reviewed BDC, Emerald Gateway and Affordable Auto Wrecking in greater detail during the tier two review, and Ecology presented those findings below.

Boeing Developmental Center, Southern Portion

Boeing is currently conducting an RI for this contaminated cleanup. Shoreline contamination characterization is ongoing. Ecology reviewed the RI Work Plan (Landau, 2021) and the Draft Phase I RI Summary Report (Boeing, 2022a). Ecology believes that there may be sources of LDW COCs to sediments via contaminated groundwater migration and bank erosion pathways.

Phase I RI results for LDW COCs in soil and groundwater are generally below sufficiency screening criteria, however Ecology identified several sample-specific exceedances of LDW COCs in media along the shoreline. In addition, site-wide contamination characterization remains a considerable information gap in Ecology's source control evaluation. Ecology cannot confirm whether sources are present from these areas, requiring further investigation in Phase II of the RI. Ecology identified source characterization information gaps in the shoreline soil and groundwater located within the Sediment Waste Management Unit-43 (SWMU-43) area in immediate proximity to RAL exceedance areas 32-35 (Figure BS-5).

Ecology's source control sufficiency found that Ecology needs more information about the sources from the areas of BDC that require further investigation in phase II of the RI. This includes the upland shoreline areas. Ecology expects to receive the shoreline characterization information in late 2023.

Emerald Gateway

Prologis, the current owner of the Emerald Gateway site, is currently conducting an RI and interim actions concurrent with construction and development of the property. Ecology expects several interim actions will be completed by Prologis in 2024.

Ecology required Prologis to complete an RI, FS, and draft CAP under the scope of work and schedule of the AO 16659 (Ecology, 2020d). Ecology identified information gaps that are present for the overall CSM, including the extent of COCs in soil and groundwater and pathways to the river. Ecology expects the information gaps at the Site will be filled once the RI and FS are completed.

Ecology does not expect sources from this cleanup to impact the planned active in-waterway sediment cleanup because of the distance between this cleanup and the nearest RAL exceedance areas 32-35.

The Emerald Gateway Site does not have shoreline features. The Site is separated from the LDW by E Marginal Way S. As a result, Ecology did not further evaluate the soil bank erosion and groundwater migration pathways for source control sufficiency.

Potential sources transported along the stormwater direct discharge pathway are conditionally controlled, considering the information gaps present at this stage of the cleanup and under the condition that two actions completed before sediment cleanup for RAL exceedance areas 32-35 begin:

1. Stormwater continues to be treated and contaminants removed for storage or disposal under WQP AO 18101 (Ecology, 2020e) and CSWGP permit WAR308823. Refer to Section 3.4.3 for information related to source tracing work in the Norfolk drainage basin.
2. Stormwater system improvements are completed under the MTCA AO 16659 (Ecology, 2020d).

Affordable Auto Wrecking

Ecology identified information gaps in soil and groundwater characterization at this contaminated site. The Site is awaiting cleanup. This Site is located approximately 4,500 ft from the LDW and does not have erodible bank features. Potential groundwater contamination from this Site is not expected to reach the LDW. Secondary transport of contaminated media to the LDW via infiltration to stormwater systems is not a pathway concern to Ecology at this site.

Ecology's source control sufficiency evaluation found that this Site is unlikely to contribute sources of contamination to the LDW due to the distance from LDW and a lack of evidence that groundwater is impacting downgradient properties.

3.5 Early Action Area 5: Terminal 117

3.5.0 Summary of Area Features

The EAA-5: Terminal 117 SCA is located on western side of the LDW between RM 3.4-3.8 (Figure 2, Figures B-5 and B-6). The associated Data Gaps report (SAIC, 2007) and SCAP (Ecology, 2009a) include detailed information about this SCA.

Ecology identified various upland properties of interest located within the SCA: South Park Marina, Port of Seattle's Terminal 117 upland cleanup and adjacent street and stormwater projects, the Basin Oil Sites, and the northern portion of Boeing's South Park facility. The Terminal 117 EAA is located within the sediment areas of this SCA.

There are two municipal outfalls, 16th Ave S SD and 17th Ave S SD, that discharge stormwater within the SCA and are regulated under phase I MS4 permits (Section 3.5.3). King County owns the 16th Ave S SD outfall located at the northern, downstream end of the South Park Marina facility (Figure B-6). The 16th Ave S SD system drains ~1.3 acres of Seattle rights of ways

(ROWs). The City of Seattle owns the 17th Ave S SD outfall located at the southern, upstream end of the South Park Marina. The City of Seattle constructed 17th Ave SD outfall and drainage system as part of the removal action for the Adjacent Streets and Stormwater portion of the T117 upland and EAA cleanups. These activities removed PCB-contaminated soil present in the ROWs along T117 (City of Seattle, 2017). The 17th Ave SD system drains ~2.9 acres of adjacent street ROWs and properties and treats stormwater before it discharges via the 17th Ave SD outfall. The private outfalls 2214, South Park Marina outfall, and Unnamed outfall No. 1 discharge stormwater conveyed from the South Park Marina facility (Aspect, 2022a)(Aspect, 2022a) (SPM, 2023)(SPM, 2023).

The shoreline structures within the T117 EAA are a mixture of unarmored, armored, and restored banks (Figures B-6 and B-7) (LDWG, 2022a). The northern end of the South Park Marina facility the shoreline is unarmored, and the remaining shoreline is armored. Port of Seattle conducted various bank stabilization and restoration projects along the shoreline areas adjacent to the T117 upland cleanup & EAA and the Duwamish River People's Park and Shoreline Habitat project.

The T117 sediment EAAs abuts the Port of Seattle Terminal 117 upland cleanup and areas of discharge. This EAA extends between 50-100 feet from the shoreline to approximately 50 feet from western edge of the FNC. The EAA geographically separates potential upland sources from RAL exceedance areas within the waterway (Figure B-6). Ecology's sufficiency evaluations for these areas are limited in this SER, since near-shore contaminated sediments were already remediated under this EAA. Upland source findings documented in this SER are more relevant to recontamination of EAAs, if recontamination is discovered during near-term sediment monitoring activities.

3.5.1 Associated Sediment Remedy Areas

Ecology associated RAL exceedance areas 11, 12, 13, 15, 16, 19, and 20 with the T-117 SCA. RAL exceedance areas 11, 12, 15, and 16 are in subtidal sediments (Figure B-1 and B-6). Areas 11 and 12 are within the FNC. Areas 15 and 16 border the T-117 EAA and are separated from the shoreline, with area 15 extending into the FNC (Figure B-6). Areas 13, 19, and 20 are in intertidal sediments and bordering the LDW shoreline except that area 20 borders on the subtidal area (Figure B-7). RAL exceedance area 13 is collocated with the 17th Avenue S SD outfall and borders the South Park Marina upland cleanup and T-117 EAA.

The EPA and LDWG defined areas 12, 15, 16, 19, and 20 with sediment exceedances of total PCBs above RALs. Some of the exceedance areas are defined by only one subsurface sediment sample. Area 11 is defined by one subsurface sediment exceedance of mercury and fluoranthene, whereas surface sediments are below ROD RALs. Area 13 is defined by surface exceedances of total PCBs and 4-methylphenol (LDWG, 2022a).

The EPA and LDWG assigned the dredging remedial technology to all RAL exceedance areas except for area 13 that was assigned dredging and ENR (LDWG, 2022c).

3.5.2 Incomplete High- and Medium-Priority Action Items

All 26 high- and medium-priority action items identified for the EAA-5: T-117 SCA are complete (Appendix A, Table A-2).

3.5.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing issues within the T-117 SCA that would impact source control sufficiency (King County, 2023).

City of Seattle

The City of Seattle did not identify any ongoing issues from businesses they inspected within the T-117 SCA that would impact source control sufficiency (City of Seattle, 2023a).

SPU cleaned PCB contamination from adjacent streets in 2016 and conducted 1,600 ft of line cleaning to remove approximately 0.2 tons of polluted solids from portions of the separated storm and combined sewers leading to the Dallas Avenue outfall (City of Seattle, 2017). SPU constructed the 17th Avenue S SD stormwater collection and treatment system in 2016 as part of the City's Terminal 117 Adjacent Streets cleanup. The stormwater treatment system effectively removes PCBs from stormwater before discharging to the T-117 EAA sediments, based on findings in the T-117 EAA 2021 (Year 6) Monitoring and Maintenance Report (Port of Seattle and City of Seattle, 2022). SPU reported to Ecology that storm solids were cleaned from the system twice in 2021. Current stormwater treatment effectively removes PCBs from stormwater prior to discharge to the 17th Avenue S SD outfall.

Recently, a storm drain sediment trap sample taken by the City of Seattle within the 17th Avenue S SD had exceedances of LDW COCs above ROD RALs (Recovery Category 2), including for PCBs. This storm drain sediment trap contained very low volumes of settled storm solids. SPU started targeted sampling to source trace these PCBs and will address any sources found consistent with their SCIP and MS4 permit requirements. They are also planning to conduct stormwater line cleaning in this area.

Given the City of Seattle's stormwater treatment and ongoing source control program, Ecology considers municipal stormwater discharges from the 17th Avenue S SD to be controlled.

City of Tukwila

The Sea King Industrial Park SCA is located outside of the boundary of the City of Tukwila. No activities are reported by the City of Tukwila for this SCA.

Port of Seattle

The Port of Seattle does not have any leased tenants within the Upper Reach. The Port of Seattle did not identify any ongoing issues within the T-117 SCA that would impact source control sufficiency (Port of Seattle, 2023).

3.5.4 Water Quality Permit Sufficiency Findings

There are two NPDES-permitted industrial facilities the T-117 SCA. Notable information is provided below.

South Park Marina

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with boatyard activities. South Park Marina is in the process of installing stormwater treatment in the CA-01 catchment area in accordance with WQ permit requirements. This catchment discharges approximately 300 ft from RAL exceedance area 13. The treatment system is expected to be in place by 2024.

Ecology's source control evaluation of South Park Marina found that sources of contaminants transported via the direct discharge pathway are unlikely to impact source control sufficiency. This is conditional upon the near-term installation of stormwater treatment.

Boeing South Park, Northern Portion

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities. Boeing installed stormwater treatment in 2014 under their WQ permit and AOs #9601 (Ecology, 2012) and amended AO #9741 (Ecology, 2013). This resulted in all five drainage areas of Boeing South Park being routed to outfall E located in the Sea King Industrial Park SCA (Figure B-8). Refer to Section 3.6.4 for additional information.

3.5.5 Upland Contaminated Site Cleanup Sufficiency Findings

Ecology identified four upland facilities within T-117 SCA that are on the CSCSL. In 2022, Ecology reviewed the status of cleanup for the Port of Seattle's T-117, South Park Marina, and the Basin Oil contaminated sites. Ecology reviewed South Park Marina and the Basin Oil contaminated sites in greater detail during the tier two review and presented those findings below.

South Park Marina

The PLPs finalized a Source Control Memo in September 2022 (Aspect, 2022) to satisfy Task 2a of the AO (Ecology, 2019c) concurrent with RI activities. The PLPs collected upland concentration data from 2007 to 2021 at this Site before and during phase I of the RI. The Site COCs, pathways, and surface sediment conditions were evaluated and modeled for sediment recontamination potential.

Ecology expects that the PLPs will reevaluate all pathways under phase II of the RI. This evaluation will focus on potential PCB discharges from the southern catchment area. Once the RI Phase II data are obtained and analyzed, the PLPs will coordinate with Ecology about whether the update should be provided as an addendum to the Source Control Memo (Aspect, 2022) or as a component of the Site RI. Ecology has not determined whether additional interim actions will be needed to control sources of contamination to the sediments.

Ecology's source control sufficiency evaluation found that contamination at this Site presents a low risk of recontaminating sediments with the COCs identified in corresponding sediments above the RAL. Sources of LDW COCs present at this Site are sufficiently controlled.

Basin Oil Dallas Avenue

The Basin Oil Dallas Avenue contaminated Site, located near the shoreline, is awaiting cleanup and is not under a formal enforcement order. Ecology noted there are information gaps regarding the CSM and characterization of sources to the LDW. Elevated soil contaminant concentrations are localized and near the surface. No contaminants were detected in groundwater at concentrations above screening criteria protective of sediments.

Ecology does not consider there to be contaminated groundwater present and migrating downgradient from the Site to the LDW, based upon groundwater conditions at the T-117 EAA (Windward et al., 2010). Ecology does not consider potential sources to be transported to the LDW via the stormwater direct discharge pathway, based on review of a 2010 site characterization report (Ecology, 2010c) and recent City of Seattle updates on stormwater treatment system effectiveness within the 17th Avenue SD basin (Section 3.5.3).

Ecology's source control sufficiency evaluation found that contamination from this Site is unlikely to contribute a significant source of LDW COCs to Dallas Avenue and associated stormwater systems, the T-117 upland cleanup, or the LDW. Ecology qualifies these findings, noting existing information gaps with the source characterization and Site CSM.

Basin Oil Dallas Drum Storage 17th Ave S

The Basin Oil Dallas Drum Storage 17th Ave S contaminated Site is next to the Basin Oil Dallas Avenue contaminated Site. The Basin Oil Dallas Drum Storage 17th Ave S is currently awaiting cleanup and is not under a formal enforcement order.

Information gaps exist regarding the CSM and the characterization of sources to the LDW (Windward et al., 2010). A Site Hazard Assessment was planned but not completed due to insufficient information (Ecology, 2015b).

Ecology's source control sufficiency evaluation found that contamination at this Site does not present significant source(s) to the LDW. Ecology qualifies these findings, noting existing information gaps with the source characterization and Site CSM.

3.6 Sea King Industrial Park

3.6.0 Summary of Area Features

The Sea King Industrial Park SCA is located on the western side of the LDW between RM 3.8-4.2 (Figure B-8) and includes a small portion of LDW shoreline and upland facilities within the S 96th Street SD basin. The associated Data Gaps report (SAIC, 2013a) and SCAP (Ecology, 2013b) include detailed information about this SCA. Since development of the SCAP, the SCWG conducted several source tracing and line cleaning activities within this SCA. Located within this SCA are nine NPDES facilities (reported in Section 3.6.4) and one contaminated site cleanup of interest to Ecology (reported in Section 3.6.5).

There are three private outfalls located within the Sea King Industrial Park SCA (outfalls 2102, Delta Marine 2 and Delta Marine 1). Outfall 2102 (referred to in Boeing South Park's SWPPP as "outfall E" or "SP1") is in the southeastern corner of the Boeing South Park facility (Section

3.6.4) and is the only outfall discharging stormwater from the facility, connected to ~10 000 linear feet of stormwater system piping (Ecology, 2022c). Outfalls Delta Marine 2 and 1 (also known as R001 and R002, respectively) are along the shoreline of the Delta Marine Industries Inc facility that is currently permitted under a Boatyard GP (Section 3.6.4).

One public outfall, Outfall S 96th St SD, is located on property owned by Duwamish Yacht Club. This outfall discharges stormwater from King County's S 96th Street SD basin, which consists of open ditches, culverts, wetlands, and piped storm drains in the S 95th Street and S 96th Street systems. Flow from the two systems merges at S 95th Street, east of SR99. Less than 10% of this drainage basin receives discharges from Seattle-owned stormwater collection system (Ecology, 2020f).

Ecology identified one outfall that has unclear ownership; outfall 2101 located approximately at RM 3.95 is connected to a stormwater settling pond at the Sea King Industrial Park facility. The 2101 outfall is presumed to be owned and operated by King County; however, the ownership is currently under dispute (Ecology, 2020f). Ecology identified one ditch discharge point at the end of S Director St (referred to as the S Director St ditch), and Ecology did not assess this direct discharge pathway consistent with our evaluation approach.

The shoreline structures within the Sea King Industrial Park SCA include a mixture of restored banks, unarmored slopes, and armored structures and bulkheads (LDWG, 2022a).

3.6.1 Associated Sediment Remedy Areas

Ecology associated RAL exceedance area 23 within the Sea King Industrial Park SCA. Area 23 is in the intertidal zone and near the S Director St ditch and the southern portion of the Boeing South Park Facility outfall 2102 (outfall "E") (Figure B-8). Area 23 is not adjacent to the LDW shoreline, and the relatively small size of the area is driven by two surface exceedances of total PCBs collected in 2005 and 2011 (LDWG, 2022a). LDWG and the EPA assigned ENR remedial technology to this area (LDWG, 2022c).

3.6.2 Incomplete High- and Medium-Priority Action Item Status

All 21 high- and medium-priority action items identified for the Sea King Industrial Park SCA are complete (Appendix A, Table A-2).

3.6.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing issues within the Sea King Industrial Park SCA that would impact source control sufficiency (King County, 2023).

City of Seattle

The City of Seattle reported that they are unaware of any concerns for stormwater direct discharge in this SCA and its drainage basins (City of Seattle, 2023a). The City of Seattle is actively conducting sampling and source tracing in the S 96th Street SD basin in accordance with their SCIP and MS4 permit requirements. In 2022, the City of Seattle cleaned stormwater lines

within the basin and installed a low-profile sediment trap to overcome past storm system line sampling issues from sediment deposition and pipe sizing. In 2023, the City of Seattle will analyze sediment from the trap to fill information gaps regarding potential sources within the S 96th Street SD basin (City of Seattle, 2020).

Given Seattle's ongoing Source Control program implementation, municipal stormwater discharges from the Sea King Industrial Park SCA are unlikely to impact source control sufficiency.

City of Tukwila

The Sea King Industrial Park SCA is located outside of the boundary of the City of Tukwila. No activities are reported by the City of Tukwila for this SCA.

Port of Seattle

The Port of Seattle does not have any leased tenants within the Upper Reach. The Port of Seattle did not identify any ongoing issues within the Sea King Industrial Park SCA that would impact source control sufficiency (Port of Seattle, 2023).

3.6.4 Water Quality Permit Sufficiency Findings

There are nine NPDES-permitted facilities in the Sea King Industrial Park SCA (eight Industrial Stormwater General Permits and one Boatyard General Permit). Notable information is provided below.

Boeing South Park, Southern Portion

This facility has an NPDES permit that conditionally authorizes stormwater discharges associated with industrial activities. Boeing installed stormwater treatment (linked bioretention cells) in 2014 under their WQ permit and AOs #9601 (Ecology, 2012) and amended AO #9741 (Ecology, 2013). This resulted in all five drainage areas of Boeing South Park being routed to bioengineered "outfall E" (private outfall 2102) (Ecology, 2022c) (Figure B-8).

Surface sediment samples adjacent to and immediately downstream of the South Park outfall do not exceed RALs. Extremely low and consistent total suspended solids effluent concentrations from the bioswales suggest most of the particulates to which PCBs are expected to sorb are filtered out by the engineered media in the bioswales. The engineered media bioswales appear to be effective in treating stormwater to reduce PCB concentrations below detection limits, based upon media filter installations and pilot studies at other Boeing sites using similar engineered media bioswales.

Based on a review of storm solids samples for PCBs and associated decreasing concentrations (Geosyntec, 2023b), and the effectiveness of installed stormwater treatment technologies, Ecology's source control sufficiency evaluation found that this facility is unlikely to recontaminate LDW sediments with PCBs above the RALs.

3.6.5 Upland Contaminated Site Cleanup Sufficiency Findings

Ecology identified eight upland facilities within the Sea King Industrial Park SCA that are on the CSCSL. In 2022, Ecology reviewed the status of cleanup for the following contaminated sites:

Precision Engineering, FMH Materials Handling Solutions, Gary Merlino Construction, Fruehauf Trailer Services, Advance Electroplating, Selland Auto Transport, Glen Acres Golf & Country Club, and Shillings Auto. Ecology evaluated the Precision Engineering Site in greater detail during the tier two review and presented the findings below.

Precision Engineering

The Precision Engineering contaminated cleanup is located approximately 1,900 ft upland from the LDW (Figure B-8). LDW COCs present in soil are not transported to the LDW via soil bank erosion pathway. It does not appear as though contaminated groundwater is migrating from the Precision Engineering contaminated Site to downgradient properties. Precision does not contribute PCBs to RAL exceedance area 23 via the direct discharge pathway given prior stormwater pathway investigations (GeoEngineers, 2022).

Ecology's source control sufficiency evaluation found that contaminated media from this Site are unlikely to be transported to the LDW from the Precision Engineering contaminated site.

3.7 Restoration Areas

3.7.0 Summary of Area Features

The Restoration Areas SCA is located on the western side of the LDW between RM 4.2-5.8 (Figure B-9). Publicly accessible beach areas are located adjacent to the shoreline, and various restored habitats are dispersed within the SCA (Ecology, 2013c). Hamm Creek is composed of four tributaries known as the South, Middle, Lost, and North Forks. South Fork of Hamm Creek is located within the SCA, and the remaining forks are located within the Sea King Industrial Park SCA (Figure B-10). The associated Data Gaps report (SAIC, 2013b) and SCAP (Ecology, 2013c) include details information about this SCA.

The status of several upland properties of interest are reported in Section 3.7.5, such as City of Seattle's Duwamish substation and Moimoi Property properties. One NPDES- permitted facility, Amazon.com Services LLC – DWA2, is located within this SCA and sufficiency findings are reported in Section 3.7.4.

Except for a several natural drainage discharge points (Hamm Creek, and Ditches #1 and #2), the only other notable discharges are from outfalls owned by the City of Seattle and City of Tukwila municipalities (Figure B-9). The City of Seattle owns outfalls DuwSD#3, 2098, 2099 that are associated with the Duwamish substation facility. The City of Tukwila owns outfalls W Marginal Pl S SD and 2201 (Ecology, 2020f); however, additional outfalls are reported by the City of Tukwila in their ArcGIS online datasets (outfall IDs 4191, 4172, 4161, 4114, 4113, 3903) and these were incorporated into this report's figures (City of Tukwila, 2022d).

The shoreline structures of the Restoration Areas SCA are a mixture of armored and unarmored slopes between RM 4.2-4.75, and south of RM 4.75 (LDWG, 2022a). Between RM 4.75-5.0 the shoreline is classified by LDWG as having post-phase I PDI bank construction activities.

3.7.1 Associated Sediment Remedy Areas

Ecology associated RAL exceedance areas 30 and 31 with the Restoration Areas SCA. These RAL exceedance areas are located outside of the southern limits of the FNC, within intertidal areas of the upper turning basin (Figure B-9) and do not border the LDW shoreline. The closest area of discharge to these areas is a natural ditch #1 located at approximately RM 4.7 (about 500 ft). Area 30 is defined by one relatively high surface exceedance (RAL exceedance factor [EF] of 19) and one relatively low subsurface exceedance of total PCBs (RAL EF 1.3); area 31 is defined by one subsurface exceedance (RAL EF 13) of total PCBs (LDWG, 2022a). LDWG and the EPA assigned the dredging remedial technology to these RAL exceedance areas (LDWG, 2022c).

3.7.2 Incomplete High- and Medium-Priority Action Items

All four medium-priority action items identified for the Restoration Areas SCA are complete. No high-priority action items were defined by Ecology for this SCA (Appendix A, Table A-2).

3.7.3 Source Control Program Sufficiency Findings

King County

King County did not identify any ongoing issues within the Restoration Areas SCA that would impact source control sufficiency (King County, 2023).

City of Seattle

The City of Seattle did not identify any ongoing issues within the Restoration Areas SCA that would impact source control sufficiency (City of Seattle, 2023a).

City of Tukwila

The City of Tukwila reported that there are no unmanaged sources to the Upper Reach sediments from illicit discharges or site O&M discharging to their municipal stormwater system (City of Tukwila, 2022b).

Port of Seattle

The Port of Seattle reported there are no leased tenants under the Port's Municipal Phase I Permit located within the Upper Reach (Port of Seattle, 2023).

3.7.4 Water Quality Permit Sufficiency Findings

There is one NPDES-permitted industrial facility in the T-117 SCA. Ecology's source control evaluation found that stormwater discharges from this facility are unlikely to impact source control sufficiency.

3.7.5 Upland Contaminated Site Cleanup Sufficiency Findings

Ecology identified six upland facilities within the Restoration Areas SCA that are on the CSCSL. In 2022, Ecology reviewed the status of cleanup for the following contaminated sites: SCL Duwamish Substation, Moimoi Property, UNOCAL 6248, Chavez Auto Repair, Prasad Property, and Boulevard Auto Service.

Ecology's source control sufficiency evaluation found that these contaminated sites are unlikely to contribute sources of LDW COCs to RAL exceedance areas 30 and 31. These sites are not adjacent to the LDW and are between 5,000 to 7,500 ft from the shoreline. Two notable exceptions are the Moimoi Property (not adjacent but within 700 ft of the shoreline) and the SCL Duwamish Substation (adjacent). Neither of these upland sites have corresponding areas of sediments where active in-waterway remedies are planned by LDWG.

Ecology's source control sufficiency evaluation found that contamination from the SCL Duwamish Substation may present a potential source to the LDW; however, remedial actions are not necessary to meet source control sufficiency goals because RAL exceedance areas 30 and 31 are geographically separated and approximately 1,200 ft upstream from the sediment areas adjacent to SCL Duwamish Substation.

4 SUFFICIENCY RECOMMENDATIONS

Ecology's source control sufficiency recommendations are organized by SCA and presented for each RAL exceedance area.

4.0 Early Action Area 4: Boeing Plant 2/Jorgensen Forge

4.0.0 RAL Exceedance Areas 2-5

RAL exceedance areas 2-5 correspond to sediment areas contaminated with total PCBs. The RAL exceedance areas are located within the FNC, in subtidal areas that are immediately adjacent to the Boeing Plant 2 EAA. They are separated from shoreline by approximately 200 ft (LDWG, 2022a), and are not adjacent to areas with direct discharges, groundwater seeps, or erodible soil banks (Figure B-1).

Sediments within the boundary of EAA separate the RAL exceedance areas from the shoreline area and are undergoing compliance monitoring by the EPA. Ecology did not evaluate the sediments of the EAA, since recontamination of the EAA sediments, should they occur by upland sources, will be addressed by the Agencies in a separate process from the active in-waterway sediment cleanup.

Ecology recommends that the EPA proceed with in-waterway remediation for RAL exceedance areas 2-5.

Table 9: RAL Exceedance Areas 2-5 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via adequate permitting compliance.	Not applicable	Not applicable
Soil bank erosion/leaching	Not applicable[a]	Qualifications, information unavailable for review[a].	Not applicable[a]
Groundwater migration	Not applicable[a]	Qualifications, information unavailable for review[a].	Not applicable[a]

[a] These pathways and potential sources corresponding to Boeing Plant 2 and Early Action Areas and were not evaluated by the EPA and were not presented in this report. However, impacts to sediments within the EAA are considered minimal, and there is very low risk to the RAL exceedance areas approximately 150 to 200 ft away from source discharge/erosion areas.

4.0.1 RAL Exceedance Areas 14 and 17

RAL exceedance areas 14 and 17 correspond to sediment areas contaminated with total PCBs (area 17 is also contaminated with mercury). These RAL exceedance areas are located in subtidal areas within the FNC, and they are not close to shoreline areas with direct discharges, groundwater migration or erodible soil banks (Figure B-1).

Ecology recommends the EPA can proceed with in-waterway remediation after noting existing information gaps (Table 10).

Table 10: RAL Exceedance Areas 14-17 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via adequate permitting compliance.	Not applicable	Not applicable
Soil bank erosion/leaching	No[a]	Qualifications	Complete the RI and FS at Jorgensen Forge.
Groundwater migration	No[a]	Qualifications	Complete the RI and FS at Jorgensen Forge.

[a] Ecology considers there to be soil erosion and groundwater migration pathways to the LDW, and sources are identified in the RI. However, impacts to sediments within the EAA are considered minimal, and there is very low risk to the RAL exceedance areas approximately 150 to 200 ft away from source discharge/erosion areas.

4.1 Boeing Isaacson/Central King County International Airport

4.1.0 RAL Exceedance Area 18

RAL exceedance area 18 corresponds to sediment areas contaminated with total PCBs, arsenic, and various PAHs. Notably, area 18 includes surface sediment contamination of arsenic upwards of 19 RAL EF (LDWG, 2022a). Area 18 is located primarily in the intertidal zone immediately adjacent to the port sliver property and shoreline in the northern half of the Boeing Isaacson Thompson properties. Area 18 is located immediately adjacent to shoreline areas with direct discharge (outfalls KCIA SD#2 and 2061), groundwater migration and soil bank erosion features corresponding to the wooden bulkhead along the Port of Seattle sliver property (Figure B-2). Ecology recommends that the EPA does not proceed with in-waterway remediation (Table 11).

Table 11: RAL Exceedance Area 18 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via adequate permitting compliance.	Conditions and qualifications are considered minor.	Continued BMP effectiveness and any future potential on-site PCB investigations are addressed under CWA. MTCA actions supportive of this pathway.
Soil bank erosion/leaching	No, sources currently known, and remedies are ongoing.	Not applicable	Source remedy under MTCA cleanup.
Groundwater migration	No, sources currently known, and remedies are ongoing.	Not applicable	Source remedy under MTCA cleanup.

4.1.1 RAL Exceedance Area 21

RAL exceedance area 21 corresponds to a relatively small area with one subsurface vertical core sample with exceedances of total PCBs (LDWG, 2023a). Area 21 is located in the shoal and scour zone immediately adjacent to the southern portion of RAL exceedance area 18. Area 21 is located approximately 140 ft from the shoreline (Figure B-2).

Ecology recommends that the EPA proceed with in-waterway remediation, noting source characterization information gaps and under the condition that additional characterization work for soil and groundwater in the near term confirms Ecology's findings (Table 12).

Table 12: RAL Exceedance Area 21 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via adequate permitting compliance.	Conditions and qualifications are considered minor.	Continued BMP effectiveness, any potential on-site PCB investigations are addressed under CWA.
Soil bank erosion/leaching	Uncertain, sources are known, and remedies are ongoing.	Conditions and qualifications	Shoreline source characterization.
Groundwater migration	Uncertain, sources are known, and remedies are ongoing.	Conditions and qualifications	Shoreline source characterization.

4.1.2 RAL Exceedance Area 22

RAL exceedance area 22 corresponds to sediment areas contaminated with total PCBs, lead, mercury, zinc and BBP. Area 22 is primarily within the intertidal zone adjacent to the shoreline, upland cleanup sites, and two ENR/AC pilot plots (LDWG, 2022a). Area 22 is located immediately adjacent to shoreline areas with direct discharge (outfalls 2077 and 2075), groundwater migration and soil bank erosion features corresponding to the unarmored slope located along the southern portion of Boeing Isaacson Thompson (Figure B-2).

Ecology recommends that the EPA proceed with in-waterway remediation, noting substantial source characterization information gaps and under the condition that additional characterization work for soil and groundwater in the near term confirms Ecology's findings (Table 13).

Table 13: RAL Exceedance Area 22 Sufficiency Outcome Summary Information for Boeing Isaacson Thompson/Central KCIA SCA

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via adequate permitting compliance.	Conditions and qualifications, specific to Boeing Isaacson Thompson.	Continued BMP effectiveness and any future potential on-site

			PCB investigations are addressed under CWA.
Soil bank erosion/leaching	Uncertain, sources are known, and remedies are ongoing.	Conditions and qualifications, specific to Boeing Isaacson Thompson.	Shoreline source characterization. MTCA source remedy.
Groundwater migration	Uncertain, sources are known, and remedies are ongoing.	Conditions and qualifications, specific to Boeing Isaacson Thompson.	Shoreline source characterization. MTCA source remedy.

4.2 Slip 6

4.2.0 RAL Exceedance Area 22

RAL exceedance area 22 corresponds to sediment areas contaminated with total PCBs, lead, mercury, zinc and BBP. Area 22 is primarily within the intertidal zone adjacent to the shoreline along Boeing Isaacson Thompson and 8801 E Marginal Way S (Figure B-3) (LDWG, 2022a). Area 22 is located immediately adjacent to shoreline areas with direct discharges (outfalls 2077 and 2075), groundwater migration and soil bank erosion from the unarmored slope along the southern portion of Boeing Isaacson Thompson.

Ecology recommends that the EPA proceed with in-waterway remediation (Table 14).

Table 14: RAL Exceedance Area 22 Sufficiency Outcome Summary Information for the Slip 6 SCA

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via appropriate permitting compliance.	Conditions and qualifications, specific to Boeing Isaacson Thompson.	Continued BMP effectiveness and any future potential on-site PCB investigations are addressed under CWA. Considered a minimal risk.
Soil bank erosion/leaching	Yes, shoreline is structured with a sheet pile wall preventing soil erosion.	Conditions	Ensure bank erosion is controlled, CMRs available for review in late 2023.
Groundwater migration	Yes, contaminated groundwater remedy is being completed in 2023.	Conditions and qualifications are considered minor.	CMRs available for review in late 2023.

4.2.1 RAL Exceedance Areas 24 and 25

RAL exceedance areas 24 and 25 correspond to sediment areas with surface contamination of total PCBs of upwards of 20 RAL EF (LDWG, 2022a). Area 24 is within the intertidal zone on the southern boundary of the ENR pilot plot and the shoreline of 8801 E Marginal Way S (Figure B-3). Area 25, also within the intertidal area, is defined by one sample location where total PCBs exceed ROD RALs. Area 25 is separated from the shoreline of 8801 E Marginal Way S by approximately 100 ft. These RAL exceedance areas are not close to outfall areas with direct

discharges, groundwater migration (nearest seep locations are near area 26), or soil bank erosion features (the slope is armored).

Ecology recommends that EPA proceed with in-waterway remediation for RAL exceedance areas 24 and 25.

Table 15: RAL Exceedance Areas 24 and 25 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	NA, no known direct discharge areas in immediate vicinity.	Not applicable	None. If industrial activities resume, the Site should require compliance with NDPES permit.
Soil bank erosion/leaching	Yes, shoreline is structured with a sheet pile wall preventing soil erosion.	Conditions	Ensure erosion is controlled, and CMRs available for review in late 2023.
Groundwater migration	Yes, contaminated groundwater remedy in 2023.	Conditions and qualifications, considered minor.	CMRs available for review in late 2023.

4.2.2 RAL Exceedance Area 26

RAL exceedance area 26 corresponds to sediment areas contaminated with total PCBs, dioxins/furans, and BBP. Notably, area 26 includes one surface exceedance of total PCBs at 18.0 RAL EF (LDWG, 2022a). Area 26 is within the intertidal zone along the shoreline of 8801 E Marginal Way S (Figure B-3) and is next to areas of known groundwater migration (seeps 1-4, Figure 2 of Addendum to FS and IAWP), and historical direct discharges (outfall 2073) (Shannon & Wilson, 2020a).

Ecology recommends that the EPA proceed with in-waterway remediation (Table 16).

Table 16: RAL Exceedance Area 26 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, no current industrial activities; currently permitted for construction activity.	NA	ISGP permitting compliance at CenterPoint Tukwila if industrial activities resume in the future.
Soil bank erosion/leaching	Yes, shoreline protected by a 12-foot-wide berm of quarried material that is armored on the LDW side.	Conditions	Ensure erosion is controlled. CMRs available for review in late 2023.
Groundwater migration	Yes	Conditions and qualifications, considered minor.	Based upon completion of remaining interim actions and CMRs available for review in late 2023.

4.2.3 RAL Exceedance Area 27

RAL exceedance area 27 corresponds to sediment areas contaminated dioxins/furans, mercury, phenol, and total PCBs. Area 27 is within the intertidal zone along the shoreline of Container Properties (formerly Rhone-Poulenc, current tenant is Shippers Transport Express) and is adjacent to suspected areas of soil bank erosion (Figure B-3). No areas of groundwater migration or direct discharge are reported (Section 3.2.5).

Ecology recommends the EPA proceed with in-waterway remediation noting information gaps pertaining to the soil bank erosion pathway (Table 17).

Table 17: RAL Exceedance Area 27 Summary of Sufficiency Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, new permittees have the appropriate permit and conditions.	Not applicable	Not applicable
Soil bank erosion/leaching	Yes, shoreline protected by a riprap and concrete rubble is suspected to prevent soil erosion.	Conditions and qualifications	Data gaps for soil media for dioxins/furans to be filled; shoreline soils to be cleaned concurrent with sediment remedy of RAL exceedance area 27.
Groundwater migration	Yes, barrier wall is demonstrated to restrict groundwater from discharging to the LDW.	Not applicable	Based upon completion of remaining interim actions and CMRs available for review in late 2023.

4.2.4 RAL Exceedance Area 28

RAL exceedance area 28 corresponds to a relatively small, subsurface sediment area contaminated with total PCBs. Notably, area 28 is defined by two subsurface exceedances (1.1 RAL EF); however, surface sediments in the same location are below ROD RALs (LDWG, 2022c). Area 28 is located in the subtidal area of Slip 6 approximately 40 to 100 ft from the shoreline of BDC (Figure B-3). The southern portion of area 28 is in BDC's SWMU-43 areas, where current investigations of the shoreline groundwater and soil media are taking place in 2023 (Section 3.2.5). The closest areas of direct discharge outfalls are approximately 200 to 340 ft away (outfalls KCIA SD#1, DC14, and DC15). Several overwater structures historically occupied the area of slip 6 corresponding with RAL exceedance area 28, based on aerial images dating from 1950s onward.

Ecology found that potential sources to area 28 are not characterized well enough for Ecology to assess sediment recontamination potential. Ecology considers the direct discharge pathway to be controlled, based on the WQ permitting compliance in the northern drainage areas of BDC (DC-14 and DC-15). Ecology suspects there to be groundwater migration and soil bank erosion pathways to the LDW. Ecology identified a potential for upland sources to impact sediments along the shoreline of BDC, based on limited shoreline groundwater and soil

characterization conducted under Phase I of the RI, however more characterization is necessary to determine the extent of contamination and potential for sediments to become recontaminated over time. Shoreline soil and groundwater characterization the SWMU-43 area will be completed in 2023 as part of phase II of the RI.

Ecology recommends the EPA proceed with in-waterway remediation at RAL exceedance area 28, after noting the source characterization information gaps and under the condition that findings from the Phase II RI for shoreline source characterization confirm Ecology's recommendation outcome (Table 18).

Table 18: RAL Exceedance Area 28 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via permitting compliance. Sediments are not impacted by nearest outfall discharges.	Not applicable	Not applicable
Soil bank erosion/leaching	Uncertain, source characterization data gaps are present.	Conditions and qualifications.	Fill data gaps for shoreline soils, SWMU-43 to be characterized and reported in 2023.
Groundwater migration	Uncertain, source characterization data gaps are present.	Conditions and qualifications.	Fill data gaps for shoreline groundwater, SWMU-43 to be characterized and reported in 2023.

4.3 Boeing Developmental Center

4.3.0 RAL Exceedance Area 29

RAL exceedance area 29 corresponds to a relatively small sediment area contaminated with various PAHs. Area 29 is defined by one sample location with surface (0-10 cm) and subsurface (0-45 cm) exceedances ranging from 0.9-4.8 RAL EF (LDWG, 2022c). Area 29 is located primarily within the subtidal area of the LDW adjacent to the shoreline of BDC, near where bank stabilization actions were proposed by Boeing (Boeing, 2021). Area 29 is adjacent to the SWMU-43 area of the BDC upland cleanup, where investigation of shoreline groundwater and soil are taking place in 2023 (Section 3.3.5). The closest neighboring outfall is DC8 located 100 ft upstream from area 29 (Figure B-4).

Ecology concludes that potential sources to RAL exceedance area 29 are not characterized well enough for Ecology to assess sediment recontamination potential. Ecology suspects there to be potential sources to the LDW, particularly contaminated groundwater and soil transported via the groundwater migration and soil bank erosion pathways. Shoreline concentration data in soil and groundwater collected during the Phase I RI exceed LDW PCULs that are protective of sediments. Ecology requires additional characterization to define the extent and degree of contamination present on the site. The remaining characterization work will occur in 2023, during Phase II of the RI. Ecology concludes that the direct discharge pathway is conditionally controlled, pending completion of storm system improvements scheduled for late 2024.

Ecology recommends EPA proceed with in-waterway remediation at RAL exceedance area 29 after noting the extensive source characterization information gaps for soil and groundwater. Ecology's recommendation is conditional upon Phase II RI sampling activities fill in the information gaps and confirm Ecology's outcome. These findings should be revisited for the EPA's determinations when phase II RI preliminary data are reported in 2023 (Table 19).

Table 19: RAL Exceedance Area 29 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via permitting compliance, sediments are not impacted by nearest outfall discharges.	Conditions	Improved stormwater treatment systems will be installed by end of 2024.
Soil bank erosion/leaching	Uncertain, source characterization data gaps and uncertainty on timeframe for bank erosion control.	Conditions and qualifications.	SWMU-43 to be characterized and reported in 2023, bank stabilization.
Groundwater migration	Uncertain, source characterization data gaps are present.	Conditions and qualifications.	SWMU-43 to be characterized and reported in 2023.

4.4 Early Action Area 7: Norfolk Combined Sewer Overflow/Storm Drain

4.4.0 RAL Exceedance Area 32

RAL exceedance area 32 corresponds to a relatively small area of surface sediments contaminated with high exceedances of total PCBs (RAL EF 1.3 – 880, spanning 2020 to 1995 respectively) and moderate exceedances of benzoic acid (RAL EF 3.5) (LDWG, 2022c). RAL exceedance area 32 is located primarily within the intertidal zone adjacent to the shoreline and BDC's drainage Area 4 and the DC4 outfall (Figure B-5). The Area 4 and DC4 outfall are being reconfigured into the DC-9N stormwater treatment system by August 1st, 2024 (Section 3.4.4). RAL exceedance area 32 is located in the SWMU-43 area of the BDC upland cleanup, where investigations of shoreline groundwater and soil are taking place in 2023, and where Boeing proposed shoreline bank stabilization activities (Section 3.4.5).

Ecology concludes that potential sources to RAL exceedance area 32 are not characterized well enough for Ecology to assess sediment recontamination potential. While Ecology may conclude that present contamination is mostly due to historical direct discharges at the DC4 outfall, upland sources transported along the groundwater migration and soil bank erosion pathways are not well understood, and shoreline soil and groundwater in the SWMU-43 area is yet to be characterized. The closest available shoreline data indicate a potential for upland sources to impact sediments along the BDC shoreline, inside and outside of area 32 (Boeing, 2022a). While Ecology could conclude that sources of PCBs and benzoic acid transported along the direct discharge pathway are conditionally controlled, given storm system improvements scheduled

for late 2024, Ecology notes there are significant information gaps for shoreline characterization of COCs in soils and groundwater.

Considering the extent of characterization gaps for upland media, Ecology recommends the EPA proceed with in-waterway remediation at RAL exceedance area 32 after noting the extensive source characterization information gaps for soil and groundwater. Ecology's recommendation is conditional upon Phase II RI sampling activities fill in the information gaps and confirm Ecology's outcome. These findings should be revisited for the EPA's determinations when Phase II RI preliminary data are reported in 2023 (Table 20).

Table 20: RAL Exceedance Area 32 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via permitting compliance and improved stormwater treatment.	Conditions	Improved stormwater treatment system will be installed by end of 2024.
Soil bank erosion/leaching	Uncertain, source characterization data gaps and uncertainty on timeframe for bank erosion control.	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023, bank stabilization.
Groundwater migration	Uncertain, source characterization data gaps are present.	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023.

4.4.1 RAL Exceedance Area 33

RAL exceedance area 33 corresponds to a relatively small surface sediment area contaminated with low-level exceedances of total PCBs (RAL EF 1.1 and 2.9, two results from sampling in 1995) (LDWG, 2022c). Area 33 is in the intertidal zone on the shoreline of BDC, located approximately 15 to 25 ft from the shoreline of BDC's drainage Area 16 and the DC16 outfall (Figure B-5). The Area 16 and DC16 outfall convey and discharge stormwater from an area of BDC that is considered non-industrial; nevertheless, the drainage area is being reconfigured to the DC-9N stormwater treatment system by August 1st, 2024 (Section 3.4.4). Area 33 is located in the SWMU-43 areas of the BDC upland cleanup, where investigation of shoreline groundwater and soil are taking place in 2023, and where Boeing proposed shoreline bank stabilization activities (Section 3.4.5).

Ecology concludes that potential sources to RAL exceedance area 33 are not characterized well enough for Ecology to assess sediment recontamination potential.

The age of surface sediment samples within the RAL exceedance area and nearest to outfall DC16 is 25-30 years old (NFK309 and 310 locations [sampled 1995], SD0074 location [1997])—with the exception of one vertical core (0-45cm subsurface sampled but not analyzed, while B interval was below RALs, core location 699Y) (LDWG, 2022a). Considering the age of the

samples and lack of current surface sediment data for area 33, it is unclear whether legacy contamination is due to a history of direct discharges of PCBs, is a product of in-waterway transport of sediments from surrounding contaminated areas or is a product of both.

Potential sources transported along the direct discharge pathway are conditionally controlled, pending completion of storm system improvements scheduled for late 2024. Upland sources transported along the groundwater migration and soil bank erosion pathways are not well understood, and shoreline soil and groundwater in the SWMU-43 area are being characterized in 2023. The closest available shoreline data indicate the potential for upland sources to impact sediments along the shoreline of BDC, inside and outside of RAL exceedance area 33 (Boeing, 2022a).

Ecology recommends the EPA can proceed with in-waterway remediation at RAL exceedance area 33 after noting the extensive source characterization information gaps for soil and groundwater. Ecology's recommendation is conditional upon Phase II RI sampling activities fill in the information gaps and confirm Ecology's outcome. These findings should be revisited for the EPA's determinations when Phase II RI preliminary data are reported in 2023 (Table 21).

Table 21: RAL Exceedance Area 33 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via permitting compliance and improved stormwater treatment	Conditions	Improved stormwater treatment systems will be installed in 2024.
Soil bank erosion/leaching	Uncertain; source characterization data gaps and uncertainty on timeframe for bank erosion control	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023, bank stabilization project.
Groundwater migration	Uncertain; source characterization data gaps are present	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023.

4.4.2 RAL Exceedance Area 34

RAL exceedance area 34 corresponds to a small surface sediment area (one sample location) contaminated with low-to-moderate exceedances of total PCBs (RAL EF 1.1) and benzoic acid (RAL EF 3.2) (LDWG, 2022c). Area 34 is located in the intertidal zone adjacent to the shoreline and BDC's drainage Areas 16 and 3 and the DC3 outfall (Figure B-5). Drainage Area 3 and DC3 outfall are being reconfigured with the DC-9N stormwater treatment system by August 1st, 2024 (Section 3.4.4). DC3 has been capped and is no longer discharging stormwater into the LDW. Area 34 is located in the SWMU-43 areas of the BDC upland cleanup, where shoreline groundwater and soil characterization are taking place in 2023, and where Boeing proposed shoreline bank stabilization activities (Section 3.4.5).

Ecology concludes that potential sources to RAL exceedance area 34 are not characterized well enough for Ecology to assess sediment recontamination potential. Present contamination from historical direct discharges at the DC3 outfall appears localized to the shoreline (neighboring surface sediment samples are below RALs, dated 2020–2021). Ecology concludes that sources of PCBs transported along the direct discharge pathway are controlled, pending storm system improvements for surrounding drainage areas are complete by late 2024. However, upland sources transported through the groundwater migration and soil bank erosion pathways are not well understood. The closest available shoreline data indicate a potential for upland sources to impact sediments along the shoreline of BDC, inside and outside of area 34 (Boeing, 2022a).

Ecology recommends EPA proceed with in-waterway remediation at RAL exceedance area 34, after noting the extensive source characterization information gaps for soil and groundwater. Ecology's recommendation is conditional upon Phase II RI sampling activities fill in the information gaps and confirm Ecology's outcome. These findings should be revisited for the EPA's determinations when phase II RI preliminary data are reported in 2023 (Table 22).

Table 22: RAL Exceedance Area 34 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via outfall capping and storm system reconfiguration to DC-2N.	Condition	Improved stormwater treatment system will be installed in of 2024.
Soil bank erosion/leaching	Not applicable, source characterization data gaps and uncertainty on timeframe for bank erosion control.	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023, bank stabilization project.
Groundwater migration	Not applicable, source characterization data gaps are present.	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023.

4.4.3 RAL Exceedance Area 35

RAL exceedance area 35 corresponds to a larger sediment area spanning approximately 85 ft from the shoreline to portions of the Norfolk EAA. Area 35 has exceedances of total PCBs and one exceedance of benzoic acid and benzoic acid in surface sediments (LDWG, 2022c). Area 35 is located primarily within the intertidal zone adjacent to the shoreline of BDC's drainage Areas 1-3 and the DC2 outfall (Figure B-5). Abandoned Outfall 2094 in drainage Area 1 and is closed. Areas 2 and 3 and the DC2 outfall will be reconfigured to the DC-9N stormwater treatment system by August 1st, 2024 (Section 3.4.4). RAL exceedance area 35 is located in the SWMU-43 area of the BDC upland cleanup, where shoreline groundwater and soil characterization are taking place in 2023, and where Boeing proposed shoreline bank stabilization activities (Section 3.4.5).

Ecology concludes that potential sources to RAL exceedance area 35 are not characterized well enough for Ecology to assess sediment recontamination potential. Contamination may be primarily due to direct discharges at the DC2 outfall (noting that sediment results closest to the

outfall are generally older than other samples within area 35). Upland sources transported through groundwater migration and soil bank erosion are not well understood, and shoreline soil and groundwater in the SWMU-43 area will be characterized in 2023 as part of the BDC upland cleanup. The closest available shoreline data indicate upland sources could impact sediments along the BDC shoreline, inside and outside of area 35 (Boeing, 2022a).

Ecology recommends the EPA can proceed with in-waterway remediation at RAL exceedance area 35 after noting the extensive source characterization information gaps for soil and groundwater. Ecology's recommendation is conditional upon Phase II RI sampling activities fill in the information gaps and confirm Ecology's outcome. These findings should be revisited for the EPA's determinations when Phase II RI preliminary data are reported in 2023 (Table 23).

Table 23: RAL Exceedance Area 35 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via storm system reconfiguration to DC-2N.	Condition	Improved stormwater treatments systems will be installed in 2024.
Soil bank erosion/leaching	Uncertain, source characterization data gaps and uncertainty on timeframe for bank erosion control.	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023, bank stabilization project.
Groundwater migration	Uncertain, source characterization data gaps are present.	Conditions and qualifications	SWMU-43 to be characterized and reported in 2023.

4.5 Early Action Area 5: Terminal 117

4.5.0 RAL Exceedance Areas 11 and 12

RAL exceedance areas 11 and 12 correspond to relatively small sediment areas within the FNC in potential scour and shoal zone (LDWG, 2022a); and are separated from the shoreline by approximately 150 to 180 ft. Area 11 is defined by only one subsurface (0-60cm) sample with relatively low exceedances of mercury and fluoranthene, area 12 is defined by one surface exceedance of total PCBs. These areas are not close to shoreline areas with direct discharges, groundwater migration or soil bank erosion features (Figures B-1 and B-6).

Ecology recommends the EPA proceed with in-waterway remediation (Table 24).

Table 24: RAL Exceedance Areas 11 and 12 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes. RAL exceedance areas are within the FNC approximately 150 ft from shoreline.	Not applicable	Not applicable
Soil bank erosion/leaching	Yes. RAL exceedance areas are within the FNC approximately 150 ft from shoreline, and shoreline is adequately controlled through erosion control.	Not applicable	Not applicable
Groundwater migration	Yes. RAL exceedance areas are within the FNC approximately 150 ft from shoreline. Groundwater migration is a minimal concern at SPM.	Not applicable	Not applicable

4.5.1 RAL Exceedance Area 13

RAL exceedance area 13 corresponds to a relatively small sediment area contaminated with low exceedances of total PCBs, except for one sediment sampling location that is co-contaminated with 4-methylphenol (LDWG, 2022c). Area 13 is located in the intertidal zone next to the shoreline between the SPM and T-117 cleanups (Figure B-6). Area 13 is adjacent to outfall 2214, associated with SPM and approximately 20 ft of the 17th Avenue S SD outfall associated with the T-117 cleanup and the City of Seattle's Adjacent Streets cleanup.

Ecology recommends that EPA proceed with in-waterway remediation. Ecology's recommendation is contingent upon the condition that storm system improvements are implemented at the SPM facility (Section 3.5.4) and that stormwater treatment implemented by SPU at T-117 remains effective (Section 3.5.3). Ecology notes information gaps in our understanding of sources present in groundwater at the southeastern shoreline area of the SPM cleanup Site (Table 25).

Table 25: RAL Exceedance Area 13 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via permitting compliance and improved stormwater treatment.	Conditions	Improved stormwater treatments are expected to be installed by end of 2024.
Soil bank erosion/leaching	Yes, via erosion control by existing block wall along the shoreline of SPM and T-117.	Not applicable	Not applicable
Groundwater migration	Yes	Conditions and qualifications	Phase II of the RI should fill data gaps regarding groundwater characterization and flow near block wall.

4.5.2 RAL Exceedance Areas 15 and 16

RAL exceedance areas 15 and 16 correspond to sediment areas with subsurface (0-60 cm) contamination of total PCBs; surface sediments are generally below ROD RALs with the exception of one surface (0-10cm) sediment sample R17 (1997, total PCBs 1.3 RAL EF) (LDWG, 2022c). Areas 15 and 16 are vessel scour and shoal zones along the southern boundary of the T-117 EAA (Figure B-6). These areas are separated from the shoreline by approximately 100 ft and are not near active outfalls.

Ecology concludes recommends the EPA proceed with in-waterway remediation (Table 26).

Table 26: RAL Exceedance Areas 15 and 16 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Not applicable, no nearby direct discharge features.	Not applicable	Not applicable
Soil bank erosion/leaching	Yes, via erosion control by shoreline infrastructure at T-117.	Not applicable	Not applicable
Groundwater migration	Yes, via remedy at T-117 and continual monitoring.	Condition, T-117 remedy remains effective.	Continued monitoring at T-117.

4.5.3 RAL Exceedance Areas 19 and 20

RAL exceedance areas 19 and 20 correspond to sediment areas with subsurface (0-45 cm) total PCBs contamination, notably with RAL EFs between 5.2-15 (LDWG, 2022a). Surface sediment data (0-10 cm) was collected only at area 20 and is below ROD RALs. Area 19 is along the shoreline of the Duwamish River People's Park and Shoreline Habitat project area (Port of Seattle, 2022), and the WQ permitted facility Boeing South Park (Section 3.5.4). Area 20 is located approximately 90 ft from the shoreline (Figure B-7). Both areas are in the intertidal zone.

The Port of Seattle's Duwamish River People's Park and Shoreline Habitat project (Port of Seattle, 2022) completed several bank stabilization activities that prevents bank erosion from occurring. Riprap was removed from the shoreline, grading done to slope the shoreline back towards Boeing South Park and a forested buffer/riparian vegetation was installed. Ecology believes that the vegetation buffer combined with regrading adequately controls bank erosion, and that the new soil added to the bank during these processes is uncontaminated.

Ecology does not consider there to be a direct discharge pathway to the LDW. The Boeing South Park facility has approximately 90% impervious surfaces, and facility stormwater from the five drainage areas discharges from outfall E located outside of the T-117 SCA and approximately 550 ft upstream from RAL exceedance areas 19 and 20 (Figures B-7 and B-8).

Upland groundwater is uncharacterized, presenting a potential information gap. The closest contaminated upland cleanup is approximately 1,500 ft from the shoreline (South Park BP, Ecology's Facility Site Identification Number 48968474, Ecology's Cleanup Site Identification Number 9426) and separated from the LDW by the Boeing South Park Facility and the

Duwamish River People's Park. The Boeing South Park BP cleanup is exclusively for petroleum and Ecology ruled out this cleanup as a potential source to the LDW during the tier 1 cleanup site review. Additionally, sediments along most of the T-117 southern shoreline are below ROD RALs (except for RAL exceedance areas 19 and 20), indicating that the areas 19 and 20 are better explained to be a result of other source transport mechanisms not evaluated in this SER (such as in-waterway activity and sediment transport).

Ecology recommends that EPA proceed with in-waterway remediation (Table 27).

Table 27: RAL Exceedance Areas 19 and 20 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Not applicable. Drainage areas discharge outside SCA.	Not applicable	Not applicable
Soil bank erosion/leaching	Yes, via erosion control by shoreline habitat features.	Not applicable	Not applicable
Groundwater migration	Yes	Qualifications. Contamination is not present in upland groundwater media.	Not applicable

4.6 Sea King Industrial Park

4.6.0 RAL Exceedance Area 23

RAL exceedance area 23 is a relatively small sediment area contaminated with two historical surface sediment (0-10 cm) exceedances of total PCBs (sampled 2005 and 2011) (LDWG, 2022c). Area 23 is located in the intertidal zone about 40 ft from the shoreline (Figure B-8) and is about 60 ft upstream of outfall 2102 (also referred to as "outfall E" of the Boeing South Park facility).

Ecology considers the direct pathway here to present minimal risk of recontaminating river sediments, especially RAL exceedance area 23. Surface sediments nearest and downstream of outfall E are below ROD RALs and sediment remedies are not recommended by the EPA and LDWG in these areas. As discussed in Section 3.6.4, Boeing's April 2023 technical memorandum for the South Park facility concluded that stormwater conveyed and discharged from this facility have very low potential to contribute to recontamination of LDW sediments above ROD RALs (Geosyntec, 2023b).

The Port of Seattle's Duwamish River People's Park and Shoreline Habitat project (Port of Seattle, 2022) completed several bank stabilization activities that prevents bank erosion from occurring. Riprap was removed from the shoreline, grading done to slope the shoreline back towards Boeing South Park and a forested buffer/riparian vegetation was installed. Ecology believes that the vegetation buffer combined with regrading adequately controls bank erosion from occurring.

Ecology presents similar findings here about sources transported via the groundwater migration pathway, as discussed in Section 4.5.3. Ecology notes the groundwater characterization data

gap, due to incomplete upland groundwater characterization. The closest contaminated upland cleanup is approximately 1,500 ft from the shoreline (Warners Foreign Auto Repair, Ecology's Facility Site Identification Number 166671, Ecology's Cleanup Site Identification Number 7438) and is separated from the LDW by the Boeing South Park Facility and the Duwamish River People's Park. The Boeing South Park BP cleanup is for exclusively for petroleum in soil and was ruled out as a potential source to the LDW during the tier 1 cleanup review. Additionally, sediments along most of the T-117 southern shoreline area are below ROD RALs (except for RAL exceedance area 23), indicating that area 23 contamination likely resulted from transport pathways that are not evaluated in this SER (such as in-waterway activities and transport of sediments, or historical releases, or unreported spills).

Ecology concludes sources are controlled, noting information gaps pertaining to groundwater characterization, and recommends EPA proceed with in-waterway remediation (Table 28).

Table 28: RAL Exceedance Area 23 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Yes, via permitting compliance.	Condition	Improved stormwater treatments systems will be installed in 2024.
Soil bank erosion/leaching	Yes, via erosion control by shoreline habitat features.	Not applicable	Not applicable
Groundwater migration	Yes	Qualifications	Contamination is not present in upland groundwater media.

4.7 Restoration Areas

4.7.0 RAL Exceedance Areas 30 and 31

RAL exceedance areas 30 and 31 correspond to a relatively small sediment area within the Recovery Category 1 boundary inside the turning basin of the LDW (Figure B-9). Ecology notes that area 30 represents a surface sediment hotspot, with subsurface less contaminated than the surface (19 RAL EF) but still above ROD RALs (1.3 RAL EF), while lower sediment depths are below ROD RALs (Vertical Core ID 694). Area 31 is defined by LDWG with a subsurface exceedance exclusively (0-45 cm, 13 RAL EF). Ecology considers these areas are isolated surface sediment hotspots of total PCBs, since neighboring sediments are below ROD RALs for surface and subsurface samples. Both areas are approximately 60 ft from the shoreline of a protruding sliver parcel. A natural ditch (Ditch #1) is located approximately 500 ft from the areas close to W Marginal Pl S (LDWG, 2022c). There are no direct discharges close to these areas and no upland contaminated cleanups of interest. Surface sediments between these areas and the shoreline are below ROD RALs. Based upon these findings, Ecology concludes that these areas are likely to be a localized surface and subsurface hotspot of PCBs.

While Ecology cannot establish a clear relationship between these RAL exceedance areas and relevant pathways, we do note that the upper turning basin of the LDW receives a considerable

amount of sediment movement and deposition—due to a combination of localized river hydrogeological processes and the movement of the tidally-driven salt-water wedge beyond RM 5. LDWG's Sediment Transport Model concludes this tuning basin has the highest sedimentation rates (greater than 3cm per year, over a 30-year period) and acts a sediment sink. This basin captures a large portion of the sand load from the green river, however the area corresponding to areas 30 and 31 is mostly outside the model's geographic boundary (LDWG, 2008) and these rates and their predictive resolution for areas 30 and 31 are considered to be general and low. Additionally, a 2018 USGS study (USGS, 2018) and 2020 dissertation study by the Margaret Ann McKeon at the University of Washington (McKeon, 2020) adds greater complexity to our understanding of hydrodynamics and sediment transport within this system.

Ecology recommends the EPA proceed with in-waterway remedy for RAL exceedance areas 30 and 31, due to the absence of upland sources and our emerging understanding of the complexity of sediment transport and deposition within the upper turning basin (Table 29).

Table 29: RAL Exceedance Areas 30 and 31 Sufficiency Outcome Summary Information

Pathway	Controlled?	Conditions and/or Qualifications?	Remaining Relevant Actions
Direct discharge	Not applicable, no sources currently identified.	Not applicable	Not applicable
Soil bank erosion/leaching	Not applicable, no sources currently identified.	Not applicable	Not applicable
Groundwater migration	Not applicable, no sources currently identified.	Not applicable	Not applicable

4.8 Sufficiency Recommendation Summary

Table 30 summarizes Ecology's source control sufficiency recommendations for the Upper Reach.

Table 30: Upper Reach Sufficiency Recommendation Summary

Recommendation Outcome to EPA	Sufficiency Recommendation Category	Remedial Action Level (RAL) Exceedance Areas	Associated Source Control Areas
Not applicable, and not evaluated	Not applicable	1[a], 6[ab], 7[a], 8[a], 9[b], 10[a]	Riverside Drive
Proceed with sediment cleanup	Sources are sufficiently controlled (some recommendations may include minor qualifications or conditions)	2, 3, 4, 5, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 25, 26, 27, 30, 31	Early Action EAA-4: Boeing Plant 2 to Jorgensen Forge, Boeing Isaacson/Central KCIA, EAA-5: Terminal 117, Sea King Industrial Park, Restoration Areas

Proceed with sediment cleanup, noting significant information gaps[c]	Sources are conditionally controlled; Sources are controlled with qualifications	22, 28, 29, 32, 33, 34, 35	Boeing Isaacson/Central KCIA, Slip 6, Boeing Developmental Center, EAA-7: Norfolk CSO/SD
Do not proceed with sediment cleanup	Sources are not sufficiently controlled	18	Boeing Isaacson/Central KCIA

[a] RAL exceedance areas associated with the Middle Reach (Riverside Drive SCA) are not evaluated in this SER.

[b] RAL exceedance area 6 is an artifact from the interpolation process and LDWG is collecting additional data during Phase III pre-design investigations to confirm whether to assign an active remedial technology. RAL exceedance area 9 is an artifact from the interpolation process and EPA expects no active in-water remedy to occur.

[c] RAL exceedance areas that correspond to shoreline areas where there are significant information gaps in our understanding of soil and/or groundwater sources to the river and where additional sampling and analysis is planned in the near term. Ecology qualifies our recommendation that the EPA proceed with these RAL exceedance areas considering the existing substantial information gaps and the additional data collection planned to occur prior to the EPA's in-waterway cleanup.

5 REFERENCES

Aspect. (2022). *South Park Marina Source Control Review Memorandum.* Prepared by Aspect Consulting for City of Seattle, Port of Seattle, South Park Marina Limited Partnership. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/116095

Boeing. (2021). *ESAS & SEPA Checklist Review for Boeing Developmental Center and Thompson Sites Shoreland Infrastructure Stabilization Project.* Application provided by the Boeing Company for the City of Tukwila.

Boeing. (2022a). *Agency Review Draft Data Summary Report Phase 1 Remedial Investigation Boeing Developmental Center.* Prepared by Landau Associates for the Boeing Company.

Boeing. (2022c). *Boeing Developmental Center Stormwater Pollution Prevention Plan WAR000146.* The Boeing Company. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=407897

City of Seattle. (2017). *Removal Action Construction and Completion Report--Phase 2: Adjacent Streets and Residental Yards Study Area and Part 2: Adjacent Streets and Removal, T117 Early Action Area.* Prepared by Integral Consulting Inc. for the City of Seattle.

City of Seattle. (2020). *Seattle's Source Control Plan for the Lower Duwamish Waterway (2021-2026).* Prepared by City of Seattle for the Washington State Department of Ecology. Retrieved from https://www.seattle.gov/Documents/Departments/SPU/Services/DrainageSewer/LDWSourceControlImplementationPlan2021-2026.pdf; http://www.seattle.gov/Documents/Departments/SPU/Services/DrainageSewer/LDWSourceControlImplementationPlanAppendices2021-2026.pdf; ht

City of Seattle. (2022a). Email Letter from Nate Hart (City of Seattle) to Anthony Wenke (Ecology) RE: City of Seattle/SPU LDW Upper Reach Source Control actions after 2021. September 9.

City of Seattle. (2022b). Email Letter from Nate Hart (City of Seattle) to Anthony Wenke (Ecology) RE: City of Seattle/SPU LDW Upper Reach Source Control actions after 2021. September 14.

City of Seattle. (2022c). Email Letter from Michael Jeffers (City of Seattle) to Jess Huybregts (Ecology) RE: Two Norfolk Basin Sites.msg. September 23.

City of Seattle. (2023a). Email Letter from Nate Hart (City of Seattle) to Anthony Wenke (Ecology) RE: Norfolk update 1/18/2023. February 28.

City of Seattle. (2023b). *Seattle Public Utilities Lower Duwamish and East Waterway Projects*. Retrieved from https://www.seattle.gov/utilities/neighborhood-projects/lower-duwamish-waterway

City of Tukwila. (2022b). Email Letter from Russell Betteridge (City of Tukwila) to Anthony Wenke (Ecology) RE: Source Control activities in the Upper Reach.msg. November 11.

Ecology & Environment. (2007). *Lower Duwamish Waterway Early Action Area 7, Final Summary of Existing Information and Identification of Data Gaps Report.* Prepared for Washington Department of Ecology.

Ecology & Environment. (2008). *Lower Duwamish Waterway RM 3.9-4.4 East (Slip 6), Summary of Existing Information and Identification of Data Gaps, Final Report.* Prepared for Washington Department of Ecology.

Ecology. (2007a). *Lower Duwamish Waterway Early Action Area 4 Final Summary of Existing Information and Identification of Data Gaps Report.* Prepared for Washington Department of Ecology Toxics Cleanup Program.

Ecology. (2007b). *Lower Duwamish Waterway Source Control Action Plan for Early Action Area 4.* Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/41000

Ecology. (2007c). *Source Control Action Plan for Early Action Area 7.* Prepared by Washington State Department of Ecology and Ecology and Environment, Inc. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/40998

Ecology. (2008a). *Source Control Action Plan for Slip 6.* Prepared by the Washington State Department of Ecology, and Ecology & Environment, Inc. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/40972

Ecology. (2009a). *Lower Duwamish Waterway, Source Control Action Plan for the Terminal 117 Early Action Area, Publication 05-09-093.*

Ecology. (2009b). *Source Control Action Plan for Early Action Area 6.* Prepared by the Washington State Department of Ecology, and Science Applications International Corporation. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/40966

Ecology. (2010a). *Boeing Isaacson Thompson Agreed Order No. DE-7088.* Prepared by the Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/2340

Ecology. (2010b). *Source Control Action Plan for Boeing Developmental Center.* Prepared by the Washington State Department of Ecology and Science Applications International Corporation. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/41032

Ecology. (2010c). *Basin Oil Property - Summary of Site Characterization Activities.* Prepared by Science Applications International Corporation for Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/8786

Ecology. (2012). *Boeing South Park Administrative Order 9601.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=52279

Ecology. (2013). *Boeing South Park Administrative Order 9741.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=89743

Ecology. (2013a). Lower Duwamish Waterway Source Control Action Plan Handbook. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/41094

Ecology. (2013b). *Source Control Action Plan for Sea King Industrial Park.* Prepared by Washington State Department of Ecology, and Science Applications International Corporation. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/41080

Ecology. (2013c). *Source Control Action Plan for Restoration Areas.* Washington State Department of Ecology, and Science Applications International Corporation. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/41078

Ecology. (2015a). *PCB Chemical Action Plan.* Washington State Department of Ecology, and Washington State Department of Health. Retrieved from https://apps.ecology.wa.gov/publications/documents/1507002.pdf

Ecology. (2015b). *Basin Oil Drum Storage Site Hazard Assessment Memo: SHA Not Complete.* Prepared by the Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/50884

Ecology. (2016a). *Lower Duwamish Waterway Source Control Strategy.* Prepared by Northwest Regional Office, Washington State Department of Ecology, and Leidos. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/56204

Ecology. (2016b). PCB Congener Study: Phase 1. Washington State Department of Ecology, and Leidos. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/54944

Ecology. (2017). *Boeing Military Delivery Center WQ Administrative Order 13392.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=203361

Ecology. (2017a). *PCB Congener Study: Phase 2 Source Evaluation.* Washington State Department of Ecology, and Leidos. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/65346

Ecology. (2017b). *Jorgensen Forge Corp Agreed Order No. DE-14143.* Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/64503

Ecology. (2018). *Boeing Developmental Center Agreed Order No. 15600 WAR000146.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=225488

Ecology. (2019a). *Boeing Developmental Center Agreed Order No. DE-16275 and Exhibits.* Prepared by the Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/site/5059#site-documents

Ecology. (2019c). *South Park Marina Agreed Order No. DE-16185.* Prepared by Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/81684

Ecology. (2020a). *Jorgensen Forge Corp Administrative Order No. 18074 WAR003232.* Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=309311

Ecology. (2020c). *Boeing Developmental Center Amendment to Agreed Order No. 19427 WAR000146.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=341888

Ecology. (2020d). *Emerald Gateway Agreed Order No. DE-16659 and Exhibits.* Prepared by Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/89370

Ecology. (2020e). *Emerald Gateway CSWGP Administrative Order No. 18101.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/91898

Ecology. (2020f). *Lower Duwamish Waterway Outfall Inventory.* Washington State Department of Ecology, and Leidos.

Ecology. (2022a). *Preliminary Cleanup Levels for the Lower Duwamish Waterway, August, 2022.* Prepared by Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/89202

Ecology. (2022b). *Boeing Developmental Center Amended Agreed Order No. 20873 WAR000146.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=424275

Ecology. (2022c). *Stormwater Pollution Prevention Plan - Boeing South Park Facility WAR001009.* Washington State Department of Ecology. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=420928

Ecology. (2023). Letter from Ecology to The Boeing Company Re: Ecology Comments on the Feasibility Study Report Final – For Public Review, Isaacson-Thompson Site. January 31.

EPA. (2014). *Record of Decision Lower Duwamish Waterway Superfund Site.* Retrieved from https://semspub.epa.gov/work/10/715975.pdf

GeoEngineers. (2022). *Precision Engineering Remedial Investigation Work Plan, Tables and Figures, Appendices.* GeoEngineers for Dick Morgan. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/111475; https://apps.ecology.wa.gov/cleanupsearch/document/111474; https://apps.ecology.wa.gov/cleanupsearch/document/111473; https://apps.ecology.wa.gov/cleanupsearch/document/111472

Geosyntec. (2023a). *Q4 2022 Progress Report Stormwater Treatment Installation at Boeing Developmental Center.* Prepared by Geosyntec Consultants for The Boeing Company. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=432164

Geosyntec. (2023b). *Technical Memo: Boeing South Park Stormwater Treatment System Technical Review - Storm Solid PCBs.*

King County. (2016). *A Review of Select PCB Source Tracing Programs.* Prepared for Washington State Department of Ecology by King County. Retrieved from https://your.kingcounty.gov/dnrp/library/2016/kcr2778/kcr2778-txt.pdf

King County. (2019). *Lower Duwamish Waterway Source Control Implementation Plan 2019-2023.* Prepared by King County for the Washington State Department of Ecology. Retrieved from https://kingcounty.gov/~/media/services/environment/wastewater/duwamish-waterway/source-control/plan/KC-LDW-SCIP-2019-2023-Oct2019.ashx?la=en

King County. (2021). *Duwamish Waterway Superfund Cleanup Library and Resources*. Retrieved from https://kingcounty.gov/services/environment/wastewater/duwamish-waterway/superfund-cleanup/library.aspx

King County. (2023). *Memo to Ecology Toxics Cleanup Program from Debra Williston, King County Departmnt of Natural Resources and Parks, Wastewater Treatment Division.* Re: King County Lower Duwamish Waterway Upper Reach Source Control Sufficiency Support Information. March 1.

Landau. (2021). *Boeing Developmental Center Remedial Investigation Work Plan.* Prepared by Landau Associates for The Boeing Company. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/98195

Landau. (2022). *Boeing Isaacson Thompson Final Feasibility Study - For Public Review.* Prepared by Landau Associates for The Boeing Company.

LDWG. (2008). *Lower Duwamish Waterway Sediment Transport Modeling Report.* Prepared by Quantitative Environmental Analysis, LLC, for EPA and Ecology. Retrieved from https://ldwg.org/wp-content/uploads/2019/01/LDW_STM_report_final_081103.pdf

LDWG. (2022a). *Basis of Design Report (30%) Figures 5-13.* Prepared by Anchor QEA in association with Windward Environmental LLC, for submittal to EPA. Retrieved from https://ldwg.org/wp-content/uploads/2022/09/LDW_BODR_30Pct_Sec5_13_Figures_toEPA_08292022.pdf

LDWG. (2022b). *Pre-Design Investigation Data Evaluation Report for the LDW-Upper Reach.* Prepared by Anchor QEA and Windward Environmental for the Lower Duwamish Waterway Group. Retrieved from https://ldwg.org/wp-content/uploads/2022/07/Final-LDW-DER_toEPA_071522.pdf

LDWG. (2022c). *Preliminary (30%) Remedial Design Basis of Design Report for Lower Duwamish Waterway Upper Reach.* Prepared by Anchor QEA in association with Windward Environmental LLC, for submittal to EPA. Retrieved from https://ldwg.org/wp-content/uploads/2022/09/LDW_BODR_30Pct_toEPA_08292022.pdf

LDWG. (2023a). Preliminary Unvalidated Phase III Data for Upper Reach Sediments. February 9.

LDWG. (2023b). *60% Remedial Design Basis of Design Report for the Lower Duwamish Waterway Upper Reach*. Retrieved from https://ldwg.org/wp-content/uploads/2023/02/LDW_60Pct_RD_BODR_2023-02-20.pdf. March 20.

McKeon, M. A. (2020). *Hydrodynamics and Sediment Transport in the Duwamish River Estuary.* University of Washington. Retrieved from https://digital.lib.washington.edu/researchworks/handle/1773/46412

Port of Seattle. (2022). *Duwamish River People's Park Habitat Restoration and Shoreline Access Project*. Retrieved from https://www.portseattle.org/peoplesparkproject

Port of Seattle. (2023). Email Correspondence between Roy Kuroiwa (Port of Seattle) and Anthony Wenke (Ecology) FW: [EXTERNAL] Port of Seattle and Upper Reach Sufficiency.msg. January 17.

Port of Seattle and City of Seattle. (2022). *2021 (Year 6) Annual Monitoring and Maintenance Report for Terminal 117 Early Action Area.* Prepared by Seattle Public Utilities and Anchor QEA. August 1.

SAIC. (2007). *Lower Duwamish Waterway South Park Marina, Summary of Existing Information and Identification of Data Gaps.* Prepared by Science Applications International Corporation for Washington Department of Ecology.

SAIC. (2008). *Lower Duwamish Waterway RM 3.7-3.9 East, Early Action Area 6, Summary of Existing Information and Identification of Data Gaps.* Prepared by Science Applications International Corporation for Washington Department of Ecology.

SAIC. (2010). *Lower Duwamish Waterway RM 4.3 to 4.9 East (Boeing Developmental Center, Summary of Existing Information and Identification of Data Gaps.* Prepared by Science Applications International Corporation for Washington Department of Ecology.

SAIC. (2013a). *Lower Duwamish Waterway, RM 3.8 to 4.2 West, Sea King Industrial Park, Summary of Existing Information and Identification of Data Gaps.* Prepared by Science Applications International Corporation for Washington Department of Ecology.

SAIC. (2013b). *Lower Duwamish Waterway, RM 4.2 to 5.8 West (Restoration Areas), Summary of Existing Information and Identification of Data Gaps.* Prepared by Science Applications International Corporation for Washington Department of Ecology.

Shannon & Wilson. (2020a). *8801 E Marginal Way Addendum to Feasibility Study and Interim Action Work Plan.* Prepared by Shannon & Wilson for PACCAR Inc. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/97936

Shannon & Wilson. (2020b). *8801 E Marginal Way Feasibility Study.* Prepared by Shannon & Wilson for PACCAR Inc. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/93568

Shannon & Wilson. (2020c). *8801 E Marginal Way Interim Action Work Plan.* Prepared by Shannon & Wilson for PACCAR Inc. Retrieved from https://apps.ecology.wa.gov/cleanupsearch/document/93570

Shannon & Wilson. (2022a). *Draft Remedial Investigation Report Jorgensen Forge Corporation Property.*

Shannon & Wilson. (2022b). *8801 E Marginal Way Compliance Monitoring Plan.* Prepared by Shannon & Wilson for PACCAR Inc.

Shannon & Wilson. (2022c). *Compliance Monitoring Report Risk-Based Removal of PCB Remediation Waste at Area 4, 8801 East Marginal Way.*

Shannon & Wilson. (2022d). Email Letter from Meg Strong (Shannon & Wilson) to Anthony Wenke (Ecology) RE 8801 - status of remedial actions.msg. October 25.

SPM. (2023). *Level Three Response Engineering Report for ZInc and Copper.* Prepared by TIG Environmental for South Park Marina. Retrieved from https://apps.ecology.wa.gov/paris/DownloadDocument.aspx?id=427240

USGS. (2018). *Sediment Transport to the Lower Duwamish Waterway.* Washington Water Science Center. Retrieved from https://www.usgs.gov/media/files/sediment-transport-lower-duwamish-waterway

Windward et al. (2010). *Revised Engineering Evaluation/Cost Analysis -Terminal 117 Early Action Area.* Prepared by Windward et. al, for The Port of Seattle and The City of Seattle. Retrieved from http://www.t117.com/documents/eeca/Final%20Revised%20EECA.pdf

APPENDICES

Appendix A: Action Items

Refer to the Lower Duwamish Upper Reach Sufficiency Evaluation Report Appendices companion document.

Appendix B: Map Figures

Refer to the Lower Duwamish Upper Reach Sufficiency Evaluation Report Appendices companion document.