Lower Duwamish Waterway Group

City of Seattle/King County/The Boeing Company

Pre-Design Investigation Quality Assurance Project Plan Addendum No. 2 for the Lower Duwamish Waterway Middle Reach – Phase II Sampling for the Inlet at RM 2.2W

FINAL

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TITLE AND APPROVAL PAGE

Remedial Design of Middle Reach
Pre-Design Investigation Quality Assurance Project Plan
Addendum No. 2

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ABBREVIATIONS

AST	area-specific technology
BBP	butyl benzyl phthalate
BEHP	bis(2-ethylhexyl) phthalate
BGS	below ground surface
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CPT	cone penetration testing
DER	data evaluation report
DQO	data quality objective
dw	dry weight
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FNC	Federal Navigation Channel
FS	feasibility study
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
ID	identification
ICS	Industrial Container Services
LDW	Lower Duwamish Waterway
LIDAR	light detection and ranging
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
MHHW	mean higher high water
MLLW	mean lower low water
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PD&C	partial dredge and cap
PDI	Pre-Design Investigation
QA	quality assurance
QAPP	quality assurance project plan
RAL	remedial action level
RD	remedial design
RI	remedial investigation
RM	river mile
ROD	Record of Decision
SPT	standard penetration testing
SVOC	semivolatile organic compound
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers

1 Introduction

This document is the second addendum to the Pre-Design Investigation (PDI) quality assurance project plan (QAPP) for the middle reach[1] of the Lower Duwamish Waterway (LDW) (Map 1-1) (Windward and Anchor QEA 2022). The QAPP describes the quality assurance (QA) objectives, methods, and procedures for PDI sampling and analysis. This work will support remedial design (RD) for the middle reach per the Fifth Amendment to the Administrative Order on Consent for the LDW (EPA 2021a), in accordance with the U.S. Environmental Protection Agency's (EPA's) November 2014 Record of Decision (ROD) (EPA 2014).

This QAPP addendum presents information related to the Inlet at river mile (RM) 2.2W, which is located within the middle reach of the LDW. Data for the outer portion of the inlet were presented in the Middle Reach PDI Work Plan, QAPP, Phase I DER, and QAPP Addendum No. 1 for Phase II, but the inlet as a whole was not addressed.[2] This is because the inlet was being addressed as part of the Washington State Model Toxics Control Act (at the Industrial Container Services [ICS]/former NW Cooperage Site to the south and the Douglas Management Site to the north). Sediment within the inlet is now being addressed as part of the RD for the middle reach. Cleanup of the two adjacent upland sites will continue under the Washington State Model Toxics Control Act.

Thus, this addendum includes an overview of the Inlet at RM 2.2W; an evaluation of existing data (including both the inner and outer inlet); a preliminary discussion of remedial technologies; and a detailed study design for middle reach PDI sampling within the inlet (i.e., sampling locations, intervals, and analytes). All aspects of PDI sampling and analysis not addressed herein are the same as those specified in the Middle Reach PDI QAPP (Windward and Anchor QEA 2022) and/or PDI QAPP Addendum No. 1 for Phase II (Anchor QEA and Windward 2023b).

The remainder of this document is organized into the following sections:

- Section 2. Overview of the Inlet at RM 2.2W
- Section 3. Evaluation of Existing Data
- Section 4. Phase II Sampling within the Inlet at RM 2.2W
- Section 5. References

In addition, the following attachments are part of this document.

- Attachment A. Figures and Aerial Photographs from Prior Reports Related to the Inlet at RM 2.2W
- Attachment B. Dataset for Inlet at RM 2.2W
- Attachment C. Sample-Specific Details and Rationale

[1] The middle reach includes river mile (RM) 1.6 to RM 3.0 of the LDW.
[2] The outer portion of the inlet was referred to as RAL Exceedance Area 20 in the Phase I DER (Anchor QEA and Windward 2023a). Based on the assessment presented in this addendum, RAL Exceedance Area 20 now includes the entire inlet.

- Attachment D. Health and Safety Plan Addendum

2 Overview of the Inlet at RM 2.2W

2.1 Description of the Inlet

The Inlet at RM 2.2W is approximately 580 feet in length and has a total area of about 1 acre, all of which is intertidal. The narrowest portion of the inlet (commonly referred to as the neck), is about 45 feet across and divides the inner inlet (where contaminant concentrations are generally higher) from the outer inlet, which is adjacent to the main channel of the LDW (Map 1-1). Figure 2-1 shows a photograph of the inlet looking west from the outer inlet toward the neck and inner inlet; additional photographs are presented on Maps 2-1a and 2-1b. The properties adjacent to the inlet include the ICS/former NW Cooperage Site to the south, the Douglas Management Site to the north, and a small Washington State Department of Transportation parcel at the head (northwest end) of the inlet (Map 1-1). There are two active outfalls in the inner inlet—a drinking water reservoir overflow is located at the head of the inlet and a private storm drain[3] is located along the south shore of the inner inlet. The drinking water reservoir overflow is believed to be the source of water that has contributed to the development of a meandering thalweg that can be seen during low tide (Figure 2-1). There are no active outfalls in the outer inlet, although there is one inactive/abandoned outfall located on the south shore near the mouth of the inlet.

[3] Information regarding this storm drain (the 2nd Avenue outfall) is summarized in the remedial investigation (RI) for the ICS/former NW Cooperage site (see Sections 2.4.1 and 5.6) (DOF 2020).

Figure 2-1
Photograph of the Inlet at RM 2.2W (looking West)

2.2 History

The Inlet at RM 2.2W was created in the mid- to late 1960s. Historical aerial photographs from 1936 and 1960 (which are provided in Figures A-1 and A-2, respectively, of Attachment A) show that the inlet and the property to the north were historically part of a shallow turning basin (i.e., the former Duwamish Turning Basin No. 2) that stretched from the area under the First Ave S Bridge (at approximately RM 2.05W) to the current location of the Inlet at RM 2.2W. Key features in these photographs include: 1) the former drainage ditch that discharged to the inlet from the ICS/former NW Cooperage site, which is south of the inlet, and 2) a former wharf that extended north from the ICS/former NW Cooperage property into what is now the inlet (this structure can be seen on Figure A-1 of Attachment A); pilings that are remnants of this structure still remain and can be seen in photographs.

Based on the 1943 U.S. Army Corps of Engineers (USACE) conditions surveys of this area (Figure A-3 of Attachment A), the mudline elevations of the former Duwamish Turning Basin No. 2 primarily ranged from 0 feet mean lower low water (MLLW) to -8 feet MLLW at the center, which is now under the Douglas Management Property (USACE 1943). The 1943 survey established that mudline

elevations in what is now the Inlet at RM 2.2W (i.e., the southern part of the former Duwamish Turning Basin No. 2) were deepest near the mouth of the inlet (about 0 feet MLLW). The historical aerial photograph of this area (Figure A-4 of Attachment A) shows that the majority of the former Duwamish Turning Basin No. 2 had been filled by March 1969, creating what is now the Douglas Management Property. The current land configuration is shown in the aerial photograph from 2004 (Figure A-5 of Attachment A).

The ICS/former NW Cooperage property has been the site of drum reconditioning operations since the 1930s. Detailed information regarding past operations at the ICS/former NW Cooperage Site property is presented in Section 2 of its RI (DOF 2020) prepared for Washington Department of Ecology. The Douglas Management Site was developed for industrial use in the early/mid-1970s; site uses have included a ready-mix concrete plant, sand and gravel batch plant, school bus maintenance, and most recently as a freight management facility (GeoEngineers 2019). At this time, there are no active commercial uses of the inlet itself.

2.3 Conceptual Site Model

Based on available information regarding the nature and extent of contamination at the ICS/former NW Cooperage Site, at the Douglas Management Site, and in the Inlet at RM 2.2W, contamination of sediments in the former Duwamish Turning Basin No. 2 is a result of industrial operations in this area (DOF 2023, 2020). As described in the ICS RI and feasibility study (FS) (DOF 2023, 2020), contamination in the inlet and under the fill at the Douglas Management Site is primarily attributed to historical releases from the ICS/former NW Cooperage Site (see Section 2 and Table A2.1 of the RI (DOF 2020)). Section 6.1 of the RI further describes how "most of the …[sediment contaminant] releases to the embayment were in the vicinity of the former wharf. Additional releases to the embayment likely occurred by seepage from mobile LNAPL from the area surrounding well SA-MW1 and, to a much lesser extent, from groundwater migration into the embayment."

A schematic of the conceptual site model (CSM) for the inlet and neighboring properties was developed as part of the FS for the ICS/former NW Cooperage Site (see Figure A-9 of Attachment A). Contamination patterns in inlet sediment and in the neighboring properties are consistent with this CSM (see Figures A-6, A-7, and A-8 of Attachment A).

- On the south side of the inlet (i.e., at the ICS/former NW Cooperage Site), contaminated soil is present starting at ground surface (the depth of the bottom of contamination is variable), reflecting contamination associated with drum reconditioning activities at this property since the 1930s (DOF 2023, 2020).
- In the inlet and under the fill layer that was placed to create what is now the Douglas Management Site, contaminated soil/sediment is present at depths consistent with the

elevations of the former Duwamish Turning Basin No. 2. Specific depth intervals where buried contamination is present vary by location but are generally between -2 and -9 feet MLLW (approximately 22 to 29 feet below ground surface [BGS]). According to the ICS RI and FS (DOF 2023, 2020), material below the elevation of the former Duwamish Turning Basin No. 2 does not indicate that contamination is present, nor is contamination found in the thick layer of fill above this elevation (Figure A-8 of Attachment A).

In the inlet itself, existing data indicate that PCB contamination is present at the sediment surface down to an elevation of +2 feet MLLW near the head of the inlet. From the middle of the inlet toward and within the outer inlet, PCB contamination extends to a deeper elevation (e.g., down to an elevation of -3 or -4 feet MLLW). This pattern is similar to what would be expected based on the bathymetry data from the 1943 USACE conditions survey (Figure A-3 of Attachment A).

3 Evaluation of Existing Data

This section presents the datasets used to derive the design dataset for the Inlet at RM 2.2W, a summary of remedial action level (RAL) exceedances in the design dataset, a delineation of RAL exceedance area based on existing data, and an identification of preliminary technologies for remediation in the inlet.

3.1 Design Dataset for Inlet

As described in the Phase I data evaluation report (DER), the middle reach design dataset includes sediment data from the Phase I PDI as well as pre-PDI data, as defined in Section 3.1 of the PDI work plan (Windward and Anchor QEA 2023). A detailed description of the data management rules used to create the design dataset was presented in Appendix D of the draft Phase I DER (Anchor QEA and Windward 2023a).[4]

Table 3-1 presents the total number of design dataset sampling locations within the inlet for each of the RAL sediment depth intervals, as well as counts of locations with data but without RAL interval data. While surface sediment samples were collected from numerous locations in the inlet, there are no existing data for subsurface (0- to 45-cm) RAL intervals (Table 3-1). Subsurface sampling locations in the inlet included 23 locations with a 0- to 30-cm (0- to 1-foot) interval and 16 locations with deeper cores (i.e., cores with total depths of 3.4 to 11.6 feet).

Table 3-1
Number of Middle Reach Design Dataset Locations by Data Source for the Inlet at RM 2.2W

Dataset[1]	Date Range	No. of Surface Sediment Locations (0–10 cm)	No. of Intertidal Subsurface Sediment Locations (0–45 cm)	No. of Locations without RAL Intervals
LDW RI/FS	1990–2010	not applicable [2]	0	0
Post-FS	2010–2021	35	0	33[3]
PDI (Phase I)	2022–2023	0	0	0
Total		**35**	**0**	**33**

Notes:
1. The design dataset for the Inlet at RM 2.2W is provided in Attachment B. The same data management rules applied to the rest of the middle reach were used for the design dataset for the inlet.
2. Surface sediment data collected prior to 2011 (i.e., LDW RI/FS data) are not included in the design dataset, consistent with the data management rules applied to the rest of the middle reach.
3. The locations without RAL intervals include 18 locations with (approximately) 0–30-cm (0–1-foot) samples and 15 locations where deeper cores were collected.
DER: data evaluation report
EPA: U.S. Environmental Protection Agency
FS: feasibility study
MHHW: mean higher high water
PDI: Pre-Design Investigation

[4] The data management rules will also be attached to the Phase II DER.

RAL: remedial action level
RI: remedial investigation
RM: river mile

3.2 Comparison of Existing Data with RALs

In order to delineate RAL exceedance areas, sediment data in the design dataset were compared with RALs for Recovery Category 2/3 presented in ROD Table 28 (EPA 2014);[5] carcinogenic polycyclic aromatic hydrocarbon (cPAH) results were compared with RALs presented in the cPAH explanation of significant differences (ESD) (EPA 2021b). A summary of surface sediment RAL exceedances in the design dataset is presented in Table 3-2. In addition, given that no subsurface sediment samples have been analyzed within RAL interval, this table presents a comparison of the non-RAL interval subsurface sediment sample results with the surface sediment RALs to provide perspective on the vertical extent of contamination. Core profiles are shown by location on Maps 3-1a and 3-1b; these maps also show RAL exceedance areas, which are discussed in Section 3.3.

Table 3-2
Summary of Surface Sediment RAL Exceedances and Comparison of Non-RAL Interval Subsurface Sediment Results with Surface Sediment RALs in the Design Dataset for the Inlet at RM 2.2W

COC	Counts by Interval in the Design Dataset[1]			
	Surface (0–10 cm)		Subsurface (Non-RAL Interval)[2]	
	No. > RAL/Total	%	No. > Surface RAL/Total	%
Human Health COCs				
PCBs	30/31	97	40/64	63
Dioxins/furans	3/3	100	no data	-
Arsenic	1/31	3	0/36	0
cPAHs[3]	1/26	4	0/24	0
Benthic COCs (with RAL Exceedances)[4]				
Metals				
Cadmium	1/31	3	0/36	0
Chromium	3/31	10	0/36	0
Lead	5/31	16	13/52	25
Mercury	8/31	26	15/47	32
Zinc	4/26	15	2/36	6
PAHs				
PAHs[5]	2/26	8	2/24	8
Other SVOCs				
1,2,4-Trichlorobenzene	1/26	4	1/24	4

[5] As presented in Figure 12 of the ROD, the entire inlet is classified as Recovery Category 2.

COC	Counts by Interval in the Design Dataset[1]			
	Surface (0–10 cm)		Subsurface (Non-RAL Interval)[2]	
	No. > RAL/Total	%	No. > Surface RAL/Total	%
1,2-Dichlorobenzene	2/26	8	1/24	4
1,4-Dichlorobenzene	1/26	4	3/24	13
2,4-Dimethylphenol	2/26	8	2/24	8
4-Methylphenol	1/26	4	0/24	0
n-Nitrosodiphenylamine	2/26	8	1/24	4
Pentachlorophenol	3/26	12	2/24	8
Phenol	1/26	4	0/24	0
Phthalates				
BEHP	2/26	8	2/24	8
BBP	3/26	12	0/24	0
Dimethyl phthalate	1/26	4	0/24	0

Notes:
1. The design dataset for the inlet is provided in Attachment B.
2. As indicated in Table 2-1, no subsurface sediment samples have been analyzed within appropriate RAL interval (i.e., 0–45 cm). Thus, this table presents a comparison of all existing subsurface data (a mix of 0–30-cm (0–1-foot) samples and deeper vertical intervals) with the applicable surface sediment RALs for Recovery Category 2.
3. cPAH results are compared with the RALs presented in the cPAH ESD (EPA 2021b).
4. PCBs and arsenic are also benthic COCs but are counted separately under human health COCs. Benthic COCs shown herein are those with RAL exceedances in the design dataset.
5. Counts include exceedances of one or more of the following PAHs: 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes, benzo(g,h,I)perylene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, total HPAHs, or total LPAHs.
BBP: butyl benzyl phthalate
BEHP: bis(2-ethylhexyl) phthalate
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
DER: data evaluation report
ESD: explanation of significant differences
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
MHHW: mean higher high water
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAL: remedial action level
SVOC: semivolatile organic compound

Key takeaways from Table 3-2 include the following:

- **PCBs** – PCBs are the primary contaminant of concern (COC) in the inlet with the most RAL exceedances. Concentrations of PCBs were greater than the RAL in 97% of surface sediment samples in the design dataset.
- **Other COCs** – Additional COCs with at least one RAL exceedance in the design dataset include dioxins/furans, six metals (arsenic, cadmium, chromium, lead, mercury, and zinc), polycyclic aromatic hydrocarbons (PAHs) (16 individual PAHs, low-molecular-weight polycyclic aromatic hydrocarbons [LPAHs], high-molecular-weight polycyclic aromatic hydrocarbons

[HPAHs], and cPAHs), eight other semivolatile organic compounds (SVOCs) (1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethylphenol, 4-methylphenol, n-nitrosodiphenylamine, pentachlorophenol, phenol), and three phthalates (bis(2-ethylhexyl) phthalate [BEHP], butyl benzyl phthalate [BBP], and dimethyl phthalate). With the exception of dioxins/furans, which were only analyzed in three samples, these COCs exceeded the RAL in 3% to 26% of the surface sediment samples in the design dataset.

- **Subsurface (non-RAL interval) samples** – PCB concentrations in non-RAL subsurface intervals exceeded the surface sediment RAL most frequently (63%). Based on a comparison of non-RAL interval subsurface data with Recovery Category 2 surface RALs, concentrations of three metals (lead, mercury, and zinc), two individual PAHs, one phthalate (BEHP), and six other SVOCs (1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethylphenol, n-nitrosodiphenylamine, pentachlorophenol) are also elevated within the inlet.

3.3 Sediment Chemistry Summary

This section presents an overview of concentration patterns for select chemicals identified as risk drivers likely to result in remedial actions in the inlet. These include PCBs, dioxins/furans, mercury, and lead. Other chemicals, including PAHs, phthalates, and other SVOCs, were detected at concentrations above surface sediment RALs; however, these chemicals are co-located with high concentrations of the risk-driver chemicals and thus are not discussed in detail here. Concentration ranges for the risk-driver chemicals are presented in Table 3-3 and Figure 3-1 for the inner inlet, outer inlet, and the rest of the middle reach.

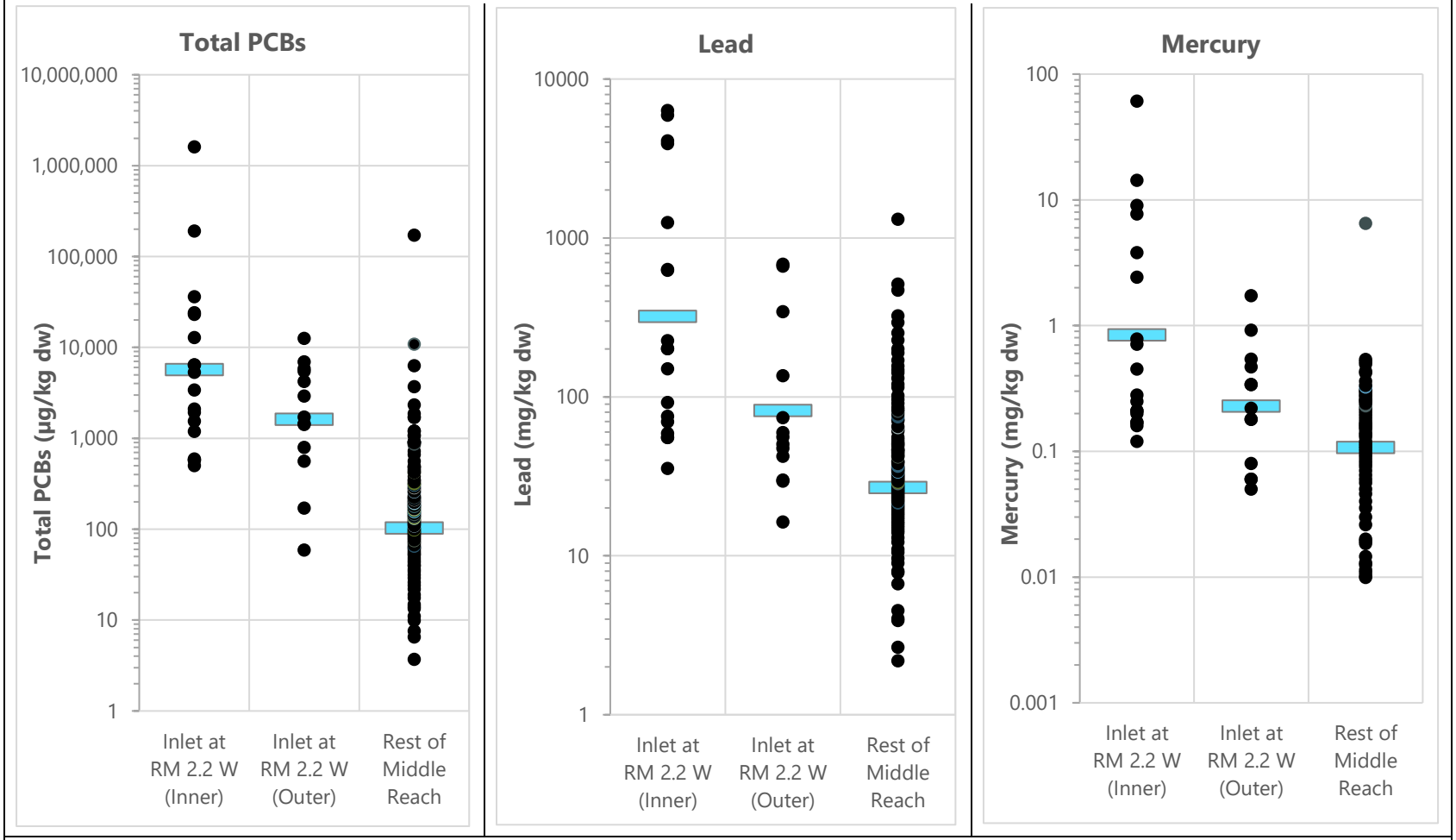
Table 3-3
Summary of Concentrations in Surface Sediment for Risk-Driver Chemicals

Risk-driver Chemical and Area	Units (dw)	Overview of Surface Sediment Concentrations in the Design Dataset[1]			
		Detection Frequency	Range of Concentrations	Geomean of Concentrations	Max. RAL Exceedance Factor
Total PCBs					
Inner inlet	µg/kg	18/18	500–1,600,000	5,700	12,000
Outer inlet	µg/kg	13/13	59–12,500	1,600	53
Rest of middle reach	µg/kg	421/429	4.4–171,000	100	640
Dioxin/Furan TEQ					
Inner inlet	ng/kg	2/2	28.8–304	-	12
Outer inlet	ng/kg	1/1	396	-	16
Rest of middle reach	ng/kg	128/128	0.55–247	7.86	9.9

Risk-driver Chemical and Area	Units (dw)	Overview of Surface Sediment Concentrations in the Design Dataset[1]			
		Detection Frequency	Range of Concentrations	Geomean of Concentrations	Max. RAL Exceedance Factor
Lead					
Inner inlet	mg/kg	18/18	35.5–6,330	320	7.0
Outer inlet	mg/kg	13/13	16.3–683	82	0.76
Rest of middle reach	mg/kg	410/410	2.18–1,310	27	1.5
Mercury					
Inner inlet	mg/kg	18/18	0.12–61	0.84	74
Outer inlet	mg/kg	13/13	0.05–1.73	0.23	2.1
Rest of middle reach	mg/kg	389/410	0.00991–6.5	0.11	7.9

Notes:
1. The design dataset for the inlet is provided in Attachment B.
DER: data evaluation report
dw: dry weight
MHHW: mean higher high water
PCB: polychlorinated biphenyl
RAL: remedial action level
TEQ: toxic equivalent

Figure 3-1
Concentrations of Total PCBs, Lead, and Mercury in Surface Sediment in the Inlet at RM 2.2W Compared with the Rest of the Middle Reach



Note: Black dots indicate individual data points; blue bars indicate the geomean of the data for a given area.

As shown in Figure 3-1, surface sediment concentrations of PCBs, lead, and mercury in some samples collected from the inner inlet are higher than those in the outer inlet and rest of the middle reach, particularly along the southern shoreline in the vicinity of the former wharf (as noted in Section 2.3 and shown on Map 3-1a); the geomeans of the samples are highest in the inner inlet. Concentrations in the inner inlet are elevated in both surface and subsurface sediment samples. Concentrations in the outer inlet are within the overall concentration range in the rest of the middle reach.

- **PCBs** – Concentrations of PCBs are elevated throughout the Inlet at RM 2.2W, with the highest concentrations (i.e., those above 50,000 µg/kg dry weight [dw]) located in the inner inlet along the southern shoreline (see Maps 3-2a and 3-2b). These elevated concentrations are found both in surface and subsurface sediment in this area. The highest concentration of total PCBs was 1,600,000 µg/kg dw in the 0- to 10-cm sample collected from location SED1 in 2014.
- **Dioxins/furans** – Only three surface sediment samples from Inlet at RM 2.2W have been analyzed for dioxins/furan; TEQs ranged from 28.8 to 396 ng/kg (Maps 3-1a and 3-1b). ; While dioxins/furans were not analyzed in the samples with the highest concentrations of PCBs, at least one sample (DSS-08) was collected near the location with the highest PCB concentration in the inner inlet (SED1) . No information is available regarding the vertical extent of contamination of dioxins/furans.
- **Mercury** – The highest concentrations of mercury (i.e., those above 4 mg/kg) were detected in surface and subsurface sediment samples from the inner inlet, primarily along the southern shoreline (see Maps 3-3a and 3-3b). The highest concentrations of mercury have been detected in subsurface sediment, with concentrations as high as 93.8 mg/kg in the 0- to 30-cm (0- to 1-foot) sample collected from location HS-21 in 2020.
- **Lead** – As with mercury, the highest concentrations of lead (i.e., those above 5,000 mg/kg) were detected in the inner inlet, primarily along the southern shoreline (see Maps 3-4a and 3-4b). This area is the same area identified as having the highest concentrations of both mercury and PCBs. The highest concentrations of lead have been found in subsurface sediment, with concentrations as high as 33,700 mg/kg in the 0- to 30-cm (0- to 1-foot) sample collected from location HS-9 in 2020.
- **Other COCs** – As shown in Table 3-2, concentrations of other COCs (including select metals [arsenic, cadmium, chromium, and zinc], PAHs, phthalates, and other SVOCs) exceeded RALs less frequently. As for PCBs, mercury, and lead, the majority of the samples with RAL exceedances for other COCs were collected from the inner inlet, particularly along the southern shoreline (Maps 3-1a and 3-1b) in the vicinity of the former wharf.

3.4 Areas with RAL Exceedances and Preliminary Technology Assignments

This section presents the preliminary RAL exceedance area delineation as well as the preliminary remedial technology assignment options. The methods used in these assessments are the same as those presented in Section 3.4 of the draft Phase I DER (Anchor QEA and Windward 2023a).

The entire Inlet at RM 2.2W (bank to bank up to mean higher high water [MHHW]) is a RAL exceedance area (Maps 3-1a and 3-1b). The outer part of this area was referred to as RAL Exceedance Area 20 in the draft Phase I DER (Anchor QEA and Windward 2023a). Based on the assessment presented in this addendum, RAL Exceedance Area 20 now includes the entire inlet. As shown on Map 1-1, the entire inlet is intertidal.

Preliminary remedial technology assignment options for RAL Exceedance Area 20 are summarized in Table 3-4. Figure 19 in the ROD (EPA 2014) describes the process by which remedial technologies are to be assigned to intertidal areas during the design process. Following the flowchart in this figure, enhanced natural recovery is not suitable for RAL Exceedance Area 20 because concentrations are above the maximum concentrations allowed for this technology. Additionally, direct placement of a cap without dredging is not appliable because of water depth restrictions. Dredging is likely to be the primary remedial technology included in the RD, and partial dredge and cap (PD&C) or area-specific technologies (ASTs) may be required in portions of the inlet.

Table 3-4
Preliminary Technology Assignment Options for RAL Exceedance Area 20

RAL Exceedance Area	Preliminary Technology Assignment Options[1]					Notes
	Dredging	PD&C	Cap	ENR	ASTs	
20	•	•			•	Entire Inlet at RM 2.2W

Notes:
1. The 30% RD will evaluate the locations within RAL Exceedance Area 20 that may require PD&C and AST options. Backfill after dredging will also be required in this intertidal area.
AST: area-specific technology
ENR: enhanced natural recovery
PD&C: partial dredge and cap
RAL: remedial action level
RM: river mile

3.5 Data Gaps

The data quality objectives (DQOs) specific to the Phase II PDI are summarized in Table 3-5. Within RAL Exceedance Area 20, additional data will be needed for each of the five DQOs.

Table 3-5
DQOs for Phase II of the PDI in the Middle Reach

Phase II
DQO10 – Further delineate RAL exceedances, as needed for unbounded areas.
DQO11 – Assess chemical and physical characteristics of banks (including topographic survey), as needed, depending on remedial technology selected for adjacent sediment and whether bank is erosional.
DQO12 – Delineate vertical elevation of RAL exceedances in dredge (and PD&C) areas and collect subsurface sediment chemistry data in cap areas where contamination under caps will remain.
DQO13 – Collect geotechnical data as needed depending on remedial technology proposed and/or physical characteristics of remedial action areas.
DQO14 – Collect other engineering-applicable data as needed (e.g., waste characterization, structures inspection results, utility location verification results, thickness of sediment on top of riprap layers, groundwater velocities).

Notes:
DQO: data quality objective
PD&C: partial dredge and cap
PDI: Pre-Design Investigation
RAL: remedial action level

4 Phase II Sampling within the Inlet at RM 2.2W

This section presents the Phase II sampling study design to address identified data gaps for the Inlet at RM 2.2W. The sediment sampling, geotechnical, and engineering data protocols are the same as those presented in the Middle Reach PDI QAPP (Windward and Anchor QEA 2022) and PDI QAPP Addendum No. 1 for Phase II (Anchor QEA and Windward 2023b). Thus, this section includes information regarding the sediment sampling study design (Section 4.1) and information regarding the study design for engineering data collection (Section 4.2).

4.1 Sampling Design for Sediment and Bank Analytical Samples

This section provides details regarding the sediment sampling study design for the Inlet at RM 2.2W.

4.1.1 General Principles for Identification of Locations

As shown in Table 3-1, surface sediment samples from 38 locations and samples with subsurface non-RAL intervals from 39 locations have already been collected within the Inlet at RM 2.2W. The available data indicate that the entirety of the inlet will require remediation.

To determine specific sediment and bank[6] sampling locations for Phase II sampling, the following three principles were applied based on the existing design dataset for the inlet:

- **Refine horizontal boundaries of RAL exceedances (DQO 10):** As noted, based on current data, the entire inlet is likely to require remediation, so additional RAL intervals within the inlet are not being analyzed to refine horizontal boundaries during this PDI phase. However, additional horizontal bounding is planned near the mouth of the inlet to refine the horizontal extent of the RAL exceedance area (i.e., to reduce uncertainties in the PCB data interpolation and/or refine Thiessen polygon shapes for other COCs).
- **Bound vertical extent (DQO 11 and 12):** Phase II sampling will target the collection of additional vertical extent cores within the inlet where needed for RD to refine the vertical extent of contamination. In addition, the placement of vertical extent cores will target bank areas (below MHHW) to collect information needed for RD (Map 4-2a and 4-2b).
- **Refine vertical and horizontal extents of PCBs above applicable Toxic Substances Control Act (TSCA) thresholds for waste characterization and disposal (DQO 14)**: Phase II sampling will target the collection of samples to further define the volume of sediment in the inner inlet with PCB concentrations above 50 mg/kg dw.

Using these principles, sediment sampling is proposed at 21 locations in the inlet (Table 4-1).

[6] As defined in Section 4.2.6 of the PDI QAPP for the middle reach (Windward and Anchor QEA 2022), banks are the transition areas from the LDW subtidal or intertidal bed to MHHW.

Table 4-1
Summary of Phase II Sampling Locations for the Inlet at RM 2.2W

Sample Type	Count of Design Dataset Locations[1]			Notes and Map Symbology (Maps 4-1a and 4-1b)[2]
	No. Prior to Phase II	No. of Phase II Locations		
		Tier 1	Tier 2	
Surface (0–10 cm)	35	2	0	Tier 1 locations are indicated on maps by blue circles (Map 4-1b).
Intertidal subsurface (0–45 cm)	0 (17 0–30-cm [0–1-ft] samples)	2	19[3]	Tier 1 locations are indicated on maps by blue pentagons (Tier 2 locations associated with vertical cores are not indicated on maps).
Vertical extent cores	15	19	1	Indicated on maps by blue Vs (Tier 1) and gray Vs (Tier 2); core profiles on the Map 4-1 series and in Attachment C provide details regarding which intervals will be analyzed in Tier 1 and which will be archived.

Notes:
1. This table presents the location counts by sample type for Phase II. The sample counts are greater than the location counts because many locations have multiple sample intervals. See Attachment C for details.
2. Sample locations to the east of the inlet boundary line on the Map 4-1 series are covered in QAPP Addendum No. 1 but are also shown here for completeness.
3. At each vertical extent location where only a V is shown on the Map 4-1 series, a 0–45-cm archive sample will also be collected as part of that core. These locations are included in the Tier 2 counts in this table.
DER: data evaluation report
MHHW: mean higher high water
QAPP: quality assurance project plan
RM: river mile

4.1.2 Depth Intervals

Depth intervals for Phase II sampling were described in Section 4.1.2 of the PDI QAPP Addendum No. 1 for Phase II (Anchor QEA and Windward 2023b). Given that the entire inlet is intertidal, the applicable RAL intervals are 0 to 10 cm for surface sediment samples and 0 to 45 cm for subsurface sediment samples.

To determine the depths for the vertical extent cores, subsurface sediment data were reviewed from the ICS/former NW Cooperage Site RI and FS (DOF 2023, 2020), and upland data were reviewed from both the ICS/former NW Cooperage and Douglas Management Sites RIs. These data indicate that sediment cores targeting a specific elevation—rather than a depth of 7.5 feet, which was the typical Phase II intertidal core depth—should be collected in order to delineate the vertical extent of contamination in the inlet.

As described in Section 2.3 of this QAPP Addendum, historical mudline elevations were shallower toward the head of the inlet, a trend consistent with the fact that contamination has been found at

shallower elevations in vertical cores (i.e., above -1 feet MLLW) in this area. Historical mudline elevations in other parts of the inlet have been deeper, and as expected, the available information indicates that contamination is also deeper (i.e., generally above -3 or -4 feet MLLW). Based on this pattern, vertical cores collected in the inlet will target the following:

- Toward the head of the inlet – The core length will be such that the bottom of the core reaches an elevation of -3 feet MLLW.
- Middle and outer part of the inlet – The core length will be such that the bottom of the core reaches an elevation of -5 or -6 feet MLLW.

Thus, specific core depths will be determined in the field based on mudline elevations at the sample collection locations. Based on current bathymetry information at target locations, core lengths in the inlet are anticipated to range from approximately 7 to 13 feet (see Maps 4-1a and 4-1b, Maps 4-2a and 4-2b, and Attachment C for details).

4.1.3 Tiered Sample Analysis

The approach for tiered sample analysis is the same as described in Section 4.1.3 of the PDI QAPP Addendum No. 1 for Phase II (Anchor QEA and Windward 2023b). Phase II sediment sampling will involve the collection of two tiers of samples, which will be collected during the same sampling effort:

- Tier 1 – Locations sampled for immediate sample analysis
- Tier 2 – Locations sampled for sample archival, with analyses and analytes dependent on the results of Tier 1 analyses

As shown in Table 4-1, the majority of the sampling locations in the inlet are for the collection of Tier 1 vertical extent cores. In these Tier 1 cores, the first two 30-cm sample intervals below the RAL interval(s) will be analyzed in Tier 1. Then, each subsequent, alternating interval will be archived or analyzed until the end of the core, native sediment, or target depth is reached (see Attachment C for interval details). Alternating intervals will be analyzed as part of Tier 1 to help define the vertical extent of contamination (defined as concentrations above surface sediment RALs). The remaining intervals will be archived for potential analysis in Tier 2, if further refinement of the vertical extent of contamination or further delineation of the extent of PCBs above 50 mg/kg dw is necessary. Archive material will be available for both Tier 1 and Tier 2 samples if additional analyses are determined to be needed.

Given that horizontal bounding is not needed in the majority of the inlet (i.e., there are sufficient data to indicate that the RAL exceedance area extends throughout the inlet), the only Tier 1 RAL interval sampling locations are located near the mouth of the inlet to further define the extent of this RAL

exceedance area. The need for any Tier 2 analyses will be determined in consultation with EPA following a review of design needs and Tier 1 results.

4.1.4 Analytes

As described in Section 3 of this QAPP Addendum, chemicals with RAL exceedances in the inlet include PCBs, dioxins/furans, metals (including mercury), PAHs, phthalates, and other SVOCs. Analytes for Tier 1 samples collected in the inlet will be as follows:

- **Tier 1 RAL interval samples** –The Tier 1 RAL interval samples (all of which will be from locations near the mouth of the inlet) will be analyzed for the full suite of COCs with RALs, including dioxins/furans.
- **Vertical extent cores** – Tier 1 intervals from the vertical extent cores will be analyzed for PCBs and mercury. The Tier 2 analyses will be determined in consultation with EPA following a review of Tier 1 results.

Analytes and sample-specific details are summarized in Attachment C.

4.1.5 Sample Collection

Sample collection methods are the same as those described in the Middle Reach PDI QAPP (Windward and Anchor QEA 2022) and PDI QAPP Addendum No. 1 for Phase II (Anchor QEA and Windward 2023b).

Given the elevated concentrations in the Inlet at RM 2.2W (particularly in the inner inlet) and the target depths for the vertical extent cores (approximately 7 to 13 feet, depending on the elevation), sample collection will be done using a vibracorer deployed from a sampling vessel at high tide when the water depth is sufficient for a given location and vessel. Care will be taken to avoid sediment disturbances caused by propeller wash or vessel grounding. Samples will not be hand collected in the inner inlet to minimize exposure of the field crew to contaminated sediment in this area. Some hand collection of samples (particularly surface sediment samples or shallower cores) may occur depending on field conditions in the outer inlet. Additional health and safety measures will also be taken during collection and processing of samples in the inner inlet (locations 1596 through 1610); an addendum to the Health and Safety Plan has been prepared to address this area (Attachment D).

4.1.6 Field-generated Waste Disposal

Existing sediment data from the Inlet at RM 2.2W have been reviewed to identify areas with sediment exceeding thresholds for hazardous wastes under Washington State regulations and reporting requirements under TSCA. The results show that sediment samples with PCB concentrations exceeding TSCA levels, or metals (cadmium, chromium, lead and mercury) or SVOC (chlorobenzenes

and pentachlorophenol) concentrations exceeding Washington State hazardous waste thresholds, have been collected from the inlet, particularly the inner inlet along the southern shoreline. Therefore, excess sediment associated with samples from areas with PCB concentrations exceeding TSCA reporting requirements (i.e., more than 1 parts per million) or Washington State Hazardous waste thresholds will be segregated into drums and labelled as potentially hazardous waste or potentially TSCA-regulated material, as appropriate. Representative samples of materials from each drum will be tested as appropriate to complete the final waste profiles. Containers will be secured for off-site disposal via a licensed waste disposal company.

Decontamination water (i.e., an Alconox®/water solution) will be contained for disposal via the sanitary sewer. All disposable sampling materials and personal protective equipment used for processing samples from the inner inlet will be disposed of in drums with the excess sediment from the inner inlet. For the outer inlet, all disposable sampling materials and personal protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the site by sampling personnel and placed in a normal refuse container for disposal as solid waste.

4.2 Engineering PDI Elements for the Inlet at RM 2.2W

The PDI QAPP Addendum No. 1 for Phase II (Anchor QEA and Windward 2023b) describes the methods for collecting, handling, and managing engineering data necessary to complete RD. For the Inlet at RM 2.2W, the following PDI engineering elements will be performed:

- Topographic surveys and bank feature data collection performed along the entire inlet extents (DQO 11)
- Geotechnical data collection; material strength and settlement properties assessment; and stability modeling for banks, structures, and dredging or capping areas, as well as the potential construction of a temporary cofferdam to facilitate construction of the inner inlet remedy (DQO 13)
- Inspections and evaluations of existing structures to develop design criteria for remedial activities that may impact existing structures (DQO 14)
- Collection of other applicable engineering data (e.g., sediment thickness overlying the armoring layer in bank areas and debris locations and extents) as necessary to adequately characterize site conditions for engineering design and construction bid documents (DQO 14)

Geotechnical data collected in the nearshore upland areas will focus on strength and other geotechnical properties to support dredging or excavation design, shoreline capping, slope stability, and structural considerations (as applicable). Specific structures to be inspected and locations where

other applicable engineering data are to be collected will be identified using high-resolution photos taken during the early portion of the field program. Map 4-3 summarizes the locations of surveys, inspections, and geotechnical investigations. Table 4-2 presents the geotechnical data collection locations, methods, and target elevations for borings. Prior to drilling, all locations will be cleared through the 811 public services and, as appropriate, using private locating services.

Table 4-2
Phase II Geotechnical Field Investigation Locations at the Inlet at RM 2.2W

Sampling Location ID	RAL Exceedance Area(s)	Preliminary Remedial Technology Options[1]	Geotechnical Data Location[2]			Geotechnical Data Collection Method			Target Depth (Feet BGS)	Target Coordinates	
			Adjacent to FNC	Subtidal/ Intertidal	Upland	SPT Boring	CPT	Vane Shear		Latitude	Longitude
LDW23-GT32	20	Dredge, PD&C, AST			X	X			40 feet BGS	47.539538	-122.332700
LDW23-GT33					X	X				47.539482	-122.333096
LDW23-GT34					X	X				47.539459	-122.333744
LDW23-GT35					X	X				47.539262	-122.332619

Notes:
1. Area-specific technologies potentially include the use of a temporary cofferdam to facilitate construction of the remedy in the inner inlet.
2. Assignment of *ex situ* geotechnical tests—as described in Sections 5.2.4 and 5.2.5 of the PDI QAPP Addendum No. 1 for Phase II (Anchor QEA and Windward 2023b) and Section 5.3.3, Table 5-1, of the Middle Reach PDI QAPP (Windward and Anchor QEA 2020)—will be coordinated by the field geologist/geotechnical engineer and lead geotechnical engineer and be based on geologic conditions observed in the field.
AST: area-specific technology
BGS: below ground surface
CPT: cone penetration testing
FNC: Federal Navigation Channel
ID: identification
PD&C: partial dredge and cap
PDI: Pre-Design Investigation
QAPP: quality assurance project plan
RAL: remedial action level
RM: river mile
SPT: standard penetration testing

5 References

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FINAL

Attachment A
Figures and Aerial Photographs from Prior Reports Related to the Inlet at RM 2.2W

FINAL

Attachment B
Dataset for Inlet at RM 2.2W

FINAL

Attachment C
Sample-Specific Details and Rationale

FINAL

Attachment D
Health and Safety Plan Addendum