Appendix F
Construction Quality Assurance Plan Summary Table

The Construction Quality Assurance Plan (CQAP) describes how the Owner, their consultant, and the selected Remedial Action Contractor (Contractor) will construct the removal project in a manner that complies with the conditions and requirements of the design documents approved by U.S. Environmental Protection Agency (EPA) for the Lower Duwamish Waterway upper reach.

The CQAP will detail the remediation verification methods and approaches to quality assurance during construction activities in the project area, including compliance with applicable or relevant and appropriate requirements. The plan will describe the methods used to measure compliance with performance and method requirements, including (for example) target dredge or excavation depths and design cap thicknesses. It specifies the types of environmental monitoring that will be performed and how modifications to the construction procedures will be directed, as necessary, in response to monitoring data. A summary of the required inspections, surveys, monitoring actions, verification samples, reporting mechanisms, and documentation will be provided. Further, it delineates the quality assurance (QA) protocols necessary for project personnel to understand the construction quality control (QC) issues, monitoring and feedback processes, and potential corrective actions.

The CQAP will be executed in conjunction with the contract drawings and specifications, the final approved water quality monitoring plan (WQMP), and the final approved Contractor's Remedial Action Work Plan (RAWP).

There are three main categories of construction QA activities that will be performed during construction:

- Construction Inspection and Engineering Support (compliance with plans and specifications)
- Environmental Controls and Monitoring (compliance with environmental protection requirements, including water quality monitoring)
- Remedy Performance (compliance with Record of Decision remedial action requirements immediately following construction)

The draft CQAP will be developed during Pre-Final (90%) Remedial Design (RD) and will include a description of construction QA roles and responsibilities and QA activities that the Owner's Project Representative will conduct. Section 1.4 of the Basis of Design Report summarizes the roles and responsibilities of the Implementing Entity, Owner, Project Representative, and Designer that will be used in the draft CQAP. Frameworks and reporting mechanisms will also be developed. EPA is the regulatory authority and responsible agency for overseeing and authorizing the selected remedy. EPA will review and approve the Final (100%) RD, including the CQAP, Contractor's RAWP, and other Contractor pre-construction submittals to ensure that the Contractor's QC program is compliant with the design objectives.

In general, Contractor QC requirements are defined in the specifications and summarized in the Contractor's RAWP. QA activities will be conducted by the Owner's construction management team and Project Representative (to be selected by the Owner); QA activities are defined in the CQAP. In addition, EPA will perform oversight on field activities to ensure the selected remedy is implemented in accordance with the design objectives.

For the upper reach remediation, a key construction element requiring strategic QC protocols is the management of dredge residuals. To facilitate early feedback on this topic, this Intermediate (60%) RD CQAP includes an outline of sediment quality sampling evaluations and contingency actions to determine if contingency re-dredging and/or residuals management cover (RMC) is necessary. The following CQAP elements are included in Appendix F:

- Summary of key CQAP elements (see the following table)
- Table F-1: Post-dredge contingency action decision framework for missed inventory and generated residuals
- Figure F-1: Post-dredge confirmation sampling and contingency action decision framework flowchart for missed inventory and generated residuals
- Figure F-2: Conceptual post-dredge confirmation sampling plan using sediment management areas 17 and 18 as example areas
- Attachment F-1: A detailed outline of the WQMP with an attached water quality monitoring depths and locations figure
- Attachment F-2: CQAP document outline (to be completed at Pre-Final [90%] RD)

Summary of Key CQAP Elements

Construction Element	QA Categories	Contractor QC Requirements	Owner QA Activities
Pre-Construction Activities			
Contractor's Pre-Construction Submittals and Mobilization	Construction Inspection and Engineering Support	Contractor submits pre-construction submittals as required in specifications, including the following: • RAWP (e.g., construction means and methods, material supply source, transport and disposal plan, landfill facility location, sequencing and construction schedule) – Project Work Plan – Initial Project Schedule – Site-Specific Safety and Health Plan – Traffic Control Plan – Environmental Pollution Control – Contractor QC Plan – Transportation and Disposal Plan (includes proposed transloading facility) – Surveying Plan – Capping Plan – Dredging and Excavation Plan – Vessel Management Plan – Demolition Plan • Structures condition documentation (within or adjacent to RAAs) • Pre-construction bathymetric/topographic survey of RAAs, including buffer areas and calculation of quantities • Contractor equipment inspection • Procure materials, including placement materials, and conduct and document results of QC testing. • Establish real time kinematic positioning control and maintain. • Establish and maintain vertical control, including tide gauges and survey monuments.	• Owner and EPA review and approve Contractor pre-construction submittals. • Equipment pre-construction inspection review • Structures condition documentation (within or adjacent to RAAs) review • Review and approve pre-construction bathymetric/topographic surveys and calculation of quantities. • Review and approve materials. • An Independent Licensed Surveyor performs existing conditions surveys. • Owner may perform independent QA surveys.
During Construction Activities			
Construction Progress Tracking and Reporting	Construction Inspection and Engineering Support	Contractor submits daily and weekly construction reports including the following: • Quantity estimates (dredging, placement) • Progress summaries • Environmental monitoring summaries • Vessel movements • Health and safety incidences • Work hours, notes, visual observations and change conditions • Look-ahead construction schedule and activities	Review daily and weekly construction reports and prepare the following: • Progress summaries for all construction activities • Environmental monitoring summaries • Deviations from Contractor's RAWP or plans and specifications
Structures Demolition, Installation, and Utility Relocation	Construction Inspection and Engineering Support	Contractor submits daily and weekly construction reports including the following: • Material supply quality submittals • As-built surveys	• Review daily and weekly progress tracking and reports.

Construction Element	QA Categories	Contractor QC Requirements	Owner QA Activities
Dredging and Excavation Activities	Construction Inspection and Engineering Support	• Conduct and submit bathymetric/topographic surveys (progress surveys and post-dredge acceptance surveys [as required by specifications], and as-built surveys). • Submit barge measurements (empty and loaded) for transport and transload operations. • Submit disposal weight tickets from approved landfill facilities. • Submit bucket maps showing work progress.	• Review Contractor's daily and weekly construction reports. • On-site inspections and observations • Review bathymetric and topographic surveys, bucket maps, barge measurements and weight tickets for conformance with plans and specifications. • An Independent Licensed Surveyor performs acceptance surveys (may be contracted by Owner or Contractor, TBD). • Review transload and disposal information to track progress of transport and disposal of dredged materials/debris at approved landfills. • Determine need for corrective action or contingency re-dredging in coordination with EPA.
Placement Activities (Enhanced Natural Recovery, Capping, Backfilling, Slope Armoring, and RMC)	Construction Inspection and Engineering Support	• Conduct and submit bathymetric/topographic surveys (progress surveys and post-dredge acceptance surveys [as required by specifications], and as-built surveys). • Submit placement material supplier test results per specifications. • Submit placement material supplier quantity weight tickets and/or transport barge measurements. • Submit bucket maps showing work progress.	• Review Contractor's daily and weekly construction reports. • On-site inspections and observations • Review surveys and other submitted information for conformance with plans and specifications. • An Independent Licensed Surveyor performs acceptance surveys (may be contracted by Owner or Contractor, TBD). • Review material supplier and barge measurement information to track quantities of placement materials. • Review material supplier testing results for acceptance. • Conduct verification sampling (e.g., coring, sediment profile imaging, probing, placement elevations and thickness, and mass balance calculations). • Determine need for corrective action in coordination with EPA.
Site Cleanup and Restoration	Construction Inspection and Engineering Support	• Submit Closeout Checklist to Project Representative and Designer for review. • Submit draft as-built record drawings. • Inspect all construction-impacted areas, including staging and transload to cleanup, restore vegetation (as required), and decontaminate equipment and the site for final acceptance per the specifications.	• Review Contractor's Closeout Checklist and identify final corrective actions. • Review as-built surveys. • Inspect the site to confirm cleanup, restoration, and decontamination work has occurred per the Contractor's RAWP .
All Construction Activities	Environmental Controls and Monitoring	• Comply with specification requirements for all environmental protection criteria and comply with Contractor's approved Environmental Protection Plan. • Upgrade BMPs if environmental performance criteria are not being met. • Contractor's QC officer will be responsible for ensuring compliance with environmental protection criteria.	• Conduct water quality monitoring during in-water construction activities per the approved WQMP to ensure Contractor is meeting performance criteria in the specifications and the WQMP and to modify BMPs, if needed. • Other required monitoring TBD in consultation with EPA during 60% and 90% RD • On-site inspectors will observe Contractor's operations to note compliance with environmental protection specifications and the Contractor's approved Environmental Protection Plan. • Follow the procedures in the Community Outreach and Communications Plan and Community Impacts Mitigation Plan, including notifications and communications. • Determine need for corrective action in coordination with EPA.
Dredging, Excavation, and Demolition Activities	Environmental Controls and Monitoring	• Visual observations for potential evidence of archaeological, cultural, and historic artifacts; reporting to Owner Archaeological Monitor	• Archaeological Monitor implements the approved Monitoring and Inadvertent Discovery Plan during dredging, excavation, and demolition activities. • Coordinate response and communications to all relevant stakeholders if an inadvertent discovery occurs.
Required Contingency Actions	Remedy Performance	• Perform contingency actions, as directed, in compliance with plans and specifications	• Conduct post-dredge confirmation sediment sampling to identify missed inventory and/or generated residuals requiring contingency action. • Conduct post-material placement performance monitoring for capping, ENR, and RMC placement areas. • Determine need for contingency action in coordination with EPA. • Implement (through directing the Contractor) contingency actions per the EPA-approved contingency action decision framework as described in the CQAP (see post-dredge contingency action decision framework [Table F-1 and accompanying flowchart Figure F-1]).

Construction Element	QA Categories	Contractor QC Requirements	Owner QA Activities
Post-Construction Activities			
Post-Construction Documentation	Remedy Performance	• Submit final as-built record drawings • Submit Contractor's Closeout Report	• Develop and submit Completion Report to EPA.

Notes:
BMP: best management practice
ENR: enhanced natural recovery
EPA: U.S. Environmental Protection Agency
QA: quality assurance
QC: quality control
RAA: remedial action area
RAWP: Remedial Action Work Plan
RMC: residuals management cover
TBD: to be determined
WQMP: water quality monitoring plan

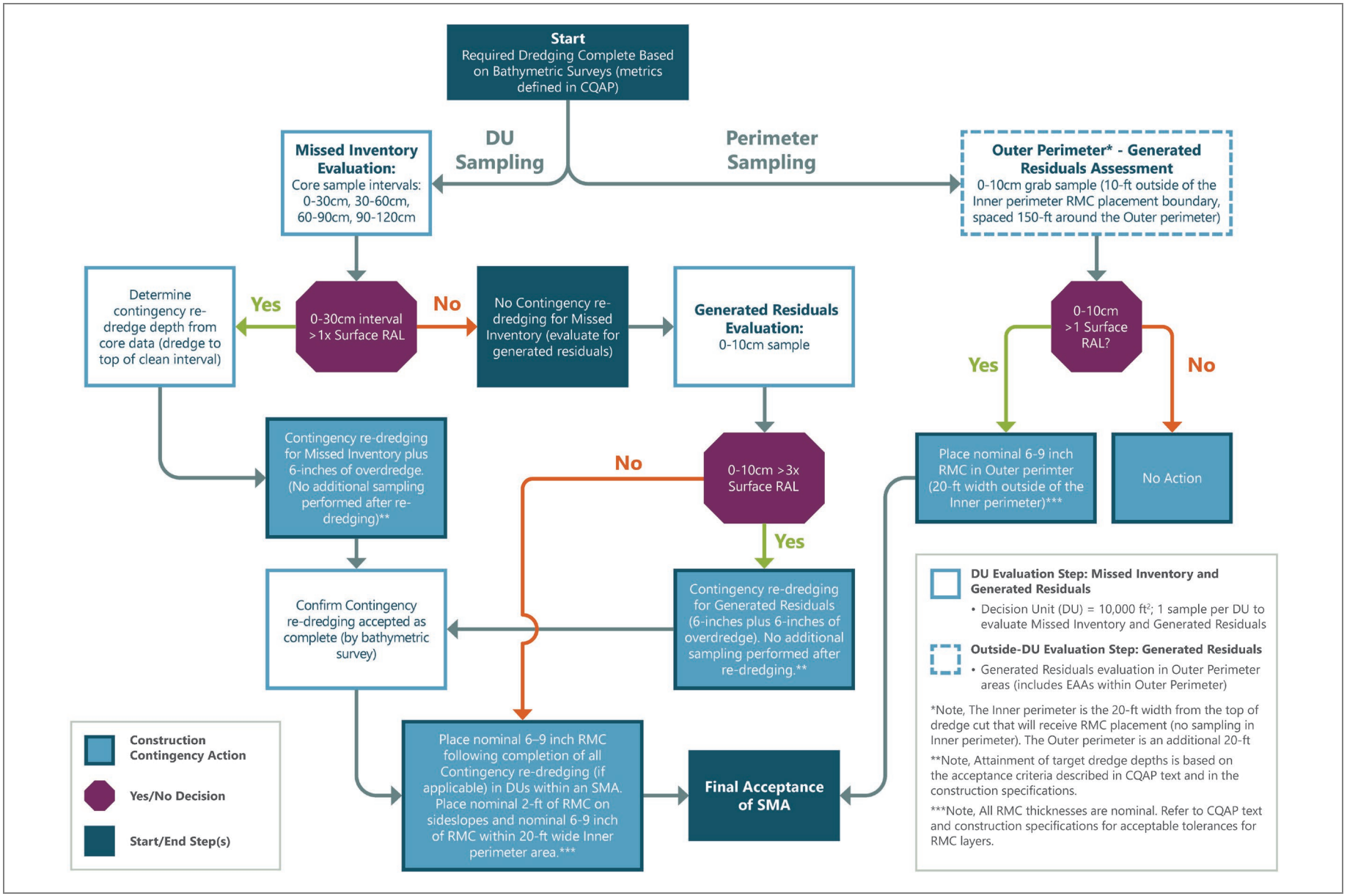
Table

Table F-1
Construction Quality Assurance Plan: Post-Dredge Verification and Contingency Action Framework

Option ID	Post-Dredge Confirmation Sampling Objective	Density[1,2]	Sediment Sample Type	Sample Intervals	Analytes	Criteria	Contingency Action
Missed Inventory	• Determine if missed inventory by collecting a sample taken within toe of dredge footprint within each DU • Note: No missed inventory samples within thin-cut (1-foot) dredge RAAs	• DU = 10,000 square feet (4 samples per acre) • 1 sample per DU	Core (4 feet)	0–30 cm; 30–60 cm; 60–90 cm; 90–120 cm (analyze all core intervals)	RAA-specific lists	• Greater than 1x surface RAL (0–10-cm surface RAL; e.g., 12 mg/kg OC for PCBs)[4]	• No dredging for missed inventory if 0–30 cm sample result is less than surface RAL • If 0–30 cm sample result is greater than surface RAL, re-dredge down to top of clean 1-foot interval (within the 4-foot core) plus 6-inch of overdredge and place nominal 6- to 9-inch RMC (no additional sampling performed after re-dredging) • Place nominal 2 feet of RMC material on side slopes
Generated Residuals	• Assess generated residuals within each DU	• DU = 10,000 square feet (4 samples per acre • 1 sample per DU	Split from core	0–10 cm (archived from core when collected)		• Less than 3x surface RAL	• Place nominal 6- to 9-inch RMC within DU • Place nominal 6- to 9-inch RMC within 20-foot inner perimeter from top of dredge cut daylight
						• Greater than 3x surface RAL	• Contingency re-dredging (6 inches plus 6-inch overdredge; assumes no missed inventory) followed by nominal 6- to 9-inch RMC (no additional sampling performed after re-dredging) • No contingency re-dredging for generated residuals if contingency re-dredging for missed inventory is conducted
Outer Perimeter Residuals Sampling (includes EAAs)[3]	• Outer perimeter residuals (laterally and around dredge/RMC footprint)	• Sample every 150 feet along outer perimeter • Sample located 10 feet from edge of inner perimeter RMC (i.e., 30 feet away from top of dredge cut)	Grab	0–10 cm		• Greater than 1x surface RAL	•Nominal 6- to 9-inch RMC • No dredging in outer perimeter and EAA areas; if sample is greater than three times >3x surface RAL, then place additional RMC and discuss with EPA

Notes:
1. No sampling will be done on side slopes (only within toe of dredge footprint).
2. For thin-cut dredge areas (1-foot cut), no missed inventory sampling.
3. The outer perimeter is the 20-foot width outside the inner perimeter boundary. The inner perimeter is the 20-foot width from the top of the dredge cut that will receive RMC placement (no sampling in inner perimeter).
4. RALs for other COCs dependent on location.
5. All RMC thicknesses are nominal. Refer to CQAP text and construction specifications for acceptable tolerances for RMC layers.
6. Attainment of target dredge depths is based on the acceptance criteria described in CQAP text and in the construction specifications.
cm: centimeter
DU: Decision Unit
EAA: early action area
EPA: U.S. Environmental Protection Agency
LDWG: Lower Duwamish Waterway Group
mg/kg: milligram per kilogram
OC: organic carbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
RMC: residuals management cover

Figures



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ANCHOR QEA

Figure F-1
Post-Dredge Confirmation Sampling and Contingency Action Decision Framework
60% Remedial Design Basis of Design Report
LDW Upper Reach

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ANCHOR QEA

Figure F-2
Conceptual Post-Dredge Confirmation Sampling
60% Remedial Design Basis of Design Report
LDW Upper Reach

Attachment F-1
Water Quality Monitoring Plan Detailed Outline

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TABLES

FIGURE

ABBREVIATIONS

µg/L	microgram per liter
7-DADMax	7-day average of the daily maximum temperatures
ARAR	Applicable or Relevant and Appropriate Requirement
BMP	best management practice
BODR	*Basis of Design Report*
CLARC	Cleanup Levels and Risk Calculation
COC	contaminant of concern
CWA	Clean Water Act
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
LDW	Lower Duwamish Waterway
mg/L	milligrams per liter
NTU	nephelometric turbidity units
PCB	polychlorinated biphenyl
QAPP	quality assurance project plan
RD	remedial design
SMA	sediment management area
WAC	Washington Administrative Code
WQMP	Water Quality Monitoring Plan

1 Introduction

This Water Quality Monitoring Plan (WQMP) is a component of the remedial design (RD) for the upper reach of the Lower Duwamish Waterway (LDW). The upper reach encompasses river miles 3.0 to 5.0 of the LDW. The RD has been prepared consistent with the sediment remedy outlined in the U.S. Environmental Protection Agency's (EPA's) November 2014 *Record of Decision* (ROD; EPA 2014) as modified by an *Explanation of Significant Differences* (EPA 2021). The purpose of the LDW upper reach WQMP is to obtain information during construction to identify water quality effects that may be caused by remedy construction.

This WQMP is being developed as part of the Construction Quality Assurance Plan and identifies the specific requirements for monitoring water quality during in-water construction, in particular those regarding dredging and clean material placement activities, and steps to be taken to mitigate exceedances of water quality criteria if any occur. This WQMP outline will be developed into a draft plan at the Pre-Final (90%) RD and a final plan at the Final (100%) RD. The final WQMP will be updated by the Implementing Entity, in coordination with EPA, as required to reflect any conditions or requirements contained in the final Clean Water Act (CWA) §404 Applicable or Relevant and Appropriate Requirement (ARAR) Memorandum.

1.1 Project Description

Remedial activities in the LDW upper reach will consist of mechanical dredging of contaminated sediment, clean material placement, and select demolition activities. Construction best management practices (BMPs), environmental protection measures, and water quality management controls for the anticipated work activities are described in Section 11 of the *Basis of Design Report* (BODR).

The in-water components of this work are limited to occur only within the LDW designated in-water work window and consideration of the tribal net fishery, which is expected to extend from October 1 through February 15 annually. In-water work conducted outside of the work window will only occur if approved by EPA. The total project duration is estimated to take approximately three in-water work seasons to complete, as discussed in Section 13 of the BODR.

The Implementing Entity will designate a Water Quality Monitoring Lead to conduct water quality monitoring during in-water construction dredging activities to ensure compliance with state water quality criteria for surface water. For safety reasons, water quality monitoring will be restricted to daylights hours.

1.2 Water Quality Effects Assessment

A site-specific water quality modeling evaluation was performed to assess the potential for water quality exceedances during dredging (BODR, Appendix K) and concluded there is unlikely to be

water quality criteria exceedances for contaminants of concern (COCs) from resuspension of sediment during dredging operations, or from barge dredge return water discharge into the dredging area. Monitoring for turbidity at an anticipated 150-foot compliance mixing zone distance from dredging and barge discharge activities is expected to provide real-time feedback of water quality conditions during dredging operations and provide a mechanism for corrective action(s) should excessive sediment resuspension be observed.

The results of Appendix K can be considered by EPA to inform the detailed water quality monitoring requirements in EPA's CWA §404 ARAR Memorandum.

2 Monitoring Personnel and Responsibilities

Key monitoring personnel required to implement this WQMP include the following:

- Water quality monitoring lead
- Implementing Entity's Project Representative
- Water quality monitoring personnel
- Other key personnel identified in the WQMP Quality Assurance Project Plan (QAPP)

Persons fulfilling these roles will be designated at least 1 month prior to the start of monitoring activities and contact information will be provided at that time to EPA. All monitoring personnel will be experienced in the collection and measurement of water quality parameters.

2.1 Water Quality Monitoring Lead

The Water Quality Monitoring Lead will be responsible for the following:

- Oversight of all water quality monitoring activities and field personnel
- Verification that results are properly recorded and forms are completely filled out
- Verification that appropriate calibration and quality control/quality assurance procedures are being implemented
- Notifying the key personnel in the event that water quality exceedances are observed, and providing key personnel with all necessary supporting field documentation to be able to determine an appropriate path forward in consultation with EPA

Under the oversight of the Water Quality Monitoring Lead, monitoring personnel will be responsible for conducting the field activities, required instrument calibrations, quality assurance and quality control procedures, and documentation of results in daily field reports.

2.2 Project Representative

The Project Representative, assigned by the Owner to oversee the entire construction quality assurance program, will consult with the Designer, communicate directly with the Contractor, and be responsible for the following:

- Reviewing field reports to verify that appropriate field methods and quality control procedures are being implemented in accordance with the procedures specified in this WQMP
- Weekly reporting of water quality results to the EPA project manager
- Notifying EPA as soon as possible if a confirmed water quality exceedance is observed, and coordinating with EPA to determine an appropriate path forward if a response action is warranted

- Coordinating with the Contractor to ensure appropriate construction BMPs are being implemented and to strategize ways to add BMPs or enhance the effectiveness of existing BMPs as necessary to mitigate water quality exceedances

3 Water Quality Monitoring Plan

Sections 3.1 through 3.4 describe the specific water quality criteria to be assessed, monitoring locations, monitoring frequency, field procedures, and analytical procedures.

3.1 Water Quality Criteria

The ROD states that the LDW is considered marine water under the state's water quality standards regulation because it meets the salinity threshold described in Washington Administrative Code (WAC) 173-201A-260(3)(e) and that salinity measurements show tidal conditions exist beyond the turning basin. The ROD also states that the LDW is not specifically noted in WAC 173-201A-610 and 612, Table 612, but is a continuation of Elliott Bay for the purposes of applying marine criteria. Based on the beneficial use classification of the LDW as "excellent quality" to support salmonid migration and rearing, the compliance criteria for conventional parameters will be the "excellent quality" Washington State Surface Water Quality Standards for marine waters (WAC 173-201A-210). Compliance criteria for chemical parameters will be the State of Washington Marine Acute Water Quality Criteria for the protection of aquatic life found in the Water Quality Standards (WAC 173-201A-210); Chronic Water Quality Criteria are not proposed for this project because of the nature of the dredging and placement work that will be constantly changing locations within the upper reach such that the Chronic Water Quality Criteria, which typically is compared against a 4-day averaged concentration, is not applicable. Dredging and placement activities are not conducted over a 24-hour continuous period, and construction equipment will be moved multiple times per day. Testing for chemical parameters is discussed in Section 3.1.2.

The Contractor is responsible for providing quality control of its work, including following BMPs with the goal of meeting applicable and relevant state water quality criteria at the designated point of compliance. Dredging and clean material placement effects on water quality are typically assessed by complying with the provisions of EPA's CWA §404 ARAR Memorandum.

3.1.1 Conventional Parameters

The following field parameters will be monitored during construction activities at the compliance stations and background stations:

- Turbidity (in nephelometric turbidity units [NTU])
- Dissolved oxygen (DO; in milligrams per liter [mg/L])
- Temperature (in ºC)
- Hydrogen ion concentration (in pH units)

3.1.1.1 Turbidity

Expected provisions of the CWA §404 ARAR Memorandum are that in-water construction activities do not increase the in-water turbidity, measured as NTU, >5 NTU above background (or 10% above background if background is ≥50 NTU) at the compliance mixing zone distance. Compliance is typically measured at the edge of the EPA-approved mixing zone (e.g., 150 feet away from the construction work zone). The area of mixing established for marine waters is proposed to be a 150-foot radius (i.e., point of compliance) surrounding the in-water activity. The background stations will be upstream and a sufficient distance away from the influence of the activities occurring in the construction work zone (e.g., 500 feet).

If there is a preliminary exceedance of the turbidity criteria, the Contractor will be informed of this preliminary exceedance, and the turbidity will be measured again at the location of the turbidity exceedance within 30 minutes to confirm there is a sustained turbidity exceedance that will require corrective action (Section 5). If there are two consecutive turbidity exceedances at 30 minutes apart, this will be defined as a confirmed turbidity exceedance.

3.1.1.2 Dissolved Oxygen

- DO concentrations are measured as a 1-day minimum in mg/L.
- DO criteria in marine waters with "excellent quality" is 6.0 mg/L, and the DO at the point of compliance shall not decrease below 6.0 mg/L within a 24-hour period, per WAC 173-201A-210.
- If the background DO is lower than 6.0 mg/L (or within 0.2 mg/L) and is due to natural conditions, then human actions considered cumulatively may not cause the DO of the waterbody to decrease >0.2 mg/L.

3.1.1.3 Temperature

When the waterbody temperature is >16°C (or within 0.3°C of 16°C; 1-day maximum), and that condition is due to natural conditions, then human actions considered cumulatively may not cause an incremental increase of >0.3°C (7-day average of the daily maximum temperatures [7-DADMax]) per Table 210 (1)(c) of WAC 173-201A-210 for "excellent quality" marine water, where 7-DADMax is the arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the 3 days prior and the 3 days after that date.

If waterbody temperature is <16°C (or >0.3°C below 16°C [<15.7°C]), incremental temperature increases resulting from individual point source activities must not, at any time, exceed 12/(T-2) as measured at the edge of a mixing zone boundary, where T = highest representative ambient background temperature in the vicinity (°C).

3.1.1.4 pH

In marine waters with excellent quality, pH must be within the range of 7.0 to 8.5 with a human-caused variation within the above range of <0.5 units difference from background, per WAC 173-201A-210.

3.1.1.5 Summary of Conventional Parameters and Criteria

Table F-1 summarizes the conventional water quality parameters and criteria.

Table F-1
Summary of Conventional Parameters

Parameter	Criteria[a]	Units
Turbidity	Background+10%[a]; background+5 NTU	NTU
DO	>6.0 mg/L[b]	mg/L
Temperature	No incremental increase of >0.3°C[c]	°C
pH	7 to 8.5 pH Units [d]	pH Units

Notes:

a. When background station measurement is above 50 NTU
b. When a waterbody's DO is lower than the criteria in Table 210 (1)(d) of WAC 173-201A-210 (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the DO of that waterbody to decrease >0.2 mg/L.
c. When the waterbody temperature is >16°C (or within 0.3°C of 16°C; 1-day maximum), and that condition is due to natural conditions, then human actions considered cumulatively may not cause an incremental increase of >0.3°C (7-DADMax). When the waterbody temperature is <16°C (or >0.3°C below 16°C [<15.7°C]), incremental temperature increases resulting from individual point source activities must not, at any time, exceed 12/(T - 2) as measured at the edge of a mixing zone boundary, where T = highest representative ambient background temperature in the vicinity.
d. Any human-caused variation within the range listed previously in the table must be <0.5 units.

DO: dissolved oxygen
mg/L: milligram per liter
NTU: nephelometric turbidity unit

3.1.2 Chemical Testing for Contaminants of Concern

Chemical testing is intended to document whether the turbidity exceedance may also be associated with elevated chemical concentrations that exceed Washington State Acute Water Quality Criteria. However, chemical testing will not be used for real-time construction corrective action because there is a long lag time between collecting samples for chemical testing and receiving test results from the laboratory. Turbidity measurements are the primary indicator of the potential for water quality chemical exceedance as described and evaluated in the BODR Appendix K, and it is expected that any field corrective measures will be based on confirmed turbidity exceedances. Thus, a limited series of chemical analyses is proposed under "worst case" conditions to generate the data that is expected to confirm modeling results and past experience (i.e., that chemical water quality criteria are not

exceeded during dredging operations even with observed turbidity exceedances). The "worst case" conditions identified for chemical testing are as follows:

- Condition 1: The first three times in which confirmed turbidity exceedances are observed during dredging.
- Condition 2: The first time considerably higher sediment COC concentrations relative to the other sediment management areas (SMAs) is being dredged (SMA[s] to be identified in consultation with EPA)

The following chemical testing will be conducted only during dredging activities at the compliance stations under the following conditions:

- Chemical testing will be performed if there is a confirmed turbidity exceedance during dredging; other conventional parameter exceedances will not trigger chemical testing. Chemical testing is not applicable when placing clean materials because the placement materials will be required to meet EPA approved low concentration levels in order to be used as clean placement materials.
- Based on predictive modeling described in Appendix K of the BODR that predicts no acute water quality criteria exceedances during dredging, it is anticipated that chemistry testing will confirm that there are no chemical water quality exceedances associated with a confirmed turbidity exceedance. Upon confirming that no chemical water quality exceedances are measured during both Conditions 1 and 2, no further chemistry testing will be conducted in response to further confirmed turbidity exceedances except as noted below.
- In consultation with EPA, chemical testing may be conducted when the Contractor is dredging an SMA with considerably higher sediment COC concentrations relative to the other SMAs (i.e., Condition 2).
- Under Condition 1, when chemical testing is to be conducted, the turbidity exceedance will first be confirmed with field measurement, and then a water quality sample will be collected and sent to a laboratory for chemical analyses. (See Section 3.4 regarding separate QAPP development for chemical testing.)
- Under Condition 2, the decision on when to collect the water quality sample will be made in consultation with EPA but potentially may be collected without a confirmed turbidity exceedance.
- The point of compliance for chemical parameters will be 150 feet from the construction work zone for water quality criteria.
- Acute criteria for protection of aquatic life in marine water was selected as the water quality criteria for chemical analyses. The dissolved or total (as applicable) concentrations of metals and polychlorinated biphenyls (PCBs), from the water sample(s) collected when there is a confirmed turbidity exceedance, will be compared against the acute criteria. Please note that

the acute criteria are time-weighted concentrations and the comparison will address that consideration accordingly

- Chemical testing of the following site COCs will be performed during dredging activities for confirmed turbidity exceedances:
  - Total PCBs (microgram per liter [µg/L])
  - Dissolved metals (see Table F-2) depending on which chemicals exceeded its remedial action level in a remedial action area

Table F-2
Marine Acute Water Quality Criteria

Chemical	Marine Acute (µg/L)	
Arsenic	69	
Cadmium	33	
Chromium VI	1,100	
Copper	4.8	
Lead	140	
Mercury	1.8	
Nickel	74	
PCBs	10	
Silver	1.9	
Zinc	90	

Notes:
Values are from the Washington State Department of Ecology's CLARC database.
µg/L: microgram per liter
N/A: not applicable
PCB: polychlorinated biphenyl

3.2 Monitoring Locations and Depths

During each monitoring event, conventional parameters will be measured at the background station (500 feet upriver of the construction work zone), and at the 150-foot compliance monitoring station at two depths—near surface (approximately 3 feet below the water surface) and near bottom (approximately 3 feet above the mudline; see Figure F-1). The monitoring result that will be compared against the water quality criteria for each compliance monitoring station will be the average of the results from the entire water column (i.e., average of two data points).

- Samples will be collected in minimum water depths of 10 feet at a given monitoring location to minimize disturbance of sediment bed by monitoring vessels.
- Compliance station locations will be based on the distance downriver from the construction work zone. Although the LDW is tidally influenced and does experience some upriver current

in the lower water column, the velocities of upriver currents during flood tides in the lower water column are predicted to be low in the upper reach. Therefore, all compliance stations will be monitored downriver of the construction work zone and during the ebb tide condition.

- Water quality monitoring will not be performed when land-based excavation alone is being conducted. Construction specifications will require the contractor to use temporary erosion and sediment control measures to minimize spillage of excavation materials into the LDW during land-based excavation.

3.3 Monitoring Frequency

Water quality monitoring frequency is divided into two levels for all in-water work—intensive monitoring and routine monitoring—which are discussed in Sections 3.3.1 and 3.3.2 and summarized in Table F-3.

3.3.1 Intensive Monitoring

- Daily monitoring, with measurements being collected up to twice per day during the ebb tide condition at both the compliance monitoring station(s) and the background station(s)
- **Dredging:** Intensive monitoring will be conducted at the start of dredging. If no exceedances of the water quality criteria for conventional parameters are identified during 2 consecutive days, then water quality monitoring activities will switch to routine monitoring (Section 3.3.2).
  - The first daily monitoring round will be conducted at least 1 hour after the startup of daily work activities. The second daily monitoring round should be separated by a minimum of 4 hours from the first monitoring round. Monitoring events should target the ebb tide condition. No monitoring will be performed that cannot be completed by 1 hour before dark and during dark hours due to safety concerns.
  - Background stations will be monitored prior to compliance stations, within 1 hour of the compliance station monitoring.
- Intensive monitoring will be restarted when there is a significant change to the Contractor's remedial activities or changes to equipment, including the following:
  - Contractor changes bucket type (e.g., environmental bucket to open clamshell bucket)
  - Contractor relocates equipment to a new SMA
  - Contractor switches activities (e.g., dredging switches to material placement activities)
- **Clean Material Placement:** Intensive monitoring will be conducted at the start of in-water clean material placement. If no exceedances of the water quality criteria for conventional

parameters are identified over a 2-day period, then water quality monitoring activities will switch to routine monitoring.

3.3.2 Routine Monitoring

- Routine monitoring is performed once intensive monitoring is no longer required.
- Routine monitoring will occur 2 days per week during dredging and clean material placement activities.
- Monitoring measurements will be collected once per day.

Table F-3
Summary of Water Quality Monitoring Plan During Dredging and Clean Material Placement

Component	Intensive Monitoring	Routine Monitoring
Duration	• First 2 days after start of dredging or clean material placement • Intensive restarts when there is a major change in equipment (e.g., dredge bucket type) or the Contractor relocates equipment to a new SMA	• When intensive monitoring not required
Frequency	• Perform a minimum of two sampling events per day.	• Perform one sampling event per day; monitor 2 days per week.
Conventional Parameters and Locations	• Monitor in situ conventional parameters (turbidity, pH, DO, and temperature) per WAC 173-201A-210 taken at 150-foot compliance monitoring station(s) downriver and the background monitoring station(s) located at least 500 feet upriver of the in-water construction work zone. Monitoring stations must be located in at least 10 feet of water depth.	• Monitor in situ conventional parameters (turbidity, pH, DO, and temperature) per WAC 173-201A-210 taken at 150-foot compliance monitoring station(s) downriver and the background monitoring station(s) located at least 500 feet upriver of the in-water construction work zone. Monitoring stations must be located in at least 10 feet of water depth.
Preliminary Exceedance Criteria	• Occurs when the average of the two sample depths (near surface and near bottom) measured results at the compliance monitoring station exceeds any of the conventional parameters	• Occurs when the average of the two sample depths (near surface and near bottom) measured results at the compliance monitoring station exceeds any of the conventional parameters
Confirmed Exceedance Criteria	• Two consecutive measured exceedances (30 minutes apart) at the same compliance monitoring station	• Two consecutive measured exceedances (30 minutes apart) at the same compliance monitoring station
Conventional Water Quality Criteria Exceedance Contingency Action	• After a confirmed exceedance, the Water Quality Monitoring Lead and/or Project Representative will notify the Contractor, and the Contractor will be required to modify its operations to comply with the water quality criteria. EPA will be notified within 2 hours. In situ conventional parameter testing will be conducted every 2 hours for the remainder of the day (during daylight) after additional BMPs or operational modifications have been implemented by the Contractor to demonstrate and document that the Contractor's modifications have returned the site to compliance. • Intensive monitoring resets to another 2-day period of intensive monitoring.	• After a confirmed exceedance, the Water Quality Monitoring Lead and/or Project Representative will notify the Contractor and the Contractor will be required to modify its operations to comply with the water quality criteria. EPA will be notified within 2 hours. In situ conventional parameter testing will be conducted every 2 hours for the remainder of the day (during daylight) after additional BMPs or operational modifications have been implemented by the Contractor to demonstrate and document that the Contractor's modifications have returned the site to compliance. • Start intensive monitoring for a 2-day period the next day.
Chemical Testing (Dredging Only)	• None unless there is a confirmed turbidity exceedance attributed to dredging activities. If there is a confirmed turbidity exceedance, composite water samples will be collected and tested as described below. • A composite water sample made up of the near-surface and near-bottom sampling depths will be collected at the same time as the monitoring to confirm the turbidity exceedance (30 minutes after preliminary turbidity exceedance) at the confirmed exceedance location (150-foot compliance monitoring station). • Chemistry analyses will be conducted for COCs (metals and PCBs) and evaluated as discussed in Section 3.1.2. Results will be compared to acute criteria (150-foot composite sample) using the appropriate average as described in Section 3.1.2. • No further chemical testing is proposed after completion of three rounds of testing events that confirms no exceedance of acute criteria.	
Chemical Criteria Exceedance Contingency Action (Dredging Only)	• If there is an exceedance of the chemistry criteria for COCs (metals and PCBs), EPA will be consulted to determine appropriate contingency actions.	• If there is an exceedance of the chemistry criteria for COCs (metals and PCBs), EPA will be consulted to determine appropriate contingency actions.

Notes:
BMP: best management practice
COC: contaminant of concern
DO: dissolved oxygen
EPA: Environmental Protection Agency
PCB: polychlorinated biphenyl
SMA: sediment management area
WAC: Washington Administrative Code

3.4 Monitoring Methods

Water quality monitoring will be conducted from a boat during daylight hours. Monitoring will be performed using a calibrated multi-probe meter (e.g., Hydrolab, YSI probe, or similar) and/or a calibrated Hach turbidity meter. Turbidity and pH during each monitoring event and respective location will be recorded on a field data sheet.

All locations for water column measurements will be in relationship to the location of the construction activity at the time of sampling (e.g., 150 feet downriver from the construction work zone). Distances from construction activity will be verified using a range finder. Actual differential global positioning system coordinates, times, and depths of all water column sample locations will be recorded.

Monitoring equipment will be calibrated daily and allowed to equilibrate prior to use. Calibration information will be recorded in the field notebooks. Monitoring equipment will be handled according to the manufacturer's recommendations. Unusual or questionable readings will be noted, and duplicate readings will be collected.

Water samples for chemical testing will be collected using a Van Dorn or similar water sampling device deployed to the appropriate depth in the water column. The water sampling device will be decontaminated prior to collection of each sample.

A water quality monitoring QAPP will be prepared by the Implementing Entity during the Final (100%) RD or after receipt of the final CWA §404 ARAR Memorandum and submitted to EPA for review and approval as a pre-construction submittal. The Implementing Entity will be responsible for selecting its construction inspection team, including water quality monitoring team after the upper reach RD has been completed.

4 Reporting

Daily, weekly, and final reporting of water quality monitoring results are required for this project and are described in the following subsections.

4.1 Daily Reporting

Important field observations and measurement data will be recorded in a Water Quality Monitoring Form, including the following:

- Monitoring station location (background or compliance location and approximate river mile)
- Monitoring station coordinates
- Date and time
- Tidal phase (e.g., flood, ebb, and slack)
- Direction of monitoring, (i.e., downriver from the construction activity during ebb tide condition)
- Water depth on station
- Depth in the water column of each field parameter measurement (near-surface and near-bottom depths)
- Weather and current conditions

Completed forms will be scanned at the end of each field day and emailed to EPA.

4.2 Weekly Reporting

The results from each week's water quality monitoring activities will be compiled into a summary table with a comparison to water quality compliance criteria and provided to EPA. All reporting will include both regularly scheduled monitoring and any additional monitoring results that may have been triggered by exceedances of water quality criteria.

4.3 Final Water Quality Monitoring Report

After all construction has been completed, the water quality monitoring data for the entire construction project will be provided to EPA in a Water Quality Monitoring Report:

- Any deviations from the WQMP and associated approved WQMP QAPP and reasons for the deviations
- Tabular summaries of all water quality monitoring data with comparisons to water quality compliance criteria
- Narrative text describing the results of water quality monitoring related to dredging versus clean material placement

- Narrative discussion of any water quality exceedances, probable cause of the exceedance(s), results of follow-up measurements, agency communications and decisions, and actions taken to mitigate the exceedance(s), including implementation of additional or enhanced BMPs
- Lessons learned regarding BMP implementability and effectiveness
- An appendix containing all completed Water Quality Monitoring Forms
- Documentation of instrument calibration will be provided on request
- An appendix containing results from any chemistry testing conducted

5 Contingency Actions

The primary purpose of water quality monitoring during construction is to determine when unacceptable water quality effects may be occurring so that the Contractor can modify their operations or implement additional operational or engineering controls to mitigate the exceedance. If water quality measurements exceed compliance criteria at the compliance boundary, timely notifications will be made to the Contractor and EPA Remedial Project Manager.

The following conditions will require an immediate stop-work response:

- Evidence of a significant oil sheen
- Evidence of distressed or dying fish

In the event of a confirmed water quality exceedance, the Contractor will be directed to modify their operations or to implement additional BMPs and Intensive monitoring will be continued. Additional contingency actions may be required in the event of confirmed water quality exceedances at the compliance boundary and are described in this section consistent with Table F-3. If the water quality exceedance continues to persist, even with additional BMPs and/or operational modifications, the Water Quality Monitoring Lead will discuss next steps with EPA. The path forward could include some or all of the following:

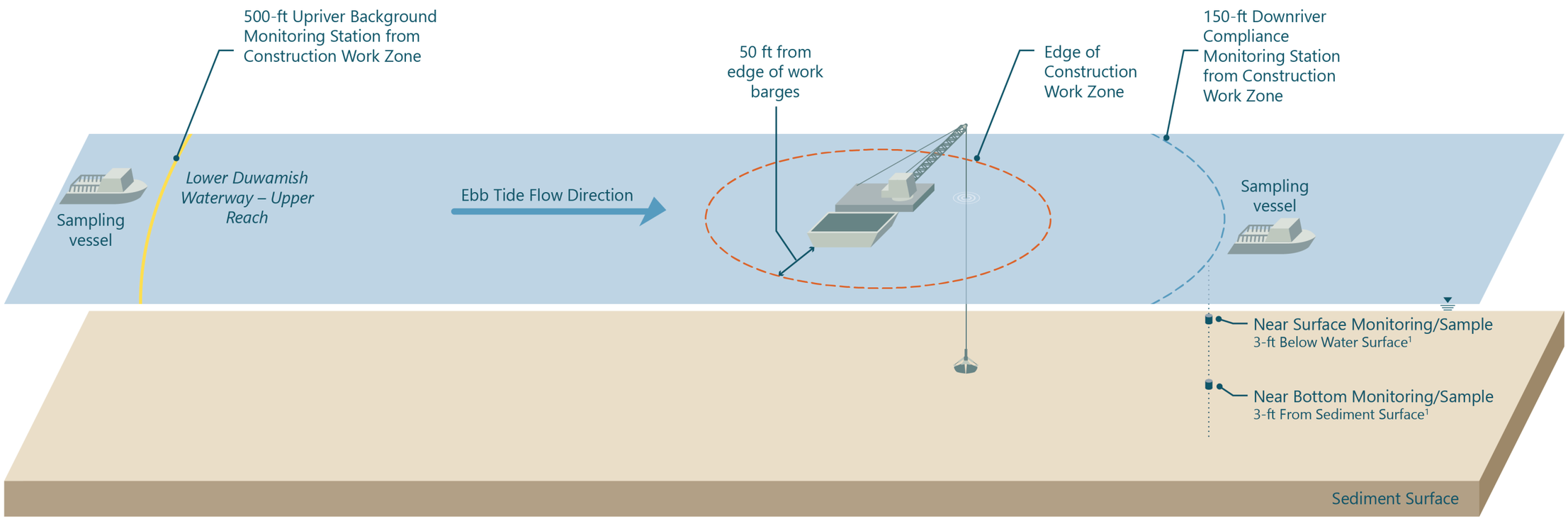
- Implement more aggressive BMPs or operational modifications.
- Increase the compliance boundary distance for turbidity if the chemistry sample testing indicates there are no exceedances of chemical water quality criteria.
- If these options are not successful at controlling the water quality exceedance, it may be necessary to temporarily stop work to further assess the source of the exceedance, identify effective mitigation measures, and allow the water column to recover.

6 References

EPA (U.S. Environmental Protection Agency), 2014. *Record of Decision*. Lower Duwamish Waterway Superfund Site. United States Environmental Protection Agency Region 10. November 2014.

EPA, 2021. *Explanation of Significant Differences.* Lower Duwamish Waterway Superfund Site. September 2021.

Figure



Not to scale

Notes:
[1]Water depths greater than 10 feet.

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ANCHOR QEA

Figure F-1
Water Quality Monitoring Locations and Depths
60% Remedial Design Basis of Design Report
LDW Upper Reach

Attachment F-2
Construction Quality Assurance Plan Outline

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