Lower Duwamish Waterway Group

City of Seattle / King County / The Boeing Company

CONSTRUCTION QUALITY ASSURANCE PLAN FOR THE LOWER DUWAMISH WATERWAY UPPER REACH

CONSTRUCTION PHASE, REVISION 1

For submittal to

The US Environmental Protection Agency
Region 10
Seattle, WA

October 22, 2024

Prepared by:

Geosyntec consultants
520 Pike Street • Suite 2600
Seattle, Washington • 98101

and

Windward environmental LLC
200 1st Ave W • Suite 500
Seattle, Washington • 98119

in association
with

ANCHOR QEA
1201 3rd Ave • Suite 2600
Seattle, Washington • 98101

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ABBREVIATIONS

µg	microgram
ANL	air, noise, and light
ANLMP	Air, Noise, and Light Monitoring Plan
ARAR	applicable or relevant and appropriate requirement
BMP	best management practice
CCPM	Construction Contract Project Manager
CM	Construction Management
COCP	Community Outreach and Communications Plan
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CQAO	Construction Quality Assurance Officer
CQAP	Construction Quality Assurance Plan
DCR	Daily Construction Report
DFAR	Daily Field Activity Report
DU	Decision Unit
Dw	dry weight
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
EQAO-1	Environmental Quality Assurance Officer for Sampling
EQAO-2	Environmental Quality Assurance Officer for Monitoring
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD	heptachlorodibenzo-*p*-dioxin
HASP	Health and Safety Plan
HxCDD	hexachlorodibenzo-*p*-dioxin
HxCDF	hexachlorodibenzofuran
IQAT	Independent Quality Assurance Team
Kg	kilogram
LDW	Lower Duwamish Waterway
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
Mg	milligram
MIDP	Monitoring and Inadvertent Discovery Plan
NELAP	National Environmental Laboratory Accreditation Program
Ng	nanogram
OCDD	octachlorodibenzodioxin
OCDF	octachlorodibenzofuran
PCB	polychlorinated biphenyl

P.E.	Professional Engineer
PeCDD	pentachlorodibenzo-*p*-dioxin
PeCDF	pentachlorodibenzofuran
PM	Project Manager
PPS	Phased Program Support and Construction Management
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAL	remedial action level
RAWP	Remedial Action Work Plan
RD	remedial design
RDWP	Remedial Design Work Plan
RM	river mile
RMC	residuals management cover
ROD	Record of Decision
RPM	Remedial Project Manager
SMA	Sediment Management Area
SSHO	Site Safety and Health Officer
TCDD	tetrachlorodibenzodioxin
TCDF	tetrachlorodibenzofuran
TEQ	toxic equivalent
WCR	Weekly Construction Report
WFAR	Weekly Field Activity Report
WQMP	Water Quality Monitoring Plan
UCT-KED	universal cell technology-kinetic energy discrimination

1 Introduction

This document presents the Construction Quality Assurance Plan (CQAP) Construction Phase for the Lower Duwamish Waterway (LDW) upper reach. This CQAP has been prepared on behalf of the Lower Duwamish Waterway Group (LDWG) and describes how the Owner (defined in this section and described in Section 2.3) will provide quality assurance (QA) inspection and monitoring during remedial construction activities. The purpose of this work will be to confirm that the selected Remedial Action Contractor (Contractor) is complying with the conditions and requirements of the design documents approved by U.S. Environmental Protection Agency (EPA) for the implementation of remedial action in the upper reach of the LDW Superfund site in King County, Washington. The upper reach encompasses river mile (RM) 3.0 to RM 5.0 of the LDW.

The CQAP was prepared initially as part of the 100% Remedial Design (Anchor QEA and Windward 2024) consistent with EPA-approved *Remedial Design Work Plan for the Lower Duwamish Waterway Upper Reach* (hereinafter referred to as the Remedial Design Work Plan [RDWP]) (Anchor QEA and Windward 2019) and EPA's November 2014 Record of Decision (ROD) (EPA 2014), as modified by the Explanation of Significant Differences (EPA 2021). This CQAP edition is an update to the 100% Remedial Design (RD) version incorporating components that were previously identified to-be-determined preceding initiation of the Construction Phase of the work. This updated CQAP is based on the CQAP that was approved by EPA as Volume II – Part I of the 100% Remedial Design.

The Lower Duwamish Waterway Group (LDWG), consisting of the City of Seattle, King County (Owner for upper reach construction), and The Boeing Company, will be implementing the selected remedy per a Consent Decree (CD) and/or Federal Order(s) under EPA oversight. In 2024, Seattle Public Utilities (SPU), on behalf of LDWG, selected Geosyntec Consultants, Inc., (Geosyntec) for the Phased Program Support and Construction Management for LDW Sediment Cleanup for all three reaches (upper, middle, lower). In 2024, King County (KC), on behalf of LDWG, awarded Pacific Pile & Marine (PPM, the Contractor) the construction contract for the upper reach remedial action. In performance of the upper reach remediation, King County serves as the Project Representative, which is the sole role that provides direction to the Contractor. Geosyntec supports the Project Representative through the Construction Manager role as well as providing the Independent Quality Assurance Team (IQAT), which provides construction quality assurance (inspection) and environmental quality assurance (sediment and water sampling for laboratory analyses, water quality monitoring, archaeological monitoring, and air/noise/light monitoring), hereafter generally described as "construction phase services." The in-water remedial construction work is seasonally limited to occur between the five months of October through February with preparations and reporting occurring during the remaining seven months.

The Contractor is responsible for providing quality control (QC) of its work to ensure compliance with contract drawings and specifications and applicable or relevant and appropriate requirements

(ARARs). The Contractor's QC requirements are defined in the specifications, and the Contractor has developed a QC plan as part of its Remedial Action Work Plan (RAWP) pre-construction submittal. (Pacific Pile & Marine 2024, in progress)

QA activities will be conducted by the IQAT, who will inspect and document the Contractor's progress and compliance with contract documents. In addition, EPA will provide oversight of field activities to ensure the selected remedy is implemented in general accordance with design objectives. EPA is the regulatory authority and agency responsible for overseeing and authorizing the selected remedy. EPA approved the final (100%) RD and is responsible for reviewing and accepting Contractor pre-construction submittals as identified in the specifications, including the RAWP, to ensure that the Contractor's proposed construction approach complies with design objectives.

This CQAP details the verification methods and approaches that will be used to provide QA review of the Contractor's activities during implementation of construction activities in the project area, including compliance with ARARs. This document describes the QA methods that will be used to measure compliance with performance and method requirements and specifies the types of environmental monitoring that will be performed and how modifications to the construction procedures will be directed, if necessary, in response to monitoring data. A summary of required inspections, surveys, monitoring actions, verification samples, reporting mechanisms, and documentation is included. This CQAP delineates the QA protocols necessary for project personnel to understand construction QC issues, monitoring and feedback processes, and potential corrective actions.

1.1 Activities Addressed by the CQAP and Schedule

This CQAP addresses QA of the following construction inspection and environmental monitoring activities/elements within the LDW upper reach:

- Construction implementation inspection and engineering support (i.e., compliance with drawings and specifications), including:
  - Demolition and removal of piles and debris and transportation and disposal of these items
  - Dredging and excavation
  - In-water transport, transload, upland transport, and off-site disposal of dredged/excavated materials
- Material placement, including post-dredge backfilling, residuals management cover (RMC) placement, enhanced natural recovery (ENR) placement, amended cover (area-specific technology) placement, and engineered capping
  - Modification of existing structures, including wall reinforcing and strengthening

  - Reinstallation of removed pilings that are used for Tribal fishing
- Environmental controls and monitoring (compliance with environmental protection requirements, including water quality monitoring)
- Remedy performance (compliance with ROD remedial action requirements immediately following construction)
- Establishment and maintenance of project limits and survey controls

In-water remedial construction activities will occur during in-water work windows designated for the LDW (to be determined by EPA but anticipated to be from approximately October 1 through February 15 or an approved extension). The in-water work window will be set to protect threatened and endangered species listed under the Endangered Species Act. Construction activities will be coordinated with the Muckleshoot Indian Tribe to reduce impacts on Tribal fishers.

Remedial construction for the upper reach is anticipated to require three construction seasons, based on the Final (100%) RD production rates for dredging and material placement. The anticipated sequence of work elements, production rates, and construction schedule are discussed in the Contractor's schedule provided in the RAWP. The Contractor will maintain and update the schedule throughout construction.

1.2 Document Organization

The remaining sections of this document summarize the elements of the CQAP that will be implemented to inspect, monitor, and oversee the Contractor's construction activities, as well as how modifications to construction procedures will be directed, if necessary, in response to monitoring results. These CQAP elements will be used to verify that Contractor QC practices are implemented and that appropriate documentation is prepared for the remedial action. The remaining sections are as follows:

- **Section 2** presents the roles and responsibilities of the QA personnel involved in remedial action implementation.
- **Section 3** describes the construction management activities—including meetings, inspections, and reporting activities—and environmental monitoring requirements and activities that will be performed during remedial action implementation; this section also describes general contract administration activities supported by key QA personnel.
- **Section 4** describes contract administration activities.
- **Section 5** describes the process for contingency actions, correction actions, and notifications.
- **Section 6** provides a list of references used in this CQAP.

The appendices to this CQAP are as follows:

- **Appendix A**: Water Quality Monitoring Plan (WQMP)
- **Appendix B**: Construction Sediment Sampling Quality Assurance Project Plan (Sediment QAPP)
- **Appendix C**: Air, Noise, and Light Monitoring Plan (ANLMP)
- **Appendix D**: Monitoring and Inadvertent Discovery Plan (MIDP)
- **Appendix E**: IQAT Health and Safety Plan (HASP)

Details on water quality monitoring during construction are provided in the WQMP (Appendix A). The Sediment QAPP (Appendix B) details sediment sampling and data-gathering methods to be used post-dredging/excavation to verify that post-dredge surface concentrations meet ROD post-dredge surface concentration requirements; the Sediment QAPP also provides the QA and QC protocols necessary to achieve the required data quality objectives. The ANLMP (Appendix C) describes environmental requirements and the monitoring approach for air, noise, and light (ANL) conditions that may occur during implementation of construction activities. The MIDP (Appendix D) describes required monitoring and inadvertent discovery protocols for cultural resource considerations during construction.

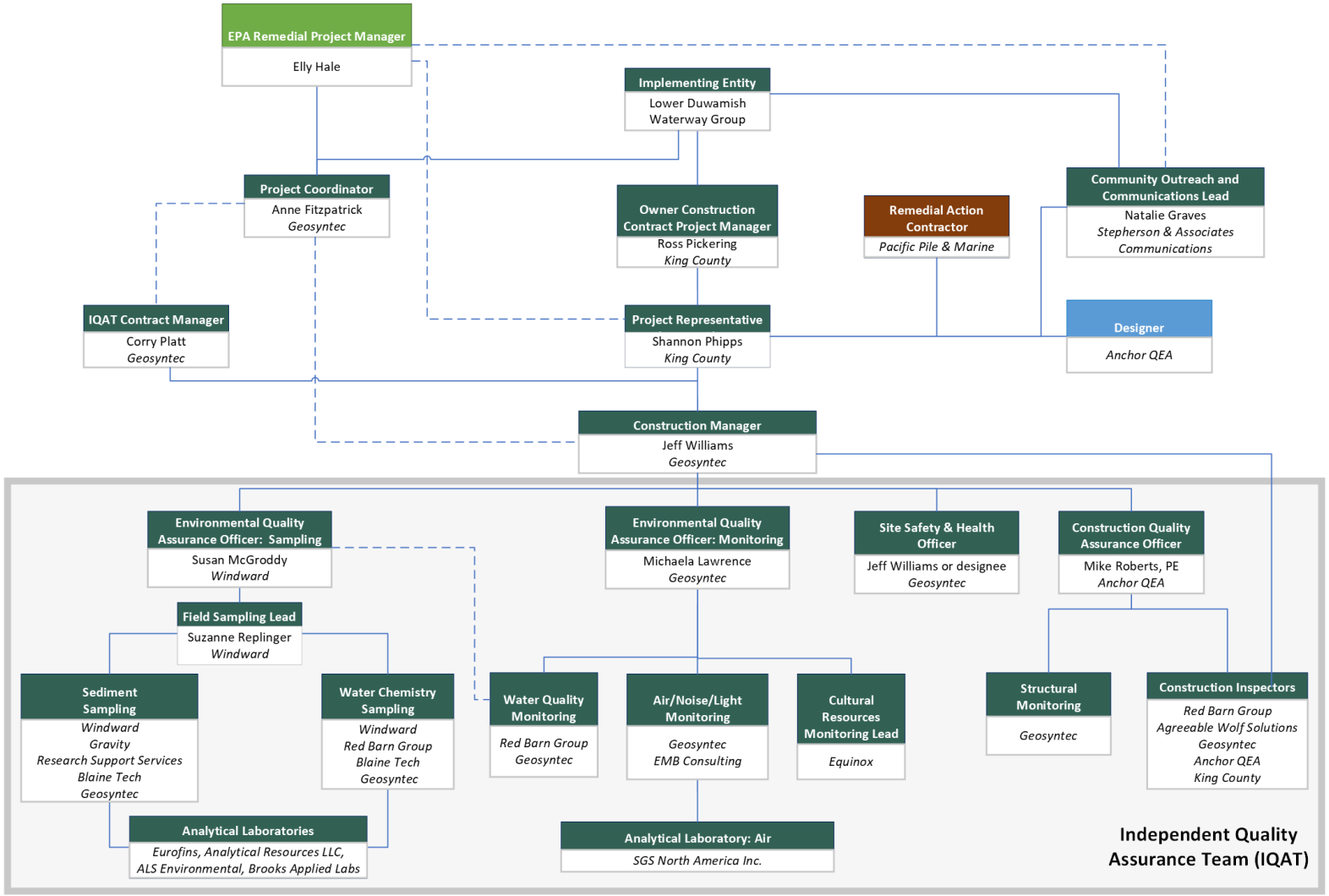
The IQAT HASP (Appendix E) addresses the protection of IQAT worker health and safety during performance of QA inspection and monitoring work. The IQAT HASP was prepared by the IQAT's Site Safety and Health Officer (SSHO) in general accordance with Geosyntec policies and procedures.

The EPA Remedial Project Manager is responsible for overall site health and safety per National Contingencies Plan 300.150. The Contractor is responsible for Work Site health and safety per Occupational Health and Safety Administration Section 5. The Contractor's construction HASP, describing the Contractor's approach to construction worker, community, and IQAT health and safety within the Work Site, is part of the RAWP. The Contractor's HASP will be the primary HASP with which anyone performing activities in the Work Site must comply. Therefore, the IQAT, Owner's representatives, EPA representatives, and any other personnel entering the Work Site will be required to comply with the Contractor's HASP as well as their own, as appropriate to the activity. EPA employees will follow an EPA site-specific HASP, which will meet or exceed requirements in the Contractor's HASP for a site visitor or observer overseeing the work.

2 Project Organization and Responsibilities

This section provides an overview and description of the organizational structure and key roles for the implementation of this CQAP (Figure 2-1). The Contractor's organization is described in its RAWP and takes direction from the Project Representative. The Community Outreach and Communications Plan Lead works collaboratively with the Project Representative and Project Coordinator.

Figure 2-1 Project Organizational Chart



Note: The EPA RPM is responsible for overall site health and safety per NCP 300.150. The Contractor's Site HSO is responsible for Work Site health and safety per OSHA Section 5. The IQAT's Health and Safety Officer coordinates with the Contractor's SSHO to require IQAT to comply with the Contractor's HSP and the IQAT's HSP.

2.1 EPA

EPA is the regulatory authority and agency responsible for overseeing the implementation of remedial actions and authorizing CQAP activities. In this capacity, EPA reviews and approves the RD documents, as well as the Contractor's RAWP and associated Contractor pre-construction submittals, to ensure that the Contractor's QC program is consistent with the remedial objectives.

EPA's Remedial Project Manager (RPM), Elly Hale, will be responsible for overseeing the remedial action to ensure that the remedy is protective of human health and the environment, and to ensure that the remedial action is implemented in accordance with the ROD. EPA's RPM will oversee EPA's remedial action oversight team and provide key personnel contact information to the Project Representative. EPA's alternate RPM will be Nasrin Erdelyi. EPA's Water Quality Specialist for this project is Whitney Conard.

2.2 Implementing Entity (LDWG)

The Lower Duwamish Waterway Group (LDWG), consisting of the City of Seattle, King County, and The Boeing Company, will implement the remedial design, remedial action, and operation and maintenance of the remedial actions that EPA has selected for the Site.

2.3 Owner (King County)

On behalf of the Implementing Entity (LDWG), the Owner (King County) is responsible for procuring and contracting with the Remedial Action Contractor (PPM; see Section 2.5) and overseeing execution of the remedial action implementation (i.e., construction) phase of the project. The Owner will also coordinate directly with the Designer (Anchor QEA, LLC; see Section 2.6), as necessary, during remedial action implementation to verify that the Contractor's RAWP approach and construction activities meet the intent of the design. The Owner is authorized to make decisions during construction on behalf of the Implementing Entity. The Owner will also implement and oversee remedial construction QA activities, as described in this CQAP.

The Owner has designated parties to fill these additional roles:

- Construction Contract Project Manager (CCPM) (see Section 2.3.1) to manage contract administration
- Project Coordinator (see Section 2.3.2) to serve as primary point of contact for EPA
- Community Outreach and Communications Plan Lead (see Section 2.3.3) to implement the Community Outreach and Communications Plan (COCP)

- Project Representative (see Section 2.3.4) to be the day-to-day representative during construction, assist the Owner's CCPM with technical review and decision making, and oversee and manage the IQAT (see Section 2.4).

- Construction Management (CM) Contract Manager (see Section 2.3.5) serves as the project manager for Geosyntec with responsibilities for fulfillment of its duties supporting the Project Representative providing the Construction Manager and the IQAT (see Section 2.4) as well as the fulfillment of the duties of the Project Coordinator.

2.3.1 Owner's Construction Contract Project Manager (Ross Pickering, King County)

The Owner's CCPM will be responsible for internal coordination of construction contract administration. The Owner's CCPM will manage all scheduling and coordination of resources as needed to ensure successful procurement of the Contractor and execution of the contract. Through the Project Representative (Section 2.3.4), the Owner's CCPM will ultimately be responsible for supervising the work. Responsibilities will include but not be limited to:

- Coordinating with the Implementing Entity and Project Coordinator
- Planning regular internal team meetings during construction implementation to track progress and identify schedule or resource issues
- Coordinating timely execution and administration of the construction contract
- Managing review and approvals of Contractor progress payment requests
- Managing Contractor claims and change orders
- Overseeing the Project Representative throughout construction

2.3.2 Owner's Project Coordinator (Anne Fitzpatrick, Geosyntec)

The Project Coordinator for upper reach remedial construction will serve as the primary point of contact for EPA to communicate and coordinate different elements of the remedial action activities under EPA oversight. The Project Coordinator will help coordinate and manage the many overlapping project components during remedial construction. In this overall capacity, the Project Coordinator will track progress and coordinate efforts among all major tasks associated with implementation of the remedy and oversee various program support services for the Implementing Entity.

Specific to the upper reach remedial construction, the Project Coordinator will work with the Project Representative (see Section 2.3.4) and IQAT to track and communicate progress, and will coordinate to provide specific services, including:

- Acting as a central coordinator for interface among the Project Representative, Implementing Entity technical staff, Community Outreach and Communications Plan lead, and EPA for all construction related work.

2.3.3 Owner's Community Outreach and Communications Plan Lead (Natalie Graves, Stepherson & Associates)

The Owner will either lead or use consultant support (Stepherson & Associates) to implement the COCP. The COCP Lead will coordinate directly with the Project Representative and Construction Manager to communicate community input and complaints to the Project Coordinator, EPA, and IQAT.

2.3.4 Owner's Project Representative (Shannon Phipps, King County)

The Project Representative will be the Owner's day-to-day representative during construction and will assist the Owner's CCPM with technical review and decision making on behalf of the Owner when construction issues (e.g., QC, construction delays, monitoring exceedances) arise. The IQAT (see Section 2.4) will report to the Project Representative. The responsibilities and authorities of the Project Representative will include, but not be limited to:

- Oversight of the Contractor and management of the IQAT
- Implementation of the CQAP
- Overseeing review and final approval of construction submittals
- Schedule and project progress tracking
- Attending all construction meetings with the Contractor and key members of the IQAT
- Directing Contractor work stoppage due to Contractor noncompliance or if directed by EPA
- Reviewing and approving Contractor progress payments in conjunction with the CCPM
- Approving—in conjunction with the CCPM and in consultation with EPA—any deviations from the requirements in the project drawings and specifications, and initiating change orders to the contract as appropriate
- Providing certification, based on Designer and IQAT review, that the remedial action has been completed in general accordance with the intent of the contract documents
- Functioning as the liaison with representatives of the Owner, EPA (and other agencies when applicable), Contractor, and others
- Coordinating with the Designer to verify design requirements or modifications during implementation of construction activities
- Coordinating with the Owner's COCP Lead to respond to community complaints and concerns
- Providing proposed responses and corrective actions (if needed) to address community complaints and concerns during construction

- Coordinating on contract administration requirements with the CCPM
- Working with the Project Coordinator to provide construction progress and inspection and monitoring reports

The Project Representative will be the only person authorized by the Owner to provide direction to the Contractor. The Project Representative has delegated responsibilities to the Construction Manager (Section 2.4.1) to provide many of the duties described above with exception of providing direction to the Contractor. The Contractor will regularly interact, communicate, and have a formal reporting relationship with the Project Representative.

2.3.5 IQAT Contract Manager (Corry Platt, Geosyntec)

The IQAT Contract Manager serves as the project manager for Geosyntec with responsibilities for fulfillment of its duties supporting the Owner and Project Representative including providing support to the Construction Manager (see Section 2.4.1), the IQAT (see Section 2.4) and the Project Coordinator (Section 2.3.2). This person will manage the coordination of resources as needed to ensure successful execution of the contract. Through the Construction Manager, the Contract Manager will ultimately be responsible for supervising the work of the construction management and IQAT team leads (Section 2.4). Additional responsibilities include coordinating other program support functions such as real property services, IQAT staffing, project scheduling, and construction progress reporting.

2.4 Independent Quality Assurance Team

The Implementing Entity has procured Geosyntec to serve as a Construction Management (CM) Consultant to provide staffing and other resources to the IQAT for construction inspection and monitoring during implementation of this CQAP. The IQAT will be responsible for fully understanding the bid documents (i.e., drawings and specifications) and implementing all Owner QA activities associated with remedial construction.

Specific IQAT roles include the Construction Manager (see Section 2.4.1), IQAT SSHO (see Section 2.4.2), the Environmental Quality Assurance Officers (EQAOs) (see Section 2.4.3), the Construction Quality Assurance Officer (CQAO) (see Section 2.4.5), environmental monitoring leads, and construction inspectors, as described in the following sections. Individuals may fill more than one key role within the IQAT. All on-site personnel will have current health and safety training required by the Washington State Department of Labor and Industries (Chapter 296-2 Washington Administrative Code, Subpart P, HAZWOPER), including on-site training.

2.4.1 Construction Manager (Jeff Williams, Geosyntec)

The Construction Manager will be the on-site day-to-day manager during construction and will support the Project Representative with technical review and consultation when construction issues

(e.g., QA, construction delays, monitoring exceedances) arise. The Construction Manager will have delegated authority from the Project Representative to oversee the on-site construction activities following instructions from the Project Representative. IQAT members will report to the Construction Manager. The responsibilities and authorities of the Construction Manager will include, but not be limited to:

- Oversight of the Contractor and management of all members of the IQAT
- Day-to-day implementation of the CQAP
- Reviewing construction submittals in support of Project Representative
- Coordinating with PPM who manages the project schedule and project progress
- Attending construction meetings with the Contractor and Project Representative
- Directing Contractor work stoppage due to emergency or safety issues and providing recommendations to the Project Representative on work stoppage due to Contractor noncompliance or if directed by EPA
- Coordinating with the Project Representative and the Designer to verify design requirements or modifications during implementation of construction activities
- Coordinating with the Project Representative and Owner's COCP Lead to respond to community complaints and concerns
- Overseeing implementation of corrective actions (if needed) to address community complaints and concerns during construction
- Working with the Project Representative to provide construction progress and inspection and monitoring reports
- Implementing and ensuring effective execution of all construction QA monitoring and inspection activities
- Conducting meetings with site personnel covering QA requirements of the contract documents, Contractor's RAWP and QC procedures, and the CQAP
- Reviewing QA construction inspection and monitoring results summaries provided by the EQAOs and CQAO leads.
- Identifying and providing recommendations to the Project Representative to resolve nonconformances in general accordance with the requirements of the contract documents, Contractor's RAWP
- Reviewing and providing recommendations to the Project Representative regarding required remedial action progress, including required dredging, contingency re-dredging, material placement, and cap placement
- Providing recommendations to the Project Representative regarding the need for corrective actions in the event of nonconformance with the contract documents, Contractor's RAWP and prescribed procedures

The Construction Manager (or a delegated backup in case of necessary absence) will be present during implementation of all critical remedial action activities, including but not limited to:

- Dredging and excavation
- Material placement
- Demolition and structures modifications
- Inspections of placement materials for acceptance
- Interpretation of pre- or post-dredge bathymetric surveys and post-material placement surveys

2.4.2 Site Safety and Health Officer (Jeff Williams, Geosyntec)

As previously noted, the Contractor is responsible for Work Site health and safety for anyone entering into the Work Site (e.g., Contractor staff, IQAT, Owner and EPA representatives, community). All personnel on site must follow the Contractor's HASP as well as their own, as appropriate to the activity. The IQAT SSHO will manage and oversee all health and safety related requirements and procedures associated with the IQAT HASP, as well as IQAT compliance with the Contractor's HASP. The SSHO will coordinate closely with the Contractor's SSHO, who will be responsible for overall Work Site health and safety.

The SSHO (or delegate) will review the Contractor's HASP and inspect construction activities to assess Contractor compliance with that document. The SSHO will also be responsible for ensuring that QA monitoring and inspection activities are performed in compliance with both the Contractor's HASP and the IQAT HASP.

2.4.3 Environmental Quality Assurance Officers (Susan McGroddy, Windward and Michaela Lawrence, Geosyntec)

The project has two EQAOs. The EQAO for sampling (EQAO-1 Windward) is responsible for overseeing the Field Sampling Lead (Section 2.4.4) and the collection of sediment and surface water chemistry samples. The EQAO for monitoring (EQAO-2 Geosyntec) is responsible for overseeing the field monitoring activities (turbidity, air/noise/light and cultural resources). The EQAOs will report to the Construction Manager and advise and support the Construction Manager on technical issues related to environmental QA monitoring efforts.

Responsibilities of the EQAOs will include but not be limited to:

- Overseeing and ensuring effective execution of sediment and water chemistry sampling and analysis activities (EQAO-1) as well as support the Construction Manager's execution of the water quality monitoring, air/noise/light monitoring, and cultural resources monitoring (EQAO-2)

- Attend IQAT meetings where the environmental monitoring QA requirements of the contract documents, Contractor's RAWP and QC procedures, and this CQAP are discussed (EQAO-1 and -2).
- Reviewing environmental QA monitoring results of the Contractor's construction activities, as well as those of its subcontractors, to ensure compliance with contract documents and ARARs (EQAO-1 and EQAO-2).
- Coordinating directly with the analytical laboratory for air sampling (EQAO-2) and working directly with the Certified Industrial Hygienist to review results.
- Review confirmed turbidity results (EQAO-2) and discuss if corrective BMPs are needed with Construction Manager (BMPs) or collection of water chemistry with EQAO-1.
- If a confirmed water quality or ANL exceedance is observed, (EQAO-1 or EQAO-2) working with the Construction Manager and/or Project Representative to coordinate with EPA to determine an appropriate path forward if a response action is warranted

2.4.4 Field Sampling Lead (Suzanne Replinger, Windward)

The Field Sampling Lead is responsible for overseeing the water chemistry and sediment sampling and analyses efforts for the QA program and will manage the Water Chemistry Sampling Team (see Section 2.4.4.1) and the Sediment Sampling Team (see Section 2.4.4.2).

The Field Sampling Lead is responsible for:

- Overseeing coordination of the field sediment and surface water chemistry sampling and laboratory programs and supervising data review
- Reviewing field reports to verify that appropriate field methods and QC procedures are being implemented for sediment sampling and water chemistry sampling in general accordance with the procedures specified in this CQAP
- Coordinating directly with the analytical laboratory(ies) (see Section 2.4.4.3) for the analysis and reporting of environmental data associated with the completion of water chemistry and sediment sampling.

2.4.4.1 Water Quality Chemistry Sampling Team

The Water Quality Chemistry Sampling Team is responsible for implementation of the WQMP (see Appendix A components that pertain to samples collected for chemical analyses), as described in Section 3.7.2, and for coordination with the analytical laboratory(ies). The Water Quality Chemistry Sampling Team will report to the Field Sampling Lead.

2.4.4.2 Sediment Sampling Team

The Sediment Sampling Team is responsible for implementation of the Sediment QAPP (see Appendix B), as described in Section 3.7.2, and for coordination with the analytical laboratory(ies). The Sediment Sampling Team will report to the Field Sampling Lead.

2.4.4.3 Analytical Laboratories for Sediment and Water Analysis

Analytical services for water chemistry and sediment samples will be provided by laboratories with National Environmental Laboratory Accreditation Program (NELAP) accreditation and current environmental laboratory accreditation from the Washington State Department of Ecology, as described in both the WQMP (Appendix A) and Sediment QAPP (Appendix B). These plans identify primary labs and back-up labs.

2.4.5 Monitoring and Inspection

The Water Quality Monitoring team, ANL Monitoring team, Cultural Resources Monitoring team will report to EQAO-2.

2.4.5.1 Water Quality Monitoring Team

The Water Quality Monitoring team is responsible for implementation of the water quality monitoring (conventional parameters) described in the WQMP (see Appendix A). This team is comprised primarily of Geosyntec and its subconsultant Red Barn Group who will be largely performing the conventional water quality turbidity and other conventional parameter monitoring. Daily results will be reported to the EQAO-2. If turbidity exceedances are confirmed, then results will be immediately reported to EQAO-1, EQAO-2, and the Construction Manager.

2.4.5.2 Air, Noise, and Light Monitoring Team

The ANL Monitoring Team is responsible for implementation of the ANLMP (see Appendix C). This team is comprised primarily of Geosyntec and its subconsultant EMB Consulting who is a Certified Industrial Hygienist. The Certified Industrial Hygienist will be reviewing work plans, air monitoring results, and reporting. Geosyntec is responsible for sampling and monitoring coincidental to the construction inspection along with coordinating directly with the analytical laboratory for the analysis and reporting. Air samples for diesel particulate matter analysis will be performed by SGS, a NELAP-accredited laboratory.

2.4.5.3 Cultural Resources Monitoring Team

The Cultural Resources Monitoring team is responsible for implementation of cultural monitoring during construction in accordance with the MIDP (see Appendix D). This team is staffed by Equinox Research and Consulting International's archaeologists and historians. Equinox will also be

providing cultural resource awareness training to the environmental samplers and construction inspectors.

2.4.6 Construction Quality Assurance Officer (Mike Roberts, Anchor QEA)

The CQAO will be responsible for performing quality assurance reviews on the construction quality assurance elements of the IQAT and support the Construction Manager. The Structural Monitoring Inspections team and Construction Inspectors will report to the Construction Quality Assurance Officer and inform the Construction Manager. The CQAO will report to the Construction Manager and advise the Construction Manager on technical issues observed during field visits, during IQAT meetings and during document reviews, related to construction inspection and construction monitoring.

Responsibilities of the CQAO will include but not be limited to:

- Overseeing construction inspectors in conjunction with Construction Manager
- Coordinating required special investigations or material inspection activities
- Identifying and resolving nonconformances in general accordance with the requirements of the contract documents, Contractor's RAWP and QC procedures, and the CQAP
- Providing recommendations to the Construction Manager regarding remedial action progress, including required dredging, contingency re-dredging, material placement, and cap placement
- Reviewing QA construction inspection results of the Contractor's construction activities, as well as those of its subcontractors, to ensure compliance with contract documents and project permits
- Providing recommendations to the Construction Manager regarding the need for corrective actions in the event of nonconformance with the contract documents, Contractor's RAWP and prescribed procedures

2.4.6.1 Structural Monitoring Inspectors

The Structural Monitoring Inspectors will be responsible for oversight and implementation of structures monitoring during construction activities, in general accordance with the structures monitoring requirements in the contract documents.

2.4.6.2 Construction Inspectors

The Construction Inspectors will be responsible for implementing all construction inspection activities, in general accordance with the construction inspection requirements described in Section 3. This team will be led by Geosyntec and staffed by credentialed inspectors from Red Barn Group, Agreeable Wolf Solutions, King County, and Anchor QEA.

2.5 Remedial Action Contractor (Pacific Pile and Marine)

The Contractor will implement remedial construction activities in general accordance with the contract documents (drawings and specifications) and Contractor's RAWP, as approved by the Owner and EPA. The Contractor will provide a team to implement the work, provide QC, and manage Work Site health and safety. The team will include, but not be limited to, the following positions: Contractor PM, Quality Control Officer, Contractor SSHO, and Superintendent. The RAWP includes the Contractor's organization chart, QC plan, and HASP. The Contractor will coordinate directly with the Project Representative and Construction Manager throughout all phases of construction implementation and will be responsible for managing all construction subcontractors retained to support completion of the construction activities.

2.6 Designer

Anchor QEA is the upper reach remedy Designer and has overseen the development of the contract documents (drawings and specifications) and cost estimate. The Engineer of Record is employed by Anchor QEA, is a Washington State Professional Engineer (P.E.), and is responsible for the remedial design. The term "Engineer of Record" generally does not appear in the drawings and specifications, except where the role of the Engineer of Record relates to consultation during the construction phase to support construction QA and design changes, if needed.

The construction activities will be supported by the Design Team PM (Tom Wang, P.E.) and the Engineer of Record (John Laplante, P.E.). They will be available to the Owner's CCPM and Project Representative to provide input on the intent of the drawings and specifications and support changes to the design, as necessary. The Engineer of Record will be responsible for reviewing all Contractor pre-construction submittals to ensure their compliance with the contract bid documents.

3 Construction Management Activities

This section describes general construction management activities to support the engineering design elements. This section focuses on providing QA inspection and documentation guidelines for the Contractor's construction work to verify the work complies with engineering design requirements in the drawings and specifications.

The following subsections describe required project meetings, submittal reviews, construction field inspections and monitoring, environmental monitoring, reporting requirements, and safety considerations. Table 3-1 provides a summary of QA construction inspections and environmental monitoring for each remedial activity; note that the Contractor will also be responsible for its own QC inspection activities as defined in its RAWP.

Table 3-1
Summary of QA Inspection and Monitoring Requirements by Construction Activity

Construction Activity	Required Construction Inspection and Monitoring Activities[1]	Required Environmental Monitoring Activities
Dredging and Excavation	• Provide daily inspection • Review Contractor's bathymetric and topographic surveys (progress and post-dredge) • Review Contractor's bucket plots, barge displacement tonnages, disposal weight tickets, and other QC information	• Water quality monitoring per WQMP (Appendix A) • Construction sediment sampling per Sediment QAPP (Appendix B) • ANL monitoring per ANLMP (Appendix C) • Cultural resources monitoring per MIDP (Appendix D)
Offloading, Upland Transportation, and Disposal at Transload Facility	• Provide regular inspection of transload facility operations • Conduct site visit of disposal facility, if requested	None
Material Placement (Backfill, RMC, Engineered Caps, ENR, Amended Cover)	• Provide daily inspection • Review Contractor's bathymetric and topographic surveys (progress and post-material placement) • Review Contractor's bucket plots, placement tonnage estimates, and other QC information • Review import material testing gradation and chemistry analytical results • Inspect import material borrow facilities (as necessary) • Inspect amended cover mix for specifications compliance • Inspect on-site import material stockpiles	• Water quality monitoring per WQMP (Appendix A) • ANL monitoring per ANLMP (Appendix C)
Demolition and removal (Identified Debris and Piles)	• Provide daily inspection • Confirm that debris and pile removal is performed at correct locations	• Water quality monitoring per WQMP (Appendix A)

Construction Activity	Required Construction Inspection and Monitoring Activities[1]	Required Environmental Monitoring Activities
	• Conduct structures monitoring	• ANL monitoring per ANLMP (Appendix C)
Modification of Existing Structures, Outfalls, Utilities, and Pile Installation	• Provide daily inspection • Inspect pile installation • Inspect outfall scour protection installation • Inspect temporary shoring installation • Inspect work to confirm Contractor does not impact existing structures and utilities • Conduct structures monitoring	• ANL monitoring per ANLMP (Appendix C)

Notes:
1: All Required Construction Inspection and Monitoring Activities include daily observation and photographic documentation of work completed, review of Contractor DCRs and WCRs, and development of DFARs and WFARs for QA documentation.
ANL: air, noise, and light
ANLMP: Air, Noise, and Light Monitoring Plan
DCR: Daily Construction Report
DFAR: Daily Field Activity Report
MIDP: Monitoring and Inadvertent Discovery Plan
QAPP: Quality Assurance Project Plan
QA: quality assurance
QC: quality control
WCR: Weekly Construction Report
WFAR: Weekly Field Activity Report
WQMP: Water Quality Monitoring Plan

3.1 Pre-Construction Meetings

A pre-construction meeting will be scheduled by the Owner for each construction season and conducted prior to commencement of any work at the Work Site. The Contractor will propose agenda topics for the pre-construction meeting, in addition to the pre-construction meeting agenda topics identified in Specifications Section 01 31 19 (Contract Meetings). The Owner's CCPM and Project Representative, Construction Manager, Project Coordinator, PPS-CM Contract Manager, IQAT key personnel (as pertinent and requested), Designer, Contractor key representatives, and EPA (or designated oversight staff) will be required to attend, as described in Specifications Section 01 31 19 (Contract Meetings).

Meeting notes will be compiled by the Project Representative (or designee) and distributed in draft format to all attendees for review and comment. If no comments are received by the due date, the meeting notes will be taken as final. If comments are received before the due date, and if the Project Representative agrees with the comments, the meeting notes will be updated accordingly and then issued as a final record of the meeting.

3.2 Contractor Submittals

A Contractor submittal is considered to be anything specified in the Contract documents (e.g., work plans, shop drawings, and similar items) or off-site project permits (i.e., off-site transload facility

permit) that requires QA review by the Project Representative, Construction Manager, and IQAT key personnel (as pertinent and requested). Contractor submittals are required to supplement the drawings and specifications by showing the details necessary to construct, verify, and confirm items to be incorporated into the work.

The Project Representative will oversee and coordinate the review of Contractor submittals by the Construction Manager, IQAT, Project Coordinator and Owner, Designer, and EPA as applicable. There are three discrete categories of Contractor submittals: pre-construction submittals, construction submittals, and post-construction submittals. A complete list of required submittals, including specifications references and schedule, is provided in Specifications Section 01 33 00A (Submittals Attachment A: Summary List/Schedule of Contractor Submittals). Many of the Contractor submittals required by the specifications are related to contract administration and will not be submitted to EPA for review and approval. This CQAP describes key Contractor submittals that focus on remedial design elements that will be submitted to EPA for review and approval, or for general information and discussion.

The Contractor will track required submittals using the Master Submittal List (Standard Form 01 33 00-D, provided in Specifications Section 01 33 10A [Standard Forms, Attachment A1]). The Master Submittal List spreadsheet will be provided to the Contractor by the Project Representative for tracking purposes. The Project Representative will provide QA tracking to verify the Contractor is providing the required submittals by the required due dates. Each month, the Contractor will update the Master Submittal List to match the submittal requirements of the Contract and submit the list to be discussed. It will be the responsibility of the Contractor to transmit the proper project submittals by their required due dates.

3.2.1 Pre-Construction Submittals

The Contractor will be required to submit key pre-construction submittals for approval by the Owner and EPA (as noted) before remedial construction activities will be allowed to start.

3.2.1.1 Draft Contractor Remedial Action Work Plan

The Contractor's RAWP will be prepared in accordance with Specifications Section 01 11 00 (Summary of Work) and will require Owner and EPA approval before any construction activities can begin. The Contractor's RAWP will detail the Contractor's construction approach, means and methods, construction schedule, and staffing organization chart to implement EPA-approved RD, including how construction activities are to be coordinated with the Owner and EPA.

Required elements of the Contractor's RAWP include but are not limited to:

- Project work plan:
  - Description of construction elements, including proposed means and methods

  - Equipment and personnel list
  - Construction sequencing plan for each anticipated construction season
- Project organization chart and reporting responsibilities
- Detailed draft project construction schedule
- Dredging and excavation plan (including dredge material dewatering and transportation plan)
- Material placement plan
- Transloading, upland transportation, waste characterization, and disposal plan, including proposed transload and disposal facility names, locations, and certifications/ permits.
- Environmental mitigation binder (see Section 3.7.1)
- Site-specific HASP
- Emergency response plan
- Survey and positioning control plan, including surveyor certifications (bathymetric and topographic)
- Green remediation plan
- Vessel management plan
- Demolition plan
- Construction QC plan
- Temporary facilities and control plan
- Notification plan
- Instrumentation and monitoring plan
- Site clearing and management plan
- Temporary irrigation plan
- Examples of progress reporting forms
- Change order forms and process

The Contractor's proposed construction QC plan will address QC means and methods for the overall construction project; specific QC procedures may also be identified under various elements of the RAWP. The draft RAWP will be reviewed by the Owner's CCPM, Project Representative, Designer, and appropriate IQAT subject matter experts. The Project Representative will provide comments to the Contractor, which will be required to address comments and resubmit an updated draft RAWP. The updated draft RAWP will be submitted to EPA for review in accordance with the Consent Decree (or equivalent legal order).

3.2.1.2 Final Contractor Remedial Action Work Plan

The Contractor will coordinate with the Project Representative and EPA to modify its draft RAWP based on EPA comments and submit a draft final RAWP to the Owner for review. The Contractor will address Owner comments and prepare a final RAWP to submit to EPA.

Should EPA require revisions to the final RAWP, the Contractor will coordinate with the Project Representative and EPA to modify its final RAWP based on EPA comments and submit a draft updated final RAWP to the Owner for review. The Contractor will address Owner comments and prepare an updated final RAWP to submit to EPA.

No construction activities can begin until the RAWP has been approved by EPA and the Owner.

3.2.1.3 Pre-Construction Structural Condition Report

Prior to initiating construction in the vicinity of an existing structure, the Contractor will be required to inspect the condition of that existing structure and submit a Pre-Construction Structural Condition Report (as described in Specifications Section 31 09 00 [Geotechnical Instrumentation and Conditions Inspections]) to the Project Representative for review. This pre-construction submittal is not a submittal requiring EPA review and approval.

The purpose of the pre-construction structural inspection will be to observe and document any material differences between actual site conditions and site conditions described by the contract documents regarding structures within and adjacent to areas requiring remediation. This inspection will require attendance (at a minimum) by the Project Representative (or designee), structural monitoring inspector, and Contractor. During each structural inspection, the Contractor will take photographs and video (as required by the specifications) of pertinent existing conditions for record purposes and submittal in its Pre-Construction Structural Condition Report. The Project Representative or designee will also document conditions during the inspection. All material differences noted by the Contractor and brought to the attention of the Project Representative will be documented as part of the report.

3.2.1.4 Pre-Construction Bathymetric and Topographic Survey

Prior to any dredging or excavation, the Contractor will complete a pre-construction bathymetric and/or topographic survey (as applicable) of the work area to verify bed elevations and volumes for completion of dredging/excavation and material placement activities. This survey(s) will be conducted by the Contractor's selected third-party surveyor, Marker Offshore, LLC, who is licensed in Washington State. The survey(s) will be supplied to the Project Representative for review prior to acceptance. The pre-construction survey(s) timing will be coordinated with the Project Representative. Since it is anticipated that remedial action implementation will take place over three construction seasons, pre-construction surveys will occur at the beginning of each construction season, rather than just once during the project.

While the pre-construction surveys will not require EPA approval, they will be provided to EPA. Any issues will be discussed with EPA to identify whether there are any unanticipated changes to elevations or grades from the contract documents (drawings) that may affect design details, such as dredging and placement volumes.

3.2.2 Construction Submittals

The Contractor will be required to provide construction submittals to the Project Representative during construction to document progress and other construction elements, as described in this section. The Project Representative, working with the IQAT, will prepare the Owner's QA daily and weekly field activity reports (see Section 3.4) and submit to EPA the weekly field activity reports that summarize key information from the Contractor's construction reports. The Contractor's construction reports will be appended to the Owner's QA reports. This section describes the Contractor's construction submittals.

3.2.2.1 Contractor's Daily Construction Report

The Contractor will be required to submit a Daily Construction Report (DCR) to the Project Representative (per Specifications Section 01 33 00 [Submittals]). The DCR will be reviewed by the Project Representative to ensure that it summarizes the required information and is complete; the Contractor will be required to revise the DCR if the Project Representative rejects the submitted DCR. The Contractor's DCR will include, at a minimum (per the specifications):

- Work conditions (e.g., weather, predicted tides, commercial navigation impacts)
- Activities: details of each activity, references to the construction schedule as possible, and location where each activity is taking place
- Daily progress summary: area(s) cleared and grubbed and any waste disposed of; quantities dredged, transported, and disposed of; material quantities placed; bucket plots displaying work areas, surveys, field notes, and survey calculations; Sediment Management Areas (SMAs) completion progress; and any delays
- Daily record of ANL criteria compliance; water quality protection; stormwater pollution prevention; water management; and any actions taken to address these issues during construction
- Daily record of vessel management coordination
- Specific QC activities performed (on days when QC activities are performed) (Contractor's daily progress survey[s] will be attached to the DCR)
- Health and safety summary: safety infractions, near misses, and accidents
- Equipment: arrival at and shipment from the Work Site of each major item of equipment by manufacturer, model, serial number, and capacity; equipment in use and reasons for idle equipment
- Tests: Contractor-conducted testing and results
- Construction progress photographs
- Daily record of QC activities for the construction work completed

3.2.2.2 Contractor's Weekly Construction Report

The Contractor will be required to submit its Weekly Construction Report (WCR) to the Project Representative (per Specifications Section 01 33 00 [Submittals]). The WCR will summarize the previous week's work, including the information listed in the Contractor's DCR. The WCR will also comprise an updated project construction schedule and construction activity look ahead, including identification of any critical issues for the upcoming work week.

3.2.2.3 Bathymetric and Topographic Surveys

Progress surveys, post-construction surveys (referring to surveys conducted after each specific remedial action, such as dredging, contingency re-dredging, and placement, has been completed), and measurement surveys that are completed on a daily or event basis will be submitted to the Project Representative as part of the Contractor's DCR or WCR (as applicable). Drawings, field notes, and quantity computations will be submitted by the Contractor to the Project Representative in compliance with Specifications Sections 02 21 00 (Site Surveys and Positioning Control), 35 20 23 (Remedial Dredging, Barge Dewatering, and In-Water Transportation), and 35 37 10 (Material Placement). The Project Representative and Construction Manager (and CQAO, as requested) will review Contractor surveys to inform acceptance of completed work, identification of corrective action if needed, and measurement and payment for the work completed.

3.2.2.4 Import Material Characterization

The Contractor must conduct import material testing at an approved testing laboratory to demonstrate that the source material meets EPA-approved chemistry criteria, in general accordance with Specifications Section 35 37 10 [Material Placement]. The Contractor will submit laboratory results and a physical sample of each material type to be used to the Owner and EPA for review and approval in advance of material use at the Work Site, in accordance with Specifications Section 35 37 10 [Material Placement].

3.2.3 Post-Construction Submittals

This section discusses both annual construction season summary reporting and close out documentation requirements in the specifications.

3.2.3.1 Annual Construction Summary Technical Memorandum

The anticipated construction duration is three construction seasons, using an assumed in-water construction window of October 1 through February 15 of any given year. Considering this schedule, the CQAP assumes that EPA will require the Owner to prepare an Annual Construction Summary Technical Memorandum after each construction season has been completed. The Contractor will provide its information to support Owner preparation of the Annual Construction Summary Technical Memorandum at the end of each season, as described in Specifications Section

01 78 39 (Project Record Documents). Key elements of the Annual Construction Summary Technical Memorandum will include:

- Summary of remediation activities completed, specifying areas remediated during the construction season and documenting where construction has been completed within an SMA
- Compilation of pre-construction and post-construction surveys completed within the SMAs where work was performed
- Summary of total volumes dredged and disposed, material placed, and surface area completed (% complete)
- Summary of structures and identified debris removal work and structures installation completed within the construction season
- Record documents, such as as-built drawing for completed SMAs, in compliance with Specifications Section 01 70 00 (Closeout Requirements)
- Summary of environmental activities completed
- Compilation of Monthly Air Pollution Compliance Summary Report, in accordance with Specifications Section 01 35 44 (Green Remediation)
- Pre- and post-construction structural condition reports
- Summary of weight tickets and Certificates of Disposal for all dredged material and debris disposed of
- Summary of weight tickets for imported materials
- Summary of deviations from the contract document or RAWP, if any, and corrective actions taken to reconcile the deviations so that remediation objectives were met

3.2.3.2 As-built Drawings, Manuals, and Certificates

In compliance with Specifications Section 01 70 00 (Closeout Requirements), after all remedial construction is complete for the upper reach, the Contractor will be required to submit as-built drawings for various elements of construction, including piling demolition, dredging/excavation/material placement surveys, and capping/outfall scour protection limits and materials. The Contractor will also submit certificates of conformance for imported materials.

3.2.3.3 Pre-final Punch List and Inspection

After all remedial construction work is complete, and following inspection of the completed work with the Owner and EPA (or its oversight designee), the Contractor will assist the Owner's CCPM, Project Representative, and Construction Manager in preparing a consolidated list of items (i.e., the pre-final punch list) to be completed or corrected after inspection. The Contractor may also be asked to assist the Project Representative and IQAT in preparing the pre-final or final inspection reports.

3.3 Construction Meetings

3.3.1 Daily Tailgate Meetings

The Contractor will hold daily tailgate meetings in general accordance with Specifications Section 01 31 19 (Contract Meetings). Besides the Contractor and Project Representative, additional attendees may include key members of the IQAT and other appropriate parties. The purpose of these meetings will be to have a field review of construction health and safety concerns, as well as a review of planned daily work activities and related environmental concerns.

3.3.2 Weekly Progress Meetings

Weekly progress meeting will be conducted, as described in Specifications Section 01 31 19 (Contract Meetings), to review work progress, schedules, and other matters needing discussion and resolution. The Project Representative will lead these meetings and take meeting notes. Anticipated attendees include the Owner's CCPM and Project Representative, Construction Manager, IQAT key staff (as invited), the Contractor, and EPA. Anticipated weekly progress meeting agenda items will include review of:

- Minutes of previous meetings and Rolling Action Item Log
- Health and safety issues
- Progress of the work
- Construction schedule and three-week look ahead
- Environmental monitoring results
- Field observations, problems, proposed changes, and decisions
- Submittals, schedule, and status of submittals
- Updated project construction schedule
- Corrective actions to address environmental, project progress, health and safety, or other issues
- Community and ARARs issues

The schedule for recurring weekly progress meetings will be determined at the pre-construction meeting based on a time that is most practicable for the participants.

3.3.3 Pre-Final Inspection Meeting

The pre-final inspection meeting will be conducted after all work has been completed and before the Contractor is allowed to demobilize. The meeting will be attended by the Owner and its QA team, EPA, and the Contractor. All attendees will review construction completion documentation and assess whether the remedy was constructed in general accordance with the approved RD and any approved changes thereto, and whether the project met construction performance standards.

3.3.4 Other Meetings

Additional meetings may also be held during the Contract as construction issues arise, or at the request of the Contractor, Project Representative, IQAT, or EPA. Participants may include the Owner CCPM, Project Representative, Construction Manager, IQAT key staff, Designer, Contractor, EPA, representatives of local jurisdictions, or other attendees as appropriate. Agenda items will range from technical issues to administrative matters. Any discussions leading to an action item for the Contractor must be reviewed and approved by the Project Representative. The Project Representative will decide documentation requirements for informal meetings on a case-by-case basis.

During the Contract, it will be necessary to schedule additional meetings to review specific issues on topics that are too involved for construction progress meetings. Such topics could include Change Order negotiations, claims conferences, quality or safety issues, community relation issues, and others. Agendas will be prepared, and meeting notes will be submitted to EPA by the Project Representative or Project Coordinator.

3.4 Owner Documentation

This section discusses Owner documentation that will be led by the Project Representative.

3.4.1 Owner's Quality Assurance Daily Field Activity Report

To keep track of QA work activities and the Contractor's progress, the Project Representative working with the Construction Manager as well as the CQAO and EQAOs (as needed) will prepare a Daily Field Activity Report (DFAR) as internal IQAT documentation. The Project Representative will review the Contractor's DCR, communicate with the Contractor if the DCR is deficient, and require the Contractor to revise its DCR if necessary; the Contractor's DCR will then be appended to the DFAR. The DFAR will serve as an overarching QA document and will record all items of importance regarding the work performed, including:

- Work conditions (e.g., weather, predicted tides, commercial navigation impacts, etc.): if and how any adverse condition may have affected the Contractor's operations.
- QA Activities: details of each QA activity, references to the construction schedule where possible, location where each activity is taking place.
- QC Activities: The DFAR will note QC activities performed by the Contractor on days when these activities are performed; Contractor daily progress survey information will be provided in the DCR (per the specifications).
- Difficulties: all difficulties encountered by the Construction Monitoring and Inspection staff, including the location where the difficulty is occurring.

- Controversial matters (e.g., disputes, questionable items, etc.): facts of the event, if matters were settled, and if so, how they were settled.
- Deviations, deficiencies, and violations: observed deviations from Contractor's RAWP and drawings and specifications, construction safety incidents, labor, etc.
- Progress information: any observed delays, actions taken, and actions contemplated.
- Photograph log: key photographs to illustrate the work conducted

The DFARs will be completed on the next working day following completion of the inspection. DFARs will include inspection documentation for all construction activities observed, including structural inspection.

Environmental monitoring efforts and results (as described in Sections 3.7 and 5) and reports prepared by the IQAT will be appended to the DFAR. The DFAR will be completed as one compiled inspection and monitoring report on the next working day following completion of the inspection and receipt of any environmental monitoring data.

3.4.2 Owner's Quality Assurance Weekly Field Activity Report

The Project Representative will prepare a Weekly Field Activity Report (WFAR) as a QA submittal and submit it to EPA on the Monday following the previous week's work. The WFAR will include a summary description of construction events, as well as any delays and their causes. The WFAR will provide a high-level summary of the previous week's QA inspections, testing, surveying, and monitoring activities; the effectiveness of the Contractor's QC activities; and any corrective actions taken during that week. The Contractor's WCR for the previous week will be appended to the WFAR. When QA inspections use the results of the Contractor's surveys and tests, these results will be summarized and included in the WFAR.

The Contractor, Owner's CCPM, Project Coordinator, Project Representative, and Construction Manager will meet weekly with the EPA PM to review the WFAR and keep EPA informed of continuing events as the remediation work proceeds. Any work that deviates from EPA-approved remedial action design drawings, specifications, and RAWP will be brought to the attention of EPA. Any proposed changes to EPA-approved documents will be approved by EPA before being implemented.

3.4.3 Annual Construction Summary Technical Memorandum

EPA will require the Owner to prepare an Annual Construction Summary Technical Memorandum, as described in Section 3.2.3.1, after each construction season has been completed by the Contractor. Anticipated elements of this memorandum include a summary, tabulated results of construction-related QA inspections, tabulated results of monitoring conducted by the IQAT, and information provided by the Contractor during construction (Section 3.2.2).

3.4.4 Remedial Action Project Report

Following completion of the upper reach remedial action, the Owner will prepare a Remedial Action Project Report in general accordance with Chapter 2 of EPA's *Close Out Procedures for National Priorities List Sites*, OLEM Directive 9320.2-23 (EPA 2022). This report will include documentation to demonstrate that construction of the remedial action project is complete, and it will include as-built drawings signed and stamped by a registered P.E.

3.5 Construction Inspection Requirements for Remedial Action Activities

This section discusses QA inspection and monitoring remedial action activities. Environmental compliance and monitoring efforts are described in detail in Section 3.7. Field construction inspection and construction monitoring will be conducted to achieve the following objectives:

- Monitor compliance with contract document requirements, ensuring that each item of work complies with the drawings and specifications.
- Identify activities that do not comply with the contract document requirements and the Contractor's RAWP and identify reason(s) why the work was not completed in general accordance with the requirements of the Contract. The Project Representative (and Designer as appropriate) and Contractor will coordinate to decide on an appropriate course of action to either implement corrective action or document the reasons why deviations still meet the intent of the design and achieve remediation objectives.
- Document construction progress on a daily and weekly basis.

This section covers engineering-related construction inspection and monitoring requirements for the remedial action activities in the following specifications sections and other applicable technical specifications:

- Remedial Dredging, Barge Dewatering, and In-Water Transportation (Specifications Section 35 20 23)
- Sediment Management Area 5 Bank Construction (Specifications Section 31 05 10)
- Offloading, Upland Transportation, and Disposal (Specifications Section 35 20 23.01)
- Material Placement (Specifications Section 35 37 10)
- Site Surveys and Positioning Control (Specifications Section 02 21 00)

Details regarding inspection and monitoring activities for structural aspects of the project are provided in Section 3.6 of this document.

3.5.1 Dredging/Excavation, Barge Dewatering, and In-Water Transportation of Dredged Materials

Specifications Sections 35 20 23 (Remedial Dredging, Barge Dewatering, and In-Water Transportation), 31 05 10 (Sediment Management Area 5 Bank Construction), and 01 35 43 (Environmental Procedures) provide detailed requirements for the Contractor. Key representative requirements are identified in this section of the CQAP. Dredging, barge dewatering, and in-water transportation construction inspection requirements will be overseen by the Construction Manager and conducted by the construction inspectors and will include:

- General inspection of work, including means, methods, and sequencing of dredging, excavation, dewatering (on- and off-site as applicable), and in-water transportation activities to verify compliance with drawings and specifications
- Review of Contractor's DCRs to identify that reporting of activities completed is consistent with observations of the activities and in compliance with the requirements of the drawings and specifications
- Daily observation of Contractor work activities and review of Contractor-provided daily progress survey information to document that:
  - The Contractor is implementing best management practices (BMPs) while conducting dredging, as described in its RAWP.
  - The Contractor is completing dredging activities to the required dredge elevation/thickness (including overdredge allowances) within the various SMAs as shown on the drawings and described in the specifications. CM inspectors will notify the Construction Manager and Project Representative if review of Contractor progress surveys indicates that required dredge elevation/thickness is not being achieved, or overdredge allowance is being exceeded.
  - The Contractor is completing excavation activities to the excavation grades required in SMA 5, as shown on the drawings and described in the specifications.
  - The Contractor is adhering to dredging offset requirements (offset distance varies; see project drawings) when performing dredging activities adjacent to specified structures.
  - The Contractor is not stockpiling material on the sediment bed or leveling the completed dredging surface by dragging a beam or clamshell bucket over the completed area.
  - The Contractor is collecting and disposing of incidental debris using procedures consistent with its RAWP.
  - The Contractor is maintaining stability of material haul barges for temporary storage of dredged materials or for their transport to the Contractor's Transload Facility. Barges shall not be overloaded or loaded such that the barge is imbalanced.

  - Dredged material haul barges are not leaking or showing signs of taking on water. The Project Representative shall be immediately notified if any signs of barge instability are observed.
  - No leakage is occurring during transportation of dredged materials to the Contractor's Transload Facility (inspections of the barge trip will occur on a periodic basis, as deemed necessary to confirm the Contractor's compliance with the Contract documents).
  - Upland excavation soil management and stockpile areas are being managed to prevent trackout and runoff and avoid potential impacts on groundwater and LDW water quality.
  - The Contractor is documenting and immediately recovering and removing any material accidentally dropped overboard from the in-water transport dredge material haul barges.
  - Other Contract activities deemed appropriate for monitoring by the Project Representative are being monitored.
- Daily visual observation of the Work Site for various environmental conditions (environmental monitoring is described in Section 3.7.2).[1] Any of the following observations will be communicated to both the CQAO and EQAO for documentation and potential corrective action, as determined by the Project Representative in coordination with the Construction Manager (with input from CQAO and EQAO, as requested). If a sheen and/or distressed or dying fish are observed, the construction activity associated with those observed impacts will be stopped within the immediate vicinity of the observed issue, and EPA will be contacted to determine how to proceed. Daily visual observations will be made for the following environmental conditions:
  - Presence of oil sheen associated with construction activities
  - Evidence of distressed or dying fish
  - Floating debris and/or visible turbidity plumes generated by construction activities
  - Dredged material haul barges are not leaking and their exteriors are clean (i.e., no dredged materials are present on outside rails/walls of barges) prior to transport off-site to the Contractor's Transload Facility.

3.5.1.1 Required Dredging Acceptance Criteria

The Project Representative and Construction Manager (and CQAO, as requested) will review results of Contractor post-dredge (or excavation) surveys to evaluate whether the Contractor has adequately achieved the required dredge elevation/thickness. In general, acceptance of a required dredge area where a required dredge elevation applies will be considered reasonable when the

[1] Construction field inspectors, including the Contractor, Construction Manager, CQAO and construction inspection staff, will be responsible for observing and reporting potential environmental impacts.

Contractor has demonstrated that it has achieved the required removal in 95% of an SMA. In locations where removal does not meet the required dredge elevation, the remaining area's elevation/thickness should not be more than 6 inches above the required dredging elevation. For areas with required thickness cuts, the Contractor will be required to achieve the minimum cut thickness over the entire area. Table 3-2 summarizes the required dredging acceptance criteria.

However, there may be locations where the Contractor does not achieve the required dredge elevation/thickness due to underlying subsurface conditions, such as the presence of a native, compacted sediment layer or hardpan within the required dredge prism. In such cases, the Project Representative will work with EPA to adaptively decide on accepting locations that the Contractor indicates cannot be dredged to the required dredge elevation/thickness, and for which the Project Representative agrees with the Contractor's basis. Areas that are not dredged to the required dredge elevation/thickness will be documented for EPA, along with the reason why the Project Representative accepted the area as completed.

Table 3-2
Required Dredging/Excavation Acceptance Criteria

Criteria	Dredging/Excavation Area Tolerance for Each SMA[1]	Vertical Tolerance
Required Dredge/Excavation Elevation	95% of dredge/excavation area must meet required dredge elevation	No spots higher than 6 inches above the required dredge/excavation elevation within the remaining high spots
Required Dredge/Excavation Thickness	100% of dredge/excavation area must meet required dredge thickness	Not applicable

Notes:
[1] The Project Representative may accept an SMA as completed for required dredging/excavation if the contractor demonstrates that there are underlying subsurface conditions that impact the Contractor's ability to meet the required dredging/excavation elevations or thicknesses (e.g., hardpan).
SMA: Sediment Management Area

3.5.2 Transloading, Upland Transportation, and Disposal of Dredged Materials

Specifications Sections 35 20 23.01 (Transloading, Upland Transportation, and Disposal) and 01 35 43 (Environmental Procedures) provide detailed requirements for the Contractor. Key representative requirements are identified in this section of the CQAP. Inspection of the Contractor's Transload Facility, where offloading, upland transportation, and disposal activities will

occur, will be conducted on a periodic basis and as deemed necessary to confirm the Contractor's compliance with the specifications and drawings. The CM inspectors' requirements will include:

- General inspection of work, including means and methods of offloading dredged sediment and debris at the Contractor's Transload Facility, sediment and debris handling and dewatering (as applicable), upland transportation, and disposal at a permitted landfill facility.
- Review of Contractor DCRs to ensure that reporting of activities completed is consistent with observation of the activities and in compliance with the requirements of the Drawings and Specifications
- Verification of Contractor operations at the Contractor's Transload Facility in accordance with facility permit requirements
- Observation of work activities at the Contractor's Transload Facility to ensure that the following are in accordance with the specifications and RAWP:
  - The Contractor's Transload Facility is laid out according to the Contractor's RAWP.
  - The Contractor is implementing BMPs while conducting offloading activities at the Contractor's Transload Facility, in-water and/or upland transportation, and disposal as described in its RAWP.
  - The Contactor is storing/handling dredged material stabilization materials (if used) in an appropriate manner such that the materials are contained while being stored and are not released in an uncontrolled manner when being mixed with the dredged material prior to offloading materials to haul trucks or rail cars.
  - The Contractor's transport equipment (i.e., rail cars and/or trucks) are clean and are not spilling or tracking contaminated material onto roadways.
  - Trucks and railcars used for transport are lined and covered.
  - The Contractor is maintaining its Transload Facility in a clean manner (i.e., sweepers and erosion control BMPs).
  - The Contractor is in compliance with environmental protection requirements as stated in Specifications Section 01 35 43 (Environmental Procedures), and in general accordance with the ARARs and any required off-site permits (as required by Specifications Section 01 41 26 [Permits, Easements, and Right-of-Entry Agreements]).
  - Appropriate measures are being taken (as required by the specifications [such as employment of a spill apron]) at the Contractor's Transload Facility to prevent spillage of material into water during offloading.
  - Stormwater runoff control, management of all liquids that drain from stockpiles, and reduced precipitation contact with impacted and non-impacted material in the stockpile area (using covers) are occurring.
  - No leakage from the transportation barge is observed while at the Contractor's Transload Facility.

- All dredged material effluent from the Contractor's Transload Facility staging and stockpile area (as applicable) is collected and treated according to the requirements of Specifications Section 35 20 23.01 (Transloading, Upland Transportation, and Disposal).

Inspections of the disposal facility(ies) will occur on a periodic basis, as deemed necessary, to confirm the Contractor's compliance with the BMPs and accepted procedures in the RAWP.

3.5.3 Clean Material Placement

Specifications Sections 35 37 10 (Material Placement), 31 05 10 (Sediment Management Area 5 Bank Construction), and 01 35 43 (Environmental Procedures) provide detailed requirements for the Contractor. Key representative requirements are identified in this section of the CQAP. Inspection requirements for material placement activities will include:

- Daily inspection of work, including means, methods, and sequencing of all material placement activities and compliance with drawings and specifications. Material placement will include backfill, ENR, engineered caps, amended cover, and RMC, as shown in Table 3-3
- Review of Contractor DCRs to ensure that reporting of activities completed is consistent with observation of the activities and in compliance with the requirements of the drawings and specifications
- Daily observation of work activities to ensure that the Contractor is:
  - Implementing BMPs while conducting material placement, as described in its RAWP
  - Placing material in a manner that prevents any damage to adjacent structures
  - Using materials that meet the gradation requirements provided in Specifications Section 35 37 10 (Material Placement)
  - Employing means and methods that allow for placement of materials on stable slope grades and within the defined material placement thicknesses, and including the overplacement allowances or tolerances provided in the specifications
  - Not completing placement of materials close to active dredging locations where dredging activities could result in contamination of clean backfill materials
  - Using appropriate equipment for placement of material at the Work Site, consistent with equipment descriptions provided in its RAWP
  - In compliance with environmental protection requirements as stated in Specifications Section 01 35 43 (Environmental Procedures) and in general accordance with ARARs
  - Placing materials in a manner that minimizes the resuspension of sediment. Such measures may include limiting the fall distance of material through the water column and/or using diffusers

Table 3-3
Material Type and Application Placement Area

Material Type	Application Technology	Application Placement Area	General Description
1	Backfill A, capping isolation layer, capping surface layer	Backfill on side slope dredge surfaces, engineered Cap B area, engineered Cap A area	Well-graded, rounded, gravelly sand
1A	Capping isolation layer	Engineered Cap A area	Well-graded, angular, gravelly sand
2	Backfill B, ENR, required RMC, inner perimeter RMC, contingent outer perimeter RMC	Backfill within flat dredge surfaces, ENR areas, Required RMC/inner perimeter RMC/contingent outer perimeter RMC areas	Well-graded medium-to-coarse sand
3	Amended cover	Area-specific Technology B areas	Material Type 1 (gravelly sand) blended with granular activated carbon
4	Capping filter layer	Engineered Cap A and B areas	Angular gravel
5	Capping erosion protection layer	Engineered Cap A and B areas	Quarry spalls

Notes:
ENR: Enhanced Natural Recovery
RMC: residuals management cover

3.5.3.1 Import Material Inspection and Testing

The Contractor will be required to provide materials testing for all sand and gravel material brought to the Work Site and intended for use on the Project (i.e., import material). The Contractor will provide the results of QC laboratory testing to the Project Representative and EPA for review and acceptance prior to the start of material placement activities. In accordance with Specifications Section 35 37 10 (Material Placement), the Contractor will perform chemistry testing for one sample for every 10,000 cubic yards of each sand and gravel material type imported to the Work Site; a minimum of two samples from each material type will be tested, and each sample will be representative of its respective imported material. Imported sand and gravel materials should have chemical concentrations equal to or less than the chemical quality criteria presented in Table 3-4. The Project Representative may increase or decrease the frequency of testing if such a change is approved by EPA, based on the results of testing or visual assessment of imported sand and gravel materials.

Table 3-4
Imported Material Chemical Quality Criteria – Specifications Section 35 37 10 (Material Placement)

Analyte	Reporting Limit	Criteria	Units	EPA Method
Metals				
Arsenic	0.2	7	mg/kg dw	EPA 6020B UCT-KED
Cadmium	0.1	2.5	mg/kg dw	EPA 6020B UCT-KED
Chromium	0.5	130	mg/kg dw	EPA 6020B
Copper	0.5	195	mg/kg dw	EPA 6020B UCT-KED
Lead	0.1	200	mg/kg dw	EPA 6020B
Mercury	0.025	0.2	mg/kg dw	EPA 7471B
Silver	0.2	3	mg/kg dw	EPA 6020B
Zinc	6	205	mg/kg dw	EPA 6020B UCT-KED
Semivolatile Organic Compounds				
Aromatic Hydrocarbons				
Total LPAH	20	2,600	µg/kg dw	EPA 8270E (calculated)
2-Methylnaphthalene	20	335	µg/kg dw	EPA 8270E
Acenaphthene	20	250	µg/kg dw	EPA 8270E
Anthracene	20	480	µg/kg dw	EPA 8270E
Fluorene	20	270	µg/kg dw	EPA 8270E
Naphthalene	20	1,050	µg/kg dw	EPA 8270E
Phenanthrene	20	750	µg/kg dw	EPA 8270E
Total HPAH	20	6,000	µg/kg dw	EPA 8270E (calculated)
Benz[a]anthracene	20	650	µg/kg dw	EPA 8270E
Benzo[a]pyrene	20	800	µg/kg dw	EPA 8270E
Benzo[g,h,i]perylene	20	335	µg/kg dw	EPA 8270E
Chrysene	20	700	µg/kg dw	EPA 8270E
Dibenzo[a,h]anthracene	20	115	µg/kg dw	EPA 8270E
Fluoranthene	20	850	µg/kg dw	EPA 8270E
Indeno[1,2,3-c,d]pyrene	20	300	µg/kg dw	EPA 8270E
Pyrene	20	1,300	µg/kg dw	EPA 8270E
Total benzofluoranthenes	40	1,600	µg/kg dw	EPA 8270E (calculated)
cPAH	18.1	590	µg TEQ/kg dw	EPA 8270E
Phthalate Esters				
Bis[2-ethylhexyl]phthalate	50	650	µg/kg dw	EPA 8270E
Butylbenzyl phthalate	20	32	µg/kg dw	EPA 8270E
Dimethyl phthalate	20	36	µg/kg dw	EPA 8270E
Organic And Chlorinated Organic Chemicals				
2,4-Dimethylphenol	20	29	µg/kg dw	EPA 8270E-SIM

Analyte	Reporting Limit	Criteria	Units	EPA Method
4-Methylphenol	20	335	µg/kg dw	EPA 8270E
Benzoic acid	200	325	µg/kg dw	EPA 8270E-SIM
Pentachlorophenol	100	180	µg/kg dw	EPA 8270E-SIM
Phenol	20	210	µg/kg dw	EPA 8270E
1,2,4-Trichlorobenzene	5	16	µg/kg dw	EPA 8270E-SIM
1,2-Dichlorobenzene	5	18	µg/kg dw	EPA 8270E-SIM
1,4-Dichlorobenzene	5	55	µg/kg dw	EPA 8270E-SIM
Dibenzofuran	20	270	µg/kg dw	EPA 8270E
Hexachlorobenzene	0.5	11	µg/kg dw	EPA 8081B
n-Nitrosodiphenylamine	5	14	µg/kg dw	EPA 8270E-SIM
PCBs				
Total PCBs (sum of congeners)	0.2	2	µg/kg dw	EPA 1668c
Dioxins/Furans				
Dioxin/furan TEQ	1.6	2	ng/kg dw	EPA 1613b
2,3,7,8-TCDD	0.1	-	ng/kg dw	EPA 1613b
1,2,3,7,8-PeCDD	0.1	-	ng/kg dw	EPA 1613b
1,2,3,4,7,8-HxCDD	0.1	-	ng/kg dw	EPA 1613b
1,2,3,6,7,8-HxCDD	0.1	-	ng/kg dw	EPA 1613b
1,2,3,7,8,9-HxCDD	0.1	-	ng/kg dw	EPA 1613b
1,2,3,4,6,7,8-HpCDD	0.1	-	ng/kg dw	EPA 1613b
OCDD	0.1	-	ng/kg dw	EPA 1613b
2,3,7,8-TCDF	0.1	-	ng/kg dw	EPA 1613b
1,2,3,7,8-PeCDF	0.1	-	ng/kg dw	EPA 1613b
2,3,4,7,8-PeCDF	0.1	-	ng/kg dw	EPA 1613b
1,2,3,4,7,8-HxCDF	0.1	-	ng/kg dw	EPA 1613b
1,2,3,6,7,8-HxCDF	0.1	-	ng/kg dw	EPA 1613b
1,2,3,7,8,9-HxCDF	0.1	-	ng/kg dw	EPA 1613b
2,3,4,6,7,8-HxCDF	0.1	-	ng/kg dw	EPA 1613b
1,2,3,4,6,7,8-HpCDF	0.1	-	ng/kg dw	EPA 1613b
1,2,3,4,7,8,9-HpCDF	0.1	-	ng/kg dw	EPA 1613b
OCDF	0.1	-	ng/kg dw	EPA 1613b

Notes:
µg: microgram
µg/kg: microgram per kilogram
cPAH: carcinogenic polycyclic aromatic hydrocarbon
EPA: U.S. Environmental Protection Agency
dw: dry weight
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD: heptachlorodibenzo-*p*-dioxin
HxCDD: hexachlorodibenzo-*p*-dioxin

HxCDF: hexachlorodibenzofuran
kg: kilogram
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
mg/kg: milligram per kilogram
ng/kg: nanogram per kilogram
OCDD: octachlorodibenzodioxin
OCDF: octachlorodibenzofuran
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-*p*-dioxin
PeCDF: pentachlorodibenzofuran
TCDD: tetrachlorodibenzodioxin
TCDF: tetrachlorodibenzofuran
TEQ: toxic equivalent
UCT-KED: universal cell technology-kinetic energy discrimination

The IQAT may complete inspections of the borrow facility(ies) (i.e., facilities providing import material to the Work Site) in advance of materials being brought to the Work Site for placement. The Contractor will provide physical QA samples of import materials to the Project Representative. The Project Representative and EPA must approve the borrow facility(ies) prior to the Contractor importing the materials to the Work Site.

Upon the arrival of import material at the Work Site, construction inspectors will conduct visual observations of the stockpiles of material on the import material barges to evaluate general compliance with Specifications Section 35 37 10 (Material Placement]), and to make comparisons to observations from borrow site inspections. These Work Site observations will be recorded in the DFAR and will include:

- General appearance of material (color, gradation, angularity, odor, etc.)
- Evidence of staining or sheen
- Presence of debris

If the results of visual inspection indicate that import materials are not in compliance with the specifications, the construction inspectors will notify the Construction Manager and Project Representative for follow-up notification to the Contractor.

The IQAT may elect to collect samples of the stockpiles of import materials (as appropriate) and send them to an Owner-selected laboratory for QA chemical or gradation testing. Testing methods will follow the chemical testing specified for the Contractor in Specifications Section 35 37 10 (Material Placement). This Owner-provided testing by a third party will not alleviate the responsibility of the Contractor to conduct its required QC testing and reporting.

3.5.3.2 Material Placement Acceptance Criteria

The Project Representative and Construction Manager (and CQAO, as requested) will review results of the Contractor post-material placement surveys and other lines of evidence (e.g., Contractor bucket plot placement maps, placement tonnage estimates [including weight tickets] from the Contractor) to confirm whether the Contractor has adequately achieved the required material

placement elevation/thickness within each SMA in general accordance with the material placement acceptance criteria provided in Table 3-5. Both acceptance criteria (i.e., vertical placement tolerance or overplacement allowance and placement area tolerance) must be met for the material placement to be accepted within each SMA.

Table 3-5
Material Placement Acceptance Criteria

Material Type	Criteria	Vertical Placement Tolerance or Overplacement Allowance	Placement Area Tolerance
Backfill Material	Targeted placement elevation and grades	Elevation +/- 6 inches from targeted placement elevation and grades	Minimum of 50% of surface area at or higher than targeted placement elevation and grades; 95% of backfill area must be backfilled to within the vertical placement tolerance
ENR Material	9-inch targeted placement thickness	+/- 3 inch of vertical placement tolerance	Minimum of 50% of surface area equal to or thicker than targeted placement thickness; 95% of surface area must be at least 6 inches thick
RMC Material	Within Toe of Dredge Cut and Inner and Outer Perimeters: 9-inch targeted placement thickness Exterior Side slopes with 3H:1V side slope placement: 24-inch targeted placement thickness	Within Toe of Dredge Cut and Inner and Outer Perimeters: Thickness +/- 3 inches of tolerance from targeted placement thickness Exterior Side slopes: Thickness +/- 6 inches of tolerance from targeted placement thickness	Minimum of 50% of surface area equal to or thicker than targeted placement thickness; 95% of surface area must be at least 6 inches thick within Toe of Dredge Cut and Inner and Outer Perimeter and at least 18 inches thick on Exterior Side slopes
Amended Cover Material	12-inch targeted placement thickness	+/- 3 inch of vertical placement tolerance	Minimum of 50% of surface area equal to or thicker than targeted placement thickness; 95% of surface area must be at least 9 inches thick
Engineered Cap Layers	Isolation Base Layer: 12-inch minimum with 6-inch overplacement allowance Filter Layer: 6-inch minimum with 6-inch overplacement allowance Erosion Protection Layer: 12-inch minimum with 6-inch overplacement allowance	Minimum placement thickness with overplacement allowances (per layer)	95% of surface area must meet minimum thickness

Notes:
Both acceptance criteria (vertical placement tolerance or overplacement allowance plus placement area tolerance) must be met for the material placement to be accepted within each SMA.

ENR: enhanced natural recovery
NA: not applicable
SMA: Sediment Management Area

3.5.4 Surveying and Positioning Control

The Contractor will be required (per Specifications Section 02 21 00 [Site Surveys and Positioning Control]) to contract with a Washington State-licensed professional land surveyor (to be determined) to conduct various bathymetric and topographic surveys during implementation of the upper reach remedial actions. Objectives and general scope for completion of surveys for the project include:

- The Contractor will identify and describe means and methods for establishing and maintaining positioning control throughout completion of the construction activities required in the Contract documents. Construction inspectors will verify that the Contractor can demonstrate acceptable positioning control prior to the start of construction activities at the Work Site.
- The Contractor will complete pre-construction bathymetric and/or topographic surveys of the Work Site to verify bed elevations and Contract volumes for completion of dredging and material placement activities. The Contractor will need to conduct multiple pre-construction surveys sequenced to address a portion of the Work Site for each construction season, since the work is anticipated to take place over three construction seasons.
- The Contractor will conduct daily progress surveys to provide QC of the dredging and material placement work, and to calculate or verify progress volumes, areas, limits, and positions.
- The Contractor will conduct post-dredge or excavation surveys once it has completed required dredging or contingency re-dredging work in a SMA. These surveys will either confirm the completion of required dredging activities in the SMA or identify areas that may require additional material removal prior to acceptance of the work.
- The Contractor will conduct post-material placement surveys once it has completed material placement work in a SMA. These surveys will occur following completion of placement of each material type to verify that the required material placement elevation/thickness has been achieved, or to identify areas that may require additional material placement prior to acceptance of the work.

In general accordance with Specifications Section 02 21 00 (Site Surveys and Positioning Control), the Contractor will use multibeam survey equipment for all surveys, unless a more accurate method is available (to be submitted as part of the RAWP). Elevations will be measured to +/-0.25 feet, at a minimum; horizontal positions will be measured to +/-1 foot at the 95% confidence interval, at a

minimum. The methods and procedures for bathymetric surveys will meet or exceed the requirements of the following standards:

- Dredging measurement and payment surveys, as defined in the Hydrographic Surveying Engineer Manual (EM 1110-2-1003) prepared by the U.S. Army Corps of Engineers, dated November 30, 2013, or the latest version
- Exclusive Order survey, as defined in the International Hydrographic Organization Standards for Hydrographic Surveys (S-44 Edition 6.1.0) prepared by the International Hydrographic Organization, dated September 2022, or the latest version

Land surveying equipment and methods shall meet or exceed the requirements of the Contract payment surveys, as defined in the *Control and Topographic Surveying* Engineer Manual (EM 1110-1-1005) prepared by the U.S. Army Corps of Engineers, dated January 1, 2007, or the latest version.

The Construction Inspectors and Construction Manager (and CQAO, as requested) will review the results of all Contractor surveys on an ongoing basis to verify that survey results demonstrate consistency with the progress of work reported in the Contractor DCRs, and to confirm completion of the work in accordance with the requirements of the Contract documents. The Construction Manager shall notify the Project Representative immediately if review of Contractor surveys indicates that work being completed is not in compliance with the requirements of the drawings and specifications; in such a situation, the Construction Manager will provide recommendations for corrective action for the Project Representative to review. The Project Representative will coordinate with the Owner's CCPM and EPA to decide upon corrective actions, if warranted.

3.5.4.1 Quality Assurance for Surveying

QA surveying may be conducted at the discretion of the Project Representative (per recommendation from the Construction Manager or CQAO) to ensure that the Contractor's QC surveys are complete and accurate. The Owner may hire a separate QA licensed surveyor to help review the Contractor's QC licensed surveyor's work or conduct its own QA survey; the Owner's QA surveyor may compare the results of its QA surveys to those of the Contractor's surveys and identify any significant discrepancies. The results of any review will be provided in WFARs, as applicable, and any edits to volumes or other quantities will be discussed in the WFAR. The decision whether to include a separate QA surveyor on the IQAT will be made by the Owner during pre-construction review of the Contractor's RAWP; if the Owner decides to hire a separate QA surveyor, the Owner's CCPM or Project Representative will inform EPA.

3.6 Inspection Requirements for Monitoring Structural Works

The Structural Monitoring Inspectors, who will report to the Construction Manager, will conduct structural inspections and monitoring to confirm compliance with Specifications Sections 02 41 00

(Demolition and Salvage), 31 09 00 (Geotechnical Instrumentation and Condition Inspections), 31 62 10 (Steel Pipe Piling), 32 32 10 (Bulkhead Wall Systems), as well as with details stated on the drawings. The schedule for structural inspection and monitoring activities will be determined based on the Contractor's RAWP and proposed schedule for structures demolition and modification work. Structural monitoring observations will be documented by the Structural Monitoring Inspectors for inclusion in the DFAR. Monitoring details for the structural inspections are provided on the drawings and in the specifications. No standalone structures monitoring plan is included in this CQAP.

During completion of all structural demolition and modification work, the Contractor will be required to follow BMPs and meet any construction conditions imposed by EPA through ARARs compliance, as directed by the Project Representative. Such conditions may include those regarding pile driving conditions included in the Biological Opinion (or substantive compliance letter) provided by the Services (i.e., National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Washington State Department of Fish and Wildlife) or included by EPA in the Clean Water Act Section 404 ARAR Memorandum (EPA 2024).

3.6.1 Demolition and Removal (Identified Debris and Piles)

Piling removal (i.e., extraction of derelict timbers) will be performed prior to dredging and material placement activities at an SMA, as described in Specifications Section 02 41 00 (Demolition and Salvage). Candidate structures for demolition include treated timber piles and dolphins located within SMAs. Pilings designated for removal are shown on the drawings. Construction inspectors will observe the Contractor's activities to verify that pile removal is performed at the correct locations and complies with pile demolition specifications and the Contractor's RAWP. Removed pilings will be transported to EPA-approved off-site permitted disposal or recycling facilities, if accepted by the facility.

Identified debris removal (i.e., large debris that cannot be removed with standard dredging equipment, as defined in the specifications) will also be performed prior to dredging and material placement activities at an SMA, as described in Specifications Section 35 20 23 (Remedial Dredging). Identified debris is shown on the drawings. Construction inspectors will observe the Contractor's activities to verify that identified debris removal is performed at the correct locations and complies with identified debris removal specifications and the Contractor's RAWP. Removed identified debris will be transported to EPA-approved off-site permitted disposal or recycling facilities, if accepted by the facility.

Characterization of identified debris and off-site disposal or recycling at an approved location is the Contractor's responsibility. Any materials to be recycled must be acceptable to the recycling facility,

and the facility must be approved by EPA as a suitable off-site facility. Trucks, rail, or barges may be used to transport demolition debris to an approved and permitted disposal or recycling facility.

Potential environmental concerns include releases of turbidity, debris, or petroleum hydrocarbons into the water column during demolition or removal of pilings and identified debris. Control measures to prevent such releases will be outlined in the Contractor's RAWP, as appropriate. The Contractor will be required to stage an oil containment boom during piling and identified debris removal. The Contractor will also be required to maintain a supply of oil-absorbent pads and snares on any dredged material haul barges; these items will be employed if visible oil sheens are observed.

Environmental conditions will be observed by the Contractor and Construction Inspectors during demolition and removal activities, including:

- Presence of oil sheen associated with construction activities
- Presence of turbidity plume
- Evidence of distressed or dying fish
- Floating debris and/or suspended materials generated by construction activities

Any such observations will be communicated to the Construction Manager and Project Representative for documentation and potential corrective action, as determined by the Project Representative.

3.6.2 Modification of Existing Structures, Outfalls, and Utilities and Pile Installation

The RD includes limited work to modify existing structures, such as the installation of replacement pilings (as shown on the drawings) for Tribal fishing purposes. Other structures modifications include constructing outfall scour protection at certain locations where an outfall is located near an SMA (as shown on the drawings), to help protect the remediated SMA from future scouring from existing outfall discharge. In addition, temporary shoring of an existing bulkhead (sheetpile wall) is required to allow dredging and debris removal adjacent to the bulkhead.

Pile installation locations are shown on the drawings, and pile installation requirements are described in Specifications Section 31 62 10 (Steel Pipe Piling). Construction inspectors will observe Contractor activities to verify that pile installation is performed at the correct locations and complies with pile installation specifications and the Contractor's RAWP.

No outfall structures are identified for demolition and replacement because there are no active outfalls located within the SMAs; any outfall structures encountered will be protected in place. Inactive/abandoned outfalls within SMAs are assumed to have been removed. If an

inactive/abandoned outfall is encountered in an SMA and its location impacts the Contractor's ability to complete the remedial action, the Contractor will be required to remove the inactive/abandoned outfall and grout/plug the remaining pipe in the bank. Specifications Section 35 20 23 (Remedial Dredging, Barge Dewatering, and In-water Transportation) describes the Contractor's requirements when encountering inactive/abandoned outfalls. Specifications Section 33 05 25 (Outfall Energy Dissipation Structures) describes the Contractor's requirements when constructing outfall scour protection. Construction inspectors will observe Contractor activities to verify that the Contractor is meeting specifications requirements and Contractor RAWP means and methods for scour protection layer thickness and material gradations, as well as achieving required placement limits.

Shoring requirements are included in Specifications Section 32 32 10 (Bulkhead Wall Systems) and the Contractor will be required to describe its means and methods for implementing shoring as part of its RAWP. Construction inspectors will observe Contractor activities to verify that shoring installation meets specifications requirements and complies with the Contractor's RAWP.

The Contractor will be required to conduct its own utility locate notification to 811. The RD has previously conducted utility locates, and the drawings show all identified utilities located within an SMA. The Contractor will be responsible for identifying in its RAWP whether the Contractor's means and methods have the potential to adversely affect any buried and active utilities, and for proposing mitigative measures (including construction offsets) to prevent damage to any buried utility. Construction inspectors will observe Contractor activities to verify that the Contractor is complying with specifications and the Contractor's RAWP and carefully working around identified utilities to ensure utilities are protected in place.

3.7 Environmental Compliance and Monitoring

This section describes the environmental monitoring program for the upper reach remedial action implementation. The objective of the program will be to conduct environmental monitoring to verify that the work is being carried out in general accordance with ARARs, approved environmental monitoring plans, and off-site permit requirements (if applicable).

3.7.1 Environmental Compliance Documentation

The Contractor will submit an Environmental Mitigation Binder, per Specifications Section 01 35 43 (Environmental Procedures), describing the environmental protection measures and monitoring activities that the Contractor will be required to implement during completion of construction activities. The Environmental Mitigation Binder will cover potential environmental releases as a result of construction operations on land, as well as monitoring and corrective actions necessary to control such releases. The Environmental Mitigation Binder will contain separate sections addressing contamination prevention, containment and cleanup, stormwater pollution prevention,

stormwater control, noise level control, light control, air pollution and dust control, and water quality. The following plans are described in Specifications Section 01 35 43 (Environmental Procedures) and will be included as part of the Environmental Mitigation Binder, which is an appendix to the RAWP:

- Water quality protection plan
- Erosion and sediment control plan
- Stormwater pollution prevention plan
- Water management plan
- Spill prevention, control, and countermeasure plan
- Air pollution and odors control plan
- Noise control plan
- Light control plan
- Personnel and equipment decontamination plan
- Traffic control plan

The Project Representative, key members of the IQAT, and EPA will review the Contractor's Environmental Mitigation Binder. The Environmental Mitigation Binder must be approved by the Owner and EPA (in conjunction with the RAWP) prior to the start of construction activities.

3.7.2 Environmental Monitoring Program

Following Owner and EPA approval of the Contractor's Environmental Mitigation Binder and prior to starting construction activities, the Project Representative, Construction Manager and the EQAOs will implement an environmental monitoring program that will include the following monitoring elements:

- WQMP
- Sediment QAPP
- ANLMP
- Cultural resources monitoring as required by the MIDP

Implementation of these four environmental monitoring plans will be led by the EQAOs, who will report results to the Construction Manager and coordinate nonconformance and need for contingency or corrective action with the Project Representative and EPA as necessary.

3.7.2.1 Water Quality Monitoring Plan

Water quality monitoring will be conducted during dredging activities to monitor potential water quality impacts caused by contaminated sediment resuspension or dredge return water. Water quality monitoring activities will be managed by the Field Lead for water chemistry monitoring and analysis and the Construction Manager for conventional water quality monitoring in accordance with the procedures described in the WQMP (Appendix A) to confirm water quality compliance

criteria are maintained throughout the project. The Contractor will be responsible for conducting construction operations that result in compliance with the water quality criteria identified in the specifications. If the Contractor's dredging operations are not in compliance with the water quality criteria, the Project Representative will direct the Contractor to modify its operations or, if the Contractor continues to be out of compliance, to stop work. Stop work decisions will be made in consultation with EPA. Refer to the WQMP for specific reporting and response procedures for any exceedances of water quality criteria.

Water quality monitoring summaries and data will be submitted to EPA during construction, as described in the WQMP and this CQAP and in compliance with the Clean Water Act 404 ARAR Memo from EPA (EPA 2024).

3.7.2.2 Construction Sediment Sampling QAPP

Construction sediment sampling will be performed following completion of required dredging activities to confirm that post-dredge surface sediment concentrations meet ROD-defined post-dredge surface concentration requirements, and to inform the need for conducting contingency re-dredging activities. In addition, sediment sampling will be performed near two public access or habitat areas, as defined in the Sediment QAPP. Public access area sediment sampling and post-dredge confirmation sampling and testing will be conducted by the sediment sampling team and the analytical laboratory(ies) under direction of the Field Lead after the Project Representative accepts that required dredging activities are complete, based on required dredge elevation or thickness (i.e., following review of the post-dredge survey for an SMA). Details for sediment sampling—including sampling locations, methods, and laboratory analysis and reporting of post-dredge confirmation sampling—are described in the Sediment QAPP (Appendix B). The decision framework for contingency re-dredge actions and RMC placement is described in Section 5.2.

3.7.2.3 Air, Noise, and Light Monitoring Plan

Specification Section 01 35 43 (Environmental Procedures) references applicable codes and standards with which the Contractor will be required to comply. ANL monitoring may be conducted during construction activities when there are community complaints, when Contractor work occurs at nighttime, and when construction begins, as described in the ANLMP (Appendix C). The purpose of this monitoring will be to document that the Contractor's equipment and operations are not exceeding local ANL ordinances. The only land-based remedial actions to take place are expected to occur at industrial sites. However, some of the construction activities will take place close to residential communities, some located directly adjacent to the waterway and some composed of live-aboard residents at two marina facilities on the upper reach. ANL monitoring activities will be managed by the ANL Monitoring Lead in accordance with the procedures described in the ANLMP (Appendix C). Based on monitoring results, the Contractor may be required to modify construction

operations, implement additional BMPs, or revise working hours to meet ANL quality concerns. The Project Representative will be responsible for communicating any needs for corrective action to the Contractor.

3.7.2.4 Cultural Resources Monitoring

Cultural resources monitoring and inadvertent discovery protocols will be in place during dredging and excavation activities to identify whether cultural resources items of interest are encountered. Cultural resources monitoring will be managed by the Cultural Resources Monitoring team in accordance with the procedures described in the MIDP (Appendix D). This plan describes the details and sequencing for completing cultural resources monitoring activities; it also provides the process that must be followed if a cultural resource item of interest is identified during dredging and excavation activities. The Cultural Resources Monitoring team will communicate any concerns or required actions to the Construction Manager, who will then advise the Project Representative for communication to the Contractor regarding any need for corrective action or stop work direction.

3.8 Health and Safety

The EPA Remedial Project Manager will be responsible for overall site health and safety per National Contingencies Plan 300.150, and the Contractor will be responsible for Work Site health and safety for anyone entering into the Work Site (e.g., Contractor staff, IQAT, Owner and EPA representatives, community). The Contractor's HASP will be the primary HASP with which anyone working in the Work Site must comply. Other workers (e.g., IQAT construction inspectors and environmental monitors) will also need to comply with their own HASPs, as appropriate to the activity. EPA employees will follow an EPA site-specific HASP that will meet or exceed requirements in the Contractor's HASP for a site visitor or observer overseeing the work. If IQAT construction inspectors or environmental monitors observe unsafe actions, they will immediately notify the SSHO and Project Representative, who will inform the Contractor's SSHO.

The Project Representative and IQAT's SSHO will be responsible for documenting and reporting on safety issues for the IQAT. Each member of the IQAT will comply with both the IQAT HASP and the Contractor's HASP. All personnel on the IQAT will be responsible for observing and notifying the SSHO if they observe violations of the IQAT HASP or the Contractor's HASP associated with IQAT personnel actions.

4 Contract Administration

Contract administration will be primarily the responsibility of the Owner's CCPM, with support from the Project Representative, Construction Manager, and PPS-CM Contract Manager (and CQAO and EQAO, as requested). The Project Representative's role in contract administration will be to assist in the review of the following elements:

- Construction progress payments
- Requests for information
- Field changes change orders
- Identification of nonconformance and/or noncompliance
- Contingency and corrective action recommendations
- Other requests that may come from the Owner's CCPM

Implementation of all contract administration elements and communications with the Contractor will be the responsibility of the Owner's CCPM and the Project Representative. Specific details regarding management of changes to the design, assessment of nonconformance and noncompliance, and the process for identifying and implementing corrective actions will be developed by the Owner in conjunction with and approved by EPA.

5 Contingency Actions, Corrective Actions, and Notification Process

Construction QA inspection and monitoring of the Contractor's activities will be performed by the IQAT on the Owner's behalf to verify that the Contractor's work is complying with design drawings and specifications, the Contractor's approved RAWP, and ARARs. When there is an observed nonconformance, the Project Representative will notify the Contractor and direct the Contractor to perform corrective actions in order to bring the construction work into compliance; the Project Representative will document the Contractor's efforts in this regard.

EPA will be notified and coordinated with whenever there is an environmental compliance issue, contingency re-dredging decision, potential design deviation (e.g., contract administration), or health and safety incident. However, most nonconformance notifications will not require EPA coordination or approval when the nonconformance is not related to environmental compliance, contingency re-dredge decisions, design deviations, or health and safety incidents, and when previous EPA-approved contingency actions are already part of the design.

For environmental compliance, the Project Representative will provide appropriate notifications to EPA in accordance with the WQMP, Sediment QAPP, ANLMP, and MIDP and coordinate with EPA to evaluate if contingency or corrective actions are required, as summarized below.

5.1 Water Quality Monitoring

In the event of a confirmed water quality exceedance, the Project Representative will notify the Contractor and EPA PM as soon as possible (within two hours) of the confirmed exceedance, and the Contractor will be directed to identify and implement its approach to return dredging operations to compliance with water quality criteria. If the water quality exceedance continues, even with additional BMPs and/or operational modifications, the Project Representative will discuss next steps with the Contractor and EPA to evaluate if additional corrective actions or a stop work contingency are needed, as described in the WQMP.

5.2 Sediment Sampling

After required dredging has been completed and accepted by the Project Representative, post-dredge sampling confirmation, EPA coordination, and contingency actions will be implemented as described in the Sediment QAPP.

The decision framework that will be used to evaluate the sediment samples and evaluate what (if any) contingency actions are needed is presented in Figure 5-1 and Table 5-1. In addition, Figure 5-2 provides an overview of the timing and sequencing of these activities. The table and figures describe how the sediment data will be evaluated (i.e., the applicable thresholds for each

type of sample), and what the resulting actions will be in each situation. Depending on the results of the sediment sampling, contingency actions may be required. The two types of contingency actions that may be required include re-dredging and/or placement of RMC.

- **Contingency re-dredging** will be required on a Decision Unit (DU)[2]-specific basis under the following conditions.
  - **Missed inventory** – If the concentration(s) in a subsurface 0- to 30-cm core interval are greater than the surface sediment remedial action level (RAL). If the concentration in the 0- to 30-cm interval is less than the RAL, but concentrations in deeper intervals are greater than the surface sediment RAL, the need for contingency re-dredging based on missed inventory will be determined by EPA in coordination with the Project Representative and the Designer.
  - **Generated residuals** – If concentration(s) in a 0- to 10-cm sample within the toe of cut of the dredge prism are more than three times the surface sediment RAL.

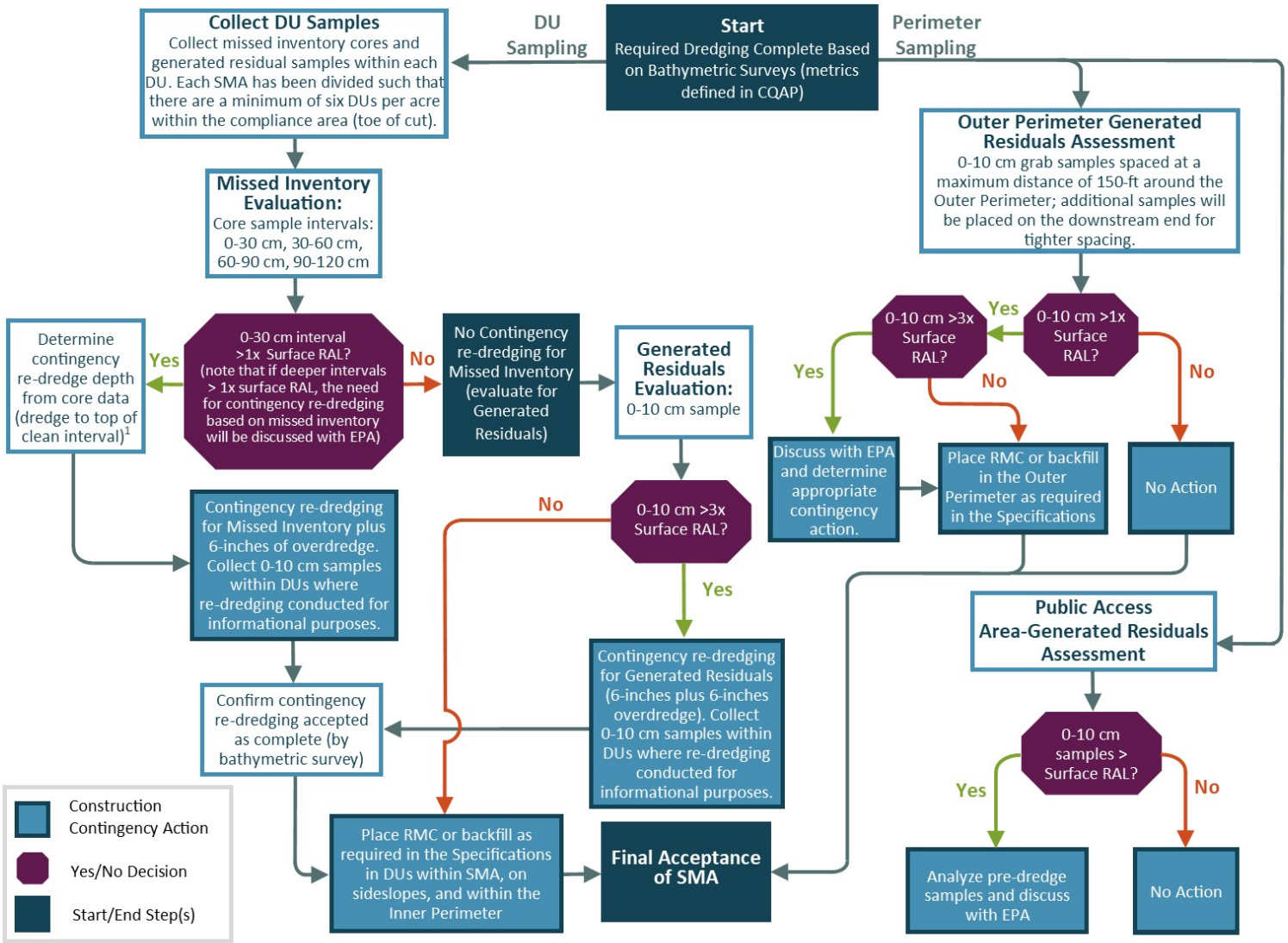
  Note that if missed inventory is discovered for a given DU, the contingency action will be based on the depth of the missed inventory. Re-dredging for missed inventory would result in a deeper contingency re-dredge than that for generated residuals; however, the missed inventory and generated residual samples will be collected concurrently. The specifics of the contingency re-dredging (i.e., the target depth in each DU) will be determined by EPA in coordination with the Project Representative and the Designer, based on the sediment sampling results.
- **Placement of RMC** in the outer perimeter of a dredge prism will be required to address generated residuals if perimeter samples have concentrations that are greater than the surface sediment RALs. Note that RMC will also be placed automatically within the dredge prism, on the side slopes after the completion of dredging (or re-dredging if applicable), and in the inner perimeter of the dredge prism.

If one or more of the post-dredging samples collected adjacent to a given public access or habitat area has a contaminant concentration greater than the surface sediment RAL, contingency actions will occur as follows.

- The sample(s) taken prior to dredging will be analyzed for the chemical(s) with RAL exceedances to assess temporal differences.
- Discussions with EPA will occur regarding next steps (e.g., potential contingency actions).

[2] For the purposes of evaluating the removal actions and conducting construction sediment sampling, each SMA has been divided into DUs, such that there are at least six DUs per acre within the compliance area (toe of cut). One missed inventory core and one generated residual surface sample will be collected within each DU. DUs are discussed further in the Sediment QAPP.

Figure 5-1
Post-Dredge Confirmation Sampling and Contingency Action Decision Framework



[1] If the depth of contamination is not defined by the missed inventory core, EPA may require additional information prior to confirming the re-dredge depth.

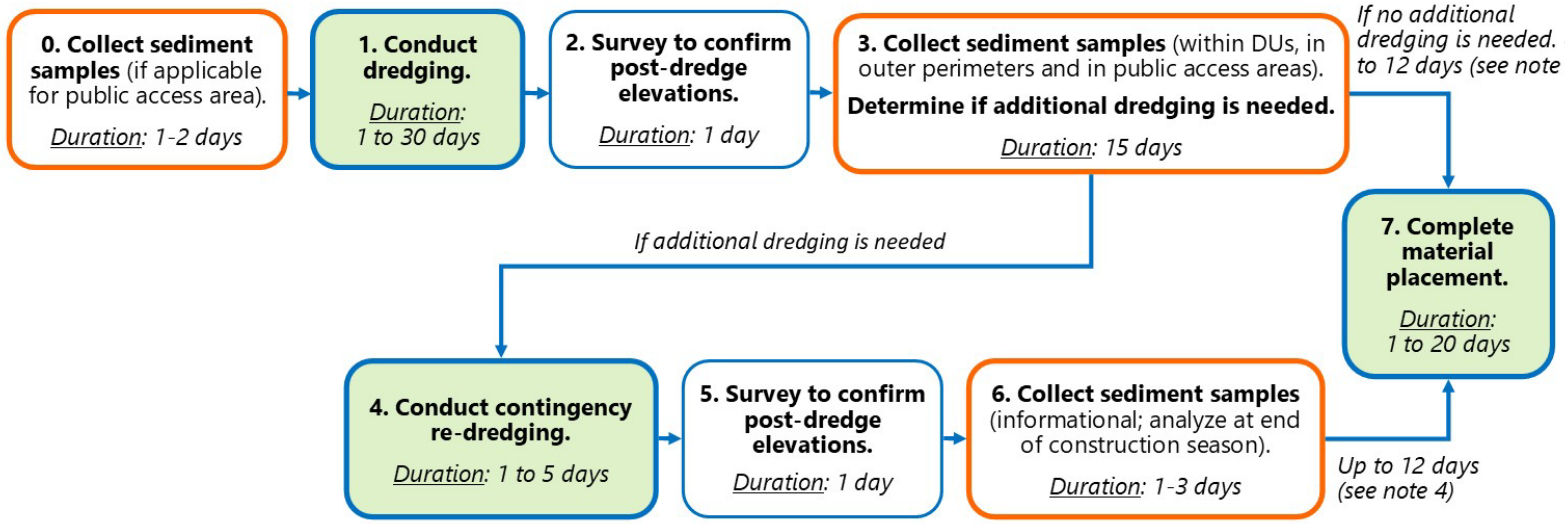
Table 5-1
Summary of Post-Dredge Confirmation Sampling and Contingency Action Framework

Sampling Objective	Sample Type[1]	Criteria[2]	Contingency Action	
			Contingency Re-Dredging	**RMC Placement[3]**
Missed Inventory within DUs[4]	120-cm [4-foot] subsurface sediment core (0–30 cm, 30–60 cm, 60–90 cm, and 90–120 cm)	<1x surface RAL	If 0–30-cm and deeper-interval sample results are less than surface RAL, no re-dredging for missed inventory. However, if deeper intervals have results greater than the surface RAL, the need for contingency re-dredging based on missed inventory will be determined by EPA in coordination with the Project Representative and the Designer.	Within DU: Place RMC (targeted 9-inch thickness) or backfill (to targeted pre-construction elevations/grades) Within Inner Perimeter: Place RMC (targeted 9-inch thickness) or backfill (to targeted pre-construction elevations/grades) Side slopes: Place RMC (targeted 2-foot thickness) or backfill (to targeted pre-construction elevations/grades)
		>1x surface RAL	If 0–30-cm sample result is greater than surface RAL, contingency re-dredge down to top of 30-cm interval (within the 120-cm [4-foot] core) that does not have concentrations greater than the RAL, plus 6-inch overdredge	
Generated Residuals within DUs[5]	Surface sediment sample (0–10 cm)	< 3x surface RAL	If 0–10-cm sample result is less than 3x the surface RAL, no re-dredging for generated residuals	
		> 3x surface RAL	If only the 0–10-cm sample result is greater than 3x the surface RAL, contingency re-dredge for generated residuals (6 inches plus 6-inch overdredge)	
Generated Residuals in the Outer Perimeter (includes EAAs)[6]	Surface sediment sample (0–10 cm)	< 1x surface RAL	Not applicable (No contingency dredging planned in outer perimeter)	If 0–10-cm sample concentrations are less than the surface RAL, no action required
		> 1x surface RAL		If 0–10-cm sample concentrations are greater than the surface RAL, place RMC (targeted 9-inch thickness) in Outer Perimeter station with RAL exceedance halfway to adjoining stations
		> 3x surface RAL		If 0–10-cm sample concentrations are greater than 3x the surface RAL, discuss results with EPA before placing RMC
Public Access Area Generated Residuals	Surface sediment samples (0–10 cm)	> 1x surface RAL	If a post-dredge surface sediment sample has contaminant concentration(s) greater than the RAL, analyze pre-dredge sample(s) and discuss results with EPA to evaluate next steps.	

Notes:

1. Details regarding sample types and placement are presented in Section 4.1 of the Sediment QAPP (Appendix B).
2. Analytes are SMA-specific (see Section 4.1.2 of the Sediment QAPP). Surface sediment RALs are those presented in the 2014 LDW ROD (e.g., 12 mg/kg-organic carbon for total polychlorinated biphenyls), except for carcinogenic polycyclic aromatic hydrocarbon RALs, which are presented in the Explanation of Significant Differences (EPA 2021).
3. All RMC thicknesses are targeted thicknesses (construction specifications for acceptable tolerances for RMC placement are presented in this CQAP).
4. For thin-cut dredge areas (1-foot cut), there is no missed inventory sampling.
5. As shown in Figure 5-1, generated residuals within a given DU are only addressed if there is no missed inventory because re-dredging for missed inventory would result in a deeper contingency re-dredge than that for generated residuals. The missed inventory and generated residual samples will be collected concurrently.
6. The outer perimeter is the 20-foot width outside the inner perimeter boundary, except for downstream where the outer perimeter is 30 feet wide. 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), except for downstream where the inner perimeter is 30 feet wide.
Cm: centimeter
DU: Decision Unit
EAA: early action area
EPA: U.S. Environmental Protection Agency
mg/kg: milligram per kilogram
QAPP: quality assurance project plan
RAA: remedial action area
RAL: remedial action level
RMC: residuals management cover
SMA: Sediment Management Area

Figure 5-2
General Construction Sediment Sampling Flowchart for a Single SMA



Notes:

1. For SMAs adjacent to public access or habitat areas (i.e., Duwamish Waterway Park and People's Park), sediment samples will also be collected along the shoreline both prior to and after dredging.
2. All durations are in terms of working days.
3. Green boxes with blue outlines indicate tasks to be completed by the construction Contractor. Boxes with orange outlines indicate tasks to be completed by the Independent Quality Assurance Team.
4. After completion of all dredging activities for an individual SMA, and accepted by the Project Representative, the Contractor shall conduct applicable material placement of Backfill Material, Required RMC, Inner Perimeter RMC, Contingent Outer Perimeter RMC, and Engineered Cap B, as shown on the Drawings and described in Section 35 37 10 (Material Placement) within the individual SMA. a. The Contractor shall begin material placement Work within 12 working days of receiving approval to proceed from the Project Representative, unless an exception is requested for a specific SMA by the Contractor and approved by the Project Representative.

5.3 Air, Noise, and Light Monitoring

As described in the ANLMP (Appendix C), if ANL monitoring is triggered during construction, EPA will be informed of the monitoring and its results by the next workday (or when data from the laboratory are available, if applicable). Should monitoring results indicate that the Contractor is exceeding threshold criteria, the Project Representative will notify the Contractor and direct the Contractor to implement corrective actions to its operations to return them to compliance with criteria.

5.4 Cultural Resources Monitoring and Inadvertent Discovery

If Tribal or other cultural materials are inadvertently discovered during excavation, project specifications require that dredging/excavation cease and the affiliated Tribe(s) or other group(s) be notified and consulted. The Project Representative will implement reporting and notification requirements as described in the MIDP (Appendix D), which will include notifying EPA within two hours of the discovery; such a notification may include leaving a voicemail message, particularly if notification occurs outside of regular work hours.

6 References

Anchor QEA, Windward. 2024. 100% Remedial Design, Volume II – Part I, Construction Quality Assurance Plan for the Lower Duwamish Waterway Upper Reach. Final. Submitted to EPA January 17, 2024. Anchor QEA, Inc. and Windward Environmental LLC, Seattle, WA.

Anchor QEA, Windward. 2019. Remedial design work plan for the Lower Duwamish Waterway upper reach. Final. Submitted to EPA December 16, 2019. Anchor QEA, Inc. and Windward Environmental LLC, Seattle, WA.

Anchor QEA, Windward. 2023. Pre-final (90%) remedial design basis of design report for Lower Duwamish Waterway upper reach. Draft. Submitted to EPA July 24, 2023. Anchor QEA and Windward Environmental LLC, Seattle, WA.

EPA. 2014. Record of Decision. Lower Duwamish Waterway Superfund Site. US Environmental Protection Agency.

EPA. 2021. Proposed explanation of significant differences. September 2021. Lower Duwamish Waterway Superfund site. US Environmental Protection Agency Region 10, Seattle, WA.

EPA. 2022. Close out procedures for National Priorities List sites. OLEM directive 9320.2-23. Office of Superfund Remediation and Technology Innovation, US Environmental Protection Agency, Washington, DC.

EPA. 2024. Clean Water Act §404 ARAR Memo: Substantive Water Quality Requirements for the Lower Duwamish Waterway Upper Reach Superfund Remedial Action. Final. Prepared by U.S. Environmental Protection Agency Region 10, Seattle, WA. OCtober 15, 2024.

Pacific Pile & Marine, 2024. Lower Duwamish Waterway Upper Reach Final Remedial Action Work Plan, Lower Duwamish Waterway Upper Reach REmedial Actino. Prepared by Pacific Pile & Marine, Seattle, WA. Prepared for King County - WTC Construction. September 2024 (work in progress)

Construction Phase, Revision 1

Appendix A
Water Quality Monitoring Plan

Lower Duwamish Waterway Group

City of Seattle / King County / The Boeing Company

CONSTRUCTION PHASE CQAP FOR THE LOWER DUWAMISH WATERWAY UPPER REACH

APPENDIX A – WATER QUALITY MONITORING PLAN

For submittal to

The US Environmental Protection Agency
Region 10
Seattle, WA

October 22, 2024

Prepared by:

Geosyntec consultants
520 Pike Street • Suite 2600
Seattle, Washington • 98101

and

Windward environmental LLC
200 1st Ave W • Suite 500
Seattle, Washington • 98119

in association
with

ANCHOR QEA
1201 3rd Ave • Suite 2600
Seattle, Washington • 98101

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

ABBREVIATIONS

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*
COC	contaminant of concern
CQAP	Construction Quality Assurance Plan
CRM	certified reference material
CV-AA	cold vapor-atomic absorption
CV-AFS	cold vapor-atomic fluorescence spectrometry
CWA	Clean Water Act
DO	dissolved oxygen
DQI	data quality indicator
EPA	U.S. Environmental Protection Agency
EQAO	Environmental Quality Assurance Officer
FNU	Formazin Nephelometric Unit
FLPE	fluorinated high-density polyethylene
GC-ECD	gas chromatography-electron capture detection
GPS	global positioning system
HDPE	high-density polyethylene
ICP-MS	inductively coupled plasma-mass spectrometry
LCS	laboratory control sample
LDW	Lower Duwamish Waterway
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NTU	nephelometric turbidity units
PCB	polychlorinated biphenyl
PM	Project Manager
QA/QC	quality assurance/quality control
RD	remedial design
RL	reporting limit
RPD	relative percent difference
SMA	sediment management area
WAC	Washington Administrative Code
WQMP	Water Quality Monitoring Plan

1 Introduction

This Water Quality Monitoring Plan (WQMP) is an appendix to the Construction Phase Quality Assurance Plan (CQAP) for the upper reach of the Lower Duwamish Waterway (LDW). The upper reach encompasses river mile 3.0 to river mile 5.0 of the LDW. The Remedial Design (RD) was prepared consistently 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 the *Explanation of Significant Differences* (EPA 2021). The purposes of the LDW upper reach WQMP are to obtain water quality data during construction to identify water quality effects that may be caused by remedy construction, and to use those data to identify the need to implement additional best management practices (BMPs) and/or operational measures for dredging and debris removal to address water quality effects in compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

This WQMP identifies the specific requirements for monitoring water quality during in-water dredging, including steps to be taken to mitigate exceedances of water quality criteria, if any occur. This WQMP also includes monitoring during removal of identified debris[1] below the water line and placement of clean material. The draft final WQMP was included in the Final (100%) RD for the LDW upper reach. This plan has been updated by the Construction Management team, in coordination with EPA, as necessary to reflect any conditions or requirements in the final Clean Water Act (CWA) §404 ARAR Memorandum. (EPA 2024). This plan has been updated to identify key staff in the organizational chart and present remaining monitoring details.

1.1 Project Description

Remedial activities in the LDW upper reach are described in the *Basis of Design Report* (BODR). Construction BMPs, environmental protection measures, and water quality management controls for the anticipated work activities are described in Section 11 of the BODR.

The in-water components of the upper reach remedy will be conducted within the LDW-designated in-water work window, which is expected to occur between October 1 and February 15, annually. Scheduling will also take into account the tribal net fishery. The total project is estimated to take approximately three construction seasons to complete, as discussed in Section 13 of the BODR.

[1] "Identified debris" refers visible nearshore debris specifically in areas identified in the remedial design drawings. Intensive conventionals monitoring is required during the removal of identified debris below the water line. Water quality effects associated with the removal of smaller debris encountered during dredging will be addressed using the level of monitoring already occurring during dredging. If larger debris is encountered that requires targeted removal from an SMA, intensive conventionals monitoring will be performed for the duration of the debris removal.

The Implementing Entity (LDWG) has designated the Owner's Project Representative and the Construction Manager or designee to oversee water quality monitoring during dredging activities to ensure compliance with Washington State water surface water quality criteria.

Water quality monitoring will not be performed when land-based excavation alone (i.e., no in-water work) 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.

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 (Appendix M of the 100% RD). The conclusion was that water quality criteria are unlikely to be exceeded for contaminants of concern (COCs) from resuspension of sediment during dredging operations, or from barge dredge return water discharge.

The results of Appendix M 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

The individuals responsible for various tasks required for water quality monitoring sample collection and analysis are described here and shown in CQAP Figure 2-1. All monitoring personnel will be experienced in the collection and measurement of water quality data.

2.1 Project Representative

The Project Representative for this project is Shannon Phipps (King County). This role is described in the CQAP; the Project Representative is assigned by the Owner (King County) to oversee the entire construction QA program. The Project Representative is the only person authorized to direct the Contractor and will be kept updated on water quality monitoring results and notified when there is an observed water quality exceedance. The Project Representative will work closely with the Construction Manager and Project Coordinator to coordinate notifications to EPA of confirmed water quality exceedances. The Project Representative will coordinate with the Contractor and EPA to ensure appropriate construction BMPs are being implemented and strategize ways to use BMPs or enhance the effectiveness of existing BMPs as necessary to mitigate water quality exceedances. The Project Representative will have the authority to stop the Contractor's work when necessary, including for reasons related to water quality exceedance(s).

2.2 Construction Manager

The Construction Manager for this project is Jeff Williams (Geosyntec). This role is described in the CQAP; the Construction Manager is the on-site day-to-day oversight QA representative to assist the Project Representative oversee the entire construction QA program.

2.3 Environmental Quality Assurance Officer

The Environmental Quality Assurance Officers (EQAOs) for this project are Susan McGroddy (Windward Environmental) (EQAP-1) and Michaela Lawrence (Geosyntec) (EQAP-2). The roles of the EQAOs are described in the CQAP. The EQAOs are responsible for coordinating, reviewing, and reporting all environmental monitoring activities, including water quality monitoring. The EQAOs report to the Construction Manager; key responsibilities for water quality monitoring include:

- Reviewing field reports to verify that appropriate field methods and QC procedures are being implemented in accordance with the procedures specified in this WQMP
- Overseeing coordination of the field sampling and laboratory programs and supervising data review, including coordination with the analytical laboratories and the EPA QA chemist, Don Matheny. Don Matheny is the EPA contact for this project and works on behalf of the EPA QA manager, Cindy Fields. Mr. Matheny can be reached as follows:

  - Mr. Don Matheny
    US Environmental Protection Agency, Region 10
    1200 6th Avenue
    Seattle, WA 98101
    Telephone: 206.553.2599
    Email: matheny.don@epa.gov
- Reporting weekly water quality results to the Project Representative and/or Construction Manager, who then report findings to EPA Project Manager
- Notifying the Project Representative and/or Construction Manager, who then report findings to EPA if a confirmed water quality exceedance is observed, and working with the Project Representative to coordinate with EPA to assess options for operational adjustments

2.4 Field Sampling Lead

Water Quality Monitoring has two components – field monitoring for water quality parameters including turbidity and collection of field samples for chemistry testing. The Field Sampling Lead for this project is Suzanne Replinger (Windward Environmental). The role of the Field Sampling Lead is described in the CQAP for surface water sampling. This person is responsible for the following activities:

- Overseeing surface water chemistry sampling activities and field personnel
- Overseeing sample collection, preservation, and holding times, and coordinating delivery of water quality samples to the designated laboratories for chemical analyses.
- Verifying that station and sample collection results are properly recorded and forms are completely filled out
- Verifying that appropriate field sampling equipment calibration and quality assurance/quality control (QA/QC) field procedures are being implemented for field sampling
- Coordinating with the analytical laboratories to track the progress of sample testing
- Notifying the EQAOs, Construction Manager, and Project Representative when water quality exceedances are observed, and providing all necessary supporting field documentation so the Project Representative can identify an appropriate path forward can be determined in consultation with EPA.
- For conventional parameter monitoring only, these responsibilities will be covered by the EQAO for monitoring (EQAO-2 Geosyntec).

2.5 Monitoring Personnel

The water quality field monitoring personnel (Red Barn Group, Windward, and Geosyntec) will be responsible for conducting field activities, instrument calibrations, QA/QC procedures, and documentation of results in daily field reports. Persons fulfilling these field roles will be designated prior to the start of monitoring activities and contact information will be provided to EPA at that time.

2.6 Analytical Laboratories

The analytical laboratories performing chemical analyses include Brooks Applied Labs, Eurofins, ALS Environmental – Kelso, and Analytical Resources, LLC. Some of the labs are designated as primary, and others are alternate labs for particular analyses depending on schedule and lab capacity. Selected analytical laboratories will have current environmental laboratory accreditation from the Washington State Department of Ecology (Ecology) and other accreditation agencies for the analytical methods to be used. Any exceptions will be identified prior to implementation of this QAPP. The laboratories will meet the following requirements:

- Adhere to the methods outlined in this plan, including those methods referenced for each procedure
- Adhere to documentation, custody, and sample logbook procedures
- Implement QA/QC procedures defined in this plan
- Meet all reporting requirements
- Deliver electronic data files as specified in this plan
- Meet turnaround times for deliverables as described in this plan
- Allow EPA and the EQAO, or a representative, to perform laboratory and data audits.

2.7 Data Management

Kim Goffman (Windward Environmental) is the data manager. She will oversee data management and ensure that analytical data are incorporated into the LDW database with appropriate qualifiers following review of the data.

3 Water Quality Monitoring Plan

Water quality monitoring during construction will include monitoring conventional parameters and water chemistry. The monitoring plan has been designed to cover the anticipated range of river conditions and construction operations. However, EPA may require additional sampling for conventional parameters and water chemistry.

Monitoring for conventional parameters, described in Section 3.1, will use a tiered -testing approach. Intensive conventionals monitoring for three days will be conducted in the following circumstances:

- At the start of dredging in each sediment management area (SMA)[2]
- The first time that a new type of dredging equipment is used
- During the removal of debris below the water line (identified debris or large debris encountered during dredging)
- During dredging in the western portion of SMA 12B adjacent to the Duwamish River People's Park and Shoreline Habitat restoration area
- If an exceedance of turbidity criteria is confirmed during monitoring associated with dredging, which would trigger an additional two-day intensive monitoring period for conventionals.

Routine monitoring of conventional parameters will occur whenever intensive monitoring is not required (i.e., there are no confirmed exceedances of turbidity criteria during the three-day intensive monitoring period and any additional two-day periods for turbidity exceedances, as well as during placement of clean material). Conventionals monitoring will be conducted if a turbidity plume is observed at the 150-foot compliance station. If there is a confirmed turbidity exceedance associated with dredging, then two days of intensive conventionals monitoring will begin.

The collection and analysis of water samples for chemical analysis is described in Section 3.2. Water chemistry monitoring will occur under three specific conditions:

- Chemistry condition 1: the initiation of dredging (one event per season)[3]
- Chemistry condition 2: a confirmed turbidity exceedance associated with dredging (at least three events per season)

[2] The start of dredging is defined as the beginning of dredging in the SMA. If contingency re-dredging is required in the SMA, the initiation of contingency re-dredging will not trigger intensive monitoring of conventionals unless directed by EPA following review of results from missed inventory and residuals sediment samples.

[3] Water chemistry monitoring will occur during the placement of the first lift of cap material in SMA 12B.

- Chemistry condition 3: dredging in an area with elevated COC concentrations in sediment (relative to COC concentrations in other SMAs) or dredging in the vicinity of public access areas.

In addition to the conventionals monitoring and the chemistry monitoring, the construction inspectors will conduct daily visual observation of the Work Site for the following environmental conditions, as described in Section 3.5.1 of the CQAP. Any observations of the following conditions will be communicated to both the Construction Manager and EQAO for documentation and potential corrective action, as determined by the Project Representative in coordination with EPA:

- Presence of oil sheen associated with construction activities
- Evidence of distressed or dying fish

The Project Representative will direct the Contractor to cease work in the immediate vicinity of construction activities associated with the observed presence of oil sheens or distressed or dying fish.

3.1 Conventional Parameters

The ROD (EPA 2014) states that the LDW is considered marine water under the Washington State's water quality standards regulation, because it meets the salinity threshold described in Washington Administrative Code (WAC) 173-201A-260(3)(e), and because 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 rather 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 applicable compliance criteria for conventional parameters are the "excellent quality" Washington State Surface Water Quality Standards for marine waters (WAC 173-201A-210).

The Contractor will be responsible for construction QC including following BMPs with the goal of meeting applicable and relevant state water quality criteria at the designated point of compliance. Dredging effects on water quality are typically assessed by complying with the provisions of EPA's CWA §404 ARAR Memorandum.

The following field conventionals will be monitored during dredging activities at the compliance and background stations:

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

- Salinity[4] (in parts per thousand) – informational only.

3.1.1 Conventionals Criteria

3.1.1.1 Turbidity

Expected provisions of the CWA §404 ARAR Memorandum are that in-water construction activities do not increase in-water turbidity 5 NTU above background when background is 50 NTU or less (or 10% above background if background is greater than 50 NTU) at the compliance mixing zone distance. Compliance is typically measured at the edge of the EPA-approved mixing zone 150 feet from the construction work zone (Figure A3-1). The proposed area of mixing for marine waters is a 150-foot radius (i.e., point of compliance) surrounding the in-water activity. The background stations will be upstream and 500 feet away from the influence of the dredging activities occurring in the construction work zone. If there is a preliminary exceedance of the turbidity criteria, the EQAO-2 and Project Representative will be informed, and the turbidity will be measured again at the same station 30 minutes after the original exceedance to determine if there is a confirmed turbidity exceedance requiring corrective action (Section 5). If there are two consecutive turbidity exceedances recorded 30 minutes apart, this will be defined as a confirmed turbidity exceedance.

3.1.1.2 Dissolved Oxygen

The DO criterion in marine waters with "excellent quality" is 6.0 mg/L; the DO at the point of compliance shall not decrease to less than 6.0 mg/L within a 24-hour period, per WAC 173-201A-210: "If the background DO is less than 6.0 mg/L (or within 0.2 mg/L of that criterion) and is due to natural conditions, then human actions considered cumulatively may not cause the DO of the water body to decrease >0.2 mg/L."

3.1.1.3 Temperature

Per WAC 173-201A-210: "When the water body temperature is >16°C (or within 0.3°C of 16°C; one 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, wherein the 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 three days prior and the three days after that date.

If water body 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

[4] Salinity will be calculated based on specific conductance and temperature readings.

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 that range of <0.5 units difference from background, per WAC 173-201A-210.

Table A3-1 summarizes the conventional water quality parameters and criteria.

Table A3-1
Criteria for Conventional Parameters

Parameter	Criteria	Units
Turbidity	If background is ≤50 NTU the criteria is background +5 NTU If background is >50 NTU the criteria is background +10%	NTU
DO	≥6.0 mg/L[1]	mg/L
Temperature	Water body temperature 16°C (60.8°F): incremental temperature increases must not exceed 12°/(T-2) where T is the highest ambient background temperature[2]	°C
pH	7 to 8.5 pH units	pH units

Notes:
1. If background DO is less than 6.0 mg/L and due to natural conditions, then dredging cannot reduce the background DO by more than 0.2 mg/L. This standard is waived within the 150-ft point of compliance but at no time should DO drop below 3.5 mg/L (EPA 2024).
2. If the water body temperature is greater than 16°C (60.8°F), the incremental increase due to dredging cannot exceed 0.3°C.
DO: dissolved oxygen
mg/L: microgram per liter
NTU: nephelometric turbidity unit
WAC: Washington Administrative Code

3.1.2 Monitoring Stations and Depths

During each monitoring event, conventional parameters will be measured at both the background station (500 feet upriver of the construction work zone) and at the 150-foot compliance monitoring station. When the water depth is at least 10 feet, measurements will be made at two depths: near surface (approximately 3 feet below the water surface) and near bottom (approximately 3 feet above the mudline) (see Figure A3-1). In water deeper than 20 feet, measurements will be made at three depths: the midpoint of the water column and the near-surface and near-bottom depths. In water shallower than 10 feet, one measurement will be made in the middle of the water column. Whenever possible, samples will be collected at a location with a minimum water depth of 10 feet to minimize the potential for disturbance of the sediment bed by monitoring vessels.

Compliance stations will be based on the distance downriver from the construction activity. All compliance stations will be monitored downriver of the construction activity and at least one station each day will be monitored approximately one to two hours after a tide reversal during the ebb tide condition to represent the assumed worst-case condition.

Sediment dynamics during flood and ebb tides, including shear stress, have been assessed in the sediment transport modeling report for the LDW (Anchor QEA 2008), sediment transport analysis report for the LDW (Windward and Anchor QEA 2008), Duwamish River water quality study (King County 1999), and King County Diagonal Duwamish current meter study (unpublished data). The resuspension potential of dredge residuals is expected to be greater downstream of dredging during the ebb tide (with its higher bottom velocity) than upstream of dredging during the flood tide. Thus, turbidity monitoring downstream likely represents the worst-case scenario.

For SMA 12B, which is adjacent to the northern part of the Duwamish River People's Park and Shoreline Habitat, additional turbidity monitoring will be conducted west of the center line of the FNC during dredging. This monitoring will be conducted during the flood tide at a location 150 feet or less from the dredge location that is closest to the entrance to the marsh habitat area. For this area, the compliance station located near the inlet of the marsh habitat area will be monitored during the flood tide, and the downstream location will be monitored during the ebb tide.

If barge dewatering occurs more than 150 feet from dredging, water quality monitoring will be conducted 150 feet downstream of the barge. Barges will be required to be watertight during transit to the transload facility and during transloading of dredge material, so water quality monitoring will be conducted only during periods of active dewatering.

When in-water work occurs at more than one location simultaneously, each location should be treated no differently than if there were only one in-water work location. Specifically, each in-water activity will require its own compliance stations for water quality monitoring. The number and location of background monitoring stations will be situationally dependent. In most instances, one background monitoring station can be shared among the multiple in-water work locations. The location of the background monitoring station should be 500 feet upriver of the most upriver construction work zone.

If in-water work locations are close to one another (less than 400 feet apart), the same background monitoring station must be used. Water quality at the more downriver of the multiple in-water work locations will be influenced by the other in-water work location(s) upriver. In this situation, water quality exceedances may require implementation of BMPs not only for the in-water work location that the water quality exceedance occurred at but also at upriver in-water work locations in order to bring activities back into compliance with water quality criteria. If background water quality parameters differ between in-water work locations for reasons that are not related to remedial

construction activities, one background monitoring station per in-water work location can be used. Valid reasons to justify multiple background monitoring stations include but are not limited to:

- difference in waterway activities unrelated to remedial construction activities unequally influencing water quality parameters at one in-water work location
- change in natural background water quality due to water inputs from a stream, ditch, or channel

In advance of using more than one background monitoring station, discuss with EPA to verify that one background monitoring station is not sufficient.

3.1.3 Monitoring Frequency

Water quality monitoring frequency for conventionals will be based on two tiers—intensive and routine conventionals monitoring.

3.1.3.1 Intensive Conventionals Monitoring

Intensive conventionals monitoring will be conducted the first three days of dredging in each SMA (Figure A3-2) and will be conducted twice per day. The first daily monitoring round will be conducted at least one hour after the start of daily work activities. The second daily monitoring round will be separated from the first monitoring round by a minimum of four hours. For one of the sampling events, monitoring will target one to two hours after tide reversal during the ebb tide condition.

Intensive conventionals monitoring will also be required: 1) the first time there is a significant change to the Contractor's dredging equipment, such as changes to bucket type (e.g., environmental bucket to open clamshell bucket), 2) if there is a confirmed turbidity exceedance associated with dredging activities at the 150-foot compliance monitoring station, 3) during the removal of identified debris below the water line, and 4) during dredging in the western portion of SMA 12B in the vicinity of the entrance to the Duwamish River People's Park and Shoreline Habitat restoration area.

If no exceedances of the water quality criteria for conventional parameters are identified over three consecutive days, then routine conventionals monitoring will be implemented.

Background stations will be monitored prior to compliance stations. The compliance station(s) will be monitored within one hour of the completion of background station monitoring.

3.1.3.2 Routine Conventionals Monitoring

Routine conventionals monitoring is performed when intensive monitoring is not required. Routine monitoring during dredging will occur once per day, two days per week (Figure A3-3). Monitoring events will target one to two hours after tide reversal during the ebb tide. If a turbidity plume is

visually observed at the 150-foot compliance station at any time during dredging, monitoring will be conducted as soon as the monitoring vessel gets to the station.

During the placement of clean material, routine turbidity monitoring will also occur. Turbidity exceedances associated with the placement of clean material will not trigger intensive monitoring or chemistry sampling. EPA will be notified of turbidity exceedances associated with the placement of clean material. After the first six monitoring events associated with the placement of clean material, the Owner, Project Representative, EQAO, and EPA will discuss the data, and EPA will determine whether to discontinue turbidity monitoring during placement of clean material.

3.1.3.3 Exceedance-Triggered Monitoring

If exceedances of the water quality criteria for conventional parameters are confirmed during any dredging monitoring event, two days of intensive conventionals monitoring will occur.

3.1.4 Monitoring Methods

Water quality monitoring of conventionals will be conducted from a boat. Monitoring will be performed using a calibrated multi-probe meter (e.g., Hydrolab, YSI© probe, or similar) and/or a calibrated Hach© turbidity meter (the standard operating procedure will be provided with final WQMP). Turbidity, DO, pH, and salinity[5] will be measured and recorded for each station using field forms provided in Attachment A.1.

All stations for water column measurements will be positioned relative to the location of the dredging, debris removal, material placement, and barge dewatering activities at the time of sampling (e.g., 150 feet downriver from the construction activity) (Figure A3-1). 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 stations 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 manufacturers' recommendations. Unusual or questionable readings will be noted, and duplicate readings will be collected.

3.1.5 Conventional Parameter Compliance

The compliance station results will be compared to those for the corresponding depth intervals at the background station. For example, the near-bottom results for both stations will be compared to one another. If the background station has only one sample because of a water depth of less than

[5] Salinity will be calculated based on specific conductance and temperature readings.

10 feet, the results for all compliance station samples will be compared to the results for the background station sample.

If the water quality criteria are exceeded at the compliance station for one or more of the conventional parameters, the measurements will be repeated at the compliance station 30 minutes after the initial measurements were taken. The exceedance will be considered a confirmed exceedance if the results of the second measurement also exceeds the criteria.

EPA will be notified within two hours of a confirmed conventional parameter exceedance at the compliance station, and conventional parameter monitoring will be conducted approximately every two hours for the remainder of the day until compliance is documented. If there is a confirmed turbidity criteria exceedance during dredge monitoring or debris removal, the Project Representative will coordinate with the Contractor to identify and institute additional BMPs or modify the Contractor's operations to bring its activities back into compliance with water quality criteria. Some potential anticipated BMPs or operational changes that may be proposed by the Contractor include:

- Adjust dredging process by decreasing the velocity of the bucket through the water column and pausing the bucket above the bottom before dredging
- Decrease dredging or debris removal cycle time to reduce suspended sediment loading to water column
- Dislodge material that may adhere to the bucket over the haul barge
- Modify dredged material barge loading to reduce potential dredge material spillage
- Change buckets or modify equipment
- Use adaptive management processes to adjust dredge operations, in conjunction with discussions with EPA and monitoring to confirm that the cause of the exceedance has been addressed.

If the turbidity exceedance continues after implementing additional BMPs and/or operational modifications, the Project Representative will direct the Contractor to stop dredging activities associated with the turbidity exceedance, and EPA will be contacted to determine how to proceed.

3.1.6 Summary of Water Quality Monitoring Plan for Conventional Parameters

The water quality monitoring plan for conventional parameters is summarized in Table A3-2 and Figures A3-2 and A3-3.

Table A3-2
Summary of Conventional Parameter Water Quality Monitoring Plan

Component	Intensive Conventionals Monitoring	Routine Conventionals Monitoring
Conditions	• Contractor begins dredging a new SMA • First time there is a major change in equipment (e.g., dredge bucket type) • Removal of identified debris below the water line • Following confirmed turbidity exceedances during dredging[1] • During dredging in SMA 12B to the west of the center of the FNC as close as possible to the entrance to the Duwamish River People's Park and Shoreline Habitat restoration area	When intensive monitoring is not required during dredging or debris removal During placement of clean material
Duration	• 3 consecutive days if no confirmed exceedance • 2 additional consecutive days following any confirmed exceedance • Daily during dredging in the western portion of SMA 12B	2 days per week
Frequency	2 sampling events per day	1 sampling event per day
Conventional Parameters and Stations	Monitor *in situ* conventional parameters (turbidity, pH, DO, and temperature) per WAC 173-201A-210 at 150-foot compliance monitoring station downriver and background monitoring station 500 feet upriver of the in-water construction work zone. Sampling will occur on the ebb tide whenever possible.	
Preliminary Exceedance Criteria	Preliminary exceedance occurs when the results exceed criteria for any of the conventional parameters at the compliance monitoring station.	
Confirmed Exceedance Criteria	Exceedance is confirmed when two consecutive measured exceedances (30 minutes apart) occur at the same compliance monitoring station.	
Conventionals Water Quality Criteria Exceedance Corrective Action	• After a confirmed conventionals exceedance, Project Representative will notify EPA and Contractor within two hours. In situ conventional parameter testing will be conducted every two hours for the remainder of the day or until compliance is demonstrated. If the confirmed exceedance is a turbidity exceedance associated with dredging, Contractor will modify its operations and turbidity monitoring will be conducted every two hours (for the remainder of day or until compliance is demonstrated) after additional BMPs or operational modifications have been implemented by Contractor to demonstrate and document that Contractor's modifications have returned the site to compliance. If the turbidity exceedance continues after implementing the additional BMPs and/or operational modifications, the dredging activities associated with the turbidity exceedance will be ceased, and EPA will be contacted to determine how to proceed. • Intensive monitoring will begin for a 2-day period the next day.	

Notes:

1. Monitoring will occur if a turbidity plume is observed at the 150-foot compliance monitoring station.
BMP: best management practice
DO: dissolved oxygen
EPA: U.S. Environmental Protection Agency
SMA: sediment management area
WAC: Washington Administrative Code

3.2 Chemical Testing

Chemical testing will be conducted based on the chemistry conditions 1 through 3, summarized herein. Surface water samples will be collected in general accordance with standard operating procedure #WQMP-001 (Attachment A.2).

Chemistry condition 1: Construction initiation

Chemical testing will be conducted at the initiation of construction for each season to assess whether dredging activities result in a water quality chemical criteria exceedance. Samples will be collected after the Contractor has finished its startup operations and tested its equipment operational methods and has been production dredging for at least one hour to verify that BMPs are working effectively. Sampling will occur under three circumstances: 1) when dredging begins in the first SMA that will require at least four days of dredging in each construction season, 2) when dredging begins in the first SMA in the first season, as samples from this SMA will receive chemical testing regardless of the required dredging duration, and 3) when the first lift of cap material is placed within SMA 12B.

Chemistry condition 2: Confirmed turbidity exceedance

Chemical testing will be conducted as soon as possible after confirmation for each of the first three confirmed turbidity exceedances associated with dredging in each construction season. After the results from the testing are received, the Project Representative or EQAO will consult with EPA to determine if additional chemistry testing is required that season. Example conditions that may necessitate additional sampling include: 1) if any of the results are close to the water quality criteria, or 2) if turbidity exceedances associated with dredging that occur later in the season are significantly greater than those in the beginning of the season.

Chemical testing is intended to document whether a turbidity exceedance may also be associated with elevated chemical concentrations that exceed Washington State Acute Water Quality Criteria. Chemical testing will not be used to initiate 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 M. It is expected that any corrective measures in the field will be based on confirmed turbidity exceedances associated with dredging.

Chemistry condition 3: Dredging in SMAs with elevated sediment concentrations or in the vicinity of public access areas

Chemical testing will occur when dredging in SMAs with substantially higher sediment COC concentrations relative to those in other SMAs. A review of the upper reach design dataset identified intertidal SMAs (SMAs 6 and 7) and subtidal SMAs (SMAs 12B and 16) as requiring water chemistry monitoring when dredging.

Table A3-3
SMAs Selected for Potential Chemical Testing Based on Elevated Sediment Concentrations

SMA	RM	Elevated sediment concentrations
6	4.1E	10 RAL intervals with PCB conc > 1,000 µg/kg 2 locations with vertical intervals with PCB conc > 10,000 µg/kg
12B	3.6	6 locations with vertical intervals with PCB conc > 1,000 µg/kg
7	4.0E	5 locations with RAL intervals with PCB conc > 1,000 µg/kg 1 location with vertical interval >1,000 µg/kg
16	3.1	5 locations with vertical intervals with PCB conc > 1,000 µg/kg

Notes:
µg/kg: microgram per kilogram
PCB: polychlorinated biphenyl
SMA: sediment management area

In addition, chemical testing will occur when dredging occurs within 150 feet of public access areas (i.e., the Duwamish Waterway Park [SMA 18]).[6]

3.2.1 Analytes

Analytical data quality indicators for water chemistry samples are summarized in Attachment A.3.

Chemicals with water quality criteria values for the protection of aquatic life and sediment concentrations greater than RALs in the UR were identified as analytes for the water quality monitoring. All water chemistry samples will be analyzed for PCBs, arsenic, lead, mercury, and zinc. Exceedances of water quality criteria are not anticipated based on the assessment in BODR Appendix M. The Project Representative and EPA will meet to discuss the data prior to the second season of construction to determine if the analyte list should be revised.

3.2.2 Chemistry Criteria

The Washington State Marine Acute and Chronic Water Quality Criteria for the protection of aquatic life (WAC 173-201A-210) are the compliance criteria for chemical parameters (Table A3-4).

[6] Condition 3 chemistry sampling during dredging near the Duwamish River People's Park and Shoreline Habitat area is required due to elevated polychlorinated biphenyl (PCB) levels in SMA 12B sediments; for this reason, this area does not require separate sampling as a public access area.

Dredging will not be conducted over a continuous 24-hour period, and construction equipment will be moved multiple times per day. Therefore, results from water quality samples collected for chemical analyses and compared to acute and chronic water quality criteria will represent very conservative scenarios. Specifically, samples will be collected during active dredging and will not factor in water quality during periods when dredging is not being conducted over a 24-hour or 4-day period.

Table A3-4
Marine Chronic and Acute Water Quality Criteria[1]

Chemical	Marine Chronic (µg/L)[2]	Marine Acute (µg/L)[3]
Metals		
Arsenic	36 (dissolved)	69 (dissolved)
Lead	8.1 (dissolved)	210 (dissolved)
Mercury	0.025 (total, whole water)	1.8 (dissolved)
Zinc	81 (dissolved)	90 (dissolved)
PCBS		
PCBs	0.030 (total, whole water)	10 (total, whole water)

Notes:
1. Standards listed are the lowest of National Recommended Water Quality Criteria: Aquatic Life Criteria EPA or Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A-240, Table 240).
2. Marine chronic criteria for metals are relevant to a 4-day exposure timeframe. The exposure timeframe for PCBs is 24 hours.
3. Marine acute criteria are relevant to a 1-hour exposure timeframe for metals and a 24-hour exposure timeframe for PCBs.
µg/L: microgram per liter
EPA: U.S. Environmental Protection Agency
PCB: polychlorinated biphenyl
WAC: Washington Administrative Code

3.2.3 Monitoring Stations and Depths

The points of compliance for chemical parameters are 150 feet and 300 feet from the construction activity for acute and chronic water quality criteria, respectively. During each monitoring event, samples will be collected at the 150-foot (acute) and 300-foot (chronic) compliance monitoring stations. When the water depth is at least 10 feet, samples will be collected at two depths: near surface (approximately 3 feet below the water surface) and near bottom (approximately 3 feet above the mudline) (see Figure A3-1). In water deeper than 20 feet, samples will be collected at three depths: the midpoint of the water column and the near-surface and near--bottom depths. In water shallower than 10 feet, one sample will be collected in the middle of the water column. The sample with the highest turbidity for each station will be selected for analysis each day. The samples not selected for analysis will be archived. The following conditions will also apply:

- Whenever possible, samples will be collected at a location with a minimum water depth of 10 feet to minimize the potential for disturbance of the sediment bed by monitoring vessels.

- Compliance station stations will be based on the distance downriver from the dredging activity.

3.2.4 Frequency of Chemical Testing

3.2.4.1 Chemistry Conditions 1 and 3

Water chemistry samples will be collected from both the 150-foot and 300-foot compliance stations twice a day for as many as four days[7] at the initiation of dredging (condition 1) and during dredging at SMAs identified as having higher sediment concentrations or as near public access areas (condition 3). At each compliance station, samples will be collected at two water depths and twice a day.

Water chemistry samples will be collected at the 150-foot compliance station one time during placement of the first lift of cap material at SMA 12B. Samples will be collected from two depths. The samples will be archived. If directed by EPA, they will be analyzed following discussion of the water and sediment chemistry results obtained during the dredging of SMA 12B.

On days one and three, the sample associated with the highest confirmed turbidity reading (among the four samples at each compliance station) will be analyzed. The remaining samples collected on days one and three and all samples collected on days two and four will be archived pending the results from the initial analyses.

If the metals concentrations in the sample with the highest turbidity analyzed from the 150-foot compliance station exceed the acute water quality criteria, then the archive sample from the 150-foot compliance station collected at the same time will be analyzed, and the two results will be averaged to represent the one-hour exposure for metals. If the PCB concentrations in the sample analyzed exceed the acute criterion at the 150-foot compliance boundary, then the three archived samples collected at that station from both sampling events that day will be analyzed. If the average PCB concentration of the four samples (representing a portion of the 24-hour acute exposure period) exceeds the acute criteria, that may be considered an exceedance of the acute water quality criteria. In consultation with EPA, a time-weighted concentration will also be evaluated.

If any of the metals concentrations in the sample analyzed from the 300-foot compliance station exceed the chronic water quality criteria, all samples collected over the four-day period will be analyzed, and the average of the samples will be compared to the chronic criteria. If the average concentration for four days exceeds the chronic value, that may be considered an exceedance of

[7] When the analytes are metals and PCBs, sampling will occur for four days because the chronic exposure period for metals is four days. When PCBs are the only analyte, sampling will occur for two days because the chronic exposure period for PCBs is 24 hours.

the chronic water quality criteria. In consultation with EPA, a time-weighted concentration will also be evaluated.

If the PCB concentration in the sample analyzed from the 300-foot compliance station exceeds the chronic water quality criteria, the three archived samples collected at that station that day will be analyzed to determine if there is a chronic exceedance. If the average exceeds the chronic water quality criteria for PCBs, that may be considered an exceedance of the chronic water quality criteria for PCBs. In consultation with EPA, a time-weighted concentration will also be evaluated.

3.2.4.2 Chemistry Condition 2

If a confirmed turbidity exceedance occurs at the 150-foot compliance station, water chemistry samples will be collected after each of the first three confirmed turbidity exceedances as soon as possible after the confirmation of the turbidity exceedance. Samples will be collected at the near-surface and near-bottom water depths, and the results will be averaged for comparison to acute criteria for informational purposes. A turbidity exceedance generally represents a transient condition. If the turbidity exceedance persists for several days, EPA may require additional water chemistry sampling in addition to corrective measures in the field.

3.2.5 Water Chemistry Monitoring Methods

3.2.5.1 Field Methods

Water samples for chemical testing will be collected using a 5-L Teflon-lined Niskin bottle sampler, which will be manually lowered on a line to the targeted depth and triggered to close via a messenger. After the end caps of the sampler have been triggered shut, the sampler will be retrieved.

The dissolved metals samples will be filtered within 15 minutes of collection using a 0.45-µm filter and preserved with nitric acid to a pH < 2. Sampling standard operating procedures will be provided in the final WQMP.

Conventional water quality parameters will be measured at the time of chemistry sample collection, as discussed in Section 3.1.

Chemistry samples will be packed in coolers and held at ≤ 4°C (± 2°C). Samples for analysis will be delivered directly to the laboratory.

3.2.5.2 Laboratory Methods

Laboratory methods and sample handling requirements for the water samples are provided in Table A3-5. Laboratory reporting limits are presented in Section 3.3.6. The samples will be analyzed with a targeted one-week (seven days) turnaround time.

Table A3-5
Analytical Methods and Sample Handling Requirements for Water Samples

Parameter	Method	Reference	Laboratory [1]	Container	Preservative	Sample Holding Time
Total PCBs (total)	GC-ECD	EPA 8082A	Eurofins[1]	2 1-L (amber glass)	None	1 year to extract, 1 year from extraction to analysis
Dissolved metals	ICP-MS	EPA 1638 or 6020B	Brooks Applied[2]	125-mL HDPE	dissolved samples field-filtered with 0.45-µm filter nitric acid to pH < 2 within 14-days of collection	180 days
Mercury (total)	CV-AFS or CV-AA	EPA 1631E or EPA 7470A	Brooks Applied[3]	125-mL FLPE	BrCl in lab within 28 days of collection (oxidation in the original sample bottle)[4]	90 days[4]

[1] Eurofins is the primary lab for PCBs analysis of water samples. ARL and ALS are alternate laboratories for the analysis of total PCBs.
[2] Brooks Applied is the primary lab for dissolved metals analysis of water samples. Eurofins is the first alternate and ARL and ALS are second alternate laboratories for the analysis of dissolved metals. The alternate laboratories follow EPA 6020B for metals analysis.
[3] Brooks Applied is the primary lab for mercury. Eurofins is the first alternate and ARL and ALS are the second alternative laboratories for the analysis of mercury. Eurofins follows EPA 1631E and ARL and ALS follow EPA 7470A for mercury analysis.
[4]Samples analyzed following EPA 7470A will be preserved with nitric acid to pH<2 and analyzed within a 28-day hold time.
Notes:
CV-AA: cold-vapor atomic absorption
CV-AFS: cold-vapor atomic fluorescence
EPA: U.S. Environmental Protection Agency
FLPE: fluorinated high-density polyethylene
GC-ECD: gas chromatography-electron capture detection
HDPE: high-density polyethylene
ICP-MS: inductively coupled plasma-mass spectrometry

3.2.6 Summary of Water Quality Monitoring Plan for Water Chemistry

The water quality monitoring plan for water chemistry is summarized in Table A3-6.

Table A3-6
Summary of Water Quality Monitoring Plan for Chemistry

Component	Chemistry Conditions 1 and 3[1]	Chemistry Condition 2
Conditions	• Condition 1 – Initiation of dredging for each construction season • Condition 3 – When dredging an SMA with elevated sediment chemistry or if the SMA is near (within 150 feet of) a public access area	Condition 2 – Associated with the first three confirmed turbidity exceedances during dredging each season
Duration	4 days of sampling (PCBs and metals) 2 days of sampling (PCBs only)	1 day of sampling

Component	Chemistry Conditions 1 and 3[1]	Chemistry Condition 2
Stations	150 feet and 300 feet downstream	150 feet downstream
Collection Frequency	Two sampling events per day	One sampling event
Timing	One of the two sampling events to occur 1 to 2 hours after tide reversal during ebb tide	As soon as possible after confirmed turbidity exceedance (for the first three confirmed exceedances)
Analytical Frequency	• Analyze one sample with the highest confirmed turbidity from each compliance location per day on days 1 and 3 • Archive all other samples pending results from initial samples	Analyze samples from both depth intervals
Chemical Parameters	PCBs and metals	PCBs and metals
Exceedance Criteria	If concentrations in selected analytical sample exceed acute or chronic criteria, analyze archived samples to determine if the average of samples representing acute exposure (24 hours for PCBs, 1 hour for metals) or chronic exposures (24 hours for PCBs, 4 days for metals) exceeds the criteria.	Concentrations compared to acute criteria. The results will be averaged to represent acute exposure (24 hours for PCBs, 1 hour for metals).

Notes:
1. Water chemistry samples will also be collected once from both depth intervals at the 150-foot compliance station during the placement of the first lift of cap material in SMA 12B. The samples will be archived. If directed by EPA, following review of water and sediment chemistry sampling results associated with SMA 12B, the samples will be analyzed.
EPA: Environmental Protection Agency
PCB: polychlorinated biphenyl
SMA: sediment management area

3.3 Analytical Data Quality Objective and Criteria

The analytical data quality objective for the water samples is to develop and implement procedures that will ensure the collection of representative data of known, acceptable, and defensible quality. Parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, and sensitivity.

3.3.1 Precision

Precision is the measure of reproducibility among individual measurements of the same property, usually under similar conditions, such as multiple measurements of the same sample. Precision is assessed by performing multiple analyses on a sample; it is expressed as a relative percent difference when duplicate analyses are performed, and as a percent relative standard deviation when more than two analyses are performed on the same sample (e.g., triplicates). Precision is assessed by laboratory duplicate analyses (e.g., duplicate samples, matrix spike duplicates (MSDs), and laboratory control sample [LCS] duplicates) for all parameters. Precision measurements can be

affected by the nearness of a chemical concentration to the detection limit, whereby the percent error (expressed as either percent relative standard deviation or relative percent difference) increases. The DQI for precision varies depending on the analyte (Tables A3-7 and A3-8). The equations used to express precision are as follows:

$$RPD = \frac{(\text{measured conc} - \text{measured duplicate conc})}{(\text{measured conc} + \text{measured duplicate conc}) \div 2} \times 100$$ **Equation 1a**

$$\%RSD = (SD/D_{ave}) \times 100$$

Where:

$$SD = \sqrt{\left(\frac{\sum(D_n - D_{ave})^2}{(n-1)}\right)}$$ **Equation 1b**

%RSD = percent relative standard deviation
D = sample concentration
D_{ave} = average sample concentration
n = number of samples
SD = standard deviation

Table A3-7
DQIs for Conventionals Water Quality Measurements

Parameter	Precision[1]	Accuracy[2]	Completeness
DO	± 20%	± 0.1 mg/L or 1% of reading	90%
pH	± 20%	± 0.2 pH unit	90%
Specific conductance	± 20%	± 0.5% of reading or 0.001 mS/cm	90%
Temperature	± 20%	± 0.05 °C	90%
Turbidity	± 20%	0 to 999 FNU: 0.3 FNU or ±2% of reading (whichever is greater); 1000 to 4000 FNU: ±5% of reading	90%

Notes:
Water quality measurements will be made using a YSI© EXO1 or similar water quality meter.
1. Precision is based on duplicate results for standard solutions following instrument calibration.
2. Accuracy is as reported for YSI© EXO1 instrument specifications.
DO: dissolved oxygen
DQI: data quality indicator
FNU: Formazin Nephelometric Unit

Table A3-8
DQIs for Chemistry Laboratory Analyses

Parameter	Unit	Precision[1]	Accuracy[1]		Completeness
			LCS	Spiked Samples	
Dissolved metals	µg/L	± 20%	80–120%	75–125%	90%
Mercury (total)[2]	µg/L	± 25%	na[3]	75–125%	90%
Total PCBs (total)	µg/L	± 30%	60-130%	60-130%	90%

Notes:
1. Values listed are performance-based limits provided by the primary laboratory. The values provided by the alternate laboratories are provided in Attachment A-3).
2. Mercury concentrations will be measured in whole water samples and compared to the acute value which is based on dissolved concentration.
3. EPA 1631E does not require an LCS. Brooks Applied uses spiked sample recovery to assess accuracy.

µg/L: microgram per kilogram
DQI: data quality indicator
LCS: laboratory control sample
na: not applicable
PCB: polychlorinated biphenyl

3.3.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy may be expressed as a percentage recovery for MS and LCS analyses. The DQI for accuracy varies depending on the analyte (Tables A3-7 and A3-8). The equation used to express accuracy for spiked samples is as follows:

$$\text{Percent recovery} = \frac{\text{spike sample result} - \text{unspiked sample result}}{\text{amount of spike added}} \times 100 \qquad \textbf{Equation 2}$$

3.3.3 Representativeness

Representativeness is an expression of the degree to which data accurately and precisely represent an environmental condition. Assuming those objectives are met, the samples collected should be considered adequately representative of the environmental conditions they are intended to characterize.

3.3.4 Comparability

Comparability is an expression of the confidence with which one dataset can be evaluated in relation to another dataset. Therefore, the sample collection and chemical testing will adhere to the most recent Puget Sound Estuary Program QA/QC procedures (PSEP 1997) and EPA analysis protocols.

3.3.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. The equation used to calculate completeness is as follows:

$$\text{Completeness} = \frac{\text{number of valid measurements}}{\text{total number of data points planned}} \times 100 \qquad \textbf{Equation 3}$$

The DQI for completeness for all components of this project is 90%. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

3.3.6 Sensitivity

Analytical sensitivity is the minimum concentration of an analyte above which a data user can be reasonably confident that the analyte was reliably detected and quantified. For field analyses, the resolution information provided by the probe manufacturer defines the capability of the method to recognize small differences between values. For chemistry, the method detection limit (MDL)[8] will be used as the measure of sensitivity for each measurement process.

Table A3-9 10list specific DQIs for water quality measurements, laboratory analyses of water samples.

Table A3-9
RL Goals and Marine Chronic and Acute Water Quality Criteria[1]

Parameter	Method	RL[2] (µg/L)	Marine Chronic (µg/L)[3]	Marine Acute (µg/L)[4]
Metals[5]				
Arsenic	EPA 1638M	0.072	36 (dissolved)	69 (dissolved)
Lead	EPA 1638M	0.012	8.1 (dissolved)	210 (dissolved)
Mercury	EPA 1631E	0.0004	0.025 (total)	1.8 (dissolved)[56]
Zinc	EPA 1638M	2.2	81 (dissolved)	90 (dissolved)
PCBS				
PCBs	EPA 8082A	0.01	0.030 (total)	10 (total)

Notes:
1. Standards listed are the lowest of National Recommended Water Quality Criteria: Aquatic Life Criteria EPA or Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A-240, Table 240).
2. Values listed are performance-based limits provided by the primary laboratory. Performance-based limits for the alternate laboratories are provided in Attachment A-3.
3. Marine chronic criteria for metals are relevant to a 4-day exposure timeframe. The exposure timeframe for PCBs is 24 hours.
4.. Marine acute criteria are relevant to a 1-hour exposure timeframe for metals and a 24-hour exposure timeframe for PCBs.

[8] The term method detection limit (MDL) includes other types of detection limits. Recent revisions to EPA SW846 methods no longer require the calculation of MDLs.

µg/L: microgram per liter
5. The primary laboratory (Brooks Applied) will perform the methods listed. Eurofins is the first alternate and will follow EPA 6020 for metals and EPA 1631 for mercury. The second alternate laboratories (ARL and ALS) will follow EPA 6020 for metals and EPA 7470A for mercury.
6. Mercury concentrations will be measured in whole water samples and compared to the acute value which is based on dissolved concentration.
EPA: U.S. Environmental Protection Agency
PCB: polychlorinated biphenyl
RL: reporting limit
WAC: Washington Administrative Code

3.4 Chemistry Quality Assurance/Quality Control

The types of samples analyzed, and the procedures conducted for QA/QC samples collected in the field and analyzed in the laboratory are described in this section.

3.4.1 Field QC Chemistry Samples

Field QA/QC samples, such as field duplicates, filter blanks, and rinsate blanks, are generally used to evaluate the efficiency of field decontamination procedures and the variability attributable to sample handling. One equipment blank will be generated once for each batch of water chemistry samples. An additional Niskin bottle sampler or equivalent will be used to collect a field duplicate during the multi-day water chemistry monitoring associated with chemistry conditions 1 and 3. Note that the interval with the field duplicate may not be selected for analysis. The equipment blank concentration target is <RL. The target RPD for the field duplicate is ±30% for results >10x the RL and ±50% for results between 5x-10x the RL, The RPD for results <5x the RL will not be calculated.

3.4.2 Laboratory Chemistry QC

Before analyzing the chemistry samples, the laboratory must provide written protocols for the analytical methods to be used, calculate reporting limits for each analyte in each matrix of interest as applicable, and establish an initial calibration curve for all analytes. The laboratory must also demonstrate its continued proficiency by participation in inter-laboratory comparison studies, and by repeated analysis of certified reference materials (CRMs), calibration checks, laboratory reagent and rinsate blanks, and spiked samples.

3.4.2.1 Chemistry Analysis QC Samples

Method-specific QC measures, such as MSs and MS duplicates or laboratory duplicates, will be analyzed per preparatory or analytical batch as specified in the analytical methods and Table A3-10.

Table A3-10
Laboratory chemistry QC sample analysis summary[1]

Analyte	Initial Calibration	Initial Calibration Verification (second source)	Continuing Calibration Verification	LCS	Laboratory Replicates	MSs	MSDs	Method Blanks	Surrogate Spikes
Dissolved metals (EPA 1638)	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	1 per 10 samples	1 per 10 samples	1 per 10 samples	3 per prep batch	na
Mercury (EPA 1631E)	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	na[1]	na	1 per prep batch	1 per prep batch	3 per prep batch	na
PCB Aroclors	prior to analysis	after initial calibration	before and after sample analysis, every 10-20 analyses or 12 hours	1 per prep batch	na	1 per prep batch	1 per prep batch	1 per prep batch	each sample

Notes:
A batch is a group of samples of the same matrix analyzed or prepared at the same time, not exceeding 20 samples.
1. Analytical methods and QC information listed were provided by the primary laboratories. The analytical methods and QC information followed by the alternate laboratories are provided in Attachment A-3.
2. EPA 1631E does not require analysis of an LCS. Accuracy will be assessed based on the MS and MSD percent recoveries.
LCS: laboratory control sample
MS: matrix spike
MSD: matrix spike duplicate
na: not applicable
QC: quality control

3.4.2.2 Laboratory QC Samples

The analyst will review the results of QC analyses from each laboratory prep batch immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded.

If control limits have been exceeded, then appropriate corrective action, such as recalibration followed by reprocessing of the affected samples, must be initiated before a subsequent group of samples is processed. The project QA/QC Coordinator must be contacted immediately by the laboratory Project Manager (PM) if satisfactory corrective action to achieve the DQIs outlined in this WQMP is not possible. All laboratory corrective action reports relevant to the analysis of project samples must be included in the data deliverable packages.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparing them to independent standards. Laboratory QC standards are verified in a multitude of ways: second-source calibration verifications (i.e., same standard, two different vendors) are analyzed to verify initial calibrations; new working standard mixes (e.g., calibrations, spikes, etc.) are verified against the results of the original solution and must be within 10% of the true value; or newly purchased standards are verified against current data. Any impurities found in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis. Table A3-8 summarizes the QC procedures to be performed by the laboratory, as well as the associated control limits for precision and accuracy.

3.4.2.2.1 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of 1 method blank will be analyzed per prep batch or for every 20 samples, whichever is more frequent.

3.4.2.2.2 Laboratory Control Samples

LCSs are prepared from a clean matrix using the same process as the project samples that are spiked with known amounts of the target compounds. The recoveries of the compounds are used as a measure of the accuracy of the test methods. An LCS will be analyzed for dissolved metals and PCB Aroclors.

3.4.2.2.3 Laboratory Replicate Samples

Laboratory replicate samples provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Laboratory replicates are subsamples of the original sample that are prepared and analyzed as a separate sample, assuming sufficient sample matrix is available. An MS/MSD pair for each prep batch or a minimum of every 20 samples for organics, metals, and mercury samples will be analyzed to demonstrate lab precision.

3.4.2.2.4 Matrix Spikes and Matrix Spike Duplicates

The analysis of matrix spike (MS) samples provides information on the extraction efficiency of the method on the sample matrix. By performing MSD analyses, information on the precision of the method is also provided for organic analyses. For organic analyses, a minimum of 1 MS/MSD pair will be analyzed for each prep batch or for every 20 samples, whichever is more frequent, when sufficient sample volume is available, For inorganic analyses (i.e., metals and mercury), a minimum of one MS/MSD sample pair will be analyzed for each prep batch or a minimum of every 20 samples, when sufficient sample volume is available.

3.4.2.2.5 Surrogate Spikes

All project samples analyzed for PCBs will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample results will be corrected for recovery using these values.

3.4.2.2.6 Internal Standard Spikes

Internal standards may be used for calibrating and quantifying organic compounds and metals using MSs. If internal standards are required by the method, all calibration, QC, and project samples will be spiked with the same concentration of the selected internal standard(s). Internal standard recoveries and retention times must be within method and/or laboratory criteria.

3.5 Instrument/Equipment Testing, Inspection, Calibration, and Maintenance

3.5.1 Conventionals Monitoring Equipment

The Field Sampling Lead or designee will be responsible for overseeing the testing, inspection, and maintenance of all field equipment. Prior to each sampling event, measures will be taken to test, inspect, and maintain all field equipment. All equipment used, including the multi-parameter water quality meter, range finder, differential global positioning system (GPS) unit, and digital camera, will be tested for accuracy before leaving for the field event.

The multi-parameter water quality meter will be used to collect in situ water quality data (i.e., specific conductance, temperature, DO, pH and turbidity) at each sampling station and associated with each composite sample, as outlined in this WQMP. All sensors, except temperature, require calibration to ensure high performance. The meter will be calibrated daily to ensure that the sensors meet the manufacturer's accuracy specifications for specific conductance, DO, pH, and turbidity.

A range finder will be used to measure the distance from the operations in order to establish the compliance stations. In addition, a Trimble© SPS461 or similar GPS receiver unit will be employed for the various sampling methods outlined in this WQMP. The GPS receiver will be calibrated daily to ensure that it is accurately recording positions from known benchmarks and functioning within the individual unit's factory specifications.

3.5.2 Analytical Equipment

The laboratory PM will be responsible for ensuring laboratory equipment testing, calibration, inspection, and maintenance requirements are met.

Multipoint initial calibration will be performed on each analytical instrument at the start of the project, after each major interruption to the instrument, and when any continuing calibration does not meet the specified criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibrations will be performed daily for organic analyses and every 10 samples for inorganic analyses to ensure proper instrument performance.

Calibration of analytical equipment used for chemical analyses includes the use of instrument blanks or continuing calibration blanks, which provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately after the continuing calibration verification, at a frequency of 1 blank for every 10 samples analyzed for inorganic analyses and 1 blank every 12 hours for organic analyses. If the continuing calibration does not meet the specified criteria, the analysis must stop. Analysis may resume after corrective actions have been taken to meet the method specifications. All project samples analyzed by an instrument found to be out of compliance must be reanalyzed.

3.6 Inspection/Acceptance of Supplies and Consumables

The Field Sampling Lead for chemistry samples or EQAO-2 (or designee) for conventional parameters will gather and check field supplies daily for satisfactory conditions before each field event. Batteries used in any field gear will be checked daily and recharged as necessary. Supplies and consumables for the field sampling effort will be inspected upon delivery and accepted if the condition of the supplies is satisfactory.

3.7 Data Management

All field data will be recorded on field forms, which the Field Sampling Lead for chemistry samples or EQAO-2 (or designee) for conventional parameters will check for missing information at the end of each field day and amend as necessary. A QC check will be done to ensure that all data have been transferred accurately from the field forms to the database.

The analytical laboratories are required to submit data in an electronic format. The laboratory PM will contact the project Data Manager prior to data delivery to discuss specific format requirements.

A library of routines will be used to translate typical electronic output from laboratory analytical systems and to generate data analysis reports. The use of automated routines will ensure that all data are consistently converted to the desired data structures, and that operator time is kept to a minimum. In addition, routines and methods for quality checks will be used to ensure such translations are correctly applied.

Written documentation will be used to clarify how field and analytical laboratory duplicates and QA/QC samples were recorded in the data tables, and to provide explanations of other issues that may arise. Accurate records of field and laboratory QA/QC samples will be maintained so that project team members who use the data will have appropriate documentation.

4 Reporting

This section presents the daily, weekly, and final reporting of water quality monitoring results.

4.1 Daily Reporting

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

- Monitoring station (background or compliance station and approximate river mile)
- Monitoring station coordinates
- Date and time
- Contractor dredging or placement of clean material activity description
- Tidal phase (e.g., flood, ebb, or slack)
- Direction of monitoring, (i.e., downriver from the construction activity during ebb tide condition)
- Water depth at 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 the EQAO.

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 the EQAO and EPA by close of business on the following Monday. All reporting will include both regularly scheduled monitoring results and any additional monitoring results that may have been triggered by exceedances of water quality criteria.

4.3 Reporting of Exceedances

The Project Representative will notify EPA as soon as possible (within two hours) of a confirmed conventionals exceedance. A confirmed exceedance that occurs at the end of a workday (i.e., less than two hours of dredging remaining) may be reported to EPA at the beginning of the following workday. In the case of a confirmed turbidity exceedance associated with dredging, the Project Representative will also notify the Contractor and will direct the Contractor to implement corrective actions to return dredging operations to compliance with water quality criteria.

Chemical exceedances of acute or chronic criteria will be reported to EPA within one workday of receipt of laboratory test results, and the final laboratory EDD will be provided. Due to the timeframe

to obtain chemistry results, any chemical exceedances will represent dredging activities in areas that have already been completed. Chemical exceedances will be discussed with EPA, along with conventionals monitoring data, to help determine whether there is ongoing potential for chemical exceedances and a need to adjust dredging operations or compliance distances.

4.4 Laboratory Records

4.4.1 Chemistry Records

The analytical laboratories will be responsible for internal checks and data verification pertaining to sample handling and analytical data reporting, and they will correct errors identified during the QA review. The analytical laboratories will submit data packages electronically, including the following as applicable:

- **Project narrative**: This summary, in the form of a cover letter, will present any problems encountered during any aspect of sample analyses. The summary will include, but not be limited to, discussion of QC, sample shipment, sample storage, and analytical difficulties. The project narrative will document any problems encountered by the laboratory and their resolutions. In addition, the summary will provide operating conditions for instruments used for the analysis of each suite of analytes and definitions of laboratory qualifiers.
- **Records**: The data package will include legible copies of the chain of custody forms. This documentation will include the time of receipt, and the condition of each sample received by the laboratory. These records will also document additional internal tracking of sample custody by the laboratory.
- **Sample results**: The data package will summarize the results for each sample analyzed. The summary will include the following information, as applicable:
  - Field sample identification code and corresponding laboratory identification code
  - Sample matrix
  - Date of sample extraction/digestion
  - Date and time of analysis
  - Weight/volume used for analysis
  - Final dilution volumes or concentration factor for the sample Instruments used for analysis
  - MDLs[9] and reporting limits (RLs)[10]
  - All data qualifiers and their definitions.

[9] The term MDL includes other types of detection limits.
[10] RL values are consistent with the lower limit of quantitation values required under EPA-846.

- **QA/QC summaries:** These summaries will contain the results of all QA/QC procedures. Each QA/QC sample analysis will document the same information required for the sample results (see previous bullet). The laboratory will make no recovery or blank corrections. The required summaries will include the following, as applicable:
  - The calibration data summary will contain the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. This summary will also list the response factor, percent relative standard deviation, relative percent difference (RPD), and retention time for each analyte, as appropriate, as well as standards analyzed to indicate instrument sensitivity.
  - The internal standard area summary will report the internal standard areas, as appropriate.
  - The method blank analysis summary will report the method blank analysis associated with each sample and the concentrations of all compounds of interest identified in those blanks.
  - The surrogate spike recovery summary will report all surrogate spike recovery data for organic analyses, and it will list the names and concentrations of all compounds added, percent recoveries, and QC limits.
  - The MS recovery summary will report the MS or MS/ MSD recovery data for analyses, as appropriate, including the names and concentrations of all compounds added, percent recoveries, and QC limits. The MS recovery summary will also report the RPD for all MS and MSD analyses.
  - The matrix duplicate summary will report the RPD for all matrix duplicate analyses and will list the QC limits for each compound or analyte.
  - The LCS analysis summary will report the results of the analyses of LCSs, including the QC limits for each compound or analyte.
  - The relative retention time summary will report the relative retention times for the primary and confirmational columns of each analyte detected in the samples and the percent differences between the columns, as appropriate.
- **Original data**: The data package will include legible copies of the original data generated by the laboratory, including the following:
  - Sample extraction/digestion, preparation, and cleanup logs
  - Instrument specifications and analysis logs for all instruments used on days of calibration and analysis
  - Enhanced and unenhanced spectra of target compounds detected in field samples and method blanks, with associated best match spectra and background subtracted spectra, for all gas chromatography/mass spectrometry analyses

- Enhanced and unenhanced spectra of target performance reference compounds detected in field samples, field blanks, and method blanks, with associated best match spectra and background subtracted spectra, for all gas chromatography/mass spectrometry analyses
- Quantitation reports for each instrument used, including reports for all samples, blanks, calibrations, MSs/MSDs, laboratory replicates, LCSs, and CRMs.

The analytical laboratories will submit data electronically in EarthSoft EQuIS® standard four-file or EZ electronic data deliverable format, or in an alternative format to be specified prior to the implementation of this WQMP. Guidelines for electronic data deliverables for chemical data will be communicated to the analytical laboratories by the Data Manager. All electronic data submittals must be tab-delimited text files, or a format specified prior to implementation of this WQMP, that include all results, MDLs (as applicable), and RLs consistent with those provided in the laboratory report. If laboratory replicate analyses are conducted on a single submitted field sample, the laboratory sample identifier must distinguish among the replicate analyses.

4.4.2 Data Reduction

Data reduction is the process by which original data (i.e., analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which the appropriate project personnel will then subject to further review and reduction. The laboratory will generate the data in a format amenable to review and evaluation. Data reduction may be performed manually or electronically.

4.4.3 Data Storage and Backup

All electronic files related to the project will be stored on a secure server, with server contents backed up regularly

4.5 Water Quality Monitoring Report

After all construction has been completed, the water quality monitoring data for the entire upper reach construction project will be provided to EPA as part of the Remedial Action Project Report. The section on water quality monitoring will contain:

- Any deviations from the WQMP and reasons for the deviations
- Tabular summaries of all water quality monitoring data with comparisons to water quality compliance criteria

- Figures depicting monitoring results over the course of construction for turbidity and chemical analytes, including (to the extent possible) relevant information on dredge areas and any BMPs implemented
- Narrative discussion of any water quality exceedances, probable cause(s) of the exceedance(s) if known, 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 implementation and effectiveness
- An appendix containing all completed Water Quality Monitoring Forms
- Documentation of instrument calibration (upon request)
- An appendix containing results from any chemistry testing conducted

In addition, a summary and tabulated results of water quality monitoring results will be included in an Annual Construction Summary Technical Memorandum, which will be submitted by the Contractor after each construction season has been completed (see CQAP for more information).

5 Corrective Actions

Corrective actions will be implemented to address water quality exceedances associated with dredging.

In the event of a confirmed turbidity water quality exceedance associated with dredging, the Project Representative will notify the Contractor and EPA Project Manager as soon as possible (within two hours) of the confirmed turbidity exceedance and will direct the Contractor to identify and implement its approach to return dredging operations to compliance with water quality criteria. The approach may involve modifying operations or implementing additional BMPs. Additional corrective actions may be required in the event of continued turbidity water quality exceedances at the compliance station; these actions are described in Section 3.1.6. If the water quality turbidity exceedance continues, even with additional BMPs and/or operational modifications, the Project Representative will discuss next steps with the Contractor and EPA. The path forward could include some or all of the following:

- Implementation of more aggressive BMPs or operational modifications
- Increases in the compliance boundary distance for turbidity by EPA, if the chemistry sample testing indicates there are no exceedances of chemical water quality criteria

If these options are not successful, it may be necessary to temporarily stop work to further assess the source of the exceedance and identify effective mitigation measures.

If a turbidity exceedance continues after implementation of additional BMPs and/or operational modifications, the Project Representative will instruct the Contractor to stop construction activities, and EPA will be contacted to determine how to proceed.

6 References

EPA. 2014. Record of Decision. Lower Duwamish Waterway Superfund Site. US Environmental Protection Agency.

EPA. 2021. Proposed explanation of significant differences. September 2021. Lower Duwamish Waterway Superfund site. US Environmental Protection Agency Region 10, Seattle, WA.

EPA. 2024. Clean Water Act §404 ARAR Memo: Substantive Water Quality Requirements for the Lower Duwamish Waterway Upper Reach Superfund Remedial Action. Final. Prepared by U.S. Environmental Protection Agency Region 10, Seattle, WA. October 15, 2024.

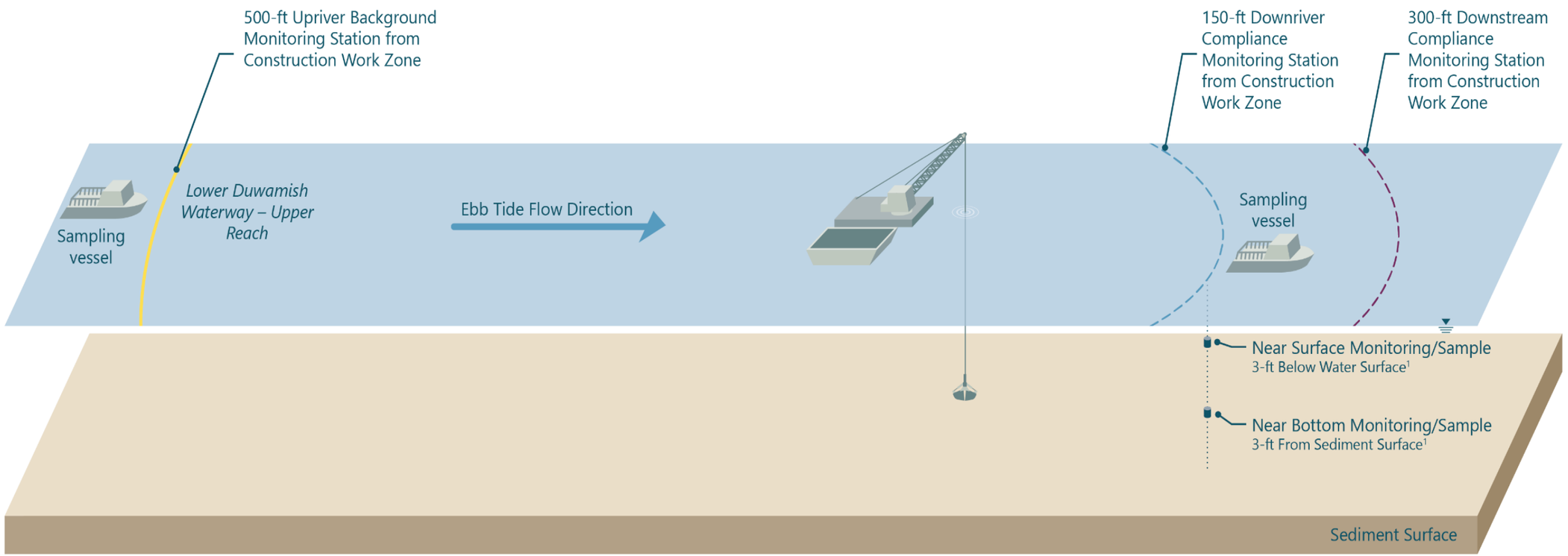
King County. 1999. King County combined sewer overflow water quality assessment for the Duwamish River and Elliott Bay. Vol 1, Appendix B1: Hydrodynamic and fate and transport numerical model. King County Department of Natural Resources, Seattle, WA.

PSEP. 1997. Recommended guidelines for sampling marine sediment, water column, and tissue in Puget Sound. Prepared for the Puget Sound Estuary Program, US Environmental Protection Agency, Region 10. King County (METRO) Environmental Laboratory, Seattle, WA.

Anchor QEA. 2008. Lower Duwamish Waterway sediment transport modeling report. Prepared for Lower Duwamish Waterway Group. Quantitative Environmental Analysis, LLC, Montvale, NJ.

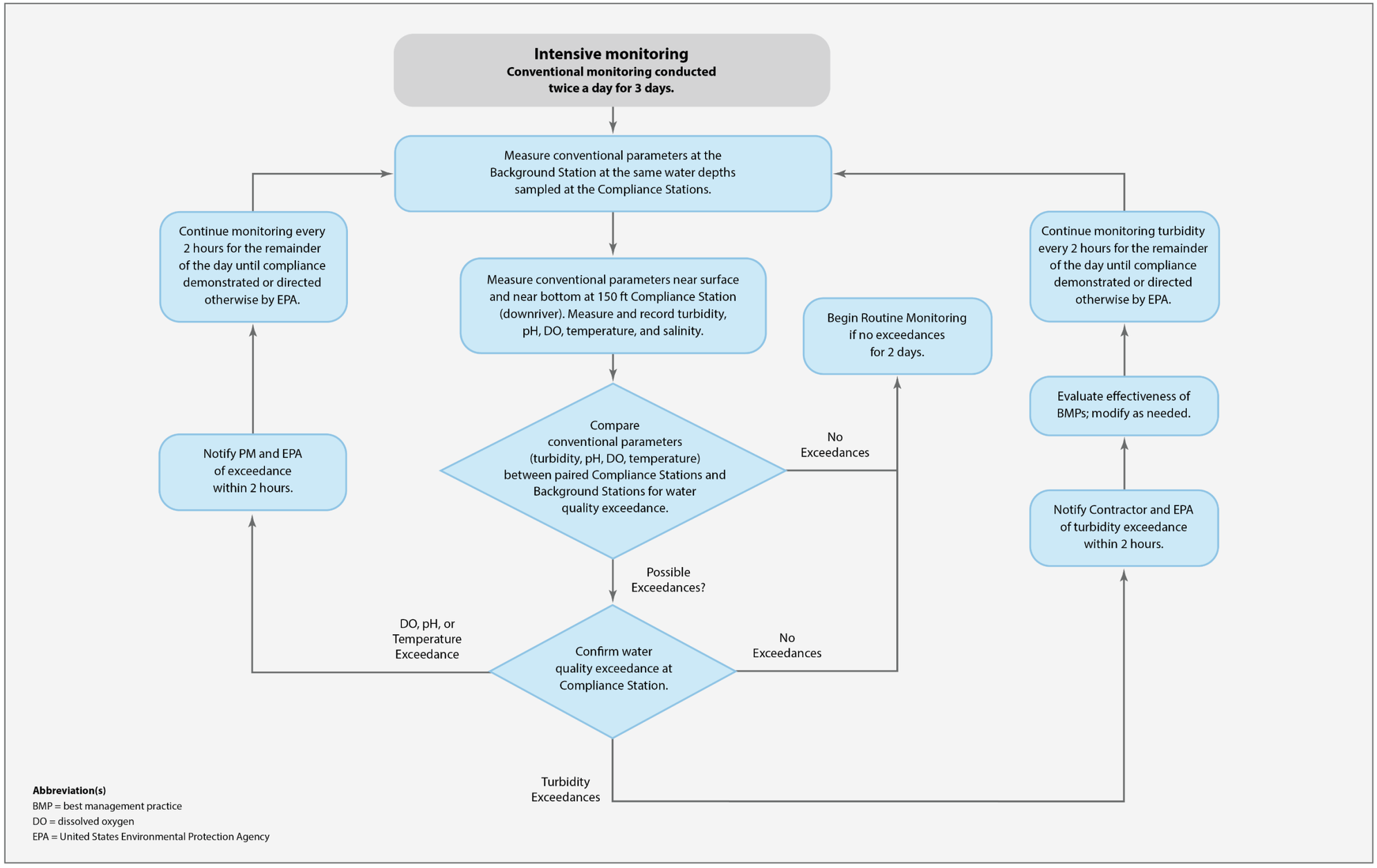
Windward, ANCHOR QEA. 2008. Lower Duwamish Waterway remedial investigation. Sediment transport analysis report. Final. Prepared for Lower Duwamish Waterway Group. Windward Environmental LLC, Seattle, WA and Quantitative Environmental Analysis, Montvale, NJ.

Figures



1. Data will be collected at two depths for water depths greater than 10 feet and less than 20 feet. Data will be collected at one depth for water depths less than 10 feet, and data will be collected at three depths for water depths greater than 20 feet (See Section 3.1.2).
2. An additional lateral location will be monitored during the flood tide during dredging in the western portion of SMA 12B.

Figure A3-1
Water Quality Monitoring Stations and Depths
Construction Phase
CQAP for the LDW Upper Reach



Abbreviation(s)
BMP = best management practice
DO = dissolved oxygen
EPA = United States Environmental Protection Agency

Figure A3-2
Intensive Monitoring for Conventionals during Dredging
Construction Phase
CQAP for the LDW Upper Reach

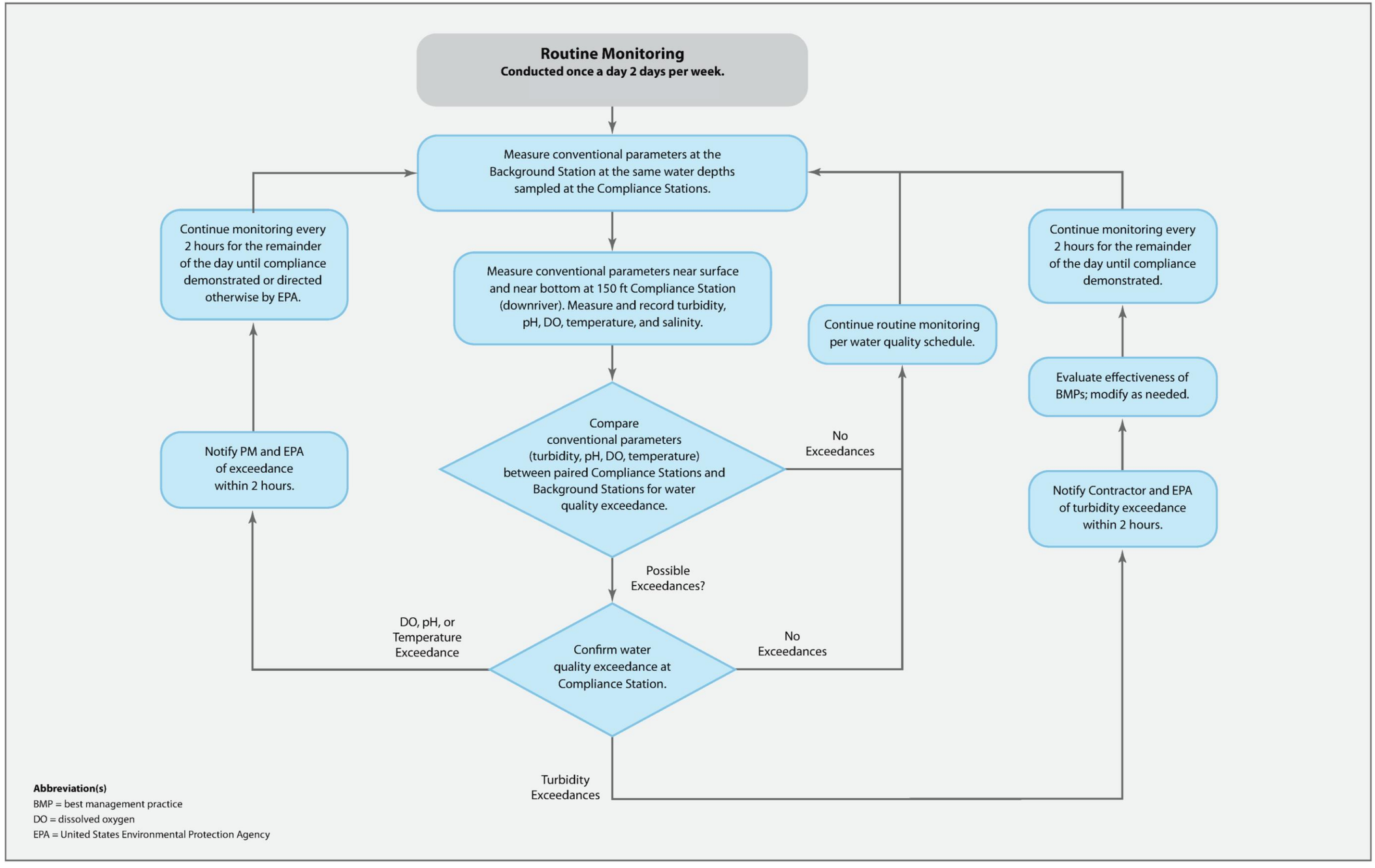


Figure A3-3
Routine Monitoring for Conventionals during Dredging
Construction Phase
CQAP for the LDW Upper Reach

Appendix A – Water Quality Monitoring Plan

Attachment A.1
Field Forms

Geosyntec
consultants

WATER QUALITY MONITORING FORM

Location ID: ________________________________ **Task no.:** ____________________

Project Name/No.: ________________________________ **Field crew:** ____________________

Date: ____________ **Time:** ________

Weather: ________________________________ **Sampling Vessel:** ______________

Northing: ____________ **Easting:** ___________ **Tide:** _____flood ____ebb ___slack

Contractor Activity (circle): Dredging Capping Backfilling Transload Other __________

Water depth: __________ft

Upstream of Activities: _______

Downstream of Activities: ______

Monitoring Station: _____ Background _____ Compliance

Distance to Activity: ________ ft

Approximate River Mile: _________

Sample ID:		**Sample time:**	**Samples for Water Chemistry Analysis**
***In situ* measurements** Turbidity:_________ NTU Temp:____________ ˚C Conductivity:_______µS/cm	DO:_________mg/L pH: _______ Salinity: ______ ppt	**Sample collection depth** ___U: Upper (3 ft below surface) ___M: Mid-depth (______m) ___L: Lower (1m above bottom)	☐ Yes ☐ Field-filtered ☐ No ☐ Archived
Notes (i.e., other water quality characteristics, presence of sheen, odor, field duplicate)**:**			

Sample ID:		**Sample time:**	**Samples for Water Chemistry Analysis**
***In situ* measurements** Turbidity:_________ NTU Temp:____________ ˚C Conductivity:_______µS/cm	DO:_________mg/L pH: _______ Salinity: ______ ppt	**Sample collection depth** ___U: Upper (3 ft below surface) ___M: Mid-depth (______m) ___L: Lower (1m above bottom)	☐ Yes ☐ Field-filtered ☐ No ☐ Archived
Notes (i.e., other water quality characteristics, presence of sheen, odor, field duplicate)**:**			

Sample ID:		**Sample time:**	**Samples for Water Chemistry Analysis**
***In situ* measurements** Turbidity:_________ NTU Temp:____________ ˚C Conductivity:_______µS/cm	DO:_________mg/L pH: _______ Salinity: ______ ppt	**Sample collection depth** ___U: Upper (3 ft below surface) ___M: Mid-depth (______m) ___L: Lower (1m above bottom)	☐ Yes ☐ Field-filtered ☐ No ☐ Archived
Notes (i.e., other water quality characteristics, presence of sheen, odor, field duplicate)**:**			

Appendix A – Water Quality Monitoring Plan

Attachment A.2
Standard Operating Procedures

Geosyntec consultants

LDW PPS CM – PNR0859

Standard Operating Procedure #WQMP-001
Collection of Surface Water Samples

Surface water analytical samples will be collected during Lower Duwamish Waterway upper reach construction at locations upstream and downstream of in-water construction activities for compliance monitoring as required in the Surface Water Monitoring Plan (Appendix A of the construction Quality Assurance Plan; Geosyntec, 2024).

1.0 Objectives

The purpose of this standard operating procedure (SOP) is to detail the methods for collecting surface water samples[1]. Surface water samples may be collected from up to three depths for this project based on overall water depths indicated in Table 1.

Table 1 – Surface Water Sampling Depths

Total Water Depth (ft)	Number of Sampling Depths	Water Quality Sampling Depth(s) Based on Total Water Depth
≤ 10 ft	1	Middle point of the water column
>10 ft and <20 ft	2	Near surface point 3f t below the water surface Near bottom point 3 ft above sediment-water interface
≥ 20ft	3	Near surface point 3 ft below the water surface Middle point of the water column Near bottom point 3 ft above sediment-water interface

2.0 Sampling Equipment

Surface water sampling may be performed with a variety of pumps or sampling devices. The primary method used for sampling will be a Niskin bottle, vanDorn water sampler, or equivalent trigger-activated device. The backup method will be a peristaltic pump with a weighted line used to deploy the tubing intake at the correct sampling depth. A minimum sample volume of 3 liters (L) is required to satisfy analytical requirements for surface water.

[1] This SOP utilizes and augments the procedures outlined in the San Francisco Estuary Institutes Field Sampling Manual for the Regional Monitoring Program for Trace Substances (David et al. 2001), the Interagency Field Manual for the Collection of Water-Quality Data (USGS 2000), and U.S. Environmental Protection Agency (EPA) Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (EPA 1996).

Niskin bottles are designed for the capture of surface water from open water and consist of an open tube with a wide valve at each end, connected by a solid rod. Each end is equipped with a cap which is either spring-loaded or tensioned by an elastic rope. The bottle is attached to a cable at its bottom using a clamp and at its top by a tripping mechanism. A messenger weight is used to trip the mechanism so the caps close and the tube is sealed. Specifications of a general Niskin bottle are provided as Attachment A to this SOP.

Sample filtration will be performed using a peristaltic pump, dedicated pre-cleaned pump and sample tubing, and filter capsules (tested or from a single manufacturer lot#).

3.0 Mobilization and Location Control

Coordinates of sampling stations will be determined from the geographic information systems maps in general accordance with the CQAP and in consultation with the Construction Manager.

If calibration is required by the global positioning system (GPS) used by the field team, the GPS will be calibrated over a known control point prior to mobilization for sampling. If calibration is not required by the GPS used by the field team, this step will be omitted.

3.1 Horizontal Control

The research vessel will be mobilized to a sampling station, and x/y station coordinates will be collected using a handheld GPS (Trimble 4000, or similar). If the accuracy of the GPS unit is not adequate at the time of sampling (e.g., fewer than four satellites are visible above the horizon), then marker buoys will be placed at each sampling station for survey when sufficient satellites become available. Coordinates will be recorded in NAD83 Washington State Plane North (feet) to the nearest 1.0 ft.

3.2 Vertical Control

Vertical elevation (water depth) will be recorded to the nearest 0.1 ft measured from the water surface to the sediment surface. Measurements will be collected using a graduated weighted line or similar device pulled taut prior to measurement and/or the vessel echo sounder (or equivalent). The time and date of measurement will also be recorded.

4.0 Sampling Methods

4.1 Clean Hands/Dirty Hands Technique

Surface water samples will be collected in general accordance with the two-person clean hands (CH) /dirty hands (DH) method (EPA 1996). This section describes CH/DH techniques and general roles each person will perform.

CH/DH techniques require two or more people working together. One person is designated as "clean hands" (CH), and a second person is designated as "dirty hands" (DH).

Although specific tasks are assigned to CH or DH, some tasks overlap and can be handled by either, as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless nitrile gloves during the entire sampling operation and change gloves frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes). The gloves that CH wears should arrive on-site inside a double ziptopped bag, and only CH should reach into this bag to retrieve gloves. The sampling team may switch who is designated in each role throughout the day, provided

clear communication is maintained by the sampling team and appropriate gloves are used when serving as the CH role.

A "clean chamber" area will be designated on board. This is an area of the vessel that will provide a clean surface for sampling equipment and the sample itself, preferably located away from engine exhaust or other sources of air-borne contamination. A work surface will be set up in this area and covered in clean aluminum foil, plastic sheeting, or equivalent. This work surface will have enough space for a peristaltic pump, sample bottles, and the sample filter.

CH will:

- Work exclusively inside the clean chamber during sample collection and processing.
- Handle materials that contact the sample (e.g., sample bottles and filters).
- Handle the discharge end of the surface-water sample tube or line from the peristaltic pump.
- Change the work surface covers as needed.
- Not handle cell phones except in cases of emergencies.

DH will:

- Work exclusively outside of the clean chamber during sample collection and processing.
- Handle operations that involve contact with potential sources of contamination.
- Handle the outside of the Niskin bottle, the deployment cable, the weighted line, and any other equipment used to deploy the sampler.
- Handle any necessary communication devices (e.g., cell phones), tools, keys, or other equipment on board.
- Handle the field instruments and record water depths and field measurements.

4.2 Calibration

- The field team will calibrate monitoring equipment each morning prior to use following manufacturer instructions. Calibration records will include date/time, specific make and model number of equipment, field technician performing the calibration, and the result of the calibration.

4.2 Surface Water Sample Collection Procedures

The field team will collect surface water samples as follows:

- After the research vessel reaches a sampling station, the captain will anchor the vessel (if possible) and switch off the engines (if possible). If the engine cannot be turned off, the vessel will remain on-station using minimal engine propulsion. If the engine cannot be turned off, the sampling team will take precautions to avoid direct flow of exhausts from the engine towards the clean chamber. This can be achieved by orienting the vessel so the engine is downwind or by using a fan to direct fresh air from the clean chamber towards the engine. Equivalent methods or equipment can be used.
- Measure and record water depth using the graduated weighted line and confirm depth(s) of sampling according to Table 1. Record the time and tidal stage.
- If using Niskin bottles for sampling, attach a 5 L Niskin bottle to a cable and check that the connection of the sampler to the deployment cable is secure. Secure the free end of the cable to a stable object on the vessel (use a davit if available), and if the cable is not graduated, attach a graduated weighted line to the cable using duct tape, zip ties, or equivalent means.
- **Begin CH/DH protocols.**

- CH will verify that the clean chamber is set up.
- DH will deploy the Niskin bottle from the working deck area of the vessel (use a davit if available) by slowly lowering the bottle through the water column to the target depth according to Table 1.
- DH will confirm deployment to the desired depth using the graduated line. After confirmation, DH will activate the messenger (or equivalent system) to seal the sampler.
- DH will slowly retrieve the sampler.
- When the Niskin bottle is retrieved on board, whole water samples will be collected from the sampler. The whole water sample for PCBs will be collected in two 1 L glass bottles and the whole water sample for mercury will be collected in a 125 ml FLPE container following the same CH/DH procedure described below
- After the whole water samples are collected, then filtered sample for dissolved metals will be collected. DH will attach sample tubing to the Niskin bottle barb (being careful to not handle the barbed connection which will go inside the tubing).
- DH will connect the tubing to the peristaltic pump, and CH will manage the clean end of the tubing from which the sample will flow.
- CH will attach the 0.45-µm filter to the tubing. The sample will be pumped through the tubing and filter capsule long enough to fill and thoroughly purge the system prior to filling the sample bottle.
- DH will open the seal of the outer Zip Top bag and hold the outer bag while CH opens the inner Zip Top bag to access the sample bottle.
- CH will handle and seal sample bottles (125 ml HDPE) as they are filled for subsequent analysis according to the CQAP.
- CH will verify sample bottles are appropriately labeled. The sampling label should contain the date, time, project name or number, sample ID, type of analysis required, and sampler initials.
- CH will close the inner Zip Top bag and DH will close the outer Zip Top bag and place the sample in a cooler with ice.
- Change or decontaminate sampling equipment prior to collecting a new sample (at a different depth or at a different sampling station) as follows:
    - Reusable components of the sampling device will be decontaminated using a soap wash (Alconox or equivalent), tap water rinse, and distilled water rinse. After the alconox wash and tap rinse, the distilled rinse and subsequent handling will be performed by the CH person.
    - A new filter, sample tubing, and silicone tubing will be used for each sample.
    - The plastic or aluminum covers of the bench will be changed or soap washed (Alconox or equivalent), tap water rinsed, and distilled water rinsed. After decontamination or when new, the handling of this equipment will be done exclusively by the CH person.
- **End CH/DH protocols.**
- After sampling is complete, measure surface water field parameters in accordance with SOP #WQMP-002: Surface Water Turbidity Monitoring.
- Return decontamination fluids to the river in accordance with the CQAP.
- Dispose of all disposable sampling materials and PPE used in sample processing, such as disposable coveralls, gloves, and paper towels, in heavyweight garbage bags or other appropriate containers. Dispose of waste bags in normal refuse containers for disposal as solid waste.

5.0 Supplies and Equipment

A detailed supply and equipment list is provided below.

- PPE and health and safety supplies:
  - Personal floating device (one per field staff)
  - Hard hat (one per field staff)
  - Steel toe boots (one per field staff)
  - Disposable, powderless nitrile gloves
  - Safety glasses
  - Hand warmer or equivalent (if necessary based on ambient temperatures)
  - First aid kit and eye wash
  - Functioning communication devices (personal cellphones, radio, or equivalent)
  - Waste bags
  - A copy of the Health and safety plan (HASP)
  - Food and drink for field staff
- Vessel Equipment:
  - Anchor and anchor-line
  - Hand-held radio or equivalent
  - Depth sounder
  - Fire extinguisher (present on the vessel)
  - GPS with electronic navigation maps
  - Deck lights and navigation lights
- Sampling equipment:
  - A 5 L Niskin Bolttle or other collection system
  - A deployment cable (50 feet or longer)
  - A graduated weighted line (50 feet or longer) [this line should not contain any leaded components]
  - Duct tape and/or zip ties to secure the cable to the graduated weighted line, if the deployment cable is not graduated
  - A hook, clamps, or equivalent tools to secure the cable to the vessel.
  - Teflon tubing and tube fittings to connect the Niskin bottle outlet to the filter
  - A peristaltic pump, battery, and backup battery
  - Filtering kits (laboratory precleaned 0.45-µm filter with C-Flex and Teflon tubing placed in a double Ziploc bag). A 10-µm pre-filter may be attached in-line to prolong the filtering capacity of the 0.45-µm filter, if necessary.
  - Any tools used to create a support system to direct the water flow outcome from the filtering unit and fill up the sample containers (5-gal bucket, clamps, or equivalent)
  - Laboratory provided sample containers
  - Ziploc bags
  - Labels for laboratory provided bottles
  - Cooler with ice
- Material to assemble the clean chamber to house the peristaltic pump, filter cartridge, sample containers, and any support system used to direct the water flow and fill up the sample bottles
  - Plastic (or aluminum) clean sheeting to cover the work bench
  - A fan to direct clean air flow towards the sampler during sample collection (or equivalent system)

- Equipment decontamination and waste handling supplies
    - Alconox or equivalent
    - Brushes or equivalent
    - Tap water or equivalent for rinsing
    - Distilled water
    - 5-gallons buckets (empty)
- Monitoring equipment:
    - Appropriate calibration kit(s)
    - A hydrocable (50 feet or longer)
    - A graduated weighted line (50 feet or longer) [this line should not contain any leaded components]
    - Duct tape and/or zip ties for use in securing equipment
    - Buoys for use if the GPS is not functioning correctly
    - Monitoring probe(s) and backup batteries
- Reporting Supplies:
    - A copy of the Construction Quality Assurance Plan (CQAP)
    - Sampling station coordinates
    - Field Forms
    - Chain of Custody
    - Tablet (if using)
    - Digital camera or equivalent for photographic records
    - White board and marker or equivalent for labeling photographic records
    - Permanent markers (fine tip and normal)

6.0 References

Anchor QEA, Windward. 2024. 100% Remedial Design Volume II for Lower Duwamish Waterway upper reach. Approved by EPA January 2024. Anchor QEA and Windward Environmental LLC, Seattle, WA.

David, N., D. Bell, and J. Gold. 2001. Field Sampling Manual for the Regional Monitoring Program for Trace Substances. San Francisco Estuarine Institute, San Francisco, CA. (February 2001).

EPA. 1996. Method 1669. Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303). Washington, DC. (July 1996).

USGS. 2000. Interagency Field Manual for the Collection of Water-Quality Data. Compiled by D.L. Lurry and C.M. Kolbe. U.S. Geological Survey, in cooperation with the U.S. Environmental Protection Agency. Open-File Report 00-213. Austin, TX.

SOP #WQMP-002: Surface Water Turbidity Monitoring. (September 2024).

Attachment A

NISKIN BOTTLES

OSIL

Non-metallic, free-flushing water samplers recommended for general-purpose water sampling.

These samplers can be individually or serially attached on a hydrocable and activated by a messenger, or placed on a 'Rosette System' and activated by remote command (mounting blocks for 'Rosette Systems' of other manufacturers are available on request: no extra charge).

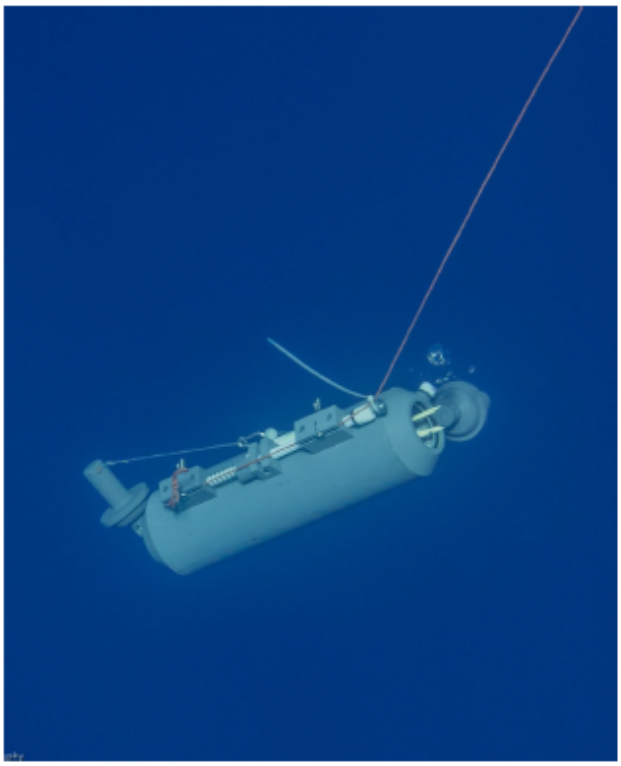
The PVC-standard water sampler is made of grey PVC (RAL 7011), with a latex tubing spring closure system, clamp bolts for attachment on a cable and mounting blocks for 'Rosette System' attachment.

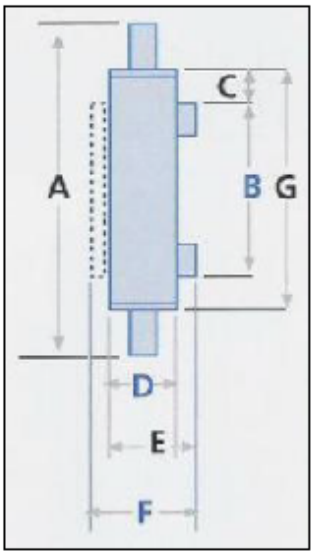
Delivery is made with lanyards for loading on both cable and 'Rosette Systems'. All metal parts are manufactured from special VA4-stainless steel. Delrin drain valves and Buna O-Rings prevent leakage from the sampler.

The PVC-standard water samplers are available in 1.7 L to 20 L capacities, and are capable of being mounted on cable of up to ¼" (6.4 mm) diameter. All samplers can be mounted on 'Rosette Systems'.

Specifications

- Mounting: Cable clamps are for cable diameters up to and including 6.4mm (1/4").
- Material: Non-metallic construction of PVC tube section, end stoppers, handles and cable clamp blocks. Delrin stopcocks, air vent screws and push rod. Stainless steel cable clamps. End stopper closure band of latex tubing. Buna-N O-ring seals (other materials available). Nylon monofilament lanyards.
- End Closure: Stopper with spherical section sealing surface held firmly against O-ring seal by internal latex tubing.
- Drainage: Thumbscrew air vent at top. Stopcock at base: 4.7mm (.187") diameter.





		Sampler Capacity (litres)					
Dimensions		1.7	2.5	5	10	12	20
A	mm	633	838	692	1041	1168	889
B	mm	330	330	330	330	330	330
C	mm	63	63	63	63	63	89
D	mm	89	89	142	142	142	218
E	mm	139	139	192	192	192	273
F	mm	204	204	257	257	257	338
G	mm	457	660	508	863	990	711
Empty Weight	kg	2.5	3.0	3.6	5.7	6.1	11.4
Full Weight	kg	4.20	5.50	8.63	15.63	18.13	31.43
End opening	mm	74					

FOR FURTHER INFORMATION PLEASE CONTACT:

Ocean Scientific International Ltd
Culkin House, C7/8 Endeavour Business Park,
Penner Road, Havant, Hampshire PO9 1QN, UK
T: +44 (0) 2392 488240 E: osil@osil.com W: www.osil.com

Geosyntec consultants

LDW PPS CM – PNR0859

Standard Operating Procedure #WQMP-002

Surface Water Turbidity Monitoring

Water quality turbidity monitoring during Lower Duwamish Waterway upper reach construction includes measuring surface water quality field parameters as required in the Surface Water Monitoring Plan (Appendix A of the Construction Quality Assurance Plan; Geosytnec, 2024) and the CWA404 ARAR Memo (EPA 2024)

1.0 Objectives

The purpose of this standard operating procedure (SOP) is to detail the methods for measuring surface water quality parameters in the field.

Surface water quality parameters may be measured at up to three depths based on total water depth (height of water column from water surface to sediment mudline) as measured at the time of sample and indicated in Table 1.

Table 1 – Water Quality Monitoring Depths

Total Water Depth (ft)	Number of Monitoring Depths	Water Quality Monitoring Depth(s) Based on Total Water Depth
≤ 10 ft	1	Middle point of the water column
>10 ft and <20 ft	2	Near-surface point 3 ft below the water surface Near-bottom point 3 ft above sediment-water interface
≥ 20ft	3	Near-surface point 3 ft below the water surface Mid-point of the water column Near-bottom point 3f t above sediment-water interface

2.0 Sampling Equipment

Deployable multi-probes (e.g., YSI, AquaTroll 500, etc.) with appropriate length deployment cables will be used as the preferred method of surface water quality monitoring. If field conditions or equipment failure prevent the deployment of in-situ probes to the target monitoring depth, then non-deployable meters will be used. Surface water volume would be collected from the target depth and retrieved on board for measuring required parameters using hand-held probes and/or HACH turbidity meter (see SOP #WQMP-001: Collection of Surface Water Samples).

Either the deployable probe cable will be marked with one-foot increments, or a measuring tape will be affixed to the deployable probe cable. Surface water quality parameters will be measured and recorded.

3.0 Mobilization and Location Control

Coordinates of monitoring stations will be determined from the geographic information systems maps in general accordance with the CQAP and in consultation with the Construction Manager.

If calibration is required by the global positioning system (GPS) used by the field team, the GPS will be calibrated over a known control point prior to mobilization for sampling. If calibration is not required by the GPS used by the field team, this step will be omitted.

3.1 Horizontal Control

The research vessel will be mobilized to a monitoring station, and x/y station coordinates will be collected using a handheld GPS (Trimble 4000, or similar). If the accuracy of the GPS unit is not adequate at the time of sampling (e.g., fewer than four satellites are visible above the horizon), then marker buoys will be placed at each monitoring station for survey when sufficient satellites become available. Coordinates will be recorded in NAD83 Washington State Plane North (feet) to the nearest 1.0 ft.

3.2 Vertical Control

Vertical elevation (water depth) will be recorded to the nearest 0.1 ft measured from the water surface to the sediment surface. Measurements will be collected using a graduated weighted line or similar device pulled taut prior to measurement and/or the vessel echo sounder (or equivalent). The time and date of measurement will also be recorded.

4.0 Sampling Methods

Calibration:

- The field team will calibrate monitoring equipment each morning prior to use following manufacturer instructions. Calibration records will include date/time, specific make and model number of equipment, field technician performing the calibration, and the result of the calibration.

The field team will monitor water quality as follows:

- Use laser distance measurer, GPS, and tide to determine upstream/downstream monitoring location
- R esearch vessel will first navigate to the background station 500-ft upstream (second station will be 150-ft downstream of construction activity)
- After confirming the sampling station, the boat captain will anchor, boat-tie to land-based feature, or try to maintain on-station using low level propulsion depending on water current, boat access, vessel traffic, and water depth. Anchoring and excessive propulsion will be avoided in shallow water, which may suspend sediment into the water column.
- Measure the water depth using a graduated weighted line and/or vessel echo sounder (or equivalent) and confirm monitoring depth(s) according to Table 1. Determine the number of water quality measurements to be collected according to Table 1. If multiple depths are to be recorded, they can be measured in any order.
- Verify that the deployable probe cable is correctly assembled and that connections are secure.
- Lower the probe to the target depth from the vessel by slowly lowering the cable through the water column. Confirm the deployment depth using either graduated marks on the cable or a weighted tape measure.

- After confirming the depth of deployment, begin monitoring the deployable probe readings. When readings have stabilized (less than a 10% change within 5 minutes), collect readings.
- Collect readings for:
  - Turbidity (in nephelometric turbidity units [NTU])
  - Dissolved oxygen (DO) (in mg/L)
  - Temperature (in ºC).
  - Hydrogen ion concentration (in pH units)
  - Conductivity (S/m)
  - Salinity (in parts per thousand or practical salinity units, which are roughly equivalent[1]), if reported. If salinity is not reported, it can be calculated from conductivity and temperature.
- Record field measurements, water depth, tide phase (flood, ebb, or slack), weather, date/time, monitoring depth, construction activities, water conditions including the presence of silt plumes (if present), distressed or dying fish (if present), and other surrounding field conditions that might influence turbidity readings, weather conditions
- If field conditions prevent the deployment of deployable probes to the target monitoring depth or necessitates the use of non-deployable meters, surface water will be collected from the target depth using a Niskin bottle or equivalent sampling device and retrieved on board the vessel for measuring required parameters (see SOP#WQMP-002: Collection of Surface Water Samples).
-
- After monitoring is complete, the field team will retrieve deployed equipment.
- Any leftover sample water will be returned to the river.
- All disposable sampling materials and personal protective equipment (PPE) used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavyweight garbage bags or other appropriate containers. Decon water will be containerized and processed with other decon water. Waste will be disposed in normal refuse containers for disposal as solid waste.

5.0 Supplies and Equipment

A detailed supply and equipment list is provided below.

- PPE and health and safety supplies:
  - Personal floating device (one per field staff)
  - Hard hat (one per field staff)
  - Steel toe boots (one per field staff)
  - Disposable, powderless nitrile gloves
  - Safety glasses
  - Hand warmer or equivalent (if necessary based on ambient temperatures)
  - First aid kit and eye wash
  - Functioning communication devices (personal cellphones, radio, or equivalent)
  - Waste bags
  - A copy of the Health and safety plan (HASP)
  - Food and drink for field staff
- Vessel Equipment:
  - Anchor and anchor-line

[1] https://salinity.oceansciences.org/overview.htm

  - Hand-held radio or equivalent
  - Depth sounder
  - Fire extinguisher (present on the vessel)
  - GPS with electronic navigation maps
- Deck lights and navigation lights
- Binoculars
- Monitoring equipment:
  - Appropriate calibration kit(s)
  - Multi-parameter probe and hydrocable (50 feet or longer)
  - A graduated weighted line (50 feet or longer) [this line should not contain any leaded components]
  - Hach turbidity meter (backup)
  - Hand-held laser distance measurer (~ 500 ft)
  - Duct tape and/or zip ties for use in securing equipment
  - Buoys for use if the GPS is not functioning correctly
  - Monitoring probe(s) and backup batteries
- Reporting Supplies:
  - A copy of the Construction Quality Assurance Plan (CQAP)
  - Proposed sampling station coordinates
  - Field Forms
  - Tablet (if using)
  - Digital camera or equivalent for photographic records
  - White board and marker or equivalent for labeling photographic records
  - Permanent markers (fine tip and normal)

6.0 References

Anchor QEA, Windward. 2024. 100% Remedial Design Volume II for Lower Duwamish Waterway upper reach. Approved by EPA January 2024. Anchor QEA and Windward Environmental LLC, Seattle, WA.

SOP #WQMP-001: Collection of Surface Water Samples. (September 2024).

EPA 2024. Clean Water Act 404 ARAR Memo: Substantive Water Quality Requirements for the Lower Duwamish Waterway Upper Reach Superfund Remedial Action. Final. Prepared by the U.S. Environmental Protection Agency Region 10, Seattle, WA. October 15, 2023.

Appendix A – Water Quality Monitoring Plan

Attachment A.3
Analytical Methods and Data Quality Indicators

Tables

Table 3-1
Brooks Applied Laboratories Analytical Methods, MDLs, RLs, and Water Quality Criteria[1]

Analyte	Method	Unit	Lab MDL	Lab RL	Marine Aquatic Life Water Quality Criteria	
					Marine Chronic (µg/L)[2]	Marine Acute (µg/L)[3]
Metals						
Arsenic	EPA 1638 Mod	µg/L	0.016	0.072	36 (dissolved)	69 (dissolved)
Lead	EPA 1638 Mod	µg/L	0.006	0.012	8.1 (dissolved)	210 (dissolved)
Mercury[4] (total)	EPA 1631E	µg/L	0.00013	0.0004	0.025 (total)	1.8 (dissolved)
Zinc	EPA 1638 Mod	µg/L	0.7	2.2	81 (dissolved)	90 (dissolved)

Notes:
1. Standards listed are the lowest of National Recommended Water Quality Criteria: Aquatic Life Criteria EPA or Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A-240, Table 240).
2. Marine chronic criteria for metals are relevant to a 4-day exposure timeframe.
3. Marine acute criteria are relevant to a 1-hour exposure timeframe for metals.
4. Mercury concentrations will be measured in whole water samples and compared to the acute value which is based on dissolved concentration.
µg/L: microgram per liter
EPA: U.S. Environmental Protection Agency
MDL: method detection limit
RL: reporting limit
WAC: Washington Administrative Code

Table 3-2
Eurofins Analytical Methods, MDLs, RLs, and Water Quality Criteria[1]

Analyte	Method	Unit	Lab MDL	Lab RL	Marine Aquatic Life Water Quality Criteria	
					Marine Chronic (µg/L)[2]	Marine Acute (µg/L)[3]
Metals						
Arsenic	EPA 6020B	µg/L	1.02	5	36 (dissolved)	69 (dissolved)
Lead	EPA 6020B	µg/L	0.2	2	8.1 (dissolved)	210 (dissolved)
Mercury[4] (total)	EPA 1631E	µg/L	0.0002	0.0005	0.025 (total)	1.8 (dissolved)
Zinc	EPA 6020B	µg/L	4.64	35	81 (dissolved)	90 (dissolved)
PCB Aroclors						
Aroclor 1016	EPA 8082A	µg/L	0.008	0.01	—	—
Aroclor 1221	EPA 8082A	µg/L	0.008	0.01	—	—
Aroclor 1232	EPA 8082A	µg/L	0.008	0.01	—	—
Aroclor 1242	EPA 8082A	µg/L	0.008	0.01	—	—
Aroclor 1248	EPA 8082A	µg/L	0.008	0.01	—	—
Aroclor 1254	EPA 8082A	µg/L	0.005	0.01	—	—
Aroclor 1260	EPA 8082A	µg/L	0.005	0.01	—	—
Total PCB Aroclors	EPA 8082A	µg/L	—	—	0.030 (total)	10 (total)

Notes:
1. Standards listed are the lowest of National Recommended Water Quality Criteria: Aquatic Life Criteria EPA or Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A-240, Table 240).
2. Marine chronic criteria for metals are relevant to a 4-day exposure timeframe. The exposure timeframe for PCBs is 24 hours.
3. Marine acute criteria are relevant to a 1-hour exposure timeframe for metals and a 24-hour exposure timeframe for PCBs.
4. Mercury concentrations will be measured in whole water samples and compared to the acute value which is based on dissolved concentration.
µg/L: microgram per liter
EPA: U.S. Environmental Protection Agency
MDL: method detection limit
RL: reporting limit
PCB: polychlorinated biphenyl
WAC: Washington Administrative Code

Table 3-3
Analytical Resources, LLC Analytical Methods, MDLs, RLs, and Water Quality Criteria[1]

Analyte	Method	Unit	Lab MDL	Lab RL	Marine Aquatic Life Water Quality Criteria	
					Marine Chronic (µg/L)[2]	Marine Acute (µg/L)[3]
Metals						
Arsenic	EPA 6020B UCT-KED	µg/L	0.0373	0.2	36 (dissolved)	69 (dissolved)
Lead	EPA 6020B	µg/L	0.0513	0.1	8.1 (dissolved)	210 (dissolved)
Mercury[4] (total)	EPA 7470A	µg/L	0.013	0.1	0.025 (total)	1.8 (dissolved)
Zinc	EPA 6020B UCT-KED	µg/L	2.92	6	81 (dissolved)	90 (dissolved)
PCB Aroclors						
Aroclor 1016	EPA 8082A	µg/L	0.05	0.1	—	—
Aroclor 1221	EPA 8082A	µg/L	0.05	0.1	—	—
Aroclor 1232	EPA 8082A	µg/L	0.05	0.1	—	—
Aroclor 1242	EPA 8082A	µg/L	0.05	0.1	—	—
Aroclor 1248	EPA 8082A	µg/L	0.05	0.1	—	—
Aroclor 1254	EPA 8082A	µg/L	0.05	0.1	—	—
Aroclor 1260	EPA 8082A	µg/L	0.05	0.1	—	—
Total PCB Aroclors	EPA 8082A	µg/L	—	—	0.030 (total)	10 (total)

Notes:
1. Standards listed are the lowest of National Recommended Water Quality Criteria: Aquatic Life Criteria EPA or Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A-240, Table 240).
2. Marine chronic criteria for metals are relevant to a 4-day exposure timeframe. The exposure timeframe for PCBs is 24 hours.
3. Marine acute criteria are relevant to a 1-hour exposure timeframe for metals and a 24-hour exposure timeframe for PCBs.
µg/L: microgram per liter
4. Mercury concentrations will be measured in whole water samples and compared to the acute value which is based on dissolved concentration.
EPA: U.S. Environmental Protection Agency
MDL: method detection limit
RL: reporting limit

PCB: polychlorinated biphenyl
WAC: Washington Administrative Code

Table 3-4
ALS-Kelso Analytical Methods, MDLs, RLs, and Water Quality Criteria[1]

Analyte	Method	Unit	Lab MDL	Lab RL	Marine Aquatic Life Water Quality Criteria	
					Marine Chronic (µg/L)[2]	Marine Acute (µg/L)[3]
Metals						
Arsenic	EPA 6020B	µg/L	1.8	10	36 (dissolved)	69 (dissolved)
Lead	EPA 6020B	µg/L	0.12	0.4	8.1 (dissolved)	210 (dissolved)
Mercury[4] (total)	EPA 7470A	µg/L	0.02	0.2	0.025 (total)	1.8 (dissolved)
Zinc	EPA 6020B	µg/L	10	40	81 (dissolved)	90 (dissolved)
PCB Aroclors						
Aroclor 1016	EPA 8082A	µg/L	0.0028	0.005	—	—
Aroclor 1221	EPA 8082A	µg/L	0.0028	0.01	—	—
Aroclor 1232	EPA 8082A	µg/L	0.0028	0.005	—	—
Aroclor 1242	EPA 8082A	µg/L	0.0028	0.005	—	—
Aroclor 1248	EPA 8082A	µg/L	0.0028	0.005	—	—
Aroclor 1254	EPA 8082A	µg/L	0.0028	0.005	—	—
Aroclor 1260	EPA 8082A	µg/L	0.0028	0.005	—	—
Total PCB Aroclors	EPA 8082A	µg/L	—	—	0.030 (total)	10 (total)

Notes:
1. Standards listed are the lowest of National Recommended Water Quality Criteria: Aquatic Life Criteria EPA or Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A-240, Table 240).
2. Marine chronic criteria for metals are relevant to a 4-day exposure timeframe. The exposure timeframe for PCBs is 24 hours.
3. Marine acute criteria are relevant to a 1-hour exposure timeframe for metals and a 24-hour exposure timeframe for PCBs.
4. Mercury concentrations will be measured in whole water samples and compared to the acute value which is based on dissolved concentration.
µg/L: microgram per liter
EPA: U.S. Environmental Protection Agency

MDL: method detection limit
RL: reporting limit
PCB: polychlorinated biphenyl
WAC: Washington Administrative Code

Table 3-5
Analytical Methods and Sample Handling Requirements for Water Samples

Parameter	Method	Reference	Laboratory[1]	Container	Preservative	Sample Holding Time
Total PCBs	GC-ECD	EPA 8082	Eurofins ARL ALS-Kelso	2 1-L (amber glass)	None	1 year to extract, 1 year from extraction to analysis
Dissolved metals	ICP-MS	EPA 1638 Mod	Brooks Applied	125-mL HDPE	dissolved samples field-filtered with 0.45-µm filter; nitric acid to pH < 2 within 14-days of collection	180 days
Dissolved metals	ICP-MS	EPA 6020B	Eurofins ARL ALS-Kelso	250-mL HDPE	filtered with 0.45-µm filter then nitric acid to pH < 2	180 days
Mercury (total)	CV-AFS	EPA 1631E	Brooks Applied Eurofins	125-mL FLPE (Brooks) 250-mL clear glass (Eurofins)	BrCl in lab within 28 days of collection (oxidation in the original sample bottle)	90 days
Mercury (total)	CV-AA	EPA 7470A	ARL ALS-Kelso	250-mL HDPE	nitric acid to pH < 2	28 days

[1] ARL and ALS are alternate laboratories for the analysis of total PCB. Eurofins, ARL and ALS are alternate laboratories for the analysis of dissolved metals and mercury.
Underline = primary lab
Notes:
CV-AA: cold vapor atomic absorption
CV-AFS: cold vapor-atomic fluorescence
EPA: U.S. Environmental Protection Agency
FLPE: fluorinated high-density polyethylene
GC-ECD: gas chromatography-electron capture detection
HDPE: high-density polyethylene
ICP-MS: inductively coupled plasma-mass spectrometry

Table 3-6
DQIs for Chemistry Laboratory Analyses

Parameter	Unit	Laboratory[2]	Precision[2]	Accuracy[2]		Completeness
				LCS	Spiked Samples	
Dissolved metals	µg/L	Brooks Applied Eurofins ARL ALS-Kelso	± 20%	80–120%	75–125%	90%
Mercury[3] (total)	µg/L	Brooks Applied Eurofins	± 24%	na[4](Brooks) 77-123% (Eurofins)	75–125% (Brooks) 77-123% (Eurofins)	90%
Mercury[3] (total)	µg/L	ARL ALS-Kelso	± 25%	80–120%	75–125%	90%
Total PCBs	µg/L	Eurofins	± 30%	60-130%	60-130%	90%
Total PCBs	µg/L	ARL	± 20%	51–128%	51–128%	90%
Total PCBs	µg/L	ALS-Kelso	± 30%	31-182%	31-182%	90%

Notes:

1. Eurofins, ARL and ALS are alternate laboratories for the analysis of dissolved metals and mercury. ARL and ALS are alternate laboratories for the analysis of total PCB.
2. Values listed are performance-based limits provided by the laboratories.
3. Mercury concentrations will be measured in whole water samples and compared to the acute value which is based on dissolved concentration.
4. EPA 1631E does not require an LCS. Brooks Applied uses spiked sample recovery to assess accuracy.

Underline = primary lab
µg/L: microgram per kilogram
ARL: Analytical Resources, LLC
DQI: data quality indicator
LCS: laboratory control sample
na – not applicable
PCB: polychlorinated biphenyl

Table 3-7
Laboratory Chemistry QC Sample Analysis Summary

Analyte	Laboratory	Initial Calibration	Initial Calibration Verification (second source)	Continuing Calibration Verification	LCS	Laboratory Replicates	MSs	MSDs	Method Blanks	Surrogate Spikes
Dissolved metals	Brooks Applied	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	1 per 10 samples	1 per 10 samples	1 per 10 samples	3 per prep batch	na
Dissolved metals	Eurofins	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	na	1 per prep batch	1 per prep batch	1 per prep batch	na
Dissolved metals	ARL ALS-Kelso	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	1 per prep batch	1 per prep batch	na	1 per prep batch	na
Mercury (total)	Brooks Applied	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	na[2]	na	1 per prep batch	1 per prep batch	3 per prep batch	na
Mercury (total)	Eurofins	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	na	2 per prep batch	2 per prep batch	3 per prep batch	na
Mercury (total)	ARL ALS-Kelso	prior to analysis	after initial calibration	every 10 samples and at end of analytical sequence	1 per prep batch	1 per prep batch	1 per prep batch	na	1 per prep batch	na
PCB Aroclors (total)	Eurofins ARL ALS-Kelso	prior to analysis	after initial calibration	before and after sample analysis, every 10-20 analyses or 12 hours	1 per prep batch	na	1 per prep batch	1 per prep batch	1 per prep batch	each sample

Notes:
A batch is a group of samples of the same matrix analyzed or prepared at the same time, not exceeding 20 samples.
1. Eurofins, ARL and ALS are alternate laboratories for the analysis of dissolved metals and mercury. ARL and ALS are alternate laboratories for the analysis of total PCB.

2. EPA 1631E does not require analysis of an LCS. Accuracy will be assessed based on the MS and MSD percent recoveries.

Underline = primary lab

LCS: laboratory control sample
MS: matrix spike
MSD: matrix spike duplicate
na: not applicable
QC: quality control

Construction Phase, Revision 1

Appendix B
Construction Sediment Sampling Quality Assurance Project Plan

Lower Duwamish Waterway Group

City of Seattle / King County / The Boeing Company

CONSTRUCTION PHASE CQAP FOR THE LOWER DUWAMISH WATERWAY UPPER REACH

APPENDIX B – CONSTRUCTION SEDIMENT SAMPLING QUALITY ASSURANCE PROJECT PLAN

For submittal to

The US Environmental Protection Agency
Region 10
Seattle, WA

October 22, 2024

Prepared by:

Geosyntec consultants

520 Pike Street • Suite 2600
Seattle, Washington • 98101

and

Windward environmental LLC

200 1st Ave W • Suite 500
Seattle, Washington • 98119

in association
with

ANCHOR QEA

1201 3rd Ave • Suite 2600
Seattle, Washington • 98101

TITLE AND APPROVAL PAGE

Construction Sediment Sampling Quality Assurance Project Plan

Project Owner's Project Manager	Signed by: Shannon Phipps 735F744D3E4F497...	10/21/2024
	Name	Date
Environmental Quality Assurance Officer; Sampling	Signed by: Susan McGroddy 04D27263A32F45E...	10/21/2024
	Name	Date
Environmental Quality Assurance Officer; Monitoring	Signed by: 8AAEC54489D449A...	10/21/2024
	Name	Date
Field Sampling Lead	Signed by: Amara Vandervort 9E6FA14F10B747F...	10/21/2024
	Name	Date
EPA Project Manager		
	Name	Date
EPA Regional QA Manager		
	Name	Date

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

ABBREVIATIONS

%RSD	relative standard deviation
BBP	butyl benzyl phthalate
BODR	Basis of Design Report
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CQAP	Construction Quality Assurance Plan
DQI	data quality indicator
DQO	data quality objective
DU	Decision Unit
dw	dry weight
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
EQAO	Environmental Quality Assurance Officer
GC/ECD	gas chromatography/electron capture detection
GC/MS	gas chromatography/mass spectrometry
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD	heptachlorodibenzo-*p*-dioxin
HpCDF	heptachlorodibenzofuran
HRGC/HRMS	high-resolution gas chromatography/high-resolution mass spectrometry
HSP	health and safety plan
HxCDD	hexachlorodibenzo-*p*-dioxin
HxCDF	hexachlorodibenzofuran
ICP/MS	inductively coupled plasma
ID	identification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDW	Lower Duwamish Waterway
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
OC	organic carbon
OCDD	octachlorodibenzo-*p*-dioxin
OCDF	octachlorodibenzofuran
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl

PeCDD	pentachlorodibenzo-*p*-dioxin
PeCDF	pentachlorodibenzofuran
PM	Project Manager
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAA	remedial action area
RAL	remedial action level
RAO	remedial action objective
RD	remedial design
RL	reporting limit
RMC	residuals management cover
ROD	Record of Decision
RPD	relative percent difference
SCUM	Sediment Cleanup User's Manual
SDG	sample delivery group
SM	Standard Method
SMA	Sediment Management Area
SOP	standard operating procedure
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzo-*p*-dioxin
TCDF	tetrachlorodibenzofuran
TEQ	toxic equivalent
TOC	total organic carbon
UCT-KED	universal cell technology/kinetic energy discrimination

1 Introduction

This Construction Sediment Sampling Quality Assurance Project Plan (Sediment QAPP) is an appendix to the Construction Quality Assurance Plan (CQAP) for the upper reach of the Lower Duwamish Waterway (LDW). The purpose of this Sediment QAPP is to outline the post-dredge sediment sampling and the associated sampling and analyses methods. Sediment samples, once post-dredge elevation requirements have been achieved, will be collected to assess generated residuals and potential missed inventory to determine if contingency actions are needed. In addition, this Sediment QAPP includes sediment sampling before and after dredging near public access and/or habitat areas to verify that dredging residuals have not contaminated these areas.

This QAPP provides the specific requirements for construction sediment sampling, including data quality objectives (DQOs), sampling design, and all methods and procedures needed to collect and analyze sediment samples. U.S. Environmental Protection Agency (EPA) guidance for QAPPs was followed in preparing this document (EPA 2002). The remainder of this QAPP is organized into the following sections.

- Section 2 – Project Objectives and Description
- Section 3 – Project Organization and Responsibilities
- Section 4 – Data Generation and Acquisition
- Section 5 – Assessment and Oversight
- Section 6 – Reporting
- Section 7 – References

This QAPP has three attachments. Attachment B.1 provides the field collection forms, Attachment B.2 presents standard operating procedures (SOPs), and Attachment B.3 presents the laboratory methods and the associated reporting limits (RLs). The Archaeological Monitoring and Inadvertent Discovery Plan for all construction-related activities (which applies to subsurface core samples) is provided in Appendix D of the CQAP. The health and safety plan (HSP), which is designed to protect on-site personnel from physical, chemical, and other hazards posed by the field sampling effort, is Appendix E of the CQAP. Attachment B.1 (field forms), Attachment B.3 (laboratory methods and RLs), and the HSP will be prepared after 100% remedial design (RD).

2 Project Objectives and Description

This section presents the DQOs for the construction sediment sampling, and an overview of the schedule/sequencing for how the sediment sampling fits with the rest of the construction work.

2.1 Data Quality Objectives

The primary purpose of the sediment sampling described in this QAPP is to collect sediment samples to assess generated residuals or potential missed inventory for each Sediment Management Area (SMA)[1] to determine if contingency actions are needed, as discussed in Section 5.2 of the CQAP. The DQOs for construction sediment sampling are provided below for both Decision Unit (DU)[2] sampling (DQOs 1 and 2) and perimeter[3] sampling (DQOs 3 and 4). The seven-step DQO process is summarized in Table B2-1 for each of the four DQOs.

- **DQO 1**: For each DU, determine if there is missed inventory within the toe of dredge[4] footprint.
- **DQO 2**: For each DU, assess whether there are generated residuals in surface sediment within the toe of the dredge footprint.
- **DQO 3**: Assess whether there are generated residuals in surface sediment in the outer perimeter of the dredge area.
- **DQO 4**: Assess whether there are generated residuals in the intertidal sediment adjacent to public access and/or habitat areas (applies only to SMAs adjacent to such areas).[5]

[1] As described in the Basis of Design Report (BODR), SMAs consist of grouped or subdivided remedial action areas (RAAs) with similar logistical considerations such as common construction methods, adjacent locations, and similar site conditions. SMAs are used to organize activities and to define discrete areas for construction management (e.g., construction sequencing).

[2] For the purposes of conducting construction sediment sampling to evaluate the completeness of dredging, each SMA has been divided into DUs, such that there are at least six DUs per acre within the compliance area (toe of cut). DUs are discussed further in Section 4.1.

[3] Perimeter sampling will be conducted in the outer perimeter area, which is a 20-foot-wide area outside of the inner perimeter boundary, except for downstream of the SMA, where the outer perimeter is 30 feet wide. The inner perimeter is the 20-foot-wide area (30 feet wide downstream) starting from the top of the dredge cut that will receive residuals management cover (RMC) placement (no sampling will occur in the inner perimeter). Perimeter areas are discussed further in Section 4.1.

[4] The toe of the dredge cut is the horizontal boundary surrounding the deepest elevation or thickness of dredging representing the target depth. Side slopes connect the toe of dredging to the existing mudline surface using either two horizontal to one vertical (2H:1V) or 3H:1V slope cuts, as described in the BODR.

[5] SMAs adjacent to public access areas and/or habitat areas include SMAs 17/18 (Duwamish Waterway Park, which provides public access to intertidal areas) and SMA 11A/12B (Duwamish River People's Park and Shoreline Habitat, which includes limited public access and extensive marsh and shoreline habitat).

Table B2-1
Construction Monitoring DQOs and Stepped Analysis

DQO Step	DU Sampling		Perimeter Sampling	
	DQO 1	**DQO 2**	**DQO 3**	**DQO 4**
STEP 1: State the problem	Data are needed to determine if there is missed inventory within the toe of the dredge footprint for a given DU.	Data are needed to assess whether there are generated residuals within the toe of the dredge footprint for a given DU.	Data are needed to assess whether there are generated residuals in the outer perimeter of the dredge area.	Data are needed to assess whether there are generated residuals in intertidal sediment adjacent to public access and/or habitat areas.
STEP 2: Identify the goals of the study	Determine if subsurface sediment in the post-dredge 0-30 cm interval has concentrations greater than thresholds (see Section 5.2 of the CQAP), and if yes, determine depth of contamination.	Determine if surface sediment (0-10 cm) concentrations within the dredge footprint are greater than thresholds (see Section 5.2 of the CQAP).	Determine if surface sediment (0-10 cm) concentrations within the outer perimeter are greater than thresholds (see Section 5.2 of the CQAP).	Determine if post-dredge surface sediment (0-10 cm) concentrations near public access and/or habitat areas are greater than thresholds (see Section 5.2 of the CQAP).
STEP 3: Identify the information inputs	Remedy design (drawings) will be used to determine DUs and sampling locations; surface and subsurface sediment data in the design dataset for the upper reach of the LDW will be used to determine analytes.			
STEP 4: Define the boundaries of the study	Within and adjacent to SMAs in the upper reach of the LDW that require dredging			
STEP 5: Develop the analytical approach	Analytes will be specific to each SMA based on the upper reach design dataset			
STEP 6: Specify performance or acceptance criteria	Performance or acceptance criteria are described in Sections 4.8 and 4.9, including field QC samples and laboratory QC samples. DQIs for laboratory analysis will be met, as described in Sections 4.8 and 4.9.			
STEP 7: Develop the detailed plan for obtaining data	Collect subsurface cores (approximately 0–120 cm [0–4 feet]) in each DU.[1] Cores will be sampled in 30-cm intervals.	Collect surface sediment samples (0–10 cm) within toe of dredge footprint in each DU.	Collect surface sediment samples (0–10 cm) around the outer perimeter of the dredge area.	Collect surface sediment samples (0–10-cm) adjacent to public access and/or habitat area.

Notes:
1. The toe of dredge cut is the horizontal boundary surrounding the deepest elevation or thickness of dredging representing the target depth.
CQAP: Construction Quality Assurance Plan
DQO: data quality objective
DU: Decision Unit
LDW: Lower Duwamish Waterway
SMA: sediment management area

2.2 Project Approach and Schedule

This section provides an overview of the approach and schedule for sediment sampling during construction. The in-water components of the upper reach remedy will be conducted within the LDW-designated in-water work window, which is expected to occur between October 1 and February 15, annually. Scheduling will also take into account the tribal net fishery. Remedial construction for the upper reach is anticipated to require three construction seasons, as discussed in Section 13 of the BODR.

Construction sediment sampling will be conducted separately for each SMA (or group of SMAs) for which dredging has been conducted. The sampling sequence is summarized below.

- **Collect samples prior to dredging (for SMAs near public access and/or habitat areas)**: Surface sediment samples will be collected and archived prior to dredging in public access and/or habitat areas within 150 feet of the SMA to be dredged (DQO 4).[6]
- **Conduct dredging**: The Remedial Action Contractor (Contractor) will conduct dredging in accordance with project specifications and drawings. Once the Contractor has completed dredging an SMA, the Contractor will conduct a survey to verify that post-dredge elevations/thicknesses have been accepted.
- **Collect sediment samples**: After the required dredge elevations/thicknesses have been accepted, the construction sediment sampling will be conducted (DQOs 1 through 4). These samples will include missed inventory cores, surface sediment samples to evaluate dredged residuals, and (if applicable), post-dredge public access and/or habitat area samples. Samples will be submitted to the laboratory for analysis (with an expedited turnaround time) and used to determine if contingency re-dredging is needed.
- **Determine if contingency re-dredging is needed**: The target timeline to determine whether contingency re-dredging is needed is 15 calendar days, which includes sample collection, laboratory analysis, data processing, and consultation with EPA.
- **Conduct contingency re-dredging (if needed)**: If the results of the first round of sampling indicate that contingency re-dredging is needed (as described in Section 5.2 of the CQAP), the following steps will be taken on a DU-specific basis:
  - **Complete contingency re-dredging**: The Contractor will complete the specified contingency re-dredging. The contingency re-dredging will be considered complete once required contingency re-dredge elevations/thicknesses have been accepted.
  - **Collect an additional round of surface sediment samples**: After the contingency re-dredging has been completed and accepted, an additional round of surface sediment sampling within the toe of dredge in DUs where re-dredging was conducted

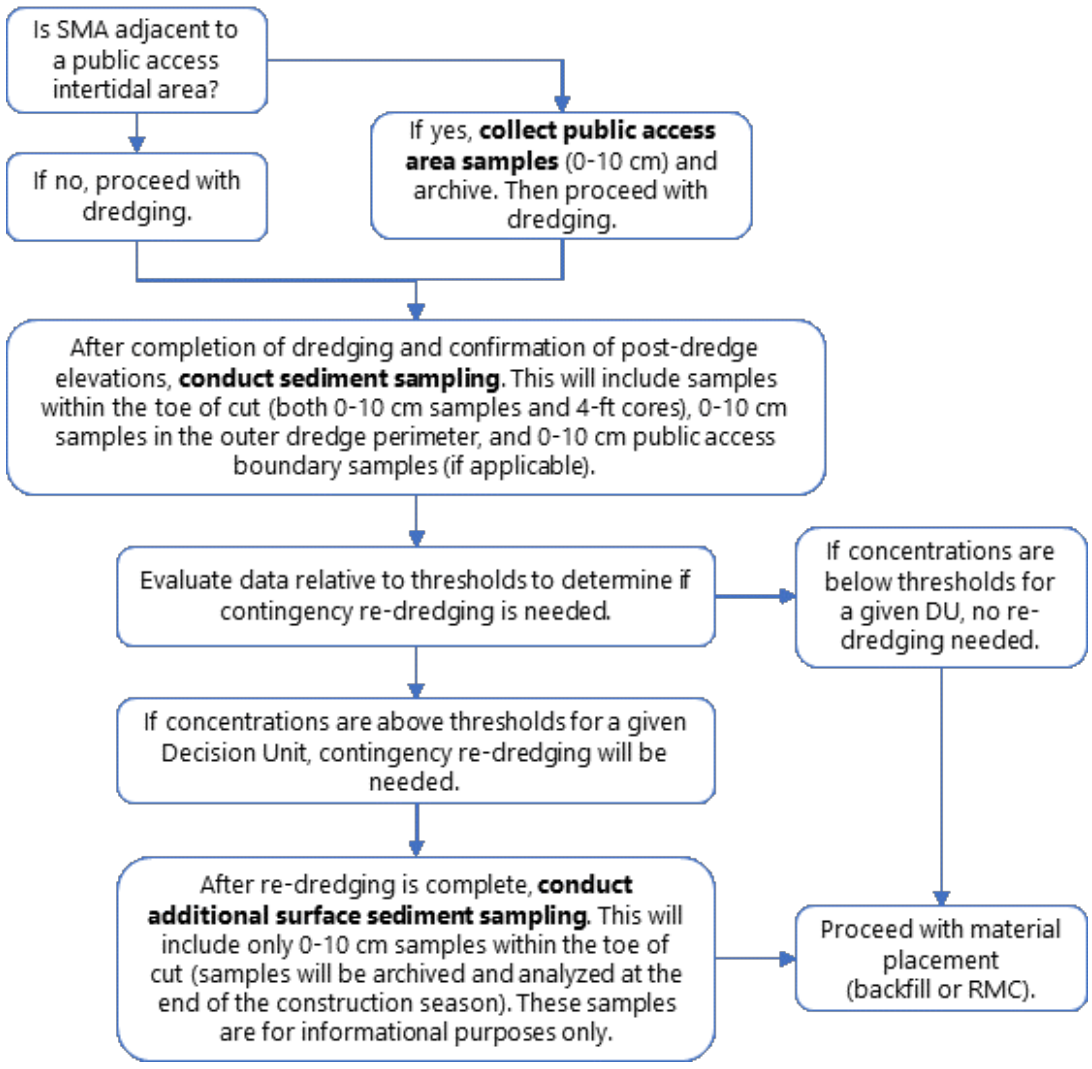
[6] Public access and/or habitat area samples will be collected near Duwamish Waterway Park (SMAs 17 and 18) and along Duwamish River People's Park and Shoreline Habitat (SMAs 11A and 12B), as described in Section 4.1.

will be conducted for informational purposes. These samples will be archived and analyzed at the end of each construction season. Results from these samples will be presented in the Annual Construction Summary Technical Memorandum.

- **Place backfill or RMC**: Material will be placed as determined by the Project Representative and EPA.

This process is summarized in Figure B2-1.

Figure B2-1
Sequencing of Construction Sediment Sampling



Note: Specific thresholds for determining whether contingency actions are needed are discussed in Section 5.2 of the CQAP.

3 Project Organization and Responsibilities

Overall project organization and team responsibilities are described in Section 2 of the CQAP. The following sections describe the responsibilities of key project team members involved in the construction sediment sampling work.

3.1 Project Representative (Shannon Phipps, King County)

The Project Representative will be assigned by the Owner (King County) to oversee the entire construction QA program. The Project Representative will be the only person authorized to direct the Contractor and will be kept updated on sediment sampling results. The Project Representative will work with the Environmental Quality Assurance Officer, Designer, and EPA to determine whether contingency actions are needed.

3.2 Construction Manager

The Construction Manager for this project is Jeff Williams (Geosyntec). This role is described in the CQAP; the Construction Manager is the on-site day-to-day oversight QA representative to assist the Project Representative oversee the entire construction QA program.

3.3 Environmental Quality Assurance Officer (Susan McGroddy, Windward)

The Environmental Quality Assurance Officer (EQAO) for sediment sampling will be responsible for coordinating, reviewing, and reporting all environmental sampling activities. Key responsibilities related to construction sediment sampling will include the following:

- Reviewing field reports to verify that appropriate field methods and QC procedures are being implemented in accordance with the procedures specified in this QAPP
- Overseeing coordination of the field sampling and laboratory programs and supervising data review, including coordination with the analytical laboratories and the EPA QA chemist
- Reporting sediment sampling results to the Project Representative and Construction Manager, who will notify EPA

3.4 Field Sampling Lead (Suzanne Replinger, Windward)

The Field Sampling Lead for will be responsible for implementing sediment sampling activities. Key responsibilities associated with sediment sampling will include the following:

- Managing field sampling activities, field personnel, and general field and quality assurance/quality control (QA/QC) oversight related to sample collection
- Overseeing sample collection, preservation, and holding times, and coordinating delivery of environmental samples to the designated laboratories for chemical analyses

- Verifying that station, sample collection, and field measurement results are properly recorded and forms are completely filled out
- Coordinating with the analytical laboratories (a laboratory coordinator may be identified prior to the implementation of the QAPP to assist with this coordination)
- Coordinating with additional individuals involved in sediment sampling (e.g., boat captains), who will be identified prior to the implementation of this QAPP
- Notifying the EQAO and Project Representative of sediment sampling results and providing all necessary supporting field documentation

3.5 Sampling Personnel

Under the Field Sampling Lead's oversight, field personnel will be responsible for conducting field activities, QA/QC procedures, and documentation of results.

3.6 Analytical Laboratory (Eurofins-Seattle, ALS-Environmental-Kelso, Analytical Resources, LLC)

The analytical laboratories will perform all chemical analyses. The laboratories will meet the following requirements:

- Adhere to the methods outlined in this QAPP, including those methods referenced for each procedure
- Adhere to documentation, custody, and sample logbook procedures
- Implement QA/QC procedures defined in this QAPP
- Meet all reporting requirements
- Deliver electronic data files as specified in this QAPP
- Meet turnaround times for deliverables as described in this QAPP
- Allow EPA and the EQAO, or a representative, to perform laboratory and data audits

3.7 Data Management (Kim Goffman, Windward)

The Data Manager will oversee data management; they will ensure that analytical data are incorporated into the LDW database with appropriate qualifiers following review of the data.

3.8 Special Training/Certification

The Superfund Amendments and Reauthorization Act of 1986 required the Secretary of Labor to issue regulations through the Occupational Safety and Health Administration providing health and safety standards and guidelines for workers engaged in hazardous waste operations. Accordingly, 29 Code of Federal Regulations 1910.120 requires that employees be given the training necessary to provide them with the knowledge and skills to enable them to perform their jobs safely and with minimum risk to their personal health. All sampling personnel will have completed the 40-hour

HAZWOPER training course and 8-hour refresher courses, as necessary, to meet Occupational Safety and Health Administration regulations. The Sediment Sampling Lead will also have completed the eight-hour HAZWOPER supervisor training.

In addition, all analytical laboratories will have current environmental laboratory accreditation from the Washington State Department of Ecology (Ecology) and other accreditation agencies for the analytical methods to be used. Any exceptions will be identified prior to implementation of this QAPP.

3.9 Documentation and Records

Field observations and laboratory records will be documented following the protocols described in this section. In addition, this section provides data reduction rules and data report formats.

3.9.1 Field Observations

All field activities will be recorded in a field logbook maintained by the Sediment Sampling Lead or designee. The field logbook will provide a description of all sampling activities, conferences among the Sediment Sampling Lead, EQAO, and EPA oversight personnel associated with field sampling activities, sampling personnel, and weather conditions, as well as a record of all modifications to the procedures and plans identified in this QAPP and the HSP (Appendix E of the CQAP). The field logbook will consist of bound, numbered pages, and all entries will be made in indelible ink. Photographs will provide additional documentation of the sample collection activities. The field logbook is intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling period.

The project team will use the following field forms (Attachment B.1) to record pertinent information after sample collection:

- Surface sediment collection form
- Sediment core collection form
- Sediment core processing log
- Protocol modification form
- Chain of custody form

The project team will document information regarding equipment calibration and other sampling activities in the field logbook.

3.9.2 Laboratory Records

3.9.2.1 Chemistry Records

The analytical laboratories will be responsible for internal checks and data verification pertaining to sample handling and analytical data reporting and will correct errors identified during the QA review. The analytical laboratories will submit data packages electronically, including the following as applicable:

- **Project narrative**: This summary, in the form of a cover letter, will present any problems encountered during any aspect of sample analyses. The summary will include, but not be limited to, discussion of QC, sample shipment, sample storage, and analytical difficulties. The project narrative will document any problems encountered by the laboratory and their resolutions. In addition, the summary will provide operating conditions for instruments used for the analysis of each suite of analytes and definitions of laboratory qualifiers.
- **Records**: The data package will include legible copies of the chain of custody forms. This documentation will include the time of receipt and the condition of each sample received by the laboratory. These records will also document additional internal tracking of sample custody by the laboratory.
- **Sample results**: The data package will summarize the results for each sample analyzed. The summary will include the following information, as applicable:
  - Field sample identification (ID) code and corresponding laboratory ID code
  - Sample matrix
  - Date of sample extraction/digestion
  - Date and time of analysis
  - Weight used for analysis
  - Final dilution volumes or concentration factor for the sample
  - Instruments used for analysis
  - Method detection limits (MDLs)[7] and RLs[8]
  - All data qualifiers and their definitions
- **QA/QC summaries**: These summaries will contain the results of all QA/QC procedures. Each QA/QC sample analysis will document the same information required for the sample results (see previous bullet). The laboratory will make no recovery or blank corrections, except for isotope dilution method correction prescribed by EPA. The required summaries will include the following, as applicable:
  - The calibration data summary will contain the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. This summary will

[7] The term MDL includes other types of detection limits, such as estimated detection limits calculated for dioxins/furans.
[8] RL values are consistent with the lower limit of quantitation values required under EPA-846.

also list the response factor, percent relative standard deviation (%RSD), relative percent difference (RPD), and retention time for each analyte, as appropriate, as well as standards analyzed to indicate instrument sensitivity.

- The internal standard area summary will report the internal standard areas, as appropriate.
- The method blank analysis summary will report the method blank analysis associated with each sample and the concentrations of all compounds of interest identified in those blanks.
- The surrogate spike recovery summary will report all surrogate spike recovery data for organic analyses, and it will list the names and concentrations of all compounds added, percent recoveries, and QC limits.
- The labeled compound recovery summary will report all labeled compound recovery data for EPA method 1613b, and it will list the names and concentrations of all compounds added, percent recovery, and QC limits.
- The matrix spike (MS) recovery summary will report the MS or MS/matrix spike duplicate (MSD) recovery data for analyses, as appropriate, including the names and concentrations of all compounds added, percent recoveries, and QC limits. The MS recovery summary will also report the RPD for all MS and MSD analyses.
- The matrix duplicate summary will report the RPD for all matrix duplicate analyses and will list the QC limits for each compound or analyte.
- The LCS analysis summary will report the results of the analyses of LCSs, including the QC limits for each compound or analyte.
- The relative retention time summary will report the relative retention times for the primary and confirmational columns of each analyte detected in the samples and the percent differences between the columns, as appropriate.
- The ion abundance ratio summary for samples analyzed by EPA method 1613b will report computed ion abundance ratios compared to theoretical ratios listed in the applicable method.

- **Original data**: The data package will include legible copies of the original data generated by the laboratory, including the following:
  - Sample extraction/digestion, preparation, and cleanup logs
  - Instrument specifications and analysis logs for all instruments used on days of calibration and analysis
  - Reconstructed ion chromatograms for all samples, standards, blanks, calibrations, spikes, replicates, and LCSs
  - Enhanced and unenhanced spectra of target compounds detected in field samples and method blanks, with associated best match spectra and background- -subtracted spectra, for all gas chromatography/mass spectrometry (GC/MS) analyses

- Enhanced and unenhanced spectra of target performance reference compounds detected in field samples, day zero blanks, field blanks, and method blanks, with associated best match spectra and background subtracted spectra, for all GC/MS analyses
- Quantitation reports for each instrument used, including reports for all samples, blanks, calibrations, MSs/MSDs, laboratory replicates, and LCSs

The analytical laboratories will submit data electronically in EarthSoft EQuIS® standard four-file or EZ_EDD format, or in an alternative format to be specified prior to the implementation of this QAPP. Guidelines for electronic data deliverables for chemical data will be communicated to the analytical laboratories by the EQAO. All electronic data submittals must be tab-delimited text files, or in a format specified prior to implementation of this QAPP, that include all results, MDLs (as applicable), and RLs consistent with those provided in the laboratory report. If laboratory replicate analyses are conducted on a single submitted field sample, the laboratory sample identifier must distinguish among the replicate analyses.

3.9.3 Data Reduction

Data reduction is the process by which original data (i.e., analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which the appropriate project personnel will then subject to further review and reduction. The laboratory will generate the data in a format amenable to review and evaluation. Data reduction may be performed manually or electronically.

3.9.4 Data Storage and Backup

All electronic files related to the project will be stored on a secure server, with server contents backed up regularly.

4 Data Generation and Acquisition

This section presents an overview of data generation and acquisition for the construction sediment sampling program.

4.1 Sediment Sampling Design

This section presents the sampling design for the construction sediment sampling program. The final QAPP will include specific sampling locations, which cannot be determined until completion of 100% RD; thus, this draft QAPP presents the rationale for the sampling design that will be applied to each SMA once RD is final.

4.1.1 Sample Types and Placement

Sediment sampling conducted as part of the construction sediment sampling program will include the collection of samples to evaluate post-dredge conditions within each DU (DQOs 1 and 2), perimeter conditions (DQOs 3), and conditions near public access and/or habitat areas (DQO 4). These post-dredge samples will address generated residuals (i.e., post-dredge surface sediment contamination) and missed inventory (i.e., contamination remaining below the required dredge elevations/thicknesses). Comparison of these results with the specified thresholds will allow for a determination of whether a contingency action is needed (Section 5.2 of the CQAP). If one or more of the post-dredging samples has a contaminant concentration greater than the RAL, discussions with EPA regarding potential contingency actions will occur.

4.1.1.1 DU Sampling

For the purposes of conducting construction sediment sampling to evaluate the completeness of dredging (DQOs 1 and 2), each SMA has been divided into DUs, such that there are at least six DUs per acre within the toe of cut. The division of each SMA into DUs has been done such that the DU boundaries follow inner dredge prism boundaries, when possible, and generally represent regular rows of samples with approximately equal areas. One surface sample and one subsurface core will be collected in the approximate center of each DU to characterize sediment quality in that DU. Exceptions to this approach include the following areas, where missed inventory cores are not applicable and thus only generated residuals samples will be collected:

- Thin cut dredge areas
- Partial dredge and cap areas – Samples from these areas will be collected for documentation purposes only (i.e., no contingency actions will be taken based on the results, given that a cap will be placed over the area).

In addition, for areas where debris piles will be removed as part of the remedy, it is unknown whether the debris currently extends below the planned 2-foot removal depth. If sampleable

sediment is present below the 2 feet of removed debris and/or sediment, surface sediment samples will be collected at a rate of one sample per debris pile. While the results may not be available prior to backfilling, EPA will determine, with the Project Engineer, the need for contingency or follow-up action following the two-foot excavation based on a review of the data and information about the debris.

4.1.1.2 Perimeter and Public Access and/or Habitat Area Sampling

Surface sediment samples will be collected along the outer perimeter of the SMA (DQO 3) and between the SMA and the two public access and/or habitat areas (DQO 4) to assess generated residuals outside of the footprint of the SMA. The public access and/or habitat areas identified as adjacent to SMAs with dredging are:

- Duwamish Waterway Park for SMA 17 and 18
- Duwamish River People's Park and Shoreline Habitat for SMA 11A and 12B

These areas will warrant special consideration because of their proximity to dredging. A minimum of three individual surface sediment samples, spaced approximately every 250 feet, will be collected adjacent to each of these areas before and after dredging in order to evaluate dredge residuals in these areas. These samples will be collected from the intertidal area between the outer perimeter of the SMA and the public access and/or habitat area. Sample collection at these locations will occur both before dredging (samples will be archived) and after dredging is complete (samples will be analyzed). If one or more of the post-dredging samples has a contaminant concentration greater than the surface sediment RAL, the pre-dredge samples will also be analyzed and discussions with EPA regarding next steps will occur.

4.1.1.3 Summary of Sample Placement

An overview of each sample type and planned sample placement to satisfy each of the four DQOs is provided in Table B4-1.

Table B4-1
Overview of Sample Types and Approach

DQO	Sample Type	Sample Placement
DU Sampling		
DQO 1: Determine if there is missed inventory within the toe of the dredge footprint.	Subsurface cores (approximately 0–120 cm [0–4 feet]), sampled in 30-cm increments resulting in 4 samples per core.[1]	Cores will be collected with a density of no fewer than 6 cores per acre within the toe of cut of the dredge area, each sample corresponding to 1 DU. The resulting sampling density will be at least 6 locations per acre within the toe of cut.

DQO	Sample Type	Sample Placement
DQO 2: Assess generated residuals in surface sediment within the toe of the dredge footprint.	Surface sediment samples (0–10 cm)	Surface sediment samples will be collected with a density of no fewer than 6 per acre within the toe of cut of the dredge area (i.e., approximately collocated with the cores for DQO 1). The resulting sampling density will be at least 6 locations per acre within the toe of cut.
Perimeter Sampling		
DQO 3: Assess whether there are generated residuals in surface sediment in the outer perimeter of the dredge area.	Surface sediment samples (0–10 cm)	Surface sediment samples will be collected within the outer perimeter of the dredge area. Sample spacing will be approximately every 150 feet, except for the downstream end of the area where additional samples will be placed for tighter spacing.[2]
DQO 4: Assess whether there are generated residuals in the intertidal sediment adjacent to public access and/or habitat areas (applies only to SMAs adjacent to public access and/or habitat areas).	Surface sediment samples (0–10 cm)	A minimum of three surface sediment samples will be collected in the intertidal area adjacent to a given public access and/or habitat area. Sample spacing will be approximately every 250 feet along the length of the public access and/or habitat areas.

Notes:
1. As described in Section 4.2.3, fewer than four samples per core may be collected if native material is encountered.
2. The tighter spacing of sampling locations at the downstream end of each SMA provides better coverage in the direction of the predominant flow of the LDW, where generated residuals are more likely.
cm: centimeter
DQO: data quality objective
DU: decision unit
LDW: Lower Duwamish Waterway

4.1.2 SMA-specific Analytes

Analytes for construction sediment sampling are specific to each SMA. Analytes for each SMA are determined based on remedial action level (RAL) exceedances (for surface or subsurface sediment) in the design dataset for the upper reach, as shown in Table B4-2. Total organic carbon (TOC) analysis will be conducted for all samples. The analyte list for public access and/or habitat area samples will be the same as that for the generated residuals samples in the adjacent SMAs (Table B4-2).

Table B4-2
SMA-specific Analytes

SMA[1]	RAA[1]	SMA-specific Analyte(s)[2]		Analyte(s) for Public Access and/or Habitat Area Samples[4]
		Generated Residuals	Missed Inventory[3]	
1A,1B	32, 34/35	PCBs	NA (thin cut)	NA
2A,2B	30, 31	PCBs	PCBs	NA
3	29	PAHs	PAHs	NA

SMA[1]	RAA[1]	SMA-specific Analyte(s)[2]		Analyte(s) for Public Access and/or Habitat Area Samples[4]
		Generated Residuals	Missed Inventory[3]	
4	28	PCBs	PCBs	NA
5	27	PCBs, mercury, dioxins/furans	NA (partial dredge and cap)	NA
6			PCBs, dioxins/furans	NA
7	24/25/26	PCBs, dioxins/furans, BBP	PCBs, dioxins/furans; also BBP for DUs in RC1 areas	NA
9	21/22	PCBs, mercury, lead, zinc, dioxins/furans, BBP	PCBs, dioxins/furans; also mercury, lead, zinc, BBP for DUs in Recovery Category 1 areas	NA
11A	19/20	PCBs	PCBs	PCBs
12A	17	PCBs, mercury	PCBs, mercury[5]	NA
12B	14/15/16	PCBs	NA (partial dredge and cap)	PCBs
14A	12	PCBs	NA (thin cut)	NA
14C	8	PCBs	NA (thin cut)	NA
14D,15,16	4/5/6	PCBs	PCBs	NA
17,18	1/2/3	PCBs	PCBs	PCBs

Notes:
1. RAAs within an SMA for which dredging is not the selected cleanup technology are not included in this table.
2. All samples will also be analyzed for TOC. Chemicals that are transient in nature have been excluded from the analyte list because a RAL exceedance for these chemicals would not drive the need for contingency actions. This applies to benzoic acid in SMA 1 and phenol in SMAs 5 and 6.
3. Missed inventory sampling is not applicable for thin cut dredge areas or partial dredge and cap areas. Consistent with the pre-design investigation sampling, missed inventory core samples will only be analyzed for chemicals with subsurface sediment RALs in a given area.
BBP: butyl benzyl phthalate
4. The analyte list for public access and/or habitat area samples will be the same as that for the generated residuals samples in the adjacent SMA.
5. Per EPA request, a missed inventory core will be collected in this area to evaluate location-specific concerns.
DU: Decision Unit
NA: not applicable
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAA: remedial action area
RAL: remedial action level
SMA: sediment management area
TOC: total organic carbon

4.1.3 Sampling Design Example

This section presents an example of the sampling design described in Sections 4.1.1 and 4.1.2 using SMAs 17 and 18. The first step in applying the sampling design is to determine sampling location placement (Figure B4-1). The application of the sampling design for SMAs 17 and 18 is as follows:

- **SMA 17 DU samples**: SMA 17 has a total area of 1.41 acres based on the SMA boundary and an area of 0.98 acres within the toe of cut of the dredge prism. Based on its size, SMA 17

has been divided into six DUs, which represent a density of 6.1 samples per acre within toe of cut.

- **SMA 18 DU samples**: SMA 18 has a total area of 1.17 acres based on the SMA boundary and an area of 0.79 acres within the toe of cut of the dredge prism. Based on its size, SMA 18 has been divided into five DUs, which represent a density of 6.3 samples per acre within toe of cut.
- **Outer perimeter samples**: A total of 12 surface sediment sampling locations have been placed in the outer perimeter of SMAs 17 and 18, which are approximately 1,800 feet (Figure B4-1). This equates to approximately 1 sample every 150 feet, except on the downstream end of the area, where several additional sampling locations have been placed for tighter spacing. As shown in Figure B4-1, for SMAs that are connected (e.g., SMAs 17 and 18) or located close to one another (e.g., SMAs 16 and 17), there is no outer perimeter area and thus, there are no outer perimeter samples between these SMAs.
- **Public access and/or habitat area samples**: SMAs 17 and 18 are adjacent to Duwamish Waterway Park, so the surface sediment in the intertidal area will be characterized to assess if generated residuals are present. Three surface sediment grabs from sampling locations between the edge of the outer perimeter boundary of SMAs 17 and 18 and the park will be collected and archived prior to dredging.[9] A second round of three samples will be collected and analyzed after dredging is complete (Figure B4-1). This sampling approach will provide data to evaluate if generated residuals are present.

Based on the described sampling location placement, Table B4-3 summarizes the numbers of samples that will be collected for SMAs 17 and 18. Each of these samples will be analyzed for polychlorinated biphenyls (PCBs), as described in Section 4.1.2 and Table B4-2. Figures B4-1 through B4-9 show the targeted sampling locations for each SMA.

[9] As described in Table B.4-1, the public access and/or habitat area samples near Duwamish Waterway Park were placed such that there are a minimum of three samples, each not more than 250 feet from the others. Because of the small size of this area, reduced spacing is needed to achieve the minimum number of samples (i.e., three grab samples).

Figure B4-1
Target Sample Placement for SMA 16, 17, 18

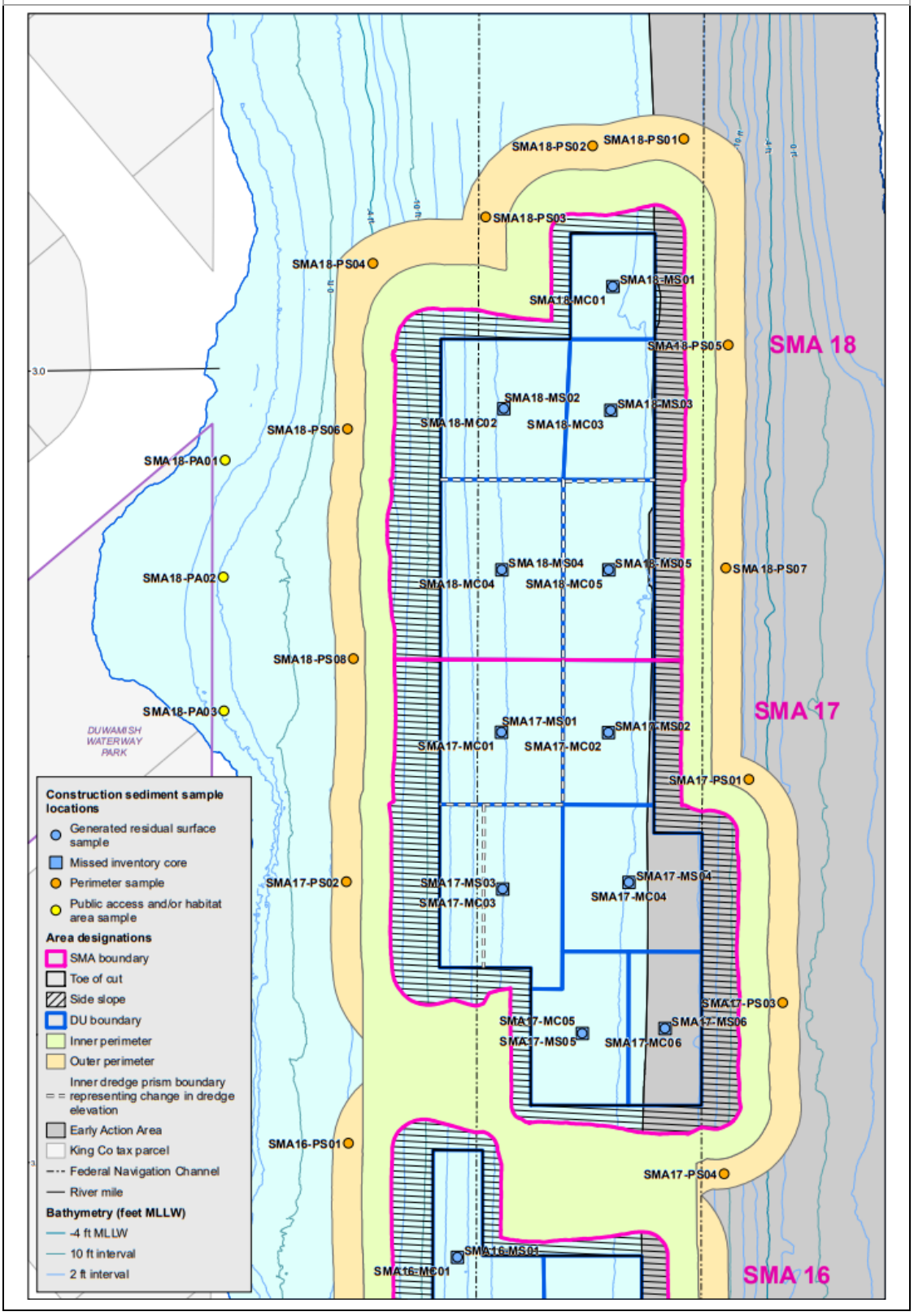


Figure B4-2
Target Sample Placement for SMA 15A, 15B, 16

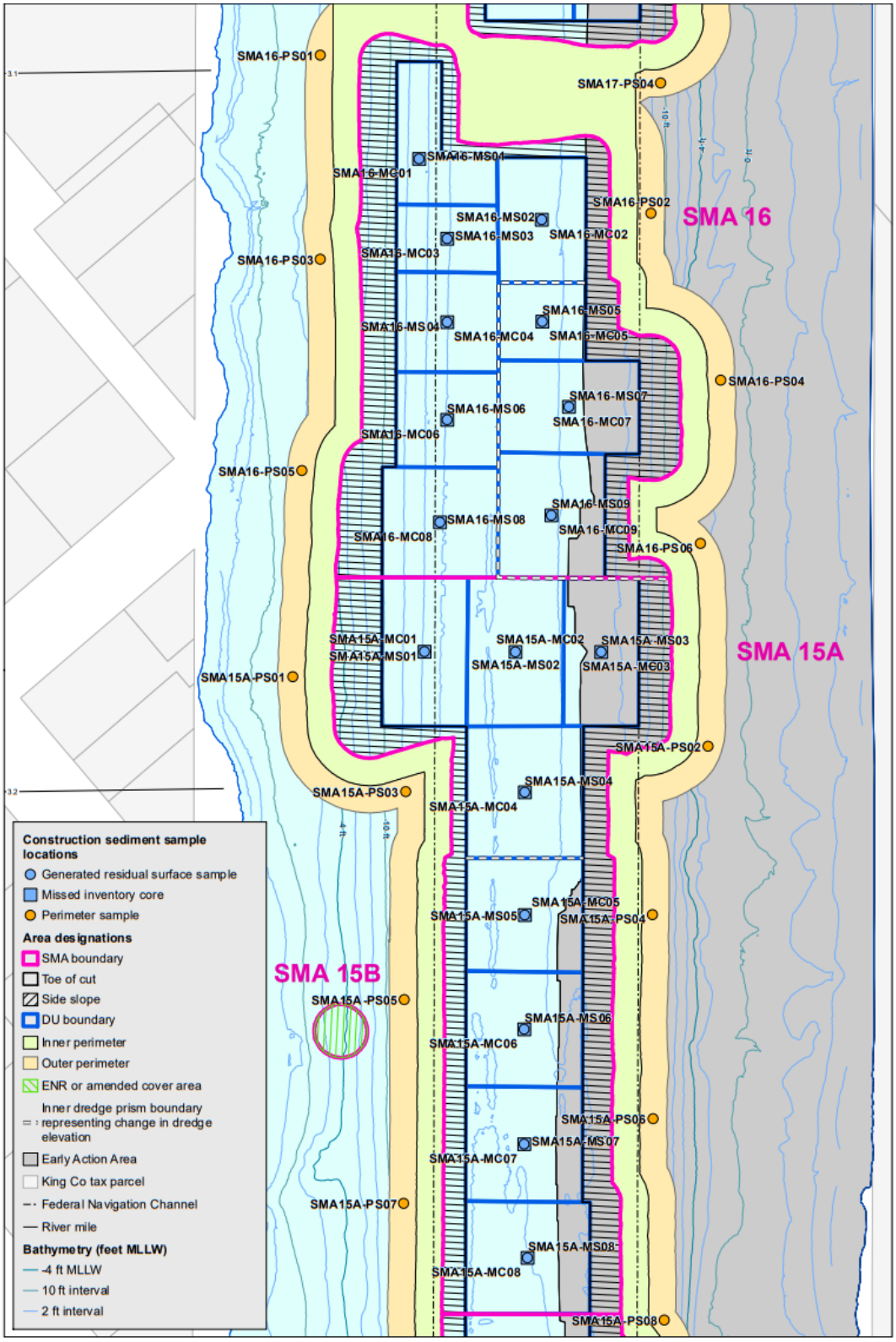


Figure B4-3
Target Sample Placement for SMA 14A, 14B, 14C, 14D

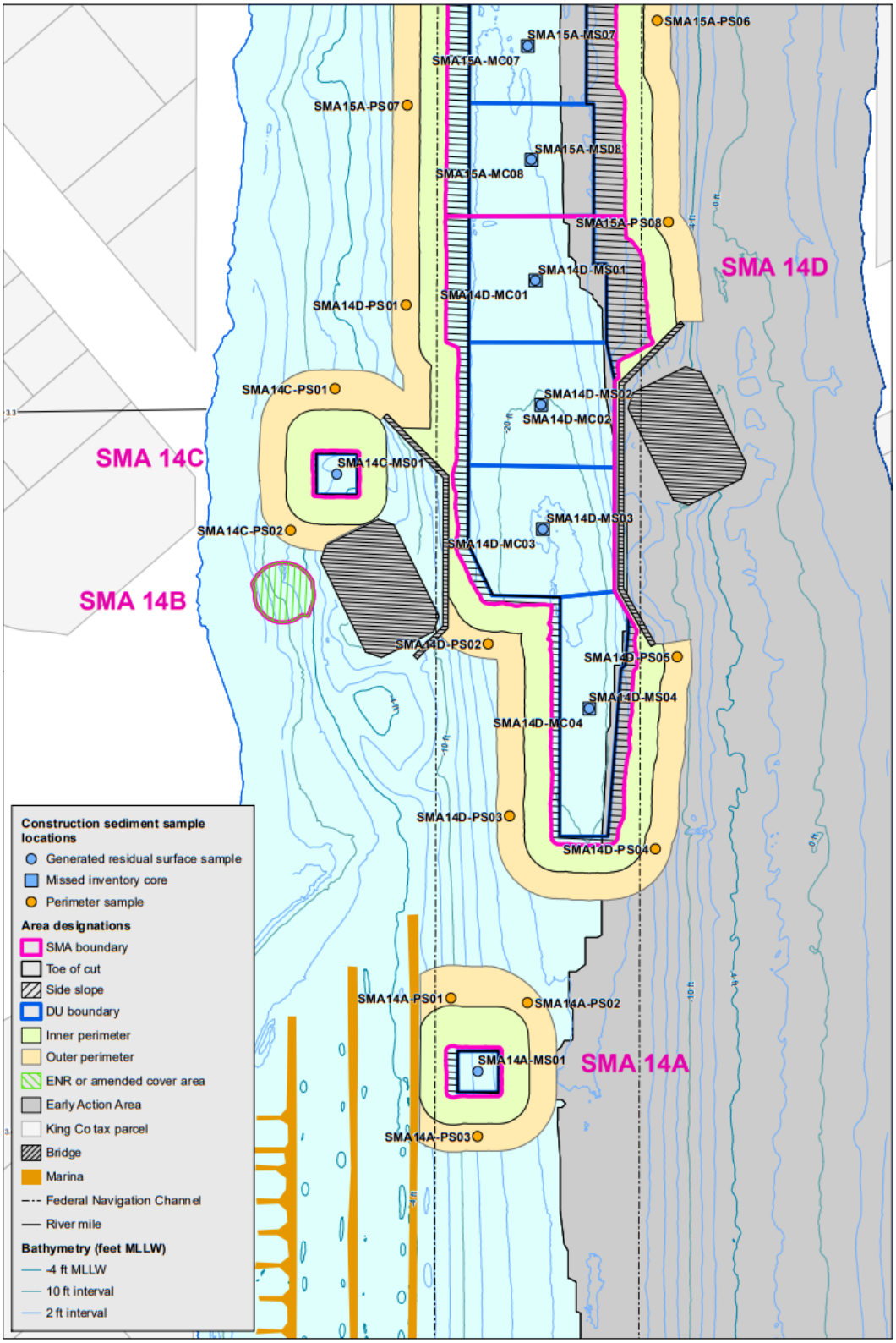


Figure B4-4
Target Sample Placement for SMA 12A, 12B, 13

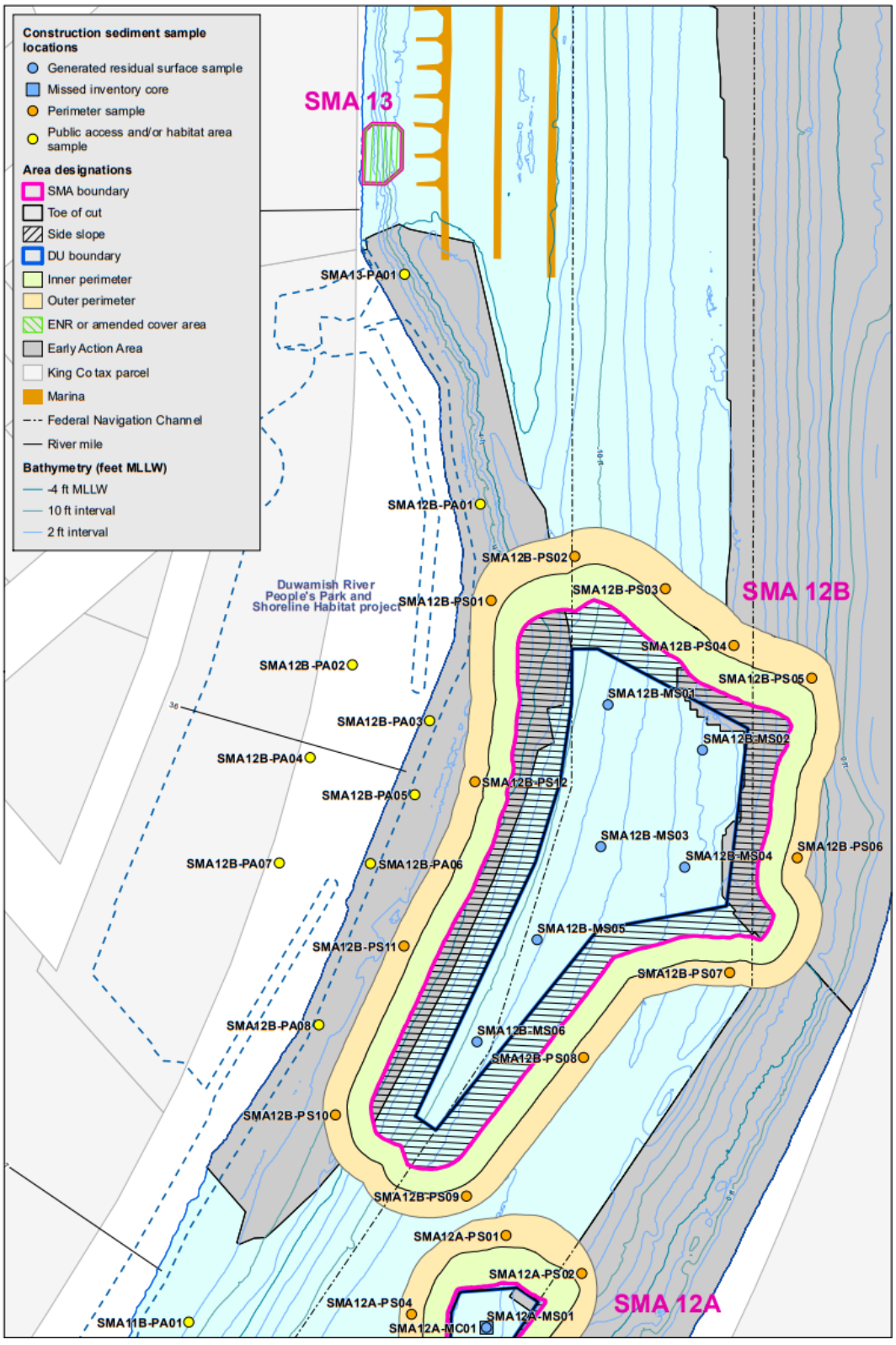


Figure B4-5
Target Sample Placement for SMA 9, 11A, 11B, 12A

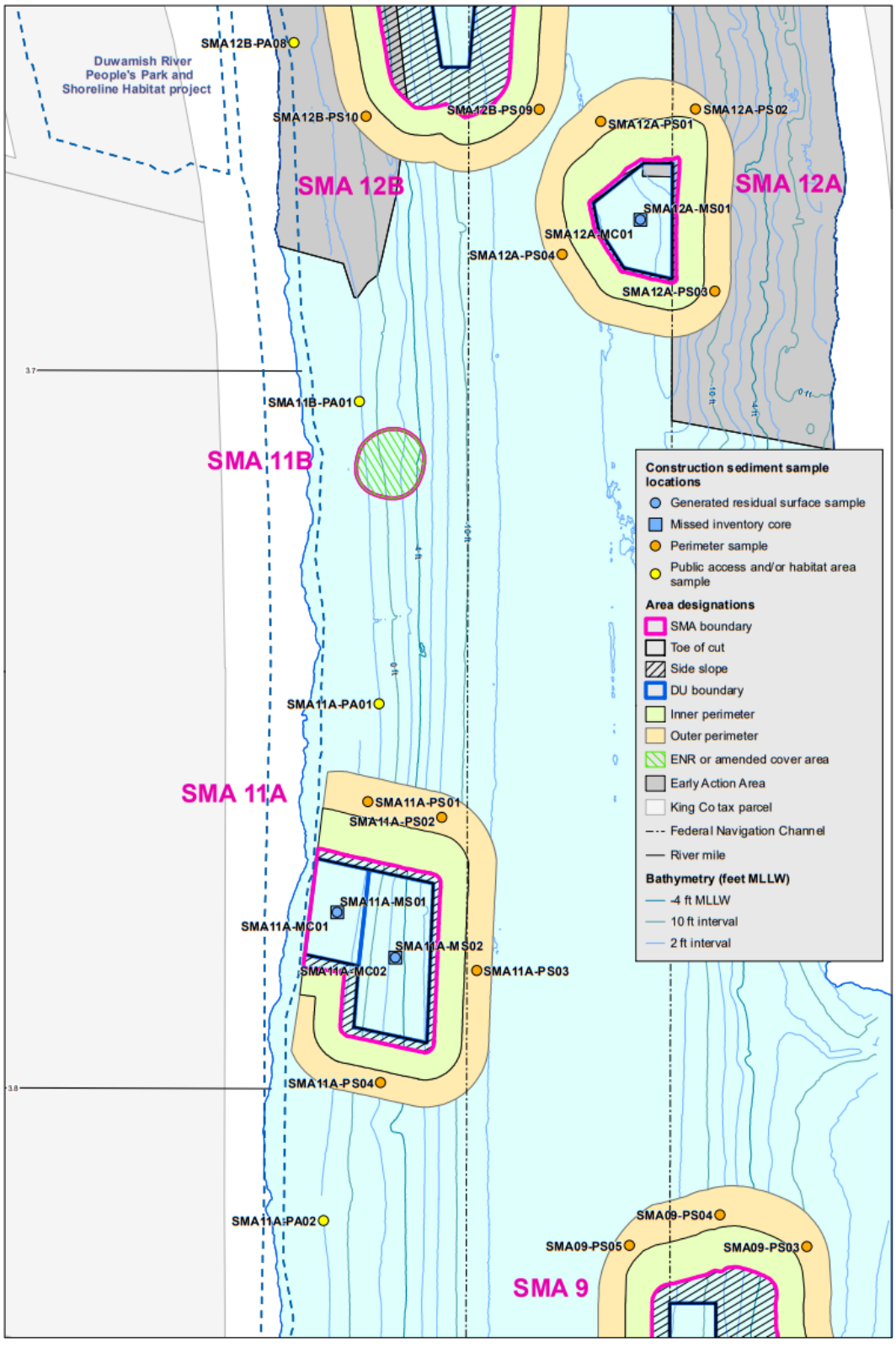


Figure B4-6
Target Sample Placement for SMA 7, 8, 9

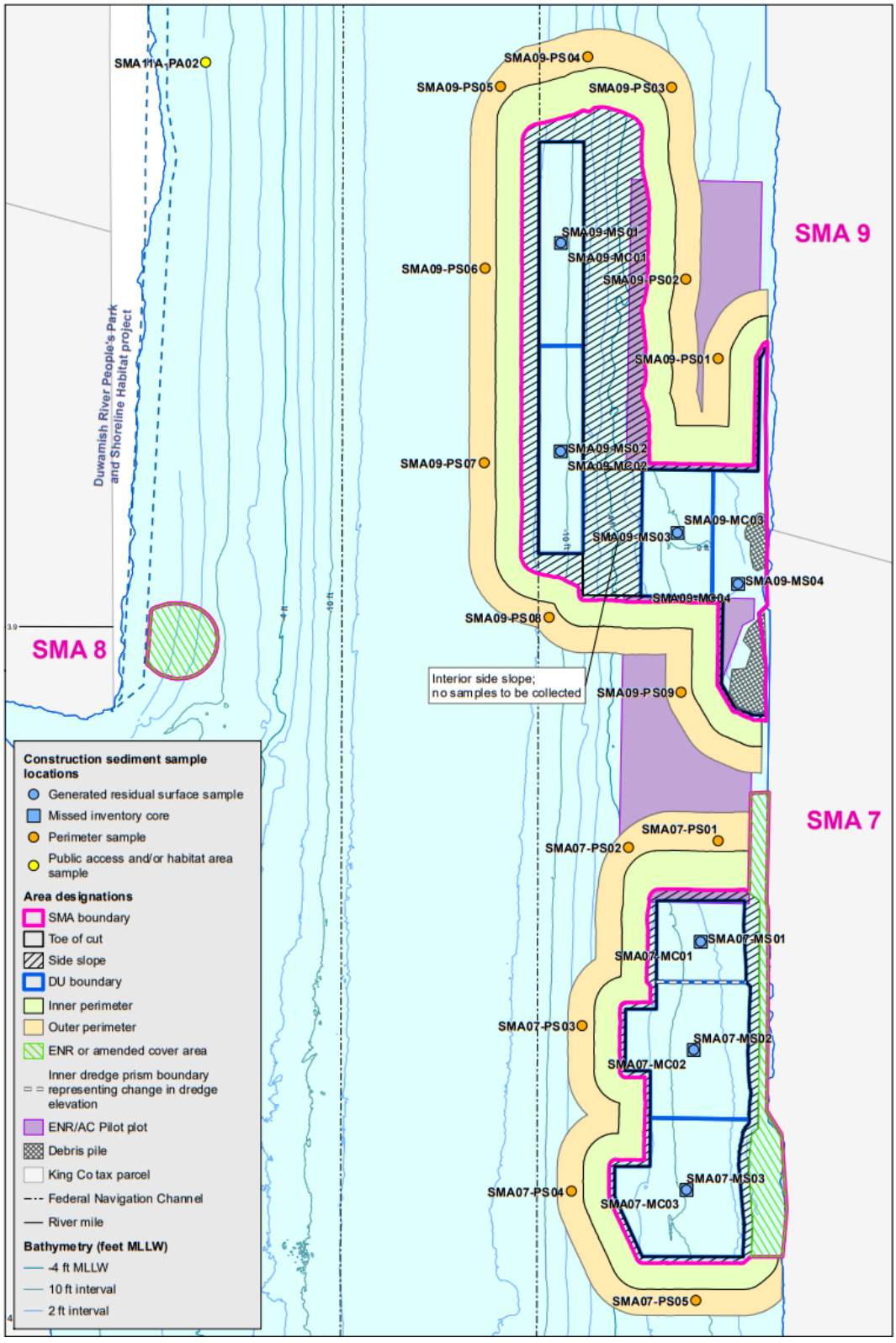


Figure B4-7
Target Sample Placement for SMA 4, 5, 6

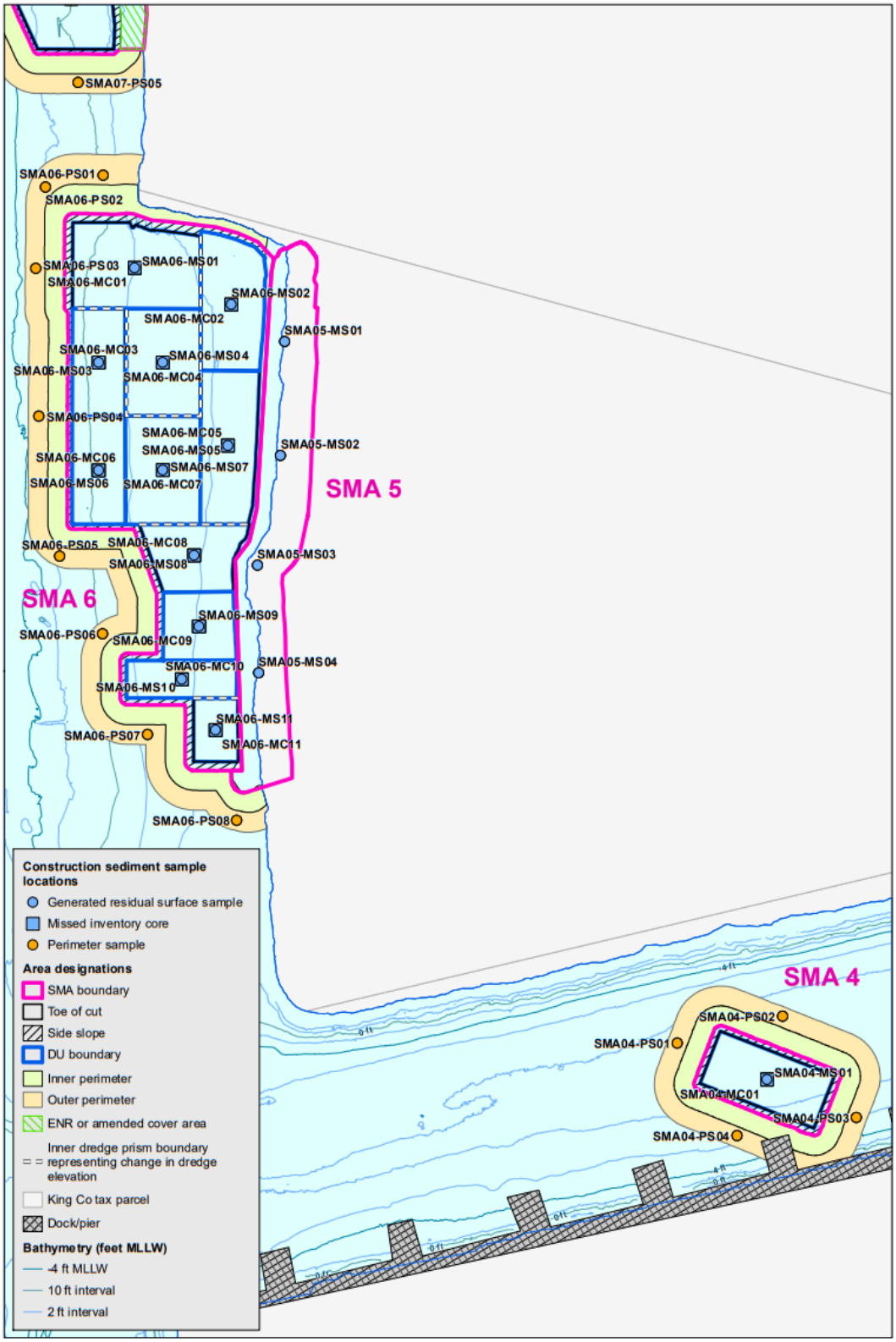


Figure B4-8
Target Sample Placement for SMA c1, 2A, 2B, 3

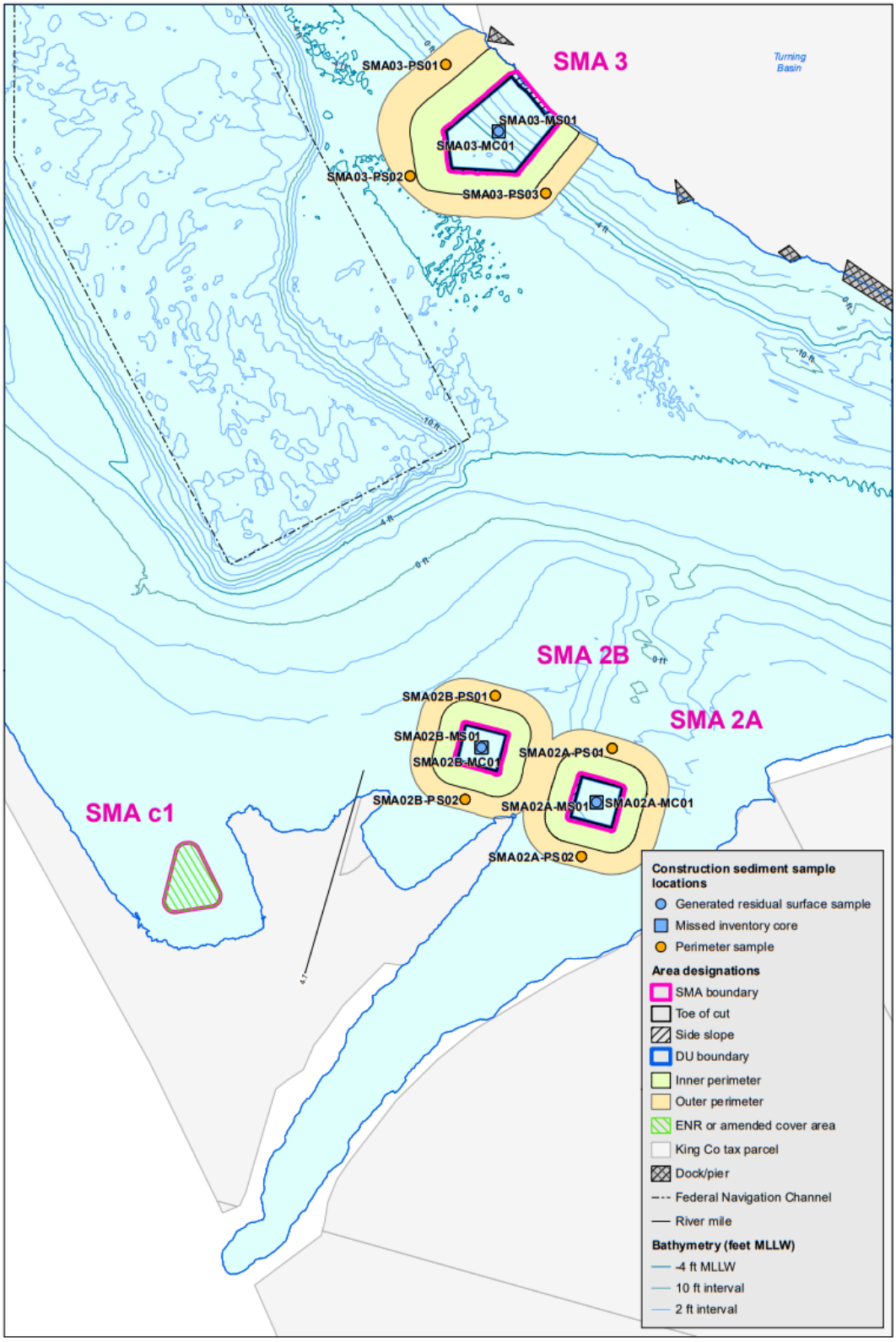


Figure B4-9
Target Sample Placement for SMA 1A, 1B

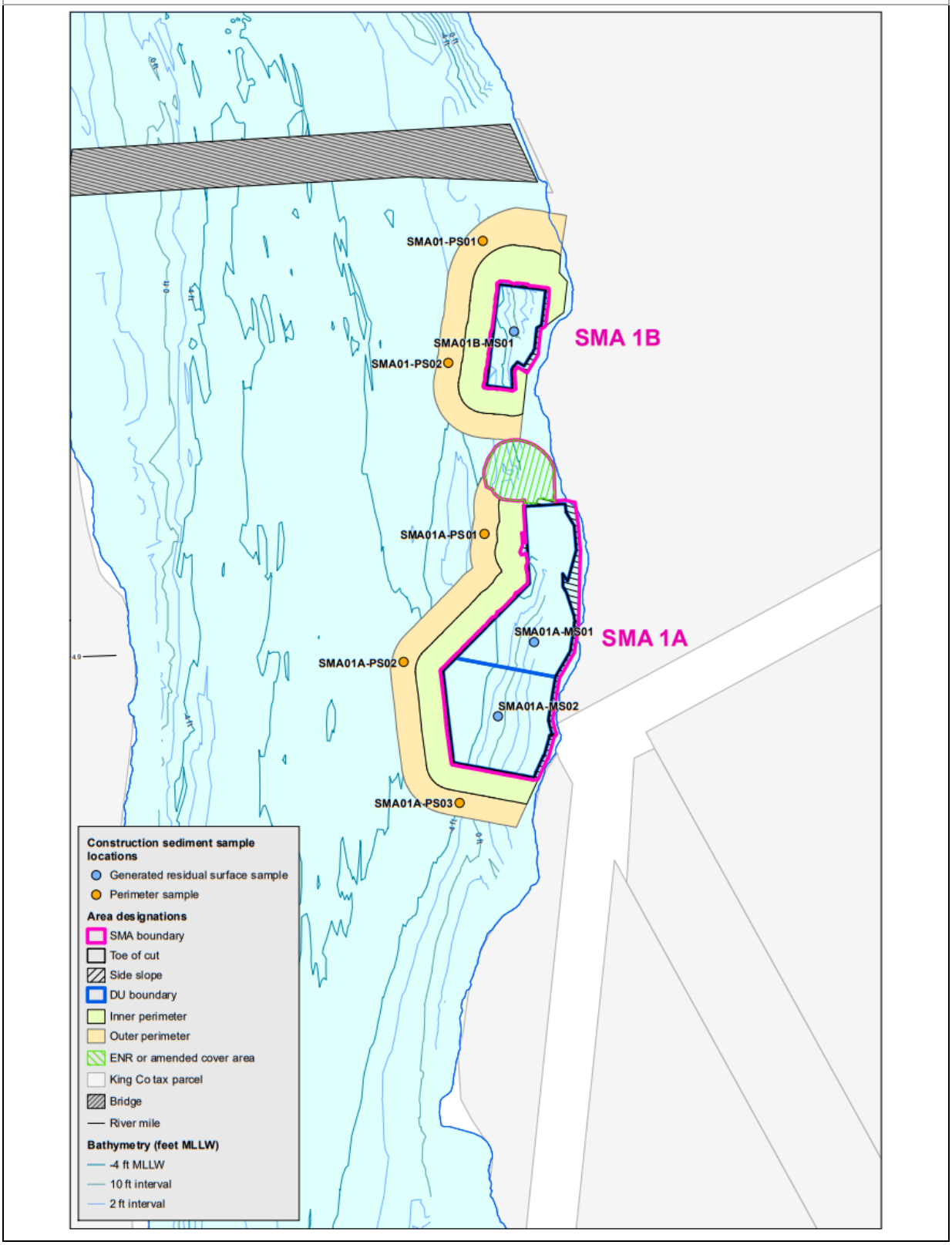


Table B4-3
Overview of Samples for SMAs 17 and 18

Sample Type	SMA 17	SMA 18	Total
DU Samples			
DQO 1: DU subsurface sediment cores	6 cores (24 samples)	5 cores (20 samples)	11 cores (44 samples)
DQO 2: DU surface sediment locations	6 samples	5 samples	11 samples
Perimeter Samples			
DQO 3: Outer perimeter locations	12 surface samples around outer perimeter		12 samples
Public access and/or habitat areas			
DQO 4: Public access and/or habitat areas	3 samples collected prior to dredging (archived) and 3 samples collected after dredging		6 samples

Notes:
DQO: data quality objective
DU: Decision Unit
RD: remedial design
SMA: sediment management area

From a sequencing perspective, the three public access and/or habitat area samples next to Duwamish Waterway Park will be collected prior to the start of dredging and archived and analyzed if there is a RAL exceedance in the post-dredge samples. Once dredging is complete and the required dredge elevations have been accepted, construction sediment sampling will be conducted. This will include DU surface and subsurface sediment sampling, outer perimeter sampling, and the post-dredge surface sediment sampling for DQO 4. These samples will be submitted to the analytical laboratory for expedited analysis.

When received, sample results will be compared with the decision framework for determining contingency actions (Section 5.2 of the CQAP), and a meeting will be held within a day or two with key project representatives and EPA to determine if there is a need for contingency re-dredging.

If contingency re-dredging is needed, the Contractor will proceed as directed by the Project Representative. Once the contingency re-dredging has been completed and accepted, an additional round of sediment sampling will occur in the applicable DU, during which only surface sediment samples will be collected. These samples will be archived for analysis at the end of the construction season for informational purposes (results will be presented in the construction report).

4.1.4 Decision Units and Sampling Locations

Using the sample placement guidelines (Section 4.1.1) and the process described in Section 4.1.3 for SMA 17/18, sample locations were placed for each SMA, both within DUs and in the outer perimeter. In addition, samples were placed along the two public access and/or habitat areas

(i.e., Duwamish Waterway Park and Duwamish River People's Park and Shoreline Habitat). The resulting sample locations are shown on Maps B1 to B9 and are summarized along with information regarding sample density in Table B4-4.

Table B4-4
Summary of SMA-specific Sampling Design

SMA[1]	RAA[1]	Surface Area Associated with Dredging within Toe of Cut (acres)	No. of DUs	Density (DUs/acre)	Number of Sampling Locations			
					Within DUs[2]		Outer Perimeter[3]	Public Access and/or Habitat Area
					Generated Residual Surface Samples	Missed Inventory Cores		
1A	33/34/35 (thin cut)	0.31	2	6.5	2	na[4]	3	-
1B	32 (thin cut)	0.06	1	16.7	1	na[4]	2	-
2A	31	0.03	1	33.3	1	1	4	-
2B	30	0.03	1	33.3	1	1		-
3	29	0.12	1	8.3	1	1	3	-
4	28	0.16	1	6.3	1	1	4	-
5	27	0.63	na[5]	na	4	na[4]	na	-
6	27	1.70	11	6.5	11	11	8	-
7	24/25/26	0.50	3	6.0	3	3	5	-
9	21/22	0.63	6	6.3	4[6]	4	9	-
11A	19/20	0.20	2	10.0	2	2	4	2
12B	14/15/16	0.90	na[5]	na	6	na[4]	12	10[7]
12A	17 (thin cut)	0.08	1	12.5	1	1[8]	4	-
14A	12 (thin cut)	0.02	1	50.0	1	na[4]	3	-
14C	8 (thin cut)	0.02	1	50.0	1	na[4]	2	-
14D,15,16	4/5/6	3.32	21	6.3	21	21	19	-
17,18	1/2/3	1.77	11	6.2	11	11	12	3

Notes:
1. RAAs within an SMA for which dredging or partial dredge and cap is not the selected cleanup technology are not included in this table.
2. Sampling within a DU will consist of both a missed inventory core and a generated residuals surface sediment sample except where noted.
3. Placement of sampling locations in the outer perimeter is discussed in Section 4.1.1. These samples will be collected at a spacing of approximately every 150 feet, except for the downstream end of the area where additional samples will be placed for tighter spacing.

4. No missed inventory cores will be collected in these areas because missed inventory sampling is not applicable for thin cut dredge areas (except for SMA 12A, where required based on area-specific concerns) and where a cap will be placed.
5. These SMAs are marked not applicable for DUs because no contingency actions will be taken based on the sampling results, given that a cap will be placed over the area. Density for generated residual samples in these areas is at least 6 samples per acre.
6. The remedy in SMA 9 includes removal of two debris piles. If sampleable sediment is present after excavation to 2 feet below mudline for debris removal, surface sediment samples will be collected for documentation purposes at a rate of one sample per debris pile.
7. Public access and/or habitat area sampling locations were placed across the mouth of and within the off-channel marsh at Duwamish River People's Park and the Shoreline Habitat area to characterize potential impacts from dredging at SMA 12B.
8. Per EPA request, a missed inventory core will be collected in this thin cut dredge area to evaluate location-specific concerns.
DU: Decision Unit
EPA: U.S. Environmental Protection Agency
RAA: remedial action area
RAL: remedial action level
SMA: sediment management area

4.2 Sampling Methods

This section provides methods to locate and collect surface and subsurface sediment samples. Detailed sediment sampling methods are included as SOPs in Attachment B.2.

4.2.1 Target Sampling Locations

Target sampling locations will be determined prior to construction. Sample collection will first be attempted within 3 m (10 feet) of the target coordinates. If this is not possible (e.g., due to an obstruction), the field crew will attempt sample collection by moving the sampling location to within a maximum distance of 10 m (32 feet) of the original location. For sampling locations where both surface (i.e., 0- to 10-cm) and subsurface sediment (i.e., 120-cm [4-foot] core) samples will be collected, the field crew will attempt to collect the samples as close together as possible.[10] For DU samples, the field crew will verify that the final sampling location remains within the targeted DU. Similarly, for the perimeter and public access and/or habitat area samples, the field crew will verify that the sampling locations remain within the outer perimeter area (or within the specified intertidal area for public access and/or habitat area samples). Post-dredging public access and/or habitat area samples shall be within 3 meters (10 feet) of the pre-dredging sample actual coordinates.

If the initial attempt and three subsequent attempts (i.e., a total of four attempts) do not result in a sample that meets the appropriate acceptance criteria, a different sampling location may be selected in consultation with EPA, the EQAO, and the Project Representative.

4.2.2 Surface Sediment Collection

Surface sediment (0- to 10-cm) samples will be collected primarily using a power grab sampler deployed from a sampling vessel. When collection from a boat is not possible, sample collection from land may occur. Surface sediment grab sample collection and processing[11] will follow standardized procedures described in Ecology's Sediment Cleanup User's Manual (SCUM) (Ecology 2021). SOPs for the collection of surface sediment by boat and from land are presented in Attachment B.2. Sediment volumes are discussed in Section 4.8.

4.2.3 Subsurface Sediment Collection and Processing

Subsurface sediment core samples will be collected using a vibracorer deployed from a sampling vessel. The target depth for all cores will be 120 cm (approximately 4 feet). Each core will be processed as four 30-cm intervals (i.e., 0 to 30 cm, 30 to 60 cm, 60 to 90 cm, and 90 to 120 cm); if

[10] Surface sediment samples cannot be collected from the cores because insufficient volume for analysis would be available in the 0- to 10-cm section of the core.

[11] If surface sediment samples are observed to contain more than 50% gravel (i.e., based on field observations), samples will be size-fractionated in the laboratory, consistent with methods used in the activated carbon pilot study, to ensure the analysis of a representative sample.

material deeper than 120 cm is available in the core tube, up to two additional 30-cm intervals will be archived.[12] All intervals will be recovery corrected following the procedures in the subsurface sample collection SOP (Attachment B.2). Cores will be logged using the Sediment Core Processing Log (Attachment B.1), and any key changes in stratigraphy will be noted. If native material is encountered, sample intervals will be adjusted as described in the SOP (intervals containing native material will not be collected). The SOP in Attachment B.2 also describes how native material will be identified.

Specific details regarding the collection and processing[13] of subsurface sediment cores are provided in the subsurface sediment SOP, which is presented in Attachment B.2. Sediment volumes are discussed in Section 4.8.

4.3 Sample Identification

Unique alphanumeric IDs will be assigned to each sample. The IDs for individual sediment samples will include the following:

- Project area ID (i.e., LDW) and two-digit year (e.g., 25 for samples collected in 2025)
- SMA ID (i.e., SMA and two-digit number)[14]
- Sample type:
  - MS – monitoring surface sediment grabs collected within each DU (0 to 10 cm)
  - MC – monitoring subsurface sediment core collected within each DU (120-cm [approximately 4-foot] core, analyzed in 30-cm intervals)
  - PS – perimeter surface sediment grab sample (0 to 10 cm)
  - PA – public access and/or habitat area surface sediment grab sample (0 to 10 cm)
- Location number (two-digit number), beginning at 01 for each SMA and corresponding to the DU, perimeter sampling station number, or public access and/or habitat area station number
- For all cores (MC), a sequential letter (e.g., A, B, etc.) will be used to identify the interval. The letter A will be used to indicate the targeted 0 to 30-cm interval, with B, C, etc. used to indicate each subsequent deeper interval.

For example, a 2025 surface sediment sample collected from DU 1 in SMA 17 would be labeled LDW25-SMA17-MS01. The subsurface sediment core samples from that DU would be labeled LDW25-SMA17-MC01A (first core interval), LDW25-SMA17-MC01B (second core interval), etc.

[12] Additional archived intervals will be collected if at least 15 cm of material is available.
[13] If any individual subsurface sediment interval samples are observed to contain more than 50% gravel (i.e., based on field observations), samples will be size-fractionated in the laboratory, consistent with methods used in the activated carbon pilot study, to ensure the analysis of a representative sample.
[14] When a perimeter area sample or a public access and/or habitat area sample is associated with multiple SMAs, the downstream-most SMA will be used in the sample ID.

The public access and/or habitat area sample locations will be labeled with sequential numbers, with b (to indicate before) for the pre-dredge samples and "p" (to indicate post) added to the post-dredge samples (e.g., PA01-b, PA02-b, and PA03-b will be the pre-dredge samples, and PA01-p, PA02-p, and PA03-p will be the post-dredge samples). For example, if sampling is conducted for SMA 18 in 2026, the pre-dredge surface sediment samples will be LDW26-SMA18-PA01-b, -PA02-b, and -PA03-b. The post-dredge surface sediment samples will be LDW26-SMA18-PA01-p, -PA02-p, and -PA03-p.

Any field duplicate sample collected will have the same sample ID as its parent sample but will be appended with "-FD" to identify it as a field duplicate.

4.4 Sample Custody and Shipping Requirements

Sample custody is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analyses, to delivery of the sample results to the recipient. Procedures to be followed for sample custody and shipping are detailed in this section.

4.4.1 Sample Custody

Samples will be considered to be in custody if they are: 1) in the custodian's possession or view, 2) in a secured place (under lock) with restricted access, or 3) in a container and secured with an official seal(s) such that the samples cannot be reached without breaking the seal(s). Custody procedures, described below, will be used for all samples throughout the collection, transportation, and analytical processes, and for all data and data documentation, whether in hard copy or electronic format. Custody procedures will be initiated during sample collection.

A chain of custody form will accompany all samples to the analytical laboratory. Each person who has custody of the samples will sign the chain of custody form and ensure that the samples are not left unattended unless properly secured. Minimum documentation of sample handling and custody will include:

- Sample location, project name, and unique sample ID
- Sample collection date and time
- Any special notations on sample characteristics or problems
- Name of the person who initially collected the sample
- Date sample was sent to the laboratory
- Shipping company name and waybill number, if applicable

The Sediment Sampling Lead or designee will be responsible for all sample tracking and custody procedures and final sample inventory and will maintain sample custody documentation. The

Sediment Sampling Lead or a designee will complete chain of custody forms prior to removing samples from the sample collection area. At the end of each day, and prior to sample transfer, chain of custody entries will be made for all samples. Information on the sample labels will be checked against sample log entries, and sample tracking forms and samples will be recounted. Chain of custody forms, which will accompany all samples, will be signed at each point of transfer. Copies of all chain of custody forms will be retained and included as appendices to QA/QC reports and data reports. Samples will be shipped in sealed coolers.

The analytical laboratories will ensure that chain of custody forms is properly signed upon receipt of the samples, and they will note questions or observations concerning sample integrity on the chain of custody forms. The laboratories will contact the Sediment Sampling Lead or EQAO immediately if discrepancies are discovered between the chain of custody forms and the sample shipment upon receipt.

4.4.2 Sample Shipping

All samples will be shipped or transported via courier in a cooler to the analytical laboratory. The original signed chain of custody forms for all samples will be placed in a sealed plastic bag and taped to the inside lid of the cooler. If samples are to be shipped, fiber tape will be wrapped completely around the cooler. On each side of the cooler, a "This Side Up" arrow label will be attached; a "Handle with Care" label will be attached to the top of the cooler, and the cooler will be sealed with a custody seal in two locations.

The temperature inside the cooler containing the samples will be checked by the laboratory upon receipt of the samples. The laboratory will specifically note any cooler that does not contain ice packs, or that is not sufficiently cold (≤4 ± 2°C)[15] upon receipt. All samples will be handled so as to prevent contamination or sample loss. Samples will be disposed of upon written notification by the PM. Holding times vary by analysis and are summarized in Section 4.7.2

4.5 Decontamination Procedures

Sampling requires strict measures to prevent contamination. Sources of extraneous contamination can include sampling gear, grease from ship winches or cables, spilled engine fuel (gasoline or diesel), engine exhaust, dust, ice chests, and ice used for cooling. All potential sources of contamination in the field will be identified by the Sediment Sampling Lead, and appropriate steps will be taken to minimize or eliminate contamination. For example, during retrieval of sampling gear, the boat will be positioned, when feasible, so that engine exhaust does not fall on the deck. Ice chests will be scrubbed clean with Alconox® detergent and rinsed with distilled water after use

[15] As stated in validation guidance documents, sample shipping coolers should arrive at the laboratory with internal temperatures within the advisory range of ≤4 ± 2°C; however, if the transit distance and time from the site to laboratory is short, the samples may not have reached this temperature by the time they arrive.

to prevent potential cross contamination. To avoid contamination from melting ice, wet ice will be placed in separate plastic bags.

All sediment sampling and homogenizing equipment, including the mixing bowl and stainless steel implements, will be decontaminated between sampling locations per Ecology guidelines (Ecology 2021) and the following procedures:

1. Rinse with site water and wash with a scrub brush until free of sediment
2. Wash with phosphate-free detergent
3. Rinse with site water
4. Rinse with distilled water.

Acid or solvent washes will not be used in the field because of safety considerations and problems associated with rinsate disposal and sample integrity, specifically:

- Use of acids or organic solvents may pose a safety hazard to the field crew
- Disposal and spillage of acids and solvents during field activities pose an environmental concern
- Residues of solvents and acids on sampling equipment may affect sample integrity for chemical testing.

Any sampling equipment that cannot be cleaned to the satisfaction of the Sediment Sampling Lead will not be used for further sampling activities.

4.6 Field-generated Waste Disposal

Excess surface sediment will be returned to each sampling location after sampling has been completed for that location. Excess subsurface sediment will be containerized (e.g., in steel drums) as non-hazardous waste, labelled, and secured for off-site disposal via a licensed waste disposal company.

Decontamination water[16] will not be contained. 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.

[16] Because decontamination water is an Alconox®/water solution (i.e., phosphate free), it can be returned to the sampling location for disposal.

4.7 Laboratory Methods

At each laboratory, a unique sample identifier (termed either project ID or laboratory ID) will be assigned to each sample. The laboratory will ensure that a sample tracking record follows each sample through all stages of laboratory processing. The sample tracking record must contain, at a minimum, the name/initials of individuals responsible for performing the analyses, dates of sample extraction/preparation and analysis, and types of analyses being performed.

The analytical laboratories will meet the sample handling requirements and follow the procedures described in this section and in Attachment B.3. In addition, analytical methods and data quality indicator (DQI) criteria are provided herein.

4.7.1 Laboratory Sample Handling

Samples will be stored at the analytical laboratory in accordance with the conditions specified in the methods. Archive samples will be stored, frozen, at the analytical laboratory. The analytical laboratories will preserve and store samples as described in Section 4.7.2. Samples will be disposed of after hold times expire, following written authorization from the PM.

4.7.2 Analytical Methods

The analyte list for each sediment sample is specific to each SMA and sample type, as discussed in Section 4.1.2 and summarized in Table B4-2. Chemical analysis of the sediment samples, which may include analytes listed in Table B4-5, will be conducted by the analytical laboratory and will be reported in dry weight (dw). Analytical methods and laboratory sample handling requirements for all measurement parameters are presented in Table B4-6.

Table B4-5
Sediment Analyses to be Conducted

Analyte Group	Individual Analytes
Conventionals	TOC
metals	arsenic,[1] lead, zinc, mercury
PAHs	acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene
PCB Aroclors	Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260
SVOCs	BBP

Analyte Group	Individual Analytes
Dioxin/furan congeners	2,3,7,8-TCDD, 1,2,3,7,8-PeCDD, 1,2,3,4,7,8-HxCDD, 1,2,3,6,7,8-HxCDD, 1,2,3,7,8,9-HxCDD, 1,2,3,4,6,7,8-HpCDD, OCDD, 2,3,7,8-TCDF, 1,2,3,7,8-PeCDF, 2,3,4,7,8-PeCDF, 1,2,3,4,7,8-HxCDF, 1,2,3,6,7,8-HxCDF, 1,2,3,7,8,9-HxCDF, 2,3,4,6,7,8-HxCDF, 1,2,3,4,6,7,8-HpCDF, 1,2,3,4,7,8,9-HpCDF, and OCDF

Notes:
1. While arsenic is not listed as an analyte in Table B4-2, it is included in this and other analytical tables to provide information for any future construction sediment sampling work associated with deferred SMA 10 (RAA 18), for which arsenic would be an analyte.
BBP: butyl benzyl phthalate
HpCDD: heptachlorodibenzo-*p*-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-*p*-dioxin
HxCDF: hexachlorodibenzofuran
OCDD: octachlorodibenzo-*p*-dioxin
OCDF: octachlorodibenzofuran
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-*p*-dioxin
PeCDF: pentachlorodibenzofuran
RAA: remedial action area
SVOC: semivolatile organic compound
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran
TOC: total organic carbon

Table B4-6
Analytical Methods and Sample Handling Requirements for Sediment Samples

Parameter[1]	Method	Reference[2]	Extraction Solvent	Cleanup	Laboratory[3]	Container	Preservative	Sample Holding Time
TOC	High-temperature combustion	EPA 9060A	NA	NA	Eurofins	4-oz amber glass jar	Cool to ≤ 6°C; freeze to ≤ -18°C	28 days 6 months if frozen
Metals	ICP/MS	EPA 3050B EPA 6020B	NA	NA	Eurofins	4-oz glass jar	Cool to ≤ 6°C; freeze to ≤ -18°C	6 months 2 years if frozen
Mercury	Cold vapor-atomic fluorescence spectroscopy	EPA 7471B	NA	NA	Eurofins			28 days 1 year if frozen
PAHs/SVOCs	GC/MS	EPA 3546/ EPA 8270E-SIM	Lab specific	Lab specific	Eurofins	4-oz glass jar	Cool to 0–6°C; freeze to ≤ -18°C	1 year to extraction if frozen; 14 days to extraction if refrigerated; when thawed, analysis within 40 days after extraction; store extracts at ≤ 6°C and in the dark
PCB Aroclors	GC/ECD	EPA 3546 Mod EPA 8082A	Lab specific	Lab specific	Eurofins	4-oz glass jar	Cool to 0–6°C; freeze to ≤ -18°C	1 year to extraction if refrigerated or frozen; analysis within 40 days after extraction; store extracts at ≤ 6°C and in the dark
Dioxins/ furans	HRGC/HRMS	EPA 1613B	Lab specific	Lab specific	Eurofins	8-oz amber glass jar	Cool to ≤ 4°C; freeze to ≤ -18°C	1 year until extraction and analysis within 1 year after extraction if stored in the dark at ≤ -18°C

Notes:
1. Individual analytes are listed in Table B4-5. All results will be reported by the analytical laboratory in dry weight.
2. Laboratory SOPs are confidential and will be available upon EPA request once the analytical laboratory has been identified.
3. ARL and ALS are alternate laboratories for all analyses.
EPA: U.S. Environmental Protection Agency
GC/ECD: gas chromatography/electron capture detection

GC/MS: gas chromatography/mass spectrometry
HRGC/HRMS: high-resolution gas chromatography/high-resolution mass spectrometry
ICP/MS: inductively coupled plasma/mass spectrometry
NA: not applicable or not available
oz: ounce
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
SM: Standard Method
SOP: standard operating procedure
SVOC: semivolatile organic compound
TOC: total organic carbon

4.8 Sediment Chemistry Analytical Data Quality Objective and Criteria

The analytical DQO for sediment samples is to develop and implement procedures that will ensure the collection of representative data of known, acceptable, and defensible quality. Parameters used to assess data quality are precision, accuracy, representativeness, completeness, comparability, and sensitivity. These parameters are discussed below.

Precision is the measure of reproducibility among individual measurements of the same property, usually under similar conditions, such as multiple measurements of the same sample. Precision is assessed by performing multiple analyses on a sample; it is expressed as an RPD when duplicate analyses are performed, and as a %RSD when more than two analyses are performed on the same sample (e.g., triplicates). Precision is assessed by laboratory duplicate analyses (e.g., duplicate samples, MSDs, and LCS duplicates) for all parameters. Precision measurements can be affected by the nearness of a chemical concentration to the detection limit, whereby the percent error (expressed as either %RSD or RPD) increases. The DQI for precision varies depending on the analyte. The equations used to express precision are as follows:

$$\%\ \text{Recovery} = \frac{(\text{measured conc} - \text{measured duplicate conc})}{(\text{measured conc} + \text{measured duplicate conc}) \div 2} \times 100 \qquad \textbf{Equation 1a}$$

$$\%\text{RSD} = {}^{SD}/_{D_{ave}} \times 100$$

Where:

$$SD = \sqrt{\left(\frac{\sum(D_n - D_{ave})^2}{(n-1)}\right)} \qquad \textbf{Equation 1b}$$

D	=	sample concentration
D_{ave}	=	average sample concentration
n	=	number of samples
SD	=	standard deviation

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy may be expressed as a percentage recovery for MS or LCS analyses. The DQI for accuracy varies depending on the analyte. The equation used to express accuracy for spiked samples is as follows:

$$\%\ \text{Recovery} = \frac{\text{spike sample results} - \text{unspiked sample results}}{\text{amount of spike added}} \times 100 \qquad \textbf{Equation 2}$$

Representativeness is an expression of the degree to which data accurately and precisely represent an environmental condition. The sampling approach was designed to address the specific objectives described in Section 2. Assuming those objectives are met, the samples collected should be considered adequately representative of the environmental conditions they are intended to characterize.

Comparability is an expression of the confidence with which one dataset can be evaluated in relation to another dataset. Therefore, sample collection and chemical and physical testing will adhere to the most recent Puget Sound Estuary Program and SCUM QA/QC procedures (PSEP 1997; Ecology 2021) and EPA and Standard Methods (SMs) analysis protocols.

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. The equation used to calculate completeness is as follows:

$$\text{Completeness} = \frac{\text{number of valid measurements}}{\text{total number of data points planned}} \times 100 \qquad \textbf{Equation 3}$$

The DQI for completeness for all components of this project is 90%. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

Analytical sensitivity is the minimum concentration of an analyte above which a data user can be reasonably confident that the analyte was reliably detected and quantified. For this study, the MDL[17] or the lower limit of quantitation will be used as the measure of sensitivity for each analyte.

Table B4-7 lists specific DQIs for laboratory analyses of sediment samples.

Table B4-7
DQIs for Laboratory Analyses

Parameter[1]	Unit	Precision[2]	Accuracy[2]		Completeness
			LCS	Spiked Samples	
TOC	%	± 20%	80–120%	80-120%	90%
Metals	mg/kg dw	± 20%	80–120%	80-120%	90%
Mercury	mg/kg dw	± 20%	80–120%	80-120%	90%
PAHs	µg/kg dw	± 30%	37-126%	37-150%	90%
PCB Aroclors	µg/kg dw	± 30%	42-150%	42-150%	90%

[17] The term MDL includes other types of detection limits, such as estimated detection limits calculated for dioxin/furan congeners. Recent revisions to EPA SW-846 methods no longer require the calculation of MDLs.

Parameter[1]	Unit	Precision[2]	Accuracy[2]		Completeness
			LCS	Spiked Samples	
SVOCs	µg/kg dw	± 30%	37-123%	37-123%	90%
Dioxins/furans	ng/kg dw	± 50%	63–170%	63–170%[3]	90%

Notes:
1. Individual analytes are listed in Table B4-5.
2. Values listed are example method limits; values will be updated by selected laboratory. The percentages provided represent the recovery range for each parameter.
3. Labelled compound percent recovery range.
µg/kg: microgram per kilogram
DQI: data quality indicator
dw: dry weight
LCS: laboratory control sample
mg/kg: milligram per kilogram
NA: not applicable
ng/kg: nanogram per kilogram
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
SVOC: semivolatile organic compound
TOC: total organic carbon

The laboratory MDL and RL goals for each analytical method are compared to their respective minimum sediment RALs in Table B4-8. All the analytical methods are sufficiently sensitive.

Table B4-8
RL Goals and RALs for Sediment Samples

Parameter	Method	RL	Lowest RAL[1]
Metals (mg/kg dw)			
Arsenic	EPA 6020B	0.5	28
Lead	EPA 6020B	0.5	450
Zinc	EPA 6020B	5.1	410
Mercury	EPA 7471B	0.0.06	0.41
PAHs and SVOCs (µg/kg dw)			
Benzo(a)anthracene	EPA 8270E SIM	3.34	2,200[2]
Benzo(a)pyrene	EPA 8270E SIM	3.34	1,980[2]
Total benzofluoranthenes	EPA 8270E SIM	6.68	4,600[2]
Chrysene	EPA 8270E SIM	3.34	2,200[2]
Dibenzo(a,h)anthracene	EPA 8270E SIM	3.34	240[2]
Indeno(1,2,3-cd)pyrene	EPA 8270E SIM	3.34	680[2]
Anthracene	EPA 8270E SIM	3.34	4,400[2]
Acenaphthene	EPA 8270E SIM	3.34	320[2]
Acenapthylene	EPA 8270E SIM	3.34	1,320[2]
Benzo(g,h,i)perylene	EPA 8270E SIM	3.34	620[2]

Parameter	Method	RL	Lowest RAL[1]
cPAH TEQ[3]	EPA 8270E SIM	3.02[4]	5,500[5]
Fluoranthene	EPA 8270E SIM	3.34	3,200[2]
Fluorene	EPA 8270E SIM	3.34	460[2]
Naphthalene	EPA 8270E SIM	6.66	1,980[2]
Phenanthrene	EPA 8270E SIM	4.66	2,000[2]
Pyrene	EPA 8270E SIM	3.34	20,000[2]
Total HPAHs[6]	EPA 8270E SIM	6.68	19,200[2]
Total LPAHs[7]	EPA 8270E SIM	13.3	7,400[2]
2-methylnaphthalene	EPA 8270E SIM	3.34	760[1]
Butyl benzyl phthalate	EPA 8270E SIM	40.0	98[2]
PCBs (µg/kg dw)			
PCBs	EPA 8082A (Aroclors)	4.0	240[2]
Dioxins/Furans (ng/kg dw)			
Dioxin/Furan TEQ[8]	EPA 1613b	5.7	25

Notes:
1. RAL is the minimum value for each chemical listed in ROD Table 27 or Table 28 (EPA 2014b), except for cPAHs, which is listed in Explanation of Significant Differences Table 3 (EPA 2021).
2. OC-normalized RAL was converted to dry weight value for this table using 2% TOC (average LDW sediment TOC). This value, which is less than the dry weight apparent effects thresholds in Table 8-1 of SCUM (Ecology 2021), is presented herein as a dry weight value only for the purpose of comparison to RLs.
3. Per the ROD (EPA 2014a), cPAHs consist of a subset of seven PAHs that EPA has classified as probable human carcinogens: benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
4. The RL for the cPAH TEQ value was calculated using one-half the RL for each of the cPAH compounds and the appropriate toxic equivalency factor values (California EPA 2009).
5. The cPAHs RAL is based on the Explanation of Significant Differences (EPA 2021).
6. HPAH compounds include fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3 cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
7. LPAH compounds include naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, and 2-methylnaphthalene.
8. The RL for the dioxin/furan TEQ value is based on the minimum calibration level from the selected laboratory; the dioxin/furan mammalian TEQ value was calculated using one-half the RL for each dioxin/furan compound and appropriate mammal toxic equivalency factor values (Van den Berg et al. 2006).
cPAH: carcinogenic polycyclic aromatic hydrocarbon
dw: dry weight
EPA: US Environmental Protection Agency
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
LDW: Lower Duwamish Waterway
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
OC: organic carbon
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAL: remedial action level
RAO: remedial action objective
RL: reporting limit
ROD: Record of Decision
SCUM: Sediment Cleanup User's Manual
SVOC: semivolatile organic compound
TEQ: toxic equivalent

TOC: total organic carbon

Standard mass requirements are specified to meet RL goals for each particular analytical method. Table B4-9 summarizes the sample volume needed for each sample type. The masses listed include those required for QC samples.

Table B4-9
Sample Mass Required per Analysis

Parameter	Sediment Mass (wet weight)	Container Size
TOC	6 g	4-oz jar
Metals	3 g	4-oz jar
Mercury	1 g	
PAHs	60 g	4-oz jar
SVOCs	60 g	
PCB Aroclors	75 g	4-oz jar
Dioxins/furan congeners	40 g	8-oz jar
Archive	NA	8-oz jar

Notes:
g: gram
NA: not applicable
oz: ounce
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
SVOC: semivolatile organic compound
TOC: total organic carbon

For all locations and intervals, following homogenization in the field, sediment for chemistry analysis will be dispensed into jars as required for the SMA-specific analytes (Section 4.1). In addition, one 8-oz jar from each location/interval will be archived in the event that issues arise (e.g., jar is lost or broken). All jars containing sediment for potential chemistry analysis will remain archived until one month after the end of the construction season, and until written authorization for disposal is received from the EQAO.

4.9 Sediment Chemistry Quality Assurance/Quality Control

The types of samples to be analyzed and the procedures to be conducted for QA/QC in the field and laboratory are described in this section.

4.9.1 Field Quality Control Samples

Field QA/QC samples, such as field duplicate samples, are generally used to evaluate the variability attributable to sample handling and processing. For surface and subsurface samples, a minimum of

1 duplicate sample[18] for every 20 samples will be collected. Field duplicate samples will be analyzed for the same analytes as the parent sample.

4.9.2 Laboratory Quality Control

Before analyzing the samples, the laboratory must provide written protocols for the analytical methods to be used, calculate RLs for each analyte in each matrix of interest as applicable, and establish an initial calibration curve for all analytes. The laboratory must also demonstrate its continued proficiency by participation in inter-laboratory comparison studies, and by repeated analysis of calibration checks, laboratory reagent blanks, and spiked samples.

4.9.2.1 Sample Delivery Group

Project- and/or method-specific QC measures, such as MSs and MSDs or laboratory duplicates, will be used per SDG preparatory batch or per analytical batch, as specified in Table B4-10. An SDG is defined as no more than 20 samples or a group of samples received at the laboratory within a 2-week period. Although an SDG may span two weeks, all holding times specific to each analytical method will be met for each sample in the SDG.

[18] Field duplicates are defined as samples from a parent sample for which twice as much volume as necessary to fill the sample containers has been collected. Following homogenization, aliquots of this parent sample are equally distributed in two sets of sample containers. Field duplicate results are used to measure and document the repeatability of sample handling procedures and heterogeneity of the sample matrix (PSEP 1997).

Table B4-10
Laboratory QC Sample Analysis Summary

Analysis Type	Method	Initial Calibration	Initial Calibration Verification (2nd source) and Calibration Blank	Continuing Calibration Verification and Calibration Blank	LCS	Laboratory Replicates	MS	MSD	Method Blanks	Internal Standards/ Surrogate Spikes
TOC	EPA 9060A	Prior to analysis	After initial calibration	Every 10 samples	1 per 20 samples or per batch	1 per 20 samples or per batch	1 per 20 samples or per batch	na	1 per 20 samples or per batch	NA
Metals	EPA 6020B	Daily, prior to analysis	After initial calibration; interference check standard and spectral interference check at beginning of analytical run; spectral interference check every 12 hours	Every 10 samples and at end of analytical sequence	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	Each sample (internal standard only)
Mercury	EPA 7471B	Prior to analysis	After initial calibration	Every 10 samples and at end of analytical sequence	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	NA
SVOCs/ PAHs	EPA 8270E-SIM	Prior to analysis	After initial calibration	Before and after sample analysis, and every 12 hours	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	Each sample
PCB Aroclors	EPA 8082A	Prior to analysis	After initial calibration	Before and after sample analysis, every 10–20 analyses or 12 hours	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	Each sample

Analysis Type	Method	Initial Calibration	Initial Calibration Verification (2nd source) and Calibration Blank	Continuing Calibration Verification and Calibration Blank	LCS	Laboratory Replicates	MS	MSD	Method Blanks	Internal Standards/ Surrogate Spikes
Dioxins/ furans	EPA 1613b	Prior to analysis	After initial calibration	Before and after sample analysis and every 12 hours	1 LCS/LCSD per prep batch[3]	na	na	na	1 per prep batch	Each sample

Notes:
A batch is a group of samples of the same matrix analyzed or prepared at the same time, not exceeding 20 samples.
EPA: U.S. Environmental Protection Agency
LCS: laboratory control sample
LCSD: laboratory control sample duplicate
MS: matrix spike
MSD: matrix spike duplicate
na: not applicable or not available
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
QC: quality control
SDG: sample delivery group
SM: Standard Method
SVOC: semivolatile organic compound
TOC: total organic carbon

4.9.2.2 Laboratory Quality Control Samples

The analyst will review the results of QC analyses from each sample group immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded.

If control limits have been exceeded, then appropriate corrective action, such as recalibration followed by reprocessing of the affected samples, must be initiated before a subsequent group of samples is processed. The EQAO must be contacted immediately by the laboratory PM if satisfactory corrective action to achieve the DQIs outlined in this QAPP is not possible. All laboratory corrective action reports relevant to the analysis of project samples must be included in the data deliverable packages.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparing them to independent standards. Laboratory QC standards are verified in a multitude of ways: Second-source calibration verifications (i.e., same standard, two different vendors) are analyzed to verify initial calibrations; new working standard mixes (e.g., calibrations, spikes, etc.) are verified against the results of the original solution and must be within 10% of the true value; newly purchased standards are verified against current data. Any impurities found in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis. Table B4-10 summarizes the QC procedures to be performed by the laboratory. The associated control limits for precision and accuracy are listed in Table B4-7.

4.9.2.3 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of 1 method blank will be analyzed for each SDG or for every 20 samples, whichever is more frequent.

4.9.2.4 Laboratory Control Samples

LCSs are prepared from a clean matrix using the same process as the project samples that are spiked with known amounts of the target compounds. The recoveries of the compounds are used as a measure of the accuracy of the test methods. A laboratory control sample duplicate (LCSD) will be analyzed for dioxins/furans.

4.9.2.5 Laboratory Replicate Samples

Laboratory replicate samples provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Laboratory replicates are subsamples of the original sample that are prepared and analyzed as separate samples, assuming sufficient sample matrix is available. A minimum of 1 laboratory replicate sample will be analyzed for each SDG or for every 20 samples, whichever is more frequent, for metals and conventional parameters.

4.9.2.6 Matrix Spikes and Matrix Spike Duplicates

The analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing MSD analyses, information on the precision of the method is also provided for organic analyses. For organic analyses, a minimum of 1 MS/MSD pair will be analyzed for each SDG or for every 20 samples, whichever is more frequent, when sufficient sample volume is available, with the exception of dioxins/furans. For inorganic analyses (i.e., metals), a minimum of one MS sample will be analyzed for each SDG, when sufficient sample volume is available.

4.9.2.7 Surrogate Spikes

All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds, as defined in the analytical methods. Surrogate recoveries will be reported by the analytical laboratories; however, no sample results will be corrected for recovery using these values.

4.9.2.8 Isotope Dilution Quantitation

All project samples analyzed for dioxin/furan congeners will be spiked with a known amount of surrogate compounds, as defined in the analytical methods. The labeled surrogate compounds will respond similarly to the effects of extraction, concentration, and gas chromatography. Data will be corrected for the recovery of the surrogates used for quantification.

4.9.2.9 Internal Standard Spikes

Internal standards may be used for calibrating and quantifying organic compounds and metals using MS. If internal standards are required by the method, all calibration, QC, and project samples will be spiked with the same concentration of the selected internal standard(s). Internal standard recoveries and retention times must be within method and/or laboratory criteria.

4.10 Instrument/Equipment Testing, Inspection, and Maintenance

Prior to each field event, measures will be taken to test, inspect, and maintain all field equipment. All equipment used, including the differential global positioning system unit and digital camera, will be tested for accuracy before leaving for the field event. The Sediment Sampling Lead will be responsible for overseeing the testing, inspection, and maintenance of all field equipment.

Laboratory instrument testing, inspection, and maintenance procedures are described in the laboratory SOPs.[19] The laboratory PM will be responsible for ensuring laboratory equipment testing, inspection, and maintenance requirements are met.

4.11 Instrument/Equipment Calibration and Frequency

Multipoint initial calibration will be performed on each analytical instrument at the start of the project, after each major interruption to the instrument, and when any continuing calibration does not meet the specified criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibrations will be performed daily for organic analyses, every 10 samples for inorganic analyses, and with every sample batch for conventional parameters to ensure proper instrument performance.

Gel permeation chromatography calibration verifications will be performed at least once every seven days, and corresponding raw data will be submitted by the laboratory with the data package. In addition, florisil performance checks will be performed for every florisil lot, and the resulting raw data will be submitted with the data package.

Calibration of analytical equipment used for chemical analyses includes the use of instrument blanks or continuing calibration blanks, which provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately after the continuing calibration verification, at a frequency of 1 blank for every 10 samples analyzed for inorganic analyses, and 1 blank every 12 hours for organic analyses. If the continuing calibration does not meet the specified criteria, the analysis must stop. Analysis may resume after corrective actions have been taken to meet the method specifications. All project samples analyzed by an instrument found to be out of compliance must be reanalyzed.

4.12 Inspection/Acceptance of Supplies and Consumables

The Sediment Sampling Lead or designee will gather and check field supplies daily for satisfactory conditions before each field event. Batteries will be checked daily and recharged as necessary. Supplies and consumables for the field sampling effort will be inspected upon delivery and accepted if the condition of the supplies is satisfactory.

4.13 Data Management

All field data will be recorded on field forms, which the Sediment Sampling Lead will check for missing information at the end of each field day and amend as necessary. A QC check will be done to

[19] Laboratory SOPs are confidential and will be available upon EPA request once the analytical laboratory has been identified.

ensure that all data have been transferred accurately from the field forms to the database. Field forms will be archived.

Analytical laboratories are required to submit data in an electronic format, as described in Section 3.7.2. The laboratory PM will contact the EQAO prior to data delivery to discuss specific format requirements.

A library of routines will be used to translate typical electronic output from laboratory analytical systems and to generate data analysis reports. The use of automated routines will ensure that all data are consistently converted to the desired data structures, and that operator time is kept to a minimum. In addition, routines and methods for quality checks will be used to ensure such translations are correctly applied.

Written documentation will be used to clarify how field and analytical laboratory duplicates and QA/QC samples were recorded in the data tables, and to provide explanations of other issues that may arise. The data management task will include keeping accurate records of field and laboratory QA/QC samples so that project team members who use the data will have appropriate documentation. All data management files will be stored on a secure server. Data management procedures will be provided prior to implementation of this QAPP.

5 Assessment and Oversight

EPA or its designees may observe field activities during each sampling event, as needed. If situations arise wherein there is a significant inability to follow the QAPP methods precisely, the EQAO will determine the appropriate actions, or will consult EPA if the issue is significant.

5.1 Compliance Assessments

Laboratory and field performance assessments will consist of on-site reviews conducted by EPA of QA systems and equipment for sampling, calibration, and measurement. EPA personnel may conduct a laboratory audit prior to sample analysis. Any pertinent laboratory audit reports will be made available to the EQAO upon request. Analytical laboratories will be required to have written procedures addressing internal QA/QC. All laboratories and the EQAO will be required to ensure that all personnel engaged in sampling and analysis tasks have appropriate training.

5.2 Response Actions for Field Sampling

The Sediment Sampling Lead or a designee will be responsible for correcting equipment malfunctions throughout field sampling, and for resolving situations in the field that may result in nonconformance or noncompliance with this QAPP. All corrective measures will be immediately documented in the field logbook, and protocol modification forms will be completed.

5.3 Corrective Action for Laboratory Analyses

Analytical laboratories will be required to comply with their current written SOPs, laboratory QA plan, and analytical methods. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data. The analysts will identify and correct any anomalies before continuing with sample analysis. The laboratory PMs will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP.

The EQAO will be notified immediately if any QC sample exceeds the DQIs provided in Attachment B.3 and the exceedance cannot be resolved through standard corrective action procedures. A description of the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, and re-extraction) will be submitted with the data package using the case narrative or corrective action form.

6 Reporting

Reporting of sediment sampling results is required for this project and is described in the following subsections.

6.1 SMA-specific Reporting

After the conclusion of sampling for each SMA, a progress update and a list of any deviations will be prepared and provided to the EQAO for submittal to EPA as part of the Annual Construction Summary Technical Memorandum. EPA will also be notified: 1) after sampling has been completed and samples have been submitted for analysis for a given SMA, and 2) when data for a given SMA are received from the laboratory.[20] Chemistry data will be prepared for use by the EQAO, Project Representative, and EPA in determining whether contingency actions are needed (Section 5.2 of the CQAP). A review of laboratory QC data consistent with Stage 1/2A validation will be conducted as part of the Annual Construction Summary Technical Memorandum to identify any data quality issues.

6.2 Final Report

All sediment sampling data will be included as part of the Annual Construction Summary Technical Memorandum prepared for each construction season. In addition to documenting chemistry results, comparison to thresholds, and resulting corrective actions (if applicable), the report's appendices will include key materials from the sediment sampling efforts for each SMA (i.e., field logs, final sampling locations, chain of custody forms, laboratory reports, and electronic data deliverables).

[20] A review of laboratory QC data will be conducted when data are received from the laboratory; unvalidated sample chemistry data and laboratory case narratives will be shared with EPA within two working days of receipt.

7 References

California EPA. 2009. Technical support document for cancer potency factors: methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures. Air Toxicology and Epidemiology Branch, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, CA.

Ecology. 2021. Sediment cleanup user's manual. Guidance for implementing the cleanup provisions of the sediment management standards, Chapter 173-204 WAC. Third revision December 2021. Pub. No. 12-09-057. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

EPA. 2002. Guidance for quality assurance project plans. QA/G-5. EPA/240/R-02/009. Office of Environmental Information, US Environmental Protection Agency, Washington, DC.

EPA. 2014a. Record of Decision, Lower Duwamish Waterway Superfund Site. Part 3. Responsiveness summary. US Environmental Protection Agency, Region 10, Seattle, WA.

EPA. 2014b. Record of Decision. Lower Duwamish Waterway Superfund Site. US Environmental Protection Agency.

EPA. 2021. Proposed explanation of significant differences. Draft for public comment. Lower Duwamish Waterway Superfund site. US Environmental Protection Agency Region 10, Seattle, WA.

PSEP. 1997. Recommended guidelines for sampling marine sediment, water column, and tissue in Puget Sound. Prepared for the Puget Sound Estuary Program, US Environmental Protection Agency, Region 10. King County (METRO) Environmental Laboratory, Seattle, WA.

Van den Berg M, Birnbaum LS, Denison M, De Vito M, Farland W, Feeley M, Fiedler H, Hakansson H, Hanberg A, Haws L, Rose M, Safe S, Schrenk D, Tohyama C, Tritscher A, Tuomisto J, Tysklind M, Walker N, Peterson RE. 2006. The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. Toxicol Sci 93(2):223-241.

Appendix B – Construction Sediment Sampling Quality Assurance Project Plan

Attachment B.1
Field Forms

SURFACE SEDIMENT COLLECTION FORM

Project Name / #: LDW Construction Management **Weather:** _____

Date: _____ **Tide Source:** _____

Sampling Method: _____ **Crew:** _____

GRAB DATA	**Location ID:**					
Latitude/Northing (Y):				**Longitude/Easting (X):**		
Grab time	**Water depth (ft)**	**Penetration depth (cm)**	**Acceptable grab (Y/N)**	**Tide Level (ft)**	**Mudline elevation (ft MLLW)**	**Comments**
SAMPLE DATA	**Sample ID:**					
Pre-homogenization analyses (circle): VOC Sulfides Ammonia AVS/SEM TPH-P Other:						

Sediment type	**Sediment color**	**Sediment odor**		**Comments:**
cobble	brown surface	none	H_2S	
gravel	drab olive	slight	petroleum	
sand (F M C)	brown	moderate	other:	
silt	gray	strong		
clay	black			

Sediment Core Collection Form

Page ___ of ___

Project: LDW Construction Management | **Location ID:**
Date: | **Attempt No.:**
Weather: | **Core Type:**
Logged By: | **Field Staf**

Field Collection Coordinates:
Lat/Northing: | Long/Easting:

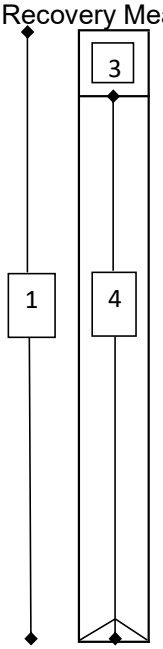
A. Water Depth
DTM Depth Sounder: ft
DTM Lead Line: ft

B. Tide Level Measurement
Time:
Height: ft
Source:

C. Mudline Elevation
(ft MLLW)

Core Collection Recovery Details:
1. Core Tube Length: ft
2. Penetration Depth: ft
3. Headspace Measurement: ft
4. Field Recovery Depth: ft
5. Field Recovery Percentage:
6. Core Accepted: Yes / No
7. Processing Recovery Depth: ft
8. Adjusted Recovery Percentage:

Recovery Measurements (prior to cuts)



Core Sections To Process:
A:
B:
C:
D:

Drive Notes:

Shoe Description:

Core Field Observations and Description:	Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Additional Notes:

Sediment Core Processing Log

Job:		Location ID:	
Job No.		Collection Date/Time:	
No. of Sections:		Core Logged By:	
Penetration Depth:	(ft)	Attempt #:	
Processing Recovery Depth:	(ft)	Type of Core ☐ Mudmole ☐ Vibracore ☐ Diver Core	
Adjusted Recovery Percentage:		Diameter of Core (inches)	
Notes:		Core Quality ☐ Good ☐ Fair ☐ Poor ☐ Disturbed	

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	**Classification and Remarks** (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (cm)	Sample	Summary Sketch

PROTOCOL MODIFICATION FORM

Project Name and Number: _____

Material to be Sampled: _____

Measurement Parameter: _____

Standard Procedure for Field Collection & Laboratory Analysis (cite reference): _____

Reason for Change in Field Procedure or Analysis Variation: _____

Variation from Field or Analytical Procedure: _____

Special Equipment, Materials or Personnel Required: _____

Initiator's Name: _____ Date: _____

Project Officer: _____ Date: _____

QA Officer: _____ Date: _____

Appendix B – Construction Sediment Sampling Quality Assurance Project Plan

Attachment B.2
Standard Operating Procedures

STANDARD OPERATING PROCEDURE

SUBSURFACE SEDIMENT COLLECTION

A Introduction

Subsurface sediment core samples will be collected primarily from a sampling vessel (using a vibracorer), or they will be manually collected from shore in intertidal areas where access from a vessel is not possible. Procedures for these two access options are described below.

B Sample Collection by Boat

B1 Collect Sediment

When sampling from a boat, most of the sediment cores will be collected using a vibracorer. The vibracorer will be deployed from the sampling vessel using an A-frame with a hydraulic winch system. The vibracorer consists of a vibrating power head attached to a 4-in.-diameter core barrel (length to be dependent on the target core depth). Once the sample depth is reached, the cpore tube or barrel will be advanced to the target depth, and then retrieved for sample processing. Continuous sediment cores will be collected using the vibracorer.

Sediment core samples will be collected and processed according to the following procedures:

1. The sampling vessel will be maneuvered to the proposed sampling location using a differential global positioning system (DGPS)[1] with sub-meter accuracy, positioned such that the DGPS receiver (located on top of the sampling frame) is within 3 m (10 ft) of the target sampling location.
2. If it is not possible to access the target location due to obstructions or difficult substrate (e.g., presence of riprap or other debris), the vessel may be relocated within 10 m (32 ft) of the proposed location.
3. The vibracorer with decontaminated[2] core tube will be deployed.
4. Continuous core samples will be collected to the project depth requirement or until refusal.
5. The depth of core penetration will be measured and recorded.
6. The sample core tube will be extracted, and the assembly will be retrieved aboard the vessel.

[1] A Trimble© SPS461 or similar DGPS receiver unit will be employed for the various sampling methods outlined in the quality assurance project plan. The DGPS receiver will be calibrated daily to ensure that it is accurately recording positions from known benchmarks and functioning within the individual unit's factory specifications.

[2] All equipment will be decontaminated following procedures described in Section D.

7. The core sample will be evaluated at the visible ends of the core tube to verify retention of the sediment in the core tube.
8. If the sediment core is acceptable (see criteria below), the core will be capped, labelled, and held vertically pending transfer to a processing crew.
9. The top of the core will be decanted and the top of the mudline will be marked on the core tube when possible.

Acceptance criteria for a sediment core sample are as follows:

- The material is collected to the target depth within the first three attempts.
- Recovery is at least 75% of the penetration depth.
- The core appears to be intact without obstructions or blocking.

If sample acceptance criteria are not achieved, the sample will be rejected. If repeated deployment (i.e., maximum three attempts) does not result in a sample that meets the acceptance criteria, or if deployment hits refusal before reaching the target depth, the sample with the best penetration depth will be retained.

Field forms and notes for all core samples will be maintained as samples are collected. The following information will be included in the sediment core collection forms and field notes:

- Water depth and tidal elevation (i.e., raw data), as well as the calculated mudline elevation of each sediment core location relative to mean lower low water
- Location of each sediment core as determined using a differential global positioning system with sub-meter accuracy
- Date and time of collection for each sediment core
- Names of field supervisor and person(s) collecting and logging the sample
- Core penetration and recovery measurements
- Designation of each coring attempt as "accepted" or "rejected"
- Observations made during sample collection, including weather conditions, complications, ship traffic, and other details associated with the sampling effort
- Core type and location identification (ID)
- Photographs of anything of note
- Any deviations from the approved sampling plan (on a Protocol Modification Form)

B2 Process Core

Sediment cores collected from a boat will be processed as soon as possible after a core has been collected that meets the acceptance criteria. The steps for processing the samples are as follows:

1. Prior to processing, evaluate any additional amount of compaction that may have occurred after core acceptance and prior to core processing, and calculate the adjusted recovery percentage (ARP) to be applied during core processing.

    - Measure the core processing recovery depth (i.e., the compacted core depth prior to processing).
    - To calculate the ARP, divide the processing recovery depth by the penetration depth (i.e., the depth recorded during core collection and acceptance).
    - Example: If the core processing recovery depth (i.e., adjusted depth) at the time of processing is 2.55 ft, and the core penetration depth (i.e., at the time of collection) was 3.00 ft, the ARP would be 85.0% (e.g., 0.85).

2. Carefully cut along the core tube or liner to expose the sediment core for processing and photograph each core.
3. The core will be examined for major stratigraphic boundaries and to evaluate if "native" material is present in the core. Native material—defined as poorly graded sand (usually medium-sized grains) that is grey and contains multi-colored grains and possibly mica flecks—will be identified by a geologist or other trained individual. This information will be documented on the sediment core processing log and used to inform sample collection.
4. Record the description of each core on the sediment core processing log, including the following parameters, as appropriate, and take photographs of anything of note.

    - Core penetration depth (from the sediment core collection form)
    - Processing recovery core depth and calculated ARP
    - Adjusted sample depth interval for each sample
    - Sediment grain size description following American Society for Testing and Materials (ASTM) visual-manual classification (ASTM D2488)
    - Odor (e.g., hydrogen sulfide, petroleum)
    - Vegetation
    - Debris
    - Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)

- Presence of oil sheen
- Any other distinguishing characteristics or features.

5. For each core, separate the material from each target depth interval, applying (i.e., multiplying) the ARP to the target sample depth that will constitute the sample for laboratory analysis. For example, if the ARP for a given core is 85.0% (e.g., 0.85), the sample material to collect for a 0- to 30-cm analysis will come from the 0- to 25.5-cm interval (i.e., 30 cm × 0.85 = 25.5 cm).
6. Transfer each sediment sample into a separate stainless steel bowl for homogenization.
7. Homogenize the sediment using clean stainless steel spoons until texture and color homogeneity have been achieved, removing large non-sediment items such as gravel, shells, wood chips, or organisms (e.g., clams) (Ecology 2021).
8. Affix a complete sample label to each individual sample jar. Sample labels will contain the project number, sampling personnel, date, time, and sample ID. Labels will be filled out as completely as possible prior to each sampling event.
9. Dispense sediment into clean and labelled jars.
10. Thoroughly check all sample containers for proper identification, analysis type, and lid tightness. The field coordinator will be responsible for reviewing sediment sample information recorded on field forms and will correct any improperly recorded information.
11. Pack each container carefully to prevent breakage and place inside a cooler with ice for storage at the proper temperature (≤ 4 ± 2°C) for delivery to the analytical laboratory.

C Sample Collection from Shore

If an intertidal sediment core cannot be collected from the boat due to site access conditions (e.g., too shallow), then the core may be manually collected from shore during a lower tide (although the full target depth may not be achieved in this situation). At the discretion of the field crew, one of the following three sampling options will be used, whichever is most suitable to the sampling location conditions. In addition, the field crew may use a combined or hybrid approach of the three methods, if necessary. The core locations may need to be adjusted in the field to account for site conditions, such as debris or armoring, that do not allow for sampling.

C1 Option 1: Use Shovel to Dig Hole

The first sampling option is to dig a hole using a shovel and collect the sample directly from the sidewall of the hole. The process for this option is as follows.

1. **Dig hole** – Using a transplanting spade (i.e., a shovel with a narrow blade), dig a hole to the target depth (or as deep as possible) at the identified location. If it is not possible to reach the target depth within three attempts, the deepest hole among the attempts will be sampled using the methodology described below, and the depth of refusal will be recorded on the sediment core collection form. At least one side of the hole should be approximately vertical to allow for the collection of the sample. Record any necessary revisions of the sampling location.

2. **Prepare for sampling** – Divide the vertical extent of the hole into equal sections (e.g., for a 45-cm hole, there might be three 15-cm sections [i.e., 0-15 cm, 15-30 cm, and 30-45 cm]) to ensure that equal amounts of sediment are collected from each depth horizon. If possible, use a spoon to draw a line in the sidewall of the hole at these breakpoints. Sample the bottom section first to ensure that the sample is collected prior to the hole filling with water.

3. **Collect and homogenize sample** – Collect the same amount of sediment from each of the subsections along the vertical extent of the hole. Exclude any debris larger than approximately 5 mm in width. If differences in the hole are apparent (e.g., the presence of differently colored material), the resulting sample should proportionally represent all material in the hole. Once all material has been collected, homogenize the contents of the bowl with a stainless steel spoon until texture and color homogeneity have been achieved, and dispense the contents into clean and labelled jars.

The procedures for processing shore-collected cores are presented below.

C2 Option 2: Use Hand-core Tube to Collect Core

The second sampling option is to use a hand-core tube to collect a core, extrude the core, and then collect the sample from the interior of the core. This process for this option is as follows:

1. **Collect core** – Drive the decontaminated hand-core tube into the sediment to target depth (or refusal) at the identified location, or as near as possible based on the substrate and debris. Cap the top of the tube and pull the core out of the sediment. If it is not possible to reach the target depth on the first attempt, up to three attempts should be made in that area (initial attempts will be retained in the core tube or extruded onto a piece of foil). After the third attempt, sample the deepest core using the methodology described below, and record the depth of refusal on the surface sediment collection form. Record any necessary movement of the sampling location.

2. **Collect and homogenize sample** – Extrude the contents of the core into a pre-cleaned stainless steel bowl and homogenize with a clean stainless steel spoon until texture and color homogeneity have been achieved. Discard any debris wider than approximately 5 mm.

The procedures for processing shore-collected cores are presented below.

C3 Option 3: Use Land-based Drilling Methods

The third option is to use land-based drilling methods to collect a vertical core. Rotary sonic drilling methods will be used with a land-based drill rig. Continuous vertical samples will be collected and extruded from the drill rig core barrel. The process for this option is as follows:

1. **Collect core** – Advance the decontaminated core barrel into the sediment to the target depth at the identified location, or as near as possible based on access, substrate, and debris. Advance the outer casing to the same depth as the core barrel. Pull the core barrel out of the sediment.

2. **Extrude core** – Extrude the sample from the core barrel into a plastic liner. Log observed lithology and notable features, as described in Section B2.

3. **Collect and homogenize sample** – Subsample the core and place sampled materials in a pre-cleaned stainless steel bowl. Homogenize materials with a clean stainless steel spoon until texture and color homogeneity have been achieved. Discard any debris wider than approximately 5 mm.

The procedures for processing shore-collected cores are presented below.

C4 Processing Cores Collected from Shore

After sediment collection and homogenization have occurred, the following steps will be completed to process the sediment cores:

1. **Record information** – Record information regarding the depth of the core, sediment characteristics (e.g., color, smell, grain size, presence of debris, etc.), and necessary revisions to the sampling location on the sediment core collection and processing forms. Take photographs of anything of note and document any deviations from the approved sampling plan on a Protocol Modification Form.
2. **Dispense into jars** – Affix a complete sample label to each individual sample jar. Sample labels will contain the project number, sampling personnel, date, time, and sample ID. Labels will be filled out as completely as possible prior to each sampling event. Dispense sediment into labeled sample containers.
3. **QC jars and forms** – Thoroughly check all sample containers for proper identification, analysis type, and lid tightness. The field coordinator will be responsible for reviewing

sediment sample information recorded on field forms and will correct any improperly recorded information.

4. **Prepare for delivery to the analytical laboratory** – Pack each container carefully to prevent breakage and place inside a cooler with ice for storage at the proper temperature (≤ 4 ± 2°C) for delivery to the analytical laboratory.

D Equipment Decontamination Procedures

All sediment sampling and homogenizing equipment, including the mixing bowl and stainless steel implements, will be decontaminated between sampling locations per Washington State Department of Ecology guidelines (Ecology 2021) and the following procedures:

1. Rinse with site water and wash with a scrub brush until free of sediment.
2. Wash with phosphate-free detergent.
3. Rinse with site water.
4. Rinse with distilled water.

Acid or solvent washes will not be used in the field because of safety considerations and problems associated with rinsate disposal and sample integrity, specifically:

- Use of acids or organic solvents may pose a safety hazard to the field crew.
- Disposal and spillage of acids and solvents during field activities pose an environmental concern.
- Residues of solvents and acids on sampling equipment may affect sample integrity for chemical testing.

Any sampling equipment that cannot be cleaned to the satisfaction of the field coordinator will not be used for further sampling activities.

E References

Ecology. 2021. Sediment cleanup user's manual. Guidance for implementing the cleanup provisions of the sediment management standards, Chapter 173-204 WAC. Third revision December 2021. Pub. No. 12-09-057. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

Appendix B – Construction Sediment Sampling Quality Assurance Project Plan

Attachment B.3 Analytical Data Quality Indicators

Tables

Table 3-1
Eurofins Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
PCBs as Aroclors				
Aroclor 1016	EPA 8082A	µg/kg dw	1.48[1]	4.0[2]
Aroclor 1221	EPA 8082A	µg/kg dw	2.4[1]	4.0[2]
Aroclor 1232	EPA 8082A	µg/kg dw	0.98[1]	4.0[2]
Aroclor 1242	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
Aroclor 1248	EPA 8082A	µg/kg dw	1.4[1]	4.0[2]
Aroclor 1254	EPA 8082A	µg/kg dw	1.8[1]	4.0[2]
Aroclor 1260	EPA 8082A	µg/kg dw	1.48[1]	4.0[2]
PAHs				
Acenaphthene[3]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Acenaphthylene[3]	EPA 8270E SIM	µg/kg dw	0.666[1]	3.34[2]
Anthracene[3]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Benzo(a)anthracene[4]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Benzo(a)pyrene[4]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Total benzofluoranthenes (benzo(b)fluoranthene, benzo(k)fluoranthene) [4]	EPA 8270E SIM	µg/kg dw	2.67[1]	6.68[2]

Table 3-1
Eurofins Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
Benzo(g,h,i)perylene[4]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Chrysene[4]	EPA 8270E SIM	µg/kg dw	0.666[1]	3.34[2]
Dibenzo(a,h)anthracene[4]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Fluoranthene[4]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Fluorene[3]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Indeno(1,2,3-cd)pyrene[4]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
2-methylnaphthalene[3]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Naphthalene[3]	EPA 8270E SIM	µg/kg dw	2.66[1]	6.66[2]
Phenanthrene[3]	EPA 8270E SIM	µg/kg dw	2.0[1]	4.66[2]
Pyrene[4]	EPA 8270E SIM	µg/kg dw	1.33[1]	3.34[2]
Metals				
Arsenic	EPA 6020B	mg/kg dw	0.100	0.50
Lead	EPA 6020B	mg/kg dw	0.106	0.50
Zinc	EPA 6020B	mg/kg dw	1.61	5.1
Mercury	EPA 7471B	mg/kg dw	0.018	0.06
SVOCs				

Table 3-1
Eurofins Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
Butyl benzyl phthalate	EPA 8270E SIM	µg/kg dw	6.67[1]	20.0[2]
Conventionals				
Percent solids	SM 2540 G-97	% dw	0.10	0.10
TOC (based on 1-g dw sample)	EPA 9060A	% dw	0.092	0.4

Notes:
1. SW 846 no longer requires MDL values. The laboratories have the option to use these values to assess sensitivity for EPA 8000 series methods. The lab has continued to maintain MDL studies for these analytes following EPA MDL Revision 2 (EPA 2016) procedures.
2. RL values are consistent with the LLOQ values required under EPA SW-846.
3. Compound is a component of the LPAH sum.
4. Compound is a component of the HPAH sum.
dw: dry weight
EPA: US Environmental Protection Agency
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
LLOQ: lower limit of quantitation
MDL: method detection limit
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
na: not available
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RL: reporting limit
SIM: selective ion monitoring
SM: Standard Method
SVOC: semivolatile organic compounds
TOC: total organic carbon

Table 3-2
Eurofins Methods and RL goals for dioxin/furan congeners in sediment

Analyte	EPA Method 1613B			
	Sediment (ng/kg dw)		TEQ (ng/kg)	
	EDL[1]	LOQ[2]	TEF	TEQ[3]
2,3,7,8-TCDD	0.161	1.0	1	0.5
1,2,3,7,8-PeCDD	0.628	5.0	1	2.5
1,2,3,4,7,8-HxCDD	1.04	5.0	0.1	0.25
1,2,3,6,7,8-HxCDD	0.768	5.0	0.1	0.25
1,2,3,7,8,9-HxCDD	1.05	5.0	0.1	0.25
1,2,3,4,6,7,8-HpCDD	0.853	5.0	0.01	0.025
OCDD	3.61	5.0	0.0003	0.00075
2,3,7,8-TCDF	0.368	1.0	0.1	0.05
1,2,3,7,8-PeCDF	1.39	5.0	0.03	0.075
2,3,4,7,8-PeCDF	1.11	5.0	0.3	0.75
1,2,3,4,7,8-HxCDF	1.58	5.0	0.1	0.25
1,2,3,6,7,8-HxCDF	1.38	5.0	0.1	0.25
1,2,3,7,8,9-HxCDF	1.32	5.0	0.1	0.25
2,3,4,6,7,8-HxCDF	1.29	5.0	0.1	0.25
1,2,3,4,6,7,8-HpCDF	1.15	5.0	0.01	0.025
1,2,3,4,7,8,9-HpCDF	0.955	5.0	0.01	0.025
OCDF	2.47	5.0	0.0003	0.00075

Notes:

1. EDL is a sample-specific DL. The value provided here is an estimate, and the sample-specific values will vary based on sample mass and the analytical conditions at the time of analysis.
2. LOQ is lab's lowest concentration, at or above the LMCL, at which test accuracy (precision and bias) has been demonstrated. Values below the LOQ are J-qualified. The reported LOQ will be adjusted based on the sample mass of each sample
3. TEQ calculated using ½ RL value multiplied by the 2005 WHO TEF.

DL: detection limit
dw: dry weight

EDL: estimated detection limit
EPA: US Environmental Protection Agency
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
LMCL: lower method calibration limit
LOQ: limit of quantitation
OCDD: octachlorodibenzo-*p*-dioxin
OCDF: octachlorodibenzofuran
PeCDD: pentachlorodibenzo-*p*-dioxin
PeCDF: pentachlorodibenzofuran
RL: reporting limit
TCDD: tetrachlorodibenzo-*p*-dioxin
TCDF: tetrachlorodibenzofuran
TEF: toxic equivalency factor
TEQ: toxic equivalent
WHO: World Health Organization

Table 3-3
Analytical Resources, LLC Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
PCBs as Aroclors (based on 12.5-g dw sample)				
Aroclor 1016	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
Aroclor 1221	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
Aroclor 1232	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
Aroclor 1242	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
Aroclor 1248	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
Aroclor 1254	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
Aroclor 1260	EPA 8082A	µg/kg dw	1.6[1]	4.0[2]
PAHs (based on 10-g dw sample)				
Acenaphthene[3]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Acenaphthylene[3]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Anthracene[3]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Benzo(a)anthracene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Benzo(a)pyrene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]

Table 3-3
Analytical Resources, LLC Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
Total benzofluoranthenes (benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene) [4]	EPA 8270E	µg/kg dw	10[1]	40.0[2]
Benzo(g,h,i)perylene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Chrysene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Dibenzo(a,h)anthracene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Fluoranthene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Fluorene[3]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Indeno(1,2,3-cd)pyrene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
2-methylnaphthalene[3]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Naphthalene[3]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Phenanthrene[3]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Pyrene[4]	EPA 8270E	µg/kg dw	10[1]	20.0[2]
Metals (based on 1-g ww unless otherwise noted)				
Arsenic	EPA 6020B UCT-KED	mg/kg dw	na	0.2[2]
Lead	EPA 6020B	mg/kg dw	0.0026[5]	0.1[2]
Zinc	EPA 6020B UCT-KED	mg/kg dw	0.146[5]	6[2]

Table 3-3
Analytical Resources, LLC Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
Mercury (based on 0.2-g ww sample)	EPA 7471B	mg/kg dw	0.00525[5]	0.025[2]
SVOCs (based on 10-g dw sample)				
Butyl benzyl phthalate	EPA 8270E	µg/kg dw	9.4[1]	20.0[2]
Conventionals				
Percent solids	SM 2540 G-97	% dw	na	0.040
TOC (based on 1-g dw sample)	EPA 9060A	% dw	0.018	0.02

Notes:
1. SW 846 no longer requires MDL values. The laboratories have the option to use these values to assess sensitivity for EPA 8000 series methods. The lab has continued to maintain MDL studies for these analytes following EPA MDL Revision 2 (EPA 2016) procedures.
2. RL values are consistent with the LLOQ values required under EPA SW-846.
3. Compound is a component of the LPAH sum.
4. Compound is a component of the HPAH sum.
5. SW 846 no longer requires MDL values.
dw: dry weight
EPA: US Environmental Protection Agency
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
LLOQ: lower limit of quantitation
MDL: method detection limit
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
na: not available
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RL: reporting limit

SIM: selective ion monitoring
SM: Standard Method
SVOC: semivolatile organic compounds
TOC: total organic carbon

Table 3-4
Analytical Resources, LLC Methods and RL goals for dioxin/furan congeners in sediment

Analyte	EPA Method 1613B			
	Sediment (ng/kg dw) Based on 10-g sample		TEQ (ng/kg)	
	EDL[1]	LOQ[2]	TEF	TEQ[3]
2,3,7,8-TCDD	0.1	1.0	1	0.5
1,2,3,7,8-PeCDD	0.1	1.0	1	0.5
1,2,3,4,7,8-HxCDD	0.1	1.0	0.1	0.05
1,2,3,6,7,8-HxCDD	0.1	1.0	0.1	0.05
1,2,3,7,8,9-HxCDD	0.1	1.0	0.1	0.05
1,2,3,4,6,7,8-HpCDD	0.1	2.5	0.01	0.0125
OCDD	01	10.0	0.0003	0.0015
2,3,7,8-TCDF	0.1	1.0	0.1	0.05
1,2,3,7,8-PeCDF	01	1.0	0.03	0.015
2,3,4,7,8-PeCDF	0.1	1.0	0.3	0.15
1,2,3,4,7,8-HxCDF	0.1	1.0	0.1	0.05
1,2,3,6,7,8-HxCDF	0.1	1.0	0.1	0.05
1,2,3,7,8,9-HxCDF	0.1	1.0	0.1	0.05
2,3,4,6,7,8-HxCDF	0.1	1.0	0.1	0.05
1,2,3,4,6,7,8-HpCDF	0.1	1.0	0.01	0.005
1,2,3,4,7,8,9-HpCDF	0.1	1.0	0.01	0.005
OCDF	0.1	2.5	0.0003	0.000375

Notes:

1. EDL is a sample-specific DL. The value provided here is an estimate, and the sample-specific values will vary based on sample mass and the analytical conditions at the time of analysis.
2. LOQ is lab's lowest concentration, at or above the LMCL, at which test accuracy (precision and bias) has been demonstrated. Values below the LOQ are J-qualified. The reported LOQ will be adjusted based on the sample mass of each sample
3. TEQ calculated using ½ RL value multiplied by the 2005 WHO TEF.

DL: detection limit

dw: dry weight
EDL: estimated detection limit
EPA: US Environmental Protection Agency
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
LMCL: lower method calibration limit
LOQ: limit of quantitation
OCDD: octachlorodibenzo-*p*-dioxin
OCDF: octachlorodibenzofuran
PeCDD: pentachlorodibenzo-*p*-dioxin
PeCDF: pentachlorodibenzofuran
RL: reporting limit
TCDD: tetrachlorodibenzo-*p*-dioxin
TCDF: tetrachlorodibenzofuran
TEF: toxic equivalency factor
TEQ: toxic equivalent
WHO: World Health Organization

Table 3-5
ALS-Kelso Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
PCBs as Aroclors (based on 12.5-g dw sample)				
Aroclor 1016	EPA 8082A	µg/kg dw	0.5[1]	2.0[2]
Aroclor 1221	EPA 8082A	µg/kg dw	0.5[1]	2.0[2]
Aroclor 1232	EPA 8082A	µg/kg dw	0.5[1]	2.0[2]
Aroclor 1242	EPA 8082A	µg/kg dw	0.5[1]	2.0[2]
Aroclor 1248	EPA 8082A	µg/kg dw	0.5[1]	2.0[2]
Aroclor 1254	EPA 8082A	µg/kg dw	0.5[1]	2.0[2]
Aroclor 1260	EPA 8082A	µg/kg dw	0.5[1]	2.0[2]
PAHs (based on 10-g dw sample)				
Acenaphthene[3]	EPA 8270E	µg/kg dw	0.3[1]	5.0[2]
Acenaphthylene[3]	EPA 8270E	µg/kg dw	0.28[1]	5.0[2]
Anthracene[3]	EPA 8270E	µg/kg dw	0.29[1]	5.0[2]
Benzo(a)anthracene[4]	EPA 8270E	µg/kg dw	0.23[1]	5.0[2]
Benzo(a)pyrene[4]	EPA 8270E	µg/kg dw	0.38[1]	5.0[2]

Table 3-5
ALS-Kelso Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
Total benzofluoranthenes (benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene) [4]	EPA 8270E	µg/kg dw	0.76[1]	10.0[2]
Benzo(g,h,i)perylene[4]	EPA 8270E	µg/kg dw	0.4[1]	5.0[2]
Chrysene[4]	EPA 8270E	µg/kg dw	0.31[1]	5.0[2]
Dibenzo(a,h)anthracene[4]	EPA 8270E	µg/kg dw	0.23[1]	5.0[2]
Fluoranthene[4]	EPA 8270E	µg/kg dw	0.63[1]	5.0[2]
Fluorene[3]	EPA 8270E	µg/kg dw	0.57[1]	5.0[2]
Indeno(1,2,3-cd)pyrene[4]	EPA 8270E	µg/kg dw	0.36[1]	5.0[2]
2-methylnaphthalene[3]	EPA 8270E	µg/kg dw	0.37[1]	5.0[2]
Naphthalene[3]	EPA 8270E	µg/kg dw	0.47[1]	5.0[2]
Phenanthrene[3]	EPA 8270E	µg/kg dw	0.59[1]	5.0[2]
Pyrene[4]	EPA 8270E	µg/kg dw	0.32[1]	5.0[2]
Metals (based on 1-g ww unless otherwise noted)				
Arsenic	EPA 6020B	mg/kg dw	0.06[5]	0.5[2]
Lead	EPA 6020B	mg/kg dw	0.02[5]	0.05[2]

Table 3-5
ALS-Kelso Methods and RL goals for PCB Aroclors, PAHs, metals, other SVOCs, and conventionals in sediment

Analyte	Method	Unit	MDL	RL
Zinc	EPA 6020B	mg/kg dw	0.2[5]	0.5[2]
Mercury (based on 0.2-g ww sample)	EPA 7471B	mg/kg dw	0.002[5]	0.02[2]
SVOCs (based on 10-g dw sample)				
Butyl benzyl phthalate	EPA 8270E	µg/kg dw	3.7[1]	10.0[2]
Conventionals				
Percent solids	SM 2540 G-97	% dw	na	0.040
TOC (based on 1-g dw sample)	EPA 9060A	% dw	0.01	0.02

Notes:
1. SW 846 no longer requires MDL values. The laboratories have the option to use these values to assess sensitivity for EPA 8000 series methods. The lab has continued to maintain MDL studies for these analytes following EPA MDL Revision 2 (EPA 2016) procedures.
2. RL values are consistent with the LLOQ values required under EPA SW-846.
3. Compound is a component of the LPAH sum.
4. Compound is a component of the HPAH sum.
5. SW 846 no longer requires MDL values.
dw: dry weight
EPA: US Environmental Protection Agency
HPAH: high-molecular-weight polycyclic aromatic hydrocarbon
LLOQ: lower limit of quantitation
MDL: method detection limit
LPAH: low-molecular-weight polycyclic aromatic hydrocarbon
na: not available
PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl
RL: reporting limit
SIM: selective ion monitoring
SM: Standard Method
SVOC: semivolatile organic compounds
TOC: total organic carbon

Table 3-6
ALS-Kelso Methods and RL goals for dioxin/furan congeners in sediment

Analyte	EPA Method 1613B			
	Sediment (ng/kg dw) Based on 10-g sample		TEQ (ng/kg)	
	EDL[1]	LOQ[2]	TEF	TEQ[3]
2,3,7,8-TCDD	0.1	1.0	1	0.5
1,2,3,7,8-PeCDD	0.1	1.0	1	0.5
1,2,3,4,7,8-HxCDD	0.1	1.0	0.1	0.05
1,2,3,6,7,8-HxCDD	0.1	1.0	0.1	0.05
1,2,3,7,8,9-HxCDD	0.1	1.0	0.1	0.05
1,2,3,4,6,7,8-HpCDD	0.1	2.5	0.01	0.0125
OCDD	01	10.0	0.0003	0.0015
2,3,7,8-TCDF	0.1	1.0	0.1	0.05
1,2,3,7,8-PeCDF	01	1.0	0.03	0.015
2,3,4,7,8-PeCDF	0.1	1.0	0.3	0.15
1,2,3,4,7,8-HxCDF	0.1	1.0	0.1	0.05
1,2,3,6,7,8-HxCDF	0.1	1.0	0.1	0.05
1,2,3,7,8,9-HxCDF	0.1	1.0	0.1	0.05
2,3,4,6,7,8-HxCDF	0.1	1.0	0.1	0.05
1,2,3,4,6,7,8-HpCDF	0.1	1.0	0.01	0.005
1,2,3,4,7,8,9-HpCDF	0.1	1.0	0.01	0.005
OCDF	0.1	5.0	0.0003	0.00075

Notes:

1. EDL is a sample-specific DL. The value provided here is an estimate, and the sample-specific values will vary based on sample mass and the analytical conditions at the time of analysis.
2. LOQ is lab's lowest concentration, at or above the LMCL, at which test accuracy (precision and bias) has been demonstrated. Values below the LOQ are J-qualified. The reported LOQ will be adjusted based on the sample mass of each sample
3. TEQ calculated using ½ RL value multiplied by the 2005 WHO TEF.

DL: detection limit

dw: dry weight
EDL: estimated detection limit
EPA: US Environmental Protection Agency
HpCDD: heptachlorodibenzo-p-dioxin
HpCDF: heptachlorodibenzofuran
HxCDD: hexachlorodibenzo-p-dioxin
HxCDF: hexachlorodibenzofuran
LMCL: lower method calibration limit
LOQ: limit of quantitation
OCDD: octachlorodibenzo-*p*-dioxin
OCDF: octachlorodibenzofuran
PeCDD: pentachlorodibenzo-*p*-dioxin
PeCDF: pentachlorodibenzofuran
RL: reporting limit
TCDD: tetrachlorodibenzo-*p*-dioxin
TCDF: tetrachlorodibenzofuran
TEF: toxic equivalency factor
TEQ: toxic equivalent
WHO: World Health Organization

Table 3-7
Analytical Methods and Sample Handling Requirements for Sediment Samples

Parameter[1]	Method	Reference[2]	Extraction Solvent	Cleanup	Laboratory[3]	Container	Preservative	Sample Holding Time
TOC	High-temperature combustion	EPA 9060A	na	na	Eurofins ARL ALS-Kelso	4-oz amber glass jar	Cool to ≤ 6°C; freeze to ≤ -18°C	28 days 6 months if frozen
Metals	ICP/MS	EPA 3050B EPA 6020B	na	na	Eurofins ARL ALS-Kelso	4-oz glass jar	Cool to ≤ 6°C; freeze to ≤ -18°C	6 months 2 years if frozen
Mercury	Cold vapor-atomic fluorescence spectroscopy	EPA 7471B	na	na	Eurofins ARL ALS-Kelso			28 days 1 year if frozen
PAHs/SVOCs	GC/MS	EPA 3546/ EPA 8270E-SIM (ARL and ALS 8270E)	Lab specific	Lab specific	Eurofins ARL ALS-Kelso	4-oz glass jar	Cool to 0–6°C; freeze to ≤ -18°C	1 year to extraction if frozen; 14 days to extraction if refrigerated; when thawed, analysis within 40 days after extraction; store extracts at ≤ 6°C and in the dark
PCB Aroclors	GC/ECD	EPA 3546 Mod EPA 8082A	Lab specific	Lab specific	Eurofins ARL ALS-Kelso	4-oz glass jar	Cool to 0–6°C; freeze to ≤ -18°C	1 year to extraction if refrigerated or frozen; analysis within 40 days after extraction; store extracts at ≤ 6°C and in the dark
Dioxins/ furans	HRGC/HRMS	EPA 1613B	Lab specific	Lab specific	Eurofins ARL ALS-Kelso	8-oz amber glass jar	Cool to ≤ 4°C; freeze to ≤ -18°C	1 year until extraction and analysis within 1 year after extraction if stored in the dark at ≤ -18°C

Notes:
1. Individual analytes are listed in Tables 1-1 and 1-2. All results will be reported by the analytical laboratory in dry weight.
2. Laboratory SOPs are confidential and will be available upon EPA request once the analytical laboratory has been identified.
3. ARL and ALS are alternate laboratories for all analyses.
Underline = primary lab

EPA: U.S. Environmental Protection Agency
GC/ECD: gas chromatography/electron capture detection
GC/MS: gas chromatography/mass spectrometry
HRGC/HRMS: high-resolution gas chromatography/high-resolution mass spectrometry
ICP/MS: inductively coupled plasma/mass spectrometry
NA: not applicable or not available
oz: ounce
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
SM: Standard Method
SOP: standard operating procedure
SVOC: semivolatile organic compound
TOC: total organic carbon

Table 3-8
DQIs for Laboratory Analyses

Parameter[1]	Unit	Laboratory	Precision[2]	Accuracy[2]		Completeness
				LCS	Spiked Samples	
TOC	%	Eurofins ARL ALS-Kelso	± 20%	80–120%	80-120% (Eurofins) 75-125%	90%
Metals	mg/kg dw	Eurofins ARL ALS-Kelso	± 20%	80–120%	80-120% (Eurofins) 75-125%	90%
Mercury	mg/kg dw	Eurofins ARL ALS-Kelso	± 20%	80–120%	80-120% (Eurofins) 75-125%	90%
PAHs	µg/kg dw	Eurofins	± 30%	37-126%	37-150%	90%
PAHs	µg/kg dw	ARL ALS-Kelso	± 35%	30–160%	30–160%	90%
PCB Aroclors	µg/kg dw	Eurofins	± 30%	42-150%	42-150%	90%
PCB Aroclors	µg/kg dw	ARL	± 35%	56-120%	56–120%	90%
PCB Aroclors	µg/kg dw	ALS-Kelso	± 35%	56-130%	44-156%	90%
SVOCs	µg/kg dw	Eurofins	± 30%	37-123%	37-123%	90%
SVOCs	µg/kg dw	ARL ALS-Kelso	± 35%	10–160%	10–160%	90%
Dioxins/furans	ng/kg dw	Eurofins ARL ALS-Kelso	± 50% (Eurofins) ±25%	63–170%	63-170%[3]	90%

Notes:
1. Individual analytes are listed in Table B4-5.
2. Values listed are example method limits; values will be updated by selected laboratory. The percentages provided represent the recovery range for each parameter.
3. Labelled compound percent recovery range.
Underline = primary lab
µg/kg: microgram per kilogram
ARL: Analytical Resources, LLC
DQI: data quality indicator
dw: dry weight
LCS: laboratory control sample
mg/kg: milligram per kilogram
na: not applicable
ng/kg: nanogram per kilogram
PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl
SVOC: semivolatile organic compound
TOC: total organic carbon

Table 3-9
Laboratory QC Sample Analysis Summary

Analysis Type	Laboratory	Method	Initial Calibration	Initial Calibration Verification (2nd source) and Calibration Blank	Continuing Calibration Verification and Calibration Blank	LCS	Laboratory Replicates	MS	MSD	Method Blanks	Internal Standards/ Surrogate Spikes
TOC	Eurofins ARL ALS-Kelso	EPA 9060A	Prior to analysis	After initial calibration	Every 10 samples	1 per 20 samples or per batch	1 per 20 samples or per batch	1 per 20 samples or per batch	na	1 per 20 samples or per batch	na
Metals	Eurofins	EPA 6020B	Daily, prior to analysis	After initial calibration; interference check standard and spectral interference check at beginning of analytical run; spectral interference check every 12 hours	Every 10 samples and at end of analytical sequence	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	Each sample (internal standard only)
Mercury	Eurofins	EPA 7471B	Prior to analysis	After initial calibration	Every 10 samples and at end of analytical sequence	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	na

Analysis Type	Laboratory	Method	Initial Calibration	Initial Calibration Verification (2nd source) and Calibration Blank	Continuing Calibration Verification and Calibration Blank	LCS	Laboratory Replicates	MS	MSD	Method Blanks	Internal Standards/ Surrogate Spikes
Metals	ARL ALS-Kelso	EPA 6020B UCT-KED	Daily, prior to analysis	After initial calibration; interference check standard and spectral interference check at beginning of analytical run; spectral interference check every 12 hours	Every 10 samples and at end of analytical sequence	1 per prep batch	1 per batch or SDG	1 per batch or SDG	na	1 per prep batch	Each sample (internal standard only)
Mercury	ARL ALS-Kelso	EPA 7471B	Prior to analysis	After initial calibration	Every 10 samples and at end of analytical sequence	1 per prep batch	1 per batch or SDG	1 per batch or SDG	na	1 per prep batch	na
SVOCs/ PAHs	Eurofins ARL ALS-Kelso	EPA 8270E-SIM	Prior to analysis	After initial calibration	Before and after sample analysis, and every 12 hours	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	Each sample
PCB Aroclors	Eurofins ARL ALS-Kelso	EPA 8082A	Prior to analysis	After initial calibration	Before and after sample analysis, every 10-20 analyses or 12 hours	1 per prep batch	na	1 per batch or SDG	1 per batch or SDG	1 per prep batch	Each sample
Dioxins/ furans	Eurofins ARL ALS-Kelso	EPA 1613b	Prior to analysis	After initial calibration	Before and after sample analysis and every 12 hours	1 LCS/LCSD per prep batch	na	na	na	1 per prep batch	Each sample

Notes:
A batch is a group of samples of the same matrix analyzed or prepared at the same time, not exceeding 20 samples.
Underline = primary lab

ARL: Analytical resources, LLC
EPA: U.S. Environmental Protection Agency
LCS: laboratory control sample
LCSD: laboratory control sample duplicate
MS: matrix spike
MSD: matrix spike duplicate
NA: not applicable or not available
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
QC: quality control
SDG: sample delivery group
SM: Standard Method
SVOC: semivolatile organic compound
TOC: total organic carbon

Construction Phase, Revision 1

Appendix C
Air, Noise, and Light Monitoring Plan

Lower Duwamish Waterway Group

City of Seattle / King County / The Boeing Company

CONSTRUCTION PHASE CQAP FOR THE LOWER DUWAMISH WATERWAY UPPER REACH

APPENDIX C – AIR, NOISE, AND LIGHT MONITORING PLAN

For submittal to

The US Environmental Protection Agency
Region 10
Seattle, WA

October 22, 2024

Prepared by:

Geosyntec consultants
520 Pike Street • Suite 2600
Seattle, Washington • 98101

and

Windward environmental LLC
200 1st Ave W • Suite 500
Seattle, Washington • 98119

in association
with

ANCHOR QEA
1201 3rd Ave • Suite 2600
Seattle, Washington • 98101

TABLE OF CONTENTS

TABLES

ATTACHMENTS

ABBREVIATIONS

$\mu g/m^3$	micrograms per cubic meter
ANL	air, noise, and light
ANLMP	Air, Noise, and Light Monitoring Plan
BMP	best management practice
COC	chain-of-custody
COCP	Community Outreach and Communications Plan
CQAP	Construction Quality Assurance Plan
dB(A)	A-weighted decibel
EC	elemental carbon
EPA	U.S. Environmental Protection Agency
EQAO	Environmental Quality Assurance Officer
H2S	hydrogen sulfide
IQAT	Independent Quality Assurance Team
LDW	Lower Duwamish Waterway
NIOSH	National Institute for Occupational Safety and Health
$PM_{2.5}$	Particulate matter with a diameter of 2.5 micrometers or less
PPM	parts per million
QA	quality assurance
QC	quality control
RAWP	Remedial Action Work Plan
RD	remedial design
SMA	Sediment Management Area
SMC	Seattle Municipal Code
SOP	Standard Operating Procedure
T117	Terminal 117
TMC	Tukwila Municipal Code
TWA	time-weighted average
WAC	Washington Administrative Code

1 Introduction

This Air, Noise, and Light Monitoring Plan (ANLMP) is an appendix to the Construction Quality Assurance Plan (CQAP) for the upper reach of the Lower Duwamish Waterway (LDW).

Nearly all remedial actions in the upper reach will be accomplished using water-based equipment (which is regularly employed throughout the LDW for other industrial activities) in the vicinity of upland properties that have mixed industrial, commercial, and residential uses. Therefore, residents in adjacent neighborhoods, live-aboard residents in marinas, marine users on the LDW, residents and businesses using roads shared with project truck traffic, and workers could potentially be affected by remedial action construction activities. The Remedial Action Contractor (Contractor) will be required to comply with all local, state, and federal regulations relevant to controlling construction impacts on air, noise, and light (ANL) criteria.

This ANLMP provides the means and methods to conduct field monitoring to assess potential impacts on the adjacent community during construction activities if there are community complaints with respect to ANL impacts. This ANLMP will be implemented by the Project Owner for quality assurance (QA) purposes. The Project Owner's Independent Quality Assurance Team (IQAT) will implement QA monitoring under this plan.

Review of a similar recent cleanup project located within the upper reach indicates that the potential for ANL impacts on the community during construction is low. The Port of Seattle's Terminal 117 (T117) Early Action Area remediation project was located within the upper reach and was a combined upland excavation and in-water remedial dredging project that was an early action for the LDW Comprehensive Environmental Response, Compensation, and Liability Act cleanup. The T117 project location was adjacent to residential properties and the South Park Marina, whereas the upper reach remedial actions will be located almost entirely on the waterway; only one shoreline excavation area will be located on the eastern shoreline at Container Properties (an industrial site). The upland excavation activities were located close to residential areas and used multiple pieces of diesel excavation equipment and trucks to transport excavated materials. The Port of Seattle conducted daily monitoring for ANL (including multiple air quality parameters) during upland excavation and only noise and light monitoring after upland excavation had been completed. Construction took place over 247 days during 2 construction seasons, and there were only 2 individual ANL criteria exceedances (for 1 of 5 air quality parameters [diesel particulate matter]) during upland excavation over that period.[1] There were no ANL criteria exceedances during dredging operations, nor were

[1] Diesel particulate matter was exceeded on 2 out of 166 days of daily upland excavation monitoring when construction vehicles were idling immediately adjacent to the monitoring instrument.

there any exceedances for noise or light standards. ANL monitoring results are documented in Appendix 19 of the T117 Phase 1 Removal Action Construction Report (AECOM 2016).

This ANLMP describes baseline monitoring for air and noise at the outset of construction activities to verify that the Contractor's general operations are compliant with applicable regulations for air and noise criteria. Baseline monitoring for light will not be conducted, since there are no measurable criteria for light; rather, light "monitoring" will be qualitative and complaint based. Following verification, any further air and noise monitoring for this project will be conducted on an as-needed basis; monitoring will be triggered by community feedback submitted via the project website or project hotline, as described in the Community Outreach and Communications Plan (COCP, Volume II, Part VIII). The COCP recognizes the potential for project impacts on the community and identifies a communication plan to document questions/complaints and provide responses. The Contractor's work is anticipated to occur during standard working hours (7:00 a.m. to 7:00 p.m.); the Contractor may propose to conduct some of its work outside of standard working hours, which have different criteria for noise. This ANLMP also describes optional monitoring equipment, general guidance for monitoring distances/locations, and monitoring frequency when a monitoring event is triggered.

1.1 Purpose

As with any construction project, construction equipment, trucks, tugboats, and other workboats may generate dust, odor, noise, and light that could impact normal quality of life near the work areas.

This plan addresses potential project-related quality of life impacts associated with air quality, noise, and light that may affect the community. This plan provides methods and procedures for monitoring air quality (including odors), noise, and light during the cleanup construction period. Baseline monitoring of air quality and noise is discussed. The specific goals of this plan are:

- Identify performance standards for air quality, noise, and light that apply to construction activities during standard working hours and outside of standard working hours.
- Outline monitoring protocols (methods, location, and frequency) that will be used to evaluate compliance with performance standards.
- Identify performance specifications for monitoring equipment to be used to perform field measurements.
- Document and report monitoring results.

1.2 Project Organization and Communications

This section provides a description of the key roles and communications for the implementation of this plan. Additional details of these key roles are provided in Section 2 of Construction Quality Assurance Plan (CQAP) to which this is an appendix.

- **Project Representative**: The Project Representative (Shannon Phipps, King County), whose role is described in the CQAP, will oversee the entire construction QA program. The Project Representative will be the only person(s) authorized to direct the Contractor and will be kept updated by the ANL Monitoring Lead on monitoring results. The Project Representative will work with the Environmental Quality Assurance Officer (EQAO), and EPA to determine when to conduct ANL monitoring during construction, and whether mitigation actions are needed to respond to community complaints.

- **Construction Manager:** The construction manager (CM) (Jeff Williams, Geosyntec) will be the on-site day-to-day oversight QA representative and have delegated authorize from the Project Representative to oversee all monitoring results. He will review ANL monitoring results prepared by the EQAO(s), report results to Project Representative and recommend corrective actions.

- **Environmental Quality Assurance Officer** (EQAO): The project has two EQAOs for sampling (Susan McGroddy, Windward, EQAO-1) and monitoring (Michaela Lawrence, Geosyntec, EQAO-2), whose roles are described in the CQAP. ANL monitoring is the responsibility of EQAO-2, and will be responsible for coordinating, reviewing, and reporting all ANL environmental monitoring activities. The EQAO-2 will report to the Construction Manager and Certified Industrial Hygienist (see next bullet), and together will provide recommendations regarding the need for corrective actions in the event of monitoring exceedances and nonconformance with contract documents and the Contractor's approved Remedial Action Work Plan (RAWP).

- **ANL Monitoring Lead**: The air, noise, and light (ANL) Monitoring Lead (Elisabeth Black, Certified Industrial Hygienist, EMB Consulting, LLC) will be responsible for oversight and implementation of the ANLMP. The ANL Lead will conduct initial data review of results and provide recommendations. The ANL Monitoring Lead will report to the EQAO-2 and Construction Manager.

- **COCP Lead**: The community outreach and communication plan (COCP) lead (Stepherson & Associates) will be responsible for implementing the COCP. The COCP Lead will coordinate directly with the Project Representative and Construction Manager to communicate community input and complaints to the Project Coordinator, EPA, and IQAT.

The ANL Monitoring Lead will document and report monitoring results on a weekly basis (during weeks when monitoring is conducted), unless there is an exceedance of any performance standard. In that case, the ANL Monitoring Lead will report exceedances to the Project Representative immediately and to EPA within 2 hours of the exceedance (during standard working hours or the next day if exceedance occurs outside of standard working hours). These results will be included in the Owner's Weekly Field Activity Reports to EPA (see CQAP for descriptions of Daily and Weekly Field Activity Reports).

The Project Representative will be responsible for communicating with and directing the Contractor and coordinating with the EQAO, Construction Manager and ANL Monitoring Lead to observe the implementation of mitigation actions.

2 Potential Impacts, Performance Standards, and Monitoring Scope

This section describes potential air quality, noise, and light impacts on the surrounding community that may originate from the project and potential prevention measures. It also defines the performance standards and proposed monitoring program for ANL. Qualitative monitoring relies on the observations of workers and the community to identify issues with air quality, noise, and light. This type of monitoring depends on human senses, such as visual, olfactory, and auditory signals; therefore, such monitoring is subjective. Quantitative monitoring using equipment and laboratory analysis is based on applicable regulations; such monitoring is objective and can be used to clearly demonstrate how the project does not impact the community or determine if adjustments to site activities are needed

When concerns are identified by the community, they will be reportable through any of the incoming communication mechanisms described in the COCP; this may trigger the quantitative monitoring defined in this section. Quantitative monitoring of ANL disturbances associated with this project will be implemented during baseline monitoring; after that, quantitative ANL monitoring will only occur in response to community feedback submitted in accordance with the COCP and as directed by the Project Representative, Construction Manager, and/or EQAO.

2.1 Air Quality

2.1.1 Potential Impacts and Prevention Measures

Because upper reach remedial actions will take place on the LDW, potential impacts are most likely to affect properties and people on or immediately adjacent to the LDW. While many of the properties around the upper reach are industrial/commercial, there are also private residences in parts of the upper reach, as well as live-aboard residents at marinas.

As discussed in Section 1, the T117 Early Action Area project conducted daily monitoring during upland excavation[2] and had minimal exceedances over two construction seasons. Although the potential for air quality impacts is considered low, the upper reach RD recognizes community concerns for potential air quality impacts and specifies air quality performance requirements to be met by the Contractor. These air quality performance requirements follow air emission standards defined in EPA's Tier System (EPA 2022) for fossil fuel consumption; the standards are intended to help reduce engine emissions from construction equipment. These specifications requirements help projects achieve EPA's goals for green remediation and reduce the risk of air quality impacts. The

[2] Upland excavation is considered to be a significantly higher risk for air quality impacts than is dredging that takes place on the waterway.

upper reach RD considers potential air quality impacts on the adjacent community to include fugitive and visible dust, diesel exhaust, and fugitive odors, as follows:

- Fugitive dust may be released when dry soil is disturbed during excavation (potential limited to one location at Sediment Management Area [SMA] 5), or when stockpiling or transporting dredged materials on uncovered trains or trucks[3]. Fugitive dust concerns include impacts on property and inhalation of dust and contaminants adhered to dust.
- Diesel exhaust will be generated by dredging equipment, tugboats and other small workboats; upland construction equipment (in limited areas requiring upland excavation); local haul trucks (if used); upland transload facility equipment; and trains transporting dredged materials to an off-site landfill.
- Fugitive odors from construction present a potential quality of life nuisance issue. Dredging and excavation of wet sediment can potentially result in unusual odors, which can be a nuisance. Odors may be generated by dredged sediments that contain decaying organic matter (hydrogen sulfide [H2S]), during shoreline bank soils excavation, and from diesel emissions.

Diesel exhaust (diesel particulate matter) is considered an air quality criterion for this project, due to the on-site operation of construction equipment using diesel engines for the duration of the project. In the open-air, dilute environment of the Work Site, which is primarily located over water within the LDW, the potential for any significant exposure of the community to diesel exhaust is low. Air quality performance requirements to be met by the Contractor during construction are defined in the RD specifications (Specifications Sections 01 35 44 [Green Remediation] and 01 35 43 [Environmental Procedures]), which follow air emission standards defined in EPA's Tier System (EPA 2022) for fossil fuel consumption. Meeting these requirements will help reduce engine emissions from construction equipment.[4]

The Contractor will be required to control dust particles from project activities at all times (including when work is not in progress), per Specifications Section 01 35 43 (Environmental Procedures). Federal and state air quality requirements include those for dust control. To meet dust control requirements and reduce potential odor complaints, the Contractor will implement dust control best management practices (BMPs).

[3] Specifications require all trucks and railcars to be covered while transporting dredged material.
[4] EPA emissions standards for each tier are specific to the type of equipment (e.g., on-road vehicles, non-road equipment/engines), year of manufacture, and engine power. See 100% Basis of Design Report, Appendix N (Anchor QEA and Windward 2023), for more detailed information on EPA's Tier System.

The following BMPs are listed in Specifications Section 01 35 43 as either required BMPs or example BMPs for the Contractor to consider implementing to comply with dust, diesel exhaust, and odor standards:

- Required BMPs per the specifications:
  - Wetting excavation areas and sediment stockpiles (if necessary) for dust control[5]
  - Covering truck and railcar loads to prevent the escape of dust-bearing materials
  - Covering stockpiles with plastic sheeting when loading and stockpiling activities are not occurring (i.e., inactive for a specified period of time) or if nuisance odors are encountered prior to transportation off site
  - Cleaning vehicles leaving the single upland work areas (SMA 5) to remove dirt or dust from wheel treads and exterior
- Sweeping any paved, on-site transload facility staging and stockpiling areas daily during dry weather
  - Not allowing vehicles on land to idle for extended periods of time; Specifications Sections 01 35 44 (Green Remediation) and 01 35 43 (Environmental Procedures) identify a maximum idling time for trucks and off-road vehicles.
- Example BMPs for the Contractor to consider include:
  - Using Work Site controls, such as ceasing above-water excavation during high winds or limiting the number and size of excavations open at the same time
  - Transporting sediment emitting odors off site as soon as possible

The Contractor's RAWP identifies air quality prevention, mitigation, and control measures to be implemented during construction activities for federal and state criteria compliance. Air quality is addressed in the Air Pollution and Odors Control Plan as part of the Contractor's Environmental Mitigation Binder, which will be reviewed and approved by the Owner and EPA prior to construction.

2.1.2 Performance Standards

The Contractor will be required, per the specifications, to comply with federal, state, and local air quality standards (Clean Air Act [42 U.S. Code 7401-7671q; 40 Code of Federal Regulations 50], National Ambient Air Quality Standards, the Washington Clean Air Act [Revised Code of Washington 70.94; Washington Administrative Code (WAC) 173-400], and Puget Sound Clean Air Agency [Sections 9 and 15] regulations). The Contractor will be required during construction activities to protect the surrounding community from diminished air quality. Performance standards will apply at the project perimeter. Because the upper reach remedial actions will take place over approximately 2 river miles, and adjacent to multiple properties, the project perimeter is defined as the shoreline

[5] The work will be conducted during the wet weather time of year, and this control method is not anticipated to be necessary.

boundary when the Contractor is working over water and upland property boundaries when the Contractor is working on land.

Specific requirements pertaining to fugitive dust, diesel exhaust, and odor (H2S) are as follows:

- Fugitive dust
  - Qualitative criterion of "no visible dust" at the property perimeter to conform to Puget Sound Clean Air Agency Regulation I, Section 9.15
- Diesel exhaust
  - In 2002, the American Conference of Governmental Industrial Hygienists recommended a threshold limit value for diesel particulate matter: elemental carbon (EC) of 20 micrograms per cubic meter (µg/m^3) as an 8-hour time-weighted average (TWA). This threshold limit value represents the only available health-based criterion for diesel exhaust in air in an industrial setting; however, it is not an enforced or regulated criterion and has not been adopted by Washington State. This threshold limit value is based on a measurement of EC using an established National Institute for Occupational Safety and Health (NIOSH) 5040 method that includes field collection and laboratory analysis, as discussed in Section 3. However, in the absence of a regulated criterion for diesel particulate matter, the proposed performance standard for this project is a TWA of 20 µg/m^3 at the project perimeter, defined for the upper reach as the shoreline boundary when working over water and as property boundaries when working on land.
- Odor (H2S):
  - Odor is typically a nuisance issue but not a health issue. The potential source of odor for this project is H2S from anerobic sediments. H2S odors can be detected at very low levels by the human nose.
  - The Agency for Toxic Substances and Disease Registry cites studies that demonstrate odor detection for H2S between 0.0005 and 0.3 parts per million (ppm; ATSDR 2006). WAC 173-460-150 sets the performance standard for H2S as a daily 24-hour TWA of 2 µg/m^3 at the project perimeter (adjusted to 8-hr construction window for this project). Odor complaints will be an indicator that H2S concentrations may have reached a level that warrants monitoring during construction.

2.1.3 Baseline Monitoring

The purpose of conducting baseline air quality monitoring for diesel particulate matter and H2S will be to demonstrate early during the construction process that the dredging activities are not causing a diesel particulate matter or H2S criteria exceedance. This will be accomplished by monitoring the ambient and baseline air quality conditions: ambient conditions before the start of construction and

baseline conditions at the start of over-water dredging activities. Both instances of monitoring will occur during standard working hours, and both instances will last for approximately three days.

Ambient (pre-construction) and baseline (start of dredging) monitoring locations will be selected based on the Contractor's sequencing plan in its approved RAWP. The baseline monitoring location will be located downwind from planned dredging activity, approximately 100 feet away; this distance represents a conservative measurement, since most dredging activities will be more than 100 feet from the shoreline in the vicinity of receiving properties along the shoreline.

Air quality monitoring will be conducted on a vessel that can be positioned downwind of construction activities, or along the shoreline. During baseline monitoring, monitoring staff will also document activities in the area that could impact monitoring results, such as other construction occurring in the vicinity.

2.1.4 Monitoring During Construction

It is anticipated that the baseline monitoring will record no exceedances of diesel particulate matter or H2S concentration criteria. Due to the Work Site being located on the water within the LDW and the broad presence of other, similar sources of diesel particulate matter, daily air quality monitoring is not proposed. The specifications include requirements for the Contractor to comply with all applicable air quality regulations and meet air quality performance requirements (i.e., equipment use must meet a stricter standard than is typical for dredging projects: a minimum percent use of specific Engine Tier [II to IV], depending on construction equipment type).

Dust monitoring will be based on ongoing visual observations required of the Contractor for areas where dust generation may occur (e.g., upland excavation at SMA 5, stockpile management at the Transload Facility). The specifications require the Contractor to control dust; if the construction IQAT (i.e., Construction Management inspectors, environmental monitoring staff) observes fugitive dust, the Contractor will be notified by the Project Representative and directed to take corrective action to control the dust.

H2S concentrations will be monitored if there are multiple odor complaints, and if the Project Representative determines that the complaints are resulting from upper reach remedial actions, rather than from other activities that are not related to the upper reach cleanup. In the event of such monitoring, it will occur at the project perimeter in the general vicinity of the complaint(s). The human sense of smell will allow for recognition of the odor; recognition will be followed by quantitative measurements with field instruments and a comparison of the concentrations with

performance standards. If monitoring indicates that H2S levels may exceed state criteria[6], mitigation measures will be implemented by the Contractor until H2S levels comply with performance standards (Section 2.1.2).

Similarly, diesel particulate matter samples may be collected if there are multiple complaints, and if the Project Representative determines that the complaints are resulting from upper reach remedial actions, rather than from other activities unrelated to the upper reach cleanup. In the event of such monitoring, it will occur at the project perimeter in the general vicinity of the complaint(s). However, since the diesel particulate matter threshold limit value is an eight-hour TWA, and since the sampling methods prescribed in this monitoring plan do not provide real-time results (i.e., samples collected are sent to a laboratory for analysis), the primary purpose of diesel particulate matter monitoring will be to document the conditions at the time of the complaint.

Background/upwind and performance/downwind air quality monitoring will be conducted at two stations in any instance of a triggered monitoring event. The background station will be located at least 100 feet upwind of construction activities; monitoring will occur during construction activities, and H2S and/or diesel particulate matter levels will be evaluated for compliance with project performance standards. The downwind monitoring station (to assess the air quality impacts from dredging) will be located at the project perimeter (previously defined) for that dredging location.

Data from the National Oceanic and Atmospheric Administration Boeing Field weather station (NOAA 2023) will be reviewed to determine wind direction for any monitoring event (i.e., which station is downwind, and which is upwind). Monitoring station locations may be adjusted based on changing weather conditions or movement of construction activities. The ANL Monitoring Lead or designee will be on-site to determine monitoring locations.

2.2 Noise

2.2.1 Potential Impacts and Prevention Measures

Construction activities use heavy equipment to dredge sediment, place clean materials, excavate bank sediment, and remove/install piles and temporary shoring; in addition, tugboats are used to move materials and barges around the site. Noise will be generated by both in-water and upland sources (dredging and excavation of one bank area [SMA 5]) in an industrial waterway; however, the locations receiving noise will include limited residential (including upland and marina live-aboard residents), commercial, and industrial locations. These construction activities may generate noise at levels greater than the ambient levels typically experienced in the project setting. The site is in an

[6] The H2S criteria are a daily TWA value, so individual readings may need to be converted to a TWA value based on the duration of the Contractor's work in the area each day (WAC 296-841).

area with other significant background noise sources, such as airplane traffic from King County International Airport and Sea-Tac International Airport, adjacent industrial property operations, commercial and recreation vessel traffic, and roadway noise. Noise monitoring conducted during construction of the T117 Early Action Area project (located within the upper reach)—an upland remedial action area that used both upland and in-water heavy equipment, and that would have been expected to generate more noise than the forthcoming upper reach remedial actions—did not detect any noise standards exceedances. Therefore, it is expected that construction activities on the upper reach will be in compliance with noise standards.

For noise standards, the Seattle Municipal Code (SMC) defines daytime hours as between 7:00 a.m. and 10:00 p.m. on weekdays and 9:00 a.m. and 10:00 p.m. on weekends and legal holidays; Tukwila Municipal Code (TMC) has similar hours for its noise standards. The SMC, TMC, and King County Title 12 noise ordinances require lower sounds levels for any work conducted outside of these hours. In general, remedial construction work is anticipated to take place between the hours of 7:00 a.m. and 7:00 p.m. On occasion, the Contractor may propose to work outside of daytime hours (as defined by the noise ordinances). The specifications require the Contractor to obtain approval from the Project Representative and EPA to conduct work outside of standard working hours.

The project specifications define noise performance requirements to be met during construction based on the most stringent noise ordinance. The Contractor will be required to develop a Noise Control Plan—including a description of the BMPs to be implemented as part of that plan, per Specifications Section 01 35 43 (Environmental Procedures)—as part of the Environmental Mitigation Binder. The following BMPs to prevent and mitigate noise impacts on the community are listed among the Specifications for Contractor to consider including in the Noise Control Plan:

- Use electric or hydraulic tools and equipment.
- Adjust noisy operations to occur within the hours of Work.
- Install individual noise barriers or enclosures around equipment.
- Use the best available equipment and technology that assist in meeting noise requirements.
- Provide equipment with properly sized and maintained mufflers and silencers, as appropriate.
- Use broadband alarms on equipment with backup alarms.
- Turn off vehicle engines (trucks and off-road vehicles) when inactive in accordance with Specifications Section 01 35 43 (Environmental Procedures).
- Reduce vehicle speeds when transiting near residential areas (if applicable).
- Perform Work using construction equipment that generates noise in phases.
- Potentially limit work hours or work only during standard work hours in locations near residential or live-aboard residents.

2.2.2 Performance Standards

The specifications will require the contractor to comply with noise criteria for the cities of Seattle and Tukwila and unincorporated King County when working close to residential areas (upland areas and live-aboard residential marinas) adjacent to the project site perimeter to limit the extent of potential noise impacts on the community.

All local ordinances (SMC Chapter 25.08 [Subchapters 410, 420, and 425], TMC Chapter 8.22, and King County Title 12.86) establish equally stringent maximum permissible sound levels from industrial sources to a receiving property (residential at daytime or nighttime, commercial, or industrial), as listed in Table C2-1. For construction activity within industrial zones, exterior sound level limits—measured at the project perimeter or at a distance of 50 feet from the construction equipment generating the sound, whichever is further—may be exceeded by no more than 25 A-weighted decibels (dB[A]).

Table C2-1
Maximum Permissible Sound Levels from All Local Ordinances

District of Sound Producing Source	Maximum Permissible Sound Level in District of Receiving Property[1]			
	Residential, Daytime	Residential, Nighttime	Commercial	Industrial
Industrial	60 dB(A)[2]	50 dB(A)	65 dB(A)[2]	70 dB(A)[2]
Construction Equipment at Project Perimeter or 50-foot Distance from Equipment (whichever is further), Daytime Only[2]	Additional noise allowance of 25 dB(A)	N/A	Additional noise allowance of 25 dB(A)	Additional noise allowance of 25 dB(A)

Notes:
Maximum permissible sound levels applicable to sound sources within the limits of the Cities of Seattle and Tukwila and unincorporated King County.
1. The maximum permissible noise level is applied to a minimum measurement interval of 1 minute for a constant sound source or a 1-hour measurement for a non-continuous sound source.
2. Daytime is defined as the most stringent daytime period among all local ordinances: between 7:00 a.m. and 10:00 p.m. on weekdays and between 9:00 a.m. and 10:00 p.m. on weekends and legal holidays. This definition is also applicable to construction equipment used on public projects per SMC 25.08.425.
dB(A): A-weighted decibel
N/A: not applicable
SMC: Seattle Municipal Code

Additional specific maximum permissible sound levels and working hours associated with various types of impact equipment used at construction sites and for short-duration construction activities (up to 1 hour) are described in SMC Chapter 25.08.425C and TMC Chapter 8.22. For residential receiving properties, maximum permissible sound levels are more stringent for construction work occurring during nighttime hours, as unusual noise can cause annoyance, generate stress, and

disturb sleep. Noise levels may be monitored as event-driven monitoring if there are multiple community complaints relating to noise-generating activities, and site activities will be assessed for any potential modifications in consultation with EPA.

2.2.3 Baseline Monitoring

The purpose of conducting baseline noise level monitoring will be to demonstrate early on during construction that the Contractor's dredging equipment is not exceeding noise criteria. This goal will be accomplished by monitoring the ambient and baseline noise levels: ambient noise levels before the start of construction during daytime hours (see Table C2-1, Note 2) and baseline noise levels at the start of over-water dredging activities. Both monitoring efforts will occur over a period of approximately three days.

The baseline monitoring location will be positioned at the project perimeter along the shoreline or at a distance of 50 feet from the construction equipment producing the noise, whichever is further. During baseline monitoring, monitoring staff will also document activities in the area that could impact monitoring results, such as regular, on-going activities and other construction occurring in the vicinity.

Since the same type of equipment will be used to both dredge sediment and place clean materials, early noise level monitoring results will represent both types of remedial actions.

2.2.4 Monitoring During Construction

It is anticipated that the baseline monitoring will record no exceedances of noise level criteria caused by the Contractor's dredging equipment. Due to the Work Site being located on the water within the LDW and the limited number of residences along the upper reach, daily noise level monitoring is not proposed. The specifications require the Contractor to comply with all applicable noise regulations.

Noise will be event-driven monitoring if there are multiple noise complaints, and if the Project Representative determines that the complaints are resulting from upper reach remedial actions, rather than from other activities that are not related to the upper reach cleanup. In the event of such monitoring, it will occur at the project perimeter along the shoreline or at a distance of 50 feet from the construction equipment producing the noise, whichever is farther, in the general area of the complaint. If monitoring indicates that the noise levels are exceeding criteria, mitigation measures will be implemented by the Contractor to bring its operations back into compliance with performance standards, as discussed in Section 2.2.2.

2.3 Light

2.3.1 Potential Impacts and Prevention Measures

It is anticipated that artificial lighting may be required for construction work conducted during the winter season to accommodate construction activities that need to be performed during low or high tides, or to facilitate meeting the construction schedule (i.e., progress of activities within the in-water work window). Lighting may be needed during the following activities:

- For general lighting at the beginning and end of each workday during fall and winter months, as even standard work hours will be outside of the fall/winter daylight periods
- For project vessels to ensure their safe passage during nighttime or early morning transport of materials
- For any extended work hours (e.g., 18- or 24-hour workdays) for specific tasks, such as bank excavation, which may be necessary to meet the schedule or to do work at specific tide levels.

Artificial light provides worker and community safety but may present a nuisance to surrounding residences. When work is conducted outside of standard working hours (7:00 a.m. to 7:00 p.m.), light levels will be measured in response to multiple community complaints, and to assess compliance with performance standards for light at construction sites. Acceptable light performance best management practices are identified in the specifications (e.g., the contractor can use light shrouds or barriers to help direct light into the work areas, re-sequence work during the day, reposition lighting equipment to avoid directing light outside of immediate work areas).

The Contractor's construction methods to prevent quality of life impacts from lighting will include the selection and setup of equipment that complies with specifications performance standards. If light levels do create a disturbance for residents or LDW users outside of standard work hours, actions may be taken, in consultation with EPA, to identify the source of the nuisance and mitigate the problem. Specific actions will be selected on a case-by-case basis and will only be used to the extent that they do not impede safe operations. Actions may include:

- Repositioning lights
- Re-sequencing work to avoid work outside of standard work hours in areas more sensitive to light disturbance
- Repositioning equipment, such as material barges or dredging equipment, relative to the lighting source.

2.3.2 Performance Standards

To limit the extent of potential light impacts on the community, project specifications will require the Contractor to comply with light requirements of the Cities of Seattle and Tukwila (SMC Chapter 23.50.046 and TMC Chapter 18.044.050) when working close to residential areas (residential shoreline private property owners and marina live-aboard residents) and commercial/industrial areas. Exterior lighting shall be shielded and directed away from lots in adjacent residential zones, per the SMC.

2.3.3 Monitoring During Construction

Light monitoring will be conducted if multiple community complaints are received when construction activities are taking place outside of standard work hours (7:00 a.m. to 7:00 p.m.), and if the Project Representative determines that the complaints are resulting from upper reach remedial actions, rather than from other activities that are not related to the upper reach cleanup. Light monitoring typically will be conducted using a hand-held light meter. Visual inspections of lighting may be conducted at appropriate locations; these locations will be determined based on community complaints, the location of the construction activity that is the cause of the complaints, and the location(s) of the impacted residents.

3 Monitoring Methods

This section discusses monitoring methods that may be used. The actual means and methods, equipment, and standard operating procedures will be finalized by the IQAT and implemented by the ANL Monitoring Lead and EQAO, as discussed in Section 2.

3.1 Air Quality

3.1.1 Fugitive Dust

Qualitative dust visual monitoring will occur on a daily basis around construction activities that may suspend dust. Monitoring for fugitive dust will be a contractor responsibility, per the specifications.

3.1.2 Diesel Particulate Matter

Diesel exhaust (EC) samples will be collected and analyzed in general accordance with the National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, Method 5040 for Diesel Particulate Matter (as EC). Samples will be submitted to SGS Laboratory located in Syracuse, NY. It should be noted that sample collection results will not be real time measurements, as the laboratory will require approximately 10 days or more to analyze the sample(s) following sample collection using NIOSH Method 5040. Laboratory methods and sample handling requirements for the diesel exhaust samples are provided in Table C3-1.

Table C3-1
Analytical Method and Sample Handling Requirements for Diesel Exhaust Samples

Parameter	CAS	Method	Laboratory	Collection Medium	Laboratory MDL	Laboratory RL/LOQ
Diesel Particulate Matter	7440-44-0	NIOSH 5040	SGS	37MM Quartz Fiber	3 µg	9 µg

Notes:
CAS: Chemical Abstract Service number
LOQ: Level of Quantitation
MDL: Method Detection Limit
NIOSH: National Institute for Occupational Safety and Health
RL: Reporting Limit

3.1.3 Hydrogen Sulfide (H2S) Monitoring

H2S levels will be measured using a hand-held monitoring instrument, such as a Jerome® H2S analyzer or equivalent. The instrument will collect continuous monitoring data, and data will be

processed to achieve a TWA measurement over an 8-hour period and quantified for each workday of testing in general accordance with WAC 173-460-150[7] and WAC 296-841.

3.2 Noise

Monitoring will be conducted using monitoring instruments, such as a Larson Davis Model 820 or equivalent, integrating sound level meters in protective, weather-resistant cases.

3.3 Light

Light monitoring will be conducted, as needed, by visual inspection to verify that construction lights are properly shielded to direct light away from residences, as required by the SMC.

[7] WAC 173-469-150 indicates monitoring will occur over a 24-hour TWA, however, we have modified to perform monitoring during construction hours.

4 Monitoring Quality Assurance/Quality Control

QA/quality control (QC) will be followed during implementation of this ANLMP to ensure consistent data collection and analysis procedures, and to ensure that data are representative of site conditions. The monitoring QA/QC procedures described herein will be led by the ANL Monitoring Lead and reported to the EQAO, as described in Section 1.2. The ANL Monitoring Lead will be responsible for maintaining communications, maintaining equipment, and reviewing field documentation.

4.1 Documentation

ANL monitoring personnel will record field conditions in a project logbook during monitoring events; document equipment inspection, calibration checks, and operation; and document instrument monitoring frequency, results, and readings. Any exceedances of performance standards and associated control measures will be documented, including the exceedance level, the time of the exceedance, the location measurements were taken, a description and implementation time of the control measure, the time the readings met criteria, and when the Project Representative and EPA were notified.

Equipment calibration and operational checks—along with any instrument problems such as, but not limited to, battery failures—will be recorded in the project logbook. The logbook will document instrument makes and models, serial numbers, and factory calibration data. The most recent factory calibration date will be compared to manufacturer-recommended criteria to ensure that calibration dates are valid. Any maintenance and repair operations required during the project will also be recorded.

Data will be downloaded from data logging instruments (if used) to a personal computer on a weekly basis. This will help minimize any potential loss of data from instrument failures. Monitoring data will then be summarized in the weekly monitoring report.

4.2 Equipment Calibration and Maintenance

Field maintenance and calibration will be performed according to manufacturer specifications prior to instrument use. Each piece of equipment will be carefully inspected and tested to check for any damage, and to ensure it is functioning properly when brought to the site. The operating manuals will specify equipment operating procedures.

4.3 Sample Handling for Diesel Particulate Matter

A chain-of-custody (COC) form will be prepared for each day's samples during air quality monitoring for diesel particulate matter; the form will include the project number, sampling date, sample numbers, sample volumes, analyses requested, and the sampler's signature. Samples and the original

COC form will be shipped to the laboratory for next-day delivery. Copies of the COC form will be kept with the daily field notes.

4.4 QA/QC Samples for Diesel Particulate Matter

Along with the batch of samples submitted to the laboratory for baseline air quality monitoring for diesel particulate matter, one field blank will be submitted for QC purposes.

5 References

AECOM. 2016. Removal action construction report. Phase 1: Sediment and upland cleanup. Lower Duwamish Waterway Superfund Site, Terminal 117 Early Action Area. AECOM Environment, Seattle, WA.

Anchor QEA, Windward. 2023. Final (100%) remedial design basis of design report for Lower Duwamish Waterway upper reach. Draft. Submitted to EPA December 2023. Anchor QEA and Windward Environmental LLC, Seattle, WA.

ATSDR. 2006. Toxicological profile for hydrogen sulfide. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

EPA. 2014. Record of Decision. Lower Duwamish Waterway Superfund Site. US Environmental Protection Agency.

EPA. 2021. Proposed explanation of significant differences. September 2021. Lower Duwamish Waterway Superfund site. US Environmental Protection Agency Region 10, Seattle, WA.

EPA. 2022. Emission standards reference guide for on-road and nonroad vehicles and engines [online]. US Environmental Protection Agency. Updated August 5, 2022. Available from: https://www.epa.gov/emission-standards-reference-guide.

NIOSH. 2020. Manual of Analytical Methods (NMAM). 5th ed., Andrews R, O'Connor PF, eds. National Institute for Occupational Safety and Health.

NOAA. 2023. Boeing Field - King County International Airport weather station [online]. National Oceanic and Atmospheric Administration. Available from: https://tgftp.nws.noaa.gov/weather/current/KBFI.html.

Appendix C – Air, Noise, and Light Monitoring Plan

Attachment C.1
Standard Operating Procedures

Geosyntec consultants

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

LDW PPS CM – PNR0859
Standard Operating Procedure #ANL-001
Noise Monitoring

Noise monitoring is required per the Air, Noise, and Light Monitoring Plan, Appendix C of the Construction Quality Assurance Plan (Geosyntec, Windward and AnchorQEA, 2024) for the Lower Duwamish Waterway Upper Reach construction project.

1.0 Objectives and Definitions

The purpose of this standard operating procedure (SOP) is to detail the methods for monitoring noise during active construction operations. Construction operations include dredging sediment, placing clean materials, excavating bank sediment, removal and installation of piles and temporary shoring, and the use of tugboats and barges to move materials around the Site.

Noise standards are defined by daytime hours – 7:00 a.m. and 10:00 p.m. – on weekdays as per the Seattle Municipal Code (SMC), such that any work conducted outside of daytime hours requires lower sound levels. In order to conduct work outside of daytime hours, contractor is required to obtain approval from the Project Representative and EPA.

The specifications will require the contractor to comply with noise criteria for the cities of Seattle and Tukwila and unincorporated King County when working close to residential areas (upland areas and live-aboard residential marinas) adjacent to the project site perimeter (the shoreline when working inwater) to limit the extent of potential noise impacts on the community.

For construction activity within industrial zones, exterior sound level limits measured at the project perimeter or at a distance of 50 feet from the construction equipment generating the sound, whichever is further, may be exceeded by no more than 25 A-weighted decibels (dB[A]) during daytime hours. This equates to 95 dB(A) maximum permissible sound level.

2.0 Monitoring Equipment

Noise will be monitored and recorded using a hand-held digital sound level meter such as Larson Davis Model 820 or equivalent, that collects instantaneous readings, placed in protective, weather-resistant case as needed.

3.0 Monitoring Methods

The field team, consisting of a minimum of two staff, will mobilize to the monitoring stations determined from the geographic information systems maps in general accordance with the CQAP and in consultation with the Construction Manager.

3.1 Mobilization and Location Control

Equipment will be positioned downwind of field activities for two scheduled events – baseline (3 days at the start of construction) and ambient (3 days before the start of construction). The baseline monitoring location

will be positioned at the project perimeter along the shoreline or at a distance of approximately 50 feet (ft) from the construction equipment producing the noise, whichever is further. Ambient monitoring will be conducted at the same location.

Monitoring during construction will be conducted at two stations in the instance of a triggering monitoring event. Monitoring will be conducted at the 50 (ft) or site perimeter compliance point from construction equipment and at the location of the event-driven complaint(s).

If calibration is required by the global positioning system (GPS) used by the field team, the GPS will be calibrated over a known control point prior to mobilization for sampling. If calibration is not required by the GPS used by the field team, this step will be omitted. If monitoring stations are identified on the water, the research vessel will be mobilized to a monitoring station, and x/y station coordinates will be collected using a handheld GPS. Coordinates will be recorded in NAD83 Washington State Plane North (feet).

3.2 Measuring Noise Parameters

Field personnel will perform the following steps to conduct ambient and baseline noise monitoring:

- Mobilize to the specified monitoring locations.
- Utilize a sound level meter (i.e., Larson Davis Model 820 or equivalent) to measure sound at monitoring locations; connect microphone and amplifier to main body.
- Turn boat engine off.
- Calibrate sound meter.
- Record calibration in field notes.
- Hold the meter in the air and begin taking measurements.
- Baseline (during construction): record at least 3 to 5 readings measured over one-minute period and compute the average concentration among the readings.[1]
- Ambient (before construction): record at least 10 readings measured over one-hour period and compute the average concentration among the readings collected in one hour.
- Document the individual and average readings at each location
- Document activities in the area that could impact monitoring results.
- Repeat these readings for three days (baseline) and another three days (ambient).
- Repeat baseline readings for different types of equipment (e.g., dredging, trucking, excavation, pile driving), as appropriate.

Additional noise monitoring will be conducted on an as-necessary basis if community complaints are filed. Monitoring will be performed using the same equipment and timeframes as baseline monitoring. Event-driving monitoring will be conducted at the project perimeter along the shoreline or 50 ft downwind from the construction activity producing the noise, whichever is further. Monitoring will also be conducted in the general area of the complaint, if different from above.

4.0 Supplies and Equipment

The general types of equipment required for noise monitoring are described below.

- Monitoring equipment:

[1] The maximum permissible noise level is applied to a minimum measurement interval of 1 minute for constant sound source (dredging, excavation), and 1 hour measurement for non-continuous sound source (pile driving, ambient).

    - Hand-held Larson Davis Model 820 (or equivalent) Sound Level Meter
- Personal protective equipment (PPE) and health and safety supplies:
    - Personal floating device, as necessary
    - Hard hat
    - Steel toe boots
    - Safety glasses
    - Hand warmer or equivalent
    - First aid kit and eye washer
    - Fire extinguisher
    - Functioning communication devices (personal cellphones, radio, or equivalent)
    - A copy of Health and Safety Plan
    - Water/hydrating liquids for field team
- Field and reporting supplies:
    - A copy of the Construction Quality Assurance Plan (CQAP)
    - Monitoring stations coordinates (hard copy or equivalent)
    - Field Forms including daily field log, monitoring log, and tailgate safety meeting log (hard copy or equivalent)
    - Digital camera or equivalent for photographic records

5.0 References

Geosyntec, Windward, Anchor QEA. 2024. Construction Phase, Construction Quality Assurance Plan (CQAP), Lower Duwamish Waterway Upper Reach. Prepared by Geosyntec, Windward Environmental LLC, and Anchor QEA, Seattle, WA. Prepared for the Lower Duwamish Waterway Group.

Geosyntec consultants

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

LDW PPS CM – PNR0859

Standard Operating Procedure #ANL-002
Light Monitoring

Light monitoring during construction includes measuring light parameters as required per the Air, Noise, and Light Monitoring Plan, Appendix C of the Construction Quality Assurance Plan (Geosyntec, Windward and Anchor, 2024).

1.0 Objectives

The purpose of this standard operating procedure (SOP) is to detail the methods for monitoring artificial light required for construction activities on-site.

Light standards are defined by standard working hours – 7:00 a.m. to 7:00 p.m. When work is conducted outside of standard working hours, light levels will be measured in response to multiple community complaints, and to assess compliance with performance standards for light at construction sites. Acceptable light performance best management practices are identified in the specifications (e.g., the contractor can use light shrouds or barriers to help direct light into the work areas, re-sequence work during the day, reposition lighting equipment to avoid directing light outside of immediate work areas).

2.0 Monitoring Equipment

Light will be monitored and recorded using visual inspections and, if needed, a hand-held light meter.

2.1 Visual Inspection

Upon receipt of a complaint, quality assurance staff will mobilize to the work area and perform a visual inspection of the area in question. Visual inspections will include documentation of the inspection, location of the operation, visual observations made, and date and time of inspection. Visual inspections will include the verification that construction lights are properly shielded and that light is direct towards the work area and away from shoreline properties, if possible.

2.2 Light Meter Measurements

If needed, a handheld light meter (Konica Minolta T-10 or equivalent) will be utilized to take luminescence measurements. Measurements will be collected in the area of the complaint and at the project perimeter, defined as the shoreline adjacent to the on-water operations. Measurements will be collected prior to advising the contractor on making any adjustments to their lighting operations.

3.0 Monitoring Methods

3.1 Mobilization and Location Control

The field team will mobilize to the specified location of the complaint. Monitoring will occur within the project perimeter, defined as the shoreline adjacent to the on-water operations.

If calibration is required by the global positioning system (GPS) used by the field team, the GPS will be calibrated over a known control point prior to mobilization. If calibration is not required by the GPS used by the field team, this step will be omitted.

In the event readings need to be taken on the water, the research vessel will be mobilized to a sampling station, and coordinates will be collected using a handheld GPS. Coordinates will be recorded in NAD83 Washington State Plane North (feet).

3.2 Measuring Light Parameters

Field personnel will take the following steps to conduct light monitoring in the event of community complaints:

- Mobilize to the specified locations during construction activities.
- Perform visual inspection including inspection of shielding of light operations.
- Calibrate light meter.
- Hold the light meter in the air and begin collecting light measurements.
- Record measurements at each monitoring location.
- Document other sources of light that may be affect light readings.

4.0 Supplies and Equipment

The general types of equipment that are required are described in this section. A detailed supply and equipment list is provided below.

- Field equipment:
  - Hand-held light meter (Konica Minolta T-10 or equivalent)
  - Handheld GPS
- Personal protective equipment (PPE) and health and safety supplies:
  - Personal floating device, as necessary
  - Hard hat
  - Steel toe boots
  - Safety glasses
  - Hand warmer or equivalent
  - First aid kit and eye washer
  - Fire extinguisher
  - Functioning communication devices (personal cellphones, radio, or equivalent)
  - Copy of Health and Safety Plan
  - Food and drink for field team
- Reporting Supplies:
  - A copy of the Construction Quality Assurance Plan (CQAP)
  - Monitoring stations coordinates (hard copy or equivalent)
  - Field Forms including daily field log, monitoring log, and tailgate safety meeting log (hard copy or equivalent)
  - Digital camera or equivalent for photographic records

5.0 References

Geosyntec, Windward, AnchorQEA. 2024. Construction Phase, Construction Quality Assurance Plan (CQAP). Geosyntec, Windward Environmental LLC, and Anchor QEA, Seattle, WA. Prepared for the Lower Duwamish Waterway Group.

Geosyntec consultants

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

LDW PPS CM – PNR0859

Standard Operating Procedure #ANL-003
Diesel Particulate Matter Sampling

Air quality monitoring during construction include measuring air quality parameters as required per the Air, Noise, and Light Monitoring Plan, Appendix C of the Construction Quality Assurance Plan (Geosyntec, Windward and Anchor, 2024) for the Lower Duwamish Waterway upper reach construction.

1.0 Objectives

The purpose of this standard operating procedure (SOP) is to detail the methods for measuring diesel exhaust (diesel particulate matter) air quality field parameter during baseline and field mobilizations. It is considered an air quality criterion for this project, due to the on-site operation of construction equipment using diesel engines for the duration of the project. *Diesel Exhaust* (diesel particulate matter) will be generated by dredging equipment, tugboats and other small workboats; upland construction equipment (in limited areas requiring upland excavation); local haul trucks (if used); upland transload facility equipment; and trains transporting dredged materials to an off-site landfill.

In the open-air the potential for any significant exposure of the community to diesel exhaust is low. Air quality performance requirements to be met by the Contractor during construction are defined in the RD specifications (Specifications Sections 01 35 44 [Green Remediation] and 01 35 43 [Environmental Procedures]), which follow air emission standards defined in EPA's Tier System (EPA 2022) for fossil fuel consumption.

2.0 Sampling Equipment

Diesel particulate sampling will be completed using an open-faced quartz fiber filter cassette and pump. Field personnel will deploy precleaned quartz fiber filters affixed to a calibrated sampling pump. Sampling pumps will be calibrated to a flow rate between 2 to 4 liters per minute (L/min) and sampled over a period of at least 8 hours to achieve a time weighted average of 8 hours.

3.0 Sampling Methods

Air quality parameters will be monitored and recorded prior to (ambient) and during (baseline) active dredging activities. A minimum of two field blanks will be collected during baseline air sampling. Field blanks will be collected at specified locations upwind of construction activities concurrently with baseline sampling. Field team will follow the same procedures to collect field blank samples as for baseline samples

3.1 Mobilization and Location Control

The field team, consisting of a minimum of two people, will mobilize to the sampling stations determined from the geographic information systems maps (GIS) in general accordance with the CQAP and in consultation with the Construction Manager. Baseline and ambient (preconstruction) monitoring will occur within the project perimeter and at a minimum of approximately 100 feet downwind from planned dredging activity to the extent feasible.

Background and performance monitoring will be conducted at two stations in any instance of a triggering monitoring event. Similarly, background will be located a minimum of 100 feet and within the project perimeter both downwind of current construction activities to the extent feasible.

If calibration is required by the global positioning system (GPS) used by the field team, the GPS will be calibrated over a known control point prior to mobilization for sampling. If calibration is not required by the GPS used by the field team, this step will be omitted.

In the event samples need to be taken on the water, the research vessel will be mobilized to a sampling station, and x/y station coordinates will be collected using a handheld GPS. Coordinates will be recorded in NAD83 Washington State Plane North (feet).

3.2 Calibration Procedures

Prior to sample collection, each sampling pump will be calibrated to achieve the prescribed flow rate of 2-4 L/min. Sampling pump will then be calibrated after sampling to ensure flow rate has been maintained.

- Run pump for a minimum of 5 minutes before performing calibration.
    - During this time, inspect tubing and cassette for damages.
- Attach the pump to suction port of electronic calibrator and the calibration cassette. ***Do not remove top of cassette; calibration must be performed with closed cassette.***
- Turn on air pump and set flow rate to approved range under NIOSH Method 5040 (2-4L/min).
- Perform a minimum of 3 consecutive measurements and stop when measured values are within +/- 2% of each other.
- Repeat calibration procedure after sampling is complete without adjusting pump parameters; post-sampling calibration values must be within +/- 5% of each other. If values are outside of this range, samples must be retaken.
- Record calibration results in field notebook.

3.3 Measuring Air Quality Parameters

During sampling of air quality parameters, measurements of diesel particulate matter will be documented by field personnel using the following standard operating procedures:

- Mobilize to sampling area.
- Calibrate sampling pump with calibration cassette.
- Attach ¼" I.D. tubing to calibrated sampling pump.
- Attach the calibrated pump to a post or pole and secure the pump using zip ties or rope.
- Label sample prior to the start of sampling.
- Remove the top piece of cassette for open-face sampling.
- Turn on pump and document the start time.
- Allow pump to sample for **at least** 8 hours.
- At the completion of the sampling interval, stop the pump and document the time.
- Replace the top piece of cassette and pack the sample cassette for shipment.
    - Note: sample does not require refrigeration unless there is potential exposure to temperature well above collection temperature.
- Record sample collection details in the field notebook, including start and stop time, location, weather, wind direction, and observations of the surrounding area.

4.0 Supplies and Equipment

The general types of equipment required for monitoring are described in this section. A detailed supply and equipment list is provided below.

- Field equipment:
  - Quartz-fiber filter, precleaned (laboratory provided)
  - 3-piece cassette with filter support (laboratory provided)
    - Note: Add two additional cassettes to the number of samples per sample location to account for field blanks and calibration filters.
  - Sampling pump with ¼" flexible tubing (laboratory provided **upon request**)
  - Calibration meter (rental from lab)
  - Zip ties or rope to secure sampler
  - Stakes/wood post to secure cassette/pump system to buoys
  - Trimble GPS or equivalent
- Personal protective equipment (PPE) and health and safety supplies:
  - Personal floating device
  - Hard hat
  - Steel toe boots
  - Disposable, powderless nitrile gloves
  - Safety glasses
  - Hand warmer or equivalent
  - First aid kit and eye washer
  - Fire extinguisher
  - Functioning communication devices (personal cellphones, radio, or equivalent)
  - Copy of Health and Safety Plan
  - Food and drink for field team
- Waste handling supplies
  - 5-gallons buckets (empty)
  - Waste bags
- Reporting Supplies:
  - A hard copy of the Construction Quality Assurance Plan (CQAP)
  - Sampling stations coordinates (hard copy or equivalent)
  - Field Forms including daily field log, sample log, and tailgate safety meeting log (hard copy or equivalent)
  - Chain of Custody
  - Digital camera or equivalent for photographic records
  - White board and marker or equivalent for labeling photographic records
  - Permanent markers.

5.0 References

Anchor QEA, Windward. 2024. 100% Remedial Design Volume II for Lower Duwamish Waterway upper reach. Approved by EPA January 2024. Anchor QEA and Windward Environmental LLC, Seattle, WA. Prepared for the Lower Duwamish Waterway Group.

CDC. 1996. Diesel Particulate Matter (as Elemental Carbon) [online]. Centers for Disease Control and Prevention. Updated March 10, 2016. Available from :https://www.cdc.gov/niosh/docs/2003-154/pdfS/5040.pdf.

SGS Galson. 2023. Diesel Particulate/CAS# 7440-44-0 [online]. SGS Galson. Updated January 17, 2023. Available from: https://www.sgsgalson.com/sag-detail/std/Diesel+Particulate/7440-44-0/.

University of Michigan Center for Occupation Health and Safety Engineering. 2018. Personal Air Sampling Pump Calibration [online]. YouTube. Updated January 24, 2018. Available from: https://www.youtube.com/watch?v=1iyHbSW6gi8.

Geosyntec consultants

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

LDW PPS CM – PNR0859

Standard Operating Procedure #ANL-004
Fugitive Dust Monitoring

Air quality monitoring during construction includes measuring air quality parameters as required per the Air, Noise, and Light Monitoring Plan, Appendix C of the Construction Quality Assurance Plan (Geosyntec, Windward, and AnchorQEA, 2024) for the Lower Duwamish Waterway Upper Reach construction project.

1.0 Objectives

The purpose of this standard operating procedure (SOP) is to detail the methods for measuring fugitive dust air quality parameters during baseline and field mobilizations. *Fugitive dust* may be released when dry soil is disturbed during excavation (potentially limited to one location at Sediment Management Area [SMA] 5), or when stockpiling or transporting dredged materials on uncovered trains or trucks[1]. Fugitive dust concerns include impacts on property and inhalation of dust and contaminants adhered to dust.

2.0 Monitoring Equipment

Air monitoring of fugitive dust will be completed via visual inspections.

3.0 Monitoring Methods

Fugitive dust monitoring will occur via ongoing visual inspections during construction activities. In the event visual dust in observed, visual inspection will be documented. Field personnel will document where dust is observed identified in general accordance with the CQAP, at the project perimeter. The contractor will be notified and will take action to mitigate dust at the property perimeter.

3.1 Mobilization and Location Control

The field team consisting of a minimum of two people will mobilize to the monitoring stations determined from the geographic information systems maps in general accordance with the CQAP and in consultation with the Construction Manager. Monitoring will occur within the project perimeter and at a minimum of approximately 100 feet up and downwind from planned dredging activity to the extent feasible.

Monitoring will be conducted at two stations in any instance of a triggering monitoring event. Similarly, stations will be located a minimum of 100 feet and within the project perimeter both up and downwind of current construction activities to the extent feasible.

If calibration is required by the global positioning system (GPS) used by the field team, the GPS will be calibrated over a known control point prior to mobilization for sampling. If calibration is not required by the GPS used by the field team, this step will be omitted.

[1] Specifications require all trucks and railcars to be covered while transporting dredged material.

3.1 Horizontal Control

In the event measurements need to be taken on the water, the research vessel will be mobilized to a monitoring station, and x/y station coordinates will be collected using a handheld GPS (Trimble 4000, or similar). Coordinates will be recorded in NAD83 Washington State Plane North (feet) to the nearest 1.0 ft.

3.2 Vertical Control

Vertical elevation (water depth) will be recorded to the nearest 0.1 ft measured from the water surface to the sediment surface. Measurements will be collected using a graduated weighted line or similar device pulled taut prior to measurement and/or the vessel echo sounder (or equivalent). The time and date of measurement will also be recorded.

4.0 Measuring Air Quality Parameters

During baseline monitoring and dredging events, air quality parameters will be measured and documented by field personnel using the following standard operating procedures:

Fugitive dust inspections will occur via ongoing monitoring on the basis of "no visible dust" at the property perimeter. The following steps will be taken to monitor fugitive dust:

- Field personnel will mobilize to specified location at property perimeter.
- Field personnel will perform and document visual inspections on dust at specified location.
- Record visual observations in the field notebook, including date, time, location, weather, wind direction, and observations of the surrounding area.
- In the event that visible dust is observed at property perimeter, the contractor will be notified and will take actions to mitigate dust.

5.0 Supplies and Equipment

The general types of equipment that are required are described in this section. A detailed supply and equipment list is provided below.

- Personal protective equipment (PPE) and health and safety supplies:
    - Personal floating device
    - Hard hat
    - Steel toe boots
    - Disposable, powderless nitrile gloves
    - Safety glasses
    - Hand warmer or equivalent
    - First aid kit and eye washer
    - Fire extinguisher
    - Functioning communication devices (personal cellphones, radio, or equivalent)
    - Copy of Health and Safety Plan
    - Water/hydrating liquids for field team
- Field equipment:
    - Trimble GPS or equivalent
- Reporting Supplies:
    - A hard copy of the Construction Quality Assurance Plan (CQAP)
    - Monitoring station coordinates (hard copy or equivalent)

- Field Forms including daily field log, monitoring log, and tailgate safety meeting log (hard copy or equivalent)
- Digital camera or equivalent for photographic records
- White board and marker or equivalent for labeling photographic records
- Permanent markers.

6.0 References

Anchor QEA, Windward. 2024. 100% Remedial Design Volume II for Lower Duwamish Waterway upper reach. Approved by EPA January 2024. Anchor QEA and Windward Environmental LLC, Seattle, WA.

Geosyntec, Windward, Anchor QEA. 2024. Construction Phase, Construction Quality Assurance Plan (CQAP), Lower Duwamish Waterway Upper Reach. Prepared by Geosyntec, Windward Environmental LLC, and Anchor QEA, Seattle, WA. Prepared for the Lower Duwamish Waterway Group.

Geosyntec consultants

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

LDW PPS CM – PNR0859

Standard Operating Procedure #ANL-005
Fugitive Odors Monitoring

Air quality monitoring during construction includes measuring air quality parameters as required per the Air, Noise, and Light Monitoring Plan, Appendix C of the Construction Quality Assurance Plan (Geosyntec, Windward, and Anchor QEA, 2024) for the Lower Duwamish Waterway upper reach construction project.

1.0 Objectives

The purpose of this standard operating procedure (SOP) is to detail the methods for measuring air quality parameters during baseline and field mobilizations. *Fugitive odors* from construction present a potential quality of life nuisance issue. Dredging and excavation of wet sediment can potentially result in unusual odors, which can be a nuisance. Odors may be generated by dredged sediments that contain decaying organic matter (hydrogen sulfide [H_2S]), during shoreline bank soils excavation, and from diesel emissions.

2.0 Monitoring Equipment

Air monitoring for fugitive odors will be completed by using an H_2S gas detection monitor, such as Jerome® J631 model with a rechargeable battery pack. This equipment can display instantaneous readings or programmed to record longer term readings with time-weighted average (TWA) reporting.

3.0 Monitoring Methods

Fugitive odors in the form of H_2S will be monitored and recorded prior to (ambient) and during (baseline) active dredging activities. Field personnel will measure and record H_2S levels at each monitoring station. If H_2S standards are exceeded, field staff will notify the construction manager to determine if action needed to mitigate fugitive odors. H_2S measurements will be taken continuously over an 8-hour period per monitoring location for ambient and baseline monitoring.

3.1 Mobilization

Field personnel will mobilize to the monitoring stations determined from the geographic information systems (GIS) maps in general accordance with the CQAP and in consultation with the Construction Manager. Ambient and baseline will occur within the project perimeter and at a minimum of approximately 100 feet up and downwind from planned dredging activity to the extent feasible.

Monitoring will be conducted at two stations in any instance of a triggering monitoring event (e.g. multiple community complaints). Similarly, stations will be located a minimum of 100 feet and within the project perimeter both up and downwind of current construction activities to the extent feasible.

If calibration is required by the global positioning system (GPS) used by the field team, the GPS will be calibrated over a known control point prior to mobilization for sampling. If calibration is not required by the GPS used by the field team, this step will be omitted.

3.2 Horizontal and Vertical Control

In the even measurements need to be taken on the water, the research vessel with a minimum of two field personnel will be mobilized to a monitoring station, and x/y station coordinates will be collected using a

handheld GPS (Trimble 4000, or similar). Coordinates will be recorded in NAD83 Washington State Plane North (feet) to the nearest 1.0 ft.

Vertical elevation (water depth) will be recorded to the nearest 0.1 ft measured from the water surface to the sediment surface. Measurements will be collected using a graduated weighted line or similar device pulled taut prior to measurement and/or the vessel echo sounder (or equivalent). The time and date of measurement will also be recorded.

3.3 H_2S Analyzer Calibration Procedures

Prior to and after H_2S level collection, each hand-held H_2S monitor should have sensory regeneration performed at the beginning and end of each day of readings, and when the sensor becomes saturated.

To perform a sensor regeneration field personnel will follow these steps:

- Press right arrow button to enter main menu.
- Use arrow buttons to navigate to REGEN menu option. Press right arrow button to enter regeneration menu.
- Select REGEN NOW. Press ENTER.
- Allow the regeneration cycle to run for approximately 45 minutes, until it has completely regenerated.

Note: do not interrupt the regeneration cycle.

Clean air system check should be performed after each regeneration cycle. To perform a clean air system check, follow these steps:

- Insert zero air filter into intake port located on the front of H_2S meter. Arrow on air filter should be pointing towards the instrument.
- To take a sample, press the ENTER/START button on the main screen or the silver SAMPLE button located at the tip of the instrument handle.
- Take 5 samples. Wait at least 15 seconds between each reading to maximize sample accuracy.
    - At least 3 of the 5 readings should be 0.000 ppm. If less than 3 readings read 0.000 ppm, retake clean air system check. If problem persists, contact local AMETEK representative.

For levels less than 10 ppb, field personnel will have to run a warm-up routine using the zero-air filter before sampling. To perform a system warmup, follow these steps:

- Install zero air filter.
- Select WARMUP from REGEN menu. Warmup will take 5 minutes.

3.4 Measuring Air Quality Parameters

Fugitive odors parameters [H_2S] will be measured and documented by field personnel using the following standard operating procedures:

- Mobilize to specified monitoring locations.
- Calibrate monitoring instrument (Jerome H_2S analyzer or equivalent).
- Instrument will be mounted and record readings in the air.
- Begin collecting H_2S levels. Press the ENTER/START button on the keypad, or the silver SAMPLE button on the tip of the instrument handle.
- Instrument will collect continuous monitoring data.
- Data will be processed to achieve a time weighted average measurement over an 8 hour period on each work day.

- Record the date, weather, wind direction, and location of sampling plus the general work activities in the surrounding area.

4.0 Supplies and Equipment

The general types of equipment that are required are described in this section. A detailed supply and equipment list is provided below.

- Field equipment:
  - Trimble GPS or equivalent
  - Jerome H_2S analyzer, or equivalent
  - Mounting system for equipment
- Personal protective equipment (PPE) and health and safety supplies:
  - Personal floating device
  - Hard hat
  - Steel toe boots
  - Disposable, powderless nitrile gloves
  - Safety glasses
  - Hand warmer or equivalent
  - First aid kit and eye washer
  - Fire extinguisher
  - Functioning communication devices (personal cellphones, radio, or equivalent)
  - A copy of the Health and Safety Plan
  - Water/hydrating liquids for field team
- Reporting Supplies:
  - A copy of the Construction Quality Assurance Plan (CQAP)
  - Monitoring station coordinates (hard copy or equivalent)
  - Field Forms including daily field log, monitoring log, and tailgate safety meeting log (hard copy or equivalent)
  - Digital camera or equivalent for photographic records
  - White board and marker or equivalent for labeling photographic records
  - Permanent markers.

5.0 References

Geosyntec, Windward, Anchor QEA. 2024. Construction Phase, Construction Quality Assurance Plan (CQAP), Lower Duwamish Waterway Upper Reach. Prepared by Geosyntec, Windward Environmental LLC, and Anchor QEA, Seattle, WA. Prepared for the Lower Duwamish Waterway Group.

Jerome By AMETEK Brookfield. 2019. Jerome J605 Set Up, Sensor Regeneration & Daily Use Guide [online]. YouTube. January 2, 2019. Available from: https://www.youtube.com/watch?v=Svo8UeNdGco.

Construction Phase, Revision 1

Appendix D
Monitoring and Inadvertent Discovery Plan

No changes made to version of the Monitoring and Inadvertent Discovery Plan submitted in the 100% Remedial Design. Document is still cited in the CQAP and will be available to field archaeologist.

Construction Phase, Revision 1

Appendix E
IQAT Health and Safety Plan

The IQAT Health and Safety Plan has been prepared and submitted under separate cover for EPA concurrence.