Appendix O
Final (100%) Remedial Design Engineer's Cost Estimate

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ABBREVIATIONS

BODR	*Basis of Design Report*
CY	cubic yard
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
GAC	granular activated carbon
LDW	Lower Duwamish Waterway
LTMMP	Long-Term Maintenance and Monitoring Plan
QA	quality assurance
RD	remedial design
RMC	residuals management cover
SMA	sediment management area

1 Introduction

This appendix presents the Final (100%) Remedial Design (RD) Engineer's Cost Estimate and associated cost assumptions for the sediment remedy for the upper reach (river miles 3.0 to 5.0) of the Lower Duwamish Waterway (LDW) Superfund Site in King County, Washington. The design process is presented in the *Remedial Design Work Plan for the Lower Duwamish Waterway Upper Reach* (Anchor QEA and Windward 2019) for the remedy selected in U.S. Environmental Protection Agency's (EPA's) November 2014 *Record of Decision* (EPA 2014). This Final (100%) RD Engineer's Cost Estimate was prepared in support of the Final (100%) RD *Basis of Design Report* (BODR), based on the design information provided on the Final (100%) Drawings (Volume III).

This Final (100%) RD Engineer's Cost Estimate evaluation was prepared on behalf of the City of Seattle, King County, and The Boeing Company, collectively referred to as the Lower Duwamish Waterway Group.

Based on the BODR's design criteria and other key elements for implementing the sediment remedy, this appendix outlines the basis and rationale for the Final (100%) RD Engineer's Cost Estimate and includes the following supporting information:

- **Section 2:** Sources of Cost Information and Costing Approach
- **Section 3:** Direct and Indirect Construction Tasks
- **Section 4:** Costing Assumptions Used for the Final (100%) RD
- **Section 5:** Dredge and Material Placement Quantities Summary
- **Section 6:** Costs Summary

Attachment O.1 contains the detailed Engineer's cost estimate workbook for the Final (100%) RD Engineer's Cost Estimate, organized as follows:

- **Attachment O.1.1:** Summary 100% RD Engineer's Cost Estimate
- **Attachment O.1.2:** Detailed 100% RD Engineer's Cost Estimate
- **Attachment O.1.3:** Detailed Notes
- **Attachment O.1.4:** Detailed Quantities
- **Attachment O.1.5:** Production Rates and Durations
- **Attachment O.1.6:** Detailed Structural Work Costs

2 Sources of Cost Information and Costing Approach

The development of the Final (100%) RD Engineer's Cost Estimate was based on a multiple-step process to derive site-specific unit costs and lump sum prices for the upper reach sediment remedy; this process consisted of using both parametric and bottom-up costing approaches. Parametric costing uses historical cost data to assign a dollar value to certain project costs. Parametric costing applied to this Engineer's Cost Estimate consisted of reviewing historical unit costs for similar sediment remediation and/or dredging projects completed locally and regionally, based on their relevance and applicability to the upper reach (i.e., similar quantities and/or remediation conditions).

In bottom-up costing, the large project is broken down into a number of smaller components, and costs are specifically derived for each of these smaller work components. Bottom-up costing applied to this Engineer's Cost Estimate was developed by estimating labor, equipment, and other ancillary add-ons for each construction activity based on engineering cost guidance (e.g., RS Means) and past project experience. By comparing bottom-up costs with parametric cost information, along with engineering best professional judgment, "probable" unit costs and "probable" lump sums were then derived.

To support the Final (100%) RD Engineer's Cost Estimate, several sources of information were reviewed, including the following:

- Contractors' bid costs and engineers' construction cost estimates for similar sediment remediation and/or dredging projects completed locally (in the Seattle area) and regionally (in the Pacific Northwest), as well as knowledge of construction activities and challenges identified during construction oversight. The following project costs were reviewed:
  - Glacier Northwest, Inc., Terminal Maintenance Dredging (Seattle, Washington)
  - Terminal 18 Maintenance Dredging (Seattle, Washington)
  - J.A. Jack & Sons, Inc., and Lehigh Hanson Berths Maintenance Dredging (Seattle, Washington)
  - Denny Way CSO Nearshore Interim Sediment Cleanup (Seattle, Washington)
  - Terminal 117 Phase 1 Sediment and Upland Cleanup (Seattle, Washington)
  - Jorgenson Forge Sediment Remediation – LDW Early Action Area (Seattle, Washington)
  - Slip 4 Sediment Remediation – LDW Early Action Area (Seattle, Washington)
  - Port Gamble Bay Sediment Cleanup Project (Port Gamble, Washington)
  - Whatcom Waterway Phase 1 Sediment Cleanup (Bellingham, Washington)
  - Port of Olympia Marine Berths 2 & 3 Interim Action Dredging (Olympia, Washington)
- Anchor QEA's engineering best professional judgment based on past experience with similar remedial actions and associated pricing, as well as project-specific considerations that influence key cost factors (e.g., production rates)

- Engineering cost guidance (RS Means)
- Vendor quotes for clean placement materials and amendment to be imported

Some of the above-referenced projects were recently constructed, while others were completed more than 10 years ago. The age of the reference project bid cost data was considered when reviewing historical sediment remediation costs (i.e., unit costs were adjusted for standard inflation to present-day U.S. dollars [2023] for comparison to current costing of the upper reach sediment remedy).

3 Direct, Indirect Construction, and Additional Construction Oversight Tasks

This section describes the activities used to develop costs for direct construction (Section 3.1), indirect construction (Section 3.2), and additional construction oversight (Section 3.3) tasks. Additional detailed descriptions of these tasks are provided in the detailed Engineer's cost estimate workbook, Attachment O.1 (Attachment O.1.3).

3.1 Direct Construction Tasks

Direct construction tasks include all construction activities anticipated to be conducted by the contractor. The following direct construction tasks are included in this Final (100%) RD Engineer's Cost Estimate:

- **Mobilization and demobilization** include the costs associated with mobilizing and demobilizing personnel and marine/land equipment, procedures, contractor work plan development and other submittals, and the contractor site office and administration. Special bonding and insurance are assumed to be included under this task.
- **Site preparation** includes the costs associated preparing the work site (clearing and grubbing upland areas prior to excavation) and preparation, setup, and maintenance of the upland staging area.[1]
- **Surveys** include the costs for contactor pre- and post-construction bathymetric and topographic surveys plus progress, post-dredge, and post-material placement bathymetric/topographic surveys and as-built surveys.
- **Structural work** includes the costs for bulkhead strengthening and reinforcement; removal, offloading, upland transportation, and disposal of timber piles (including dolphins); and replacement of piles used for Tribal fishing with steel pipe piles. Costs for outfall pipe energy dissipator installation are included under the structural work task.
- **Dredging and excavation** activities include costs for dredging, contingency re-dredging, excavation, in-water barge transportation, and removal/disposal of both dredge debris (considered incidental to dredging) and identified debris.
- **Transloading, upland transportation, and disposal** activities include costs for transloading dredged sediment, dredge debris, and identified debris at the transload facility and upland transportation for final Subtitle D landfill disposal.

[1] As described in Section 10.2.6 of the BODR, it is assumed that the selected contractor for the LDW upper reach project will use an established commercial transload facility in close proximity (Duwamish Reload Facility, operated by WM [formerly Waste Management]) that could readily be used for offloading dredged material from barges and onloading to trucks or railcars for transportation to a Subtitle D disposal facility. Therefore, no costs have been included in this Engineer's Cost Estimate for developing a project-specific transload facility.

- **Material placement** activities include costs for material procurement, material transport to the site, and placement of backfill, residuals management cover (RMC), enhanced natural recovery (ENR), amended cover (Area-Specific Technology B for dredge offset area; see Section 10.5 of the BODR), and engineered capping materials.
- **Environmental controls** include costs for environmental protection during construction by providing an allowance for controls and best management practices.
- **Planting preparation, landscaping, and 1-year maintenance in Sediment Management Area (SMA) 5** include costs for plantings to be installed along the length of Engineered Cap A in SMA 5, starting from an offset from the post-Engineering Cap A top of bank.

Additional contractor health and safety, quality control, and project management costs were not separately estimated, as they are assumed to be included under the lump sum for mobilization/demobilization costs.

3.2 Indirect Construction Tasks

Indirect construction tasks include additional activities to provide quality assurance (QA) that are necessary to the project but are performed by parties other than the contractor. The following indirect construction tasks have been included in this Final (100%) RD Engineer's Cost Estimate:

- **Project management** costs involve professional services, such as planning and reporting (e.g., weekly and/or monthly status reports during construction activities), community relations support during construction, health and safety reviews/checks, and bid/contract administration. In addition, costs for budget tracking, invoicing, and reporting—along with schedule, staff, and agency management—are accounted for in the project management task. Furthermore, project team communications, client/agency meetings and meeting materials, web sharing, and document management are also included.
- **Engineering support service** costs are typically provided from the office and include design interpretation, contingency action decision coordination, change order negotiation support, and construction completion and closeout reports preparation.
- **Construction QA** costs, which include the following activities (as described in the *Construction Quality Assurance Plan*; see Volume II):
  - **Construction management**, which involves providing oversight of the contractor's implementation of the sediment remedy. It typically refers to in-field oversight of the contractor's work and includes construction inspection, progress tracking and reporting, reviewing progress payment requests, reviewing contractor submittals and work plans, addressing contractor requests for information and change order requests, leading adaptive design changes, and communicating with the Owner and EPA. It also includes monitoring and inspection for structural stability when dredging adjacent to existing structures. Note that the construction management effort will comprise various

inspection specialties (structural, geotechnical, etc.) overseeing different construction activities, and labor for these specialties are already accounted for in this cost line item.
  - **Environmental compliance monitoring**, which includes activities during construction such as confirmatory sediment sampling and contingency action determination, water quality monitoring, air/noise/light monitoring, and inadvertent discovery monitoring.
- **Site access agreements and temporary leases** include costs for leases, if needed, and coordination costs associated with construction site access (e.g., directed barge or vessel temporary relocations, Tribal Usual and Accustomed fishing agreements).
- **Community outreach and communications** include planning-level costs for actions that will be used to engage with community members during construction activities related to the cleanup of the upper reach.

3.3 Additional Construction Oversight Tasks

Additional construction oversight tasks include supplemental activities conducted by EPA to provide QA during construction.

4 Costing Assumptions Used for the Final (100%) RD

The Final (100%) RD criteria form the basis for development of the upper reach Engineer's Cost Estimate. General and specific RD costing assumptions are summarized in this section. Further details are contained on the Drawings (Volume III) and in the detailed Engineer's cost estimate workbook (Attachment O.1).

4.1 General Costing Assumptions

The following are general assumptions used in the Final (100%) RD Engineer's Cost Estimate:

- **Construction Seasons:** In-water construction activities for the LDW upper reach will occur during fish windows designated for the LDW (generally from October 1 through February 15, equivalent to 138 calendar days[2]). The contractor may not be able to conduct work during Tribal fishing activities and other events that impact its access to the work area. Therefore, for the Final (100%) RD, it is estimated that remedial construction for the LDW upper reach will span three construction seasons based on production rates for dredging, material placement, and structural activities (see Sections 10.2.5 and 10.6.6 of the BODR and Attachment O.1.5) to closely mirror recently experienced regional remediation production rates in Puget Sound and in alignment with anticipated typical daily transloading and dredged material transportation and disposal rates.
- **Daily Work Schedule:** It is assumed that work will be performed in one 10-hour shift per day, 6 days per week, during the following work hours: 7:00 a.m. to 7:00 p.m. on weekdays and 9:00 a.m. to 7:00 p.m. on Saturdays. Note that, for costing purposes only, general project conditions (such as work conducted during standard work hours) have been assumed in this Final (100%) RD Engineer's Cost Estimate to reflect the most representative daily contractor operations conducted during the winter season; actual work hour limits are included in the project Final (100%) Specifications.
- **Sales Tax:** Sales tax is included at 10.25% to account for Washington State (6.5%) and the City of Seattle (3.75%) taxes. Although the upper reach SMAs fall into the Cities of Seattle and Tukwila and unincorporated King County area jurisdictions, for the purposes of this Final (100%) RD Engineer's Cost Estimate, sales tax for the City of Seattle is included as a conservative assumption for the Final (100%) RD; sales tax for the City of Tukwila and unincorporated King County areas is 10.1%.
- **Contingency:** A 25% contingency is applied to total direct construction, indirect construction, and additional construction oversight costs, based on consideration of potential cost uncertainty associated with the level of information currently available and engineering best professional judgment. Due to the nature of the project (i.e., environmental sediment

[2] Equivalent to an effective 111 days per construction season, excluding 10 Sundays and 7 holidays.

remediation), additional factors that cannot be forecasted at this time—such as scope unknowns (i.e., significant changes in site conditions or quantities), price uncertainty (i.e., varying market conditions, increasing inflation, fuel and labor changes), or any other unforeseen circumstances (i.e., additional design requirements)—may influence contractor bidding prices and impact the final project costs outside, in excess, or below this contingency.

All costs in this Final (100%) RD Engineer's Cost Estimate are presented in present-day U.S. dollars (i.e., 2023).

4.2 Specific Remedial Design Costing Assumptions

The following specific RD assumptions are incorporated into the Final (100%) RD Engineer's Cost Estimate:

- **Required Dredging:**
  - Required cut thicknesses or elevations for the SMAs and associated side-slopes, as shown on the Drawings (Volume III)
  - Overdredge allowance of 1 foot in excess of the required cut thickness or elevation within the dredge footprint and associated side-slopes
  - Dredging around existing structures considers horizontal dredge offset requirements based on adjacent required sediment removal elevations/thickness cuts and associated short- and long-term structure stability (see Section 9.2.1 of the BODR).
- **Contingency Re-Dredging:** Consists of one additional dredging pass conducted over a portion of the total dredge area with the following assumptions:
  - 15% of the total dredge area to be re-dredged to a total 1-foot thickness (including a 6-inch overdredge allowance) to address generated residuals that have concentrations elevated above RMC placement criteria
  - An additional 20% of the total dredge area to be re-dredged to a total 2.5-foot thickness (including a 6-inch overdredge allowance) to remove missed inventory
- **Identified Debris:** An estimated 780 tons of larger debris are assumed for this Engineer's Cost Estimate for discrete and separate removal and disposal, based on visual aerial observations, shoreline photograph inventory, and measurements derived from ArcGIS LDW web map imagery of the LDW upper reach shorelines/banks; identified debris includes generally large concrete blocks as shown on the Drawings (Volume III; see also Section 2.3.10 of the BODR). For this Engineer's Cost Estimate, buried and smaller debris is considered to be incidental dredge debris, and its removal, transportation, and disposal are accounted for in the total dredge volume.
- **Structural Work:** This item includes the costs for removal, offloading, upland transportation, and disposal of 36 timber piles; installation of two steel replacement piles; and bulkhead

strengthening and reinforcement. Costs for outfall pipe energy dissipator installation are included under the structural work task.

- **Disposal of Dredge/Excavated Sediment at Permitted Off-Site Subtitle D Disposal Facility:** For costing purposes, it is assumed that all dredged material will be disposed of at a Subtitle D landfill.
- **Standby Time:** Paid standby time is assumed for costing purposes to be 20 days total over the three construction seasons. This is the time for work stoppage of contractor construction equipment to allow for Tribal fishing activities during the in-water work window.
- **Placement of Backfill:**
  - Backfill is intended to restore, for habitat purposes, the sediment bed to pre-construction elevations and to flatten temporary steeper dredge cuts (e.g., along the Boeing Plant 2 Early Action Area).
  - All dredge areas located outside of the federal navigation channel and above elevation -10 feet mean lower low water are assumed to be backfilled and integrated with habitat material placement in intertidal areas as appropriate, as shown on the Drawings (Volume III; see also Section 10.2.10 of the BODR). As described in Section 14.1 of the BODR, the backfill volume for each SMA design was calculated by developing a backfill TIN surface model with AutoCAD Civil3D software, based on backfill design placement elevations and grades, as well as the final design dredge plan to be backfilled (back from the overdredge allowance surface). The backfill volume also accounts for a 6-inch vertical overplacement tolerance.
  - For costing purposes, backfill material is assumed to conform to a gravelly sand placed in sloped dredge surfaces and a medium-to-coarse-grained sand placed in flat dredge surfaces (see Section 10.6.1 of the BODR).
- **Placement of Required RMC:**
  - RMC is assumed to be placed over 100% of the dredge areas that do not receive backfill and in specific SMAs (as shown on the Drawings [Volume III]).
  - The RMC placement footprint includes dredge cut side-slopes areas (top to toe of dredge cut daylight).
  - For costing purposes, the following is assumed:
    - Over the dredge flat areas within the dredge SMAs, RMC is assumed to be placed at a 9-inch targeted placement thickness, plus the upper end of the vertical placement tolerance.
    - On the dredge cut side-slopes (top to toe of dredge cut daylight), RMC is assumed to be placed at a 24-inch targeted placement thickness, plus the upper end of the vertical placement tolerance (see Section 10.2.9 of the BODR).
    - Required RMC material is assumed to conform to a medium-to-coarse-grained sand (see Section 10.6.1 of the BODR).

- **Placement of Inner and Outer Perimeter RMC:**
  - The perimeter RMC placement surrounding the dredge areas consists of two buffer areas: the inner and the outer perimeter RMC, which generally are each 20 feet wide in the upstream and cross-channel directions and 30 feet wide in the downstream direction.
  - Inner perimeter RMC will be automatically placed surrounding the dredge area (from top of dredge cut daylight), without the need for perimeter sampling.
  - Outer perimeter RMC consists of RMC placed within an assumed 25% of the perimeter outside and surrounding the inner RMC perimeter. Perimeter sediment sampling results within the outer perimeter will be performed to determine whether there is a need for RMC placement in the outer perimeter.
  - For costing purposes, the following is assumed:
    - Both inner and outer perimeter RMCs are assumed to be placed at a 9-inch targeted placement thickness, plus the upper end of the vertical placement tolerance.
    - Inner and outer perimeter RMC material is assumed to conform to a medium-to-coarse-grained sand.
- **Placement of ENR:**
  - ENR will be placed in specific SMAs (as shown on the Drawings [Volume III]). The ENR quantity assumes a placement footprint that includes a 10-foot buffer around the planned ENR placement area as shown on the Drawings.
  - For costing purposes, ENR is assumed to be placed at a 9-inch targeted placement thickness, plus the upper end of the vertical placement tolerance.
  - For costing purposes, ENR material is assumed to conform to a medium-to-coarse-grained sand (see Section 10.6.1 of the BODR).
- **Placement of Area-Specific Technology B – Amended Cover:**
  - Amended cover will be placed to limited portions of SMAs 7 and 13, as shown on the Drawings [Volume III]). For costing purposes, the amended cover material is assumed to include amendment (uniform blending) with granular activated carbon [GAC] at a 2% dose (by dry weight, to achieve a minimum of 1.0% design dosage; see Section 10.5.2 of the BODR and Appendix K).
  - For costing purposes, amended cover is assumed to be placed at a 12-inch targeted placement thickness, plus the upper end of the vertical placement tolerance.
  - For costing purposes, amended cover material is assumed to conform to gravelly sand mixed with GAC (see Section 10.6.1 of the BODR).

- **Placement of Engineered Caps A (in SMA 5) and B (in SMA 12B):**
  - As described in Section 10.3 of the BODR, engineered caps are assumed to be placed within the shoreline slope of SMA 5 and within SMA 12B (as shown on the Drawings [Volume III]). For costing purposes, the caps are assumed to consist of three layers:
    - Isolation layer (conforming to gravelly sand material, with 12-inch minimum thickness plus a 6-inch maximum overplacement allowance)
    - Filter layer (conforming to gravel material, with 6-inch minimum thickness plus a 6-inch maximum overplacement allowance)
    - Erosion protection layer (conforming to quarry spalls, with a 12-inch minimum thickness plus a 6-inch maximum overplacement allowance)
  - In addition, Engineered Cap A includes the application of 310 tons of a well-graded rounded gravelly sand as a cap surface layer.
- **Planting Preparation, Landscaping, and Maintenance in SMA 5:**
  - A planting area will be installed along the length of Engineered Cap A in SMA 5 starting from a 2.5-foot offset from the post-cap top of bank. The planting area is approximately 9,050 square feet. For costing purposes, planting preparation, landscaping, and maintenance for the planting area assume the following:
    - All existing soil outside the extents of Engineered Cap A and within the planting area will be rototilled to a 12-inch minimum depth.
    - To protect topsoil, a filter layer will be placed at a 12-inch thickness at the interface of Engineered Cap A and the erosion protection layer along the length of Engineered Cap A.
    - Riparian seed mix will be placed at an approximate 6-foot width along the length of Engineered Cap A.
    - Plant quantities will be spaced in a triangular formation for groundcovers and shrubs.
    - Mulch will be placed in the riparian understory area at a 3-inch depth.
    - Wire mesh fencing for herbivore exclusion will be installed around the perimeter of the planting area.
    - Temporary irrigation will be required in the entire planting area.
    - This cost is for a 1-year maintenance period following planting work.
- **Project Management:** This cost is assumed on a monthly basis for the total construction duration and additional time needed for project management activities before and after each construction season.
- **Engineering Support Services:** This cost is assumed on a monthly basis for the total construction duration and additional time needed for engineering support before and after each construction season.
- **Construction QA:**

  - **Construction Management**: This cost is assumed on a monthly basis for the total construction duration and additional time needed for construction management before and after each construction season.
  - **Environmental Compliance Monitoring:** This includes costs for equipment, labor, analytical, and data validation for sediment and water quality sampling, as well as air/noise/light monitoring and inadvertent discovery monitoring, incurred during construction.
- **Site Access Agreements and Temporary Leases:** This is assumed to include allowances for Tribal Usual and Accustomed fishing agreements and directed barge or vessel temporary relocations. It is not anticipated that special leases will be required.
- **Community Outreach and Communications**: This planning-level cost includes actions that will be used to engage with community members during construction activities related to the cleanup of the upper reach.
- **EPA Construction Oversight:** This cost is assumed on a monthly basis for the total construction duration and additional time needed before and after each construction season.

5 Dredge and Material Placement Quantities Summary

The Final (100%) RD dredging and material placement quantities for the LDW upper reach are summarized in Tables O5-1 and O5-2, respectively.

Table O5-1
Summary of Final (100%) RD Dredging Quantities

Required Dredge Volume (CY)	Overdredge Allowance Volume (CY)	Contingency Re-Dredging Volume (CY)	Total Dredge Volume[1] (CY)
100,500	22,300	9,500	132,300

Notes:
Total dredge volume includes the following: 1) required dredge volume, including associated external side-slope and transition (between SMAs) volumes, as shown on the Drawings (Volume III); 2) 1-foot overdredge allowance (with the exception of SMA 5) on the entire dredge footprint; and 3) contingency re-dredging volume (with the exception of SMAs 5 and 12B). Total dredge volume includes required dredge and required excavation volumes.

1. Volumes are rounded to the nearest hundred. See the detailed Engineer's Cost Estimate workbook, Attachment O.1 (Attachment O.1.4), for detailed dredging quantities.

CY: cubic yard

RD: remedial design

SMA: sediment management area

Table O5-2
Summary of Final (100%) RD Material Placement Quantities

Backfill Placement Volume (CY)	RMC + Inner/Outer Perimeter RMC Placement Volume (CY)	ENR Placement Volume (CY)	Amended Cover Placement Volume (CY)	Engineered Cap A (SMA 5) Placement Volume (CY)	Engineered Cap B (SMA 12B) Placement Volume (CY)	Total Placement Volume (CY)
57,600	25,200	400	300	3,700	8,000	95,200

Notes:

- Volumes are rounded to the nearest hundred. See the detailed Engineer's Cost Estimate workbook, Attachment O.1 (Attachment O.1.4), for detailed material placement quantities.
- Amended cover is to be placed in limited portions of SMA 7 and in SMA 13, as shown on the Drawings (Volume III).
- Engineered Cap A for SMA 5 is to be placed along the shoreline bank portion of the SMA, as shown on the Drawings.
- Engineered Cap B for SMA 12B is to be placed in a portion of the SMA, as shown on the Drawings.
- ENR placement volume does not include the volume associated with SMA-c1 (cPAH-only area, which adds approximately 100 CY).

CY: cubic yard
ENR: enhanced natural recovery
RD: remedial design
RMC: residuals management cover
SMA: sediment management area

6 Costs Summary

The Engineer's Cost Estimate for the Final (100%) RD for the upper reach is summarized in Table O6-1.

As described in Section 4.1, a contingency of 25% was applied at the Final (100%) RD level to the total direct construction, total indirect construction, and total additional construction oversight costs. This contingency is based on potential cost uncertainty associated with the level of information currently available and best professional judgment. It also accounts for scope unknowns, price uncertainty, and any other unforeseen circumstances that may impact the final project costs.

In addition, specific construction tasks are included in this Final (100%) RD Engineer's Cost Estimate but considered as allowances to cover potential costs incurred due to uncertainty in the associated scope. Two types of allowances are included: 1) allowances for construction tasks considered reasonably likely to occur and their scope (e.g., contingency re-dredging volume, outer perimeter RMC volume, identified debris quantity, and standby time); and 2) allowances for construction tasks considered highly unlikely to occur but are still presented (e.g., environmental controls).

Table O6-1
Total Project Cost for LDW Upper Reach Implementation at Final (100%) RD

Task ID	Task Description	Probable Total Cost
Direct Construction Costs		
1	Mobilization/Demobilization	$3,869,100.00
2	Site Preparation	$264,000.00
3	Surveys	$1,211,270.00
4	Structural Work	$870,912.00
5	Dredging, Excavation, Transloading, Upland Transportation, and Disposal	$23,395,224.00
6	Material Placement	$6,037,738.00
7	Environmental Controls	$150,000.00
8	Planting Preparation, Landscape, and Maintenance – SMA 5	$128,133.00
	Direct Construction Costs Subtotal	**$35,926,377.00**
9	Direct Construction Contingency (25.0 %)	$8,981,594.00
	Direct Construction Costs Subtotal with Contingency	**$44,907,971.00**
10	Sales Tax (10.25%)	$4,603,067.00
	Total Direct Construction Costs (with Contingency and Sales Tax) – Rounded	**$49,512,000.00**
Indirect Construction Costs		
11	Project Management	$3,750,000.00
12	Engineering Support Services	$665,000.00
13	Construction QA	$7,222,100.00
14	Site Access Agreements and Temporary Leases	$150,000.00
15	Community Outreach and Communications	$300,000.00
	Indirect Construction Costs Subtotal	**$12,087,100.00**
16	Indirect Construction Contingency (25.0 %)	$3,021,775.00
	Total Indirect Construction Costs (with Contingency) – Rounded	**$15,109,000.00**
Additional Construction Oversight Costs		
17	Additional Construction Oversight Costs	**$1,550,000.00**
18	Additional Construction Oversight Contingency (25.0 %)	**$387,500.00**
	Total Additional Construction Oversight Costs (with Contingency) – Rounded	**$1,938,000.00**
19	**Total Project Costs – Rounded**	**$66,559,000.00**

Notes:
- Costs are presented in present-day U.S. dollars (i.e., 2023).
- Sales tax is included at 10.25% to account for Washington State (6.5%) and the City of Seattle (3.75%) taxes.
- Attachment O.1 contains the detailed Engineer's Cost Estimate workbook for the Final (100%) RD Engineer's Cost Estimate.

LDW: Lower Duwamish Waterway
QA: quality assurance
RD: remedial design
SMA: sediment management area

7 Conceptual Long-Term Maintenance and Monitoring Costs

The Final (100%) RD includes an annotated outline for the Long-Term Maintenance and Monitoring Plan (LTMMP), but costs associated with long-term maintenance and monitoring will be developed when the LTMMP is developed after Final (100%) RD is completed. For Final (100%) RD, conceptual long-term maintenance and monitoring costs associated with the sediment remedy for the upper reach were developed by applying the Alternative 5C post-construction performance monitoring, operations, maintenance, and repair costs presented in the *Final Feasibility Study, Lower Duwamish Waterway* (AECOM 2012). Because the LDW upper reach is approximately one-third of the entire LDW project site, the conceptual long-term maintenance and monitoring costs for the upper reach sediment remedy were assumed to be approximately $14.5 million (escalated from 2012 dollars to 2023 dollars) for a 30-year period.

8 References

AECOM, 2012. *Final Feasibility Study, Lower Duwamish Waterway*. Submitted to EPA October 2012.

Anchor QEA and Windward (Anchor QEA, LLC; Windward Environmental LLC), 2019. *Remedial Design Work Plan for the Lower Duwamish Waterway Upper Reach*. Final. Submitted to EPA December 16, 2019.

EPA (U.S. Environmental Protection Agency), 2014. *Record of Decision*. Lower Duwamish Waterway Superfund Site. November 2015.

Appendix O – Final (100%) Remedial Design
Engineer's Cost Estimate

Attachment O.1
Detailed Engineer's Cost Estimate Workbook

Attachment O.1.1
Summary 100% RD Engineer's Cost Estimate

Task ID	Task Description	Probable Total Cost ($)
DIRECT CONSTRUCTION COSTS		
1	Mobilization/Demobilization	$ 3,869,100.00
2	Site Preparation	$ 264,000.00
3	Surveys	$ 1,211,270.00
4	Structural Work	$ 870,912.00
5	Dredging, Excavation, Transloading, Upland Transportation, and Disposal	$ 23,395,224.00
6	Material Placement	$ 6,037,738.00
7	Environmental Controls	$ 150,000.00
8	Planting Preparation, Landscape, and Maintenance for SMA 5	$ 128,133.00
	Direct Construction Costs Subtotal	**$ 35,926,377.00**
9	Direct Construction Contingency (25.0%)	$ 8,981,594.00
	Direct Construction Cost Subtotal with Contingency	**$ 44,907,971.00**
10	Sales Tax (10.25%)	$ 4,603,067.00
	Total Direct Construction Costs (with Contingency and Sales Tax) - Rounded	**$ 49,512,000.00**
INDIRECT CONSTRUCTION COSTS		
11	Project Management	$ 3,750,000.00
12	Engineering Support Services	$ 665,000.00
13	Construction Quality Assurance	$ 7,222,100.00
14	Site Access Agreements and Temporary Leases	$ 150,000.00
15	Community Outreach and Communications	$ 300,000.00
	Indirect Construction Costs Subtotal	**$ 12,087,100.00**
16	Indirect Construction Contingency (25.0%)	$ 3,021,775.00
	Indirect Construction Costs Subtotal with Contingency	**$ 15,108,875.00**
	Total Indirect Construction Costs (with Contingency) - Rounded	**$ 15,109,000.00**
ADDITIONAL CONSTRUCTION OVERSIGHT COSTS		
17	Additional Construction Oversight Costs	$ 1,550,000.00
	Additional Construction Oversight Costs Subtotal - Rounded	**$ 1,550,000.00**
18	Additional Construction Oversight Contingency (25.0%)	$ 387,500.00
	Additional Construction Oversight Costs Subtotal with Contingency	**$ 1,937,500.00**
	Total Additional Construction Oversight Costs (with Contingency) - Rounded	**$ 1,938,000.00**
19	**TOTAL PROJECT COSTS**	**$ 66,559,000.00**

Notes:

1. In providing this Engineer's Cost Estimate (Opinion of Probable Cost), the Client understands that the Consultant (Anchor QEA, LLC) has no control over the cost or availability of labor, equipment, or materials, or over market condition or the Contractor's method of pricing, and the Consultant's Engineer's construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the work will not vary from the Consultant's Engineer's construction costs.

2. Costs are presented in present-day U.S. dollars (i.e., 2023).

3. Although the upper reach SMAs fall into both the Cities of Seattle and Tukwila and Unincorporated King County area jurisdictions, for the purposes of this engineer's cost estimate, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Final (100%) RD; City of Tukwila tax rate and Unincorporated King County areas is 10.1%.

4. A 25% contingency is applied to both total direct construction, total indirect construction costs and total additional construction oversight costs, based on consideration of potential cost uncertainty associated with the level of information currently available and engineering best professional judgement. Due to the nature of the project (i.e., environmental sediment remediation), additional factors that cannot be forecasted at this time—such as scope unknowns (i.e., significant changes in site conditions or quantities), price uncertainty (i.e., varying market conditions, increasing inflation, fuel and labor changes), or any other unforeseen circumstances (i.e., additional design requirements)—may influence contractor bidding prices and impact the final project costs outside, in excess, or below this contingency.

Attachment O.1.2
Detailed 100% RD Engineer's Cost Estimate

Task ID		Task Description	Quantity	Units	Probable Unit Cost ($)	Probable Total Cost ($)
DIRECT CONSTRUCTION COSTS						
1		**Mobilization/Demobilization**				
1	a	Mobilization/Demobilization for All Equipment (In-Water, Specialized, Upland)	3	LS	$ 1,200,000.00	$ 3,600,000.00
1	b	Procedural Costs and Contractor Workplan Submittals	3	LS	$ 89,700.00	$ 269,100.00
2		**Site Preparation**				
2	a	Shoreline/Upland Site Preparation (Removal, Handling, Disposal and/or Reuse)	1	AC	$ 14,000.00	$ 14,000.00
2	b	Upland Staging Area Setup and Site Decommissioning	1	LS	$ 250,000.00	$ 250,000.00
3		**Surveys**				
3	a	Contractor Progress Surveys	264	EA	$ 3,000.00	$ 792,169.72
3	b	Pre-Construction Surveys (Bathy and Topo)	3	LS	$ 23,300.00	$ 69,900.00
3	c	Post-Dredge Construction Survey (per SMA)	15	EA	$ 8,000.00	$ 120,000.00
3	d	Post-Placement Construction Survey (per SMA)	17	EA	$ 8,000.00	$ 136,000.00
3	e	Post-Construction Survey (Bathy and Topo)	3	LS	$ 23,300.00	$ 69,900.00
3	f	As-Built Surveys	1	LS	$ 23,300.00	$ 23,300.00
4		**Structural Work**				
4	a	Remove Timber Piles, Including Dolphins	1	LS	$ 122,531.90	$ 122,531.90
4	b	Replace Timber Piles with Steel Pipe Piles	1	LS	$ 25,443.88	$ 25,443.88
4	c	Strengthening/ Reinforcing of Existing Bulkheads	1	LS	$ 492,936.00	$ 492,936.00
4	d	Outfall Protection and Energy Dissipation	1	LS	$ 230,000.00	$ 230,000.00
5		**Dredging, Excavation, Transloading, Upland Transportation, and Disposal**				
5	a	Required Dredging and In-Water Transportation (Open-Water)	89,720	CY	$ 25.49	$ 2,287,075.88
5	b	Required Dredging and In-Water Transportation (Nearshore)	12,272	CY	$ 41.61	$ 510,576.80
5	c	Required Dredging and In-Water Transportation (Restricted Access)	2,007	CY	$ 53.91	$ 108,196.18
5	d	Contingency Re-Dredging - Allowance	9,472	CY	$ 40.43	$ 383,005.97
5	e	Shoreline/Bank Excavation	18,740	CY	$ 25.16	$ 471,476.09
5	f	Dredged/Excavated Material Transloading	201,342	TON	$ 5.00	$ 1,006,710.17
5	g	Dredged/Excavated Material Upland Transportation and Disposal (Subtitle D)	200,562	TON	$ 90.00	$ 18,050,582.97
5	h	Identified Debris Removal - Allowance	5	DAY	$ 20,000.00	$ 100,000.00
5	i	Identified Debris Upland Transportation and Disposal (Subtitle D) - Allowance	780	TON	$ 120.00	$ 93,600.00
5	j	Standby Time - Allowance	20	DAY	$ 19,200.00	$ 384,000.00

Task ID		Task Description	Quantity	Units	Probable Unit Cost ($)	Probable Total Cost ($)
6		**Material Placement**				
6	a	Procure/Deliver Material Type 2 for RMC (Required+Inner+Outer Perimeter RMC), ENR and Backfill B	69,086	TON	$ 32.13	$ 2,219,398.35
6	b	Procure/Deliver Material Type 1 for Backfill A and Engineered Caps (B) Chemical Isolation Layer (SMA 12B)	56,679	TON	$ 25.25	$ 1,431,140.21
6	c	Procure/Deliver Material Type 1A for Engineered Cap (A) Chemical Isolation Layer (SMA 5)	1,835	TON	$ 29.25	$ 53,667.27
6	d	Procure/Deliver Materail Type 4 for Engineered Caps (A and B) Filter Layer (SMAs 5 and 12B)	4,444	TON	$ 36.25	$ 161,088.73
6	e	Procure/Deliver Material Type 5 for Engineered Caps (A and B) Erosion Protection Layer (SMAs 5 and 12B)	7,126	TON	$ 34.25	$ 244,050.98
6	f	Procure/ Deliver/ Preparation Material Type 3 (Material Type 1 + GAC) for Amended Cover (SMAs 7 and 13)	440	TON	$ 96.00	$ 42,223.16
6	g	Place Material Type 2 for RMC (Required+Inner+Outer Perimeter RMC) and ENR (Open-Water)	18,681	CY	$ 18.93	$ 353,689.66
6	h	Place Materila Type 2 for RMC (Required+Inner+Outer Perimeter RMC) and ENR (Nearshore)	3,943	CY	$ 21.94	$ 86,514.43
6	i	Place Material Type 2 for RMC (Required+Inner+Outer Perimeter RMC) and ENR (Restricted Access)	1,339	CY	$ 32.55	$ 43,587.67
6	j	Place Material Type 2 for RMC (Required+Inner+Outer Perimeter RMC) and ENR (Land-Based Equipment)	1,606	CY	$ 16.11	$ 25,877.08
6	k	Place Material Types 1 and 2 for Backfills A and B (Open-Water)	30,342	CY	$ 18.93	$ 574,452.59
6	l	Place Material Types 1 and 2 for Backfills A and B (Nearshore)	11,172	CY	$ 21.94	$ 245,162.20
6	m	Place Mateiral Types 1 and 2 for Backfills A and B (Land-Based Equipment)	16,096	CY	$ 16.11	$ 259,307.06
6	n	Place Material Type 3 for Amended Cover (SMAs 7 and 13; Land-Based Equipment)	286	CY	$ 16.11	$ 4,604.03
6	o	Place Material Type 1 for Engineered Cap B Chemical Isolation Layer (SMA 12B; Open-Water)	2,982	CY	$ 26.45	$ 78,884.87
6	p	Place Material Type 4 for Engineered Cap B Filter Layer (SMA 12B; Open-Water)	1,988	CY	$ 27.14	$ 53,953.36
6	q	Place Material Type 5 for Engineered Cap B Erosion Protection Layer (SMA 12B; Open-Water)	2,982	CY	$ 26.24	$ 78,261.58
6	r	Place Material Type 1A for Engineered Cap A Chemical Isolation Layer (SMA 5; Land-Based Equipment)	1,133	CY	$ 22.03	$ 24,954.56
6	s	Place Material Type 4 for Engineered Cap A Filter Layer (SMA 5; Land-Based Equipment)	755	CY	$ 22.31	$ 16,844.33
6	t	Place Material Type 5 for Engineered Cap A Erosion Protection Layer (SMA 5; Land-Based Equipment)	1,768	CY	$ 22.67	$ 40,075.81
7		**Environmental Controls**				
7	a	Environmental Controls - Allowance	3	LS	$ 50,000.00	$ 150,000.00
8		**Planting Preparation, Landscape, and Maintenance for SMA 5**				
8	a	Planting Preparation, Landscape, and Maintenance for SMA 5	1	LS	$ 128,132.52	$ 128,132.52
		Direct Construction Costs Subtotal				**$ 35,926,377.00**
9		**Direct Construction Contingency**	25.00%	PERCENT		$ 8,981,594.00
		Direct Construction Cost Subtotal with Contingency				**$ 44,907,971.00**
10		**Sales Tax**	10.25%	PERCENT		$ 4,603,067.00

Attachment O.1.2
Detailed 100% RD Engineer's Cost Estimate

Task ID		Task Description	Quantity	Units	Probable Unit Cost ($)	Probable Total Cost ($)
		Total Direct Construction Costs (with Contingency and Sales Tax) - Rounded				**$ 49,512,000.00**
INDIRECT CONSTRUCTION COSTS						
11		**Project Management**	25.0	MO	$ 150,000.00	$ 3,750,000.00
12		**Engineering Support Services**	19.0	MO	$ 35,000.00	$ 665,000.00
13		**Construction Quality Assurance**	1	LS	$ 7,222,100.00	$ 7,222,100.00
13	a	Construction Management (Inspection and Oversight)	17.0	MO	$ 250,800.00	$ 4,263,600.00
13	b	Environmental Compliance Monitoring	1	LS	$ 2,958,500.00	$ 2,958,500.00
14		**Site Access Agreements and Temporary Leases**	1	LS	$ 150,000.00	$ 150,000.00
15		**Community Outreach and Communications**	1	LS	$ 300,000.00	$ 300,000.00
		Indirect Construction Costs Subtotal				**$ 12,087,100.00**
16		**Indirect Construction Contingency**	25.00%	PERCENT		$ 3,021,775.00
		Indirect Construction Costs Subtotal with Contingency				**$ 15,108,875.00**
		Total Indirect Construction Costs (with Contingency) - Rounded				**$ 15,109,000.00**
ADDITIONAL CONSTRUCTION OVERSIGHT COSTS						
17		**Additional Construction Oversight Costs**				
17	a	EPA Oversight	25.0	MO	$62,000.00	$ 1,550,000.00
		Additional Construction Oversight Costs Subtotal - Rounded				**$ 1,550,000.00**
18		**Additional Construction Oversight Contingency**	25.00%	PERCENT		$ 387,500.00
		Additional Construction Oversight Costs Subtotal with Contingency				**$ 1,937,500.00**
		Total Additional Construction Oversight Costs (with Contingency) - Rounded				**$ 1,938,000.00**
19		**TOTAL PROJECT COSTS**				**$66,559,000.00**

Notes:

1. In providing this Engineer's Cost Estimate (Opinion of Probable Cost), the Client understands that the Consultant (Anchor QEA, LLC) has no control over the cost or availability of labor, equipment, or materials, or over market condition or the Contractor's method of pricing, and the Consultant's Engineer's construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, express or implied, that the bids or the negotiated cost of the work will not vary from the Consultant's Engineer's construction costs.

2. Costs are presented in present-day U.S. dollars (i.e., 2023).

3. Although the upper reach SMAs fall into both the Cities of Seattle and Tukwila and Unincorporated King County area jurisdictions, for the purposes of this engineer's cost estimate, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Final (100%) RD; City of Tukwila tax rate and Unincorporated King County areas is 10.1%.

4. A 25% contingency is applied to both total direct construction, total indirect construction costs and total additional construction oversight costs, based on consideration of potential cost uncertainty associated with the level of information currently available and engineering best professional judgement. Due to the nature of the project (i.e., environmental sediment remediation), additional factors that cannot be forecasted at this time—such as scope unknowns (i.e., significant changes in site conditions or quantities), price uncertainty (i.e., varying market conditions, increasing inflation, fuel and labor changes), or any other unforeseen circumstances (i.e., additional design requirements)—may influence contractor bidding prices and impact the final project costs outside, in excess, or below this contingency.

AC: acre
CY: cubic yard
EA: each
GAC: granular activated carbon
LS: lump sum
MO: month
RD: remedial design
SF: square foot
SMA: sediment management area
TON: U.S. ton

General Notes		
1		The approach for developing the LDW upper reach Engineer's Cost Estimate was based on several sources of information, including the following: • Anchor QEA's best professional judgment and past experience with similar remedial actions and associated pricing • Review of contractor's bid costs and engineer's construction cost estimates for similar remediation projects completed (locally) in Seattle, Washington and (regionally) in the Pacific Northwest, as well as knowledge of construction activities and challenges identified during construction oversight. • Engineering cost guidance (RS Means). Anchor QEA performed a detailed internal review of the cost assumptions and unit prices to determine their relevance, anticipated accuracy, and cost variability.
2		Assumed CY to TON conversions: 1) sediment: 1.5 TON/CY (in situ); 2) sand/gravel mix: 1.6 TON/CY, 3) sand: 1.4 TON/CY; 4) for quarry spalls: 1.5 TON/CY.
3		Although the upper reach SMAs fall into both the Cities of Seattle and Tukwila and Unincorporated King County area jurisdictions, for the purposes of this engineer's cost estimate, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Final (100%) RD; City of Tukwila tax rate and Unincorporated King County areas is 10.1%.
4		Estimated costs assume that construction could occur without interruptions from ongoing site operational uses, except as noted by stand-by time.
Specific Notes by Task ID		
DIRECT CONSTRUCTION COSTS		
1		**Mobilization/Demobilization**
1	**a**	Mobilization/Demobilization cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumes three mobilization/demobilization events, which includes: 150-ton derrick/spud rig, 5- to 8-cy buckets, 2 tugs, up to 4 x 1,700-ton scows, work boat, front-end loader, and specialized equipment (i.e., various bucket sizes) for working in shallow-water environments and under restricted conditions. Costs also includes costs for bond and insurance premiums (estimated to be 2% of the total direct construction costs). Includes three mobilization/demobilization events for three construction seasons (in-water work window is defined as October 1 through February 15).
1	**b**	Includes labor for procedural costs and contractor's development of required workplans and submittals. Costs estimated from Anchor QEA past project experience. Includes three sets of project workplans and submittals for three construction seasons.
2		**Site Preparation**
2	**a**	Includes shoreline preparation and remediation, estimated on a acre-basis, from Anchor QEA past project experience for similar projects of similar size.
2	**b**	Includes preparation of an upland area at a designated location (TBD) for contractor use for on site trailer office and other temporary facilities, as well as staging of equipment. Also, site decommissioning costs are included. Estimated from Anchor QEA past project experience for similar projects of similar size.
3		**Surveys**
3	**a**	Contractor progress bathymetric survey cost assumes multi-beam hydrographic survey equipment using: Real-Time Kinematic (RTK) GPS Positioning, Motion Platform, Multibeam Sonar, SV Profiler, eqQPS QINSy Software, mobilization/demobilization of survey vessel and survey equipment, data processing and product generation, one boat operator, and one licensed surveyor. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Contractor progress bathymetric survey costs assumed for the dredging and placement durations.
3	**b**	Includes costs for payment bathymetric and topographic surveys to be conducted prior to construction for the whole LDW upper reach site. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Includes three sets of pre-construction bathy/topo surveys for three construction seasons.
3	**c**	Includes costs for payment bathymetric survey to be conducted post-dredging for each SMA that requires dredging. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects.
3	**d**	Includes costs for payment bathymetric survey to be conducted post-backfill, Required RMC, Inner Perimeter RMC, Contingent Perimeter RMC, ENR, Amended Cover, Engineered Caps A and B placement for each SMA that requires material placement. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects.
3	**e**	Includes costs for payment bathymetric and topographic surveys to be conducted post-construction for the whole LDW upper reach site. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Includes three sets of post-construction bathy/topo surveys for three construction seasons.
3	**f**	Includes costs for final as-built surveys to be conducted post-construction for the whole LDW upper reach site. Cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Includes one set of as-built surveys at the end of the third construction season.

4		**Structural Work**
4	**a**	Cost provided by Bright Engineering Inc. in October 2023. See Attachment O.1.6 for detailed assumptions for costing.
4	**b**	Cost provided by Bright Engineering Inc. in October 2023. See Attachment O.1.6 for detailed assumptions for costing.
4	**c**	Cost provided by Bright Engineering Inc. in October 2023. See Attachment O.1.6 for detailed assumptions for costing.
4	**d**	Cost provided by Bright Engineering Inc. in October 2023. See Attachment O.1.6 for detailed assumptions for costing.
5		**Dredging, Excavation, Transloading, Upland Transportation, and Disposal**
5	**a**	Open-water dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required dredge volume and daylight dredge volume for open-water dredging. Probable open-water dredge production rate estimated to be approximately 1,100 CY/10-hour shift.
5	**b**	Nearshore dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required dredge volume and daylight dredge volume for dredging conducted in nearshore shallow areas, slopes, and any slow dredging. Probable nearshore dredge production rate estimated to be approximately 700 CY/10-hour shift.
5	**c**	Restricted access dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required dredge volume and daylight dredge volume for dredging conducted under bridge, near structures or bulkhead. Probable restricted access dredge production rate estimated to be approximately 500 CY/10-hour shift.
5	**d**	Contingency re-dredging unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Contingency re-dredging conducted over a portion of the total dredge area, applied to a 1-ft thickness to address generated residuals (15% of area; 1-ft thickness includes a 6-in overdredge allowance) and 2.5-ft thickness to remove missed inventory (20% of area; 2.5-ft thickness includes a 6-in overdredge allowance). Contingency re-dredging production rate estimated to be 700 CY/10-hour shift. These costs are considered an 'allowance' for this Final (100%) RD Engineer's Cost Estimate.
5	**e**	Excavation unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Volume includes required excavated volume and daylight excavated volume in shorelines and riverbanks. Probable excavation production rate estimated to be approximately 500 CY/10-hour shift.
5	**f**	Transloading unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Contractor's tonnage for transloading calculated from the contractor's dredge/excavated and incidental debris volume (converted with a 1.5 TON/CY factor), and anticipated identified debris tonnage (converted with a 1.9 TON/CY factor).
5	**g**	Transportation and disposal unit cost in a Subtitle D landfill facility based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Tonnage for transportation and disposal calculated from the contractor's dredge/excavated, amended dredge and incidental debris volume (converted with a 1.5 TON/CY factor) for material designated as "Subtitle D" Landfill Waste.
5	**h**	Identified debris removal unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Debris removal includes visible and potentially buried debris associated with concrete blocks, timber piling, steel I beams, rubble, cables, and other items. Identified debris dimensions/quantities estimated based on visual aerial observations, shoreline photograph inventory, and measurements derived ArcGIS LDW webmap imagery, of the LDW upper reach shorelines/riverbanks for larger debris items. Buried and smaller debris is considered incidental dredge debris and its removal, transportation, and disposal are already accounted for in the contractor's dredge volume. These costs are considered an 'allowance' for this Final (100%) RD Engineer's Cost Estimate.
5	**i**	Identifies debris transportation and disposal unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Tonnage for transportation and disposal calculated for identified debris material is assumed to be designated as "Subtitle D" Landfill Waste. These costs are considered an 'allowance' for this Final (100%) RD Engineer's Cost Estimate.
5	**j**	In-water standby time is estimated to be 20 days of contractor's time, over three construction seasons. Unit cost assumed to include equipment and labor costs at 70% of the daily dredging/placement costs; unit costs based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Work stoppage of contractor construction equipment is assumed due to tribal fishing activities. These costs are considered an 'allowance' for this Final (100%) RD Engineer's Cost Estimate.

6		**Material Placement**
6	**a**	Unit cost for Material Type 2 (for Required RMC [including inner perimeter placement] and Contingent Outer Perimeter RMC), ENR, and Backfill B based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed Material Type 2 cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for in the unit cost. Material Type 2 is assumed to be used for placement of RMC at a 9-in targeted placement thickness (plus 3-in vertical placement tolerance) on the neatline dredge surface area and 2-ft targeted placement thickness (plus a 6-in vertical placement tolerance) on the side slope surface area, ENR at 9-in targeted placement thickness (plus a 3-in vertical placement tolerance), and Backfill B (to pre-construction elevations and to flatten temporary steeper dredge cuts in all dredge areas located outside of the FNC above -10-ft mean lower low water). The RMC quantity also includes an additional automatic inner and contingent outer placement buffer surrounding the dredge area (at 9-in targeted placement thickness plus 3-in vertical placement tolerance); the Contingent Outer Perimeter RMC consists of RMC placed within an assumed 25% of perimeter outside of and surrounding the inner RMC perimeter. The Inner and Outer perimeter RMC are generally 20-ft wide in the upstream and cross channel directions and 30 -ft wide in the downstream direction.
6	**b**	Unit cost for Material Type 1 based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed Material Type 1 unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for in the unit cost. Material Type 1 is assumed to be used for placement of Backfill A (to pre-construction elevations and to flatten temporary steeper dredge cuts in all dredge areas located outside of the FNC above -10-ft mean lower low water), and for placement of Engineered Cap B isolation layer at 1-ft minimum thickness (plus 6-in maximum overplacement allowance).
6	**c**	Unit cost for Material Type 1A based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed Material Type 1A unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for in the unit cost. Material Type 1A is assumed to be used for placement of Engineered Cap A isolation layer at 1-ft minimum thickness (plus 6-in maximum overplacement allowance).
6	**d**	Unit cost for Material Type 4 based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed Material Type 4 unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for in the unit cost. Material Type 4 is assumed to be used for placement of Engineered Caps (A and B) filter layer at 6-in minimum thickness (plus 6-in maximum overplacement allowance).
6	**e**	Unit cost for Material Type 5 based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed Material Type 5 unit cost from a local supplier includes loading onto barge; delivery of material by barge to the LDW upper reach site has also been accounted for in the unit cost. Material Type 5 is assumed to be used for placement of Engineered Caps (A and B) erosion protection layer at 1-ft minimum thickness (plus 6-in maximum overplacement allowance).
6	**f**	Unit cost for Material Type 3 for amended cover placement is based on discussion with local material supplier, review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Assumed GAC unit cost for amended cover includes delivery by truck (from Pacific Coast Carbon, Ridgefield, WA) to LDW upper reach site. GAC material is assumed to be blended at 2% by weight with Material Type 1 to generate Material Type 3 and placed in SMAs 7 and 13. Assumed unit cost includes material procurement (Material Type 1 and GAC) costs and equipment and labor costs required for mixing.
6	**g**	Material Type 2 open-water placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 2 open-water placement rate for RMC/ENR is estimated to be 1,100 CY/10-hour shift.
6	**h**	Material Type 2 nearshore placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 2 nearshore placement rate for RMC/ENR is estimated to be 1,000 CY/10-hour shift.
6	**i**	Material Type 2 restricted access placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 2 restricted access placement rate for RMC/ENR is estimated to be 700 CY/10-hour shift.
6	**j**	Material Type 2 land-based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 2 land-based equipment placement rate for RMC/ENR is estimated to be 800 CY/10-hour shift.
6	**k**	Material Type 1 open-water placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 1 open-water placement rate for backfill and is estimated to be 1,100 CY/10-hour shift.
6	**l**	Material Type 1 nearshore placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 1 nearshore placement rate for backfill and is estimated to be 1,000 CY/10-hour shift.
6	**0**	Material Type 1 restricted access placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 1 restricted access placement rate for backfill and is estimated to be 700 CY/10-hour shift.
6	**m**	Material Type 1 land-based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 1 land-based equipment placement rate for backfill and is estimated to be 800 CY/10-hour shift.

6	**n**	Material Type 3 land-based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 1 land-based equipment placement rate for amended cover and is estimated to be 800 CY/10-hour shift.
6	**o**	Material Type 1 open water placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 1 open water placement rate for Engineered Cap B chemical isolation layer and is estimated to be 800 CY/10-hour shift.
6	**p**	Material Type 4 open water placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 4 open water placement rate for Engineered Cap B filter layer and is estimated to be 800 CY/10-hour shift.
6	**q**	Material Type 5 open water placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 5 open water placement rate for Engineered Cap B erosion protection layer and is estimated to be 800 CY/10-hour shift.
6	**r**	Material Type 1 land based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 1 land-based equipment placement rate for Engineered Cap B chemical isolation layer and is estimated to be 600 CY/10-hour shift.
6	**s**	Material Type 4 land based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 4 land-based placement rate for Engineered Cap A filter layer and is estimated to be 600 CY/10-hour shift.
6	**t**	Material Type 5 land based equipment placement unit cost based on review of contractor's bid costs, construction cost estimates of projects recently completed in Washington State, and Anchor QEA's best professional judgement based on past project experience for similar projects. Material Type 5 land-based placement rate for Engineered Cap A erosion protection layer and is estimated to be 600 CY/10-hour shift.
7		**Environmental Controls**
7	**a**	Costs assume general environmental controls during construction activities. These costs are considered an 'allowance' for this Final (100%) RD Engineer's Cost Estimate.
8		**Planting Preparation, Landscape, and Maintenance for SMA 5**
8	**a**	SMA5 planting, preparation, landscape, and 1-year maintenance includes costs for placement of Material Type 4 for filter layer (at 12-in placement thickness) along the top of Engineered Cap A, for topsoil (at 12-in placement thickness) over the planting area, riparian seed mix, groundcovers, riparian shrubs, and trees.
		Direct construction costs subtotal is the sum of costs from all direct construction tasks.
9		Direct construction contingency of 25% is applied to the direct construction costs subtotal.
		Direct construction costs subtotal with contingency is the sum of direct construction cost subtotal and contingency costs.
10		Although the upper reach SMAs fall into both the Cities of Seattle and Tukwila and Unincorporated King County area jurisdictions, for the purposes of this engineer's cost estimate, sales tax is included at 10.25% (to account for Washington State [6.5%] and the City of Seattle [3.75%] taxes), as a conservative assumption for Final (100%) RD; City of Tukwila tax rate and Unincorporated King County areas is 10.1%.
		Total direct construction costs are the sum of direct construction cost subtotal, contingency costs, and sales tax.
INDIRECT CONSTRUCTION COSTS		
11		Project management costs is assumed on a monthly basis for the total construction duration and additional time needed for project management before and after each construction season.
12		Engineering support services cost is assumed on a monthly basis for the total construction duration and and additional time needed for engineering support before and after each construction season.
13		**Construction Quality Assurance**
13	**a**	Construction management (including inspection and oversight) costs include providing oversight of the contractor's implementation of the sediment remedy. Construction management costs typically refers to in-field work to oversee the contractor's work and includes construction inspection, progress tracking and reporting, reviewing progress payment requests, reviewing contractor submittals and work plans, addressing contractor Requests for Information and change order requests, leading adaptive design changes, and communicating with the Owner and EPA. Construction management cost is assumed on a monthly basis for the total construction duration and additional time needed for construction management before and after each construction season.
13	**b**	Environmental compliance monitoring costs assumed equipment, labor, analytical, and data validation for confirmatory sediment and water quality sampling, as well as air/noise/light monitoring, and cultural resources and inadvertent discovery monitoring.
14		Site access agreements and temporary leases include costs for leases, if needed, and coordination costs associated with site access (e.g., directed barge or vessel temporary relocations, Tribal Usual and Accustomed Fishing agreements. It is not anticipated that special leases will be required.
15		Community outreach and communications include planning-level costs for actions that will be used to engage with community members during construction activities related to the cleanup of the LDW upper reach.
		Indirect construction costs subtotal is the sum of costs from all indirect construction tasks.
16		Indirect construction contingency of 25% is applied to the indirect construction cost subtotal.
		Indirect construction costs subtotal with contingency is the sum of indirect construction cost subtotal and contingency costs.

		Total indirect construction costs are the sum of indirect construction cost subtotal and contingency costs.
ADDITIONAL CONSTRUCTION OVERSIGHT COSTS		
17	**a**	EPA oversight costs include supervision activities by EPA during implementation of the sediment remedy. EPA oversight costs are assumed on a monthly basis for the total construction duration and additional time needed before and after each construction season.
		Additional construction oversight costs subtotal is the sum of costs from implementing oversight and EPA oversight tasks.
18		Additional construction oversight contingency of 25% is applied to the additional construction oversight cost subtotal.
		Additional construction oversight costs subtotal with contingency is the sum of additional construction oversight cost subtotal and contingency costs.
		Total additional construction oversight costs are the sum of additional construction oversight cost subtotal and contingency costs.
19		**Total project cost is the sum of total direct construction costs, indirect construction costs, and additional construction oversight costs.**

Notes:
CY: cubic yard
ENR: enhanced natural recovery
EPA: Environmental Protection Agency
GAC: Granular Activated Carbon
LDW: Lower Duwamish Waterway
LS: lump sum
MO: month
RD: remedial design
RMC: residuals management cover
SMA: sediment management area
TBD: to be determined
TON: U.S. ton

Attachment O.1.4
Detailed Quantities

				Quantities Throughout LDW Upper Reach								RMC Placement Quantities		Backfill Placement Quantities				Dredge/Excavation Volume Distribution (CY)			
Sediment Management Area	Remedial Action Area	Technology Assignment	Slope Assumptions Description	Required ENR/ Amended Cover/ Cap Surface Area (SF)	Required Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side- Slopes Only (CY)	Total Payable Dredge Volume (No Contingency Re-Dredging Included) (CY)	Contingency Re-Dredge Volume (Generated Residuals and Missed Inventory)	Required Surface Area (No Side Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Surface Area (Including Side Slopes) (SF)	Backfill Volume (Neatline+ Sideslope+ Overdepth; CY)	Vertical Placement Tolerance Volume (CY)	Total Backfill Volume	Open Water Dredging (CY)	Nearshore / Slope/ Slow Dredging (CY)	Restricted Access Dredging (CY)	Excavation (Shoreline/Bank) (CY)
18 (1/2/3A and partial 1/2/3B), 17 (1/2/3b partial and 1/2/3C)	AREA 01/02/03	Dredge and Partial Backfill/Partial RMC	2:1 Outside FNC, 3:1 Inside FNC (7/18/22)		77,202	34,761	20,871	2,859	1,287	25,018	1,859	62,127	14,314	35,524	6,342	658	7,000	25,018	0	0	0
16 (partial 4/5/6A and 4/5/6B), 15A (partial 4/5/6A and partial 4/5/6C), 14D (4/5/6D)	AREA 04/05/06	Dredge and Partial Backfill/Partial RMC	2:1 outside FNC, 3:1 Inside (12/7/22)		144,280	56,168	31,033	5,344	2,080	38,457	3,473	125,432	33,217	41,799	7,933	774	8,707	36,450	0	2,007	0
15B	AREA 07	ENR		1,201				0	0	0						0	0	0	0	0	0
14C	AREA 08	Dredge and Backfill	2:1 Slopes All Around (6/21/22)		900	256	38	33	9	81	22			1,156	81	21	102	0	0	0	81
14B	AREA 10	ENR		1,558				0	0	0						0	0	0	0	0	0
14A	AREA 12	Dredge and RMC	3:1 Slopes All Around (6/20/22)		900	570	43	33	21	97	22	900	569	0	0	0	0	97	0	0	0
13	AREA 13	Amended Cover (Area Specific Technology-B)		1,439				0	0	0						0	0				
12b	AREA 14/15/16	Dredge and Backfill/ Cap	3:1 Slopes All Around (7/20/22)	53,684	39,332	37,161	21,110	1,457	1,376	23,943			6,682	31,745	9,203	588	9,791	21,549	2,394	0	0
12a	AREA 17	Dredge and RMC	3:1 Slopes All Around (6/3/22)		3,658	839	151	135	31	318	88	3,658	839	0	0	0	0	318	0	0	0
11B	AREA 36	ENR		2,031				0	0							0					
11A	AREA 19/20	Dredge and Backfill	2:1 Slopes All Around (6/7/22)		8,855	2,456	1,425	328	91	1,844	213			11,311	1,760	209	1,969	0	1,844	0	0
9	AREA 22	Dredge and Partial Backfill/Partial RMC	3:1 Slopes toward the FNC, 2:1 for the rest (12/9/22)		27,416	20,296	7,085	1,015	752	8,852	660	0	4,013	43,699	7,770	809	8,579	6,289	0	0	2,564
8	AREA 23	ENR		2,534				0	0	0						0	0	0	0	0	0
7	AREA 24/25/26	Amended Cover (Area Specific Technology-B)		4,734				0	0	0						0	0				
7	AREA 24/25/26	Dredge and Backfill	2:1 Slopes All Around (12/8/22)		21,645	4,996	2,511	802	185	3,498	521	0	0	26,641	3,498	493	3,991	0	3,499	0	0
6	AREA 27	Dredge and Backfill	2:1 Slopes All Around (6/21/22)		75,999	6,990	9,792	2,815	259	12,866	1,830	0	0	82,989	12,867	1,537	14,404	0	1,396	0	11,469
5	AREA 27	Dredge and Cap		24,390		31,639	4,626			4,626				7,207	400		400	0	0	0	4,626
5	AREA 27	ENR		574				0	0	0						0	0	0			
4	AREA 28	Dredge and RMC	3:1 Slopes All Around (6/7/22)		7,038	2,440	610	261	90	961	169	7,038	2,440			0	0	0	961	0	0
3	AREA 29	Dredge and Backfill	2:1 Slopes All Around (8/11/22)		5,388	1,093	329	200	40	569	130	0	0	6,482	568	120	688	0	569	0	0
2B	AREA 30	Dredge and Backfill	2:1 Slopes All Around (4/7/22)		1,304	426	84	48	16	148	31	0	0	1,730	148	32	180	0	148	0	0
2A	AREA 31	Dredge and Backfill	2:1 Slopes All Around (4/7/22)		1,489	531	97	55	20	172	36	0	0	2,019	172	37	209	0	172	0	0
1B	AREA 32	Dredge and Backfill	2:1 All Around, Ex Shoreline Toe of Slope (6/6/22)		2,997		111	111	0	222	72	0	0	2,997	222	56	278	0	222	0	0
1A	AREA 33/34/35 A	ENR		2,390				0	0	0						0	0	0	0	0	0
1A	AREA 33/34/35 B	Dredge and Backfill	2:1 Slopes All Around Ex Shoreline Toe of Slope (12/8/22)		14,393		533	533	0	1,066	347	0	0	14,393	1,044	267	1,311	0	1,066	0	0

Total Quantities Throughout Site								RMC Placement Quantities		Backfill Placement Quantities				Dredge/Excavation Volume Distribution (CY)			
Required ENR/ Amended Cover/ Cap Surface Area (SF)	Required Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Overdredge Allowance Volume for Side- Slopes Only (CY)	Dredge Volume (No Contingency Re-Dredging Included) (CY)	Re-Dredge Volume (Generated Residuals and Missed Inventory)	Required Dredge Surface Area (No Side-Slopes) (SF)	Required Side-Slope Surface Area (SF)	Required Dredge Surface Area (No Side-Slopes) (SF)	Required Dredge Volume (CY)	Overdredge Allowance Volume (No Side-Slopes) (CY)	Dredge Volume (No Contingency Re-Dredging Included) (CY)	Open Water Dredging (CY)	Nearshore / Slope/ Slow Dredging (CY)	Restricted Access Dredging (CY)	Excavation (Shoreline/Bank) (CY)
94,534	432,797	200,622	100,449	16,030	6,259	122,737	9,472	199,155	62,074	309,692	52,008	5,602	57,610	89,720	12,272	2,007	18,740

Attachment O.1.4
Detailed Quantities

				Material Placement Volume Distribution (CY)								Capping Materials		
				Sand Material				Gravelly Sand Material			Gravelly Sand Material Blended with Granular Activated Carbon			
Sediment Management Area	Remedial Action Area	Technology Assignment	Slope Assumptions Description	RMC/ ENR (Open Water) (CY)	RMC/ ENR (Nearshore) (CY)	RMC/ ENR (Restricted Access) (CY)	RMC/ ENR (Land-Based Equipment) (CY)	Backfill (Open Water) (CY)	Backfill (Nearshore) (CY)	Backfill (Land-Based Equipment) (CY)	Amended Cover (Land- Based Equipment)	Gravelly Sand For Cap Chemical Isolation Layer (CY)	Gravel For Cap Filter Layer (CY)	Light Riprap Erosion/Protection Layer (CY)
18 (1/2/3A and partial 1/2/3B), 17 (1/2/3b partial and 1/2/3C)	AREA 01/02/03	Dredge and Partial Backfill/Partial RMC	2:1 Outside FNC, 3:1 Inside FNC (7/18/22)	3,626	0	0	0	7,000	0	0	0	0	0	0
16 (partial 4/5/6A and 4/5/6B), 15A (partial 4/5/6A and partial 4/5/6C), 14D (4/5/6D)	AREA 04/05/06	Dredge and Partial Backfill/Partial RMC	2:1 outside FNC, 3:1 Inside (12/7/22)	6,859	0	863	0	8,707	0	0	0	0	0	0
15B	AREA 07	ENR		0	44	0	0	0	0	0	0	0	0	0
14C	AREA 08	Dredge and Backfill	2:1 Slopes All Around (6/21/22)	0	0	0	0	0	0	102	0	0	0	0
14B	AREA 10	ENR		0	0	0	58	0	0	0	0	0	0	0
14A	AREA 12	Dredge and RMC	3:1 Slopes All Around (6/20/22)	86	0	0	0	0	0	0	0	0	0	0
13	AREA 13	Amended Cover (Area Specific Technology-B)		0	0	0	0	0	0	0	67	0	0	0
12b	AREA 14/15/16	Dredge and Backfill/ Cap	3:1 Slopes All Around (7/20/22)	557	62	0	0	8,812	979	0	0	2,982	1,988	2,982
12a	AREA 17	Dredge and RMC	3:1 Slopes All Around (6/3/22)	213	0	0	0	0	0	0	0	0	0	0
11B	AREA 36	ENR		0	0	0	75							
11A	AREA 19/20	Dredge and Backfill	2:1 Slopes All Around (6/7/22)	0	0	0	0	0	1,969	0	0	0	0	0
9	AREA 22	Dredge and Partial Backfill/Partial RMC	3:1 Slopes toward the FNC, 2:1 for the rest (12/9/22)	372	0	0	0	5,823	0	2,756	0	0	0	0
8	AREA 23	ENR		0	0	0	94	0	0	0	0	0	0	0
7	AREA 24/25/26	Amended Cover (Area Specific Technology-B)		0	0	0	0	0	0	0	219	0	0	0
7	AREA 24/25/26	Dredge and Backfill	2:1 Slopes All Around (12/8/22)	0	0	0	0	0	3,991	0	0	0	0	0
6	AREA 27	Dredge and Backfill	2:1 Slopes All Around (6/21/22)	0	0	0	0	0	1,567	12,837	0	0	0	0
5	AREA 27	Dredge and Cap		0	0	0	0	0	0	400	0	1,133	755	1,768
5	AREA 27	ENR		0	0	0	21	0	0	0	0	0	0	0
4	AREA 28	Dredge and RMC	3:1 Slopes All Around (6/7/22)	0	487	0	0	0	0	0	0	0	0	0
3	AREA 29	Dredge and Backfill	2:1 Slopes All Around (8/11/22)	0	0	0	0	0	688	0	0	0	0	0
2B	AREA 30	Dredge and Backfill	2:1 Slopes All Around (4/7/22)	0	0	0	0	0	180	0	0	0	0	0
2A	AREA 31	Dredge and Backfill	2:1 Slopes All Around (4/7/22)	0	0	0	0	0	209	0	0	0	0	0
1B	AREA 32	Dredge and Backfill	2:1 All Around, Ex Shoreline Toe of Slope (6/6/22)	0	0	0	0	0	278	0	0	0	0	0
1A	AREA 33/34/35 A	ENR		0	89	0	0	0	0	0	0	0	0	0
1A	AREA 33/34/35 B	Dredge and Backfill	2:1 Slopes All Around Ex Shoreline Toe of Slope (12/8/22)	0	0	0	0	0	1,311	0	0	0	0	0

RAAs	SMAs	Inner Dredge Perimeter RM Area (SF)	Outer Dredge Perimeter RMC Area (SF, Assumed to be 25% of Outer RMC Placement Area)	Inner Dredge Perimeter RMC Volume (CY)	Outer Dredge Perimeter RMC Volume (CY)
Area 01/02/03	18, 17	39,593	8,300	1,466	307
Area 04/05/06, 08	16, 15, 14E, 14D, 14C	71,293	14,946	2,640	554
Area 12	14A	4,990	1,497	185	55
Area 14/15/16	12B	30,442	8,545	1,127	316
Area 17	12A	7,721	2,702	286	100
Area 19/20	11A	11,375	3,571	421	132
Area 22	9	24,317	6,447	901	239
Area 24/25/26	7	11,860	3,281	439	122
Area 27	6	17,727	4,755	657	176
Area 28	4	9,316	2,953	345	109
Area 29	3	9,145	2,492	339	92
Area 30, 31	2A, 2B	9,254	3,436	343	127
Area 32	1	5,283	1,520	195.7	56
Area 33/34/35B	1	7,203	1,779	267	66
	Total	**259,519**	**66,222**	**9,611.813**	**2,453**
			264,890		

RMC Inner Perimeter (thickness/SF)	0.037
RMC Outer Perimeter (Thickness/SF	0.037

RMC/ ENR (Open Water) (CY)	RMC/ ENR (Nearshore) (CY)	RMC/ ENR (Restricted Access) (CY)	RMC/ ENR (Land-Based Equipment) (CY)	Backfill (Open Water) (CY)	Backfill (Nearshore) (CY)	Backfill (Land-Based Equipment) (CY)	Amended Cover (Land- Based Equipment)	Gravelly Sand For Cap Chemical Isolation Layer (CY)	Gravel For Cap Filter Layer (CY)	Light Riprap Erosion/Protection Layer (CY)
11,712	**548**	**863**	**0**	**30,342**	**1,667**	**0**	**286**	**4,115**	**2,743**	**4,750**
0	**133**	**0**	**248**	**0**	**9,505**	**16,096**				

Attachment O.1.4
Detailed Quantities Notes

Notes:

1. ENR material assumed to be a Material Type 2 (medium-to-coarse grained sand), applied at a 9-inch targeted placement thickness, plus a 3-inch vertical placement tolerance intended in specific SMAs (as shown on the Final [100%] Drawings).

2. Total payable dredge volume includes the following: 1) required dredge volume (neatline), including associated external side-slope and transition (between SMAs) volumes, as shown on the Drawings; and 2) 1-foot overdredge allowance on the entire dredge footprint. It includes required dredge and excavation volumes.

3. Backfill material assumed to be Material Type 1 (gravelly sand) or Material Type 2 (medium-to-coarse grained sand), intended to restore for habitat purposes sediment bed to pre-dredge elevations in specific SMAs, for areas outside the FNC and above -10-foot MLLW (as shown on the Drawings).

4. RMC material assumed to be a Material Type 2 (medium-to-coarse grained sand), applied at a 9-inch targeted placement thickness, plus a 3-inch vertical placement tolerance over 100% of the dredge area that does not receive backfill, and at a 2-foot targeted placement thickness, plus a 6-inch vertical placement tolerance on the side-slope surface area. The RMC quantity also includes an additional automatic inner and contingent outer placement buffer surrounding the dredge area (at 9-inch targeted placement plus 3-inch vertical placement tolerance).

5. Amended cover is assumed to be Material Type 3 (blend of gravelly sand [Material Type 1] and GAC [2% by weight]), applied at a 12-inch targeted placement thickness, plus a 3-inch vertical placement tolerance, for SMAs 7 and 13 (as shown on the Drawings).

6. Only 25 % of the Outer Perimeter RMC surface area is considered for RMC placement for costing purposes (as shown on the Drawings).

7. For costing purposes, Engineered Cap A include the following assumptions: 1) Material Type 1A for isolation layer (conforming to gravelly sand, with 12-inch minimum thickness plus a 6-inch maximum overplacement allowance); 2) Material Type 4 for filter layer (conforming to gravel material, with a 6-inch minimum thickness plus a 6-inch maximum overplacement allowance); and 3) Material Type 5 for erosion protection layer (conforming to quarry spalls, with a 12-inch minimum thickness plus a 6-inch maximum overplacement allowance.

7. For costing purposes, Engineered Cap B include the following assumptions: 1) Material Type 1 for isolation layer (conforming to gravelly sand, with 12-inch minimum thickness plus a 6-inch maximum overplacement allowance); 2) Material Type 4 for filter layer (conforming to gravel material, with a 6-inch minimum thickness plus a 6-inch maximum overplacement allowance); and 3) Material Type 5 for erosion protection layer (conforming to quarry spalls, with a 12-inch minimum thickness plus a 6-inch maximum overplacement allowance.

8. SMA 10 is not included in the Final (100%) RD.

CY: cubic yard
ENR: enhanced natural recovery
FNC: federal navigation channel
GAC: granular activated carbon
MLLW: mean lower low water
RD: remedial design
RMC: residuals management cover
SF: square foot
SMA: sediment management area

Attachment O.1.5
Production Rates and Durations

Summary Table

Item Description	Unit	Dredging/Excavation					Material Placement												
		Dredging (Open-Water)	Dredging (Nearshore/ Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-Dredging	Excavation (Shoreline/ Bank)	Material Type 2 for RMC/ENR (Open-Water)	Material Type 2 for RMC/ENR (Nearshore)	Material Type 2 for RMC/ENR (Restricted Access)	Material Type 2 for RMC/ENR (Land-Based Equipment)	Material Type 1 for Backfill (Open-Water)	Material Type 1 for Backfill (Nearshore)	Material Type 1 for Backfill (Land-Based Equipment)	Material Type 3 for Amended Cover (Land-Based Equipment)	Material Type 1 for Cap Chemical Isolation Layer (Open-Water)	Material Type 4 for Cap Filter Layer (Open-Water)	Material Type 5 for Cap Erosion/ Protection Layer (Open-Water)	Material Type 1A for Cap Chemical Isolation Layer (Land-Based Equipment)	Material Type 4 for Cap Filter Layer (Land-Based Equipment)	Material Type 5 for Cap Erosion/ Protection Layer (Land-Based Equipment)
Dredge Volume/Placement Volume	CY	89,720	12,272	2,007	9,472	18,740	18,681	3,943	1,339	1,606	30,342	11,172	16,096	286	2,982	1,988	2,982	1,133	755	1,768
Cycle Time	min	2.03	2.13	2.53	2.07	2.53	2.23	2.40	2.67	2.43	2.23	2.40	2.43	2.43	2.70	2.77	2.87	2.40	2.43	2.47
Daily Production Rate	CY/day	1,076	659	509	678	498	1,130	975	657	778	1,130	975	778	778	809	788	815	569	562	553
	CY/day (rounded)	1,100	700	500	700	500	1,100	1,000	700	800	1,100	1,000	800	800	800	800	800	600	600	600
Daily Cost per Unit Volume	$/CY-day	$25.49	$41.61	$53.91	$40.43	$25.16	$18.93	$21.94	$32.55	$16.11	$18.93	$21.94	$16.11	$16.11	$26.45	$27.14	$26.24	$22.03	$22.31	$22.67
No. Dredge/Placement Work Days	Days	84	19	4	14	38	17	5	2	3	27	12	21	1	4	3	4	2	1	3
No. Dredge/Placement Calendar Days	Days	98	22	5	16	44	19	6	2	4	32	14	25	1	5	4	5	2	2	4

Cycle Times

Item Description	Unit	Dredging/Excavation					Material Placement												
		Dredging (Open-Water)	Dredging (Nearshore/ Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-Dredging	Excavation (Shoreline/ Bank)	Material Type 2 for RMC/ENR (Open-Water)	Material Type 2 for RMC/ENR (Nearshore)	Material Type 2 for RMC/ENR (Restricted Access)	Material Type 2 for RMC/ENR (Land-Based Equipment)	Material Type 1 for Backfill (Open-Water)	Material Type 1 for Backfill (Nearshore)	Material Type 1 for Backfill (Land-Based Equipment)	Material Type 3 for Amended Cover (Land-Based Equipment)	Material Type 1 for Cap Chemical Isolation Layer (Open-Water)	Material Type 4 for Cap Filter Layer (Open-Water)	Material Type 5 for Cap Erosion/ Protection Layer (Open-Water)	Material Type 1A for Cap Chemical Isolation Layer (Land-Based Equipment)	Material Type 4 for Cap Filter Layer (Land-Based Equipment)	Material Type 5 for Cap Erosion/ Protection Layer (Land-Based Equipment)
Load Bucket	sec	22	24	30	24	30	20	22	22	20	20	22	20	20	30	30	32	26	26	26
Lift Load	sec	18	20	22	18	22	18	20	22	22	18	20	22	22	28	28	28	24	24	24
Swing Load	sec	16	16	22	16	22	20	20	22	20	20	20	20	20	18	18	20	16	16	18
Lower Load	sec	16	18	18	16	18	20	22	24	22	20	22	22	22	18	18	20	16	16	18
Dump/Place Load	sec	12	12	12	12	12	18	22	28	20	18	22	20	20	26	30	26	22	24	22
Return Swing	sec	12	12	16	12	16	12	12	12	16	12	12	16	16	12	12	12	12	12	12
Lower Bucket	sec	14	14	16	14	16	14	14	16	14	14	14	14	14	16	16	16	16	16	16
Lost Time (accelerating, positioning, stepping ahead, weather, hydraulics, bucket change, shifting anchors/silt curtains)	sec	12	12	16	12	16	12	12	14	12	12	12	12	12	14	14	18	12	12	12
Total Cycle Time	**sec**	**122**	**128**	**152**	**124**	**152**	**134**	**144**	**160**	**146**	**134**	**144**	**146**	**146**	**162**	**166**	**172**	**144**	**146**	**148**
	min	**2.03**	**2.13**	**2.53**	**2.07**	**2.53**	**2.23**	**2.40**	**2.67**	**2.43**	**2.23**	**2.40**	**2.43**	**2.43**	**2.70**	**2.77**	**2.87**	**2.40**	**2.43**	**2.47**

Daily Production Rate

Item Description	Unit	Dredging/Excavation					Material Placement												
		Dredging (Open-Water)	Dredging (Nearshore/ Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-Dredging	Excavation (Shoreline/ Bank)	Material Type 2 for RMC/ENR (Open-Water)	Material Type 2 for RMC/ENR (Nearshore)	Material Type 2 for RMC/ENR (Restricted Access)	Material Type 2 for RMC/ENR (Land-Based Equipment)	Material Type 1 for Backfill (Open-Water)	Material Type 1 for Backfill (Nearshore)	Material Type 1 for Backfill (Land-Based Equipment)	Material Type 3 for Amended Cover (Land-Based Equipment)	Material Type 1 for Cap Chemical Isolation Layer (Open-Water)	Material Type 4 for Cap Filter Layer (Open-Water)	Material Type 5 for Cap Erosion/ Protection Layer (Open-Water)	Material Type 1A for Cap Chemical Isolation Layer (Land-Based Equipment)	Material Type 4 for Cap Filter Layer (Land-Based Equipment)	Material Type 5 for Cap Erosion/ Protection Layer (Land-Based Equipment)
Cycle Time	min	2.03	2.13	2.53	2.07	2.53	2.23	2.40	2.67	2.43	2.23	2.40	2.43	2.43	2.70	2.77	2.87	2.40	2.43	2.47
Bucket Capacity	CY	8	6	6	6	5	8	8	6	6	8	8	6	6	8	8	8	5	5	5
Effective Bucket Capacity	%	70%	65%	65%	65%	70%	75%	75%	75%	75%	75%	75%	75%	75%	70%	70%	75%	70%	70%	70%
	CY	5.6	3.9	3.9	3.9	3.5	6	6	4.5	4.5	6	6	4.5	4.5	5.6	5.6	6	3.5	3.5	3.5
Shift Duration	hrs/day	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
No. of Shifts	No.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Work Days/Week	No.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Running Time Efficiency	%	65%	60%	55%	60%	60%	70%	65%	65%	70%	70%	65%	70%	70%	65%	65%	65%	65%	65%	65%
Daily Production Rate (per Shift)	**cy/day**	**1,076**	**659**	**509**	**678**	**498**	**1,130**	**975**	**657**	**778**	**1,130**	**975**	**778**	**778**	**809**	**788**	**815**	**569**	**562**	**553**

Attachment O.1.5
Production Rates and Durations

Specific Durations

Item Description	Unit	Dredging/Excavation					Material Placement												
		Dredging (Open-Water)	Dredging (Nearshore/ Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-Dredging	Excavation (Shoreline/ Bank)	Material Type 2 for RMC/ENR (Open-Water)	Material Type 2 for RMC/ENR (Nearshore)	Material Type 2 for RMC/ENR (Restricted Access)	Material Type 2 for RMC/ENR (Land-Based Equipment)	Material Type 1 for Backfill (Open-Water)	Material Type 1 for Backfill (Nearshore)	Material Type 1 for Backfill (Land-Based Equipment)	Material Type 3 for Amended Cover (Land-Based Equipment)	Material Type 1 for Cap Chemical Isolation Layer (Open-Water)	Material Type 4 for Cap Filter Layer (Open-Water)	Material Type 5 for Cap Erosion/ Protection Layer (Open-Water)	Material Type 1A for Cap Chemical Isolation Layer (Land-Based Equipment)	Material Type 4 for Cap Filter Layer (Land-Based Equipment)	Material Type 5 for Cap Erosion/ Protection Layer (Land-Based Equipment)
Total Dredge Volume/Placement Volume	CY	89,720	12,272	2,007	9,472	18,740	18,681	3,943	1,339	1,606	30,342	11,172	16,096	286	2,982	1,988	2,982	1,133	755	1,768
No. Dredge/Placement Work Days	Days	84	19	4	14	38	17	5	2	3	27	12	21	1	4	3	4	2	1	3
No. Dredge/Placement Work Hours	hrs	840	190	39	140	380	165	50	20	30	270	120	210	10	40	30	40	20	13	32
Total Dredge/Placement Duration (Work Days)	**Days**	**159**					**105**													
No. Dredge/Placement Calendar Days	Days	98	22	5	16	44	19	6	2	4	32	14	25	1	5	4	5	2	2	4
Total Dredge/Placement Duration (Calendar Days)	**Days**	**185**					**123**													

Daily Unit Costs

Item Description	Unit	Dredging/Excavation					Material Placement												
		Dredging (Open-Water)	Dredging (Nearshore/ Slope/ Slow Dredging)	Dredging (Restricted Access)	Contingency Re-Dredging	Excavation (Shoreline/ Bank)	Material Type 2 for RMC/ENR (Open-Water)	Material Type 2 for RMC/ENR (Nearshore)	Material Type 2 for RMC/ENR (Restricted Access)	Material Type 2 for RMC/ENR (Land-Based Equipment)	Material Type 1 for Backfill (Open-Water)	Material Type 1 for Backfill (Nearshore)	Material Type 1 for Backfill (Land-Based Equipment)	Material Type 3 for Amended Cover (Land-Based Equipment)	Material Type 1 for Cap Chemical Isolation Layer (Open-Water)	Material Type 4 for Cap Filter Layer (Open-Water)	Material Type 5 for Cap Erosion/ Protection Layer (Open-Water)	Material Type 1A for Cap Chemical Isolation Layer (Land-Based Equipment)	Material Type 4 for Cap Filter Layer (Land-Based Equipment)	Material Type 5 for Cap Erosion/ Protection Layer (Land-Based Equipment)
Dredge/Excavator	$/day	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000
Tug (2 for dredging and 1 for material placement)	$/day	$ 4,000	$ 4,000	$ 4,000	$ 4,000	--	$ 2,000	$ 2,000	$ 2,000	--	$ 2,000	$ 2,000	--	--	$ 2,000	$ 2,000	$ 2,000	--	--	--
Barge (2 for dredging and 1 for material placement)	$/day	$ 4,000	$ 4,000	$ 4,000	$ 4,000	--	$ 2,000	$ 2,000	$ 2,000	--	$ 2,000	$ 2,000	--	--	$ 2,000	$ 2,000	$ 2,000	--	--	--
Work Boat	$/day	$ 600	$ 600	$ 600	$ 600	--	$ 600	$ 600	$ 600	--	$ 600	$ 600	--	--	$ 600	$ 600	$ 600	--	--	--
Front-end loader	$/day	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500
Daily Subtotal Cost for Equipment	**$/day**	$ 16,100	$ 16,100	$ 16,100	$ 16,100	$ 7,500	$ 12,100	$ 12,100	$ 12,100	$ 7,500	$ 12,100	$ 12,100	$ 7,500	$ 7,500	$ 12,100	$ 12,100	$ 12,100	$ 7,500	$ 7,500	$ 7,500
FOG (15%)	$/day	$ 2,415	$ 2,415	$ 2,415	$ 2,415	$ 1,125	$ 1,815	$ 1,815	$ 1,815	$ 1,125	$ 1,815	$ 1,815	$ 1,125	$ 1,125	$ 1,815	$ 1,815	$ 1,815	$ 1,125	$ 1,125	$ 1,125
Daily Total Cost for Equipment	**$/day**	$ 18,515	$ 18,515	$ 18,515	$ 18,515	$ 8,625	$ 13,915	$ 13,915	$ 13,915	$ 8,625	$ 13,915	$ 13,915	$ 8,625	$ 8,625	$ 13,915	$ 13,915	$ 13,915	$ 8,625	$ 8,625	$ 8,625
	$/cy	$ 17.21	$ 28.09	$ 36.40	$ 27.30	$ 17.32	$ 12.31	$ 14.27	$ 21.17	$ 11.09	$ 12.31	$ 14.27	$ 11.09	$ 11.09	$ 17.20	$ 17.65	$ 17.07	$ 15.16	$ 15.35	$ 15.61
Superintendent	$/day	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800
Operator Foreman	$/day	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650
Dredge/Excavator Operator	$/day	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650
Deck Hands for Dredge (assumed 3)	$/day	$ 1,950	$ 1,950	$ 1,950	$ 1,950	--	$ 1,950	$ 1,950	$ 1,950	--	$ 1,950	$ 1,950	--	--	$ 1,950	$ 1,950	$ 1,950	--	--	--
Tug Operator (2 for dredging and 1 for material placement)	$/day	$ 1,300	$ 1,300	$ 1,300	$ 1,300	--	$ 650	$ 650	$ 650	--	$ 650	$ 650	--	--	$ 650	$ 650	$ 650	--	--	--
Deck Hands for Tug (2 for dredging and 1 for material placement)	$/day	$ 1,300	$ 1,300	$ 1,300	$ 1,300	--	$ 650	$ 650	$ 650	--	$ 650	$ 650	--	--	$ 650	$ 650	$ 650	--	--	--
Front-loader Operator	$/day	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650	$ 650
Health and Safety and Quality Assurance	$/day	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800
Daily Subtotal Cost for Labor	**$/day**	$ 8,100	$ 8,100	$ 8,100	$ 8,100	$ 3,550	$ 6,800	$ 6,800	$ 6,800	$ 3,550	$ 6,800	$ 6,800	$ 3,550	$ 3,550	$ 6,800	$ 6,800	$ 6,800	$ 3,550	$ 3,550	$ 3,550
Travel / Per Diem Allowance (10%)	$/day	$ 810	$ 810	$ 810	$ 810	$ 355	$ 680	$ 680	$ 680	$ 355	$ 680	$ 680	$ 355	$ 355	$ 680	$ 680	$ 680	$ 355	$ 355	$ 355
Daily Total Cost for Labor	**$/day**	$ 8,910	$ 8,910	$ 8,910	$ 8,910	$ 3,905	$ 7,480	$ 7,480	$ 7,480	$ 3,905	$ 7,480	$ 7,480	$ 3,905	$ 3,905	$ 7,480	$ 7,480	$ 7,480	$ 3,905	$ 3,905	$ 3,905
	$/cy	$ 8.28	$ 13.52	$ 17.52	$ 13.14	$ 7.84	$ 6.62	$ 7.67	$ 11.38	$ 5.02	$ 6.62	$ 7.67	$ 5.02	$ 5.02	$ 9.25	$ 9.49	$ 9.17	$ 6.87	$ 6.95	$ 7.07
Daily Total Cost for Equipment and Labor	**$/day**	$ 27,425	$ 27,425	$ 27,425	$ 27,425	$ 12,530	$ 21,395	$ 21,395	$ 21,395	$ 12,530	$ 21,395	$ 21,395	$ 12,530	$ 12,530	$ 21,395	$ 21,395	$ 21,395	$ 12,530	$ 12,530	$ 12,530
	$/cy	$ 25.49	$ 41.61	$ 53.91	$ 40.43	$ 25.16	$ 18.93	$ 21.94	$ 32.55	$ 16.11	$ 18.93	$ 21.94	$ 16.11	$ 16.11	$ 26.45	$ 27.14	$ 26.24	$ 22.03	$ 22.31	$ 22.67

Attachment O.1.5
Production Rates and Durations

Project Quantities and Durations

Item Description	Totals
Dredge Volume (CY)	103,999
Contingency Re-Dredging Volume (CY)	9,472
Excavation Volume (CY)	18,740
Material Placement Volume (CY)	95,073
Total Dredge Duration (Work Days)	159
Total Material Placement Duration (Work Days)	105
Total Mob/Demob + Dredge/Material Placement Durations + Structural Work (Work Days)	315
Total Duration (Work Months)	10.4
Total Duration (Work Months) - Rounded	11.0
Total Dredge Duration (Calendar Days)	185
Total Material Placement Duration (Calendar Days)	123
Total Mob/Demob + Dredge/Material Placement Durations + Structural Work (Calendar Days)	368
Total Duration (Calendar Months)	12.1
Total Duration (Calendar Months) - Rounded	13.0

Notes:
CY/day: cubic yard per day
CY: cubic yard
$/CY-day: dollars per cubic yard per day
ENR: enhanced natural recovery
GAC: granular activated carbon
hrs/day: hours per day
min: minute
RMC: residuals management cover
sec: second
SF: square foot

LDWG - Structures and Outfalls
Sediment Cleanup of Upper Reach of Lower Duwamish Waterway
Probable Construction Cost Estimate
100% Design - Phase 3, Revised October 26, 2023

Bid Item No.	Specs Section No.	Item	Quantity	Unit	Min Unit Cost	Max Unit Cost	Bracketed Avg Unit Cost[1]	Probable Unit Cost[2]	Min Total Cost	Max Total Cost	Bracketed Avg Total Cost	Probable Total Cost[2]	Duration (days)
SCHEDULE A - Structures													
OVER AND IN-WATER STRUCTURES													
		Remove Timber Piles, Incl Dolphins											
		Remove Creosote and Untreated Timber Piles (6 per day)	36	Ea	$ 50.00	$ 3,500.00	$ 2,729.46	$ 3,138.88	$ 1,800	$ 126,000	$ 98,261	$ 113,000	6
		Timber Pile Disposal (12" Dia Avg x 40ft @ 58.37pcf)	33.01	Ton	$ 100.99	$ 650.00	$ 251.12	$ 288.79	$ 3,333	$ 21,455	$ 8,289	$ 9,532	
		Sub Total							$ 5,133	$ 147,455	$ 106,550	$ 122,532	6
		Replace Steel Pipe Piles and Timber Piles with Steel Pipe Piles											
		New Coated Steel Pipe Piles - Material and Driving	2	EA	$ 5,500.00	$ 13,712.67	$ 11,062.56	$ 12,721.94	$ 11,000	$ 27,425	$ 22,125	$ 25,444	1
		Sub Total							$ 11,000	$ 27,425	$ 22,125	$ 25,444	1
		Strengthening/Reinforcing of Existing Bulkheads											
		Wall 1 Bulkhead - Wall Reinforcement and Strengthening at Debris Piles (95 LF @ 12 ft per day)	5,700	SF	$ 67.26	$ 83.38	$ 75.20	$ 86.48	$ 383,400	$ 475,250	$ 428,622	$ 492,936	8
		Sub Total							$ 383,400	$ 475,250	$ 428,622	$ 492,936	8
					Total				**$ 399,533**	**$ 650,130**	**$ 557,297**	**$ 640,912**	**$ 15**
SCHEDULE B - Outfalls													
		Outfall Protection and Energy Dissipation											
		Pipe Protection (2 days total)	4	EA	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 23,000.00	$ 80,000	$ 80,000	$ 80,000	$ 92,000	2
		Energy Dissipators (3 days Each)	2	EA	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 69,000.00	$ 120,000	$ 120,000	$ 120,000	$ 138,000	6
		Sub Total							$ 200,000	$ 200,000	$ 200,000	$ 230,000	8
					Total				**$ 200,000**	**$ 200,000**	**$ 200,000**	**$ 230,000**	**$ 8**
											TOTAL	**$ 870,912**	**23**
												$ 857,297	

[1] Bracketed Average is calculated average with outliers omitted.

[2] Probable Cost is Bracketed Average plus 15% bump.

Structures (ST) - Bulkheads, Single Pile Fields, Guide Piles, Dolphins and Bridge Work Inventory

(See Structural Drawings and Structural Decision Table in BODR for Quantities Indicated)

Structure ID	RAA	RM	Riverbank Stationing				LF	Adjacent Property Owner	Description	# Piles			Creosote Dolphin Removal	Dolphin Replacement w/ Steel Piles	Cleat Replacement	Stub Pile Bulkhead Removal	Bulkhead Replacement w/ Steel Sheet Piles, SF (Exposed)	Bulkhead Shoring or Support, LF	Comments
			Start STA		End STA					Creosote and Untreated Single/Gro	Steel Piles Removal	Steel Pile Replacement							
ST02	8	3.3						South Park Bridge	Fenders										
	9	3.3							Bascule Pier										
	10	3.3							South Abutment										
ST03		3.5	284	10	289	70	560	Star Forge (Jorgensen Forge)											
		3.7	289	70	291	60	190	Star Forge (Jorgensen Forge)	Bulkhead - New Sheet Piles										
		3.7	291	60	294	80	320	Boeing (Boeing Vacant Land)	Bulkhead - H-Piles								9		~~Assumed per total LF, Piles @ 8ft oc & 15ft tall walls~~
		3.7	294	80	295	20	40	Boeing (Thompson Site)	Bulkhead - H-Piles										
	18A	3.7	295	20	295	90	70	Boeing (Thompson Site)	Wall 3 Bulkhead - H-Piles								0	0	Repair with Steel Plate Lagging and Tiebacks
	18A, C D and E	3.8	295	90	297	80	190	Boeing (Thompson Site)	Wall 2 Bulkhead - Newer Sheet Piles								0	0	Assumed 15 LF x 10ft High Wall Repair
		3.8	297	80	301	50	370	Boeing (Thompson Site)	Bulkhead - Stub Piles							0	0		~~Assumed stub piles @ 18" oc, 15ft long, 5ft exposed~~
	22	3.9	301	50	301	85	35	Centerpoint Properties	~~Wall 1 Bulkhead~~ - Older Sheet Piles (North End)	4							2400	40	Assumed total LF x 60ft tall Steel Sheet Piles
	24/25/26	3.9					50	Centerpoint Properties	Older Sheet Piles (South End)	2		1					3300	55	Assumed total LF x 60ft tall Steel Sheet Piles
		3.9	0	0	306	20	~~30620~~	Centerpoint Properties	Wall 1 Bulkhead - Older Sheet Piles								0	0	~~Assumed per total LF, 15ft tall walls~~
ST04	27A, 27B, 27	4.0-4.1	309	60	315	80	620	Container Properties, LLC	Piles	1		1	3						Replace Fishing Pole #38 and
	27								Dolphins										
ST07	29	4.6	361	70	362	90	120	Boeing Developmental Center	Wharf										
ST07	32	4.8	371	20	371	40	20	Boeing Developmental Center	Piles	7									
ST07	33	4.8	371	60	372	00	40	Boeing Developmental Center	Groin?										
ST07	34	4.8	372	40	373	00	60	Boeing Developmental Center	Piles	10		0							
ST10	30	4.7	410	70	410	90	20	Port of Seattle	Piles	9									Demolish Piles, not replaced
ST20	13	3.5	492	20	492	60	40	South Park Marina	Guide Piles										
									Totals	**33**	**0**	**2**	**3**	**0**	**0**	**0**	**5700**	**95**	

Structures (ST) - Outfall Work Inventory

(See Structural Drawings and Structural Decision Table in BODR for Quantities Indicated)

Structure ID	RAA	RM	Riverbank Stationing STA		Adjacent Property Owner	Description	Plug and Abandon	Temporary Support	Temporary Diversion	Protect in Place[1]	Extension	Energy Dissipation	Comments
2214	13	3.5	492	75	South Park Marina	15"Dia PVC				0		0	Pipe Material and Dia from Survey
17th Ave SD	13	3.5	492	20	South Park Marina	15"Dia PVC							Pipe Material and Dia from Survey
2062	18C	3.7	296	10	Jorgensen Forge (Boeing Thompson Site)	48"Dia CMP				0		0	
2061	18C	3.7	296	30	Jorgensen Forge (Boeing Thompson Site)	24"Dia Steel				0			With Duckbill Valve
2075	22	3.9	301	80	Insurance Auto Auction	32"Dia Steel Riser				1			
2073	26	3.9	307	10	Insurance Auto Auction	18"Dia Concrete				1		1	
2093	35	4.9	375	00	Boeing	24"Dia Concrete				1		1	
2094	35	4.9	375	10	Boeing	12"Dia Concrete	0						
2077	22	3.8	301	10	Boeing	20"Dia Steel				1			With Duckbill Valve
2076	22	3.9	301	70	Insurance Auto Auction	30"Dia Steel							Not Observed, No Action
2092	North of 32	4.8	370	90	Boeing								Outside Dredge Prism, No Action
2097	32	4.8	371	50	Boeing	8"Dia Steel							Not Observed, No Action
DC16	33	4.8			Boeing	6"Dia Ductile Iron							No Action
2096	34	4.8	373	50	Boeing	6"Dia Cast Iron							Outside Dredge Prism
2074	24/25B	3.9	304	70	Insurance Auto Auction	8"Dia CMP							Already Abandoned
						Totals	**0**	**0**	**0**	**4**	**0**	**2**	