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Gasco Sediments Project Area

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Final Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan

Prepared for U.S. Environmental Protection Agency, Region 10

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Gasco Sediments Project Area

Final Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan

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ABBREVIATIONS

µg	microgram
ARAR	Applicable or Relevant and Appropriate Requirement
B-APS	Bauer Assistant Positioning System
BFSC	blast furnace slag cement
BMP	best management practice
BOL	bill of lading
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
cm	centimeter
COC	contaminant of concern
CUL	cleanup level
CWA	Clean Water Act
DEQ	Oregon Department of Environmental Quality
DMPDB	dual membrane passive diffusion bag
DNAPL	dense nonaqueous phase liquid
DOC	depth of contamination
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FPS	field pilot study
GCL	geosynthetic clay liner
HME	HME Construction
IDP	Inadvertent Discovery Plan
ISS	in situ stabilization and solidification
L	liter
LEAF	Leaching Environmental Assessment Framework
MEC	munitions and explosives of concern
mg	milligram
MGP	manufactured gas plant
NAPL	nonaqueous phase liquid
NCP	*National Contingency Plan*
NMFS	National Marine Fisheries Service
OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish and Wildlife
ORS	Oregon Revised Statutes
PAH	polycyclic aromatic hydrocarbon

PAR	*Preferred Alternative Report*
PC	Portland cement
PGM	Portland Gas Manufacturing
ppm	part per million
Project Area	Gasco Sediments Site Project Area
psi	pounds per square inch
PTW	principal threat waste
QA	quality assurance
QC	quality control
RBC	risk-based concentration
RD	remedial design
ROD	*Record of Decision – Portland Harbor Superfund Site, Portland, Oregon*
RTK	real-time kinematic
SES	Sevenson Environmental Services
Siltronic	Siltronic Corporation
SOW	*Statement of Work – Gasco Sediments Site*
TBC	To Be Considered
TCLP	toxicity characteristic leaching procedure
TEWP	*Final Pre-Remedial Basis of Design Technical Evaluations Work Plan*
TMC	Trimble Machine Control
TS	treatability study
USC	United States Code
VOC	volatile organic compound
W/C	water to cement admixture
WBZ	water-bearing zone
Work Plan	*Final Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan*
WQMQAP	*Final Revised In Situ Stabilization and Solidification Field Pilot Study Water Quality Monitoring and Quality Assurance Plan*

1 Introduction

NW Natural appreciates the U.S. Environmental Protection Agency's (EPA's) willingness to expedite a field pilot study (FPS) for detailed evaluation of in situ stabilization and solidification (ISS) treatment technology at the Gasco Sediments Site. This *Final Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan* (Work Plan) has been prepared by NW Natural's Design Team (Anchor QEA, Sevenson Environmental Services [SES], and Hahn and Associates) for the Gasco Sediments Site Project Area (Project Area), located on the Willamette River adjacent to the NW Natural Gasco and Siltronic Corporation (Siltronic) properties in Portland, Oregon (Figure 1-1). This Work Plan has been jointly prepared under the *Administrative Settlement Agreement and Order on Consent* (EPA 2009a; CERCLA Docket No. 10-2009-0255) and *Statement of Work – Gasco Sediments Site* (SOW; EPA 2009b) between NW Natural and EPA and the *Voluntary Agreement* (DEQ 1994; No. WMCVC-NWR-94-13; as amended October 11, 2016). This Work Plan summarizes the proposed FPS for the integrated design area (including the Intermediate, Shallow, and Riverbank Regions [collectively, "the nearshore area"). These data and lessons learned from the field implementation will be used to allow the treatment technology, ISS, to be fully developed during remedial design (RD) of the full remedy and to reduce performance uncertainties such that an optimally effective and implementable integrated ISS remedy can be designed within the nearshore area.

This Work Plan has been revised to address: 1) EPA's comments dated July 27, 2023, on the *In Situ Stabilization and Solidification Field Pilot Study Work Plan* for the Project Area dated June 9, 2023; and 2) EPA's comments dated September 8, 2023, on the *Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan* dated August 21, 2023. Responses to EPA's comments are provided in Appendix J. The responses incorporate discussions with the EPA team during multiple conference calls held in August and September 2023.

1.1 Background and Summary of Project Area Remedy

NW Natural submitted the *Preferred Alternative Report* (PAR; Anchor QEA 2022a) to EPA on October 31, 2022, to present a sediment RD alternatives analysis and comparison for the Revised Dredge and Cap Design and the preferred Full Dredge and ISS Design. EPA and the Oregon Department of Environmental Quality (DEQ) commented that they agree with the general approach of ISS treatment at the Project Area with the caveat that site-specific details of the approach will need to be further developed during RD of the Full Dredge and ISS Design. NW Natural intends to submit a *Revised Basis of Design Report* (BODR) that describes the expected elements of the design and associated methods and evaluations. Once the BODR is approved by EPA, supporting evaluations for the Full Dredge and ISS Design will be further developed and presented in design deliverables that will be developed in collaboration with and approved by EPA. NW Natural would like to implement this FPS as soon as possible to: 1) incorporate more detailed design information earlier in the design process (i.e., in the Interim Design) to support EPA's review and minimize the potential for substantive design changes during development of the Final Design; and 2) inform the means and methods elements of design and ensure Interim and Final Design documents can be produced without delay.

1.2 Summary of ISS Remedial Technology

ISS is a proven treatment technology identified in the *National Contingency Plan* (NCP; EPA 1994) and *Record of Decision – Portland Harbor Superfund Site, Portland, Oregon* (ROD; EPA 2017) that remediates contaminants within environmental media, such as soil and sediment, through a physical modification and chemical reaction to bind the target compounds (i.e., solidification) or transform them into a less mobile form (i.e., stabilization). Through the physical process of solidification, the contaminated material is encapsulated, and the physical properties of the environmental media are transformed by the addition of grout to modify the hydraulic conductivity and meet the specified performance standards. Stabilization is a chemical process wherein grout reacts with the contaminated media to significantly reduce leachability to specific RD targets. ISS can be conducted in situ by mixing environmental media with stabilizers or binding agents, such as Portland cement (PC) and slag cement. The blend of cementitious materials (e.g., PC and slag cement) is defined as the admixture, and the grout is the combination of admixture with water. The environmental media is then considered to be treated sediment or soil once the grout is added. This physical and chemical modification of the impacted materials has been proven to be effective for nonaqueous phase liquid (NAPL) and a variety of contaminants in environmental media (Grubb et al. 2020; Olean et al. 2016; ITRC 2011; EPA 2009c).

2 Field Pilot Study Objectives

The Design Team is confident that ISS will be effective at the Project Area. The technology has been used to achieve remedial objectives at multiple in-water sediment cleanup sites with similar contaminants and conditions, as presented in the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a). The ISS FPS will determine which means and methods optimize ISS implementation and performance in the Project Area. The Design Team has spent considerable effort designing the FPS to maximize site-specific information gathering and refine and optimize potential RD means and methods based on Project Area-specific considerations. Factors considered in the development of the FPS include the following:

1. Bench-scale ISS treatability testing with FPS area sediments to determine the optimized grout composition based on Phases I and II testing, as detailed in the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan*.
2. Establishing FPS area dimensions that are sufficient to evaluate optimizing ISS implementation and performance.
3. Working directly with the ISS auger manufacturer in Germany to design an auger head that is specific to the depth of contamination (DOC) and sediment characteristics in the FPS area.

FPS objectives include the following:

1. Determine optimized construction means and methods in the field, including the best approach for assuring ISS columns are homogeneously mixed and completed to the design elevations, as described in Section 3.3.
2. Determine optimized construction means and methods for post-ISS swell materials (i.e., the volume increase caused by the addition of cement grout into the sediments) management in the field and discussed in Section 3.4. This will include removal of swell materials to the design elevations, dewatering (if needed), transportation, and disposal at the landfill.
3. Determine in the field which best management practices (BMPs) most effectively address potential water quality, odor, and air quality impacts during sediments ISS and post-ISS swell materials removal, as discussed in Section 3.7.
4. Field verify the post-construction ISS characteristics (strength and permeability) using the bench scale treatability study (TS) Phase I and II test results obtained during implementation of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a), as discussed in Section 3.3.8.
5. Quantify construction vibrations at the Siltronic property for in-water construction, as discussed in Section 3.9.

6. Perform post-construction sampling to evaluate potential chemical diffusion from the surface of the ISS-treated sediments over several time steps for the full list of contaminants of concern (COCs) containing ROD Table 17 groundwater cleanup levels (CULs), as discussed in Section 4.

3 Sediment Field Pilot Study Scope of Work and Associated Means and Methods

This section summarizes the FPS scope of work and associated means and methods. This information was informed by SES direct experience performing both in-water and upland ISS at other sites, lessons learned from the Gasco Sediments Site Early Action (2005) and Portland Gas Manufacturing (PGM) sediment cleanup projects (2019), discussions with equipment manufacturers, and multiple recent visits to the Project Area by the entire Design Team coupled with nearly two decades of experience collectively working on sediment and upland cleanup issues at the Gasco property.

3.1 Field Pilot Study Area and Volumes

As summarized in Section 2, the objectives of the FPS are intended to inform the design and implementation of full-scale sediment ISS throughout the Project Area. Therefore, the Design Team performed a detailed, multiple lines of evidence evaluation to identify a proposed FPS area that is a representative and conservative (i.e., highest potential for increased permeability and leachability) scenario for Project Area sediment conditions. This selection was based on evaluation of the primary and secondary lines of evidence presented in Section 2.1 of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a), accounts for site-specific implementability considerations associated with an isolated pilot footprint, and addresses EPA's comments dated January 18, 2023 (EPA 2023a), on the *In Situ Stabilization and Solidification Laboratory Pilot Study Work Plan* (Anchor QEA 2022b); EPA's comments dated March 14, 2023 (EPA 2023b) on the *Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023b); EPA's comments dated April 14, 2023 (EPA 2023c) on the *Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan Addendum* (Anchor QEA 2023c); and EPA's comments dated June 29, 2023 (EPA 2023d), on the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a). Specifically, the following lines of evidence were evaluated:

- **Primary lines of evidence:** Presence of principal threat waste (PTW)-NAPL and grain size distribution
- **Secondary lines of evidence:** Bulk sediment chemical concentrations for naphthalene, benzene, and metals; visual observations of substantial product that do not achieve the Project Area-specific definition of PTW-NAPL; mudline bathymetry and water depths; and the presence of nearby marine structures

Regarding the primary lines of evidence, it was deemed critical that the FPS area be located in an area containing deposits of PTW-NAPL in fine-grained sediments. As discussed in Section 3.3 of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a), fine-grained sediments were targeted because sediment with high fines content (i.e., with a high proportion of clays) have the potential to present a greater challenge for stabilization treatment. Due to inherently lower permeability, sediment with high fines content generally requires a higher grout dosage to achieve significant permeability reduction and strength development compared to coarser grained (i.e., sandy) sediments. Although the FPS area is located in an area with fine grained sediments, the bench scale treatability study includes sediment samples with a range of representative grain sizes observed at the Project Area. Regarding the secondary lines of evidence, it was deemed critical that the FPS area be located in an area containing ROD Table 21 naphthalene PTW-not reliably contained threshold exceedances, elevated benzene concentrations, metals concentrations that are representative of the central tendency of the data in the Project Area, visual observations of substantial product that do not achieve the Project Area-specific definition of PTW-NAPL, representative sloping bathymetry elevations at water depths that will allow sufficient draft for marine equipment to perform the work from the waterside, and marine structures in relatively close proximity to facilitate a demonstration the work can be performed adjacent to structures. The results for these lines of evidence are presented in Table 3-1 and Figures 3-1a through 3-1d. Based on these results, the FPS area is proposed directly adjacent to the ISS bench scale treatability location ISSTS-003, approximately 50 feet from the Siltronic outfall, as shown in Figure 3-2. This proximity will allow for direct comparison of the strength and permeability results collected during implementation of the FPS (see Section 3.3.8.3) and the bench scale laboratory treatability study.

The selection of this location is also supported by the observations from sediment core LW3-C662, which was collected in 2008 (Appendix A; Figures 3-1a and 3-1c). This sediment core is located within the FPS area and contained visual observations of "abundant free product," "sticky tar body," and "solidified tar body" in a relatively fine-grained matrix (sand, silty sand, silt with sand, and clayey silt).

The footprint of the FPS area (1,750 square feet) has been sized to accommodate approximately 4 weeks of ISS work (not including mobilization and demobilization) at a daily rate informed by the Design Team's experience at other sites and the DOC. Additional discussion of the sizing of FPS area is included in Section 3.3. The ability to perform ISS in the entire FPS area depends on several factors, including EPA approval, the in-water work window, and conditions during construction. The work will be performed in a manner that ensures the objectives of the FPS are met even if the entire FPS area cannot be treated during the limited window. The DOC within the FPS area was determined via the DOC characterization performed in accordance with the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area* memorandum (Anchor QEA 2023d). DOC surrounding the perimeter of the proposed FPS area has been determined based on chemical analysis for the full suite of ROD Table 21 chemicals in four sediment cores during the DOC characterization (Figure 3-3). The bottom depth of ROD Table 21 exceedances ranged from less than 17.0 feet to 29.0 feet below mudline,[1] as shown in Table 3-2. Therefore, the target DOC throughout the FPS area is conservatively set at a constant depth below mudline set equivalent to the deepest confirmed DOC from the four sediment cores (i.e., 29.0 feet). To ensure all sediments with RAL exceedances or the presence of PTW are treated, the target ISS depth for the FPS area was set 1 additional foot below the deepest DOC (i.e., 30 feet below mudline) and will account for the existing mudline slope (see Figure 3.5). The final design of the ISS treatment area for the full-scale remedy will be based on a negotiated three-dimensional area informed by the results of the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area* memorandum (Anchor QEA 2023d).

Based on the size of the FPS area and the DOC, it is anticipated that approximately 1,940 cubic yards of sediment will be treated. With swell materials anticipated to represent 22% to 25% of the total treated sediment volume, approximately 490 cubic yards of swell materials will be generated, removed, and transported off site for disposal. Significant debris, either surficial or buried, is not anticipated within the FPS area.

3.2 Summary of ISS Bench Scale Treatability Study Results Completed to Date and Recommended FPS Grout Composition

The ISS bench scale TS commenced in March 2023 to inform the ISS design and select a grout composition and dosage(s) that meets the performance criteria established in the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a). Physical property testing has been performed on homogenized sediment samples collected from representative sample locations before and after the addition of various grout compositions and dosages to determine the optimal grout composition and dosage to meet the targeted strength and permeability specific to the ISS TS. The strength target for treated sediment and soil was 50 pounds per square inch (psi) or as needed to structurally support the minimal post-construction loading on top of the ISS-treated materials, which will be limited to placement of cover (or cap if deemed necessary based on the results of the ongoing ISS TS) materials such as materials for habitat restoration, as determined during RD. The permeability target for treated sediments was 10^{-6} centimeters (cm) per second or less. This target was selected to be consistent with performance criteria set forth for other ISS studies at similar sediment cleanup sites, including the Gowanus Canal, Quanta Resources Site (OU1; EPA 2011), Sydney Tar Ponds (PWGSC 2014), and the Connecticut River (EPRI 2014).

[1] The additional DOC samples were collected based on visual and olfactory field observations relative to the co-located historical vertically unbounded DOC. The analytical results were below the ROD Table 21 "Sediment RALs and PTW Thresholds for Selected Remedy - Updated for ESD" for sediment samples collected from two cores (PDI-198 and -199). Therefore, the DOC has been identified as less than or equal to the shallowest analyzed sediment sample that is deeper than the historical vertically unbounded DOC.

The ISS TS is composed of four phases of treatability testing using ISS-treated sediment. The FPS design is dependent on the results of the Phases I and II testing, which was completed in August 2023. Testing is being performed at four locations (ISSTS-001 through ISSTS-004). Location ISSTS-003 is located closest to the FPS area and contains the greatest percent fines, which has the potential to present a greater challenge for stabilization treatment, as discussed in Section 3.1. Therefore, the Phase I and II testing results from this location will be directly used for the FPS. Phase III testing is ongoing, and Phase IV testing will commence following the completion of Phase III testing. These testing results will be reported in the Interim Design Report concurrent with the results of the FPS. A summary of these phases includes the following:

- Phase I testing was completed at ISSTS-003 to determine the most efficient composition of the two cementitious components, blast furnace slag cement (BFSC) and PC, and the optimal water to cement admixture (W/C) ratio. This testing evaluated the impacts to treated sediment strength and permeability due to changes in the ratio of BFSC and PC under a constant grout dosage.
- Phase II testing was also completed at ISSTS-003 using the grout composition selected based on the Phase I testing results to evaluate the optimal grout dosage(s) for treated sediment strength and permeability.
- Phase III testing is in the process of being performed on duplicate samples from Phase II testing. It includes sediment leachability testing via synthetic precipitation leaching procedure modified EPA Method 1312 on both untreated sediment and treated sediment using the single (or more if the multiple grout compositions equally achieve the composition criteria) BFSC-to-PC ratio and grout dosage that best achieved the grout composition selection criteria.
- Phase IV testing will be performed on selected additional duplicate samples for target COCs from Phase II testing. It will consist of additional sediment leachability testing via Leaching Environmental Assessment Framework (LEAF) EPA Method 1315M (modified for organic COCs) on treated sediment using the single BFSC-to-PC ratio and grout dosage that achieves the lowest leachability during Phase III leachability testing. However, consideration will also be given to the strength, cost considerations associated with adding increased dosage amounts (i.e., a lower dosage with a slightly higher leachability would be much more cost effective at approximately the same level of performance), amount of swell materials, and workability of the grout to determine which grout should be advanced to Phase IV testing.
- NW Natural will determine whether Phase V testing of sediments is warranted in coordination with EPA based on Phase IV testing results. If warranted, the sediment/grout composition from Phase IV would be advanced for column testing in which the optimized grout composition and dosage treated sediments will be placed in columns with simulated cover material on top of the treated sediments to evaluate the potential for movement of COCs into the cover layer and associated concentrations if movement occurs.

The Phase I optimal admixture composition of BFSC and PC was found to be 60 percent and 40 percent, respectively, with an optimal W/C ratio of 0.8. This grout composition was advanced to Phase II testing to evaluate the strength and permeability of the treated sediments after being mixed with the following range of grout dosages: 10%, 12%, 14%, 16%, and 20%. As shown in Appendix H, each of these dosages achieve the preliminary 50 psi strength target within 28 days, and the strengths increase generally proportionally over the 3-day, 7-day, 14-day, 28-day, and 56-day cure durations. The 10% dosage showed little increase in strength between the 28-day and 56-day cure durations, whereas all other dosages showed relatively high increases between those durations. Also, as shown in Appendix H, each of the dosages achieved the 1×10^{-6} cm/s permeability preliminary target during both the 7-day and 28-day cure durations. However, the 20% grout dosage showed higher permeabilities for both the 7-day and 28-day test durations. For the remaining three grout dosages, the 14% and 16% dosages showed the lowest permeability for both the 7-day and 28-day permeability test durations. The ISSTS-003 sampling location and the strength and permeability results are depicted in Figures 1 through 3 of Appendix H, respectively.

Based on evaluation of the ISSTS-003 Phase I and II testing results, rather than using an anticipated single optimal dosage for the FPS, the Design Team proposes using both the 14% and 16% dosages because these dosages achieved significant strength increases within the 14-day cure duration and showed the lowest permeabilities relative to the other dosages. As discussed in response to EPA Comment 2 on the "New Redlined Text and New Appendices" included in Appendix H and Section 3.6.1 of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a), this proposal was not informed by the results of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* Phase III testing results because the objective of that testing is to provide a discrete (single time step) batch extraction test that is representative of the maximum leachability of the early curing stage of the treated sediment cylinder immersed in the water bath. This maximum initial curing stage leachability will then be compared to the untreated sediment leachability to support narrowing down the Phase IV testing to a single grout dosage specific to determination of site-specific diffusion coefficients. However, because the 14% and 16% grout dosages both performed optimally during Phase I and II testing, the Phase III testing data are not necessary to further narrow down the grout dosage selection. However, the Phase III leachability testing results will be used to inform the full-scale ISS remedy by providing initial leachability data at all four TS test locations that will inform the Phase IV leachability testing. As discussed in Section 3.6.2 of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a), the Phase IV testing data will be used to quantify diffusive mass flux of target COCs from ISS-treated sediments to support the RD of any necessary chemical isolation of the materials placed on top of the ISS-treated surface. Empirical sampling results from the sampling ports installed during the FPS will also provide an important line of evidence on potential diffusive mass flux to inform RD.

As shown in Figure 3-4, columns were selected to receive the different grout dosages. Based on experience at other project sites, the grout dosage can be changed efficiently in the field and the Design Team believes that continued collection of data from a range of grout dosages from field-mixed columns that can be correlated with our ISS TS laboratory results will be of benefit during the design process.

3.3 Summary of ISS Treatment Scope of Work

As discussed in Section 3.1 and shown in Figure 3-2, a representative 1,750 square foot in-water area within the Project Area has been selected to conduct an ISS FPS. The FPS construction will be conducted using barge-based equipment and will include the following scope of work activities:

- Prior to mobilization, a diver survey and a sub bottom profile survey were performed in August 2023 to identify surficial debris and potentially buried debris that could impact the advancement of the augers into the sediment (see Section 3.3.3 and Appendix I for more details). In addition, a pre-construction structural inspection of the Siltronic outfall was conducted in August 2023 to document pre-construction conditions (see Section 3.10 and Appendix I for more details).
- Mobilization.
- Installation of sediment and erosion controls in the uplands.
- Reconfiguration of existing oil containment and oil absorbent booms and installation of new sections of oil containment and oil absorbent booms.
- Performance of water quality monitoring, including monitoring baseline conditions prior to the start of in-water activities.
- Performance of vibration monitoring surveys at the Siltronic property, including monitoring baseline conditions prior to the start of the FPS.
- Installation of temporary pier and dock structures.
- Monitoring of air, noise, and odor.
- Removal of historical timber dolphin structure in close proximity to the FPS area.
- Completion of multibeam bathymetric surveys from a survey vessel with the objective of documenting mudline elevations within and directly surrounding the FPS area pre-construction (i.e., the current condition before any mudline disturbance and before timber dolphin removal), interim condition (i.e., progress surveys performed during completion of the FPS), and final condition of the sediment surface (i.e., following completion of the FPS construction).
- Completion of continuous and post-construction surveys of the Siltronic outfall and upland structures using topographic survey methods.
- Removal of superficial and subsurface debris that could impact construction and placement in a watertight scow for disposal at an approved off-site facility.

- Treatment of sediments within the FPS area using the design grout composition (i.e., 60% BFSC and 40% PC at a 0.8 W/C ratio) and dosages (i.e., 14% and 16%) determined via the Phase I and II treatability testing using a purpose-built drill rig equipped with 8-foot-diameter augers. The grout will be injected into the sediment through the augers as they advance through the sediment column. The augers generate a column of ISS-treated sediment, and an overlapping pattern of columns will be created to treat 100% of the sediment within the FPS area to the DOC.
- Removal of swell materials using a barge-based excavator or crane so the post-construction mudline is returned to elevations similar to pre-construction conditions. The swell materials will be placed in a standard watertight deck barge. Swell materials will be amended (if needed) to support dewatering and characterized for disposal. Swell materials will be sampled from the haul barge and characterized for disposal suitability. Following characterization, the swell materials removal barge will be transported to a transloading facility[2] for off-site disposal of the swell materials at an approved disposal facility.
- Completion of ISS treatment and swell materials removal activities will be conducted within a moon pool system that is described in Section 3.7.1.2.
- Following swell materials removal and final hydrographic surveys, removal of oil containment and absorbent booms and placement in watertight scow for disposal, followed by demobilization of in-water equipment.
- Installation of the four long-term sampling ports detailed in Section 4 on the surface of the ISS-treated sediment.
- Completion of post-construction structural inspection of the Siltronic outfall.
- Decontamination of upland equipment and demobilization (e.g., grout plant and horizontal silos).
- Marine equipment will be demobilized from the FPS area.

The average daily production rate over the 4-week FPS duration is anticipated to be 60 to 100 cubic yards of ISS-treated sediment (e.g., approximately two ISS columns). Based on the Design Team's experience and future application of lessons learned during the FPS, higher production rates are anticipated for full-scale implementation of ISS activities. The FPS will be slower in terms of daily production rates compared to a full-scale project, even when using the same size equipment because:

- The FPS has been designed to test and validate techniques, materials, and processes.

[2] SES has identified a support and transloading facility at 2649 River Road, The Dalles, Oregon, for the ISS FPS. This facility is located approximately 85 miles east of the Gasco Sediments Site on the Columbia River. It will be used for mobilization, staging equipment, decanting of any overlying water, and offloading swell materials to lined or sealed and covered trucks for disposal.

- During the FPS, unforeseen challenges may be encountered, and revisions to the scope of work discussed herein may need to be adjusted. This intended learning process is anticipated to slow down the daily production rates initially.
- As the FPS progresses, issues may be discovered where the process can be optimized or made more efficient. This refinement often happens during the pilot phase, and it may lead to some delays as changes are implemented and tested.
- Pilot projects involve extensive sampling, monitoring, and evaluation to gather data and assess the effectiveness of the stabilization technique. This thorough evaluation process can require more time and attention, diverting some resources from production.
- Even with the same size equipment, site-specific conditions can vary between the FPS area and the full-scale Project Area. The team may need to adjust the approach to accommodate the differences in geology, weather, or other unforeseen factors, which can affect daily production rates.

The FPS is intended to identify and address potential issues before scaling up to a full project. The lessons learned during the FPS can lead to greater efficiency and smoother execution in the full-scale project, which will eventually result in higher daily production rates once all the optimizations are in place.

The proposed FPS area was estimated to be three rows totaling 29 ISS columns based on drill barge moonpool widths, minimizing barge moves, and assessing swell materials removal. This FPS area was selected to ensure drilling can occur in open water, between two columns that have been treated in a line and perform treatment between two rows that have been treated. An additional 19 columns were added to the scope to better understand the work as time allows. The proposed minimum ISS pilot is 29 columns with a target goal of 48 columns. The work will be performed in a manner that ensures the objectives of the FPS are met even if the entire FPS area cannot be treated during the limited construction window. The overall schedule on site is approximately 6 weeks, as detailed in Section 6. The following sections described the ISS scope of work in more detail.

3.3.1 Timber Dolphin Removal

A dilapidated out-of-service timber dolphin structure is located adjacent to the northwest of the FPS area. The structure will be removed prior to the start of ISS treatment to create more space for FPS construction. To remove the dolphin piling cluster, one of the two EPA BMP methods will be used, as identified below. Both methods involve the placement of a floating containment boom around the piling cluster. An oil absorbent boom will be available to contain any sheens that may develop during the extraction process. The boom will be anchored in place using concrete blocks or Danforth-type anchors around the perimeter of the piling. If the boom becomes contaminated during the extraction process, it will be disposed of with the piling and swell materials. It is anticipated that one of the following methods will be used to remove the piling:

1. The first method to be used involves using an excavator or crane performing direct pull extraction methods. This approach involves grabbing or wrapping the piling and then directly pulling the piling from the sediment using the excavator or crane. Each piling will be removed individually by applying upward pressure to break the skin friction and suction. The removal process will continue until all pilings in the cluster have been successfully extracted.
2. If the direct pull extraction method is unsuccessful, a barge-mounted crane will be used to extract the piling. A variable moment APE 100 extractor will be locked onto the top of the piling. The crane will also apply upward pressure on the piling to break the skin friction bond between the piling and sediment.

The two methods are being considered because the exact condition of the piles is unknown below the water surface and mudline. If the variable moment vibratory extractor is used and cannot extract the pile, the excavator may have to dig at the piles to remove them or "push" on the pilling near the mudline to break the suction.

For both the excavator method and the crane extraction method, any sediment adhered to the piling will not be cleaned off over the water. The piling and adhered sediment will be collected on a watertight barge. The piling and sediment will be transported to the transloading site along with swell materials. SES will not cut the piling at or below the mudline because the pilings need to be extracted for future work at the FPS area. If piling remnants are left in place, that condition will be recorded, and they will be removed during implementation of the full-scale remedy.

In accordance with EPA's Specific Comment 7 on the FPSWP, a clean sand cover will be applied over the pile extraction footprint for residuals management. The sand will be placed at approximately a radius of 15 feet surrounding the perimeter of the pile grouping at an approximate thickness of 6 inches above the mudline. This will result in approximately 15 cubic yards of sand evenly spread throughout the perimeter footprint using excavator bucket. Consistent with the EPA comment, no post-placement bathymetric surveys will be performed.

3.3.2 Bathymetric and Diver Surveys

SES or a third party will perform full-coverage multibeam hydrographic, side-scan sonar, and diver surveys to document bathymetric elevations, support the identification and removal of debris, if necessary, and verify ISS swell materials removal activities for the ISS FPS work.

The purpose of the survey work is to collect high-resolution data below the waterline to verify bathymetric conditions for the appropriate phase of construction work. The identified survey phases include the following:

- Pre-Construction Survey—late August/early September
- Interim multibeam ISS Surveys—weekly (or more frequently), as needed
- Final As-Built Survey—expeditiously following completion of swell materials removal and confirmation from progress surveys that the target post-construction elevations have been achieved

A gridded, multibeam hydrographic dataset showing bathymetric conditions throughout the survey area will be obtained for each phase of work.

3.3.2.1 Survey Datums

To tie in with previous surveys at the Gasco Sediments Site, all control points used for data collection during the surveys and the final delivered data will be referenced to the following datums:

- Horizontal Datum – North American Datum of 1983 (HARN 91), State Plane Coordinate System Oregon Zone North, International Feet
- Vertical Datum – City of Portland, International Survey Feet

3.3.2.2 Survey Equipment and Control

A survey vessel will be mobilized to the Project Area. The survey vessel will be outfitted with all positioning and data collection equipment for the surveys. A real-time kinematic (RTK) reference station will be set up on site for use throughout the duration of the project. Programmed with the known geographic coordinates of its location, this reference station will broadcast RTK corrections to the survey vessel and rover GPS. The rover GPS will be used for positioning tie-in shots on other control points on the Gasco Sediments Site. A rover GPS will also be used to position the Bauer BG 28 drill rig, as discussed in Section 3.3.6. The RTK rover will also confirm positioning accuracy of the reference point on the survey vessel as a quality control (QC) measure.

3.3.2.3 Acquisition of Multibeam Echosounder Data

High-resolution multibeam data will be collected using an R2Sonic multibeam echosounder (or equivalent) in the FPS area for the appropriate phase of construction (or equivalent equipment). All multibeam hydrographic surveys will be conducted with 200% bottom coverage. All multibeam hydrographic survey data will be collected using a frequency of 450 kilohertz and a sonar capable of 1° beam widths. The surveying equipment allows for highly accurate positioning and accounts for the movement of the vessel along each axis (e.g., pitch, roll, and yaw). Survey data that are collected will extend a minimum of 50 feet beyond the survey boundary for the given survey area or to the extent practicable if restrictions are present, such as silt curtains. The R2Sonic 2024 specifications include the following:

- 450kHz (700kHz UHR on some units)
- 256 discrete 0.5°×1.0° beams (0.3°×0.6° at 700kHz) 1024 UHD
- 1 to 500 m minimum/maximum range
- 1.25 cm range resolution

During data acquisition, online positioning will be supplied by an onboard Applanix POS MV wavemaster (or equivalent equipment) receiving RTK corrections. The positioning equipment will have a tightly coupled GNSS and inertial motion reference unit allowing highly accurate positioning, which accounts for the movement of the vessel along each axis (e.g., pitch, roll, and yaw). The equipment specifications include the following:

- Position Accuracy: 0.02–0.1m (RTK) to 0.5-02 m (DGPS)
- Roll and Pitch Accuracy: 0.02°(RTK) to 0.03°(DGPS)
- Heading Accuracy: 0.03° with 2m baseline
- Heave Accuracy: 5 cm or 5%

The location of each sensor on the vessel is to be measured and recorded in the software. The positioning system offsets for the vessel will be confirmed with an online and PPK calibration solution.

The end product of the entire multibeam hydrographic survey system and processes used during its collection will be compliant with current International Hydrographic Organization Standard for Hydrographic Surveys (S-44 Ed. 6.1.0) Exclusive Order quality requirements and criteria.

3.3.2.4 Data Processing

The horizontal and vertical position of the vessel will be analyzed during the data collection by use of online QC measures built into the collection software. If RTK corrections during online collection were to be lost, post-processing of the positioning can still be completed in Applanix POSPac software (or similar) to allow accuracies in the horizontal and vertical positioning of less than 2 cm. Data will be cleaned and analyzed in 3D viewing software.

3.3.2.5 Deliverables

The surveyor will provide the following standard deliverables:

- **Plots.** Plots will be created for each survey that includes any existing basemap linework on record, bathymetric spot soundings, 1-foot contours, and digital terrain model. This plot will be provided in PDF format as well as AutoCAD Civil 3D. A Final As-Built Drawing will also be created.

- **Gridded Dataset.** A gridded ASCII data file (XYZ) will be provided of all bathymetric coverage. The grid size will be a maximum of 0.5 foot.
- **Volumes.** Calculation of final quantities.

3.3.3 Debris Management

As part of pre-construction activities, multibeam, side-scan sonar sub-bottom profile, and diver reconnaissance surveys have been performed throughout the FPS area to attempt to verify the presence of potential surficial debris or obstructions. Survey reports are presented in Appendix I. If surface and buried debris targets identified in Appendix I impact the construction, the excavator on the swell materials removal barge will be used to attempt to remove the obstructions and/or debris, which will be managed and transported for disposal as described in Section 3.6.

Although it is considered very unlikely based on multiple previous subsurface characterizations within and surrounding the FPS area, it is possible that refusal may be encountered when advancing the ISS auger equipment. A large subsurface object or a naturally occurring thick deposit of cobble, large boulder, or dense or well-bonded sediment may cause the refusal; features such as these have not been previously identified in or surrounding the FPS area. Refusal is defined as a condition that occurs during advancement of the ISS mixing tool where the mixing tool is unable to advance at a rate greater than 6 inches in a 5-minute period due to a subsurface obstruction. If refusal is encountered while conducting ISS operations within a column, the ISS barge will be moved off location, and attempts will be made to remove the obstructions and/or debris with the excavator on the swell materials removal barge. The obstructions and/or debris will be placed in the watertight swell materials removal barge and managed as described in Section 3.6. Following removal, the column will be re-entered with the ISS auger equipment. Columns that are temporarily halted will be reinjected with the prescribed grout volumes needed once obstructions or debris are removed. If the excavator is unable to remove the debris, the location will be recorded, and the column location will be adjusted or skipped. A location where debris cannot be removed as part of the FPS will be addressed as necessary as part of the full-scale remedy.

3.3.4 Equipment Configuration

Several barge configurations, equipment, and specific tools will be needed to perform the ISS work, swell materials removal, ISS sampling, and mixing of the BFSC and PC to achieve the design composition and dosage. Example equipment and material specification sheets are included in Appendix B. Generally, the configuration of the equipment includes the following:

- ISS barge configured to support a Bauer BG 28 drill rig with the ISS augers, fuel cube, office, welding, and support supplies with its own dedicated moon pool system with one exterior turbidity curtain around the entire perimeter of the barge. The curtain system can be winched up to the water surface when the barge needs to be moved. The curtain system will also have vertical spuds strategically positioned around the barge to help hold the curtain in place. The ISS barge will also have a 120-ton crawler crane to serve as counterbalance to the Bauer ISS drill rig and will also be used for ISS sampling equipment handling and general lifting, as needed.

- Batch plant system configured to support a Bauer CMS 45, two 1,200 CF low profile horizontal silos, generator, grout pump, hoses, and water tank on land. The batch plant will supply the grout to the ISS barge.
- Swell materials removal barge configured to support powered spuds, generator, hydraulic power pack to operate the spuds, PC300 LF excavator (or equivalent), and fuel tank. The ISS swell materials removal barge will also have its own dedicated moon pool system. This moon pool system will have two curtains as well as winches and spuds to hold the curtain in place and raise and lower the system.
- Watertight swell materials removal barges to stage swell materials and decant water (anticipated capacity ranging from 300 to 500 cubic yards).
- Tender Tug "Husky" (or equivalent) will be used for barge positioning and maneuvering.

3.3.5 ISS Equipment

ISS will be performed in the FPS area from a floating barge platform. Positioned on the platform will be the ISS drill rig and all necessary auxiliary components for advancement of the ISS columns. Columns will be installed utilizing an 8-foot-diameter auger. All drilling will occur within the confines of a moon pool constructed for containing potential turbidity generated during ISS mixing.

The plan view and profile view of the ISS barge are shown in Figures 3-4 and 3-5, respectively. The proximity to the navigation channel and Siltronic outfall (shown in Figure 3-4), as well as anticipated water conditions in the Willamette River during September and October, were taken into account when selecting the ISS barge size, draft, and configuration.

The Bauer BG 28 track-mounted rotary drilling rig will have the capability to pump fluid through the hollow-stem 8-foot-diameter auger during advancement and blend with target sediment simultaneously to achieve the range of DOCs. This rig and auger combination has demonstrated the capability to produce a well-mixed, homogeneous sediment matrix on similar projects (e.g., Slurry Pond Sediment Project in Montgomery, Alabama) with soft sediment geology. The drill rig will be chained to the deck of the barge as shown in Figure 3-6. Once a column is complete, the drill rig will "walk" along the edge of the barge to advance the next column. The barge will be repositioned as needed to achieve proper alignment over the drill location.

Sufficient 8-foot-diameter augers will be available to mix grout into the sediment within the FPS area to the range of DOCs. The augers include multiple levels of mixing blades with two blades on each level. The augers will be selected to enable efficient cutting, shearing, and mixing of the sediment with the injected grout. A variety of replacement cutting teeth will be available at the Project Area, and appropriate teeth for efficient advancement of the augers through the sediment while using appropriate grout injection rates will be used.

The state-of-the-art Bauer BG 28 comes equipped with automatic grout monitoring systems as well as the means to monitor and control the verticality of the ISS columns. It is equipped with a mast inclination system with automatic mast adjustment to maintain verticality alignment. This ensures the sediment mixed columns are installed within verticality tolerances of 0.5%, as recommended by the drill rig manufacturer. The drill rig is outfitted with a computerized column (drill) parameter monitoring system capable of monitoring the following:

- Verticality
- Penetration depth
- Penetration rate and withdrawal speed
- Rotation rate
- Drilling resistance
- Injection rate and pressure

Information needed to properly execute auger soil mixing is shown on the B-Tronic monitor to the operator and stored inside the B-Tronic computer logging system.

All drill rig and grout plant data will be logged and compiled during the FPS. Per EPA's request, drill rig and grout plant logs will be submitted to EPA in the weekly reports. This information will be considered during development of the Interim Design Report.

3.3.6 ISS Column Location Control

Accurate positioning of the ISS barge, drill rig, and ISS columns is important to achieving 100% treatment within the FPS area. The primary positioning mechanism will be the Bauer Assistant Positioning System (B-APS; 5 cm accuracy) and GPS positioning. The B-APS is a satellite-based navigation system for positioning and documentation. The ISS barge will be positioned over the target column location by a tugboat operator who views the B-APS and GPS information in real time. Once the ISS barge location is established, the drill operator will move the auger into position over the target column location. As part of the B-APS, the rig operator can see both completed and yet-to-be completed columns at a glance. The system records and saves the actual coordinates after completion of each column. As a secondary method, or backup to the B-APS, conventional RTK GPS survey methods will also be readily available.

Prior to commencing ISS activities, control points will be verified in the Project Area and additional points will be established to be maintained during the project. The ISS column layout, prepared in AutoCAD, will be used to locate each ISS column's center-point in relation to known Project Area features. These center-points will be loaded into a data acquisition system tied to a GPS system established for use at the Project Area. The contractor will use the GPS system to perform daily layout with an allowable tolerance of 0.54 inches. A spreadsheet listing the column coordinates, depths, and identifications will be provided to the tugboat and drill rig operators along with an alphanumerically identified column layout figure.

3.3.7 ISS Column Layout

A series of 8-foot-diameter sediment mix columns will be installed to stabilize and solidify the sediment within the FPS area. Each column will be advanced to 30 feet below mudline (i.e., the DOC of 29 feet plus 1 additional foot below the DOC, as discussed in Section 3.1). The columns will be installed in a honeycomb pattern on a grid spacing to provide 100% coverage of the FPS area. The honeycomb pattern is the most efficient spatial design to cover an area with overlapping circles and has become an industry standard. The Design Team has used this pattern at several cleanup sites, including but not limited to the Harrison MGP Site (New Jersey), Duke Cincinnati MGP Site (Ohio), and the Napa MGP site (California). Figure 3-4 shows the honeycomb pattern and the overlap of the columns as well as the primary and secondary column configuration. Work will progress from offshore to nearshore. The columns will be sequenced in a primary/secondary pattern. Primary columns will be sequenced first, with secondary columns constructed the following day. Based on the anticipated production rate, two columns should be completed each day. Initially, each column will be completed with one down stroke of the auger to the DOC and one upstroke to return the auger to the column surface. Based on the construction quality assurance/quality control sampling results discussed in Section 3.3.8.3, the Design Team will determine if additional strokes may be necessary to achieve a homogenous mix. Grout injection will initially commence at the surface water-mudline interface; however, if turbidity is observed outside of the established controls (see Section 3.7.1.2), the auger grout injection may begin a short distance below the mudline. The auger will be advanced and withdrawn at a rate that ensures blade rotations and penetration provide consistent homogeneous blending. Grout injection will be implemented during the downstroke (90% of theoretical grout injected) and the upstroke (10% of the theoretical grout injected) of the drill head during ISS column installation. Blade rotations and penetration speeds could vary during the FPS to evaluate homogeneity of the mixed column(s). As discussed in Section 3.3.8.3, subsamples of ISS-treated sediments will be collected as a construction quality assurance/quality control measure within each column at depths that divide the target ISS depth of 30 feet into three equivalent depth intervals to provide a representative sample of the top (i.e., 7.5 feet below the existing mudline), middle (i.e., 15 feet below the existing mudline), and bottom (i.e., 22.5 feet below the existing mudline) of the column to visually document the sediments are well mixed with the injected grout mixture. If any abnormalities are observed in the samples (e.g., incomplete mixing or clumps of untreated sediment), an additional downstroke and upstroke may be necessary.

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Each ISS column will be identified with a unique alphanumeric designation. Generally, a combination of a letter and number identification system will be used where the letter corresponds to the row and the number corresponds to the column grid that the sediment mix column center-point falls on. For instance, a sediment mix column located at the intersection of the third row and fourth column would be identified as column C4 (Figure 3-4).

3.3.8 ISS Treatment of Sediment

As discussed in Section 3.2, the Design Team proposes a mix design that consists of 60% BFSC and 40% PC at a 0.8 W/C ratio that will be added in dosages of either 14% or 16%, as shown in Figure 3-4. Upon EPA approval of the mix design, the proper amount of admixture materials to satisfy the installation requirements of the FPS will be delivered for use during the FPS.

Bulk PC and BFSC will be brought to the Gasco upland facility and stored in moisture resistant storage silos or directly loaded to horizontal silos staged near the shoreline (see grout plant location on Figure 3-4). These materials will be transported to the upland facility in bulk delivery trucks and either transferred from the trucks to the storage silos or directly into the batch plant barge pneumatically through a closed system using hoses and air. The PC and BFSC will be combined with water to create the grout that will be injected into the sediment through the augers. The batch plant will be staged near the shoreline and close to the FPS area.

A fully automatic Bauer CMS 45 MAT grout plant will be utilized for the mixing of the admixture proposed for the FPS. Grout will be prepared on a batch basis. A clean water source supply will be obtained from an on-site fire hydrant or local city water main. PC and BFSC will be pre-measured using the grout plant weigh scales and mixed with the optimal ratio of water as determined through the ISS TS testing results. A predetermined amount of grout will be metered and pumped from the mix plant for each ISS column based on the volume of the ISS column. The prescribed grout mix will be injected at the appropriate dosage rate while maintaining the desired injection rate in the treatment zone. The goal will be to maintain the calculated required number of blade rotations and penetration speeds to ensure consistent homogeneous blending. QC documentation for the grout, such as the parameters for each batch mix and grout quantity calculations per column, will be included as part of the FPS daily log or QC reports. In addition, the following Q/C tests will be performed on site during grout production: mud balance, density, viscosity, temperature, and pH.

3.3.8.1 Best Management Practices for Upland Work

The following BMPs are proposed to ensure environmentally responsible operations at the material storage and grout plant areas. These BMPs encompass effective dust control, secondary containment for generators, and vigilant monitoring for leaks and drips, and include the following:

- Install and maintain bag house systems equipped with high-efficiency filters to capture and contain dust emissions from material handling and processing activities.

- Regularly inspect and clean the bag house filters to optimize their efficiency and prevent the release of fugitive dust.
- Place generators on impermeable liners with berms to provide secondary containment, preventing any potential fuel or oil spills from reaching the surrounding environment.
- Conduct periodic inspections of the containment areas and promptly address any spills or leaks to avoid environmental contamination.
- Implement erosion and sediment control measures such as installing silt fences, erosion control blankets, or vegetative stabilization to prevent soil erosion and runoff into nearby waterbodies along the upper edge of the shoreline.
- Regularly inspect and maintain erosion control structures to ensure their effectiveness in minimizing sedimentation and protecting water quality.

3.3.8.2 Performance Objectives and Criteria

The specific performance objectives associated with ISS treatment of sediment with grout include the following:

- Complete mixing of the grout with the in situ sediment to the DOC with no unmixed sediment clumps greater than 3 inches in diameter[3] and no visual separate phase NAPL present within the ISS material.
- Measure unconfined compressive strength and permeability of the treated sediments for the same treatment curing durations identified in the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a) to facilitate a comparison with the results of the laboratory-based ISS TS Phase II testing results and support determination of performance targets for these parameters during RD.
- Perform post-construction sampling will be performed to evaluate potential chemical diffusion from the surface of the ISS-treated sediments over several time steps for the full list of COCs containing ROD Table 17 groundwater CULs.

3.3.8.3 Verification of Performance Objectives and Criteria

Successful achievement of the ISS performance objectives and criteria will be verified through equipment documentation, field sampling, and physical property testing. The Bauer B-Tronic system installed on the Bauer BG 28 drill rig will be used to ensure the ISS columns are advanced to the DOC with the appropriate mix design. The Bauer B-Tronic system will also be used to confirm the grout batch weight, horizontal and vertical accuracy of the columns, and verticality of each column.

[3] Three inches was used to represent a homogenous ISS-treated sediment to be consistent with Specification Section 03 11 00 of the Gowanus Canal Superfund Site *RTA1 100% Remedial Design* (B&B Engineers and Geologists 2020). The hydraulic sampling device used to collect the ISS-treated sediments has dimensions of 8 inches long by 8 inches wide by 14 inches tall, which is sufficient to characterize unmixed sediment clumps greater than 3 inches in diameter.

Post-treated ISS samples will be obtained using a discrete sampling device (e.g., hydraulically or mechanically activated sampler, wet grab sampler, or equivalent) that is able to collect samples at different depths of the ISS column. The interior dimensions of the sampler are 8 inches by 8 inches by 14 inches. As discussed in Section 3.3.7, samples will be collected within each column at depths that divide the target ISS depth of 30 feet into three equivalent depth intervals (i.e., 7.5 feet below the existing mudline, 15 feet below existing mudline, and 22.5 feet below existing mudline) to provide a representative sample of the top, middle and bottom of the column. Each sample will be visually observed to confirm complete mixing of the grout with the in situ sediment with no unmixed sediment clumps greater than 3 inches in diameter and that no separate phase NAPL is present. These samples will be taken at the perimeter of each mixed column and the overlap of the tie in column, as applicable. Sample molds will be prepared for both strength and permeability testing using the same methodologies identified in the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a). A sufficient quantity of cylinder molds will be prepared for the unconfined compressive strength testing at 3, 7, 14, 28, and 56 days and permeability testing at 7 and 28 days to facilitate a direct comparison of strength results to the Phase II ISS TS testing results and support determination of performance targets for these parameters during RD. An additional set of duplicate cylinder molds will also be archived for potential additional testing.

Post-construction long-term sampling will be performed as detailed in Section 4.

3.4 ISS Post-Treatment Swell Materials Management

The swell materials that are generated as part of the ISS activities need to be removed and transported off site for disposal. The target post-construction elevations for this removal are returning the sediment bed to the approximate pre-construction elevations, while accounting for the uneven surface created by removal using environmental bucket, equipment tolerances, and ensuring no net elevation increase across the FPS area. The amount of swell materials expected to be generated from the selected grout composition (selected following Phase I treatability testing) and dosages (selected following Phase II and III treatability testing) were calculated to be approximately 22 to 25%. Therefore, the Design Team anticipates that the volume of swell materials will be approximately 25% of the ISS column volume for a total removal volume of approximately 490 cubic yards, which will require the use of one or two watertight barges. The actual quantity of swell materials generated during the FPS will provide useful information regarding expected swell materials generation during full-scale implementation.

3.4.1 ISS Post-Treatment Swell Materials Removal

Swell materials removal is anticipated to occur every day or every other day following ISS treatment, as needed based on bathymetric survey progress results. This timing will allow the swell materials to begin setting up, which will improve its ability to be removed, but does not allow the swell materials to fully set, which would make the swell materials more challenging to remove. The targeted removal elevation will be the pre-construction mudline (i.e., swell materials above the pre-construction survey), while accounting for the uneven surface created by the bucket and the removal equipment tolerances discussed in Section 3.4.1.2. Swell materials removal will be sequenced in the pattern in which the ISS columns are completed.

Swell materials will be removed using a barge-mounted Komatsu PC300 Long Front excavator (or equivalent) equipped with a 2.0-cubic yard environmental bucket. The environmental bucket is specifically designed to take a near-level cut bite with minimal scalloping and limit the potential release of sediment solids. A more robust digging bucket will be available if the swell material has solidified beyond the digging capacity of the environmental bucket. Swell materials removal will occur inside the moon pool curtain, as described in Section 3.3.5.

The excavator will remove the swell materials and place them within a watertight scow. See Figure 3-6 for plan view configuration and Figure 3-7 for the profile view. The swell material will then be characterized while remaining at the Project Area to determine the disposal suitability at the appropriate permitted disposal facility prior to downriver transport (see Section 3.4.2). When filled to capacity, the scow will be transported to the project-specified transloading facility for decanting of any overlying water to frac tanks onshore (Section 3.5 includes additional information regarding decant water). The dewatered swell materials will then be stabilized with PC, as necessary to meet landfill disposal requirements. Once characterized, the dewatered swell materials will be offloaded to lined or sealed and covered trucks and hauled away for final disposal, as described in Section 3.4.2. The Design Team anticipates only a single scow will be used for the FPS based on the total design swell materials removal volume.

3.4.1.1 Mechanical Swell Materials Removal Control

GPS-based software will be used on the Komatsu PC300 Long Front excavator to ensure the swell materials are removed to the target elevations. The Trimble Machine Control (TMC) system uses a combination of inclinometers, software, and dual RTK-GPS antennas for bucket location. A local base station will be set up to provide differential corrections for the GPS-enabled equipment in the field. After the installation of the RTK base station, its accuracy will be verified against available Project Area control points. The RTK rover will check into a known point on land daily prior to work starting. All equipment control will then be checked against the rover position daily when in use.

The pre-construction mudline surface will be programmed into the TMC system and will be used as the target post-construction mudline template during swell materials removal. The operator will simultaneously view a plan and profile of the cut on the computer screen within the excavator. SES is currently using the TMC system on over 25 pieces of equipment across the country for other remedial construction projects. Data from the system will be utilized daily to assess coverage, quantities, and completion. In addition to the coordinate and elevation data collected by the system, field personnel will collect multibeam survey data for quality assurance (QA)/QC of work performed to date. The bucket footprint is programed in the TMC system software to account for appropriate bucket overlap to ensure inventory materials are removed efficiently, minimizing additional removal passes for missed inventory. SES will monitor the performance of swell materials removal using TMC system data files and multibeam bathymetric survey progress results.

Daily environmental bucket positioning monitoring will be performed by placing the bucket on a known point and at a known elevation or checked with a GPS survey rover. The TMC system output will then be compared to the known coordinates and elevation. Recalibration will be performed if the daily check is outside the expected tolerance limit. The same position monitoring will be made if changes or modifications are made to the system or if an extended period of time has passed since the system was last used.

3.4.1.1.1 Performance Objectives and Criteria

Performance objectives associated with swell materials removal include achieving the specified target grades and elevations. The specified target grades and elevations for this removal are returning the sediment surface to the approximate pre-construction elevations across the FPS area, while accounting for the uneven surface created by removal using an environmental bucket and the equipment tolerances discussed below. Due to these factors, the post-construction elevations will not exactly match pre-construction elevations. However, the post-construction elevations will be managed to ensure there is no net fill when calculated across the FPS area to ensure no flood rise impacts. Bathymetric surveys will be performed to confirm that swell materials were removed to the target elevations.

Swell materials removal performance criteria include the following:

- Multibeam bathymetry data will be collected with a horizontal and vertical accuracy of 0.5 foot.
- Multibeam XYZ files will be provided electronically with the computer mean value a maximum grid spacing of 1 foot.
- The required minimum cut elevation will be achieved in at least 90% of the FPS area. In addition, no sounding in any of the remaining 10% of the FPS area will be higher than 6 inches above the required elevation.

3.4.1.1.2 Verification of Performance Objectives and Criteria

Swell materials removal to the specified grades and elevations will be verified through interim progress bathymetric surveys and a final post-swell materials removal multibeam bathymetry survey.

It is anticipated that interim progress bathymetric surveys will be performed daily to establish interim removal depths, volume of swell materials generated, and extents of swell materials removal. The swell materials removal allowance will be limited to 0.5 feet (i.e., 0.5 feet below the target swell materials removal elevation). If progress surveys show mudline elevations have not been achieved, additional swell materials removal will be performed in those areas until target mudline elevations are achieved.

Post-swell materials removal bathymetric surveys will be performed using an integrated hydrographic surveying system consisting of a survey grade multibeam fathometer, inertial RTK differential GPS with motion platform, river gauge, and computer and software. Progress surveys may be performed using a single-beam or multibeam fathometer.

Grade uniformity will be evaluated based on the average elevation over an approximate local 3-foot by 3-foot grid. If there are areas that remain above the required elevation over more than 10% of the work area or if any grid area is greater than 6 inches above the required grade (i.e., high spots), then the performance criteria are not met, and additional swell materials removal will be performed until the grade is within the performance criteria.

3.4.2 Swell Materials Removal Material Handling, Transportation, and Disposal

The evaluation of methods for handling and transportation of removed swell materials from the FPS area is based on applicable performance standards and design objectives and methods of analysis presented in the *Final Pre-Remedial Basis of Design Technical Evaluations Work Plan* (TEWP; Anchor QEA 2019a).[4]

As discussed in Section 3.4.1, removed swell materials from the FPS area will be placed in watertight barges. Once loaded, the swell materials will be characterized for disposal suitability prior to the barges being moved to and securely moored at The Dalles waterfront facility in The Dalles, Oregon, for transloading and dewatering.

3.4.2.1 Project Area-Specific Swell Materials Disposal Suitability Framework and Construction Verification Requirements

Prior to transport of the swell materials removal barges from the Project Area, the removed swell materials will be characterized for disposal suitability. The SOW (EPA 2009b) includes a Project Area-specific framework for classification and management of removed materials for disposal. Removed materials are defined in the SOW as dredged sediment and excavated riverbank material. The

[4] NW Natural has reviewed site historical uses and has concluded that the presence of munitions and explosives of concern (MEC) is highly unlikely within the FPS area; however, NW Natural will be prepared to implement a MEC management plan similar to the Former PGM Site if MEC is encountered in dredged material.

framework prescribes a multi-step process for disposal suitability classification, including preliminary classification based on pre-RD data and confirmation based on a tiered representative sampling program during construction. On-site ex situ treatment of dredged material in barges (e.g., through PC addition to facilitate dewatering and binding of contaminants) is specifically allowed in the SOW. Disposal suitability confirmation classification for debris and swell materials disposal will be based on analysis of the material after ISS and after ex situ treatment, if needed.

The SOW (EPA 2009b) identifies three waste classifications for removed materials: Hazardous Waste, Special Waste, and Cleanup Material. Removed swell materials will be classified as Hazardous Waste, Special Waste, or Cleanup Material based on criteria established in Section 3.6.3.1 of the SOW. The classification decision tree is presented in Figure 3-8. These classifications, the criteria for each, and the appropriate disposal methods for each are summarized as follows:

- **Hazardous Waste** management standards apply to materials that contain F002 listed waste or that meet any of the characteristics of Hazardous Waste (other than toxicity associated with manufactured gas plant [MGP] waste-related constituents) at the time the material leaves the Project Area.
  - The contained-in criteria for F002 listed waste are the Oregon risk-based concentrations (RBCs) for occupational exposure via soil ingestion, direct contact, and inhalation for trichloroethene, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, 1,1-dichloroethene, and vinyl chloride from *Risk-Based Decision Making for the Remediation of Contaminated Sites* (DEQ 2018; Vrooman 2019). These RBCs are summarized in Table 3-3. Materials that contain concentrations of these constituents exceeding the RBCs will be assigned waste code F002, treated as needed to meet applicable land-disposal restrictions, and disposed of at the Chemical Waste Management of the Northwest Landfill in Arlington, Oregon.
  - Materials that exhibit any characteristic of hazardous waste other than toxicity associated with MGP-related constituents (including bulk concentrations of TCE and its degradation products) will be assigned the appropriate "D" waste code, treated as needed to meet applicable land-disposal restrictions, and disposed of at the Chemical Waste Management of the Northwest Landfill in Arlington, Oregon.
- **Special Waste** management standards apply to removed materials that are not Hazardous Waste but exceed toxicity characteristic regulatory levels identified in Table 1 of the *Code of Federal Regulations* (CFR), Title 40, Part 261.24 for MGP waste-related constituents. No hazardous waste code will be applied to these materials because of the MGP exclusion in 40 CFR 261.24(a). The criteria for Special Waste are listed in Table 3-4. Special Waste will be disposed of at the Chemical Waste Management of the Northwest Landfill in Arlington, Oregon.

- **Cleanup Material** management standards apply to removed materials that do not meet the definition of Hazardous Waste or Special Waste. Cleanup Material will be disposed of at a nonhazardous waste landfill.

For the purposes of this FPS, refer to Section 3.4.2.5 for the preliminarily identified potential disposal facilities.

Due to the anticipated small volume of swell materials to be removed as part of the FPS (i.e., one scow), the materials on the barge(s) will be characterized for disposal as described in the SOW (EPA 2009b) for Tier 1. The swell materials disposal suitability characterization methods and comparative endpoints are discussed in Section 3.4.2.3. Additional management of materials following an exceedance of toxicity characteristic leaching procedure (TCLP) criteria may include activities such as enhanced mixing of materials in the barge to increase sediment homogeneity, additional mixing to distribute any stabilization (treatment) materials, or the addition of stabilizing materials (e.g., additional PC or a similar material).

3.4.2.2 Existing Subsurface Sediment Suitability Evaluation

The swell materials will consist of sediment mixed with the selected grout composition and dosages identified in Section 3.2. Laboratory-based quantification of swell materials at this selected grout composition and dosages has not been conducted, but historical testing of amended sediment samples may be used as a proxy.

In 2010, NW Natural performed bench-scale treatment testing as part of the *Final Project AIR and Data Gaps QAPP* (Anchor QEA 2010) to evaluate the dosage of a variety of dewatering reagents that would eliminate benzene TCLP exceedances identified in unamended samples collected from portions of the Project Area. The sediment samples were treated with three different amendment dosages: 5% PC, 10% PC, and 5% quicklime. All dosages are percent by weight. The amended samples were submitted for TCLP tests, and the results of the tests indicate that all amended samples passed the TCLP test. These site-specific data indicate that amending sediment with PC or quicklime may effectively control benzene leaching (unamended samples with TCLP exceedances all passed TCLP testing after amendment) and facilitate disposal of swell materials as a Cleanup Material consistent with the disposal framework identified in the SOW (EPA 2009b).

As presented in the *Revised Final Pre-Remedial Design Data Gaps Data Summary Report* (Anchor QEA 2022c), TCLP analyses were performed on 19 pre-design investigation samples. In 3 of the 19 samples, the benzene concentrations exceeded the TCLP regulatory level (measured concentrations of 562, 2,100, and 4,280 micrograms per liter [µg/L] compared to the regulatory level of 500 µg/L). Aliquots of these samples were amended with 5% and 10% PC, allowed to cure, and retested by TCLP. In all six TCLP tests performed on the amended sediment, the benzene concentration was below the regulatory level. The highest concentration of benzene in the simulated leachate from an amended sample was 12.5 µg/L, less than 3% of the regulatory level. Based on this testing, addition of 10% PC by weight, which was previously shown to result in a material that meets other disposal criteria, should also reduce any potential benzene leaching below regulatory levels. Amendment with 5% PC was also shown to effectively control leaching.

One core (PDI-071) presented in the *Revised Final Pre-Remedial Design Data Gaps Data Summary Report* (Anchor QEA 2022c) was collected in the vicinity of the FPS area. The sample from this location did not exhibit a characteristic of Hazardous Waste (except toxicity associated with MGP waste-related constituents [benzene]). Following amendment by 5% and 10% PC (by dry weight), the sample did not exceed the TCLP limits. Because the swell materials will be a mixture of treated sediment and grout, the swell materials are anticipated to be characterized as nonhazardous Cleanup Material.

Additionally, hundreds of bulk sediment samples have been analyzed for F002 listed wastes included in the 2009 SOW, and results have been screened against the applicable RBCs discussed in Section 3.4.2.3. Based on review of the historical data, no RBC exceedances are expected to be encountered in the FPS area.

3.4.2.3 Swell Materials Disposal Suitability Characterization

A representative five-point composite sample will be collected from the mixed and amended swell materials in each barge and analyzed for waste disposal suitability characterization in accordance with the Project Area-specific requirements discussed in Section 3.4.2.1. Waste disposal suitability characterization testing will also be conducted to meet the disposal facility-specific characterization requirements. An expedited laboratory turnaround time will be requested to limit the storage duration of the swell materials in the barges at the Project Area.

The results of the analyses will be used to determine if the swell materials are hazardous waste, special waste, or cleanup material:

- **Hazardous Waste**: If the swell materials exhibit ignitability, corrosivity, or reactivity[5] or exceed F002 RBC or TCLP criteria for non-MGP constituents, the materials will be manifested as Hazardous Waste. As discussed in Section 3.4.2.4, it may be possible to add additional amendment to the swell materials within the swell materials removal barges to reclassify Special or Hazardous Waste as Cleanup Material. If additional amendment is added, the swell materials will be resampled and reclassified.

[5] As discussed in Section 3.5.1.2 of the *Revised Pre-Remedial Design Data Gaps Work Plan* (Anchor QEA 2019b), there are no disposal facility requirements to test for the reactivity characteristic. In addition, there are no current test procedures for the reactivity characteristic. There were some reactivity tests that were used historically, but those test methods were withdrawn over 20 years ago. Consistent with the findings for each of the eight reactivity criteria presented in the *Revised Pre-Remedial Design Data Gaps Work Plan*, NW Natural has no knowledge that would indicate that the sediments contain the reactivity characteristic.

- **Special Waste**. If one or more of the TCLP leachate concentrations exceed their respective toxicity characteristic criteria for MGP waste-related constituents, but the swell materials do not exhibit any other Hazardous Waste characteristics (ignitability, corrosivity, or reactivity), do not exceed F002 RBC, and do not exceed TCLP criteria for non-MGP constituents, the swell materials will be characterized as Special Waste.
- **Cleanup Material**. If the TCLP leachate concentrations are all below their respective toxicity characteristic criteria, bulk sediment samples do not exceed F002 RBC, and the bulk sediment does not exhibit other Hazardous Waste characteristics (ignitability, corrosivity, or reactivity), the swell materials will be characterized as Cleanup Material.

3.4.2.4 ROD-Required Ex Situ Treatment Evaluations

Page ii of the Declaration for the ROD states, "The need for, and extent of, ex-situ treatment will be based on the offsite disposal requirements and material testing during design and construction" (EPA 2017). Consistent with the ROD, additional treatment of removed swell materials is only necessary if required by state or federal regulations or for material acceptance by disposal facilities.

Section 12.4 of the ROD states, "Ex-situ treatment of some sediment and soil removed from the Site would result in additional reduction of toxicity, mobility, and volume on contaminants in the sediment and soil" (EPA 2017). Many historical TCLP tests have been performed on sediment samples before and after amendment, and the testing results demonstrated that, based on benzene concentrations in simulated leachate, materials preliminarily classified as Special Waste would be reclassified as Cleanup Material after amendment (Anchor QEA 2010, 2022b). The criteria for preliminary classification of Special Waste and Cleanup Materials are discussed in Section 3.4.2.1.

3.4.2.5 Waste Disposal Facility Evaluation

The waste disposal facility evaluation for the FPS is based on the performance standards and design objectives and methods of analysis presented in the TEWP (Anchor QEA 2019a). Although the swell materials are preliminarily anticipated to be characterized as Cleanup Material based on the historical amended sediment testing described in Section 3.4.2.3, it is possible the project may generate Hazardous Waste or Special Waste. Disposal of all Hazardous Waste and Special Waste will be at the Chemical Waste Management of the Northwest Landfill, which is owned and operated by Waste Management, Inc., and located in Arlington, Oregon. Cleanup Material may go to one or more of the following permitted landfills, although NW Natural proposes disposal at the Wasco County Landfill:

- Wasco County Landfill, owned by Wasco County and operated by Waste Connections, Inc., located in The Dalles, Oregon
- Columbia Ridge Landfill, Waste Management, Inc., located in Arlington, Oregon
- Roosevelt Regional Landfill, Republic Services, Inc., located in Roosevelt, Washington

Each disposal facility will operate in conformance with the terms of its solid waste permit. In conformance with Section 121(d)(3) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Off-Site Rule (40 CFR 300.440), the compliance status of the intended receiving facilities will be confirmed by writing to the Region 10 Off-Site Contact. Confirmation will be made in advance of removing swell materials so construction is not impeded.

At each point in the removal, handling, treatment (if necessary), transport, and disposal process the status of material present at each location in the process shall be determined and made clear to all personnel who are present. Regardless of the waste suitability determination, all materials will be managed in a manner to protect human health, including workers handling the material, and the environment. MGP waste may be handled using procedures similar to hazardous wastes to ensure health and safety. Where material is determined to not be Hazardous Waste or Special Waste, all health and safety procedures will be at least consistent with handling of contaminated non-hazardous wastes. Due to its particular characteristics, MGP waste may be handled using procedures similar to hazardous wastes to ensure health and safety. Changes in these procedures shall be consistent with any changes in the status of the materials during the removal, handling, treatment, transport, and disposal process. Specific procedures and equipment that will be used to protect health and safety will be described in the construction Health and Safety Plan that will be developed before beginning field work.

3.4.2.6 Removed Swell Materials Dewatering

Following swell materials characterization for disposal suitability, the swell materials removal barge(s) will be transported to the transloading facility at The Dalles facility for dewatering (if needed). Dewatering may be conducted using two methods: gravity dewatering and addition of a dewatering amendment. Sumps will be used to facilitate gravity dewatering of the swell materials. Sumps will be constructed within the swell materials removal barge to collect and pump decant water to holding tanks onshore. Management and disposal of the decant water at The Dalles facility is discussed in Section 3.5.

Following gravity dewatering, the swell materials may be amended with an approximate amount of PC if needed to meet landfill disposal requirements, using bulk super sacks to help stabilize the sediment and reduce its leachability and moisture content. The cement amendment will be done directly on the barge. Chemical Waste Management of the Northwest Landfill will require that materials pass the paint filter test (no free liquid). While landfills accepting Cleanup Material may be able to receive material with free liquids, the consistency of the material will need to allow for transportation without releases.

The removed swell materials may require additional dewatering prior to being transported to the disposal facility to pass the paint-filter test. Dewatering will be accomplished in part by gravity separation of solids from water. If the resulting material fails to pass the paint-filter test or does not meet the disposal facility's bearing capacity requirement, a dewatering amendment will be added ex situ to absorb additional free water and bind the mineral solids. Typical dewatering amendments are PC and quicklime. Because PC was already added to the sediment as part of the ISS activities, additional PC may not be required. If the addition of a dewatering amendment is required, PC and quicklime have both been previously tested on Project Area sediment as potential ex situ amendments and found to effectively eliminate free liquids and increase the bearing capacity to meet disposal requirements (Anchor QEA 2010).

NW Natural has performed bench-scale testing using representative surface and subsurface samples collected throughout the Project Area to estimate the amount of drying reagent that would need to be mixed into untreated dredged/excavated material to pass the paint filter test and achieve landfill bearing capacity requirements, if applicable. Although the FPS involves treated sediments, the untreated data inform whether and to what extent drying reagent may be necessary on the treated sediments. The bench-scale testing was performed as part of the Gasco Early Action Removal Action in 2004 (see Appendix J of the *Removal Action Project Plan – Final Design Submittal, Removal Action NW Natural Gasco Site* [Anchor Environmental 2005]). A brief summary and application of the results is provided as follows:

- **2004 Bench-Scale Treatment Testing:** For samples containing visual forms of tar or other characteristics of polycyclic aromatic hydrocarbon (PAH) contamination (e.g., sheen, blebs), the addition of approximately 5% (by weight) PC resulted in a material that met disposal facility bearing capacity requirements after 1 day of curing time. Note that during construction of the Gasco Early Action Removal Action remedy, 5% PC was not sufficient to remove all free liquid. Consequently, removed material was amended with 10% PC during construction in the haul barges at the work site. However, free water was found to be liberated during barge transport to the offloading facility, which required some amount of additional dewatering via reagent addition at the transload facility.

Based on the results of bench-scale testing, between 5 to 10 percent dewatering reagent may need to be added to dredged sediment to meet potential disposal facility requirements for free liquids and bearing capacity. Because the swell materials will already have been treated with grout, additional amendment may not need to be added. The need for additional amendment will be assessed following gravity dewatering of the swell materials at the transload facility.

3.4.2.7 Transload Facility Operations

The transload facility located in The Dalles will be operated to move the dewatered swell materials from barges to lined or sealed and covered trucks for the final leg of transportation to the disposal facility(ies). The swell materials transload facility will involve the coordination of subcontractors for barge transportation, upland transportation, and disposal. Anchor QEA will monitor operations for

NW Natural, including waste tracking; inspections for compliance with specifications, plans, and BMPs; and any required water quality monitoring (see Appendix C).

It is anticipated the swell materials will be loaded into lined or sealed and covered trucks at the transload facility using an excavator. The small bucket and maneuverability of the excavator minimizes the potential for spilling material onto the truck body or the pavement during truck loading.

The swell materials transload facility will be designed and operated to minimize the potential release of swell materials to the environment by using equipment and operating methods that provide barriers to potential loss of material to surface water, roads, or air. BMPs are described in Sections 3.7.

The waste disposal types, estimated quantities, and proposed disposal facilities for the FPS remediation wastes are listed in Table 3-5. The anticipated disposal facilities included in Table 3-5 will be confirmed prior to initiating the FPS and are contingent on waste disposal suitability characterization testing.

Procedures for managing, testing, and designating remediation waste (i.e., swell materials) for landfill disposal are described in this section. The waste management protocols will determine proper shipping descriptions and marking requirements, as follows:

- 49 CFR 172.101 will be used to identify proper shipping names for each remediation waste material (including solid waste, Special Waste, or Hazardous Waste, as appropriate) to be disposed of off site. Draft shipping documents will be submitted to NW Natural (or its designee) for review and approval.
- Remediation waste materials will be packaged, labeled, and marked using the specified documentation requirements and in accordance with the referenced regulations.
- Each shipment of remediation waste material or Hazardous Waste sent off site will be accompanied by a properly completed uniform Hazardous Waste manifest (EPA Form 8700-22, Rev. 3-05).
- A standard bill of lading (BOL) will be prepared for each shipment of nonhazardous material, which fulfills the shipping paper requirements. The BOL will satisfy the requirements of 49 CFR 172, Subpart C (and 40 CFR 279 if shipping used oil), and any applicable state or local law or regulation. For laboratory samples, the Design Team will prepare BOLs and other documentation as necessary to satisfy conditions of the sample exclusions in 40 CFR 261.4(d) and (e) and any applicable state or local law or regulation. BOLs requiring shipper's certifications will be signed by NW Natural or its designee.

Accurate documentation of transport and disposal quantities will be compiled and tracked during the duration of the project. The approximate volume/weight of material loaded into the lined or sealed and covered trucks and the date of the removal will be recorded in the daily progress reports. Copies of all project records, including manifests and BOLs indicating cargo contents, weight, and date, will be collected for each trip transporting waste for disposal and maintained in the project file. The disposal facility will verify receipt of the contents and record the weight and the time that it is received. These records will be tracked and compiled as part of the daily progress reports. Records of waste shipments received by the landfill will be reconciled with records of swell materials leaving the transload facility and FPS area, as described in Section 3.4.2.8.

3.4.2.8 Recordkeeping

Each load of swell materials that leaves the transload facility will be documented as appropriate for the applicable waste classification (e.g., manifests for Hazardous Waste) and reconciled with records of loads received at the landfill. At a minimum, the following information will be recorded:

- Identification of the barge that carried the material to the transload facility
- Date the barge was offloaded
- Identification of the truck
- Type of waste (Hazardous Waste, Special Waste, or Cleanup Material)
- Destination (disposal facility)
- Date the swell materials were loaded onto the truck

After the landfill confirms receipt of the shipment, the following information will be added to the record.

- Date the swell materials were received at the disposal facility
- Weight of the load

The final tabulation will include the total weight of material in each barge load and each truck load transported from the transload facility and a cumulative total of the weight of that class of material for the project. Separate tables will be maintained for each waste classification.

3.5 Decant Water Handling, Transport, and Disposal

All free water generated from removal of the swell materials and during the transport of swell materials to the transloading facility in The Dalles will either be absorbed with a dewatering amendment (e.g., PC) or pumped from the swell materials removal barge to Baker Tanks at The Dalles facility. Two to three Baker Tanks might be filled with decant water (up to 50,000 gallons). Due to the relatively small volume of water that will be generated, it is anticipated the water will be sampled for disposal characterization purposes and, following receipt of sample results, transported to an approved disposal facility for disposal. Decant water removed from the swell materials during dewatering operations will not be returned to either the Willamette River or Columbia River. An UltraRAE 3000 will be used to assess the benzene concentrations in the worker breathing zone to confirm elevated concentrations are not present during handling, transport, and disposal of the decant water and swell materials. If benzene is measured at concentrations above 0.5 parts per million (ppm) over an 8-hour time-weighted average, an investigation into the source of dust emissions will occur and the source will be controlled. If the source of dust emissions cannot be controlled, personnel with the potential for exposure to these materials will upgrade to Level C PPE.

3.6 Debris Handling, Transport, and Disposal

Based on Project Area experience, significant debris is not expected to be encountered within the FPS area. If debris is identified during the pre-construction survey, it will be removed as discussed in Section 3.3.4.

If large debris is identified and removed, it will be sorted and processed at The Dalles offloading facility. The sorting process will involve sizing, cutting, or breaking the debris, as needed, and removing adhered sediment if required by the disposal facility. If necessary, debris will be washed over the barge, with full capture and disposal of any solids and wash water at an approved facility. It is anticipated debris would be disposed of at Wasco County Subtitle D Facility. Ferrous material may be decontaminated and recycled.

3.7 Best Management Practices

This section identifies the proposed water quality and swell materials barge amendment and dewatering BMPs, as well as contingency measures and additional controls that could be implemented should specific circumstances arise, to minimize potential adverse short-term impacts during ISS activities and swell materials and water management operations.

3.7.1 Water Quality Best Management Practices

A series of BMPs and engineering controls will be employed during construction to minimize impacts to the water column caused by the potential resuspension of sediment in the FPS area and potential generation and migration of sheens. Engineering controls, such as careful selection of ISS and swell materials removal equipment, will minimize the resuspension of sediment. In addition, removal of swell materials should reduce the potential for resuspension of sediment. If resuspension occurs, it cannot be eliminated entirely through operational modification; therefore, additional measures have been developed. A water quality monitoring program will monitor water quality at locations upstream and downstream of the Project Area to verify that environmental controls are effectively minimizing impacts to the water column (Appendix C).

3.7.1.1 Operational Controls

Water quality operational controls include actions or modification that can be applied by the operator to the standard operational practices of the equipment being used for ISS or swell materials removal activities, to help reduce the environmental impacts of the in-water operations. Typical water quality operational controls that may reduce resuspension, contaminant releases during ISS mixing and swell materials removal include the following:

- Reduce the generation of turbidity and disruption of the sediment surface during ISS treatment by advancing the auger through the upper 2 to 3 feet of sediment using low rotational speeds or delaying grout injection until injection ports are a short distance below the sediment surface.
- Properly select the bucket for swell materials removal based on site-specific conditions (i.e., soft sediment versus debris or hard digging)—using an environmental closed bucket for soft swell materials to limit potential releases, but not using an environmental bucket in areas where the bucket cannot fully close, which can result in higher levels of resuspension.
- Deploy measures to reduce the overall potential resuspension loading rate to the water column during swell materials removal. Commonly employed methods include slowing down the rate of bucket descent and ascent, pausing the bucket above the swell materials removal barge to allow residual to fall into the barge, or bucket washing.
- Prevent multiple bites of swell materials by the bucket before ascending to the surface, which reduces material disturbance by the bucket.
- Use of precision software for the operator to assess the speed and penetration of a dredge bucket through the water column.
- Prevent "sweeping" (i.e., dragging a bucket) or leveling of the swell by pushing swell materials around with the bucket to knock down high spots to achieve target elevations. Instead of leveling to remove high spots, the contractor may be required to remove additional swell materials if high spots are identified during post-construction surveys that impact achievement of the performance objectives identified in Section 3.4.1.1.1.
- Prevent interim underwater stockpiling of swells material (i.e., take small swell cuts and temporarily stockpile swell in a mound to allow the operator to grab a fuller bucket thus creating a pile of loose material that could more easily be resuspended). Perform complete swell materials removal cuts—from the moment the bucket is closed on the swell, return the bucket to the surface and deposit swell materials onto the barge before returning the bucket back to the FPS area.
- Prevent overfilling of conventional clamshell (i.e., "open") and environmental closed buckets. When the bucket penetrates the swell, there is the potential for the bucket to penetrate beyond the designed digging depth of the bucket. If the bucket is overfilled, a significant portion of the swell materials cannot be contained within the bucket and may be lost and resuspended in the water column as the bucket is raised. If bucket overloading is observed, measures will be taken to minimize this potential (e.g., decrease the maximum cut depth).
- Prevent uneven filling and over-filling of barges beyond the top of the side rails to prevent spillage from barges.

- Open buckets when positioned inside of the swell materials barge and close to the deck/floor or other materials. Materials will not be "dropped" onto the deck.
- Attempt to minimize ISS treatment and swell materials removal operations during relatively high-water velocity conditions (turbulence in the vicinity of the bucket during high flow conditions can cause additional resuspension and release of contaminated sediments). The moon pool enclosure has a maximum operating current speed of approximately 2 feet per second, so ISS auguring and swell material removal activities will be stopped if the velocities exceed that threshold or when there is visible stress on the barge spuds or the spuds that hold the curtain in place.

3.7.1.2 Turbidity Controls

A turbidity curtain is a geotextile material that minimizes sediment transport from a disturbed area adjacent to or within a body of water (USACE 1997). Turbidity curtains do not treat turbidity or sediment resuspension; rather, they direct and restrict the movement of the resuspended sediment and associated contamination to a smaller area (USACE 2008). Mobile moon pool turbidity curtain systems are movable with the ISS and swell materials management operations (Section 3.3.5). However, unlike anchored turbidity curtains that remain in one location until the whole system is uninstalled and reinstalled in a new location, the moon pool system is designed to be mobile by arranging modular barges (e.g., Flexi-floats or similar) to create a moon pool around which the turbidity curtain is attached. A mobile moon pool turbidity curtain system has been used previously on multiple sites with similar water conditions.

Turbidity Moon Pool System No. 1 consists of a turbidity curtain attached to the outside of the ISS barge system as shown in Figure 3-4 in plan view. The profile view of the moon pool system is shown in Figure 3-5. The curtain system will fully encompass the footprint of the ISS barge due to configuration logistics. The curtain system will be configured to allow raising and lowering of the turbidity curtain with the tides to keep the turbidity curtain from dragging on the bottom (e.g., near the time of low tide) or not extending to a sufficient and effective depth (e.g., near the time of high tide).

Turbidity Moon Pool System No. 2 consists of a second system of double-walled, near-full-length turbidity curtains attached to a framework of interlocking floats, enclosing a 40- by 40-foot work area. Turbidity Moon Pool System 2 will be attached to the ISS swell materials removal barge, and swell materials removal will be conducted through the moon pool opening. Similar to the Turbidity Moon Pool System No. 1, the length of the curtains can be adjusted with winches to respond to changing tides or river conditions. Figures 3-6 and 3-7 show the moon pool configuration in plan and profile views, respectively. Turbidity will be monitored upstream and downstream of the ISS and swell materials management activities in accordance with Appendix C to maintain substantive compliance with Applicable or Relevant and Appropriate Requirements (ARARs). After ISS and swell materials management activities are completed, the turbidity barrier will remain in place until water quality within the silt curtain meets water quality criteria requirements.

As discussed in Section 3.7.2, operations of the moon pool containment system will be performed to encourage movement of fish away from the work area. These operations include maintaining the base of the moon pool between 1 and 2 feet above the mudline under normal operating conditions and leaving the curtains extended as much as practicable during equipment moves depending on water depth and current strength.

3.7.1.3 Sheen and Oil Control Measures

Based on experience during completion of the Gasco Tar Body Early Action and cleanups at other sites where NAPL-impacted sediment has been disturbed due to swell materials removal or ISS treatment activities, sheens on the surface water may be generated during FPS construction. Dense NAPL (DNAPL) typically has a specific gravity greater than 1, so it sinks in water; however, observations at remediation sites where NAPL-impacted sediments were disturbed showed that oil/tar could separate to form a light fraction, which could become emulsified and come to the surface while the heavy fraction remains within the sediment matrix.

In addition, the FPS area resides within an area that experiences sheen releases from the sediments, primarily during low-water conditions, which typically occur seasonally between July and October when FPS construction will occur. NW Natural manages an existing oil-containment boom system to contain the intermittent sheens in the area that encompasses the FPS area and spans a lateral area of the river from a point on the shoreline upriver of the Siltronic outfall to a ship dolphin on the Gasco shoreline downriver of the FPS area, as shown in Figure 3-8. The containment system includes an internal sorbent boom and an outer permanent vinyl hard boom that are maintained by an anchor system channelward of the Siltronic outfall pilings and the NW Natural historical wooden pile dolphin. NW Natural installed this containment system in cooperation with DEQ subsequent to observations of sheens during sediment data collection efforts by NW Natural in September 2007. The initial containment system configuration was installed in late-September 2007 and was then enlarged in December 2007 and again in 2009 based on intermittent observed sheens outside of the containment system. The 2009 enlarged configuration has been maintained as such to-date. NW Natural's initial agreement with DEQ required daily observations and later shifted to weekly observations and quarterly reporting. In 2010, DEQ approved a revised observation/monitoring program to include weekly sheen observations, internally retaining observation logs without DEQ submittal, discontinuing periodic reporting, weekly visual inspections of structural and functional condition, and repair and replacement of containment system components as needed. Therefore, it is anticipated that sheens may be present outside the moon pool during the FPS construction that are not associated with the construction activities.

In addition, as discussed in Appendix I of the Combined BOD-PDR (Anchor QEA 2021a), NW Natural performed a multiple lines of evidence field evaluation of ebullition-based DNAPL transport in September 2019 that included field observations of sheen production within the broader Project Area using both aerial photography concurrent with visual observations from field staff on vessels. These observations identified isolated static sheens on the water surface that were and were not associated with gas ebullition from the mudline. Ebullition and sheens were identified in the nearshore area just downriver and in some isolated areas just upriver from the FPS area.

To manage any sheens generated by the FPS construction and the documented existing Project Area-wide sheens in the direct vicinity of the FPS area, a multi-component system of sheen and oil containment measures will be deployed. The configuration and size of this system accounts for the anticipated FPS construction equipment positioning shown in Figures 3-4 through 3-7. This system of measures includes the following:

- The first layer of containment will surround the moon pool structure, extending to near mudline. This feature will enclose the ISS drilling operations, as well as excavator operations during swell materials and debris removal efforts.
- The second layer of containment will include reconfigured positioning of the existing double-layer internal sorbent boom and an outer permanent vinyl hard boom. As shown in Figure 3-9, the upriver portion of this containment system will be shifted slightly downriver to provide sufficient room for upriver staging of FPS equipment shown in Figures 3-4 and 3-6. The downriver portion of this containment system will be shifted slightly downriver to provide additional downriver containment of the sheens identified during the 2019 field observations, while also providing additional staging space for FPS equipment inside the reconfigured containment system. There is no containment boom along the channelward portion of this reconfigured positioning to allow for free movement of FPS construction equipment. The size of this boom opening will be minimized to the extent possible during FPS implementation, and equipment staged near the opening will also function as a physical barrier to sheen migration outside this second layer of containment.
- The third and final layer of containment will include connecting additional internal sorbent boom and outer permanent vinyl hard boom to the existing reconfigured containment boom. This connection will occur in the approximate locations shown in Figure 3-10 and extend between 100 and 200 feet upriver and downriver. The lengths will be determined based on additional coordination with NW Natural's tenant that manages their own oil containment boom system during frequent vessel operations at the Gasco dock and requires access upriver of the dock to store their boom. These additional booms will serve to: 1) contain non-construction related sheens present in the nearshore areas outside the second layer of containment that were identified during the 2019 field observations; and 2) serve as a physical

barrier of non-construction related sheen migration from the nearshore areas to the areas where FPS water quality monitoring is being performed (see Section 3.8.1).

To support evaluation of the effectiveness of this multi-component system of sheen and oil containment measures during FPS construction, continuous visual monitoring of sheens within the FPS work area and zones of water quality monitoring will be performed, and a dedicated cleanup crew and boat will be prepared to respond to sheens and floating oil with surface oil sorbent fabric and approximately 1,000 feet of extra oil absorbent boom available.

3.7.2 Moon Pool Fish Exclusion Best Management Practices

The setup of the moon pool containment system is expected to encourage movement of fish away from the FPS area as follows:

- Under normal operating conditions, the base of the moon pool will hang between 1 and 2 feet above the mudline, depending on water depth, to allow room for fish to escape.
- The moon pool curtains will be left extended as much as practicable during equipment moves. The practicable depth at which the curtains can be maintained during equipment moves will depend on water depth and current strength.
- The curtains will be lowered to their final depth on the three upstream sides of the moon pool first, and the downstream curtain panel will be lowered last to help minimize entrapment.
- If necessary, the speed at which the curtains are lowered by the winches can be reduced to allow fish more time to escape.
- A long-handled net will be available on deck in case any stranded fish are observed in the moon pool.

3.7.3 Swell Materials Barge Loading and Transport Best Management Practices

BMPs to minimize the potential for spillage of swell materials during swell materials removal barge loading and transportation include the following:

- To minimize spillage between the bucket and the watertight swell materials removal barges, cantilevered spill aprons will be attached to the barges to direct spilled material back into the barges and away from the river. The swell materials removal equipment will be staged to the extent possible to minimize the bucket swing path over open water outside the barrier controls or the spill aprons.
- Barges will be filled to less than 85% capacity to minimize the potential for spillage or overflow.
- Once the barge is loaded and stabilized, it will be inspected for swell materials adhered to the side of the barge that could enter the river during transport. A visual inspection around the

entire barge deck area will be conducted, and if observed, adhered swell materials will be removed and placed inside the barge before moving the barge out of the Gasco Sediments Site. Then the loaded barge will be transported to the transload facility, as described in Section 3.4.2.

- The swell materials removal barges will be watertight during all operations, and no untreated water will be allowed to enter the river either at the Project Area or in transit to the transload facility.
- The transport barges will be outfitted with decoy owls to deter birds if they are identified circling and landing on the barge prior to transport.
- Prior to shipping the materials to The Dalles, the Design Team will assess if air monitoring should continue during transport.

3.7.4 Swell Materials Barge Dewatering and Amendment Best Management Practices

The following BMPs will also be implemented during swell materials barge dewatering operations:

- The hose end of the pump line will be covered with a 5-gallon bucket when transferring the line from barge to barge, or barge to land, to collect any residual drips of water that might be in the line.
- Pumping will not begin until the hose end has been lowered into the Baker Tank or tanker truck.
- Pumping operations will be monitored for any leaks or drips.
- The pumping operations will be monitored for any leaks or drips, and all pumps, hose lines, and connections will be routinely inspected.
- SES will implement its Spill Control Plan (Appendix D) to prevent, contain, and clean up any inadvertent spills during pumping, if needed.

If swell materials contain excess free water, BMPs will be implemented during the sediment amendment process at The Dalles off-site transloading facility. Inspections of the staging and offloading facilities will be performed to confirm environmental controls are in place, BMPs are being implemented effectively, and there are no unauthorized discharges to the environment. The staging and offloading facilities will be inspected to ensure proper waste handling practices and engineering controls are in place, including but not limited to, spill aprons, waste containment structures, track-out controls, and visual monitoring of leaks, spills, or turbidity. BMPs include the following:

- Amendment will occur on watertight barges with approximately 4-foot-tall sidewalls, securely moored to a pier or spud barge.
- All mixing and amendment will be conducted within the confines of the barge sidewalls. No swell materials will be moved over the gunwales until the materials have been amended.

- Cement will be delivered to The Dalles transload facility via barge in 1-ton waterproof supersacks.
- Swell materials will be amended by creating a depression in the materials in the center of the barge with the excavator, placing an appropriate amount of PC or quicklime in the depression, covering the PC or quicklime with wet swell materials, repeating as needed to achieve the target amendment ratio, and thoroughly homogenizing the mixture; this process helps to mitigate dust generation.
- If dust does become a concern, the surface of the barge will be misted with water.
- Continuous visual turbidity monitoring of the river will be performed during sediment amendment activities.
- Weather will be monitored, and amendment will not be mixed during periods of high winds.
- If needed, odor-suppressant foam will be used to control odor.
- A Spill Control Plan (Appendix D) will be implemented to prevent, contain, and clean up any inadvertent spills.

Work will be stopped and environmental controls corrected or enhanced if waste material is observed outside of designated containment areas or turbidity is observed in the vicinity of the Project Area.

3.7.5 Transloading and Transport to Upland Disposal Facility Best Management Practices

Available BMPs to minimize the potential for spillage of swell materials during transfer and transport of swell materials for upland disposal include the following:

- To minimize potential spillage between the swell materials removal barge and transload facility upland area, cantilevered spill aprons will be used to direct spilled material back into the barges and out of the river. The bucket swing path will not be allowed to occur over open water outside the spill aprons.
- When materials are transported over land, haul trucks or containers will be lined or sealed and covered to minimize the chance of release of swell materials or water during transport.
- Trucks will be underloaded to prevent loss due to spilling.
- Truck loading areas will be swept frequently to minimize the probability of truck tires tracking contaminated materials outside of the loading areas.
- Driveways will be subject to regular visual inspections for tracking to control potential spread of contaminated material from the facility to public roadways.
- The trucks, truck loading area, and the access route will be visually inspected to ensure there is no loss of material from the trucks prior to releasing the truck from the transload facility to public roads.

- Tires and truck or rail car bodies will be cleaned, if necessary, before leaving the FPS area (e.g., dry brushing and tire/wheel washing).
- Plug storm drain catch basins within active operations areas to prevent conveyance and discharge of swell materials to the river.
- At the transload facility, extruded asphalt curbing and stormwater management berms will be used to corral precipitation and add a redundant mechanism to isolate potential spillage (if any) in the re-handle/transloading and decontamination processes.
- Documentation of no loss of material from the trucks during transport from the transfer station to the landfill.
- Documentation of no off-site tracking of the material from the transfer station through collection of pre- and post-construction soil samples at the transfer station.

Operations may need to be limited or suspended in the event of high river flows, storms, or high wave conditions at the transload facility that may impact the ability to safely and effectively moor haul barges or transload materials from the haul barges or control potential discharge of swell materials to the river. There is no specific condition (e.g., specific river velocity) that will trigger this contingency because it is impossible to predict the exact set of conditions that would impair operations. However, if conditions appear to pose a threat to meeting environmental goals at the transload facility, transload operations will be suspended in coordination with agencies until conditions improve.

3.7.6 Decontamination of Construction Equipment

Decontamination of the ISS equipment, swell materials removal equipment, barges, and other support equipment that has come into contact with the swell materials will be done at the completion of the FPS construction. The haul barges will be swept and pressure-washed (including all portions of the barge where swell materials are visually present) such that no swell materials or decant water are released to the river. The remaining swell materials and water inside the barge will be managed for off-site disposal, as described in Section 3.4.2.6.

Haul trucks will be decontaminated by pressure-washing prior to leaving the landfill. Decontaminated wash water will be managed by the selected landfill in accordance with its applicable permits.

3.7.7 Green Remediation Practices

Consistent with ROD Section 14.2.12 (EPA 2017), the FPS will include the following green remediation practices to the extent practicable:

- Use renewable energy and energy conservation and efficiency approaches, including Energy Star equipment.

- Use cleaner fuels such as low-sulfur fuel or biodiesel, diesel emissions controls and retrofits, and emission reduction strategies.
- Use water conservation and efficiency approaches, including Water Sense products.
- Use reused or recycled materials within regulatory requirements.

Furthermore, impacts to the community from the FPS will be minimized by including BMPs that limit the overall construction footprint, including but not limited to the following as indicated by the ROD:

- Use renewable energy sources.
- Limit idling of trucks and equipment.
- Rely on local sources of materials.
- Ensure that trucks and barges are full prior to transport.
- Route trucks in a manner that avoids schools or upgrades to road facilities to increase safety in the context of increased truck traffic.
- Implement on-site dust and noise control to reduce air pollutant and greenhouse gas emissions.

3.8 Environmental Monitoring

This section identifies the proposed environmental monitoring and controls and BMPs, as well as contingency measures and additional controls that could be implemented should specific circumstances arise, to minimize potential adverse short-term impacts during ISS activities and swell materials and water management operations.

3.8.1 Water Quality Monitoring

A water quality monitoring program, with corresponding action levels and contingency response actions, will be implemented to measure the effectiveness of the environmental controls, as described in the *Final Revised In Situ Stabilization and Solidification Field Pilot Study Water Quality Monitoring and Quality Assurance Plan* (WQMQAP; Appendix C) and to maintain substantive compliance with ARARs. The WQMQAP largely follows the conditions provided in EPA's *Draft Water Quality Monitoring Template for the Portland Harbor Superfund Site* (EPA 2023e), However, that document is still a "working draft," and comments that EPA requested from performing parties, including NW Natural, have not yet been incorporated. Therefore, consistency with existing Clean Water Act (CWA) guidance (i.e., EPA *Technical Support Document*, 1991) and precedents from other sediment remediation projects in and adjacent to Portland Harbor were also considered in the preparation of this plan.

Monitoring of turbidity and other field parameters (pH, temperature, and dissolved oxygen) will be performed in real time during ISS implementation and swell materials management activities.[6] Field parameter measurements will be collected during construction activities at two compliance stations 150 feet downcurrent from the existing reconfigured oil containment and absorbent booms, one early warning station 100 feet downcurrent from the existing reconfigured oil containment and absorbent booms, and one background station 300 feet upcurrent from the FPS area, as shown in Appendix C. This would be the standard complement of monitoring locations during river-dominated flows and ebb tides. However, the relative positions of the monitoring stations would be reversed during flood tides. As described in Section 3.7.1.3 and shown in Figure 3-9, the reconfigured oil containment and absorbent booms are the outer containment measures for the FPS and have been configured to facilitate access for construction equipment. In addition, upriver and downriver nearshore oil containment and absorbent booms have been included to capture existing ongoing sheens potentially generated in the nearshore area that are not related to the proposed FPS construction (as described in Section 3.7.1.3) to prevent sheen migration into the water quality monitoring compliance zone and minimize the impact to the planned monitoring activities. Field parameter results will be reported to EPA the same day that they are collected and any confirmed exceedances attributable to the FPS construction will trigger immediate notification to EPA.

Also, as discussed in Section 3.3.2 of the WQMQAP (Appendix C), in accordance with EPA's Comment 13 request in its September 8, 2023, Conditional Approval Comments on the *Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan* (see Appendix J-2), NW Natural agrees to perform monitoring of pH and temperature within the moon pool once per day during advancement of the first ISS auger column. Monitoring will be performed at the beginning and completion prior to advancement of the auger into the mudline and following completion of each the ISS column (prior to moving to the next column location) at the three depths shown above for the compliance monitoring stations for informational purposes. NW Natural disagrees with the need for the collection of this data, even for informational purposes, because the moon pool is designed to contain adverse water quality impacts during construction. The water quality compliance boundaries are specifically offset from the moon pool in the upriver and downriver directions to account for water quality impacts in the direct vicinity of the construction, including pH or temperature increases that are commonly encountered during routine marine construction when applying cementitious material in the aqueous environment. NW Natural requests that EPA reconsider its requirement that we collect this information because it does not represent the conditions at the point of compliance and is, therefore, not useful for remedial decision making.

[6] NW Natural considered the use of fixed data sondes to collect field parameters on a continuous basis and determined vessel-based monitoring to be more appropriate for the FPS, as detailed in Section 4.1.1 of the WQMQAP (Appendix C).

Scheduled water chemistry samples will be collected and submitted for analysis on a fast turnaround basis (see Section 3.5.3 of the WQMQAP [Appendix C] for more details on laboratory turnaround times) for chemical parameters (benzo(a)anthracene and benzo(a)pyrene) from the locations and depths with the highest turbidity measurements during representative construction activities. Water quality monitoring at the transload facility will be limited to performance of visual observations during transloading, unless visual impacts are observed and/or an unexpected spill occurs.

The performance objectives and criteria, water quality monitoring procedures, evaluation criteria, and contingency response actions, as required in substantive compliance with ARARs, are further described in the WQMQAP (Appendix C).

3.8.2 Air Monitoring

During FPS implementation and swell materials removal and management activities, there is a potential to generate airborne dust, organic vapors, and odors. Ambient air will be monitored throughout the duration of the FPS in accordance with standard health and safety practices. Both perimeter, work zone, and transload facility monitoring will be conducted to measure potential volatile organic compounds (VOCs), dust emissions, and odors. The PGM cleanup included air quality monitoring of fugitive dust, VOCs of concern, and odors in the public and worker exposure zones, and the results of the monitoring showed no evidence of unhealthy air quality impacts associated with construction activities (Anchor QEA 2021b). Air monitoring will be conducted with similar equipment and frequency as used on the PGM cleanup, as described below in this section. It is anticipated that monitoring results during ISS implementation, swell materials removal, and transloading of treated sediments will also indicate minimal to no impacts to air quality for workers and the surrounding community.

3.8.2.1 Particulate Monitoring

It is anticipated the potential for airborne dust to be generated during ISS of sediment or removal and management of swell materials is low because the ISS is being conducted underwater and the swell materials will be wet as they are removed and handled. While grout has the potential to create airborne particulates when it is handled or disturbed, the grout will be contained and not exposed to the air while being applied to the sediment. Thus, it represents a low risk to airborne particulate generation. Particulate monitoring will be performed during ISS implementation and swell materials removal and management activities (including transload facility) and will include the use of automated real-time aerosol dust monitors at perimeter locations, including upwind and downwind of the Project Area and in the direction of the nearest potential receptor(s). Real-time air monitoring for particulate concentrations will be conservatively compared to the action level of 0.15 milligrams/m^3. If the actional level of airborne dust is exceeded, the source of the dust generating activities will be investigated and work will be stopped while dust controls are implemented. In the event of a storm and high winds, there is the potential for wind to mobilize dried sediments from the barge, and covers may be used to control dust from dried sediments from escaping the barge.

3.8.2.2 VOC Monitoring

It is anticipated the potential for the release of VOCs to be generated during ISS of sediment or removal and management of swell materials is also low. Perimeter air monitoring for volatile constituents will be performed continuously at the same locations outlined for the particulate monitoring. Monitoring will be conducted at the transload facility where sediment dewatering activity may volatize VOCs. Monitoring results that exceed the action level for VOCs (0.040 ppm) will require an investigation into the source of the VOCs, and upwind ambient air concentrations will be examined. If the cause of the exceedance is due to FPS construction, work will be stopped and mitigation measures will be taken as appropriate to reduce or eliminate the source of the VOCs and may include the use of tarps, covers, or foams to prevent VOCs from escaping dredged sediments. PAHs have low vapor pressures and would be expected to be absorbed on particulates in air. Real-time methods for monitoring particle-bound PAHs directly do not exist, and particulate levels serve as surrogates to indicate the potential presence of PAHs in air.

Both the total VOC instrument and the particulate monitor are sensitive to excessive humidity and precipitation. Readings are not reliable during these conditions; however, precipitation events significantly limit the potential for particulate and vapor emissions so that, although monitoring will be suspended during periods of rain or snow (subject to EPA approval), the work may continue based on the Design Team's judgment.

3.8.2.3 Odor Monitoring

Odors are difficult to measure because they vary depending on the concentration of the pollutant and the sensitivity of the person exposed to the odor. One of the most reliable indicators of odor emissions is a smell detected by the human nose. The most likely odor during dredging and sediment would come from hydrogen sulfide (H_2S) released by decaying plants and other organic material found in river sediments. Odors deriving from VOCs would be monitored and addressed, as detailed in Section 3.8.2.2.

During the PGM cleanup (Anchor QEA 2021b), odor was occasionally detected on the dredge barge during "hot spot" dredging, primarily near the tar-like fragments on the haul barge, but it was not an issue that required a change in work or action to control odors. In addition, odor was never evident along the seawall during hot spot dredging or at any other time.

Odor monitoring will be conducted if an odor complaint is received or if workers detect an uncomfortable project-related odor. If the odor is identified as H_2S, monitoring will be conducted at locations upwind and downwind of the suspected odor source. H_2S level will be measured via direct readings using a hand-held H_2S meter and compared to a criterion of 10 ppm. If a project-related uncomfortable odor is identified, mitigation measures as appropriate to reduce or eliminate the source of the odor will be taken and may include the use of tarps or covers to prevent odors from escaping dredged sediments or the use of odor suppressant foams.

3.8.3 Noise Monitoring

The FPS construction will comply with all local controls and noise level rules, regulations, and ordinances that apply to construction activities. Consistent with City of Portland Code and Charter Title 18 Noise Control, Chapter 18.10, standard work hours are from 7:00 a.m. to 6:00 p.m., Monday through Saturday, and no excessive noise is allowed outside of those hours. Regarding maximum sound levels for construction activities and equipment, no person shall operate any equipment or appurtenances thereto in commercial construction activities that exceeds 85 A-weighted decibels [dBA]) when measured at 50 feet (15.2 meters) from the source. To meet standards set forth by the City of Portland Code, periodic noise monitoring will occur during various activities.

3.9 Vibration Monitoring

Possible vibration impacts to Siltronic sensitive infrastructure and employees during ISS activities have been identified as a project implementation risk both during the FPS and the full-scale remedy. Therefore, vibration monitoring will be required in areas where sensitive infrastructure exists during the FPS to confirm ISS activities do not impact Siltronic sensitive infrastructure and employees. The observations and data collected during the FPS will also be used to inform the full-scale remedy. NW Natural continues to coordinate directly with Siltronic to finalize the vibration monitoring program.

The Design Team has extensive experience with the planning, deployment of instrumentation, active monitoring, and interpretation of construction vibration data at the Gasco Sediments Site. The current project benefits from the vibration monitoring conducted during field trials of sheet pile driving in 2008/09. The early field trial provided critical site-specific vibration data for ambient (background) conditions for normal site operations and off-site sources of ground vibration (e.g., railroad, traffic on surface streets), and construction-related vibration due to movement of heavy equipment, shallow excavations, and pile driving by various methods. Free-field ground surface and structural arrays of vibration sensors provided a rich data set for characterization of the ground vibrations (amplitude and frequency content), the rate of decay of the ground motions with distance from the source of the vibration (i.e., the attenuation of vibrations) as a function of frequency, and response of structures to the ground vibrations. Interpretation of this data formed the basis for assessment of the potential impact of the vibrations on the operation of sensitive equipment, as well as the development of practical, project-specific warning thresholds and safe stand-off distances for construction equipment located in proximity to sensitive facilities and equipment.

The Design Team has developed a preliminary vibration monitoring program for the FPS based on data trends and lessons learned from the 2008/09 field trial, supplemented with field vibration data obtained at various sites where the proposed ISS equipment has been used. This program will facilitate estimates of free-field ground vibrations that are intended to estimate the vibration during construction. It is anticipated that vibration from ISS may be less than other methods, such as driving sheet piles; therefore, refinements to the 2008/09 vibration data set are warranted for the types of equipment proposed for the current project.

The following hydrogeologic units are present at the Gasco OU: the Fill water-bearing zone (WBZ), the Upper Alluvium WBZ, the Lower Alluvium WBZ, the Deep Lower Alluvium WBZ, and bedrock. The composition, stiffness, and strength of the soil and bedrock units vary both laterally and with depth, resulting in a variable resistance to excavation by drilling and trenching methods. The site-wide ground vibrations produced during construction are a complex function of the equipment used, the equipment support and foundations (e.g., in-water barge mounted, landward on native soil, landward on engineered work pad), the excavation resistance provided by the soil units during excavation, and the wave propagation characteristics of the soil units, which are affected by site-specific conditions such as soil stiffness, the nature of soil layering and interbedding, lateral continuity of soil units, and surface development.

The Design Team has characterized the FPS area stratigraphy and low-strain stiffness of the soil units as a first step in the process of preliminary estimation of construction-related ground vibration. The attenuation of ground vibrations has been estimated from the site-specific, frequency-dependent relationships developed in 2008/09. The primary goals of the 2008 construction simulation and ground motion monitoring investigation were two-fold: 1) to develop site-specific relationships for the attenuation of ground motions from the source of vibrations; and 2) to bracket the anticipated range of ground vibrations that would be generated by various construction techniques. The project experience, data gathered, and interpretation of the vibration data have informed the development of the proposed vibration monitoring program.

The scope of the proposed ground vibration monitoring program for the FPS includes monitoring both ambient conditions and construction-induced vibrations associated with the FPS. In general, the vibration monitoring program is sequenced in the following manner:

- **Step 1:** Monitoring ambient vibrations with instrument arrays in Siltronic’s buildings at locations of sensitive equipment, as identified by Siltronic.
- **Step 2:** Monitoring construction vibrations in Siltronic’s buildings at locations of sensitive equipment and implementation of a real-time warning system for specified threshold vibration limits.
- **Step 3:** Evaluation of free-field ground vibrations and attenuation due to ISS construction at critical locations across the Gasco and Siltronic sites.

- **Step 4:** Evaluation of structural vibrations and structural response due to ISS construction at critical locations across the Gasco and Siltronic sites.

The proposed construction vibration monitoring program has been developed with the following project-specific considerations:

- Current vibration criteria and limits (e.g., Threshold Warning, Maximum Tolerable Value(s), and Shutdown Limit) that are being applied by Siltronic, where provided.
- Plan maps showing the vibration sensitive areas within the Siltronic facility and constraints for the layout of instrumentation arrays within the facilities.
- A list of the larger construction equipment that is proposed or planned for use on the project. Data sheets for the equipment (i.e., size and weight) will be reviewed.
- Method of support for the drilling equipment (e.g., barge-mounted).
- The tip elevations for the ISS columns and the soil units in which the ISS columns will be embedded.
- Constructability and consideration of possible zones where the equipment reaches practical refusal prior to reaching the design depth. If practical refusal is met, the options being considered to advance the augers to design depth.

The specifics of the monitoring equipment, data acquisition system, data filtering, and processing procedures were selected by the vibration consultant in communication with the Design Team. These systems have been best configured for the FPS area conditions, project-specific requirements, and constraints imposed by working in commercial facilities that house equipment used to make precise measurements and scanning imagery, thus very sensitive to vibration and airborne particulates (Clean Room).

The vibration monitoring data during the FPS will be obtained with two arrays of accelerometers:

- A ground surface, free-field array of widely spaced sensors that will be positioned relative to the FPS area to establish the attenuation of vibrations with distance from the ISS activities
- A structural array that includes sensors at specific locations within Siltronic's facilities

NW Natural continues to coordinate with Siltronic's representatives to finalize the positioning of the latter array, to provide vibration data in close proximity to sensitive equipment as well as requisite data for evaluating the building effects on the induced vibrations. The vibration sensors utilized in the buildings will be mounted to floor slabs or ceilings (i.e., floor diaphragms) and not to raised floors, equipment pedestals, or countertops supporting process or monitoring equipment. Therefore, the vibration data from the structural array will provide an indication of the vibrations experienced by the Siltronic instruments. Additional factors contribute to the actual vibrations of the individual tools (e.g., human footfall, dynamics of raised floors and equipment support, and instrument response characteristics).

3.10 Siltronic Outfall Monitoring and Upland Surveys

To identify whether ISS FPS construction might have an impact on the Siltronic outfall or supporting piles, as well as land movement in the upland portion of the Siltronic property, pre-construction, continuous, and post-construction surveys will be conducted. In addition to evaluating potential impacts during the FPS, the data and observations will be used to inform the full-scale remedy. As mentioned in Section 3.3, the location and condition of the Siltronic outfall and supporting piles were documented during a pre-construction diver reconnaissance survey performed in August 2023 and reported in Appendix I. Multi-beam and topographic survey methods will be used to monitor potential displacements of the outfall and top of riverbank land surface at Siltronic. Survey points will be attached to the piles supporting the outfall and select upland locations near the top of riverbank, and a pre-construction survey will be conducted using an automated total station to document the location and elevation of the survey points. At a minimum, 1 week of topographic survey data will be collected as a baseline to document general pile and land movement prior to the start of any in-water FPS construction. The purpose of the pre-construction conditions surveys is to document and provide a record of baseline conditions prior to the start of FPS construction, to the extent practicable.

In addition, a diver-supported pre-construction structural inspection has been conducted (Appendix I). The pre-construction inspection consists of a written description of the condition of the outfall and supporting piles. The written descriptions included identification and location of any existing cracks, damage, or other defects and includes such information to make it possible to determine the effect, if any, of the FPS construction on the defect. A quality video survey with appropriate audio description of locations, conditions, and defects was performed, and still photographs were provided to support the inspection documentation.

During implementation of FPS construction (including dolphin removal, ISS treatment of sediment, and swell materials removal), the survey points on the piles supporting the outfall will be surveyed using the automated total station at a frequency of at least 15 minutes. If significant movements are observed and FPS area conditions appear consistent (e.g., no significant wind or waves), FPS construction will stop until the source of the movements are identified and FPS construction is adjusted accordingly.

Following completion of FPS construction, a post-construction structural inspection will be conducted in addition to a post-construction multi-beam and topographic survey. The purpose of the post-construction conditions surveys is to identify, to the extent practicable, any changes in condition that may have occurred.

4 Post-Construction Field Pilot Study Sampling

Post-construction sampling is proposed to evaluate whether and to what extent diffusive flux of contaminants occurs from the surface of the ISS-treated surface under as-built field conditions over time. In addition, an important objective of the post-construction sampling design will be to simulate aqueous concentrations within a habitat layer placed directly on the ISS-treated surface. These time-integrated data will be used as an important line of evidence during remedial design, in conjunction with the bench-scale laboratory treatability Phase IV testing data lines of evidence, to evaluate whether cover amendment (e.g., carbon) is warranted. The remainder of this section provides a summary of the FPS-specific sampling design objectives, the sampling port design, the sampling chemical analyses, the sampling port installation and the analysis schedule. NW Natural requests EPA's approval to proceed with construction of the sampling ports based on this summary. Further details regarding the passive sampling media, and laboratory analyses will beare included in thea *In Situ Stabilization and Solidification Field Pilot Study Post-Construction Sampling Field Sampling Plan* (Appendix K) and *In Situ Stabilization and Solidification Field Pilot Study Post-Construction Sampling Quality Assurance Project Plan* (Appendix L). These documents will be provided to EPA during their review of this Work Plan given the sampling ports will not be installed until immediately following completion of the ISS and swell materials management activities.

4.1 Pilot Study-Specific Sampling Design Objectives

The FPS area is limited in aerial extent (approximately 1,750 square feet), is located on a slope, and is located within a larger area of contaminated sediments that will be addressed during implementation of the full-scale Project Area remedy. Therefore, the post-construction sampling design accounts for the following site-specific considerations:

- **Maximize Sampling density:** The proposed sampling density (four sampling ports outfitted with duplicate sampling media at two different depths) is considered the maximum density to maintain positioning of the ports sufficiently offset from the perimeter of the FPS area and each other, while also providing a sufficient number of samples to support evaluation of the data.
- **Prevent short-circuiting of surface water:** The bottom of the sampling ports is specifically designed to be "sealed" to a relatively flat post-ISS surface that is slightly sloping or level to maintain them in position over time while preventing short-circuiting of surface water into the bottom of the ports.
- **Prevent contamination from off-site sources:** The lid of the sampling ports is specifically designed to prevent contaminated surface water and depositional sediment from outside the FPS area from entering the top of the ports.
- **Measure long-term time-integrated concentrations:** The sampling media installed in each support is designed to passively measure the diffusive flux concentrations that accumulate in

porewater over time (i.e., time-integrated sampling rather than discrete temporal measurements) to provide more representative long-term concentration data that will occur over the life of the full sediment remedy. Three Two different time-integrated sampling media are required to analyze for the full list of COCs containing ROD Table 17 groundwater CULs, and three rounds of sampling are proposed to measure changes in diffusive flux concentrations post-construction. EPA requested that dioxin/furan concentrations be measured for informational purposes, but at the concentrations present in the Project Area, these chemicals cannot be effectively measured in porewater using passive samplers suitable for hydrophobic chemicals like dioxin/furans within a reasonable timeframe. The partitioning kinetics of dioxin/furans are so slow that after a 2-month passive sampler deployment, the sorbed concentrations of dioxin/furans on the passive sampler media would be too low to be quantified in a laboratory.

4.2 Sampling Port Design

The sampling ports are being fabricated to address the site-specific sampling design objectives described in Section 4.1. The port design is presented in Figures 4-2 through 4-4. Each port will be constructed with the following components:

- An outer cylinder (i.e., sampling port) constructed of concrete with dimensions 48-inch inside diameter, 36-inch vertical height, and 4-inch wall thickness and a permeable base constructed from slotted stainless steel.
- Six permanent 3-inch stainless steel standpipes with a 6-inch screen interval with a screen slot size of 0.005 inches.
  - The standpipes will be installed through, and fixed to, a support plate positioned 24 inches above the base of the sampling port (consistent with the upper extent of the simulated habitat layer) and will extend 6 inches above the support plate and simulated habitat layer.
  - The annular space between the sampling port and the mounted standpipes will be filled with a simulated habitat material that EPA approved for use in the FPS. However, a full RD evaluation will be performed to determine the suitable habitat material for the final ISS-treated surfaces in the full-scale remedy throughout the remainder of the Project Area. The habitat mix will extend to 24 inches above the ISS surface. The habitat mix will consist of 21.5-inch-minus rock composed of a combination of rounded and angular rock. The material gradation and a representative photograph of this material are included in Appendix G. EPA performed a preliminary review of this material and determined it was acceptable for use in the FPS. The simulated habitat material will not include any amendments so that porewater samples collected from this media will characterize any dissolved COC concentrations that migrate upward from the ISS-treated surface via diffusion.

- A 2-inch diameter removeable sample cartridge is designed to hold the passive sampling media and to be easily removed and reinstalled by divers. The upper section of the removeable sample cartridge is a solid stainless-steel pipe to reduce void space above the screened interval. The screened interval will be detachable (threaded connection) from the upper solid section of the sample cartridge to allow installation and recovery of passive sampling media. These annular pipes will extend 6 inches above the support plate and have an extraction loop on top to facilitate diver extraction. The removeable sample cartridges will be in place within the 3-inch standpipes during sample collection periods. The cartridge will remain in place during periods with no active sample collection and with no passive sampling media installed to prevent accumulation of sediments within the 3-inch standpipes.
- The screened interval for six of the 3-inch standpipes will be deep, extending to the sample port base which will rest on top of the post-ISS surface. The other six standpipes will be shallow, screened in the top 8 inches of the simulated habitat layer. The shallow porewater sample will be collected from the 6-inch screened interval of the 2-inch sample cartridges positioned in the top 8 inches (20 cm) of the simulated habitat layer to measure chemical concentrations at the surface water boundary within the EPA-identified (EPA 2021c) biologically active zone. The deep porewater sample will be collected from the 6-inch screened interval of the 2-inch sample cartridges overlying the bottom of the simulated habitat layer (top of ISS-treated surface) to measure the maximum chemical concentration resulting from COC diffusion and any advection.
- The 2-inch sample cartridges will house the passive sampling media described in Section 4.3. Two standpipes and sample cartridge assemblies for each screened interval and each chemical group will provide duplicate measurements of each porewater interval and chemical group, increase the likelihood of recovering high quality samples during each sampling event, and increase the statistical robustness of the data set.

* A custom fabricated removable cover.
  - The covers will be affixed to each sampling port to minimize the potential for cross-contamination from NAPL, dissolved-phase, and particulate contaminants in surface water and untreated sediment surrounding the FPS area.
  - The cover will consist of a stainless-steel screen and a permeable reactive core mat impregnated with organoclay to avoid entry of NAPL or dissolved or particulate constituents into the sampling port from the surrounding area.
  - The cover will be permeable to allow surface water transfer between the surrounding surface water and the supernatant water within the sampling port. In addition to preventing cross contamination from NAPL, dissolved-phase contaminants, and particulates, the screen and reactive core mat impregnated with organoclay will help to maintain a near-zero-concentration boundary condition in the supernatant water inside

the sampling port. This condition will simulate the performance of a cover layer following full-scale implementation, in which case the overlying surface water is expected to contain relatively low chemical concentrations.

- Six passive samplers (two for each chemical group identified in Section 4.3) will be installed within the 12-inch space overlying the simulated habitat material and below the removable cover (herein termed the "supernatant water"). The configuration of the supernatant water samplers will include a 3-inch standpipe and 2-inch removeable sample cartridge, consistent with the configuration of the porewater samplers. As noted above, this supernatant water will be able to exchange with river water outside of the sampling port, but particulate exchange will be limited by the stainless-steel screen and reactive core mat in the removeable cover.
- Six additional passive samplers (two for each chemical group) will be installed on the outside of one of the four sampling ports within 12 inches (30 cm) from the top of the ISS-treated sediment surface. The configuration of the surface water samplers will include a 3-inch standpipe and 2-inch removeable sample cartridge, consistent with the configuration of the porewater samplers. Samples from these samplers will be considered representative of near-bottom surface water quality within the FPS area at all four sampling locations. The near-bottom surface water sample concentrations will be compared to the supernatant and shallow porewater concentrations to evaluate the potential for chemical concentrations in surface water to impact the samples collected within the sampling ports.

The sampling ports will be accessible by divers, who will be able to remove the covers and expeditiously deploy and retrieve the 2-inch sample cartridges from the fixed 3-inch standpipes. The passive sampling devices will be extracted from the sample cartridges once aboard the diver support vessel. The 3-inch standpipes affixed to the standpipe support plate will allow the divers to more easily track extraction and reinstallation of the sample cartridges and chemical group-specific sampling media.

4.3 Sampling Chemical Analyses

As discussed in the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a), the samples will be analyzed for the full suite of ROD (EPA 2017) Table 17 groundwater CUL chemical constituents, including those that were not included in the ISS treatability study Phase IV testing laboratory analyses (i.e., the "non-drivers," consisting of pesticides, polychlorinated biphenyls (PCBs), perchlorate, herbicides, and C10-C12 aliphatic hydrocarbons). As shown in Figure 4-1, ~~three~~ two types of passive samplers will be deployed to measure concentrations of different COCs. Dual membrane p~~P~~assive diffusion bag (DMPDB[7]) samplers will be used for VOCs, ~~; nylon mesh diffusion samplers will be used for~~ metals, cyanide, ~~and~~

[7] To obtain sufficient sample volume for the proposed chemical analyses (Section 5), DMPDBs will be installed into two sample cartridge assemblies for each discrete sample.

perchlorate, herbicides, and C10-C12 aliphatic hydrocarbons.; and lLow-density polyethylene samplers will be used for the remainder of the COCs with a ROD Table 17 groundwater CUL (i.e., PAHs, PCBs, pesticides, and semivolatile organic compounds). As described in Section 4.2, each sample will be collected in duplicate to increase the likelihood of recovering high quality samples during each sampling event and increasing statistical robustness.

4.4 Sampling Port Installation and Analysis Schedule

In January 2024, approximately 2 months[8] Ffollowing completion of all ISS treatment, swell materials removal, and confirmation that the target post-construction ISS-treated surface elevations have been achieved, sampling ports will be installed on top of the ISS-treated sediment at four pre-selected sampling locations to provide representative data throughout the FPS area. For the purposes of this Work Plan, the approximate sampling locations are shown on Figure 4-1. However, the goal is to install the meters on a relatively flat post-ISS surface that is slightly sloping or level so the sampling locations may be field-modified based on the surveyed elevations in the four areas supplemented by diver visual observations of the post-construction surface conditions. If necessary, small-scale rRegrading of the target sampling locations may will be performed by the swell materials removal excavator or divers to prepare a surface that is as flat and level as practicably possible. At a minimum, tThe sampling ports will be installed 10 feetas far as feasible from the perimeter of the FPS area, given spatial limitations, to minimize the potential for sampling artifacts caused by untreated sediments outside of the FPS area. Installation of the sampling ports may happen before or after the end of the in-water construction window on October 31 depending on the production rates for ISS and swell materials removal.

Each sampling port base will be sealed to the ISS-treated surface to prevent a hydraulic connection between water within the base of the port and ambient surface water outside of the port. The seal will consist of a 0.5- to 1.0-inch-thick geosynthetic clay liner (GCL) material (Cetco Bentomat CLT[9] or similar). The GCL material seals to the port base flange and extends to cover the surrounding ISS surface a minimum of 24 inches beyond the port base (Figure 4-42). The exact dimensions of the GCL mat will be determined in the field based on the encountered post-construction surface conditions. GCL mat material is capable of generally conforming to surface irregularities and swells as it hydrates, providing a uniform bond to the ISS surface. If feasible, the divers may place weights (bags of cement or similar) on the extended GCL material and/or port base to further support the seal between the port and the ISS-treated surface.

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[8] The Phase II testing data collected as part of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a) documented that treated sediment unconfined compressive strength measurements continue to increase up to (and possibly beyond) 56 days, so earlier data collection would not be representative of the long-term condition of the ISS-treated sediments.

[9] Cetco Bentomat CLT and similar products include an HDPE membrane that can protect the upper side of the GCL mat material from erosion, impacts related to sample collection activities, and other unforeseen impacts.

~~The four sampling ports will be installed initially without the passive sampling media installed within the 6-inch screened intervals of the 2-inch sample cartridges. This is because the Phase II testing data collected as part of the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a) documented that treated sediment unconfined compressive strength measurements continue to increase up to (and possibly beyond) 56 days, so earlier data collection would not be representative of the long-term condition of the ISS-treated sediments. Therefore, divers will access the sampling ports approximately 2 months following installation of the ports, remove the cover, remove each 2-inch sample cartridge assembly via the extraction loop, and install the sampling media into each screened interval of the 2-inch sample cartridge. The surface water and supernatant sampling media will also be installed into the respective 2-inch sample cartridge assemblies at this time. The sampling media will remain in place for approximately 1 to 2 months to equilibrate and minimize the potential for longer-term biofouling of the sampling media. Therefore, the first round of passive sampling media will be retrieved to 3 to 4 months post-construction. During retrieval of these first-round media, the divers will install the second-round media that will similarly remain in place for 1 to 2 months. This same process will also occur for a third and final round of media installation and retrieval. Of the three sampling events, it is expected that the last event will best represent the approximate long-term porewater concentrations as the ISS-treated material approaches steady state diffusive flux. This ongoing diffusive flux will result in gradual depletion of potentially available COCs from the upper portion of the ISS material. Therefore, following initial equilibration of aqueous concentrations within the simulated habitat layer, concentrations are expected to gradually decline over time.~~ The FPS footprint where the four sampling ports will be installed is on a slope, and the location where the sampling ports will be installed is expected to be generally level following construction. Therefore, there is potential for untreated sediments that are outside of the sampling port installation footprint to deposit onto the leveled area constructed for the sampling ports. To assess the potential for deposition of untreated material into these areas, hydrographic surveys will be performed monthly in November, December, and January prior to installation of the four sampling ports. Depending on the amount of deposition, the following additional construction activities will occur in early January 2024 and will be limited to less than 2 weeks of on-site work:

- **If limited deposition is documented**, divers will use a small-diameter, hand-held suction dredge to remove potential untreated materials in the footprint prior to installation. The activity will be performed consistent with this Work Plan and will include the following provisions:
  - Waste materials and water management
    - The slurry will be conveyed to a water-tight haul barge and will be managed in accordance with Sections 3.4 and 3.5.

- BMPs and mitigation
  - The BMPs described in Section 3.7 will be followed, except as noted below:
    - Removal of limited sediment using a small-diameter, hand-held suction dredge is not expected to generate excessive turbidity. However, water quality monitoring will be conducted to inform the need for additional water quality BMPs during the work. The work will not be performed within a moon pool because of the potential health and safety concerns associated with having a diver working within an enclosure.
    - An end of pipe screen will be installed over the suction dredge intake to prevent inadvertent entrainment of salmonids or other fish species during the limited construction duration. In addition, the diver will stop work if any fish are observed near the suction dredge intake.
- Environmental monitoring
  - Water quality monitoring will be conducted as described in Section 3.8.1 and Appendix C. The intensive schedule will be followed for all depositional material removal activities.
  - Air monitoring will be conducted as described in Section 3.8.2.
  - Noise monitoring will be conducted as described in Section 3.8.3.

- **If significant deposition is documented**, the depositional material will be removed using the swell materials removal excavator. Following bulk removal, divers will also use a small-diameter, hand-held suction dredge to remove any residual untreated materials in the footprint prior to installation.
  - Waste materials and water management
    - The excavated depositional material and the suction dredge slurry will be conveyed to a water-tight haul barge and will be managed in accordance with Sections 3.4 and 3.5.
  - BMPs
    - For removal using the swell material removal excavator, the BMPs described in Section 3.7 would be performed. In addition to those BMPs, river water surface elevations are typically approximately 2 to 4 feet higher, on average, in January than during the July to October in-water work window. Therefore, the removal area is expected to be located further offshore such that fish have additional nearshore shallow water pathways to traverse the work area where impacts will be minimized during the limited construction duration.
    - For suction dredging work, the BMPs would be identical to the limited deposition scenario described above.
  - Environmental monitoring

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- Water quality monitoring will be conducted as described in Section 3.8.1 and Appendix C. The intensive schedule will be followed for all depositional material removal activities.
- Air monitoring will be conducted as described in Section 3.8.2.
- Noise monitoring will be conducted as described in Section 3.8.3.

Depending on the amount of depositional material encountered in the graded sampling port area, a temporary berm may be deployed around some portion of the sampling port area's perimeter or the entire ISS area perimeter. The temporary berm alignment would be determined based on the results of the November, December, and January bathymetric surveys to be conducted prior to sampling port installation. The temporary berm would be deployed for the duration of post-construction port sampling activities to limit the potential for additional deposition. It is expected that the temporary berm would be composed of clean sand in an impermeable polypropylene supersack bag (cutsheet included in Appendix M).

Following installation of the sampling ports, divers will access each sampling port, remove the cover, remove each 2-inch sample cartridge assembly via the extraction loop, and install the sampling media into each screened interval of the 2-inch sample cartridge. The surface water and supernatant sampling media will also be installed into the respective 2-inch sample cartridge assemblies at this time. The sampling media will remain in place for approximately 1 to 2 months to equilibrate and minimize the potential for longer-term biofouling of the sampling media. Therefore, the first round of passive sampling media will be retrieved to 3 to 4 months post-construction. During retrieval of these first-round media, the divers will install the second-round media that will similarly remain in place for 1 to 2 months. This same process will also occur for a third and final round of media installation and retrieval. Of the three sampling events, it is expected that the last event will best represent the approximate long-term porewater concentrations as the ISS-treated material approaches steady state diffusive flux. This ongoing diffusive flux will result in gradual depletion of potentially available COCs from the upper portion of the ISS material. Therefore, following initial equilibration of aqueous concentrations within the simulated habitat layer, concentrations are expected to gradually decline over time.

5 ARARs Compliance

No federal, state, or local permits are required for on-site actions associated with the Gasco Sediments Site CERCLA remediation, including the ISS FPS (42 United States Code [USC] 9621(e); 40 CFR 300.400[e][1]). The NCP defines "on-site" as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action" (EPA 1994). The areal extent of contamination refers to surface area, groundwater beneath the site, and air above the site.

Although CERCLA remedial actions are exempt from obtaining permits, substantive compliance with ARARs is still required. EPA and supporting agencies must identify the ARARs that may govern the remedial action. Legally applicable requirements include those requirements promulgated under federal or state law or state facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a remedial action site. Examples of legally applicable requirements include cleanup standards, standards of control, and other environmental protection requirements, criteria, or limitations. Relevant and appropriate requirements are requirements for environmental protection promulgated under federal or state law that address situations sufficiently similar to the circumstances of the remedial action contemplated and are well-suited to the site (40 CFR 300.400[g][1-2]).

To Be Considered (TBC) items are advisories, criteria, or guidance developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. TBCs are not promulgated nor enforceable and thus not ARARs, but they may be used to set protective cleanup target levels.

EPA developed ARAR classifications to provide guidance on how to identify and address ARARs. There are three ARAR classifications:

- Chemical-specific requirements are health- or risk-based concentration limits or ranges for specific hazardous substances, pollutants, or contaminants in various environmental media. An example is the aquatic life criteria established by EPA as protective levels in surface water.
- Location-specific requirements are restrictions on activities based on the characteristics of a site or its immediate environment. The restrictions (e.g., impact minimization and conservation measures) on work performed in areas used by species on the Endangered Species List is an example of a location-specific requirement.
- Action-specific requirements are controls or restrictions on types of activities. An example of an action-specific requirement is the CWA Section 404 regulation applied to the discharge of material to waters of the United States during clean cover placement.

ARARs and TBCs for Portland Harbor were provided in Tables 25a through 25c of the ROD (EPA 2017). All ARARs identified in the ROD will be considered during RD, but those that are not pertinent to the activities for the selected remedy for the Gasco Sediments Site will be specifically identified and excluded from consideration during RD, as approved by EPA. These tables have been updated specifically for the ISS FPS and include a proposed plan for substantive compliance (Tables 5-1 through 5-3). Additional details related to how the ISS FPS will comply with the ARARs are included in Section 3.4.2.

5.1 Section 401 of the Clean Water Act

CWA Section 401 requires that any project that results in a discharge of fill to waters of the United States receive a Water Quality Certification from the state or authorized tribe where the discharge will occur. The Water Quality Certification establishes effluent limits, monitoring requirements, and other conditions, provides reasonable assurance that the action will comply with applicable provisions of the CWA, and is a requirement for other permits issued to a project that will result in discharge to waters of the United States. This regulation is action-specific and is relevant and appropriate for projects that will result in a discharge of fill to waters of the United States.

Appendix C presents the WQMQAP, which details environmental protection measures, operational controls, BMPs, monitoring, reporting, and contingency procedures relevant to water quality. Based on the WQMQAP, it is expected that EPA will prepare a Water Quality Certification equivalent memorandum to document substantive compliance with CWA Section 401 for water quality protection. The WQMQAP documents substantive compliance with CWA Sections 303 and 304 and Oregon Administrative Rule (OAR) Part 340, Division 41, Sections 0002 through 0059, 340, and 345.

5.2 Section 404 of the Clean Water Act

CWA Section 404 regulates the discharge of dredged and fill material into waters of the United States, and the Section 404(b)(1) guidelines (40 CFR 230) contain criteria for determining the acceptability of fill into waters of the United States. The discharge of dredged or fill material is prohibited if there is a practicable alternative to the proposed discharge that would have less impact on the environment, so long as the alternative does not have other significant adverse environmental consequences. This regulation is action-specific and is relevant for projects that will place fill into waters of the United States.

Appendix E presents a CWA Section 404(b)(1) Analysis of the ISS FPS, which is part of the preferred design alternative. This analysis documents compliance with the CWA Section 404(b)(1) regulations and includes an analysis of potential impacts on the physical, chemical, and biological characteristics of the ecosystem and special aquatic sites, including threatened and endangered species; fish, crustaceans, mollusks, and other aquatic organisms; and other wildlife including migratory birds, and marine mammals; and wetlands, mudflats, and floodplains. This document represents an "equivalency analysis" that can be used by EPA to document the basis for its findings regarding the selected remedy and its substantive compliance with the CWA Section 404(b)(1). The CWA 404(b)(1) Analysis also documents substantive compliance with OAR Part 141, Division 85, Sections 510, 680, 685, 690, 710, and 715 (mitigation rules); 16 USC 662 and 663, 50 CFR 6.302(g) (Fish and Wildlife Coordination Act); OAR Part 635, Division 500 (Oregon Department of Fish and Wildlife [ODFW] Fish Management Plans for the Willamette River); 16 USC 1361 et seq. 50 CFR 216 (Marine Mammal Protection Act); 16 USC 703 50 CFR 10.12 (Migratory Bird Treaty Act); Executive Order 11990 and 1977 (Wetlands Protection); Oregon Revised Statutes (ORS) 496.171 to 496.182 (Protection and Conservation Programs); and OAR 635-100-0135 (Survival Guidelines).

5.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires that actions authorized, funded, or carried out by federal agencies be evaluated to determine whether any federally listed threatened or endangered species may be present in a project area and if the project may affect or "take" such species. "Take" is defined by ESA [Section 3(19)] as, "To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." An incidental take of a listed species through a federal action requires ESA Section 7 consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service (NMFS) to determine whether the project is likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat for ESA-listed species. This regulation is location-specific and is relevant to projects that may affect ESA-listed species or critical habitats that occur within the project's area of effect.

NW Natural prepared a memorandum called "ISS Remedial Technology Information for Portland Harbor Superfund Site Programmatic Biological Assessment" (Anchor QEA 2023e) that identifies ESA-listed species and critical habitats occurring or potentially occurring within the remediation area of effect and analyzes the potential effects of ISS remedial technology on these resources. The intent was for information in the memorandum to support the inclusion of ISS as a remedial technology in the *Programmatic Biological Assessment Portland Harbor Superfund Site* (EPA 2021b). It is NW Natural's understanding that EPA has initiated formal ESA Section 7 consultation with NMFS to obtain a Biological Opinion authorizing take of ESA-listed species or adverse effects to critical habitat and that the Biological Opinion, once issued, will cover the ISS FPS construction activities. However, NW Natural understands the Programmatic Biological Opinion, will not be issued prior to implementation of the FPS. NW Natural further understands that EPA will use their regulatory authority to approve the FPS even if the Programmatic Biological Opinion is not released in time because EPA understands the ISS conditions that will be included in the Programmatic Biological Opinion (i.e., conditions included in the ISS Remedial Technology Information for Portland Harbor Superfund Site Programmatic Biological Assessment [Anchor QEA 2023e]). These conditions will also apply to the FPS for ESA compliance and Magnuson-Stevens Fishery Conservation and Management Act (50 CFR Part 600.920) compliance.

5.4 Archaeological and Historic Resource Regulations

To ensure compliance with the National Historic Preservation Act (16 USC 470), the Native American Graves Protection and Reparation Act (25 USC 3001-3013, 43 CFR 10); 16 USC 469a-1 (Archaeological and Historic Preservation Act), and applicable Oregon statutes (ORS 358.905-955 and ORS 390.235 [Archaeological Objects and Sites] and ORS 97.740-760 [Indian Graves and Protected Objects ORS 97.740-760]), Archeological Investigations Northwest, Inc., prepared *An Assessment of the Potential for Archaeological and Historical Resources at the Gasco Removal Action Location* (Ellis and Baker 2004) for the 2005 Gasco Sediments Site Early Action Removal Action. The study area included the entire Gasco and Siltronic properties, including both upland, nearshore, and in-water areas. This assessment concluded that the Early Action Removal Action area had a low potential for archaeological resources, though upland areas had higher potential. Archeological monitoring occurred during the 2005 Removal Action in the nearshore area (i.e., dredging in areas 50 feet shoreward or riverward of the ordinary low water line). No evidence of archaeological deposits was observed during the monitored excavations (Anchor Environmental 2006).

Therefore, the potential for the ISS FPS to affect historic or cultural properties depends on the amount of associated upland ground disturbance. Upland ground disturbance is expected to be minimal because the FPS area is all in-water below the ordinary low water elevation. As such, the potential for the ISS FPS to impact archaeological resources is minimal. Additionally, the ISS FPS will implement an Inadvertent Discovery Plan (IDP; included as Appendix F). The IDP describes the prescribed procedures in the event that archaeological materials are encountered to guide compliance with applicable laws and regulations.

5.5 FEMA Floodplain Regulations

Federal Emergency Management Agency (FEMA) floodplain regulations (44 CFR 60.3[d][2] and [3] and 44 CFR 9, which calls for implementation and enforcement of Executive Order 11988 [Management of Floodplain], as amended by Executive Order 13690 and 11990 [Protection of Wetlands]) require measures to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains and prohibit encroachments that would result in any rise in flood levels during occurrence of base flood discharge. Specifically, CFR 60.3 (d)(3) states that a community shall "[p]rohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base (100-year) flood discharge." Additionally, FEMA Region X released a guidance document, *Procedures for "No-Rise" Certification for Proposed Developments in the Regulatory Floodway* (FEMA 2013), that describes the procedure to follow for obtaining "no-rise" certification based on technical data and hydraulic analyses. This regulation is location-specific and is relevant to activities that may impact the floodplain or flood storage (e.g., placement of material within the river).

As described in Section 2, the ISS FPS includes ISS treatment and swell materials removal within one in-water work area at the Project Area, which is within the regulatory floodway and the 100-year and 500-year floodplain designated by FEMA. As a result of the removal of swell materials, existing elevation and slope conditions within the in-water work footprints are not expected to change because of the ISS FPS. Additionally, the FPS area represents a small percentage of the overall Project Area. It is, therefore, expected that the FPS will have no measurable impact to floodway or flood storage.

A no-rise evaluation will be conducted for the full remedy and will be included in future RD reports.

5.6 Federal and State Waste Designation Regulations

Federal and state waste designation regulations (e.g., Resource Conservation and Recovery Act and Toxic Substances Control Act) identify requirements for managing the disposal of material removed during swell materials management. These state and federal regulations are action specific. As described in Section 15.2.3 of the ROD (EPA 2017), analytical testing results of swell materials will be used for waste characterization and identification of appropriate disposal options. For the ISS FPS, analytical testing of treated swell materials will be performed during the ISS TS, and testing results will be used to inform the appropriate disposal site. Section 3.4 of this Work Plan demonstrates substantive compliance with applicable waste designation regulations, including solid waste defined in 40 CFR 261.2; determining if solid waste is hazardous per 40 CFR 262.11(a-c) and OAR 340-102-0011 (Hazardous Waste Determination); 40 CFR 261.4(g); 40 CFR 264.13(a)(1); 40 CFR 268.7(a)(1); 40 CFR 268.9(a); 49 CFR 171.1(b); 40 CFR Part 264, Subparts B, C, F, G, I, J, K, L, M, AA, BB, CC, and DD; OAR 340-101-0033(6) and (7); OAR 340-100-0010(j); and OAR 340-109-0010(3) and (4); and OAR 340-100-0001(3) and OAR 340-100-0002(1) and provide the following compliance documentation:

- Treatment Guidelines for the ROD Selected Remedy
- Pre-Construction Swell Materials Classification
- Construction Verification Swell Materials Testing
- Waste Disposal Classification Evaluation

5.7 In-Water Work Window and Construction Work Hours

As discussed in Section 4.2.5.5 of the ROD, to minimize short-term impacts to migratory fish, in-water remediation construction activities, including FPS construction, shall be performed within the work window extending from July 1 through October 31. The ROD does not identify any limitations on the number of days per week or hours per day for construction. These work periods will be determined during finalization of this Work Plan in coordination with SES.

6 Schedule

This section presents a proposed schedule for the FPS construction. The schedule is contingent upon completion of several important technical evaluations, EPA document review and approval periods, and closure of the in-water work window on October 31. A summary of each of these schedule elements and documentation that each element either is or will be complete in time to facilitate completion of the FPS in mid-September is provided as follows:

- **Completed:** Phase I and II bench-scale testing at location ISSTS-003 in accordance with the *Additional Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023a) to support determination of the W/C ratio, grout composition, and grout dosages(s) to be used for the FPS; this testing has been completed and the results are summarized in Appendix H.
- **Completed:** Additional DOC pre-design investigations in the direct vicinity of the FPS area in accordance with the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area* memorandum (Anchor QEA 2023d) to determine the bottom depths for ISS in the FPS area; four sonic borings were successfully collected and the deepest DOC identified was 29 feet below mudline, so a constant ISS depth for the FPS area was identified at 30 feet below mudline, as described in Section 3.1.
- **Completed:** Siltronic outfall baseline pre-construction diver reconnaissance and elevation surveys to document no impacts to the outfall during completion of the FPS; the baseline diver reconnaissance survey was performed on August 2, 2023, and results are summarized in Appendix I.
- **Completed:** Sub-bottom profile and diver reconnaissance surveys to identify potential visible debris within the FPS area; these surveys were completed in August 2023 and results are summarized in Appendix I.
- **To Be Completed:** Post-construction diver reconnaissance survey and elevation surveys of the Siltronic outfall will be performed following completion of the work.
- **To Be Completed:** Anchor QEA has contracted with eTrac, Inc., to perform elevation surveys of the Siltronic outfall piling supports that extend above the river surface and top of riverbank surface elevations prior to construction, during construction, and immediately following completion of construction.
- **To Be Completed:** Inadvertent discovery plan training; Anchor QEA has contracted with Archaeological Investigations Northwest, Inc., to perform pre-construction training consisting of a review of the inadvertent discovery plan procedures as well as roles and responsibilities and a slide presentation of materials that could be observed during construction. The training will occur prior to the start of ground-disturbing work and will include all contractor personnel responsible for ground-disturbing activities.

- **To Be Completed:** Water quality monitoring baseline sampling, vibration monitoring baseline testing, and BMP installation; Anchor QEA is scheduling completion of the baseline sampling and SES will mobilize all water quality BMPs in early to mid-September prior to initiation of in-water construction.
- **To Be Completed:** Pre-construction mobilization activities to be completed in early to mid-September prior to initiation of in-water construction:
  - Installation of the grout plant equipment along the top of riverbank
  - Installation of the temporary access ramps from the top of riverbank to the in-water temporary floating dock
- **To Be Completed:** Finalization of the Final FPSWP:
  - NW Natural submittal of Final FPSWP on August 21
  - EPA review and approval by September 8—EPA to notify NW Natural of any substantive remaining issues during its final review and work to address comments to achieve this important deadline
- **To Be Completed:** FPS in-water construction durations (subject to change based on field conditions encountered):
  - Week 1
    - Mobilization of in-water equipment to the FPS area—1 day
    - Set up turbidity controls, oil boom, and oil absorbent boom—1 day
    - Perform debris and dolphin removal within the ISS footprint—2 days
    - Hydrographic survey following debris removal—1 day
  - Week 2: target completion of ISS Row 1, completion of progress elevation surveys and swell materials removal—5 days
  - Week 3: target completion of ISS Row 3, completion of progress elevation surveys and swell materials removal—5 days
  - Week 4: target completion of ISS Rows 2 and 5, completion of progress elevation surveys and swell materials removal—5 days
  - Week 5: target completion of ISS Row 4, completion of progress elevation surveys and swell materials removal—5 days
  - Week 6: perform final as-built survey, diver reconnaissance survey, and any necessary small-scale grading of the ISS-treated surface to facilitate installation of the long-term sampling ports, demobilize in-water environmental controls, install the long-term sampling ports—3 days

7 Summary of Targeted FPS Data Objectives to Support Remedial Design of the Full ISS Remedy

As discussed in Section 1, the data and lessons learned from the FPS implementation will be used to support remedial design of a full ISS remedy within the nearshore Project Area. As summarized in Section 2, the Design Team has designed the FPS to maximize site-specific information gathering and refine and optimize potential remedial design means and methods based on Project Area-specific considerations. The FPSWP incorporates results of Phase I and II bench-scale ISS treatability testing with FPS area sediments, identifies FPS area dimensions that are sufficient to evaluate optimized ISS implementation and performance, and will be performed using an auger head that has been specifically tailored by its German manufacturer to the depths of contamination and sediment characteristics in the FPS area.

The remainder of this section summarizes the specific data and lessons to be learned from the FPS components described in Sections 3 through 6 that will be used to support RD of the full ISS remedy. These data and lessons learned will be fully evaluated and reported in the Interim Design.

- **Timber piling removal**: determination of the most effective equipment and method to remove timber pilings (i.e., extraction via a barge-mounted crane versus direct pull extraction methods using an excavator), information regarding the potential for breaking the piles during removal, identification of the amount of sediment adhered to the side of the pilings following removal, evaluation of the potential for water quality impacts and associated effectiveness of implemented water quality BMPs, and determination of the typical production rate for piling removal.
- **Bathymetric and diver surveys**: determination of the optimized method(s) to efficiently provide collected bathymetric and diver survey data to the Design Team and evaluate achievement of target elevations, determination of the optimized bathymetric and diver survey frequencies for the various construction activities, and determination of the turnaround time to process collected survey data to support construction decision making.
- **Equipment configuration**: Equipment configuration: determination of the optimized construction equipment configuration to achieve a homogeneous blend and future maximum production rates for each construction activity, identification and management of potential conflicts with water quality monitoring vessel positioning, optimization of sheen containment boom positioning to minimize/prevent sheen release from the work area, and optimization of transport of construction personnel and post-treated ISS samples to and from the landside.
- **ISS equipment, column location control, and column layout**: optimization of the selection and location of ISS equipment, materials, and controls; column layout and construction sequencing (e.g., downslope to upslope or vice versa); and information management and documentation.

- **ISS treatment of sediment**: optimization of transportation, storage, distribution, and upland BMPs for the cementitious materials; optimization of auger blade rotations and penetration speeds to ensure consistent homogeneous blending; providing lessons learned from QC testing (i.e., mud balance, density, viscosity, temperature, and pH); comparison of the measured unconfined compressive strengths and permeabilities across multiple cure durations for each ISS-treated column with the results of the laboratory-based ISS TS Phase II testing results to support determination of performance targets for these parameters during RD; and determination of the typical production rate for ISS treatment initially and over time as optimization occurs.
- **ISS post-treatment swell materials management**: optimization of the swell materials management means and methods to most effectively achieve the target elevations; optimization of in-water BMPs to minimize water quality impacts; optimization of the means and methods to perform the barge load disposal suitability characterization and determination of the disposal suitability for appropriate landfill disposal; determination of the amount of decant water that requires management for transportation and disposal to the selected landfill; optimization of dewatering and transloading means and methods; determination of the amount of swell materials generated and potential migration of the swell materials on sloping mudlines; and, determination of the typical production rate for swell materials management initially and over time as optimization occurs.
- **Decant water and debris handling, transport, and disposal**: determination of the amount of free water generated during swell materials removal optimization and associated chemical characteristics to facilitate disposal facility suitability; evaluation of the air quality in the worker breathing zone to support appropriate health and safety during handling, transport and disposal; and optimization of the decant water and debris handling, transport, and disposal means and methods.
- **BMPs**: Optimization of the BMP means and methods to be protective of impacts to water quality, fish exclusion from the moon pool, swell materials barge loading and dewatering, swell materials transloading and transport to the disposal facility, and decontamination of construction equipment.
- **Environmental monitoring**: determination of the potential impacts to water quality, air quality and noise; evaluation of the effectiveness of the multiple containment barriers surrounding the work area; optimization of the means and methods to perform the environmental monitoring and evaluation of the most effective sequence of BMPs to be protective.
- **Vibration and Siltronic outfall and land movement monitoring**: Documentation of upland vibrations and potential top of riverbank land movements caused by the FPS construction activities and evaluation of associated potential impacts to Siltronic's operations; diver visual

monitoring and above-water surveying of the Siltronic outfall support pilings and top of riverbank surface elevations to document any construction-related impacts.

- **Post-construction FPS sampling**: optimization of the means and methods for installing the sampling ports on the post-ISS treated surface, and installing and retrieving the sampling media; measurement of the extent of potential diffusive flux of contaminants from the surface of the ISS-treated surface under as-built field conditions over time and comparison of these results to the bench-scale; determination of the amount of biofouling on the sampling media and associated determination of the appropriate time-scale to maintain the sampling media in the ports.
- **ARAR compliance**: Optimization of the means and methods to maintain substantive compliance with Section 401 and 404 of the Clean Water Act, Endangered Species Act, archaeological and historic resource regulations, FEMA floodplain regulations, and in-water work window and construction hours.

Data collected in Phases III and IV of the bench-scale tests will be reported in the Interim Design Report and used to refine, as necessary, conclusions from the FPS.

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Tables

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Appendix D
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Appendix E
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Appendix F
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Appendix G
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Appendix H
In Situ Stabilization and Solidification Bench Scale Treatability Study Location ISSTS-003 Data Summary Report

Appendix I
Sub-Bottom Profile Piling and Debris Survey and Siltronic Outfall Inspection Report

Appendix I-1

Appendix I-2

Appendix I-3

Appendix J
NW Natural Responses to EPA's July 27, 2023 Comments on the In Situ Stabilization and Solidification Field Pilot Study Work Plan and Responses to EPA's Additional September 8, 2023 Comments on the Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan for the Gasco Sediments Site Project Area

Appendix J-1
NW Natural Responses to EPA's July 27, 2023 Comments on the In Situ Stabilization and Solidification Field Pilot Study Work Plan for the Gasco Sediments Site Project Area

Appendix J-2
NW Natural Responses to EPA's Additional September 8, 2023 Comments on the Revised In Situ Stabilization and Solidification Field Pilot Study Work Plan for the Gasco Sediments Site Project Area

Appendix K
In Situ Stabilization and Solidification Field Pilot Study Post-Construction Sampling Field Sampling Plan

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Appendix L
In Situ Stabilization and Solidification Field Pilot Study Post-Construction Sampling Quality Assurance Project Plan

Appendix M

Temporary Berm Supporting Information