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Memorandum

March 23, 2023

To: Hunter Young, U.S. Environmental Protection Agency

From: Ryan Barth, Anchor QEA

cc: Joe Smith and Jen Mott, Anchor QEA
Bob Wyatt, NW Natural
Patty Dost, Pearl Legal Group
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Re: Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area

Introduction

This final revised addendum technical memorandum (Final Revised Addendum) presents NW Natural's proposed additional subsurface sediment characterization to complete the remedial design for the Full Dredge and In Situ Stabilization and Solidification (ISS) Design presented in the *Preferred Alternative Report* (PAR; Anchor QEA 2022) for the Gasco Sediments Site Project Area (Project Area). This Final Revised Addendum addresses the U.S. Environmental Protection Agency's comments on the *Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area* prepared by Anchor QEA dated January 13, 2023. Responses to EPA's comments are provided in Appendix D. As depicted on Figure 1 and detailed in the *Combined Sediment Remedy Basis of Design and Preliminary Design Report* (Combined BOD-PDR; Anchor QEA 2021), over one hundred subsurface sediment cores have been collected previously throughout the Project Area under U.S. Environmental Protection Agency (EPA)-approved work plans. The subsurface sediment concentrations in each core within the Project Area have been compared against the *Record of Decision – Portland Harbor Superfund Site, Portland, Oregon* (ROD; EPA 2017a) Table 21[1] remedial action levels (RALs), principal threat waste-highly toxic (PTW-highly toxic) thresholds, and PTW-not reliably contained thresholds. In addition, each core was screened for visual observations of PTW-nonaqueous phase liquid as defined for the Project Area in Section 3.1.1 of the *Revised Pre-Remedial Design Data Gaps Work Plan* (DGWP; Anchor QEA 2019).

Consistent with EPA's December 5, 2022 approval to proceed with additional evaluations for design of the Full Dredge and ISS Design option described in the PAR (Anchor QEA 2022), NW Natural has determined that the bottom depth of RAL and PTW (defined as the depth of contamination [DOC]) was not identified in 58 cores/borings (including riverbank angled borings and cores that are

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[1] ROD Table 21 has been updated based on the December 2019 *Explanation of Significant Differences* (EPA 2019), Errata #1 dated April 2018 (EPA 2018), Errata #2 dated January 2020 (EPA 2020), and Errata #3 dated September 2022 (EPA 2022).

vertically bounded by only a single 1-foot interval without any RAL exceedances or PTW) collected in the Project Area, so additional deeper vertical characterization is required to achieve the Full Dredge and ISS Design objectives.

The remainder of this Final Revised Addendum describes the additional pre-design investigation activities to determine the DOC throughout the Project Area using EPA-approved sampling and analysis methodologies detailed in the DGWP (Anchor QEA 2019), with some changes described herein to allow for deeper subsurface characterization to identify the remainder of the DOCs throughout the Project Area. A *Pre-Remedial Design Data Gaps Field Sampling Plan Addendum* (FSP Addendum) and *Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum* (QAPP Addendum) accompany this Final Revised Addendum as Appendices A and B, respectively.

Subsurface Sediment and Riverbank Soils Characterization Locations and Sampling Technologies

Consistent with Figure 7-1 of the Combined BOD-PDR (Anchor QEA 2021), Figure 1 shows the 58 subsurface sediment locations in the Navigation Channel, Intermediate, Shallow, and Riverbank Regions that do not have the DOC identified as described in EPA's *Remedial Design Guidelines and Considerations—Portland Harbor Superfund Site, Portland, Oregon* (RDGC; EPA 2021). As shown in Figure 1, some of these locations are isolated (i.e., more than 150 feet from the nearest vertically unbounded location) and others are located within close proximity (i.e., less than 150 feet apart from one or more vertically unbounded location). Therefore, the proposed additional DOC sample locations in the Project Area shown in Figure 2 are positioned to collect representative data for one or more vertically unbounded historical subsurface locations such that the final distribution of vertically bounded DOCs is within 150 feet, or closer, throughout the Project Area consistent with EPA's RDGC (EPA 2021).

Three of the 58 vertically unbounded locations (GP25, GP26, and GP28), included in Table 1 and shown in Figure 1, were identified as vertically bounded in the Combined BOD-PDR (Anchor QEA 2021) but were not subsampled in consecutive 1-foot intervals, as described in EPA's RDGC (EPA 2021). Therefore, information about the discrete sampling interval thicknesses is uncertain. In addition, NW Natural identified the following lines of evidence that prevent determination of whether the existing data is representative of the true subsurface contamination profile and, therefore, proposes the collection of additional sonic borings at each of these locations to confirm the DOC using the appropriate EPA-approved technologies and procedures. Three cores will be collected at each of the three locations requiring DOC confirmation (i.e., GP25, GP26, and GP28) so a robust number of samples can be used to verify the subsurface conditions at these locations. Each of the new cores will sample the depth consistent with DOC identified in historical Geoprobe borings. Any modifications to the remedial design dataset based on the additional confirmation data will be discussed with EPA following receipt of the validated data. Additional information regarding these locations is presented in Table 2, including the three cores to be collected to further evaluate DOC at each of the historical Geoprobe locations, with a detailed summary of chemical results presented in Table 3a.

- The Geoprobe boring diameter was only 1.5 inches, which is much narrower than 3.875-inch vibracore or larger sonic boring diameters used for the remainder of the subsurface sediment samples collected within the Project Area. Due to this much smaller diameter, the sediments in contact with the boring sidewalls may have been sampled to achieve the necessary analytical volume requirements. Sampling material in contact with sidewalls could have resulted in biased high concentrations at deeper depths due to drag down of contamination from shallower depth intervals along the sidewalls of the borings.[2] NW Natural has been unable to identify the specific sample collection procedures followed during collection of these three Geoprobe samples (i.e., use of a closed tip sampler with locking pin to minimize drag down potential versus use of a dual wall system without a closed tip sampler that can result in greater drag down) to determine the potential for drag down. No sample processing photographs are available for NW Natural to evaluate the potential for drag down within each sample interval, although visual and olfactory signs of contamination within each of the Geoprobe borings were evaluated and consistently identified elevated concentrations in shallower intervals that could have contributed to elevated drag down concentrations (see Table 3b and Appendix C).
- The range of DOCs at these Geoprobe boring locations (24.3 to 36.1 feet) is much deeper than the immediately surrounding range of vertically bounded and unbounded cores (generally ranging from 8 to 16 feet). These different ranges are inconsistent with the following: similar upland contaminant source loading over time from the historically adjacent tar pond overflow area, all three sample locations being positioned within 250 feet of each other with relatively similar (i.e., within 5 feet) mudline elevations, the lack of significant consistent scour at these locations (see the bathymetric elevation differences in Figures 2-16a through 2-16h in the Combined BOD-PDR [Anchor QEA 2021]) or documented historical dredging performed at these locations.
- Mudline information for these three locations is difficult to accurately discern from the available information presented in the boring logs (e.g., "Depth to mudline approximately 9 feet below barge deck") because the sampling barge would have been on location over the course of a tidal cycle, and water depth measurements would change over time. The water depth would need to be tied to a water surface elevation at the time of water depth measurement to determine mudline elevation. Therefore, mudline elevations were estimated using bathymetry data collected temporally closest to the survey in 2004.

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[2] Note that, as discussed later in this Final Revised Addendum, chemical analysis of samples at the historical DOC (i.e., the DOC at GP25, GP26, and GP28) in each of the three proposed cores will be conducted to evaluate this hypothesis.

- These Geoprobe borings were not sampled for chemical analysis throughout the length of the boring (see Table 3a).
- The samples collected from these locations were not analyzed for the full suite of ROD Table 21 contaminants of concern (COCs), impacting the accuracy of the reported DOCs.

At 25 of the 58 vertically unbounded locations, sediment cores were collected and sampled in broad depth intervals (e.g., 4-foot-thick) that were larger than 1 foot thick, which is inconsistent with EPA's RDGC (EPA 2021). Therefore, these locations will be reoccupied and subsampled in consecutive 1-foot intervals to determine DOC. Note that 25 locations are to be reoccupied and sampled in 1-foot depth intervals to delineate DOC based on two consecutive 1-foot depth intervals. Data from both historical and newly collected subsurface samples will be considered for remedial design purposes. These locations are identified in Table 1.

At an additional four locations, the DOC is vertically bounded by only a single 1-foot interval, which is inconsistent with EPA's RDGC (EPA 2021), which defines the DOC as two consecutive 1-foot intervals without a ROD Table 21 RAL exceedance or the presence of PTW. Each of these locations was evaluated against multiple criteria (data density, DOC in nearby cores at similar elevations, and chemical and physical characteristics in the bottom intervals [e.g., presence of clean alluvium river sands corroborated by low chemical concentrations]) to determine whether an additional core/boring is needed at the given location. Based on this evaluation, it was determined that an additional core/boring would be collected at each of the four locations to confirm DOC.

For the Shallow, Intermediate, and Navigation Channel Regions of the Project Area, based on discussions with regional marine contractors, equipment is available to collect vibracores up to a maximum 30-foot penetration. EPA approved a target 70% core recovery in Appendix A of the DGWP (Anchor QEA 2019), which would result in the collection of a 21-foot core for full penetration. Review of the distribution of vertically bounded and unbounded DOCs identified 20 locations in the Project Area where this target recovery depth is anticipated to be sufficient to determine the DOC.[3] Alternatively, at 16 locations where the DOC is anticipated to be deeper than 21 feet, barge-mounted sonic drilling will be used as previously employed for geotechnical borings collected as described in the DGWP. Detailed information regarding the two coring technologies (including the proposed

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[3] If DOC is not determined using the deep vibracoring technology, additional efforts will be made at the given location to determine DOC using sonic drilling. Following core collection, if it is determined that visual and olfactory signs of contamination are present within the deepest recovered 1-foot sample interval (i.e., it is likely that the DOC will not be determined using the recovered vibracore) or if sufficient recovery cannot be achieved beyond the depths previously collected, the location will be reoccupied using sonic drilling methodologies during the same deployment. Alternatively, if no visual or olfactory signs of contamination are present in either of the deepest two consecutive 1-foot depth intervals of the collected vibracore, but bulk sediment chemical results exceed the ROD Table 21 RALs or PTW thresholds, an additional sonic coring mobilization may be necessary to delineate DOC at a given location(s) during the remedial design process. If the latter scenario occurs, which is unlikely based on NW Natural's extensive sediment coring experience within the Project Area that indicates that visual and olfactory signs of contamination typically coincide with RAL or PTW threshold exceedances, the need for additional sonic coring would be discussed in coordination with EPA.

sampling locations, geographic coordinates, and sampling technology) is provided in the FSP Addendum (Appendix A).

For the Riverbank Region of the Project Area, the DOC will be determined by the collection of 11 additional angled riverbank sonic borings performed from the top of riverbank. The borings will be co-located with the previously collected angled riverbank borings PDI-134 through PDI-144 using the methodologies identical to those described in the DGWP (Anchor QEA 2019) and reported in Appendix A of the Combined BOD-PDR (Anchor QEA 2021), except with steeper (i.e., more vertical to maximize the potential to identify the DOC underneath the riverbank) advancement and finer sampling intervals beginning in and limited to deeper portions of the boring. The specific advancement angles are identified in the FSP Addendum (Appendix A).

Sample Collection, Processing and Handling Procedures

The sample collection, processing, and handling procedures for the in-water vibracores and sonic borings and top of riverbank angled borings will be identical to those identified in Sections 3.4, 3.9, and 3.3 of Appendix A of the DGWP (Anchor QEA 2019), respectively, except for the following:

Vibracores

- Once in position, the vibracore unit will be deployed, energized, and driven to a maximum of 30 feet below mudline (bml) or refusal.
- Samples will be processed either on the sampling vessel or at an upland facility, and the entire core sample volume will be used for the DOC analyses (i.e., the core will not be split in half to sample different sides of the core tube for different objectives).
- Laboratory analyses will proceed using the description in the "Laboratory Analyses" subsection below.

Sonic Borings

- The borings will be advanced until at least one 5-foot section of the disposable core liner contains no visual or olfactory signs of contamination.
- The borings will be processed consistent with the subsurface sediment processing procedures identified in Section 3.4.3 of Appendix A of the DGWP (Anchor QEA 2019).
- Samples will be processed either on the sampling vessel or at an upland facility, and the entire core sample volume will be used for the DOC analyses (i.e., the core will not be split in half to sample different sides of the core tube for different objectives).
- Laboratory analyses will proceed using the description in the "Laboratory Analyses" subsection below.
- No standard penetration tests will be performed.
- No split spoon sampling to facilitate undisturbed sample testing will be performed.

Top of Riverbank Angled Borings

- The drill rig will be set up so the core barrel enters the ground at an angle of approximately 20 degrees (additional information is included in the FSP Addendum [Appendix A]) to target chemical characterization of the sediments/soils underlying the riverbank to the DOC.
- Each boring will be advanced, at a minimum, to a target of the deepest adjacent in-water sediment core DOC. If there are visual and olfactory signs of contamination in the bottom depth of the targeted sample interval, additional sample depth may be collected to achieve the objective of delineating the DOC at each proposed riverbank angled boring location.
- Laboratory analyses will proceed using the description in the "Laboratory Analyses" subsection below. Chemical analyses will be limited to only those chemicals that contain a RAL or PTW threshold (i.e., no analyses for chemicals containing ROD Table 17 riverbank soil/sediment of groundwater cleanup levels[4]).

Laboratory Analyses

Laboratory analyses will proceed using the following stepwise approach, generally consistent (except with four initial samples triggered in Step 1 versus Step 2 samples) with Field Change Request No. 8 from the DGWP submitted to EPA on November 15, 2019:

- **At Vertically Unbounded Locations Previously Sampled in Consecutive 1-Foot Intervals[5] and Vertically Bounded Locations Without Two Consecutive 1-Foot Intervals (see Table 1; a visual schematic is presented in Figure 3):**
  - **Step 1:** Initially, trigger laboratory analysis for chemicals containing ROD Table 21 RAL and PTW thresholds for the following two scenarios:
    - **Scenario 1 (signs of contamination deeper than the existing vertically unbounded/bounded DOC):** The deepest 1-foot interval (measured in whole 1-foot intervals below the mudline, such as 12 to 13 feet bml) that contains visual or olfactory signs of contamination in the core/boring that is deeper than the existing vertically unbounded DOC and the immediately underlying three consecutive 1-foot intervals containing no visual or olfactory signs of contamination (such as 13 to 14 feet, 14 to 15 feet, and 15 to 16 feet bml). If either of the shallower 1-foot intervals contain exceedances and the deepest two intervals do not, the DOC will be identified as the bottom depth of the exceedance interval.

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[4] As stated in the PAR (Anchor QEA 2022), under the Full Dredge and ISS Design, "ISS is applied to the DOC throughout the Intermediate, Shallow, and Riverbank Regions to treat 100% of the RAL exceedances and PTW in situ." Therefore, only COCs with a ROD Table 21 RAL or PTW threshold need to be analyzed in the riverbank samples to inform the DOC to be treated by ISS. The *Revised In Situ Stabilization and Solidification Bench Scale Treatability Study Work Plan* (Anchor QEA 2023) includes analysis of the appropriate ROD Table 17 groundwater cleanup levels to inform leachability evaluations associated with ISS.

[5] At each of these unbounded locations, there is a RAL exceedance and/or PTW in the deepest sampled 1-foot interval.

    - **Scenario 2 (no signs of contamination deeper than the existing vertically unbounded/bounded DOC):** If there are no signs of visual or olfactory signs of contamination deeper than the existing vertically unbounded/bounded DOC, sampling will begin at the next whole 1-foot interval deeper than the existing vertically unbounded/bounded DOC such that none of the previously sampled intervals are resampled. A minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. For example, if a historical core is vertically unbounded at 10 feet bml and there are no visual or olfactory signs of contamination deeper than 10 feet bml in the newly collected core/boring, the shallowest sample interval will be 10 to 11 feet with the next two consecutive 1-foot intervals being 11 to 12 feet and 12 to 13 feet.

      If there are no RAL exceedances or PTW in the newly sampled Step 1 intervals, the DOC will be set at the existing vertically unbounded/bounded DOC as the location now meets the RDGC (EPA 2021) criteria for vertical bounding (i.e., two consecutive 1-foot intervals without a RAL exceedance or PTW). This approach eliminates the potential for performing chemical analyses at depths shallower than the existing reported vertically unbounded DOC in an area.
- **Step 2:** Following Step 1, trigger additional laboratory analysis, as needed, for chemicals containing ROD Table 21 RAL and PTW thresholds (move to either Step 2a or Step 2b depending on the results of Step 1):
    - **Step 2a:** Step 2a procedures are dependent on the two scenarios identified in Step 1. This approach eliminates the potential for performing chemical analyses at depths that are shallower than the existing reported vertically unbounded DOC in an area.
        - **Scenario 1 (signs of contamination deeper than the existing vertically unbounded/bounded DOC):** If none of the submitted Step 1/Scenario 1 intervals contain RAL exceedances or PTW, a minimum of two overlying consecutive 1-foot intervals will be triggered for chemical analyses depending on the visual and olfactory characteristics of these depth intervals. This will continue until either: 1) the first overlying depth interval containing RAL or PTW threshold exceedances is encountered, and the DOC will be identified as the bottom depth of the deepest exceedance interval; or 2) the existing vertically unbounded/bounded DOC is encountered, and the DOC will be identified as the existing vertically unbounded DOC as the location would then meet the RDGC (EPA 2021) criteria for vertical bounding.
        - **Scenario 2 (no signs of contamination deeper than the existing vertically unbounded/bounded DOC):** If none of the submitted

    Step 1/Scenario 2 intervals contain RAL exceedances or PTW, the DOC will be identified as the existing vertically unbounded/bounded DOC as the location would then meet the RDGC (EPA 2021) criteria for vertical bounding.

    OR

    - **Step 2b (the Step 2 approach is the same regardless of scenario):** If either of the deepest two Step 1 intervals contain RAL or PTW threshold exceedances, a minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. This process will be repeated until two consecutive depth intervals do not contain RAL or PTW threshold exceedances. The DOC will be identified as the bottom depth of the deepest exceedance interval.

- **At Vertically Unbounded Locations with Greater Than 1-Foot-Thick Sample Intervals (see Table 1)**
  - Same as the procedures described above for vertically unbounded locations with consecutive 1-foot intervals, except the initial Step 1/Scenario 2 triggers for laboratory chemical analysis would begin at the deeper of the following:
    - **Step 1, Scenario 2 (no signs of contamination deeper than the existing vertically unbounded DOC):** If there are no visual or olfactory signs of contamination deeper than or within the deepest existing vertically unbounded DOC interval that is greater than 1 foot thick, then sampling will begin at the shallowest 1-foot interval within the deepest previously sampled interval from the existing vertically unbounded core. A minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. For example, if an existing location is vertically unbounded based on a sample interval from 23 to 27 feet and there are no visual or olfactory signs of contamination deeper than 23 feet, the initial triggers would start at the 23- to 24-foot interval and then include, at a minimum, 24 to 25 feet and 25 to 26 feet.
- **At Vertically Unbounded Riverbank Angled Boring Locations (see Table 1)**
  - **Step 1:** Initially, trigger laboratory analysis for chemicals containing ROD Table 21 RAL and PTW thresholds initiating at the deepest 1-foot interval that contains visual or olfactory signs of contamination, regardless of the existing vertically unbounded DOC, and the immediately underlying three consecutive 1-foot intervals containing no visual or olfactory signs of contamination (such as 13 to 14 feet, 14 to 15 feet, and 15 to 16 feet bml). If either of the shallower 1-foot intervals contain exceedances and the deepest two intervals do not, the DOC will be identified as the bottom depth of the exceedance interval. Then move either to Step 2a or Step 2b, depending on the results of Step 1.
  - **Step 2a:** If none of the submitted Step 1 intervals contain RAL exceedances or PTW, a minimum of two overlying consecutive 1-foot intervals will be triggered for chemical

analyses depending on the visual and olfactory characteristics of these depth intervals. This will continue until the first overlying depth interval containing RAL or PTW threshold exceedances is encountered, and the DOC will be identified as the bottom depth of the deepest exceedance interval.

OR

- **Step 2b:** If either of the deepest two Step 1 intervals contain RAL or PTW threshold exceedances, a minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. This process will be repeated until two consecutive depth intervals do not contain RAL or PTW threshold exceedances. The DOC will be identified as the bottom depth of the deepest exceedance interval.

- **At Vertically Unbounded Locations with Historical Geoprobe Borings (see Table 1):**
  - **Initial Visual and Olfactory Assessment:** Inspect the sonic core to determine the location of any visual or olfactory signs of contamination. If there are visual or olfactory signs of contamination within or deeper than the previous DOC (i.e., within the 35.1- to 36.1-foot depth interval at GP25, the 23.3- to 24.3-foot depth interval at GP26, and the 32.4- to 33.4-foot depth interval at GP28), these locations will be treated as vertically unbounded locations previously sampled in consecutive 1-foot intervals,[6] and sample analysis will proceed as detailed in "At Vertically Unbounded Locations Previously Sampled in Consecutive 1-Foot Intervals" (see above). If there are no visual or olfactory signs of contamination within or deeper than the historical DOC, the historical DOC sample depth interval will be analyzed to confirm the concentrations at that interval (i.e., 35.1- to 36.1-foot depth interval at GP25, 23.3- to 24.3-foot depth interval at GP26, and 32.4- to 33.4-foot depth interval at GP28; Table 2), and the following additional stepwise sample analysis will proceed as depicted in Figure 4:
    - **Step 1:** Initially, trigger laboratory analysis for chemicals containing ROD Table 21 RAL and PTW thresholds initiating at the deepest 1-foot depth interval that contains visual or olfactory signs of contamination, regardless of the existing vertically unbounded DOC,[7] and the immediately underlying three consecutive 1-foot depth intervals containing no visual or olfactory signs of contamination (such as 13 to 14 feet, 14 to 15 feet, and 15 to 16 feet bml). If either of the shallower 1-foot depth intervals contain exceedances and the deepest two depth intervals do not, the DOC will be identified as the bottom depth of the

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[6] If there are visual or olfactory signs of contamination at, or deeper than, the historical DOC to be confirmed, there is no identified data use associated with sampling intervals shallower than the historical DOC.

[7] The existing Geoprobe data may not accurately represent the subsurface contamination profile due to the multiple lines of evidence issues discussed above. Similarly, the newly proposed riverbank angled borings will be advanced at a steeper angle than previous, so the material encountered will be different from what was previously encountered during the 2019 pre-remedial design data gaps investigation.

exceedance interval. Then move either to Step 2a or Step 2b, depending on the results of Step 1.

- **Step 2a:** If none of the submitted Step 1 intervals contain RAL exceedances or PTW, a minimum of two overlying (shallower) consecutive 1-foot depth intervals will be triggered for chemical analyses depending on the visual and olfactory characteristics of these depth intervals. This will continue until the first overlying depth interval containing RAL or PTW threshold exceedances is encountered, and the DOC will be identified as the bottom depth of the deepest exceedance interval.

  OR

- **Step 2b:** If either of the deepest two Step 1 intervals contain RAL or PTW threshold exceedances, a minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. This process will be repeated until two consecutive depth intervals do not contain RAL or PTW threshold exceedances. The DOC will be identified as the bottom depth of the deepest exceedance interval.

Location and Sample Identification

Consistent with Section 3.13 of Appendix A of the DGWP (Anchor QEA 2019), each discrete sediment and riverbank soil sample will be assigned a unique alphanumeric identifier according to the method described in this section. The identifiers facilitate sample tracking by incorporating identifying information. The alphanumeric identifiers will be assigned in the following manner for subsurface sediment and riverbank soil samples:

- The first three characters for the in-water locations identify the sample location by the project descriptor: PDI = Pre-Design Investigation.
- The next three characters identify the sample location: 001 = Location 001.
- The next two to three characters identify the sampling matrix:
  - RAB = Riverbank Angled Boring
  - SC = Sediment Core
  - SB = Sonic Boring
- The next two to four characters identify the subsurface sampling interval in feet below ground surface.
- The next six characters identify the collection date: YYMMDD.

Example:

> Sample number PDI-180SB-19-20-230304 indicates a sonic boring sample obtained from Location 180 and collected from a depth of 19 to 20 feet bml on March 4, 2023.

References

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Tables

Table 1
Summary of Locations with Vertically Unbounded Depth of Contamination

Location ID	Notes
C263	Unbounded DOC sampled in greater than 1-foot intervals
C301	Unbounded DOC sampled in greater than 1-foot intervals
DGS-07SC	Unbounded DOC sampled in greater than 1-foot intervals
DGS-22SC	Unbounded DOC sampled in greater than 1-foot intervals
DGS-24SC	Unbounded DOC sampled in greater than 1-foot intervals
GP-25	Unbounded DOC from historical geoprobe boring
GP-26	Unbounded DOC from historical geoprobe boring
GP-28	Unbounded DOC from historical geoprobe boring
GS-05	Unbounded DOC sampled in greater than 1-foot intervals
GS-06	Unbounded DOC sampled in greater than 1-foot intervals
GS-07	Unbounded DOC sampled in greater than 1-foot intervals
GS-09	Unbounded DOC sampled in greater than 1-foot intervals
GS-B7	Unbounded DOC sampled in greater than 1-foot intervals
GSM-07	Unbounded DOC sampled in greater than 1-foot intervals
GSM-08	Unbounded DOC sampled in greater than 1-foot intervals
GTC-07	Unbounded DOC sampled in greater than 1-foot intervals
PDI-021SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-027	Vertically bounded by only one 1-foot interval without a RAL or PTW Threshold Exceedance
PDI-051	Vertically bounded by only one 1-foot interval without a RAL or PTW Threshold Exceedance
PDI-054SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-056SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-058SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-068SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-069SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-070SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-073SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-075SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-077	Vertically bounded by only one 1-foot interval without a RAL or PTW Threshold Exceedance
PDI-078SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-080SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-083	Vertically bounded by only one 1-foot interval without a RAL or PTW Threshold Exceedance
PDI-085SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-086SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-087SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-088SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-089SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-090SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-091SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-092SC-B	Unbounded DOC sampled in greater than 1-foot intervals
PDI-093SC-B	Unbounded DOC sampled in 1-foot intervals
PDI-119	Unbounded DOC sampled in greater than 1-foot intervals
PDI-134RAB	Unbounded DOC in angled riverbank boring

Table 1
Summary of Locations with Vertically Unbounded Depth of Contamination

Location ID	Notes
PDI-135RAB	Unbounded DOC in angled riverbank boring
PDI-136RAB	Unbounded DOC in angled riverbank boring
PDI-137RAB	Unbounded DOC in angled riverbank boring
PDI-138RAB	Unbounded DOC in angled riverbank boring
PDI-139RAB	Unbounded DOC in angled riverbank boring
PDI-140RAB	Unbounded DOC in angled riverbank boring
PDI-141RAB	Unbounded DOC in angled riverbank boring
PDI-142RAB	Unbounded DOC in angled riverbank boring
PDI-143RAB	Unbounded DOC in angled riverbank boring
PDI-144RAB	Unbounded DOC in angled riverbank boring
PDI-147SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-166SC-A	Unbounded DOC sampled in 1-foot intervals
PDI-171SC-A	Unbounded DOC sampled in 1-foot intervals
RAA-02	Unbounded DOC sampled in greater than 1-foot intervals
RAA-17	Unbounded DOC sampled in greater than 1-foot intervals
SC-S113	Unbounded DOC sampled in greater than 1-foot intervals

Notes:
DOC: depth of contamination
PTW: principal threat waste
RAL: remedial action level

Table 2
Summary of Historical Geoprobe Borings to Support Data Confirmation

Proposed New Location IDs For DOC Confirmation	Historical Boring Location ID (Year Sampled)	Historical Boring Unbounded DOC	Elevation Change Between Historical Sampled Year and Proposed Sample	Data Confirmation Rationale
PDI-201 (co-located) PDI-212 PDI-214 PDI-215	GP-25 (2004)	36.1	4.7	Performance of the multiple lines of evidence evaluation identified it is appropriate to confirm the historical data with the proposed DOC cores or borings. Specifically: 1. **Subsamples:** GP-25 was subsampled in approximately 0.5-foot-thick sample intervals starting at 1 foot, 6 feet, 11 feet, 16 feet, 21 feet, 26 feet, 31 feet, 36 feet, 41 feet, 91 feet, and 146 feet below mudline for sediment chemistry. From these intervals, the DOC was identified as 31.5 feet (depth-corrected[1] to 36.1 feet due to changes in mudline elevation over time). This is insufficient for determination of DOC and should be repeated via 1 foot, consecutive subsamples according to the procedures described in the FSP. 2. **Boring Technology:** The boring was sampled via Geo-Probe, which may have contributed to drag down of contamination from the side walls. Vibracore or sonic drilling will be selected based on location conditions and is expected to limit the likelihood of contamination. 3. **Mudline elevation change over time:** The mudline increased 4.7 feet from 2004[2] to 2019.
PDI-200 (co-located) PDI-199 PDI-215	GP-26 (2004)	24.3	5.8	Performance of the multiple lines of evidence evaluation identified it is appropriate to confirm the historical data with the proposed DOC cores or borings. Specifically: 1. **Subsamples:** GP-26 was subsampled in approximately 0.5-foot-thick sample intervals starting at 1 foot, 8 feet, 13 feet, 18 feet, 23 feet, 28 feet, 58 feet, 63 feet, 83 feet, and 118 feet below mudline for sediment chemistry. From these intervals, the DOC was identified as 18.5 feet (depth-corrected[1] to 24.3 feet due to changes in mudline elevation over time). This is insufficient for determination of DOC and should be repeated via 1 foot, consecutive subsamples according to the procedures described in the FSP. 2. **Boring Technology:** The boring was sampled via Geo-Probe, which may have contributed to drag down of contamination from the side walls. Vibracore or sonic drilling will be selected based on location conditions and is expected to limit the likelihood of contamination. 3. **Mudline elevation change over time:** The mudline increased 5.8 feet from 2004[2] to 2019.
PDI-203 (co-located) PDI-213 PDI-214	GP-28 (2004)	33.4	2.9	Performance of the multiple lines of evidence evaluation identified it is appropriate to confirm the historical data with the proposed DOC cores or borings. Specifically: 1. **Subsamples:** GP-28 was subsampled in approximately 0.5-foot-thick sample intervals starting at 1 foot, 5 feet, 10 feet, 15 feet, 20 feet, 25 feet, 30 feet, and 35 feet below mudline for sediment chemistry. From these intervals, the DOC was identified as 30.5 feet (depth-corrected[1] to 33.4 feet due to changes in mudline elevation over time). This is insufficient for determination of DOC and should be repeated via 1 foot, consecutive subsamples according to the procedures described in the FSP. 2. **Boring Technology:** The boring was sampled via Geo-Probe, which may have contributed to drag down of contamination from the side walls. Vibracore or sonic drilling will be selected based on location conditions and is expected to limit the likelihood of contamination. 3. **Mudline elevation change over time:** The mudline increased 2.9 feet from 2004[2]-2019.

Notes:

1. Mudline information for the historical deep geoprobe borings is difficult to accurately discern from the available information presented in the boring logs (e.g., "Depth to mudline approximately 9 feet below barge deck") because the sampling barge would have been on location over the course of a tidal cycle and water depth measurements would change over time. The water depth would need to be tied to a water surface elevation at the time of water depth measurement to determine mudline elevation. Therefore, mudline elevations were estimated using bathymetry data collected temporally closest to the survey in 2004.
2. To account for potential changes in bathymetry between the time that historical core data were collected and current conditions, bathymetry elevations were compared to the 2019 surveyed bathymetry elevations (eTrac 2019) at each historical core location. If the bathymetry difference was less than or equal to 1 foot, this was considered within the range of error for the equipment and methods, and no adjustment was made to the historical core data DOC. Alternatively, if the difference was greater than 1 foot, the historical core data DOC was converted to an EOC. The EOC was then converted back to a DOC consistent with the 2019 bathymetry elevations.

For elevation changes, negative values indicate erosion and positive values indicate deposition.
COP: City of Portland Datum
DOC: depth of contamination
EOC: elevation of contamination
EPA: U.S. Environmental Protection Agency
FSP: *Pre-Remedial Design Data Gaps Field Sampling Plan Addendum*

Table 3a
Summary of Sediment Chemistry Data in Historical Geoprobe Borings to Support Data Confirmation

Location	Sample Depth Submitted for Chemistry (Feet Below Mudline)	Naphthalene Concentration[1] (µg/kg)	Portland Harbor ROD Total PAH Concentration[2] (µg/kg)	Naphthalene PTW-Highly Toxic Threshold Exceedance Factor	TPAH Site-Wide RAL Exceedance Factor
GP-25	1	87.4	5,100	0.0	0.2
	6	5,710	120,000	0.0	4.0
	11	679,000	1,800,000	4.9	60.0
	16	2,310,000	9,100,000	16.5	303.3
	21	675,000	1,170,000	4.8	39.0
	26	484	21,000	0.0	0.7
	31	2,750	170,000	0.0	5.7
	36	171	811	0.0	0.0
	41	96.9	91	0.0	0.0
	91	14.4	--	0.0	--
	146	251	--	0.0	--
GP-26	1	2,870	1,400,000	0.0	46.7
	8	16,600,000	40,000,000	118.6	1333.3
	13	1,070,000	3,820,000	7.6	127.3
	18	334,000	1,300,000	2.4	43.3
	23	3,520	12,000	0.0	0.4
	28	466	1,500	0.0	0.1
	58	457	2,500	0.0	0.1
	63	89.5	126	0.0	0.0
	83	132	470	0.0	0.0
	118	435	694	0.0	0.0
GP-28	1	87.4	620	0.0	0.0
	5	103	14,000	0.0	0.5
	10	524,000	2,930,000	3.7	97.7
	15	1,020	310,000	0.0	10.3
	20	614	260,000	0.0	8.7
	25	345	150,000	0.0	5.0
	30	662	100,000	0.0	3.3
	35	97.2	98	0.0	0.0

Table 3a
Summary of Sediment Chemistry Data in Historical Geoprobe Borings to Support Data Confirmation

Notes:

🟨 Exceeds applicable Portland Harbor site-wide RAL or PTW threshold

1. The highest reported Naphthalene value for each depth interval is presented.
2. U = 1/2 maximum limit

μg/kg: microgram per kilogram
PAH: polycyclic aromatic hydrocarbon
PTW: principal threat waste
RAL: remedial action level
ROD: *Record of Decision – Portland Harbor Superfund Site, Portland, Oregon*
TPAH: total polycyclic aromatic hydrocarbons

Table 3b
Observations of Visual and Olfactory Contamination in Historical Geoprobe Borings to Support Data Confirmation

Geoprobe Location ID	DOC[1]	Depth Interval (Feet Below Mudline)	Visual and Olfactory Observations of Contamination from Geoprobe Boring Logs
GP-25	31.5[2]	0-5.0	No recovery
		5.0-16.0	Wet NAPL globules with moderate odor and sheen at 6.0 feet
		16.0-18.0	Strong odor and heavy sheen
		18.0-27.5	Moderate to slight odor
		27.5-28.0	Moderate odor and sheen
		28.0-29.5	No visual or olfactory signs of contamination
		29.5-30.0	Moderate odor with slight sheen
		30.0-31.0	No visual or olfactory signs of contamination
		31.0-35.5	Slight sheen
		35.5-151	No visual or olfactory signs of contamination
GP-26	18.5[3]	0.0-3.0	No recovery
		3.0-8.0	Heavy sheen and strong odor
			@ 7.0 ft NAPL present
		8.0-10.0	No recovery
		10.0-18.0	Heavy sheen and strong odor
			@ 11.0 ft 3-in layer of black tar-like material, high plasticity, and odor
			@ 13.0 ft decreasing odor to slight/moderate
		18.0-21.0	No recovery
		21.0-21.5	Slight odor
		21.5-28.0	Slight sheen
		28.0-30.0	No recovery
		30.0-32.5	Slight sheen
		32.5-128	No visual or olfactory signs of contamination
GP-28	30.5[4]	0.0-5.0	No recovery
		5.0-10.0	NAPL globules with strong odor and heavy sheen
		10.0-15.0	Slight odor
		15.0-28.5	Black tar-like fines from 20.0 ft to 25.0 ft
		28.5-34.5	Slight odor
		34.5-50.5	No visual or olfactory signs of contamination
		50.5-51.0	Slight odor
		51.0-160	No visual or olfactory signs of contamination

Table 3b
Observations of Visual and Olfactory Contamination in Historical Geoprobe Borings to Support Data Confirmation

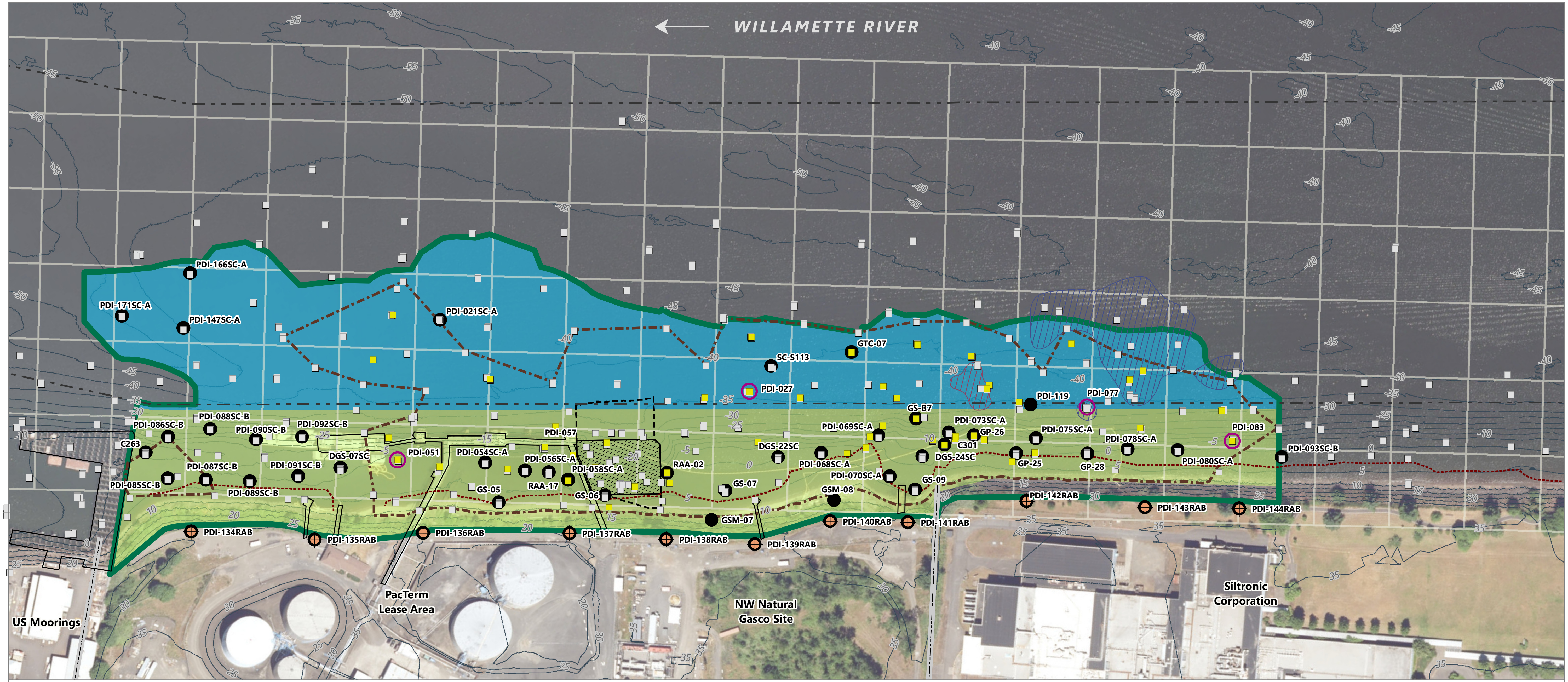
Notes:

🟨 Interval includes visual or olfactory sign(s) of contamination

1. DOC was determined based on exceedances of ROD Table 21 RALs and PTW thresholds. Data for these locations is included in Table 3a.
2. Sediment accreted 4.6 feet based on bathymetric surveys performed in 2004 (at time of collection) and 2018 (most recent). The DOC was corrected to 36.1 feet below mudline to account for the change in mudline elevation over time.
3. Sediment accreted 5.8 feet based on bathymetric surveys performed in 2004 (at time of collection) and 2018 (most recent). The DOC was corrected to 24.3 feet below mudline to account for the change in mudline elevation over time.
4. Sediment accreted 2.9 feet based on bathymetric surveys performed in 2004 (at time of collection) and 2018 (most recent). The DOC was corrected to 33.4 feet below mudline to account for the change in mudline elevation over time.

DOC: depth of contamination
NAPL: nonaqueous phase liquid
PTW: principal threat waste
RAL: remedial action level
ROD: *Record of Decision – Portland Harbor Superfund Site, Portland, Oregon*

Figures



LEGEND:

- ▬ Gasco Sediments Site Final Project Area
- ⌐ Navigation Channel
- ☐ Structures
- ─ Property Line
- ⌐ Tar Body Removal Action Area (RAPP, Anchor 2005)
- ▤ Tar Body Removal Action Pilot Cap
- ⌐ Refined PTW-NAPL Boundary
- ---- Approximate Riprap Boundary[1]

PAR Selected Design Technology[2]

- 🟦 Dredge to Bottom DOC
- 🟩 ISS to Bottom DOC
- ▨ 2010 Transition Zone Water Vinyl Chloride Area 1 Boundary (Anchor QEA 2012)[3]
- ▨ Area 2 – Detected CVOCs in TZW and One Subsurface Sediment Location[4]

- 🟨 Existing Cores with Previously Observed PTW-NAPL
- ☐ Existing Subsurface Sample Location
- ⊕ Existing Riverbank Angled Boring
- ● Existing Core/Boring with Vertically Unbounded DOC
- ○ Vertically Bounded By Only One 1-Foot Interval Without a RAL Exceedance or PTW

NOTES:

1. Estimated from side scan sonar survey conducted by Blue Water Engineering April 2011.
2. The remedial technologies shown on this figure are consistent with the technologies included in the Full Dredge and ISS Design identified in the Gasco Sediments Site Preferred Alternatives Report.
3. Boundary taken from Draft Engineering Evaluation/Cost Analysis, Appendix A, Figure 4.2. Transition zone water screening level exceedances of cis-1,2-dichloroethene identified within this vinyl chloride boundary.
4. Boundary taken from Gasco Sediments Site Statement of Work, Figure 1 (EPA 2009).
5. Bathymetry surveyed by eTrac 2019. Topography surveyed by Geometrix 2011.
6. Shown grid is in 150-foot by 150-foot dimensions to support remedial design data density determinations.
7. Arrow indicates direction of flow of river.
8. Horizontal datum is NAD83 (HARN 91) Oregon State Plane North, International Feet.
9. Vertical datum is City of Portland (COP), Feet.
10. Aerial imagery from City of Portland 2021.

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Feet

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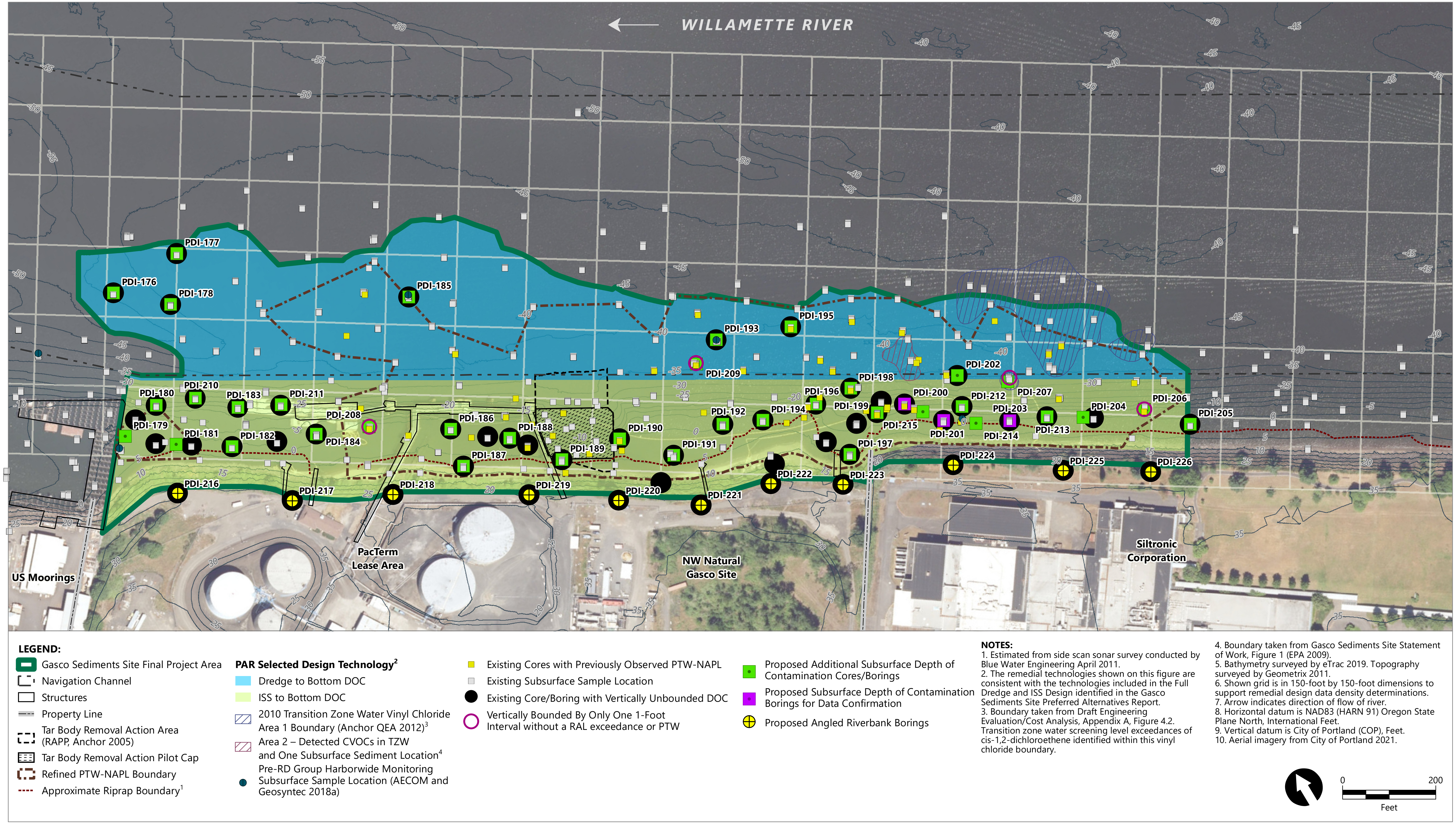
ANCHOR QEA

Figure 1
Existing Vertically Unbounded Sample Locations

Final Revised Additional Depth of Contamination Characterization Addendum Within the Gasco Sediments Project Area
Gasco Sediments Cleanup Action



LEGEND:

- Gasco Sediments Site Final Project Area
- Navigation Channel
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- Property Line
- Tar Body Removal Action Area (RAPP, Anchor 2005)
- Tar Body Removal Action Pilot Cap
- Refined PTW-NAPL Boundary
- Approximate Riprap Boundary[1]

PAR Selected Design Technology[2]

- Dredge to Bottom DOC
- ISS to Bottom DOC
- 2010 Transition Zone Water Vinyl Chloride Area 1 Boundary (Anchor QEA 2012)[3]
- Area 2 – Detected CVOCs in TZW and One Subsurface Sediment Location[4]
- Pre-RD Group Harborwide Monitoring Subsurface Sample Location (AECOM and Geosyntec 2018a)

- Existing Cores with Previously Observed PTW-NAPL
- Existing Subsurface Sample Location
- ● Existing Core/Boring with Vertically Unbounded DOC
- ○ Vertically Bounded By Only One 1-Foot Interval without a RAL exceedance or PTW

- 🟩 Proposed Additional Subsurface Depth of Contamination Cores/Borings
- Proposed Subsurface Depth of Contamination Borings for Data Confirmation
- ⊕ Proposed Angled Riverbank Borings

NOTES:

1. Estimated from side scan sonar survey conducted by Blue Water Engineering April 2011.
2. The remedial technologies shown on this figure are consistent with the technologies included in the Full Dredge and ISS Design identified in the Gasco Sediments Site Preferred Alternatives Report.
3. Boundary taken from Draft Engineering Evaluation/Cost Analysis, Appendix A, Figure 4.2. Transition zone water screening level exceedances of cis-1,2-dichloroethene identified within this vinyl chloride boundary.
4. Boundary taken from Gasco Sediments Site Statement of Work, Figure 1 (EPA 2009).
5. Bathymetry surveyed by eTrac 2019. Topography surveyed by Geometrix 2011.
6. Shown grid is in 150-foot by 150-foot dimensions to support remedial design data density determinations.
7. Arrow indicates direction of flow of river.
8. Horizontal datum is NAD83 (HARN 91) Oregon State Plane North, International Feet.
9. Vertical datum is City of Portland (COP), Feet.
10. Aerial imagery from City of Portland 2021.

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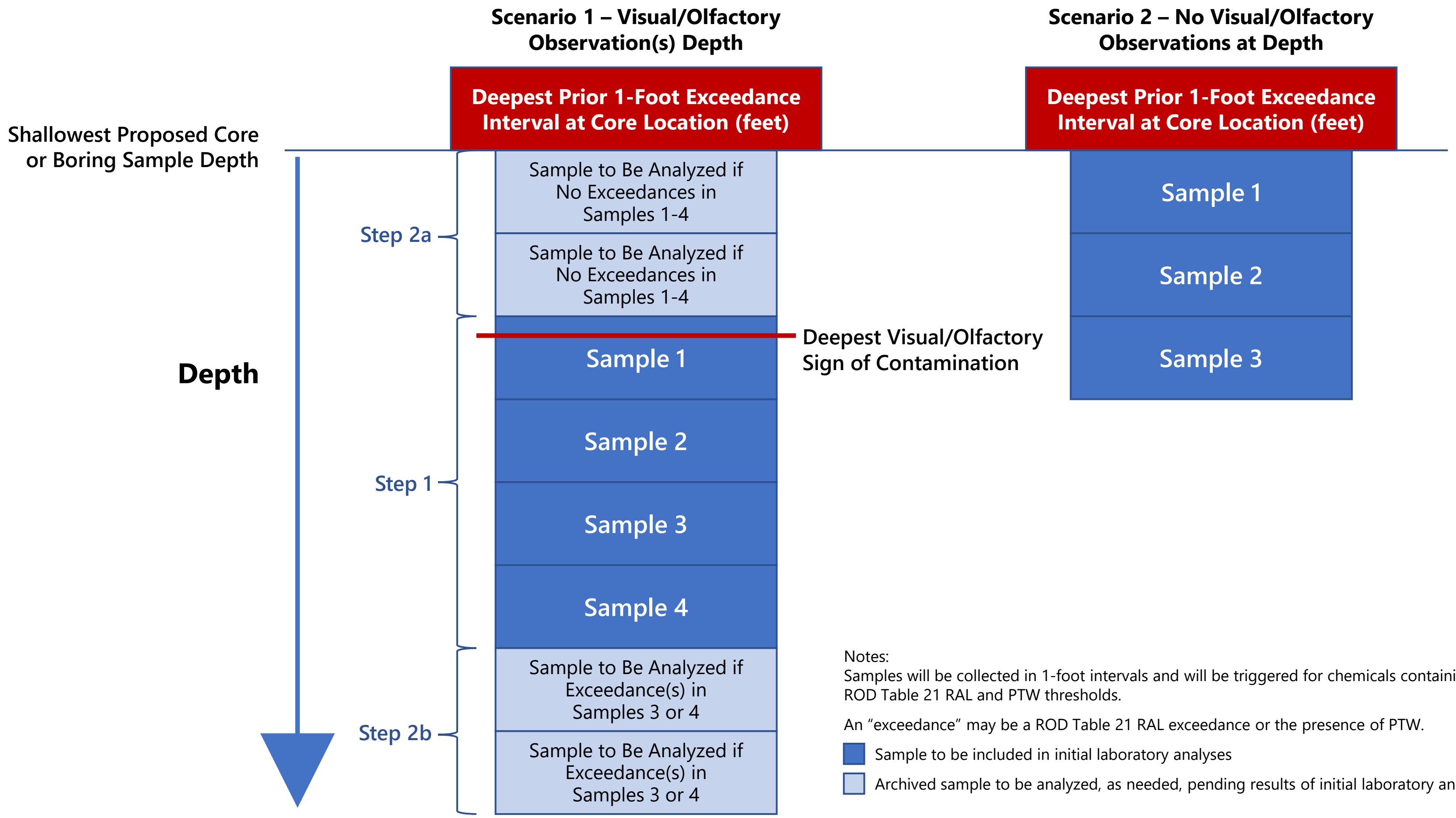
Figure 2

Proposed Subsurface Depth of Contamination Refinement Cores and Riverbank Angled Borings

Final Revised Additional Depth of Contamination Characterization Addendum Within the Gasco Sediments Project Area
Gasco Sediments Cleanup Action



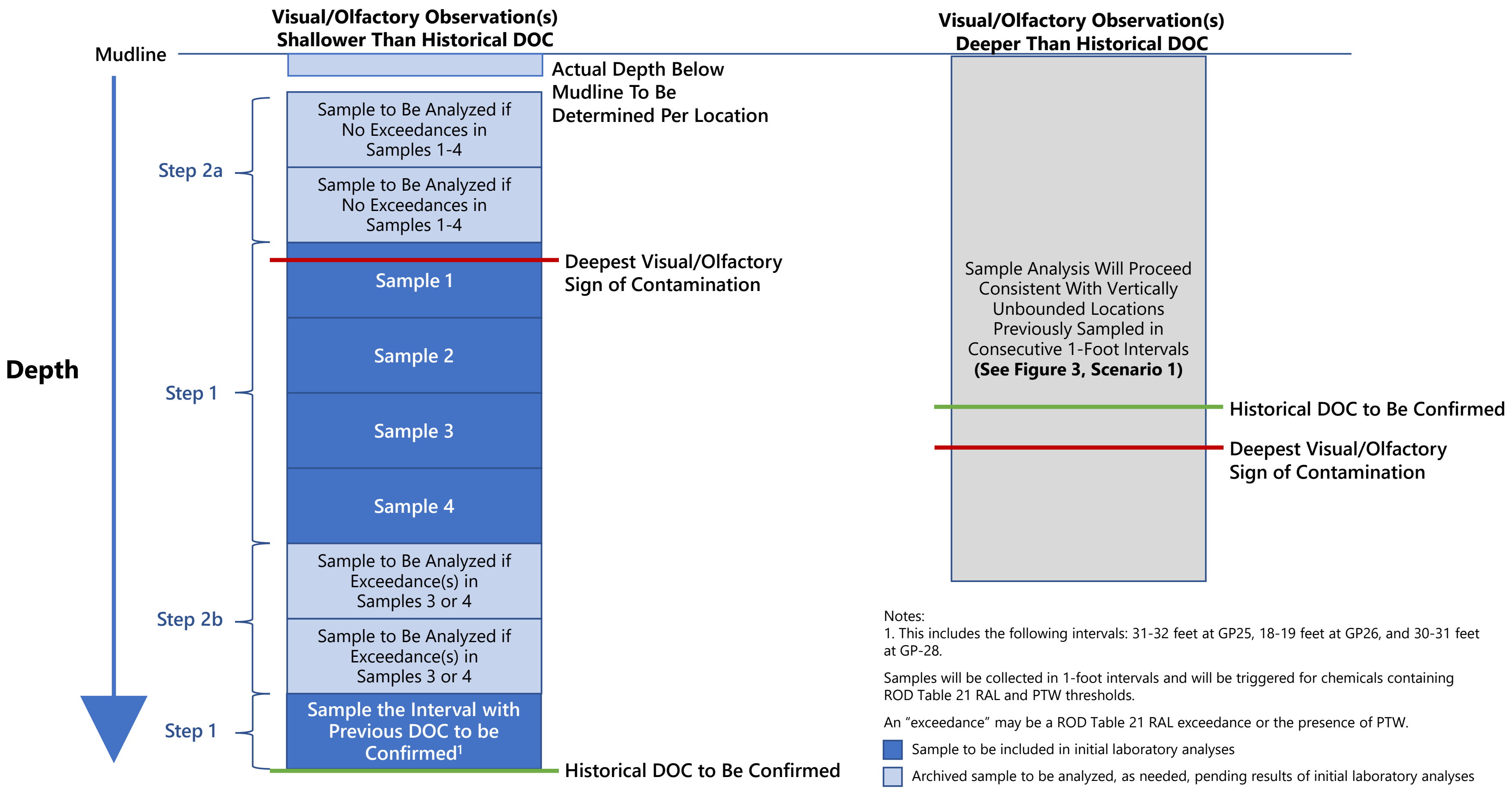
Notes:
Samples will be collected in 1-foot intervals and will be triggered for chemicals containing ROD Table 21 RAL and PTW thresholds.

An "exceedance" may be a ROD Table 21 RAL exceedance or the presence of PTW.

🟦 Sample to be included in initial laboratory analyses

☐ Archived sample to be analyzed, as needed, pending results of initial laboratory analyses

Figure 3
Conceptual Core or Boring Sampling and Analysis Plan
Final Revised Additional Depth of Contamination Characterization Addendum Within the Gasco Sediments Site Project Area
Gasco Sediments Cleanup Action



Notes:
1. This includes the following intervals: 31-32 feet at GP25, 18-19 feet at GP26, and 30-31 feet at GP-28.

Samples will be collected in 1-foot intervals and will be triggered for chemicals containing ROD Table 21 RAL and PTW thresholds.

An "exceedance" may be a ROD Table 21 RAL exceedance or the presence of PTW.

■ Sample to be included in initial laboratory analyses

□ Archived sample to be analyzed, as needed, pending results of initial laboratory analyses

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Figure 4

Conceptual Core or Boring Sampling and Analysis Plan at Historical Geoprobe Locations

Final Revised Additional Depth of Contamination Characterization Addendum Within the Gasco Sediments Site Project Area
Gasco Sediments Cleanup Action

Appendix A

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum

March 23, 2023
Gasco Sediments Cleanup Action

Pre-Remedial Design
Data Gaps Field Sampling Plan Addendum

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

March 2023
Gasco Sediments Cleanup Action

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum

Prepared for
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ATTACHMENT

Attachment A Field Forms

ABBREVIATIONS

ARL	Analytical Resources, LLC
ASTM	ASTM International
bml	below mudline
COC	contaminant of concern
COP	City of Portland datum
Data Gaps Investigation	Pre-Remedial Design Data Gaps Investigation
DEQ	Oregon Department of Environmental Quality
DGPS	differential global positioning system
DGWP	*Revised Pre-Remedial Design Data Gaps Work Plan*
DOC	depth of contamination
DOC Memorandum	*Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum*
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FCR	Field Change Request
FSP Addendum	*Pre-Remedial Design Data Gaps Field Sampling Plan Addendum*
GPS	global positioning system
HARN91	High Accuracy Reference Network 91
HDPE	high-density polyethylene
IDW	investigation-derived waste
Interim Project Area	Gasco Sediments Site active cleanup boundaries
ISS	in situ stabilization and solidification
NAD83	North American Datum of 1983
NAPL	nonaqueous phase liquid
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PTFE	polytetrafluoroethylene
PTW	principal threat waste
QA	quality assurance
QAPP Addendum	*Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum*
QC	quality control
RAL	remedial action level
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDGC	*Remedial Design Guidelines and Considerations—Portland Harbor Superfund Site, Portland, Oregon*

ROD	*Record of Decision – Portland Harbor Superfund Site, Portland, Oregon*
Siltronic	Siltronic Corporation
Site	Gasco Sediments Site
SPT	standard penetration test
TCE	trichloroethene
TPH	total petroleum hydrocarbons
USCS	Unified Soil Classification System
vibracore	vibratory core sampling
VOC	volatile organic compound

1 Introduction

This *Pre-Remedial Design Data Gaps Field Sampling Plan Addendum* (FSP Addendum) has been prepared by Anchor QEA, LLC, on behalf of NW Natural for the Gasco Sediments Site (Site), located on the Willamette River adjacent to the NW Natural Gasco and Siltronic Corporation (Siltronic) properties in Portland, Oregon (Figure A-1). This FSP Addendum is Appendix A of the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum* (DOC Memorandum) and presents the data objectives related to determination of vertical depth of contamination (DOC), the proposed field sampling and data collection methodologies, and the analytical testing to be conducted during additional Pre-Remedial Design Data Gaps Investigation (Data Gaps Investigation) at the Site. This FSP Addendum addresses the U.S. Environmental Protection Agency's (EPA's) comments dated February 16, 2023, on the *Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum* prepared by Anchor QEA dated January 13, 2023.

1.1 Purpose and Objectives of the Field Sampling Plan Addendum

This FSP Addendum has been slightly modified[1] from the EPA-approved *Pre-Remedial Design Data Gaps Field Sampling Plan* (FSP) submitted as Appendix A of the *Revised Pre-Remedial Design Data Gaps Work Plan* (DGWP; Anchor QEA 2019). This FSP Addendum is intended to detail the methods and processes that will be used to collect the additional data described in the DOC Memorandum. The Data Gaps Investigation is being implemented to collect additional site-specific data to determine the DOC at the remaining vertically unbounded locations throughout the Site active cleanup boundaries (herein termed the Project Area).

1.2 Data Quality Objectives

The Data Gaps Investigation data quality objectives (DQOs) are summarized in the DOC Memorandum and associated Appendix B, *Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum* (QAPP Addendum).

1.3 Document Organization

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

- Section 2 – Project Management and Responsibilities
- Section 3 – Sample Collection, Processing, and Handling Procedures
- Section 4 – Field Documentation, Sample Handling, Decontamination Procedures, and Investigation-Derived Waste Management

---

[1] In general, modifications include the removal of sampling media and analytical methods that are not applicable to the sampling objectives stated in the DOC Memorandum. The sediment and riverbank angled boring sampling approaches have been modified to reflect the DOC sampling objectives described in the DOC Memorandum.

- Section 5 – Chemical and Physical Testing
- Section 6 – Field Sampling Schedule
- Section 7 – References

2 Project Management and Responsibilities

This section describes the project management structure for implementing this FSP Addendum. Additional information about staff responsible for project management and other roles is defined in QAPP Addendum (Appendix B of the DOC Memorandum).

The project manager for Anchor QEA is Mr. Ryan Barth. Mr. Barth will be responsible for overall project coordination and providing oversight on planning and coordination, all project deliverables, and performance of the administrative tasks needed to ensure timely and successful completion of the project. He will also be the main point of contact for the EPA regional project manager.

The field coordinator from Anchor QEA is Mr. Nik Bacher. Mr. Bacher will provide overall direction for the sampling program in terms of logistics, personnel assignments, and field operations. Furthermore, he will be responsible for managing field activities and general field quality assurance/quality control (QA/QC) oversight. He will ensure that appropriate protocols for sample collection, preservation, and holding times are observed and oversee delivery of environmental samples to the designated laboratories for chemical and physical analyses.

The project chemist will be Ms. Delaney Peterson. Ms. Peterson's responsibilities will include coordination with laboratories regarding sample receipt, requested analyses, and turnaround times. She will also answer technical and logistical questions related to the analyses requested, including issues related to limited sample availability, which impact detection limits and matrix interferences.

Sample analysis will be conducted by pre-qualified laboratories, and the laboratory project managers will act as the primary points of contact at each analytical laboratory, as discussed in the QAPP Addendum. The project chemist will communicate with the laboratory project managers to resolve sampling, receipt, analysis, and storage issues. Multiple laboratories will be analyzing samples during the data gaps sampling program; each laboratory will have a laboratory project manager.

3 Sample Collection, Processing, and Handling Procedures

The subsurface sediment coring and riverbank angled boring sampling methods described in this document were previously presented in the EPA-approved DGWP (Anchor QEA 2019). Components of this work that rely on ASTM International (ASTM) methods will refer to currently adopted versions of the methods to ensure data quality.

To complete the field activities, Anchor QEA will work with qualified health- and safety-focused subconsultants to complete subsurface sediment coring and riverbank angled borings.

3.1 PTW-NAPL Identification

Anchor QEA will visually inspect the full depth of each individual subsurface sediment core and riverbank angled boring during core/boring processing and will note the presence of principal threat waste (PTW)-nonaqueous phase liquid (NAPL) and the depth interval of occurrence.

PTW-NAPL will be identified in accordance with the site-specific visual definition, defined in Section 3.6.2.1 of the *Statement of Work – Gasco Sediments Site* (EPA 2009) as "any layer or seam of product, regardless of thickness, that is clearly defined as liquid NAPL that is also mobile (i.e., 'oozes' or 'drips' out of the core during core observations)."

Small depressions will be made in each core in areas showing both the visual absence and presence of petroleum-impacted soils and sediments to evaluate the presence of PTW-NAPL. If NAPL freely flows into a depression, additional depressions will be made immediately above and below to delineate the depth of PTW-NAPL.

3.2 Riverbank Angled Borings

Sections 3.2.1 through 3.2.4 describe the sample collection, processing, and handling procedures to be followed during the collection of samples from riverbank angled borings during the Data Gaps Investigation sampling by the selected drilling contractor. The QAPP Addendum outlines the analytical methods and details the QA/QC protocols to be followed during these activities.

3.2.1 Riverbank Angled Borings Sampling Plan

As described in in the DOC Memorandum, the objective of the riverbank angled borings sampling program is to determine the DOC throughout the Project Area Riverbank Region to facilitate in situ stabilization and solidification (ISS) to the full vertical extent of PTW-NAPL/not reliably contained, remedial action level (RAL), and PTW-highly toxic threshold exceedances.

To achieve this objective, eleven borings will be advanced on top of the riverbank as shown in Figure A-2. The boring locations will be collocated with those identified in the *Revised Final Pre-Remedial Design Data Gaps Data Summary Report* (Anchor QEA 2022), except for the most upriver location PDI-145 that is no longer adjacent to the Project Area. Sample IDs, proposed boring entry angles, and proposed coordinates are provided in Table A-2. The riverbank angled borings are also depicted in cross sectional view with the nearest in-water cores and their associated DOCs in Figures A3a through A3c. As shown in Figures A-3a through A-3c, each boring will be advanced, at a minimum, to a target of the deepest adjacent in-water sediment core DOC. If there are visual and olfactory signs of contamination in the bottom depth of the targeted sample interval, additional sample depth may be collected to achieve the objective of delineating the DOC at each proposed riverbank angled boring location. Chemical testing, including anticipated sample intervals that will be determined based on visual and olfactory observations, is discussed in Section 5. Analytical methods and QA/QC information are discussed in the QAPP Addendum. As discussed in Section 3.2.2, the borings will be collected at an angle that allows determination of the DOC underneath the riverbank between the top of riverbank and nearest nearshore sediment core.

3.2.2 Riverbank Angled Boring Collection Methods

The borings will be advanced by a sonic drill rig after clearing the target location as necessary to facilitate access. It is not anticipated that the target locations will need to be adjusted based on contractor access due to previous boring activities at each location. The drill rig will be set up so the core barrel enters the ground at an angle unique to each location to reach the desired location and depth. The proposed angles for each sample location are presented in Table A-2. This angle will be confirmed in the field using an inclinometer.

3.2.3 Soil Logging and Processing Procedures

To account for the angled boring, the corrected vertical sample depths and effective DOC locations will be determined using AutoCAD following sample collection. To account for the angle at which each riverbank boring is advanced, the vertical DOC will be determined from the true ground surface elevation directly on top of (i.e., vertical) the bottom of the deepest 1-foot interval that defines DOC (i.e., contains a RAL exceedance or the presence of PTW). The lateral offset from the point of entry will be calculated such that the effective DOC location is located directly on top of the point where the DOC is defined. The effective DOC location will be used to delineate DOC in future design deliverables. An example schematic is provided in Figure A-4.

The following description provides a detailed account of the boring sample processing procedures:

- Lay out the sample bags horizontally for each run at a boring location. Cut the bags longitudinally using scissors to minimize penetration and disturbance of the soil during cutting.
- Visually assess the presence of PTW-NAPL using the site-specific definition provided in Section 3.1. Depressions will be made in the soil using a melon baller to evaluate for the

presence of liquid NAPL that is also mobile (i.e., oozes or drips out of the sample during processing).

- Record the description of the full length of the borehole on the boring log form, including but not limited to the following observations, as appropriate:
  - Sample recovery (recovered soil depth relative to penetration depth and percent compaction)
  - Physical soil description in accordance with Unified Soil Classification System (USCS) (ASTM D2488 – Standard Practice for Description and Identification of Soils [Visual-Manual Procedures]), including soil type, density/consistency, color, and other similar descriptors
  - Presence of PTW-NAPL and other signs of petroleum contamination (e.g., sheens)
  - Presence of substantial product (e.g., tar or black bands of product) that does not meet the site-specific definition of PTW-NAPL
  - Odor (hydrogen sulfide, petroleum)
  - Presence of organic material (e.g., vegetation, roots, and twigs)
  - Anthropogenic debris
  - Any other distinguishing characteristics or features
- As discussed in detail in Section 5.1, sample intervals will be determined in the field based on visual and olfactory signs of contamination.
- Take digital photographs of each borehole sample interval with a label indicating the location and depth of the interval.
- Using a decontaminated stainless-steel spoon, place a proportionate volume of soil from the identified sample interval(s) into a single cleaned stainless-steel bowl and homogenize until uniform color and texture is achieved.
- Using a decontaminated stainless-steel spoon, fill pre-labeled, laboratory-provided sample containers for all proposed analyses.
- Immediately place filled and sealed sample containers in a cooler with ice to maintain temperature at approximately 4°C until delivered to the project laboratory, while following the handling and chain-of-custody procedures described in Section 4.2.3. The required sample volumes, preservation, and maximum holding times for the categories of analytes are presented in the QAPP Addendum.

3.2.4 Soil Boring Abandonment

Soil borings will be abandoned using the approach approved at the upland Gasco property by the Oregon Department of Environmental Quality (DEQ) and Oregon Water Resources Department (Bayuk 2009). The bentonite grout slurry that will be placed from the bottom of the borehole to the mudline or ground surface using a tremie pipe. The discharge end of the tremie pipe will be submerged in the grout to avoid breaking the seal while filling the borehole. For intervals where

NAPL is present, as determined by visual inspection of recovered soil samples for presence of PTW-NAPL, the grout slurry will consist of a bentonite/organoclay blend consisting of approximately 9 parts Wyoming sodium bentonite and 1 part organoclay by volume, mixed to a 20% solids content. The resulting mud weight of the 20% solids solution will be approximately 9.5 to 9.7 pounds per gallon. The use of granular bentonite across the portion of the borehole within the vadose zone is an acceptable alternative to the placement of the grout slurry across this zone.

3.3 Subsurface Sediment Sampling

Sections 3.2.1 through 3.2.3 describe the subsurface sediment sample collection, processing, and handling procedures to be followed during the Data Gaps Investigation sampling to be performed by Anchor QEA. The QAPP Addendum details the QA/QC protocols to be followed during these activities.

3.3.1 Subsurface Sediment Sampling Plan

As described in the DOC Memorandum, the intent of the subsurface sediment sampling program is to collect additional information to determine the DOC at the remaining vertically unbounded locations throughout the Project Area. The DOC is needed to facilitate dredging to the full DOC in the Navigation Channel Region and ISS to the full DOC in the Intermediate and Shallow Regions. To achieve this objective, 31 sediment cores of variable depths are proposed for collection as shown in Figure A-2.

Sample IDs and proposed coordinates are shown in Table A-1. Chemical testing is discussed in Section 5. Analytical methods and QA/QC information are discussed in the QAPP Addendum. The proposed locations may change based on field conditions (e.g., presence of riprap, accessibility based on existing structures, and lack of sufficient water depth).

The subsurface sediment sampling protocols used in this investigation are generally consistent with the protocols in the EPA-approved DGWP (Anchor QEA 2019), the *Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling Subsurface Sediment Coring Field Sampling Plan* (AECOM and Geosyntec 2018a).

3.3.2 Subsurface Sediment Collection Methods

Subsurface sediment samples will be collected using vibratory core sampling (vibracore) methods or sonic drilling methods where deeper coring technology is required to determine the DOC. Sampling locations will be located using a differential global positioning system (DGPS) and the proposed sampling location coordinates are provided in Table A-1. Prior to collecting each core, the depth to mudline will be determined using a calibrated fathometer or lead line.

3.3.2.1 Vibratory Core Sampling

Subsurface sediment with DOC expected to be approximately 21 feet (assuming a minimum target 70% recovery on 30-foot penetration) or shallower, based on review of existing subsurface sediment data, will be collected via vibracore in 3.75-inch-inside-diameter aluminum core tubes with a stainless-steel core catcher riveted to the bottom end. Core tubes will be decontaminated prior to use following the protocols outlined in Section 4.3. Care will be taken during sampling to avoid contact of the core tube with potentially contaminated surfaces. Extra core tubes will be available during sampling operations for uninterrupted sampling in the event of a potential core tube breakage or contamination. Core tubes suspected to have been accidentally contaminated will not be used.

The vibracore will be deployed from the vessel using a hydraulic boom and winch assembly. A 30-foot decontaminated aluminum pipe will be clamped to the vibracore. Once in position, the vibracore unit will be deployed, energized, and driven to a maximum of 30 feet below mudline (bml) or refusal. The physical characteristics at each proposed sampling location are anticipated to be variable precluding an accurate estimation of the core recovery at each location prior to collection. Once a penetration of 30 feet bml or refusal occurs, the vibracore will be turned off and returned to the surface for comparison to the sample acceptability criteria. The location of refusal will be recorded using a DGPS for future reference. The penetration depth will be evaluated based on data from the vessel’s onboard penetration monitoring system. Upon retrieving a core, the following information will be recorded:

- Date and time the core was collected
- Depth to mudline
- Total drive length
- Recovered length
- Overlying water is present, and the core surface is intact
- Core tube is in good condition and not excessively bent
- Preliminary assessment of sediment characteristics contained in the core catcher at the bottom of the tube
- Project name, location, and sampling date on an appropriately labeled photograph

To determine if a core is suitable for processing, the following acceptability criteria will be used:

1. Recovery was at least 70% of the length of core penetration. EPA approved a target core recovery of 70% in the DGWP (Anchor QEA 2019 based on an assessment of historical data collected within the Interim Project Area. If refusal or poor recovery is consistently encountered during coring that impacts the ability to identify the DOC, the sample collection methodology for a given location will be revised to sonic drilling methods discussed in Section 3.3.2.2.

2. Cored material did not extend out the top of the core tube or contact any part of the sampling apparatus at the top of the core tube.
3. There were no obstructions noted in the core catcher that might have blocked the subsequent entry of sediment into the core tube and resulted in incomplete core collection.

Core tubes longer than 4 feet will be cut to facilitate upright storage and truck transport to the processing location. The cut tubes will be individually labeled and sealed with core caps taped over with duct tape to prevent material loss during transport. Core orientation will also be noted on each tube. Labels identifying the core section will also be securely attached to the outside of the tube using tape and waterproof ink or by scribing the information into the core tube with a metal screwdriver. The core sections will be stored upright in the core storage box on the boat until transferred to the uplands core processing area. Ice will be added to the core storage box on the boat if the core sections are kept on the boat for extended periods (e.g., not transferred in the middle of the day and at the end of each day). At the uplands core processing area, the core sections will be stored approximately upright in iced containers, or in a refrigeration unit, in the appropriate orientation until core processing is conducted. If multiple core rejections (three attempts) occur within a 20-foot radius of the planned location, the core with the best recovery will be processed if it is determined that the recovered sample depth was sufficient to potentially delineate DOC and there are no visual or olfactory signs of contamination in the deepest recovered 1-foot sample interval. If moving a core location (location X) due to refusal, low recovery, or obstruction results in that location being collected within 50 feet of another proposed core location (location Y), then the second proposed location (location Y) may not be collected. In some of the proposed nearshore locations, the cores may need to be relocated further channelward if riprap is encountered on the mudline that prevents adequate core recovery.

3.3.2.2 Sonic Core Sampling

For locations with DOC expected to be deeper than 21 feet, based on review of existing subsurface sediment data, cores will be collected using a barge-mounted sonic drill rig and drill methods in general accordance with ASTM D6914. Sonic cores will start at the mudline with a 3.875-inch inside-diameter core sampler. The sonic core barrel sampler will be advanced into the mudline, thereby forcing the soil into the inside of the sampler’s disposable, single-use plastic liner. The sampler will then be withdrawn to retrieve the liner and the sediment sample, and the liner will be cut lengthwise to remove the sediment sample.

3.3.3 Subsurface Sediment Core Logging and Processing Procedures

Vibracore and sonic sample processing will occur on the barge or on the Gasco property at the field facility along the central portion of the property near the top of the riverbank area. Core processing occurred at the field facility during completion of the *Final Project Area Identification Report and Data*

Gaps Quality Assurance Project Plan (Anchor QEA 2010) and DGWP (Anchor QEA 2019). Cores will be cut open horizontally on a table and logged.

The following is a detailed account of the core processing procedures:

- Lay out the core tubes for the entire penetration depth for a sampling location. For the vibratory core samples, cut the core tubes longitudinally using a circular saw, setting the saw blade depth to minimize penetration and disturbance of the sediment during cutting. For the sonic core samples, lay out the sample bags horizontally for each run at a boring location. Cut the bags longitudinally using scissors to minimize penetration and disturbance of the soil during cutting.
- Visually assess for the presence of PTW-NAPL using the site-specific definition provided in Section 3.1. Depressions will be made in the sediment using a melon baller to evaluate for the presence of liquid NAPL that is also mobile (i.e., oozes or drips out of the sample during processing).
- Record the description of the full length of the core sample on the core log form, including but not limited to the following observations, as appropriate:
    - Sample recovery (recovered sediment depth relative to penetration depth and percent compaction)
    - Physical soil description in accordance with USCS (includes soil type, density/consistency, color, and other similar descriptors)
    - Presence of PTW-NAPL and other signs of petroleum contamination (e.g., sheens)
    - Presence of substantial product (e.g., tar or black bands of product) that does not meet the site-specific definition of PTW-NAPL
    - Odor (e.g., hydrogen sulfide, petroleum)
    - Presence of organic material (e.g., vegetation, roots, and twigs)
    - Anthropogenic debris
    - Biological activity (e.g., shells, tubes, bioturbation, or organisms)
    - Any other distinguishing characteristics or features
- As discussed in detail in Section 5.1, sample intervals will be determined in the field based on visual and olfactory signs of contamination and characteristics of the vertically unbounded cores (e.g., thickness of previously sampled intervals).
- Take digital photographs of each 1-foot core interval with a label indicating the location and depth of the core interval.
- Using a decontaminated stainless-steel spoon, place a proportionate volume of sediment from the identified sample interval(s) into a single cleaned stainless-steel bowl or high-density polyethylene (HDPE) bucket and homogenize until uniform color and texture is achieved.
- Using a decontaminated stainless-steel spoon, fill pre-labeled, laboratory-provided sample containers for all proposed analyses. Some portion of the remaining volume following filling

of the sample containers will be placed into additional laboratory-provided sample containers for potential future analysis (e.g., treatability testing).

- Immediately place filled and sealed sample containers in a cooler with ice to maintain temperature at approximately 4°C until delivered to the project laboratory, while following the handling and chain-of-custody procedures described in Section 4.2.3. The required sample volumes, preservation, and maximum holding times for the categories of analytes are presented in the QAPP Addendum.

3.4 Horizontal Positioning and Vertical Control

Horizontal positioning at each sampling location will be determined using a DGPS with a handheld GPS unit as backup if necessary. All vertical geographical coordinates will be relative to the City of Portland datum (COP), and horizontal geographical coordinates will be in the North American Datum of 1983 (NAD83) High Accuracy Reference Network 91 (HARN91), Oregon State Plane, North Zone, in international feet.

Mudline elevations of each sediment sampling location will be determined relative to COP by measuring the water depth with a calibrated fathometer or lead line and subtracting the tidal elevation. River elevations will be determined using the on-site river gauge transducer installed on the Gasco dock.

The top of riverbank angled sonic boring ground surface elevations are expected to be the same elevations as recorded in 2019 given the same locations will be reoccupied and no ground surface alterations have occurred at the boring locations since 2019.

3.5 Field Quality Assurance/Quality Control Samples

Field QA/QC samples will be collected and used to evaluate the variability resulting from sample handling and the efficiency of field decontamination procedures (Section 4.3). All field QC samples will be documented in the Site log book.

3.5.1 Field Duplicates

Field duplicates (i.e., homogenization duplicates) will be collected at a frequency of one per 20 samples. The field duplicates will be prepared by dividing aliquots of the homogenate (during core processing and/or field collection) into two distinct samples for the laboratory (the original sample and a duplicate). The samples will be processed in the same way as the original sample and will be submitted to the laboratory as blind samples. The duplicate samples will be analyzed for the full suite of bulk sediment and soil testing listed in the QAPP Addendum. Field duplicate sample identification procedures are described in Section 3.5.

3.5.2 Field Blanks

Field blank samples will be collected to evaluate the efficiency of field decontamination procedures. One rinsate blank and one field blank will be collected weekly for each type of sampling technique used. The rinsate blank will consist of rinsing down the sediment coring and homogenization equipment after sample collection and decontamination and collecting the rinsate. The field blank will be collected by pouring distilled water directly in the sampling containers. The field blank samples will be analyzed for all chemicals within a given sampling program. Rinsate blank and field duplicate sample identification procedures are described in Section 3.5.

3.6 Location and Sample Identification

Each discrete sediment sample will be assigned a unique alphanumeric identifier according to the method described in this section. The identifiers facilitate sample tracking by incorporating identifying information. The alphanumeric identifiers will be assigned for sediments as described in Sections 3.5.1 and 3.5.2.

3.6.1 Sample Identification

The alphanumeric identifiers will be assigned in the following manner for surface sediment grab samples:

- The first three characters for the in-water locations identify the sample location by the project descriptor: PDI = Pre-design Investigation.
- The next three characters identify the sample location: 001 = Location 001.
- The next two to three characters identify the sampling matrix:
  - RAB = Riverbank Angled Boring
  - SC = Sediment Core
  - SB = Sonic Boring
- The next two to four characters identify the subsurface sampling interval in feet below ground surface.
- The next six characters identify the collection date: YYMMDD.

Example:

> Sample number PDI-180SB-19-20-230304 indicates a sonic boring sample obtained from Location 180 and collected from a depth of 19 to 20 feet bml on March 4, 2023.

The sampling depth intervals will also be noted in the field logs and provided in the chemical analytical results tables.

3.6.2 Field Quality Assurance/Quality Control Sample Identification

The field QA/QC samples will be assigned a unique alphanumeric identifier according to the following method:

- The first three characters identify the sample location by using the first letter of each word in the location name: PDI = Pre-Design Investigation
- The rinsate blank samples will be followed with an -RB and a two-letter identifier for the sample collection technique (SC for sediment core, SB for sonic boring, and AB for riverbank angled boring) followed by the date in YYMMDD format.
- The field blank samples will be followed with an –FB (SC for sediment core, SB for sonic boring, and AB for riverbank angled boring) followed by the date in YYMMDD format.
- The homogenization duplicate will be followed with –XXXSC-YYMMDD (subsurface sediments) where XXX is the location number plus 1000 and YYMMDD is the sampling date.

For example, sample number PDI-RB(FB)SC-230610 and PDI-1001SC-230610 represent a sediment core rinsate blank (field blank) collected on June 10, 2023, and a homogenization duplicate collected from sediment core sample Location 001 on June 10, 2023, respectively.

4 Field Documentation, Sample Handling, Decontamination Procedures, and Investigation-Derived Waste Management

Consistent methods of field documentation, sample handling, equipment decontamination, and investigation-derived waste (IDW) management will be used throughout the program.

4.1 Field Documentation

A complete record of all field activities will be maintained, including the following:

- Documentation of all field activities in field log books
- Documentation of all samples collected for analysis

The field staff will maintain the field log books, which will consist of bound, numbered pages. All on-site activities, including health and safety entries, and field observations will be documented in these log books. All entries will be made in indelible ink. The field log books are intended to provide sufficient data and observations to enable readers to reconstruct events that occurred during the sampling period. The field log books will include clear information concerning any modifications to the details and procedures identified in this FSP Addendum. Sediment core and riverbank angled boring log sheets will be completed for each sampling location (sample log sheets are presented in Attachment A).

Logs and field notes of all samples will be maintained as samples are collected and correlated to the sampling location map. The following information will be included as part of this documentation:

- Percent recovery and factors used to determine the recovery
- Coordinates of each location as determined by DGPS
- Date and time of collection of each sample
- Names of field supervisor and personnel collecting and logging in the sample
- Observations made during sample collection, including presence of PTW-NAPL per the site-specific definition provided in Section 3.1, weather conditions, complications, ship traffic, and other details associated with the sampling effort
- Sample location number
- Length and depth intervals of each core/boring section
- Qualitative notation of apparent resistance of sediment/soil column when coring/boring
- Any deviation from the approved DOC Memorandum and FSP Addendum

4.2 Sample Handling

This section describes the sample containers, sample handling and storage, chain-of-custody forms, and sample shipping for all sediment sampling activities.

4.2.1 Sample Containers for Analysis

All sample containers received from the analytical laboratory will be pre-cleaned and certified. Prior to shipping, the analytical laboratory will add preservative, where required. Sample container types are listed in Table A-3.

Prior to filling, each container will be clearly labeled with the name of the project, sample number, type of analysis, date, time, and initials of the person preparing the sample.

4.2.2 General Sample Handling and Storage

The guidelines for sample handling and storage for collected samples are provided in Table A-2. Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with environmental media must meet high standards of cleanliness. All equipment and instruments used to remove sediment from the sampler will be made of glass, stainless steel, or polytetrafluoroethylene (PTFE) and will be decontaminated prior to each day's use and between sampling or homogenization events.

All working surfaces and instruments will be thoroughly cleaned, decontaminated (following the protocols in Section 4.3), and covered with tinfoil to minimize outside contamination between sampling events. Disposable gloves will be discarded after processing each location and replaced prior to handling decontaminated instruments or work surfaces. Sample containers will be kept in packaging as received from the analytical laboratory until use; a sample container will be withdrawn only when a sample is to be collected and returned to a cooler containing completed samples.

4.2.3 Sample Transport and Chain-of-Custody Procedures

All containerized samples will be delivered to the designated analytical laboratories by courier after preparation is completed. Specific sample shipping procedures will be as follows:

- The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
- Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
- Glass jars will be separated in the shipping container by shock absorbent material (e.g., bubble wrap) to prevent breakage.
- Ice (in separate, sealed plastic bags) will be placed in the cooler to maintain a storage temperature of approximately 4°C.
- A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- The cooler lids will be secured by wrapping the coolers in strapping tape.

- Signed and dated chain-of-custody seals will be placed on all coolers prior to shipping.
- Each cooler or container containing the sediment and soil samples for analysis will be picked up at the Gasco facility by courier daily.

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the shipping container seal will be broken, and the receiver will record the temperature and condition of the samples and cross-check the sample inventory with the chain-of-custody form. Chain-of-custody forms will be used internally in the laboratory to track sample handling and final disposition.

4.3 Field Equipment Decontamination

To prevent sample cross contamination, sampling and processing equipment in contact with the environmental media will undergo the following decontamination procedures prior to and between collection activities in accordance with EPA protocols (EPA 2001). Between samples, all sampling equipment that will come in contact with the sample media will be decontaminated prior to use by the following procedures:

- Rinse with river water and wash with a scrub brush until free of sediment.
- Wash with phosphate-free detergent (e.g., Alconox).
- Visually inspect the sampler and repeat the rinse and scrub step, if necessary. If scrubbing and rinsing with Alconox is insufficient to remove visually observable tar/oil-related contamination on sampling equipment, the equipment will be scrubbed and rinsed using acetone (or similar type solution) until all visual signs of contamination are absent.
- Rinse with deionized water three times.

All sample homogenizing equipment (e.g., spoons and bowls) will be decontaminated prior to and between processing cores/borings at each location using the same procedures detailed in this section.

4.4 Management of Investigation-Derived Waste and Surface Water Sheens

Information regarding the management of IDW and incidental surface water sheens produced during sampling are detailed in Sections 4.4.1 and 4.4.2.

4.4.1 Management of Investigation-Derived Waste

IDW, including excess sediments remaining following chemical and physical subsampling, purge water, fluids used for decontamination of sampling equipment, and disposable wastes (e.g., gloves, paper towels, and foil) will be placed into appropriate containers and staged on-site for disposal.

Consistent with the *Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling Surface Sediment Field Sampling Plan* (AECOM and Geosyntec 2018b), excess surface sediments will not be IDW and returned to the river at the approximate sampling location if the sediments do not contain visible sheens or PTW-NAPL.

Sediments and soil remaining after collection and processing will be placed into sealable containers (55-gallon open-top drums). Disposable wastes will be placed into two heavy-duty plastic bags (i.e., double-bagged). All solid waste will be disposed off site at an appropriate Resource Conservation and Recovery Act (RCRA)-permitted solid waste disposal facility.

Per the current IDW Management Plan (HAI 2008) for the Site and follow-up communication from DEQ (DEQ 2010), sediment and soil IDW will be characterized by collecting and analyzing one five-part composite sample per drop box and one composite sample per every five to ten 55-gallon drums. Samples will be tested for the following Site contaminants of concern (COCs) and whether the waste is characteristically hazardous (ignitable, reactive, or corrosive):

- Free liquids
- Volatile organic compounds (VOCs)
- Diesel- and oil-range hydrocarbons
- Gasoline-range hydrocarbons
- RCRA eight metals (total)
- Total cyanide
- PAHs
- Ignitability
- Corrosivity

All sediment and soil IDW will be screened to determine suitable waste disposal options. In addition, sediment and soil IDW generated will be screened against F002 Threshold Screening Values, DEQ's most current risk-based concentrations (RBCs) for human health occupational exposure pathway for F002-related constituents, in order to determine whether the waste will need to be handled as an F002-listed RCRA (Pearl Legal Group 2018). The IDW Management Plan (HAI 2008) identifies the following chemicals as F002-related constituents:

- Trichloroethene (TCE)
- Cis-1,2-dichloroethene
- Trans-1,2-dichloroethene
- 1,1-dichloroethene
- Vinyl chloride

After laboratory results have been compiled and screened as required, NW Natural will prepare a letter of intent to dispose IDW, which will be submitted to DEQ for review. The request to DEQ will include laboratory testing results, screening results, and the proposed final disposition of the waste. Upon DEQ approval of the proposed final waste disposition, a waste profile will be submitted to the selected disposal facility requesting acceptance of the waste for the disposal. Upon acceptance by the disposal facility, waste will be transported from the site to the facility by a selected licensed contractor.

The decontamination fluids and other water generated during the investigation will be stored in sealable containers and disposed on site at the Siltronic pretreatment facility, which is part of the Gasco Groundwater Treatment System.

4.4.2 Management of Surface Water Sheens

There is potential for surface water sheens to develop while implementing the Data Gaps Investigation sampling. Sheens observed may be the result of natural processes or investigation methods. To ensure that any sheen observed is managed appropriately, the following protocols will be followed:

- Sheens resulting from the disturbance of sediments during the Data Gaps Investigation will be handled using the following procedures:
  - Sorbent booms will be deployed to capture any significant sheen observed on the water surface during subsurface core collection.
  - If necessary, the sorbent booms will be deployed/managed by a small support vessel to allow the sampling vessel to operate without interruption.
  - Depending on the size of the sheen observed, the National Response Center (800-424-8802) will be contacted to advise on additional mitigation measures and appropriate agency notifications, if necessary. The EPA project manager will also be notified under this scenario.

5 Chemical and Physical Testing

This section summarizes the target physical and chemical analyses for the various media sampled. Sample analyses will be conducted in accordance with EPA-approved methods (where available) and the QAPP Addendum. Prior to analysis, all samples will be maintained according to the appropriate holding times and temperatures for each analysis (Table A-2). Chemical and physical testing analytes are summarized in Table A-1. The methods for each of the chemical and physical analyses are described in the QAPP Addendum.

Prior to the chemical analysis of the samples, the laboratories will calculate method detection limits for each analyte of interest, where applicable. Method detection limits will be below the values specified in the QAPP Addendum if technically feasible. To achieve the required detection limits, some modifications to the specified analytical methods may be necessary. These modifications will be provided by the laboratories at the time of establishing the laboratory contract.

Sediment and soil chemical and physical testing will be conducted at Apex Laboratories in Tigard, Oregon. Samples submitted for comprehensive hydrocarbon analysis [including alkylated PAHs and total petroleum hydrocarbons (TPH) at select sampling intervals based on visual observations[2]] will be submitted to Analytical Resources, LLC (ARL) in Tukwila, Washington. Dioxin/furan analyses will be performed by Enthalpy in El Dorado Hills, California. Apex Laboratories, ARL, and Enthalpy are accredited under the National Environmental Laboratories Accreditation Program. Geotechnical index parameter analyses will be performed by GeoTesting Express in Acton, Massachusetts. All chemical and physical testing will adhere to SW-846 QA/QC procedures and analysis protocols (EPA 1986, 1992, 1993, 1994, 1995) or follow the appropriate ASTM or standard method. All the analytical laboratories will prepare detailed reports in accordance with the QAPP Addendum.

Sediment and soil samples will be submitted for a variety of tests prepared by different methods including bulk chemistry, physical parameters, and geotechnical parameters. Section 5.1 discusses the testing for riverbank angled borings and subsurface sediment samples in more detail. Analytical methods and QA/QC requirements are discussed in the QAPP Addendum.

Note that polychlorinated biphenyl (PCB) Aroclors will be analyzed for all DOC subsurface samples.

5.1 Riverbank Angled Boring Soil and Subsurface Sediment Sampling

As discussed in Section 3.4.1 of the DGWP (Anchor QEA 2019) and consistent with Section 5.1.2 of the EPA *Remedial Design Guidelines and Considerations—Portland Harbor Superfund Site, Portland, Oregon* (RDGC; EPA 2021), the DOC will be determined by identifying the bottom depth/elevation of subsurface sediments containing *Record of Decision – Portland Harbor Superfund Site, Portland,*

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[2] The deepest interval containing visual or olfactory signs of contamination will be analyzed for alkylated PAHs and TPH. All shallower intervals that are triggered for analyses, if needed to define DOC, will be analyzed for alkylated PAHs and TPH.

Oregon (ROD; EPA 2017) Table 21 RAL exceedances and PTW, with two consecutive underlying 1-foot sampling intervals containing no RAL exceedances or PTW. To make this determination, the following tiered sampling approach will be employed:

- **At Vertically Unbounded Locations Previously Sampled in Consecutive 1-Foot Intervals[3] and Vertically Bounded Locations Without Two Consecutive 1-Foot Intervals (see Table 1 of the DOC Memorandum):**
  - **Step 1:** Initially, trigger laboratory analysis for chemicals containing ROD Table 21 RAL and PTW thresholds for the following two scenarios:
    - **Scenario 1 (signs of contamination deeper than the existing vertically unbounded/bounded DOC):** The deepest 1-foot interval (measured in whole 1-foot intervals below the mudline, such as 12 to 13 feet bml) that contains visual or olfactory signs of contamination in the core/boring that is deeper than the existing vertically unbounded DOC and the immediately underlying three consecutive 1-foot intervals containing no visual or olfactory signs of contamination (such as 13 to 14 feet, 14 to 15 feet, and 15 to 16 feet bml). If either of the shallower 1-foot intervals contain exceedances and the deepest two intervals do not, the DOC will be identified as the bottom depth of the exceedance interval.
    - **Scenario 2 (no signs of contamination deeper than the existing vertically unbounded/bounded DOC):** If there are no signs of visual or olfactory signs of contamination deeper than the existing vertically unbounded/bounded DOC, sampling will begin at the next whole 1-foot interval deeper than the existing vertically unbounded/bounded DOC such that none of the previously sampled intervals are resampled. A minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. For example, if a historical core is vertically unbounded at 10 feet bml and there are no visual or olfactory signs of contamination deeper than 10 feet bml in the newly collected core/boring, the shallowest sample interval will be 10 to 11 feet with the next two consecutive 1-foot intervals being 11 to 12 feet and 12 to 13 feet.

    If there are no RAL exceedances or PTW in the newly sampled Step 1 intervals, the DOC will be set at the existing vertically unbounded/bounded DOC as the location now meets EPA's RDGC (EPA 2021) criteria for vertical bounding (i.e., two consecutive 1-foot intervals without a RAL exceedance or PTW). This approach eliminates the potential for performing chemical analyses at depths shallower than the existing reported vertically unbounded DOC in an area.

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[3] At each of these unbounded locations, there is a RAL exceedance and/or PTW in the deepest sampled 1-foot interval.

  - **Step 2:** Following Step 1, trigger additional laboratory analysis, as needed, for chemicals containing ROD Table 21 RAL and PTW thresholds (move to either Step 2a or Step 2b, depending on the results of Step 1):
    - **Step 2a:** Step 2a procedures are dependent on the two scenarios identified in Step 1. This approach eliminates the potential for performing chemical analyses at depths that are shallower than the existing reported vertically unbounded DOC in an area.
      - **Scenario 1 (signs of contamination deeper than the existing vertically unbounded/bounded DOC):** If none of the submitted Step 1/Scenario 1 intervals contain RAL exceedances or PTW, a minimum of two overlying consecutive 1-foot intervals will be triggered for chemical analyses depending on the visual and olfactory characteristics of these depth intervals. This will continue until either: 1) the first overlying depth interval containing RAL or PTW threshold exceedances is encountered, and the DOC will be identified as the bottom depth of the deepest exceedance interval; or 2) the existing vertically unbounded/bounded DOC is encountered, and the DOC will be identified as the existing vertically unbounded DOC as the location would then meet the RDGC (EPA 2021) criteria for vertical bounding.
      - **Scenario 2 (no signs of contamination deeper than the existing vertically unbounded/bounded DOC):** If none of the submitted Step 1/Scenario 2 intervals contain RAL exceedances or PTW, the DOC will be identified as the existing vertically unbounded/bounded DOC as the location would then meet the RDGC (EPA 2021) criteria for vertical bounding.

    OR

    - **Step 2b (the Step 2b approach is the same regardless of scenario):** If either of the deepest two Step 1 intervals contain RAL or PTW threshold exceedances, a minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. This process will be repeated until two consecutive depth intervals do not contain RAL or PTW threshold exceedances. The DOC will be identified as the bottom depth of the deepest exceedance interval.
- **At Vertically Unbounded Locations with Greater Than 1-Foot-Thick Sample Intervals (see Table 1 of the DOC Memorandum)**
  - Same as the procedures described above for vertically unbounded locations with consecutive 1-foot intervals, except the initial Step 1/Scenario 2 triggers for laboratory chemical analysis would begin at the deeper of the following:

  - **Step 1, Scenario 2 (no signs of contamination deeper than the existing vertically unbounded DOC):** If there are no visual or olfactory signs of contamination deeper than or within the deepest existing vertically unbounded DOC interval that is greater than 1 foot thick, then sampling will begin at the shallowest 1-foot interval within the deepest previously sampled interval from the existing vertically unbounded core. A minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. For example, if an existing location is vertically unbounded based on a sample interval from 23 to 27 feet and there are no visual or olfactory signs of contamination deeper than 23 feet, the initial triggers would start at the 23- to 24-foot interval and then include, at a minimum, 24 to 25 feet and 25 to 26 feet.
- **At Vertically Unbounded Riverbank Angled Boring Locations (see Table 1 of the DOC Memorandum)**
  - **Step 1:** Initially, trigger laboratory analysis for chemicals containing ROD Table 21 RAL and PTW thresholds initiating at the deepest 1-foot interval that contains visual or olfactory signs of contamination, regardless of the existing vertically unbounded DOC, and the immediately underlying three consecutive 1-foot intervals containing no visual or olfactory signs of contamination (such as 13 to 14 feet, 14 to 15 feet, and 15 to 16 feet below mudline). If either of the shallower 1-foot intervals contain exceedances and the deepest two intervals do not, the DOC will be identified as the bottom depth of the exceedance interval. Then move either to Step 2a or Step 2b, depending on the results of Step 1.
  - **Step 2a:** If none of the submitted Step 1 intervals contain RAL exceedances or PTW, a minimum of two overlying consecutive 1-foot intervals will be triggered for chemical analyses depending on the visual and olfactory characteristics of these depth intervals. This will continue until the first overlying depth interval containing RAL or PTW threshold exceedances is encountered, and the DOC will be identified as the bottom depth of the deepest exceedance interval.

    OR

  - **Step 2b:** If either of the deepest two Step 1 intervals contain RAL or PTW threshold exceedances, a minimum of two additional deeper, consecutive 1-foot intervals will be triggered for analyses. This process will be repeated until two consecutive depth intervals do not contain RAL or PTW threshold exceedances. The DOC will be identified as the bottom depth of the deepest exceedance interval.

- **At Vertically Unbounded Locations with Historical Geoprobe Borings (see Table 1 of the DOC Memorandum):**
    - **Initial Visual and Olfactory Assessment:** Inspect the sonic core to determine the location of any visual or olfactory signs of contamination. If there are visual or olfactory signs of contamination within or deeper than the previous DOC (i.e., within the 35.1- to 36.1-foot depth interval at GP25, the 23.3- to 24.3-foot depth interval at GP26, and the 32.4- to 33.4-foot depth interval at GP28), these locations will be treated as vertically unbounded locations previously sampled in consecutive 1-foot intervals,[4] and sample analysis will proceed as detailed in "At Vertically Unbounded Locations Previously Sampled in Consecutive 1-Foot Intervals" (see above). If there are no visual or olfactory signs of contamination within or deeper than the historical DOC, the historical DOC sample depth interval will be analyzed to confirm the concentrations at that interval (i.e., 35.1- to 36.1-foot depth interval at GP25, the 23.3- to 24.3-foot depth interval at GP26, and the 32.4- to 33.4-foot depth interval at GP28; see Table 2 of the DOC Memorandum), and the following additional stepwise sample analysis will proceed as depicted in Figure 4 of the DOC Memorandum:
        - **Step 1:** Initially, trigger laboratory analysis for chemicals containing ROD Table 21 RAL and PTW thresholds initiating at the deepest 1-foot depth interval that contains visual or olfactory signs of contamination, regardless of the existing vertically unbounded DOC,[5] and the immediately underlying three consecutive 1-foot depth intervals containing no visual or olfactory signs of contamination (such as 13 to 14 feet, 14 to 15 feet, and 15 to 16 feet bml). If either of the shallower 1-foot depth intervals contain exceedances and the deepest two depth intervals do not, the DOC will be identified as the bottom depth of the exceedance interval. Then move either to Step 2a or Step 2b, depending on the results of Step 1.
        - **Step 2a:** If none of the submitted Step 1 intervals contain RAL exceedances or PTW, a minimum of two overlying (shallower) consecutive 1-foot intervals will be triggered for chemical analyses depending on the visual and olfactory characteristics of these depth intervals. This will continue until the first overlying depth interval containing RAL or PTW threshold exceedances is encountered, and the DOC will be identified as the bottom depth of the deepest exceedance interval.

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[4] If there are visual or olfactory signs of contamination at, or deeper than, the historical DOC to be confirmed, there is no identified data use associated with sampling intervals shallower than the historical DOC.

[5] The existing Geoprobe data may not accurately represent the subsurface contamination profile due to the multiple lines of evidence issues discussed above. Similarly, the newly proposed riverbank angled borings will be advanced at a steeper angle than previous, so the material encountered will be different from what was previously encountered during the 2019 pre-remedial design data gaps investigation.

OR

- **Step 2b:** If either of the deepest two Step 1 depth intervals contain RAL or PTW threshold exceedances, a minimum of two additional deeper, consecutive 1-foot depth intervals will be triggered for analyses. This process will be repeated until two consecutive depth intervals do not contain RAL or PTW threshold exceedances. The DOC will be identified as the bottom depth of the deepest exceedance interval.

This stepwise chemical analysis approach will be completed using unvalidated data to decrease the amount of time it will take to identify the DOC; however, the final DOC will be determined using final, validated data. Each submitted riverbank angled boring soil and subsurface sediment sample will be analyzed for the following analyses:

- ROD Table 21 COCs with RALs and PTW thresholds except for chlorobenzene, consistent with EPA's approval of the DGWP (Anchor QEA 2019).
- TOC and TS
- Geotechnical index parameter testing (see Section 5.1.1)

5.1.1 Geotechnical Index Parameter Testing

Representative subsurface sediment and riverbank angled boring soil homogenized samples will be submitted for laboratory testing of geotechnical index parameters. The density and sampling depth intervals within each core will be made after reviewing the subsurface stratigraphy interpretations so that test results are representative and comprehensive over the range of major stratigraphic units encountered in the DOC sampling intervals (and potentially shallower intervals if there is no existing geotechnical data and it is deemed necessary to support remedial design).

Triggered samples will be tested for the following geotechnical index parameter tests:

- Grain size distribution (ASTM D6913 and D7928)
- Moisture content (ASTM D2216)
- Atterberg limits (ASTM D4318)
- Specific gravity (ASTM D854)

6 Field Sampling Schedule

The Data Gaps Investigation sampling program is projected to begin as soon as possible after EPA approval of the DOC Memorandum. The field sampling program is expected to be completed within 20 working days. The actual start and end dates for the sampling event will depend on EPA approval of the project plans and coordination with subcontractors. Other conditions that may affect the sampling schedule are weather, contractor availability, and equipment availability.

7 References

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HAI (Hahn and Associates, Inc.), 2008. *Investigation-Derived Waste Management, Remedial Investigation—Historical Manufactured Gas Plant Activities, Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon*. February 2008.

Pearl Legal Group, 2018. Letter to: Gary Vrooman, Oregon Department of Justice. Regarding: Gasco Sediments Site (US EPA Region 10 CERCLA Docket No. 10-2009-0255) Request for DEQ Concurrence on Contained-In Criteria. August 3, 2018.

Tables

Table A-1
Subsurface Sediment Sampling Locations

Proposed Location ID	Nearest Historical Vertically Unbounded Core Location ID	Vertically Unbounded DOC at Nearest Historical Core (Feet Below Mudline)	Proposed Location Easting (X)	Proposed Location Northing (Y)	Proposed Coring Technology[1]
PDI-176	PDI-171	13.5	7623282.77	706397.35	Vibracore
PDI-177	PDI-166	11.2	7623442.51	706400.18	Vibracore
PDI-178	PDI-147	14.5	7623374.76	706313.32	Vibracore
PDI-179	C263	12.3	7623145.75	706120.70	Sonic
PDI-180	PDI-086	18.6	7623237.31	706142.93	Sonic
PDI-181	PDI-085	9.9	7623230.29	706049.36	Sonic
	PDI-087	8.9			
PDI-182	PDI-089	10.8	7623330.94	705983.22	Sonic
PDI-183	PDI-090	18.0	7623385.03	706048.70	Sonic
PDI-184	DGS-07	13.4	7623499.32	705913.46	Sonic
PDI-185	PDI-021	15.4	7623821.91	706063.84	Vibracore
PDI-186	PDI-054	11.1	7623752.83	705773.84	Vibracore
PDI-187	GS-05	11.0	7623735.00	705692.00	Vibracore
PDI-188	RAA-17	18.4	7623851.40	705692.04	Vibracore
PDI-189	GS-06	20.9	7623923.20	705594.98	Sonic
PDI-190	RAA-02	14.0	7624052.79	705568.96	Vibracore
PDI-191	GS-07	27.0	7624134.000	705479.00	Sonic
PDI-192	DGS-22	13.3	7624258.40	705482.59	Vibracore
PDI-193	SC-S113	13.0	7624339.80	705645.22	Vibracore
PDI-194	PDI-068	12.3	7624336.63	705445.66	Vibracore
PDI-195	GTC-07	5.4	7624491.74	705586.41	Vibracore
PDI-196	PDI-069	14.3	7624452.36	705416.65	Sonic
PDI-197	GS-09	27.0	7624459.00	705286.00	Sonic
PDI-198	GS-B7	16.5	7624534.00	705407.00	Sonic
PDI-199	C301	16.9	7624555.66	705332.78	Sonic
PDI-200	GP-26	24.3	7624614.95	705318.74	Sonic
PDI-201	GP-25	36.1	7624668.87	705244.95	Sonic
PDI-202	PDI-119	18.3	7624744.14	705312.44	Sonic
PDI-203	GP-28	33.4	7624790.64	705171.26	Sonic
PDI-204	PDI-080	8.8	7624928.96	705096.53	Vibracore
PDI-205	PDI-093	6.6	7625118.55	704965.45	Vibracore
PDI-206	PDI-083	16.0	7625050.31	705043.44	Vibracore
PDI-207	PDI-077	10.0	7624829.76	705245.29	Vibracore
PDI-208	PDI-051	11.0	7623605.33	705868.8	Vibracore
PDI-209	PDI-027	13.0	7624276.47	705622.55	Vibracore
PDI-210	PDI-088	16.0	7623317.42	706113.33	Vibracore
PDI-211	PDI-092	12.0	7623467.87	706006.42	Vibracore
PDI-212	PDI-075	16.0	7624717.95	705250.56	Sonic
PDI-213	PDI-078	9.6	7624863.36	705137.32	Sonic
PDI-214	PDI-075	16	7624725.57	705204.23	Sonic
	GP-25	36.1			
	GP-28	33.4			
PDI-215	GP-26	24.3	7624639.91	705283.8	Sonic
	GP-25	36.1			Sonic

Notes:

1. If DOC is not determined using the deep vibracoring technology, additional efforts will be made at the given location to determine DOC using sonic drilling.

Coordinates are in North American Datum of 1983 (HARN91) Oregon State Plane North, International Feet.

DOC: depth of contamination

Table A-2
Riverbank Angled Boring Locations

Previous Angled Boring Location	Proposed Location ID	Easting (X)	Northing (Y)	Sample Location Entry Angle (Degrees from Vertical)	Proposed Boring Technology
PDI-134	PDI-216	7623179.28	705957.87	20	Sonic
PDI-135	PDI-217	7623382.2	705817.55	20	Sonic
PDI-136	PDI-218	7623574.24	705717.83	20	Sonic
PDI-137	PDI-219	7623823.89	705566.46	20	Sonic
PDI-138	PDI-220	7623983.16	705456.98	20	Sonic
PDI-139	PDI-221	7624129.24	705358.08	20	Sonic
PDI-140	PDI-222	7624281.46	705319.85	20	Sonic
PDI-141	PDI-223	7624413.07	705238.14	20	Sonic
PDI-142	PDI-224	7624637.47	705152.38	20	Sonic
PDI-143	PDI-225	7624833.4	705020.88	20	Sonic
PDI-144	PDI-226	7624993.46	704921.71	20	Sonic

Note:
Coordinates are in North American Datum of 1983 (HARN91) Oregon State Plane North, International Feet.

Table A-3
Sample Handling and Storage

Parameter	Sample Size	Container Size and Type[1]	Holding Time	Sample Preservation Technique	Laboratory
Moisture content	100 g	1 to 4 gallons in zip-top bags	None	None	GTX
Specific gravity	100 g		None	None	
Atterberg limits	100 g		None	None	
Grain size	100 g		None	None	
Total solids	50 g	16 oz glass	None	Cool <6°C	All
Total organic carbon	50 g		28 days	Cool <6°C	Apex
			6 months	Freeze -18°C	
PCB Aroclors, pesticides	200 g	16 oz glass	1 year until extraction	Freeze -18°C	
			40 days after extraction	Cool <6°C	
PAHs and alkylated PAHs, TPH	200 g	8 oz glass	14 days until extraction	Cool <6°C	ARL
			1 year until extraction	Freeze -18°C	
			40 days after extraction	Cool <6°C	
Dioxin/furans	30 g	4 oz glass	1 year to extraction	Freeze -18°C	Enthalpy
			1 year after extraction		

Notes:

1. Container size, type, and sample size required may change based on laboratory guidance.

ARL: Analytical Resources, LLC

g: gram

GTX: Geotesting Express

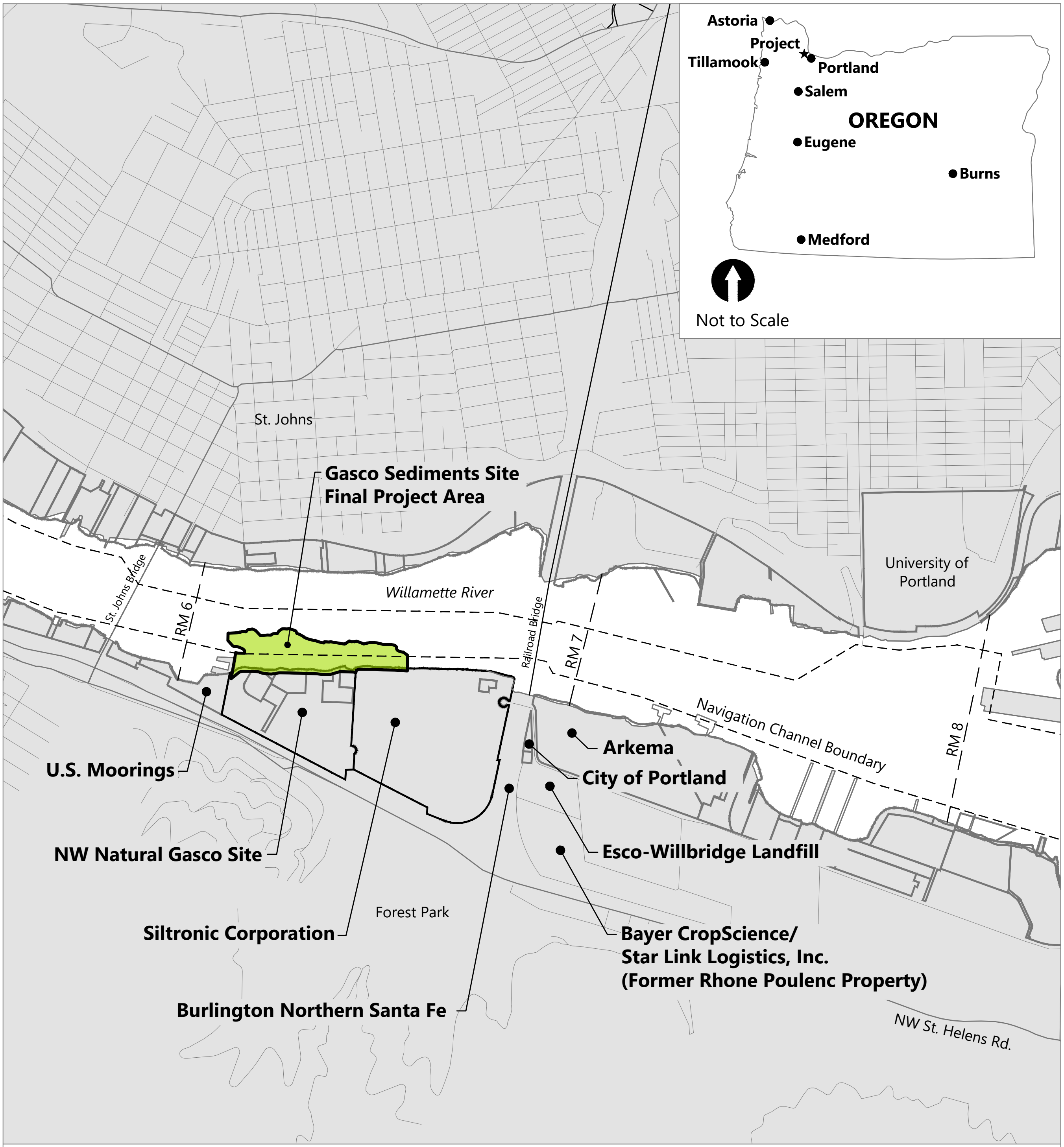
oz: ounce

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

TPH: total petroleum hydrocarbons

Figures



HORIZONTAL DATUM: Oregon State Plane North, North American Datum (NAD83/HARN 91), International Feet.

NOTE: All locations are approximate.

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Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Sediments_Pre-Remedial Design\Pre-RD Data Gaps Field Sampling Plan Addendum\0029-RP-000 (Vicinity Map).dwg Figure A-1

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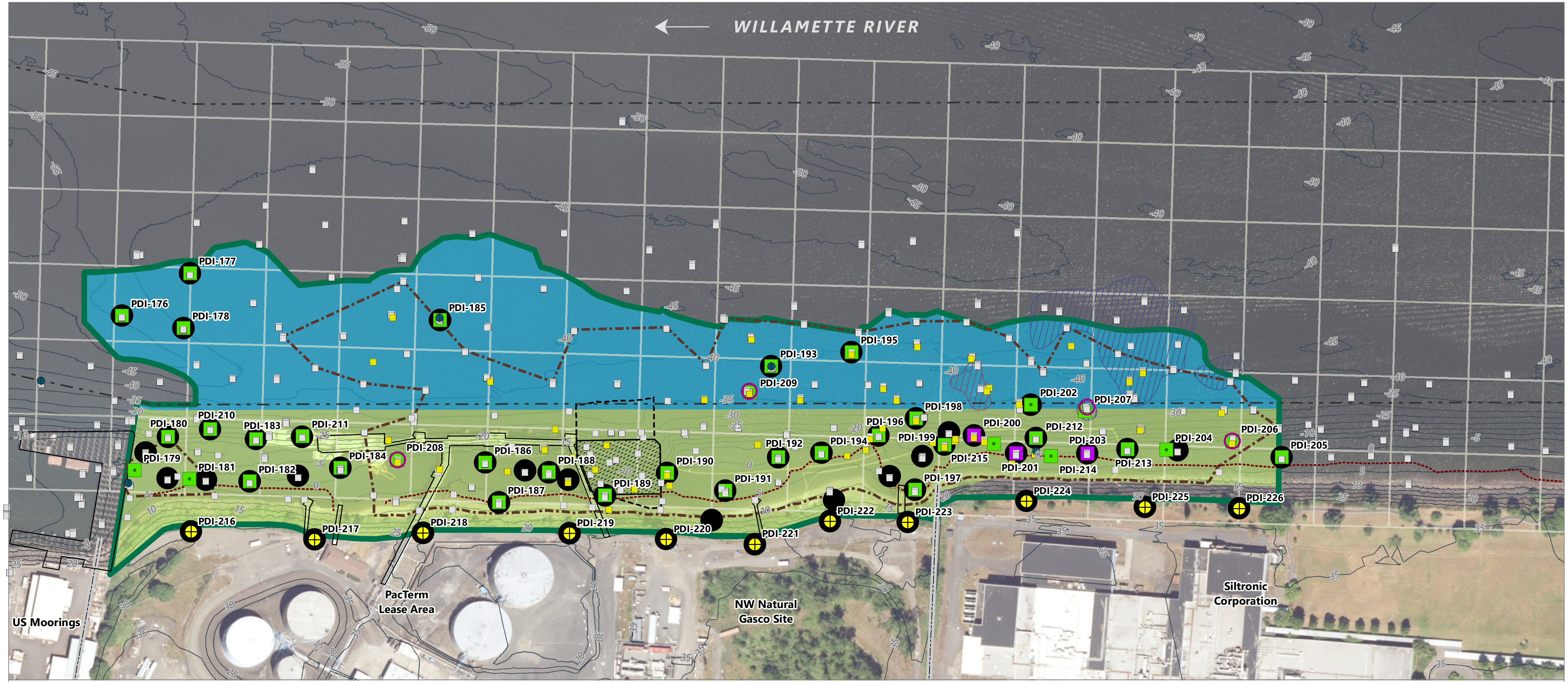
Figure A-1
Vicinity Map

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum
Gasco Sediments Cleanup Action



LEGEND:

- ▬ Gasco Sediments Site Final Project Area
- ⌐ Navigation Channel
- ☐ Structures
- ---- Property Line
- ⌐ Tar Body Removal Action Area (RAPP, Anchor 2005)
- ▦ Tar Body Removal Action Pilot Cap
- ⌐ Refined PTW-NAPL Boundary
- ---- Approximate Riprap Boundary[1]

PAR Selected Design Technology[2]

- 🟦 Dredge to Bottom DOC
- 🟩 ISS to Bottom DOC
- ▨ 2010 Transition Zone Water Vinyl Chloride Area 1 Boundary (Anchor QEA 2012)[3]
- ▨ Area 2 – Detected CVOCs in TZW and One Subsurface Sediment Location[4]
- ● Pre-RD Group Harborwide Monitoring Subsurface Sample Location (AECOM and Geosyntec 2018a)

- 🟨 Existing Cores with Previously Observed PTW-NAPL
- ☐ Existing Subsurface Sample Location
- ● Existing Core/Boring with Vertically Unbounded DOC
- ○ Vertically Bounded By Only One 1-Foot Interval without a RAL exceedance or PTW

- 🟩 Proposed Additional Subsurface Depth of Contamination Cores/Borings
- 🟪 Proposed Subsurface Depth of Contamination Borings for Data Confirmation
- ⊕ Proposed Angled Riverbank Borings

NOTES:

1. Estimated from side scan sonar survey conducted by Blue Water Engineering April 2011.
2. The remedial technologies shown on this figure are consistent with the technologies included in the Full Dredge and ISS Design identified in the Gasco Sediments Site Preferred Alternatives Report.
3. Boundary taken from Draft Engineering Evaluation/Cost Analysis, Appendix A, Figure 4.2. Transition zone water screening level exceedances of cis-1,2-dichloroethene identified within this vinyl chloride boundary.
4. Boundary taken from Gasco Sediments Site Statement of Work, Figure 1 (EPA 2009).
5. Bathymetry surveyed by eTrac 2019. Topography surveyed by Geometrix 2011.
6. Shown grid is in 150-foot by 150-foot dimensions to support remedial design data density determinations.
7. Arrow indicates direction of flow of river.
8. Horizontal datum is NAD83 (HARN 91) Oregon State Plane North, International Feet.
9. Vertical datum is City of Portland (COP), Feet.
10. Aerial imagery from City of Portland 2021.

0 200
Feet

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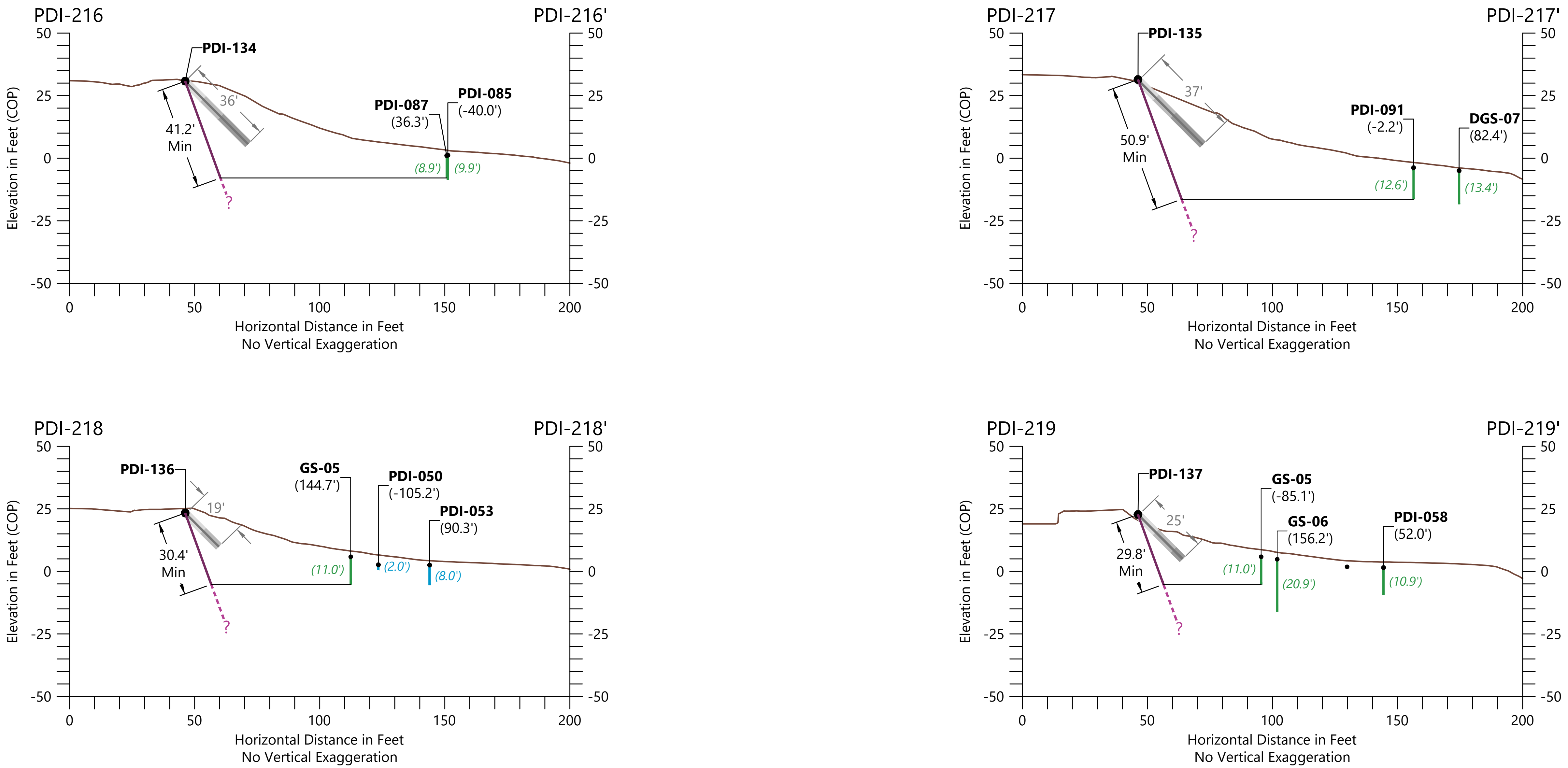
Figure A-2

Proposed Subsurface Depth of Contamination Refinement Cores and Riverbank Angled Borings

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum
Gasco Sediments Cleanup Action



LEGEND:

2019 PDI Sampling

- ●— Riverbank Angled Boring Location
- ▯ 0'-10' Sample Interval
- ▮ 10'-20' Sample Interval
- ▮ 20'-Bottom of Boring Sample Interval

2023 Proposed Sampling

- — Proposed Riverbank Angled Boring Location (sample depths to be determined based on visual and olfactory signs of contamination)
- - - - -? Additional Sample Depth (may be needed to achieve DOC based on visual and olfactory signs of contamination)

- • Nearest In-Water Depth of Contamination Core Location
- (X') | Bounded Depth of Contamination (in feet below mudline)
- (X') | Unbounded Depth of Contamination (in feet below mudline)

- — Existing Mudline
- (5.4') Core Offset Distance From Section Line (in feet)

HORIZONTAL DATUM: Oregon State Plane North Zone, NAD83/HARN 91, International Feet
VERTICAL DATUM: City of Portland (COP)
NOTES:

1. Sampling will be performed as described in Section 5.1 of the *Pre-Remedial Design Data Gaps Field Sampling Plan Addendum.*
2. As discussed in the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum*, sample locations with the naming convention "GPxx" are being resampled to reevaluate the previously reported DOC using a more appropriate technology and procedures. The DOC information at these locations is presented in this figure for informational purposes only.

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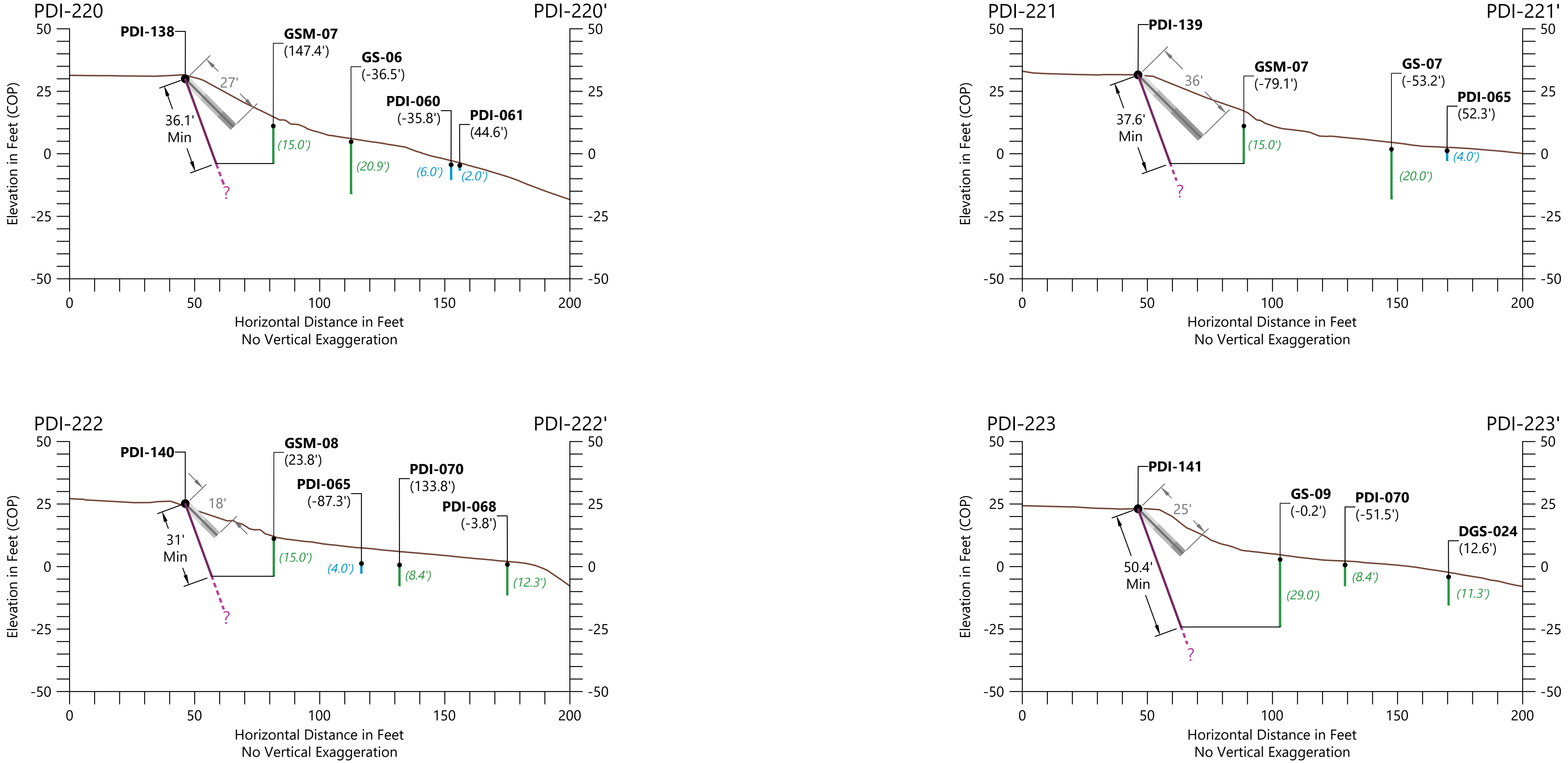
Figure A-3a
Proposed Angled Top of Riverbank Borings – Riverbank Borings PDI-216 - PDI-219

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum
Gasco Sediments Cleanup Action



LEGEND:

2019 PDI Sampling

- ●— Riverbank Angled Boring Location
- ▯ 0'-10' Sample Interval
- ▮ 10'-20' Sample Interval
- ▮ 20'-Bottom of Boring Sample Interval

2023 Proposed Sampling

- — Proposed Riverbank Angled Boring Location (sample depths to be determined based on visual and olfactory signs of contamination)
- - - - -? Additional Sample Depth (may be needed to achieve DOC based on visual and olfactory signs of contamination)

- • Nearest In-Water Depth of Contamination Core Location
- (X') | Bounded Depth of Contamination (in feet below mudline)
- (X') | Unbounded Depth of Contamination (in feet below mudline)

- — Existing Mudline
- (5.4') Core Offset Distance From Section Line (in feet)

HORIZONTAL DATUM: Oregon State Plane North Zone, NAD83/HARN 91, International Feet
VERTICAL DATUM: City of Portland (COP)
NOTES:

1. Sampling will be performed as described in Section 5.1 of the *Pre-Remedial Design Data Gaps Field Sampling Plan Addendum.*
2. As discussed in the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum*, sample locations with the naming convention "GPxx" are being resampled to reevaluate the previously reported DOC using a more appropriate technology and procedures. The DOC information at these locations is presented in this figure for informational purposes only.

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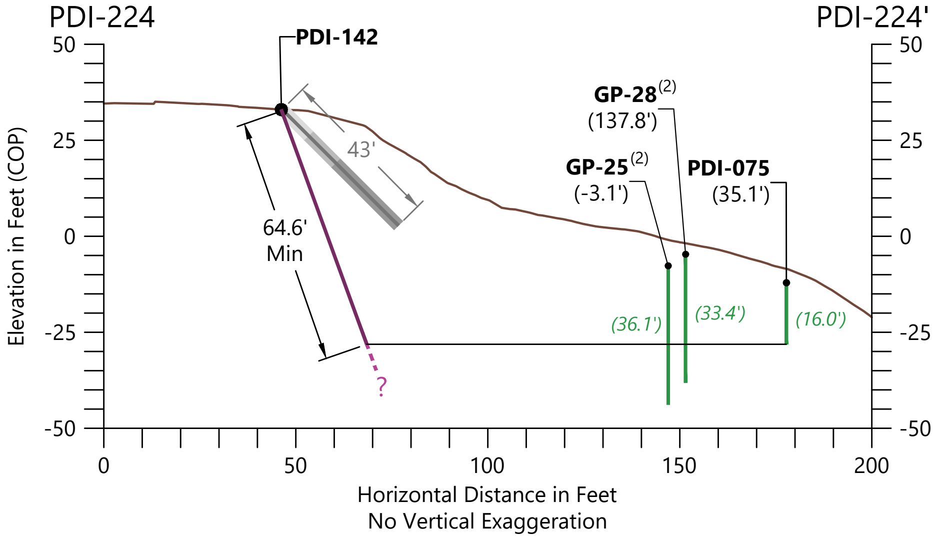
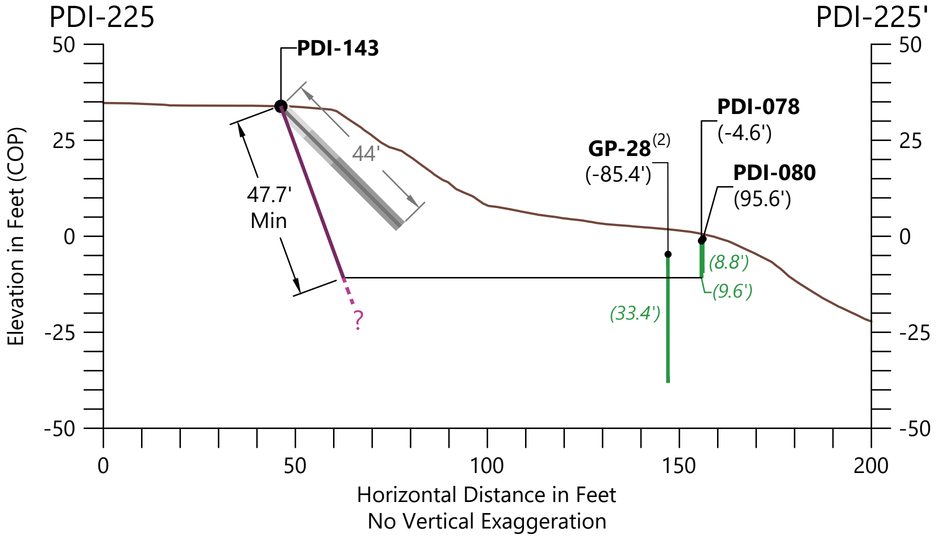
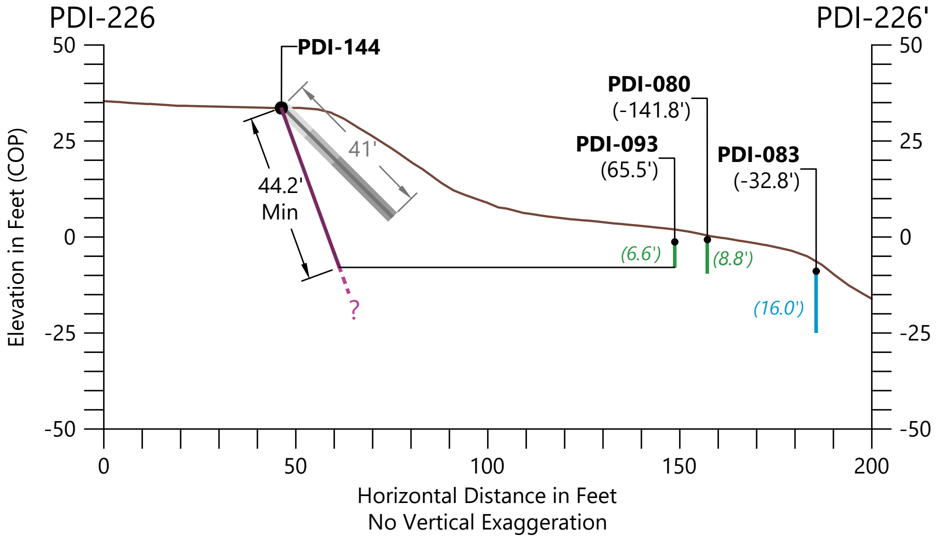
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Sediments_Pre-Remedial Design\Pre-RD Data Gaps Field Sampling Plan Addendum\0029-RP-002 (Angled Boring Sections).dwg Figure A-3b

Figure A-3b
Proposed Angled Top of Riverbank Borings – Riverbank Borings PDI-220 - PDI-223

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum
Gasco Sediments Cleanup Action







LEGEND:

2019 PDI Sampling

●— Riverbank Angled Boring Location

▯ 0'-10' Sample Interval

▮ 10'-20' Sample Interval

▮ 20'-Bottom of Boring Sample Interval

2023 Proposed Sampling

— Proposed Riverbank Angled Boring Location (sample depths to be determined based on visual and olfactory signs of contamination)

- - - -? Additional Sample Depth (may be needed to achieve DOC based on visual and olfactory signs of contamination)

• Nearest In-Water Depth of Contamination Core Location

(X') | Bounded Depth of Contamination (in feet below mudline)

(X') | Unbounded Depth of Contamination (in feet below mudline)

— Existing Mudline

(5.4') Core Offset Distance From Section Line (in feet)

HORIZONTAL DATUM: Oregon State Plane North Zone, NAD83/HARN 91, International Feet
VERTICAL DATUM: City of Portland (COP)

NOTES:

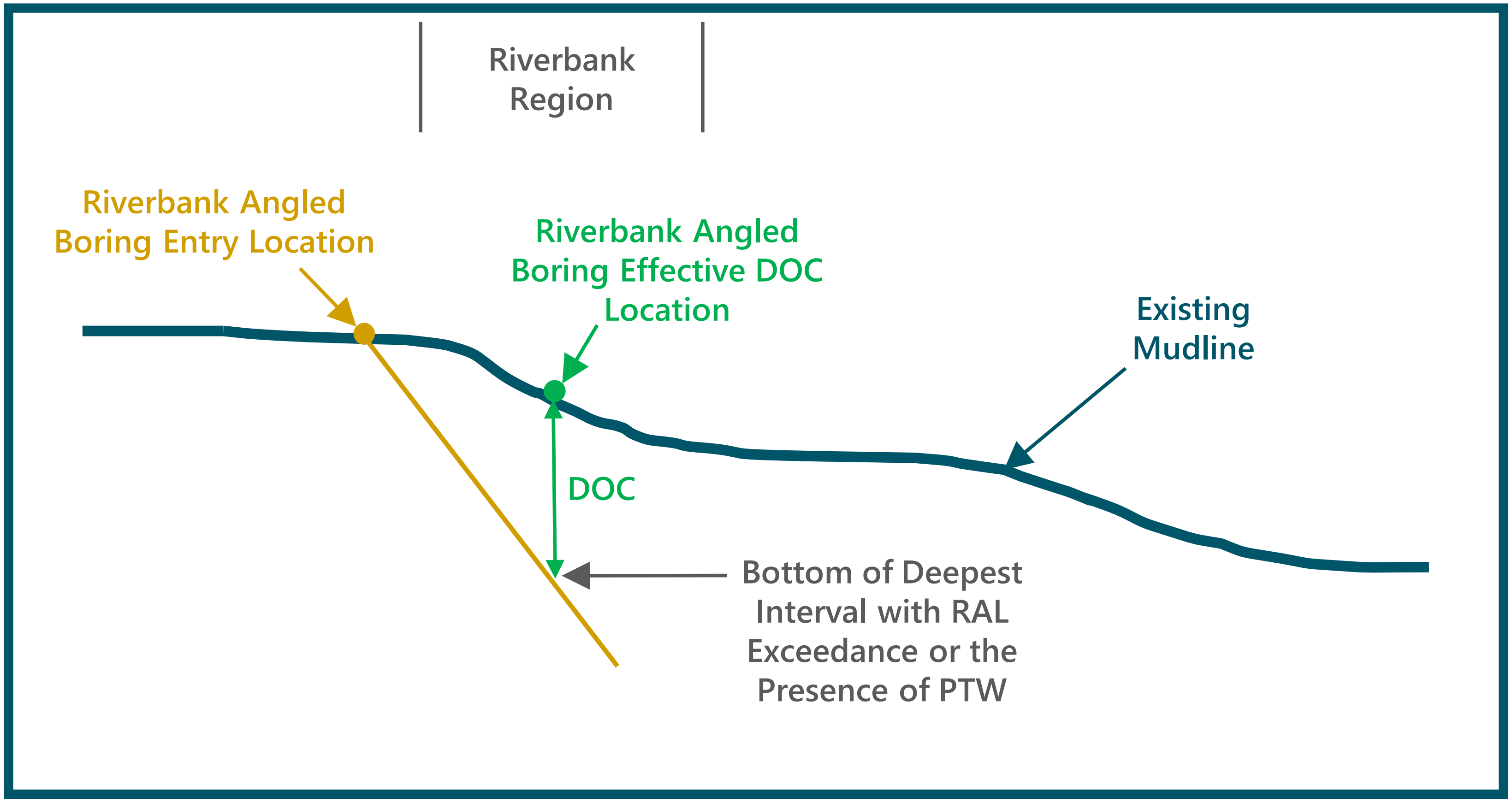
1. Sampling will be performed as described in Section 5.1 of the *Pre-Remedial Design Data Gaps Field Sampling Plan Addendum.*
2. As discussed in the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum*, sample locations with the naming convention "GPxx" are being resampled to reevaluate the previously reported DOC using a more appropriate technology and procedures. The DOC information at these locations is presented in this figure for informational purposes only.

Publish Date: 2023/03/23 8:30 AM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Sediments_Pre-Remedial Design\Pre-RD Data Gaps Field Sampling Plan Addendum\0029-RP-002 (Angled Boring Sections).dwg Figure A-3c

ANCHOR QEA

Figure A-3c
Proposed Angled Top of Riverbank Borings – Riverbank Borings PDI-224 - PDI-226

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum
Gasco Sediments Cleanup Action



ANCHOR QEA

Figure A-4

Conceptual Riverbank Angled Boring DOC Correction

Pre-Remedial Design Data Gaps Field Sampling Plan Addendum
Gasco Sediments Cleanup Action

Attachment A

Field Forms

Sediment Core Collection Log

Page __ of __

Job:
Job No:
Field Staff:
Contractor:
Vertical Datum:

Station ID:
Attempt No.
Date:
Logged By:
Horizontal Datum:

Field Collection Coordinates:

Lat/Northing:

Long/Easting:

A. Water Depth

DTM Depth Sounder:
DTM Lead Line:

B. Water Level Measurements

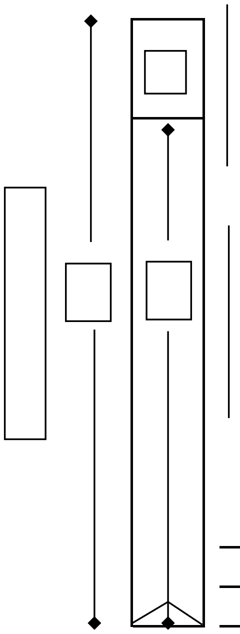
Time:
Tide Height:
Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:

Core Accepted: Yes / No
Core Tube Length:
Drive Penetration:
Headspace Measurement:
Recovery Measurement:
Recovery Percentage:
Total Length of Core To Process:



Drive Notes:

Sections To Process:

A:
B:
C:
D:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

Sediment Core Processing Log

ANCHOR QEA

Job:

Job No.

No. of Sections:

Drive Length:

Recovery:

% Recovery:

Notes:

Station ID:

Date/Time:

Core Logged By:

Attempt #:

Type of Core ☐ Mudmole ☐ Vibracore ☐ Diver Core

Diameter of Core (inches)

Core Quality ☐ Good ☐ Fair ☐ Poor ☐ Disturbed

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

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Appendix B
Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum

March 23, 2023
Gasco Sediments Cleanup Action

Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum

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

March 2023
Gasco Sediments Cleanup Action

Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum

Prepared for
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

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U.S. Environmental Protection Agency, Region 10

Cindy Fields, Quality Assurance Manager

Signature: Date:

NW Natural

Robert J. Wyatt, Director, Legacy Environmental Programs

Signature: Date: March 23, 2023

Anchor QEA, LLC

Ryan Barth, Project Manager

Signature: Date: March 23, 2023

Anchor QEA, LLC

Delaney Peterson, Project Quality Assurance Manager

Signature: Date: March 23, 2023

DISTRIBUTION LIST

The following individuals will receive copies of this document and any approved revisions:

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Nik Bacher	Field Coordinator	Anchor QEA, LLC
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Darwin Thomas	Laboratory Project Manager	Apex Laboratories
James Fox	Laboratory Project Manager	Enthalpy
Shelly Fishel	Laboratory Project Manager	Analytical Resources, LLC
Joe Tomei	Laboratory Project Manager	Geotesting Express
Stella Cuenco	Data Validator	Laboratory Data Consultants, Inc.

The Anchor QEA Project Quality Assurance Manager is responsible for maintaining the official, approved *Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum*.

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FIGURE

Figure B-1 Project Organizational Chart

ABBREVIATIONS

ASTM	ASTM International
CCV	continuing calibration verification
COC	chain of custody
Data Gaps Investigation	Pre-Remedial Design Data Gaps Investigation
DOC	depth of contamination
DOC Memorandum	*Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum*
DQO	data quality objective
EDL	estimated detection limit
EPA	U.S. Environmental Protection Agency
FC	Field Coordinator
FSP Addendum	*Pre-Remedial Design Data Gaps Field Sampling Plan Addendum*
HAZWOPER	Hazardous Waste Operations and Emergency Response
MD	matrix duplicate
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NIST	National Institute of Standards and Technology
OPR	ongoing precision and recovery sample
OSHA	Occupational Safety and Health Administration
Project Area	Gasco Sediments Site Project Area
QA	quality assurance
QAPP Addendum	*Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum*
QC	quality control
RL	reporting limit
ROD	*Record of Decision – Portland Harbor Superfund Site, Portland, Oregon*
RPD	relative percent difference
SOP	standard operating procedure

1 Introduction

This *Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum* (QAPP Addendum) has been prepared by Anchor QEA, LLC, on behalf of NW Natural for the Gasco Sediments Site Project Area (Project Area), located on the Willamette River adjacent to the NW Natural Gasco and Siltronic Corporation properties in Portland, Oregon. This QAPP Addendum is Appendix B of the *Final Revised Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum* (DOC Memorandum) and establishes the quality assurance (QA) objectives to be conducted during additional Pre-Remedial Design Data Gaps Investigation (Data Gaps Investigation) at the Project Area. The analytical methods and QA procedures described here will be followed by NW Natural and its contractors during sample collection activities described in the DOC Memorandum. The goal of this QAPP Addendum is to ensure that data of sufficiently high quality are generated to support the project data quality objectives (DQOs). This QAPP Addendum will address project management responsibilities; sampling and analytical procedures; assessment and oversight; and data reduction, validation, and reporting.

This QAPP Addendum was prepared following U.S. Environmental Protection Agency's (EPA's) *Guidance for Quality Assurance Project Plans* (EPA 2002). Analytical QA/quality control (QC) procedures were also developed based on the analytical protocols and QA guidance of EPA's *Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods* (EPA 1986) and the EPA Contract Laboratory Program National Functional Guidelines for Data Review (EPA 2020a, 2020b, 2020c).

1.1 Purpose and Objectives

The purpose of this program is to determine the depth of contamination (DOC) to complete the final remedial design for the Project Area.

1.2 Document Organization

EPA guidance (EPA 2002) specifies four groups of information that must be included in a QAPP (Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Validation and Usability). Each group comprises several QAPP elements. EPA's guidance provides a suggested outline for the QAPP elements. However, the guidance indicates that certain elements may not be applicable to a given project and that the elements need not be presented in the order presented in the guidance.

The remainder of this QAPP Addendum is organized into the following sections:

- Section 2 – Project Management
- Section 3 – Data Generation and Acquisition
- Section 4 – Assessment and Oversight

- Section 5 – Data Validation and Usability
- Section 6 – References

2 Project Management

This section identifies key project personnel, describes the rationale for conducting the investigation studies, identifies the studies to be performed and their respective schedules, outlines project DQOs and criteria, lists training and certification requirements for sampling personnel, and describes documentation and record keeping procedures.

2.1 Project Organization

Responsibilities of the team members, as well as Laboratory Project Managers, are described in the following sections. Contact information for each member of the project is provided in Table B-1. A project organizational chart showing the relationships and lines of communication among project participants is presented in Figure B-1.

2.1.1 Project Planning and Coordination

The Project Manager, Ryan Barth of Anchor QEA, LLC, will act as the direct line of communication between contractors, NW Natural, and EPA, and he is responsible for implementing activities described in this QAPP Addendum. He will also be responsible for producing project deliverables and performing the administrative tasks needed to ensure the timely and successful completion of the investigation. The Project Manager will also be responsible for resolving project concerns or conflicts related to technical matters.

Mr. Barth will be responsible for reporting the findings of the Data Gaps Investigation that will include a summary of the sampling effort, analytical methods, QA/QC narrative, and analytical results.

2.1.2 Field Sample Collection

Nik Bacher of Anchor QEA, or his designee, will serve as the Field Coordinator (FC) and will provide direction to the field sampling in logistics, personnel assignments, and field operations. The FC will supervise the field collection of samples and will be responsible for ensuring accurate positioning and recording of sample locations, depths, and identification; conformity to sampling and handling requirements, including field decontamination procedures; physical evaluation and documentation of the samples; and delivery of the samples to the laboratories. He will ensure that the samples are stored under proper conditions while in custody until delivery to the laboratories. The FC will be responsible for summarizing field sampling activities, including details of the sampling effort, sample preparation, sample storage and transport procedures, field quality assurance, and documentation of any deviation from this QAPP Addendum.

The sampling will be completed by Anchor QEA and its subconsultants as described in the DOC Memorandum. Subconsultants will follow the QA/QC and analytical protocols established in this QAPP Addendum.

2.1.3 Quality Assurance/Quality Control Management

Delaney Peterson of Anchor QEA, or her designee, will serve as the Project Quality Assurance Manager (Project QA Manager) for this project and will be responsible for the coordination with the analytical laboratories and field team. She will perform oversight for both the field sampling and laboratory programs. She will be kept fully informed of field program procedures and progress during sample collection and laboratory activities during sample preparation and analyses. She will record and correct any activities that vary from this QAPP Addendum. She will be responsible for the review of laboratory reports and case narratives describing any anomalies and exceptions that occurred during analysis. Any QA/QC problems will be brought to her attention as soon as possible to discuss issues related to the problem and evaluate potential solutions. She will be responsible for performing or overseeing the validation of the data according to the requirements of this QAPP Addendum and incorporating the results of the validation into the final project database. Upon completion of the sampling and analytical program, she will review laboratory QA/QC results and incorporate findings into future reports.

The analytical laboratories will be responsible for physical and chemical analyses of sediment samples and will ensure that the submitted samples are handled and analyzed in accordance with the selected analytical testing protocols and QA/QC requirements, as well as the requirements specified in this QAPP Addendum. The laboratories will provide certified, pre-cleaned sample containers and sample preservatives, as appropriate, and prepare a data package containing the analytical and QA/QC results.

The Laboratory Project Managers for the physical and chemical testing are listed in Table B-1. Each of them will oversee laboratory operations associated with the receipt of the environmental samples, chemical/physical analyses, and laboratory report preparation for this project. They will review the laboratory reports and prepare case narratives describing any anomalies and exceptions that occurred during sample preparation and analyses. They will also notify the Project QA Manager of any QA/QC problems when they are identified to allow for quick resolution.

2.2 Problem Definition/Background

The DOC Memorandum describes the investigations that will be performed as part of the additional Data Gaps Investigation at the Project Area. A detailed project overview, site description, project figures, and supporting field sampling details are provided in the DOC Memorandum and *Pre-Remedial Design Data Gaps Field Sampling Plan Addendum* (FSP Addendum). The data gaps sampling event is being implemented to collect additional data to determine the DOC throughout the remainder of the Project Area.

2.3 Project/Task Description and Schedule

Sampling activities described in the DOC Memorandum and FSP Addendum will be initiated following EPA approval. The data gaps sampling activities are currently estimated to occur in the Spring of 2023 contingent on EPA review and approval timelines. See DOC Memorandum and FSP Addendum Section 3 for descriptions of the specific tasks to be conducted, and FSP Addendum Table A-1. The sampling schedule is discussed in FSP Addendum Section 6.

2.4 Data Quality Objectives and Criteria

The DQOs for this project are to develop and implement procedures that will ensure the collection of representative data of known, acceptable, and defensible quality to achieve the project objectives described in the DOC Memorandum and FSP Addendum. The quality of the laboratory data is assessed by precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity (see Section 3.4).

2.5 Special Training Requirements/Certifications

For sample preparation tasks, it is important that field personnel are trained in standardized data collection requirements so that the data collected are consistent among the field crew. Field personnel must be fully trained in the collection and processing of subsurface sediment core samples, decontamination protocols, visual inspections, and chain-of-custody (COC) procedures. Training for staff will be provided through on-the-job training and attendance at internal and external seminars and workshops on relevant subject matter. The Anchor QEA FC will be responsible for ensuring that staff and any contractors have the necessary training required to conduct the field investigation procedures described in the DOC Memorandum, FSP Addendum, and this QAPP Addendum.

In addition, the 29 Code of Federal Regulations 1910.120 Occupational Safety and Health Administration (OSHA) regulations require training to provide employees with the knowledge and skills enabling them to perform their jobs safely and with minimum risk to their personal health. Sampling personnel will have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and 8-hour refresher courses, as necessary, to meet OSHA regulations. Anchor QEA's project Health and Safety Officer, Tim Shaner, is responsible for the completion and retention of HAZWOPER certification. In addition, all sampling personnel will have basic training in boat safety for the over-water work. Certifications will be maintained in Anchor QEA's project files.

2.6 Documentation and Records

This project will require central project files to be maintained at Anchor QEA for a minimum of 10 years. Project records will be stored and maintained in a secure manner. The Project QA Manager will be responsible for maintaining and providing updated copies of the most current approved version of the QAPP Addendum. Updates will be distributed to appropriate personnel electronically. Each project team member is responsible for filing necessary project information or providing it to the person responsible for the filing system. Individual team members may maintain files for individual tasks but must provide such files to the central project files upon completion of each task. Hard copy documents will be kept on file at Anchor QEA or at a document storage facility throughout the duration of the project, and electronic data will be maintained in the Anchor QEA central database and backed up regularly as part of routine file maintenance.

2.6.1 Field Records

Documents generated during the field effort are controlled documents that become part of the project file. Field documents may be generated electronically or recorded on hard copies in the field. Field team members will keep a daily record of significant events, observations, and measurements on field logs developed specifically for each activity. The field logs will be the main source of documentation for field activities and will be maintained by the FC. The sampling documentation will contain information on each sample collected and will include, at a minimum, the following information:

- Project name
- Field personnel on site
- Facility visitors
- Weather conditions
- Field observations
- Maps and/or drawings
- Sample collection date and time
- Sampling method and description of activities
- Identification or serial numbers of instruments or equipment used
- Deviations from the DOC Memorandum, FSP Addendum, or QAPP Addendum
- Conferences associated with field sampling activities

Entries for each day will begin on a new form. The person recording information must enter the date and time and initial each entry. Additional specific field reporting requirements and checklists for each study are defined in the DOC Memorandum and FSP Addendum. In general, sufficient information will be recorded during each sampling event so that reconstruction of the event can occur without relying on the memory of the field personnel.

The field forms will be either collected electronically or on water-resistant, durable paper to prevent deterioration of the project record due to adverse field conditions. Hard copy notes will be taken in indelible, waterproof blue or black ink. Errors will be corrected by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Each form will be marked with the project name, number, and date. The field forms will be scanned into Anchor QEA's project file directory as convenient during the sampling event or upon completion of each sampling event.

Sample collection tables are included in the FSP Addendum and will be used to inform proposed coordinates of each location, the sampling scheme, and whether any QC samples are to be collected.

2.6.2 Analytical and Chemistry Records

The laboratory will retain analytical data records. Additionally, Anchor QEA will retain them in central project files. For chemical analyses, the data reporting requirements will include those items necessary to complete data validation, including copies of raw data. The laboratories will prepare a detailed laboratory data package documenting the activities associated with the sample analyses. Laboratory data packages will contain information necessary to perform a Stage 4 data validation per EPA guidelines (EPA 2009b), and one Stage 4 validation will be conducted on one representative data package submitted from each laboratory, with the exception of geotechnical data. Stage 2B validations will be conducted on the remainder of the data, with the exceptions of the geotechnical data, unless the Stage 4 validations reveal errors or issues that warrant additional Stage 4 validations. Stage 1 validations will be conducted on geotechnical data. The laboratory data reports will include, but are not limited to, the following information:

- **Project Narrative.** This summary, in the form of a cover letter, will discuss problems (if any) encountered during any aspect of sample receipt, preparation, and analyses. This summary will discuss, but not be limited to, sample receipt, sample storage, QC deviations, and any other analytical difficulties. Problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate.
- **COC Records.** Legible copies of the COC forms will be provided as part of the data package. This documentation will include the time of receipt and condition of the samples received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented on a sample receipt form. The form must include sample shipping container temperatures measured at the time of sample receipt.

- **Sample Results.** The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:
  - Field sample identification code and the corresponding laboratory identification code
  - Sample matrix
  - Date of sample preparation
  - Date and time of analysis
  - Weight and/or volume used for analysis
  - Final dilution or concentration factor for the sample
  - Identification of the instrument used for analysis
  - Method detection and reporting limits accounting for sample-specific factors (e.g., dilution and total solids)
  - Analytical results with reporting units identified
  - Data qualifiers and their definitions
- **QA/QC Summaries.** This section contains the results of the laboratory QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results. No recovery or blank corrections will be made by the laboratory. The required summaries include, but are not limited to, the following:
  - **Calibration Data Summary.** This summary will report the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. The response factor, percent relative standard deviation, percent difference, and retention time for each analyte will be listed, as appropriate. Results for standards used to quantify instrument sensitivity will be documented.
  - **Instrument Performance Checks.** Ion abundances and the ranges of acceptable criteria will be reported for gas chromatography/mass spectrometry methods. Mass calibration atomic mass unit and percent relative standard deviation values will be reported for inductively coupled plasma/mass spectrometry methods.
  - **Internal Standard Area Summary.** Internal standard areas will be reported for each sample analyzed, as appropriate.
  - **Method Blank Analysis.** The method blank analyses associated with each sample and the concentration of compounds of interest identified in these blanks will be reported.
  - **Surrogate Spike Recovery.** Surrogate spike recovery results for organic analyses will be reported for each sample. The names and concentrations of the compounds added, percent recoveries, and range of acceptable recoveries will be reported.
  - **Matrix Spike Recovery.** The names and concentrations of analytes added, percent recoveries, and range of acceptable recoveries will be listed. The relative percent difference (RPD) for matrix spike duplicate (MSD) analyses will be reported.
  - **Matrix Duplicate.** This summary will include the RPD or difference value for matrix duplicate (MD) analyses, as appropriate to the sample concentrations.

  - **Laboratory Control Sample.** The name and concentration of analytes added, percent recoveries, and range of acceptable recoveries will be listed. The RPD values for laboratory control sample duplicate analyses will be included.
  - **Relative Retention Time.** This summary will include a report of the relative retention time of each analyte detected in the samples for both primary and confirmatory analyses.
- **Original Data.** Legible copies of the original data generated by the laboratory will include the following:
  - Identification of preparation method used and cleanup logs, as appropriate
  - Instrument specifications and analysis logs for instruments used on days of calibration and analysis
  - Original printouts of full-scan chromatograms and quantitation reports for gas chromatography and/or gas chromatography/mass spectrometry samples, blanks, calibrations, spikes, replicates, and reference materials
  - Reconstructed ion chromatograms for samples, standards, blanks, spikes, replicates, and reference materials
  - Enhanced spectra of detected compounds with associated best-match spectra for each sample
  - Instrument outputs for inorganic analyses, including calibrations and sample analyses
  - Calculation worksheets

Instrument data shall be fully restorable at the laboratory from electronic backup. The laboratory will be required to maintain records relevant to project analyses for a minimum of 5 years. Data validation reports will be maintained in the central project files with the analytical data reports.

2.6.3 Data Reduction

Data reduction is the process by which original data (analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data. Data reduction requires that aspects of sample preparation that could affect the test result (such as sample volume analyzed or dilutions required) be taken into account in the final result. Data reduction is the laboratory analyst’s responsibility, and final results are subjected to further review by the Laboratory Project Manager, the Project Manager, the Project QA Manager, and independent reviewers. Data reduction may be performed manually or electronically. If performed electronically, software used must be demonstrated to be true and free from error.

2.6.4 Electronic Data Deliverables and Database Development

All data generated in the field will be documented electronically or on hard copy and provided to the Data Manager, who is responsible for the data’s entry into the database. Laboratory data will be provided to the Data Manager in the EQuIS electronic data deliverable format and loaded into Anchor QEA's centralized database.

2.6.5 Data Management

Field data sheets will be checked for completeness and accuracy by the FC prior to delivery to the Project QA Manager. Data generated in the field will be documented electronically or on hard copy and loaded directly into the database or provided to the Project QA Manager, who will coordinate data entry into the database. Manually entered data will be checked by a second party. Field documentation will be filed in the main project file after data entry and checking are complete.

Laboratory data will be loaded directly into the database or provided to the Project QA Manager in the EQuIS electronic format. Laboratory data that are electronically provided and loaded into the database will undergo a check against the laboratory hard copy data. Data will be validated or reviewed manually, and qualifiers (if assigned) will be entered manually. The accuracy of manually entered data will be verified. Data tables and reports will be exported from EQuIS to Microsoft Excel tables for report presentations and data analysis.

The *Program Data Management Plan: Portland Harbor Remedial Design Investigation* (EPA 2021) outlines how the data will be handled from planning, field, and post-field work.

3 Data Generation and Acquisition

Data generation and acquisition begins with the development of the rationale for locating and selecting environmental samples for analysis and ends with the generation and reporting of analytical data for those samples by the analytical laboratories.

3.1 Sampling Design

The sampling design including the rationale for locating and selecting environmental samples for analyses is detailed in the FSP Addendum.

3.2 Sampling Methods and Handling Requirements

Sample collection procedures are described in detail in the FSP Addendum. Sampling procedures are generally consistent with EPA protocols or other approved sample collection standards established for the site.

3.3 Analytical Methods

Analytical methods for chemical and physical analyses are listed in Table B-2, corresponding to the sample and analytical programs described in FSP Addendum Section 5.

In completing analyses for this project, the laboratories are expected to meet the following minimum requirements:

- Adhere to the methods outlined in this QAPP Addendum, including methods referenced for each analytical procedure.
- Follow documentation, custody, and sample tracking procedures.
- Notify the Project QA Manager of any QA/QC problems when they are identified.
- Provide a detailed discussion of any modifications made to approved analytical methods.
- Deliver Adobe PDF and electronic data as specified.
- Meet reporting requirements for deliverables.
- Meet turnaround times for deliverables.
- Implement QA/QC procedures, including the DQOs, laboratory QA requirements, and performance evaluation testing requirements.
- Allow laboratory and data audits to be performed, if deemed necessary.

Analytical methods and reporting limits (RLs) for sediment are presented in Table B-2. Table B-3 presents the field and laboratory QA/QC sample frequency requirements (e.g., field duplicates, matrix spikes (MSs), and laboratory control samples).

3.4 Data Quality Objectives

The parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. These parameters are presented on Table B-4 and discussed in greater detail in the following sections.

3.4.1 Precision

Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability or random error in sample collection and laboratory analyses. ASTM International (ASTM) recognizes the following two levels of precision (ASTM 2002):

1. Repeatability: the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions
2. Reproducibility: the random error associated with measurements made by different test operators in different laboratories, using the same method but different equipment to analyze identical samples of test material

In the laboratory, "within-batch" precision is measured using replicate sample or QC analyses and is expressed as the RPD between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

Field precision will be evaluated by the collection of field duplicates analyses at a frequency of 1 per 20 samples collected. Field chemistry duplicate precision will be screened against an RPD of 50% for all analyses and matrices. Data qualification based on field duplicate precision will be at the discretion of the data validator. The equation used to express precision is as follows:

Equation 1

$$\mathrm{RPD} = \frac{\left(\mathrm{C}_1 - \mathrm{C}_2\right) \times 100\%}{\left(\mathrm{C}_1 + \mathrm{C}_2\right)/2}$$

where:

RPD = relative percent difference

C_1 = larger of the two observed values

C_2 = smaller of the two observed values

Precision measurements can be affected by the nearness of a chemical concentration to the RL, where the percent error (expressed as RPD) increases. In cases where either the parent or duplicate result is less than five times the RL, results will be evaluated by the difference with a control limit of ± RL for aqueous sample matrices and ± 2 times the RL for solid sample matrices.

3.4.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is evaluated by calculating percent recovery results from analyses of laboratory control samples, standard reference materials, surrogate standards, and standard solutions. In addition, matrix-spiked samples, laboratory control samples (e.g., blank spikes and reference materials), and surrogate spikes are also analyzed, which provide accuracy or bias information in the actual sample matrix. Accuracy measurements will be carried out at a minimum frequency of 1 per 20 samples analyzed, with the exception of surrogates, which will be added to all samples. Accuracy is expressed as percent recovery of the measured value, relative to the true or expected value. If a measurement process produces results for which the result is not the true or expected value, the process is said to be biased. Bias is discussed further in Section 3.4.6.

Laboratory accuracy will be evaluated against quantitative spike recovery performance criteria provided by the laboratory and shown in Table B-4. Accuracy can be expressed as a percentage of the true or reference value or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

Equation 2

$$\%R = 100\% \text{ x } (S\text{-}U)/C_{sa}$$

where:

$\%R$ = percent recovery
S = measured concentration in the spiked aliquot
U = measured concentration in the unspiked aliquot
C_{sa} = actual concentration of spike added

MS recovery values become distorted when the sample concentration is greater than four times the spike concentration. No data will be qualified in these instances, regardless of percent recovery values.

Field accuracy will be controlled by adherence to sample collection procedures outlined in the DOC Memorandum and the FSP Addendum.

3.4.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. For the site, the list of analytes has been identified to provide a comprehensive assessment of the known and potential contaminants.

3.4.4 Comparability

Comparability expresses the confidence with which one dataset can be evaluated in relation to another dataset. For this program, comparability of data will be established through the use of standard analytical methodologies and reporting formats and common traceable calibration and spike materials.

3.4.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

Equation 3

$$\mathrm{C} = \frac{\underline{\text{(Number of acceptable data points) x 100}}}{\text{(Total number of data points)}}$$

where:

C = Completeness (%)

The DQO for completeness for components of this project is 95%. Data that have been qualified as estimated because QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been rejected will not be considered valid for the purpose of assessing completeness.

3.4.6 Bias

Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction. Bias can be either inherent in a method of analysis (e.g., extraction efficiency) or caused by an artifact of the measurement system (e.g., contamination). Bias assessments for environmental measurements are made using personnel, equipment, and spiking materials or reference materials as independent as possible from those used in the calibration of the measurement system. Analytical laboratories utilize several quality control measures to eliminate analytical bias, including systematic analyses of method blanks, laboratory control samples, and independent calibration verification standards. When possible, bias assessments should be based on analysis of spiked samples or matrix-matched reference samples rather than spiked blanks so that the effect of the matrix on recovery is incorporated into the assessment. A documented spiking protocol and consistency in following that protocol are important to obtaining meaningful data quality estimates. Because bias can be positive or negative and because several types of bias can occur simultaneously, only the net or total bias can be evaluated in a measurement.

3.4.7 Sensitivity

Analytical sensitivities must be consistent with or lower than the target limits listed in Table B-2 to demonstrate compliance with this QAPP Addendum.

The method detection limit (MDL) is defined as the minimum concentration at which a given target analyte can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The limit of detection is the smallest amount or concentration of a substance that must be present in a sample to be detected at a 99% confidence level. Estimated detection limits (EDLs) are associated with high-resolution analytical methods and are calculated for each analyte and sample based on the signal-to-noise ratio. Undetected compounds analyzed by high-resolution methodology (e.g., dioxin/furans) will be reported at the EDL, which is typically lower than the MDL listed in Table B-2 and is sample and compound specific. The EDL is anticipated to meet *Record of Decision – Portland Harbor Superfund Site, Portland, Oregon* (ROD; EPA 2017) cleanup levels in most cases. Detections between the EDL and RL will be reported as estimated. Laboratory practical quantitation limits, limits of quantitation, or RLs are defined as the lowest level that produces a quantitative result within specified limits of precision and accuracy during routine laboratory operating conditions. Laboratory MDL and RL results (Table B-2) will be used to evaluate the method sensitivity and/or applicability prior to the acceptance of a method for this program.

The sample-specific MDLs, EDLs, and RLs will be reported by the laboratory and will take into account factors relating to the sample analysis that might decrease or increase the MDLs and RLs (e.g., dilution factor, percent moisture, and sample aliquot weight or volume). In the event that the MDL (or EDL) and RL are elevated for a sample due to matrix interferences and subsequent dilution or reduction in the sample aliquot, the data will be evaluated by Anchor QEA and the laboratory to determine if an alternative course of action is required or possible. The sample-specific MDL and RL will be the value recorded in the project database.

Estimated detection limits are dependent on sample and analysis-specific factors. They are calculated at the time of analysis and are typically only reported when analytes are below detection. Since they are not pre-determined, NW Natural cannot include them in the QAPP Addendum tables; however, NW Natural does anticipate they will be below MDLs and the ROD Table 17 CULs for samples without significant matrix interferences based on other project experience.

3.5 Quality Assurance and Quality Control

Field and laboratory activities must be conducted in such a manner that the results meet specified quality objectives and are fully defensible. Guidance for QA/QC is derived from the protocols developed for EPA's *Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods* (EPA 1986), the EPA Contract Laboratory Program (EPA 2020a, 2020b, 2020c), and the cited methods.

3.5.1 Field Quality Control

Anchor QEA personnel will identify and label samples in a consistent manner to ensure that field samples are traceable, and labels provide the information necessary for the laboratory to properly conduct the required analyses. Samples will be placed in appropriate containers and preserved for shipment to the laboratory.

3.5.1.1 Sample Containers

The analytical laboratories will provide certified pre-cleaned sample containers (Table B-5) with the exceptions of the geotechnical analyses. The laboratories will maintain documentation certifying the cleanliness of bottles and the purity of preservatives provided.

3.5.1.2 Sample Identification and Labels

Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. The following information will be recorded on the container label:

- Project name
- Sample identification
- Date and time of sample collection
- Preservative type (if applicable)
- Required analyses
- Sampler's name or initials

Samples will be uniquely identified with a sample identification that, at a minimum, specifies sample matrix, sample number, sample location, and type of sample. Specific sample nomenclature is described in the FSP Addendum.

3.5.1.3 Sample Custody and Shipping Requirements

Samples are considered to be in one's custody if they are in the following: 1) the custodian's possession or view; 2) a secured location (under lock) with restricted access; or 3) a container that is secured with official seals such that the sample cannot be reached without breaking the seals.

COC procedures will be followed for the samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the COC form.

Each sample will be represented on a COC form the day it is collected. Data entries will be made using indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Blank lines or spaces on the COC form will be lined out, dated, and initialed by the individual maintaining custody.

A COC form will accompany each cooler of samples sent to the analytical laboratories. Each person who has custody of the samples will sign the COC form and establish that the samples were not left unattended unless properly secured. Copies of COC forms will be retained in the project files.

Filled sample containers for chemistry and physical analyses will be stored in coolers containing ice to maintain the samples at 2°C to 6°C until delivery to the analytical laboratories.

Samples will be shipped to the analytical laboratory no later than the day after collection. Samples collected on Friday may be held until the following Monday for shipment provided that this does not jeopardize any hold time requirements (Table B-5). Specific sample shipping procedures are as follows:

- Each cooler or container with the samples for analysis will be hand-delivered, couriered, or shipped the same day as collection or via overnight delivery to the appropriate analytical laboratory. In the event that Saturday delivery is required, the FC will contact the analytical laboratory before 3:00 p.m. on Friday to ensure that the laboratory will be staffed to receive samples on a Saturday and is aware of the number of containers shipped and the airbill tracking numbers for those containers. Following shipment, the FC will confirm the samples have been received and are in good condition.
- Coolant ice will be sealed in separate zip-top plastic bags and placed in the shipping containers. Plastic bags will be doubled for overnight shipping.
- Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
- Glass bottles and jars will be separated in the shipping container by shock-absorbent material (e.g., bubble wrap) to prevent breakage.
- The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
- COC forms will be enclosed in a plastic bag and placed inside of the cooler.
- A minimum of two signed and dated COC seals will be placed on adjacent sides of each cooler prior to shipping.
- Each cooler will be wrapped securely with packing tape and will be clearly labeled with the laboratory's shipping address and the consultant's return address.

Upon transfer of sample possession to the analytical laboratory, the person transferring custody of the sample container will sign the COC form. Upon receipt of samples at the laboratory, the shipping container seals will be broken, and the receiver will sign the COC forms and record the condition of the samples and any discrepancies encountered on a sample receipt form.

3.5.1.4 Field Quality Assurance Sampling

Field QA procedures will consist of following procedures for acceptable practices for collecting and handling of samples. Adherence to these procedures will be complemented by periodic and routine equipment inspection.

Field QA samples will be collected along with the environmental samples. Field QA samples are useful in identifying possible problems resulting from sample collection or sample processing in the field. The collection of field QA samples includes equipment rinsate blanks and field duplicates as specified in Table B-3. Rinsate blanks will be collected at a frequency of one per collection method per sampling event. If decontamination procedures are not adequate, additional rinsate blanks will be collected after procedures have been modified. Adequacy of decontamination procedures will be evaluated by rinsate blank chemistry results. Results will be compared to associated samples, and the Project QA Manager’s best professional judgment will be used to evaluate whether decontamination procedures should be modified. Field duplicate samples will be collected at a frequency of one per sampling event or 1 in 20 samples collected, whichever is more frequent.

Field QA samples will also include the collection of additional sample volume or mass to ensure that the laboratory has sufficient sample volume to run the program-required analytical QA/QC (MD/MS/MSD) samples for analysis as specified in Table B-3. Additional sample volume or mass to meet this requirement will be collected at a frequency of one per sampling event or 1 in 20 samples processed, whichever is more frequent. The sample collection team will confirm with the laboratory the appropriate extra volume or mass required for these analyses. The samples designated for MD/MS/MSD analyses should be clearly marked on the COC.

Field QA samples will be documented on the field forms and verified by the Project QA Manager or designee.

3.5.2 Laboratory Quality Control

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, standard reference materials, laboratory control samples, matrix replicates, MSs, surrogate spikes (for organic analyses), and method blanks. Table B-3 lists the frequency of analysis for laboratory QA/QC samples, and Table B-4 summarizes the DQOs for precision, accuracy, and completeness.

An analyst will review the results of the QC samples from each analytical batch immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the batch and reanalysis or re-extraction does not correct the exceedance, the Project QA Manager will be contacted and alternative corrective action (e.g., method modifications followed by reprocessing the affected samples) will be explored prior to processing a subsequent group of samples.

3.5.2.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used prior to analyses, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. A calibration verification sample will be analyzed following each initial calibration and will meet method criteria prior to analysis of samples. Continuing calibration verifications (CCVs) will be analyzed at required frequencies to track instrument performance. The frequency of CCVs varies with method. For gas chromatography/mass spectrometry methods, one will be analyzed every 12 hours. For gas chromatography, metals, and inorganic methods, 1 will be analyzed for every 10 field samples analyzed and at the end of each run. If the CCV is out of control, the analysis must come to a halt until the source of the control failure is eliminated or reduced enough to meet control specifications. Project samples analyzed while instrument calibration was out of control will be reanalyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to or right after the CCV as applicable to the method.

3.5.2.2 Laboratory Duplicates

Laboratory duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Laboratory duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample. For high-resolution mass spectrometry analyses, laboratory duplicates will be analyzed to assess laboratory precision. An MSD, ongoing precision and recovery sample (OPR) duplicate, or lab control sample duplicate may be analyzed in lieu of a laboratory duplicate.

3.5.2.3 Matrix Spikes and Matrix Spike Duplicates

Analyses of MS samples provide information on the extraction efficiency of the method on the sample matrix, as well as any interferences introduced by the sample matrix. By performing duplicate MS analyses, information on the precision of the method is also provided.

3.5.2.4 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at every stage of sample preparation and analysis. The method blank results must be less than the reporting limit of each target analyte. If a laboratory method blank exceeds this criterion for any analyte, and the analyte is detected in any of the samples and is less than five times the concentration found in the blank (10 times for common contaminants), analyses must stop, and the source of contamination must be eliminated or reduced.

3.5.2.5 Laboratory Control and Ongoing Precision and Recovery Samples

Laboratory control samples and OPRs are analyzed to assess possible laboratory bias at the stages of sample preparation and analysis. The laboratory control sample is a matrix-dependent spiked sample prepared at the time of sample extraction along with the preparation of the sample, method blank, and MS. The laboratory control sample and OPR will provide information on the accuracy of the analytical process and, when analyzed in duplicate, will provide precision information as well.

3.5.2.6 Laboratory Deliverables

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested in Section 2.6.2 are present.

3.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Testing, inspection, and maintenance of field and laboratory equipment are important determinants of the quality of sampling and analysis results.

3.6.1 Field Instruments/Equipment

In accordance with the QA program, Anchor QEA shall maintain an inventory of field instruments and equipment. The frequency and types of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment.

The Anchor QEA FC will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. The equipment maintenance information will be documented in the instrument's calibration log. The frequency of maintenance is dependent on the type and stability of the equipment, the methods used, the intended use of the equipment, and the recommendations of the manufacturer. Detailed information regarding the maintenance procedures and frequency of equipment maintenance is provided in specific manufacturer's instruction manuals.

Maintenance records will be verified prior to each sampling event. The FC will be responsible for verifying that required maintenance has been performed prior to using the equipment in the field.

The worker or subcontractor responsible for navigation will confirm proper operation of the navigation equipment daily. This verification may consist of internal diagnostics or visiting a location with known coordinates to confirm the coordinates indicated by the navigation system. The winch line and grab sampler will be inspected daily for fraying, jaw misalignment, loose connections, and any other applicable mechanical problems. All equipment will be operated and maintained according to manufacturer specifications. Any problems will be noted in the field logbook and corrected prior to continuing sampling operations.

3.6.2 Laboratory Instruments/Equipment

In accordance with the QA program, the laboratory shall maintain an inventory of instruments and equipment, and the frequency of maintenance will be based on the manufacturer's recommendations and previous experience with the equipment.

The laboratory preventative maintenance program, as detailed in the laboratory QA Manual, is organized to maintain proper instrument and equipment performance and to prevent instrument and equipment failure during use. The program considers instrumentation, equipment, and parts that are subject to wear, deterioration, or other changes in operational characteristics; the availability of spare parts; and the frequency at which maintenance is required. Any equipment that has been overloaded or mishandled, gives suspect results, or has been determined to be defective will be taken out of service, tagged with the discrepancy noted, and stored in a designated area until the equipment has been repaired. After repair, the equipment will be tested to ensure that it is in proper operational condition. The client will be promptly notified in writing if defective equipment casts doubt on the validity of analytical data. The client will also be notified immediately regarding any delays due to instrument malfunctions that could impact holding times.

Laboratories will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. Maintenance records will be checked according to the schedule on an annual basis and recorded by the responsible individual. The Laboratory Manager, or designee, shall be responsible for verifying compliance with the preventative maintenance program.

3.7 Instrument Calibration

Proper calibration of equipment and instrumentation is an integral part of the process that provides quality data. Instrumentation and equipment used to generate data must be calibrated at a frequency that ensures sufficient and consistent accuracy and reproducibility.

3.7.1 Field Instrument/Equipment Calibration

Field equipment will be calibrated prior to each sampling event according to manufacturer's recommendations and using manufacturer's calibration standards. The equipment, calibration, and maintenance information will be documented in the instrument calibration log. The frequency of calibration is dependent on the type and stability of the equipment, the methods used, the intended use of the equipment, and the recommendations of the manufacturer. Detailed information regarding the calibration and frequency of equipment calibration is provided in specific manufacturer's instruction manuals.

Equipment that fails calibration or becomes inoperable during use will be removed from service and tagged (time and date of action) to prevent inadvertent use. Such equipment will be satisfactorily recalibrated or repaired and tagged (date and time of return to service) prior to use.

A post-survey calibration check may be performed at the end of each day's activities to confirm that the instrument functioned properly throughout the day. The instrument will also be checked during the day if erratic or suspect readings are observed.

3.7.2 Laboratory Instrument/Equipment Calibration

As part of their QC program, laboratories perform two types of calibrations. A periodic calibration is performed at prescribed intervals (i.e., balances, drying ovens, refrigerators, and thermometers), and operational calibrations are performed daily, at a specified frequency, or prior to analysis (i.e., initial calibrations) according to method requirements. Calibration procedures and frequency are discussed in the laboratory QA Manual. Calibrations are discussed in the laboratory standard operating procedures (SOPs) for analyses.

The Laboratory Manager will be responsible for ensuring that the laboratory instrumentation is calibrated in accordance with specifications. Implementation of the calibration program shall be the responsibility of the respective laboratory department supervisors. Recognized procedures (EPA, ASTM, or manufacturer's instructions) shall be used when available.

Physical standards (i.e., weights or certified thermometers) shall be traceable to nationally recognized standards such as the National Institute of Standards and Technology (NIST). Chemical reference standards shall be NIST standard reference materials or vendor-certified materials traceable to these standards.

The calibration requirements for each method and respective corrective actions are written in the laboratory SOPs and/or the laboratory's QA Manual for each instrument or analytical method in use. Calibrations shall be preserved on electronic media.

3.8 Inspection/Acceptance Requirements for Supplies and Consumables

Inspection and acceptance of field supplies, including laboratory-prepared sampling bottles, will be the responsibility of the FC. Primary chemical standards and standard solutions will be used in this project in the field and laboratory and will be traceable to documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

3.9 Non-Direct Measurements

Non-direct measurements are suitable for use in the data gaps evaluation without limitation for the purposes of the data gaps evaluation stated in the DOC Memorandum and FSP Addendum. Specifically, the criteria that will be used to evaluate the subsurface sediment and soil results will include the following:

- Existing data from the Portland Harbor Feasibility Study database, including subsurface sediment results from samples greater than 30 cm (1 foot) below mudline
- Existing upland data (e.g., soil, groundwater) and riverbank data, if collected under oversight of EPA or the Oregon Department of Environmental Quality and in an area adjacent to the Project Area
- Bathymetry and other survey data (e.g., debris survey) collected for the Portland Harbor Remedial Investigation/Feasibility Study, by NW Natural, and by others within the Project Area
- Portland Harbor remedial action levels and cleanup goals included in the ROD and updated in the Explanation of Significant Differences, Errata No. 2, and Errata No. 3

4 Assessment and Oversight

Once data are received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

4.1 Field and Laboratory Audits/Inspections

Laboratory and field performance audits or inspections consist of on-site reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted as part of this study. However, laboratory audit reports will be made available to the Project QA Manager upon request. Apex, ARL, and Enthalpy are NELAC-certified laboratories that undergo regular audits as part of their certification procedures. Audits are conducted no more than 2 years apart. The laboratory is required to have written procedures addressing internal QA/QC. These procedures have been submitted, and the Project QA Manager will review them to ensure compliance with this QAPP Addendum. The laboratory must ensure that personnel engaged in preparation and analysis tasks have appropriate training. As part of the audit process, the laboratory will provide written details of any method modifications planned for the consultant's review.

Planned and documented performance inspections will be conducted for field operations to assess the accuracy of the measurement systems and to determine the effectiveness of QA/QC procedures and compliance with the QAPP Addendum. Field performance inspections should be conducted by the FC.

A field inspection is not planned but may be scheduled at the discretion of the Project QA Manager to observe and review field procedures and documentation from sample collection through packaging and shipment to the laboratories. If the Project QA Manager determines it necessary, additional inspections may be scheduled over the course of the field program. The Project Manager will be responsible for identifying an appropriate schedule of inspections prior to commencement of investigation activities.

Field inspections may be performed by the FC in accordance with written procedures or checklists. The field inspection will involve the review and evaluation of (as appropriate) implementation of approved work procedures, sampling procedures, sampling documentation; labeling, packaging, storage, and shipping of samples; completion of field records; QC compliance; subcontractor performance; and field change documentation. Field records will also be reviewed to verify that field-related activities are performed and documented in accordance with the QAPP Addendum. Items to be reviewed include, but are not limited to, field activity logs, collection forms, custody transfer forms and/or chain-of-custody forms, field measurement logs, and waste inventory logs. The FC may impose stop work order at any time if activities being conducted are determined to compromise the integrity of the program.

Preliminary results of the inspections will be reviewed with the Project Manager to ensure that deficiencies adversely affecting data quality are immediately corrected. Inspection findings will be reviewed to determine the cause of any noncompliance issues identified, schedule corrective action to prevent recurrence, evaluate the impact of the findings on completed work, and notify the FC and the Project QA Manager in an email communication of action taken or planned. The findings of the field inspection, as well as any corrective actions, will be reported to EPA as part of the Monthly Progress Reports and the Sediment Sampling and Analysis Report. The FC and the Project QA Coordinator will be responsible for verifying and documenting completion of the corrective action.

4.2 Response and Corrective Actions

The following sections identify the responsibilities of key project team members and actions to be taken in the event of an error, problem, or non-conformance to protocols identified in this document.

4.2.1 Field Activities

The FC will be responsible for correcting equipment malfunctions during the field sampling effort. The Project QA Manager will be responsible for resolving situations identified by the FC that may result in non-compliance with this QAPP Addendum. Corrective measures will be immediately documented in the field logbook.

4.2.2 Laboratory

The laboratory is required to comply with its SOPs. The Laboratory Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP Addendum. Laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The Laboratory Project Manager will be notified if any QC sample result grossly exceeds the project-specified control limits and standard corrective actions do not resolve the anomaly. If the anomaly cannot be corrected, the Laboratory Project Manager will document the corrective action taken and relay this to the Project QA Manager in a timely manner, and possible additional corrective actions will be discussed. If the anomaly cannot be corrected by additional measures, the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, and re-extraction) will be described in the case narrative and submitted with the data package.

4.3 Reports to Management

QA reports to management include verbal status reports, written reports on field sampling activities and laboratory processes, data validation reports, data summary reports, and field and laboratory inspection and/or audit reports. These reports shall be prepared in coordination with the project team.

5 Data Validation and Usability

Laboratory data will be provided in both PDF and electronic format. Once data are received from the laboratory, QC procedures will be followed to provide an accurate evaluation of the data quality. The data will be validated in accordance with the EPA National Functional Guidelines for Data Review (EPA 2020a, 2020b, 2020c) project-specific DQOs (Table B-4), analytical method criteria, and the laboratory's internal performance standards based on their SOPs.

5.1 Data Review, Validation, and Verification

During the validation process, analytical data will be evaluated for method and laboratory QC compliance, and their validity and applicability for program purposes will be determined. Based on the findings of the validation process, data validation qualifiers may be assigned. The validated project data, including qualifiers, will be entered into the project database, thus enabling this information to be retained or retrieved as needed.

5.2 Validation and Verification Methods

Data verification includes signed entries by the field and laboratory technicians on field data sheets and laboratory datasheets, respectively; review for completeness and accuracy by the FC and Laboratory Project Manager; review by the Project QA Manager for outliers and omissions; and the use of QC criteria to accept or reject specific data. Data will be entered into the EQuIS database, and a data file will be generated. A verification of the database file will be performed. One hundred percent of manually entered qualifiers will be verified. Any errors found will be corrected in the database.

Laboratory data will be reviewed and verified to determine whether DQOs have been met and that appropriate corrective actions have been taken, when necessary. The Project QA Manager or designee will be responsible for the final review of the data generated from analyses of samples.

The first level of review will take place in the laboratory as the data are generated. The laboratory department manager or designee will be responsible for ensuring that the data generated meet minimum QA/QC requirements and that the instruments were operating under acceptable conditions during data acquisition. DQOs will also be assessed at this point by comparing the results of QC measurements with pre-established criteria as a measure of data acceptability.

A Stage 4 validation will be conducted on one representative data package submitted from each laboratory, with the exception of geotechnical data. With the exception of the geotechnical data, Stage 2B validations will be conducted on the remainder of the data by Anchor QEA (or a subcontractor), in accordance with EPA National Functional Guidelines for Data Review (EPA 2020a, 2020b, 2020c) and this QAPP Addendum, unless the Stage 4 validations reveal errors or issues that warrant additional Stage 4 validations. Stage 1 validations will be conducted on geotechnical data. Chemical and physical data will be reviewed with regard to the following, as appropriate to the particular analysis:

- Data completeness
- Holding times
- Instrument performance checks
- Initial calibrations
- Continuing calibrations
- Column confirmation results
- Equipment blanks
- Method blanks
- Surrogate recoveries
- Detection limits
- Reporting limits
- Laboratory control samples
- Field and laboratory duplicates
- MS/MSD samples
- Standard reference material results
- Interference check samples
- Serial dilutions

The results of the data validation, including text assigning qualifiers in accordance with the EPA National Functional Guidelines for Data Review (EPA 2020a, 2020b, 2020c) and a tabular summary of qualifiers, will be generated by the validator and submitted to the Project QA Manager for final review and confirmation of the validity of the data.

5.3 Reconciliation with User Requirements

The Project QA Manager will review data after each survey to determine if DQOs have been met. If data do not meet the project's specifications, the Project QA Manager will review the outliers and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors and will then suggest corrective action. If problems cannot be corrected by retraining, revision of techniques, or replacement of supplies or equipment, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the Project QA Manager will consult with EPA and recommend appropriate modifications to either the laboratory or to the program requirements.

6 References

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Tables

Table B-1
Project Contact List

QAPP Recipients	Title	Organization	Telephone Number	Email Address
—	Emergency Response Team	EPA Region 10	(206) 553-4973	—
Ryan Barth	Project Manager	Anchor QEA, LLC	(206) 903-3334	rbarth@anchorqea.com
Nik Bacher	Field Coordinator	Anchor QEA, LLC	(206) 903-3376	nbacher@anchorqea.com
Laurel Menoche	Database Manager	Anchor QEA, LLC	(360) 715-2705	lmenoche@anchorqea.com
Delaney Peterson	QA/QC Manager	Anchor QEA, LLC	(360) 715-2707	dpeterson@anchorqea.com
Darwin Thomas	Laboratory Project Manager	Apex Laboratories, LLC	(503) 718-2323	dthomas@apex-labs.com
Shelly Fishel	Laboratory Project Manager	Analytical Resources, LLC	(206) 695-6210	shelly.fishel@arilabs.com
James Fox	Laboratory Project Manager	Enthalpy	(916) 673-1520	jfox@vista-analytical.com
Joe Tomei	Laboratory Project Manager	Geotesting Express	(978) 635-0424	Jtomei@geotesting.com

Notes:
—: not applicable
EPA: U.S. Environmental Protection Agency
QAPP: Quality Assurance Project Plan

Table B-2
Depth of Contamination Subsurface Sediment and Riverbank Angled Boring Soil Analytes, Methods, and Targeted Reporting Limits

Parameter	Recommended Analytical Method	Site-Wide RALs[1]	Navigation Channel RALs[1]	PTW Thresholds[1]	MDL[2]	MRL[2]
Geotechnical						
Moisture content	ASTM D2216	—	—	—	—	—
Specific gravity	ASTM D854	—	—	—	—	—
Grain size	ASTM D6913 & D7928	—	—	—	—	—
Atterberg limits	ASTM D4318	—	—	—	—	—
Conventionals (%)						
Total Solids	SM 2540 G	—	—	—	0.10	0.10
Total Organic Carbon	SM 5310 B	—	—	—	0.10	0.20
Polycyclic Aromatic Hydrocarbons (µg/kg)						
2-Methylnaphthalene	EPA 8270E	—	—	—	2.67	5.33
Acenaphthene	EPA 8270E	—	—	—	1.33	2.67
Acenaphthylene	EPA 8270E	—	—	—	1.33	2.67
Anthracene	EPA 8270E	—	—	—	1.33	2.67
Benzo(a)anthracene	EPA 8270E	—	—	—	1.33	2.67
Benzo(a)pyrene	EPA 8270E	—	—	—	2.00	4.00
Benzo(b)fluoranthene	EPA 8270E	—	—	—	2.00	4.00
Benzo(g,h,i)perylene	EPA 8270E	—	—	—	1.33	2.67
Benzo(b)+(k)Fluoranthene	EPA 8270E	—	—	—	4.00	8.00
Chrysene	EPA 8270E	—	—	—	1.33	2.67
Dibenz(a,h)anthracene	EPA 8270E	—	—	—	1.33	2.67
Fluoranthene	EPA 8270E	—	—	—	1.33	2.67
Fluorene	EPA 8270E	—	—	—	1.33	2.67
Indeno(1,2,3-c,d)pyrene	EPA 8270E	—	—	—	1.33	2.67
Naphthalene	EPA 8270E	—	—	140,000	2.67	5.33
Phenanthrene	EPA 8270E	—	—	—	—	—
Pyrene	EPA 8270E	—	—	—	1.33	2.67
cPAHs (BaP eq)[3,4]	—	—	—	774,000	—	—
Total PAHs[3,5]	—	30,000	170,000	—	—	—
PCB Aroclors (µg/kg)						
Aroclor 1016	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1221	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1232	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1242	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1248	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1254	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1260	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1262	EPA 8082A	—	—	—	2.00	4.00
Aroclor 1268	EPA 8082A	—	—	—	2.00	4.00
Total PCB Aroclors[3]	—	75	1,000	200	—	—
Dioxin/Furans (ng/kg)						
2,3,7,8-TCDD[6]	EPA 1613B	0.6	2	10	0.27	0.5
1,2,3,7,8-PeCDD[6]	EPA 1613B	0.8	3	10	0.61	2.5
1,2,3,4,7,8-HxCDD	EPA 1613B	—	—	—	0.71	2.5
1,2,3,6,7,8-HxCDD	EPA 1613B	—	—	—	0.67	2.5
1,2,3,7,8,9-HxCDD	EPA 1613B	—	—	—	0.69	2.5
1,2,3,4,6,7,8-HpCDD	EPA 1613B	—	—	—	0.66	2.5
OCDD	EPA 1613B	—	—	—	1.85	5.0
2,3,7,8-TCDF	EPA 1613B	—	—	600	0.26	0.5
1,2,3,7,8-PeCDF	EPA 1613B	—	—	—	0.72	2.5
2,3,4,7,8-PeCDF	EPA 1613B	200	1,000	200	0.74	2.5
1,2,3,4,7,8-HxCDF	EPA 1613B	—	—	400	0.92	2.5
1,2,3,6,7,8-HxCDF	EPA 1613B	—	—	—	0.77	2.5
1,2,3,7,8,9-HxCDF	EPA 1613B	—	—	—	0.74	2.5
2,3,4,6,7,8-HxCDF	EPA 1613B	—	—	—	0.77	2.5
1,2,3,4,6,7,8-HpCDF	EPA 1613B	—	—	—	0.89	2.5
1,2,3,4,7,8,9-HpCDF	EPA 1613B	—	—	—	0.77	2.5
OCDF	EPA 1613B	—	—	—	0.15	5.0
2,3,7,8-TCDD eq (2005 WHO TEQ)[3]	—	—	—	—	—	—
Low Resolution Pesticides (µg/kg)						
2,4'-DDD	EPA 8081B	—	—	—	0.50	1.00
2,4'-DDE	EPA 8081B	—	—	—	0.50	1.00
2,4'-DDT	EPA 8081B	—	—	—	0.50	1.00
4,4'-DDD	EPA 8081B	—	—	—	0.50	1.00
4,4'-DDE	EPA 8081B	—	—	—	0.50	1.00
4,4'-DDT	EPA 8081B	—	—	—	0.50	1.00
DDx[3]	—	160	650	7,050	—	—

Table B-2

Depth of Contamination Subsurface Sediment and Riverbank Angled Boring Soil Analytes, Methods, and Targeted Reporting Limits

Parameter	Recommended Analytical Method	Site-Wide RALs[1]	Navigation Channel RALs[1]	PTW Thresholds[1]	MDL[2]	MRL[2]
Parent and Alkylated Polycyclic Aromatic Hydrocarbons (µg/kg)						
1-Methylnaphthalene	EPA 8270D-SIM	—	—	—	0.378	5.00
1-Methylphenanthrene	EPA 8270D-SIM	—	—	—	0.496	5.00
2,3,5-Trimethylnaphthalene	EPA 8270D-SIM	—	—	—	0.449	5.00
2,6-Dimethylnaphthalene	EPA 8270D-SIM	—	—	—	0.388	5.00
2-Methylnaphthalene	EPA 8270D-SIM	—	—	—	0.445	5.00
Acenaphthene	EPA 8270D-SIM	—	—	—	0.459	5.00
Acenaphthylene	EPA 8270D-SIM	—	—	—	0.257	5.00
Anthracene	EPA 8270D-SIM	—	—	—	0.0468	5.00
Benzo(a)anthracene	EPA 8270D-SIM	—	—	—	1.41	5.00
Benzo(a)pyrene	EPA 8270D-SIM	—	—	—	0.977	5.00
Benzo(b)fluoranthene	EPA 8270D-SIM	—	—	—	0.794	5.00
Benzo(b)naphtho(2,1-d)thiophene	EPA 8270D-SIM	—	—	—	5.00	5.00
Benzo(b)thiophene	EPA 8270D-SIM	—	—	—	0.357	5.00
Benzo(e)pyrene	EPA 8270D-SIM	—	—	—	0.622	5.00
Benzo(g,h,i)perylene	EPA 8270D-SIM	—	—	—	0.519	5.00
Benzo(k)fluoranthene	EPA 8270D-SIM	—	—	—	0.794	5.00
Biphenyl	EPA 8270D-SIM	—	—	—	0.335	5.00
C1-Benzo(a)anthracenes/Chrysenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Benzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Decalins	EPA 8270D-SIM	—	—	—	—	10.00
C1-Dibenzo(a)anthracenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Dibenzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Fluoranthenes/Pyrenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Fluorenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Naphthalenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Naphthobenzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C1-Phenanthrenes/Anthracenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Benzo(a)anthracenes/Chrysenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Benzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Decalins	EPA 8270D-SIM	—	—	—	—	10.00
C2-Dibenzo(a)anthracenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Dibenzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Fluoranthenes/Pyrenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Fluorenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Naphthalenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Naphthobenzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C2-Phenanthrenes/Anthracenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Benzo(a)anthracenes/Chrysenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Benzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Decalins	EPA 8270D-SIM	—	—	—	—	10.00
C3-Dibenzo(a)anthracenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Dibenzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Fluoranthenes/Pyrenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Fluorenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Naphthalenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Naphthobenzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C3-Phenanthrenes/Anthracenes	EPA 8270D-SIM	—	—	—	—	10.00
C4-Benzo(a)anthracenes/Chrysenes	EPA 8270D-SIM	—	—	—	—	10.00
C4-Decalins	EPA 8270D-SIM	—	—	—	—	10.00
C4-Dibenzothiophenes	EPA 8270D-SIM	—	—	—	—	10.00
C4-Fluoranthenes/Pyrenes	EPA 8270D-SIM	—	—	—	—	10.00
C4-Naphthalenes	EPA 8270D-SIM	—	—	—	—	10.00
C4-Naphthobenzothiopenes	EPA 8270D-SIM	—	—	—	—	10.00
C4-Phenanthrenes/Anthracenes	EPA 8270D-SIM	—	—	—	—	10.00
Carbazole	EPA 8270D-SIM	—	—	—	0.711	5.00
Chrysene	EPA 8270D-SIM	—	—	—	0.706	5.00
cis-Decalin	EPA 8270D-SIM	—	—	—	0.486	5.00
Dibenzo(a,h)anthracene	EPA 8270D-SIM	—	—	—	0.674	5.00
Dibenzofuran	EPA 8270D-SIM	—	—	—	0.411	5.00
Dibenzothiophene	EPA 8270D-SIM	—	—	—	0.652	5.00
Fluoranthene	EPA 8270D-SIM	—	—	—	1.36	5.00
Fluorene	EPA 8270D-SIM	—	—	—	0.468	5.00
Indeno(1,2,3-cd)pyrene	EPA 8270D-SIM	—	—	—	0.372	5.00
Naphthalene	EPA 8270D-SIM	—	—	—	0.448	5.00
Perylene	EPA 8270D-SIM	—	—	—	0.449	5.00
Phenanthrene	EPA 8270D-SIM	—	—	—	0.934	5.00
Pyrene	EPA 8270D-SIM	—	—	—	1.02	5.00
Total Benzofluoranthenes	EPA 8270D-SIM	—	—	—	1.59	15.00
trans-Decalin	EPA 8270D-SIM	—	—	—	0.0286	5.00

Table B-2
Depth of Contamination Subsurface Sediment and Riverbank Angled Boring Soil Analytes, Methods, and Targeted Reporting Limits

Parameter	Recommended Analytical Method	Site-Wide RALs[1]	Navigation Channel RALs[1]	PTW Thresholds[1]	MDL[2]	MRL[2]
cPAHs (BaP eq)[2]	—	—	—	774,000	—	—
Total PAHs[2,3]	—	30,000	170,000	—	—	—
Total Petroleum Hydrocarbons (mg/kg)						
Diesel range organics	NWTPHDx	—	—	—	20.3	50.0
Motor oil range organics	NWTPHDx	—	—	—	21.0	

Notes:

1. The Sediment RALs and PTW Threshold Values are presented in Table 21 of the *Record of Decision – Portland Harbor Superfund Site* (EPA 2017) as amended by the Explanation of Significant Differences (EPA 2019), Errata #1 dated April 2018 (EPA 2018), Errata #2 dated January 2020 (EPA 2020), and Errata #3 dated September 2022 (EPA 2022).
2. Actual MDLs and QLs may vary based on sample aliquot size, moisture content, and required dilution factor.
3. cPAH (BaP eq), total PAHs, total PCBs, 2,3,7,8-TCDD eq, and DDx are calculated values; therefore, there are no MDLs or MRLs for these parameters.
4. Total cPAH is the sum of benzo(a)pyrene equivalent concentrations, calculated by multiplying the cPAHs by their respective potency factors. cPAHs include benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, and dibenzo(a,h)anthracene.
5. Total PAH is the sum of 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
6. As communicated in EPA's email with the subject "Portland Harbor RDGC Update - Dioxin RALS - FAQs" dated October 28, 2022, the remediation thresholds for TCDD and PeCDD are 0.001 and 0.0025 µg/kg, respectively. It is NW Natural's understanding that these remediation thresholds will be used in the BODR to fully delineate SMAs and identify DOC.

—: not applicable
µg/kg: micrograms per kilogram
ASTM: ASTM International
BaP Eq: benzo(a)pyrene equivalent
BODR: Basis of Design Report
cPAH: carcinogenic polycyclic aromatic hydrocarbon
DOC: depth of contamination
EPA: U.S. Environmental Protection Agency
MDL: method detection limit
mg/kg: milligrams per kilogram
MRL: method reporting limit
ng/kg: nanograms per kilogram
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PTW: principal threat waste
RAL: remedial action level
SM: Standard Method
SMA: sediment management area

Table B-3
Field and Laboratory Quality Control Sample Analysis Frequency

Analysis Type	Rinsate Blanks	Field Duplicates	Initial Calibration	Ongoing Calibration	LCS/SRM[2]	Duplicates	Matrix Spikes	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Geotechnical Analyses	—	—	—	—	—	—	—	—	—	—
Total Solids	—	1 per 20 samples	Daily	—	—	1 per 20 samples	—	—	—	—
Total Organic Carbon	—	1 per 20 samples	As needed[1]	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	—	1 per 20 samples	—
Pesticides	1 per collection method per event	1 per 20 samples	As needed[1]	1 per 10 samples	1 per 20 samples	—	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
PCB Aroclors	1 per collection method per event	1 per 20 samples	As needed[1]	1 per 10 samples	1 per 20 samples	—	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
TPH	—	—	As needed[1]	1 per 10 samples	1 per 20 samples	—	—	—	1 per 20 samples	Every sample
PAHs and Alkylated PAHs	1 per collection method per event	1 per 20 samples	As needed[1]	Every 12 hours	1 per 20 samples	—	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
Dioxin/Furans	1 per collection method per event	1 per 20 samples	As needed[1]	Every 12 hours	1 per 20 samples	1 per 20 samples	—[3]	—[3]	1 per 20 samples	Every sample

Notes:

1. Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.
2. When a standard reference material is available, it may be used in lieu of an LCS.
3. Isotope dilution is required by the method.

—: not applicable
LCS: laboratory control sample
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
SRM: standard reference material
TPH: total petroleum hydrocarbon

Table B-4
Data Quality Objectives

Parameter	Precision (Duplicate RPD)	Accuracy (Spike Recoveries)	Completeness
Soils and Sediments			
Geotechnical Analyses	—	—	95%
Total Solids	± 20% RPD	—	95%
TOC	± 25% RPD	70 to 130% R	95%
PAHs/alkylated PAHs	± 35% RPD	50 to 150% R	95%
TPH	± 35% RPD	50 to 150% R	95%
Dioxin/Furans	± 35% RPD	50 to 150% R	95%
PCB Aroclors	± 35% RPD	50 to 150% R	95%
Pesticides	± 35% RPD	50 to 150% R	95%

Notes:
—: not applicable
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
R: recovery
RPD: relative percent difference
TOC: total organic carbon
TPH: total petroleum hydrocarbon

Table B-5
Guidelines for Solids Sample Handling and Storage

Parameter	Sample Size	Container Size and Type[1]	Holding Time	Sample Preservation Technique	Laboratory
Moisture content	100 g	1 to 4 gallons in zip-top bags	None	None	GTX
Specific gravity	100 g		None	None	
Atterberg limits	100 g		None	None	
Grain size	100 g		None	None	
Total Solids	50 g	16 oz glass	None	Cool < 6°C	All
Total Organic Carbon	50 g		28 days	Cool < 6°C	Apex
			6 months	Freeze -18°C	
PCB Aroclors/ Pesticides	200 g		1 year until extraction	Freeze -18°C	
			40 days after extraction	Cool <6°C	
PAHs and alkylated PAHs, TPH	200 g	8 oz glass	14 days until extraction	Cool <6°C	ARL
			1 year until extraction	Freeze -18°C	
			40 days after extraction	Cool <6°C	
Dioxin/furans	30 g	4 oz glass	1 year to extraction	Freeze -18°C	Enthalpy
			1 year after extraction		

Notes:

1. Container size, type, and sample size required may change based on program and laboratory guidance.

—: not applicable
ARL: Analytical Resources, LLC
g: gram
GTX: Geotesting Express
oz: ounce
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl

Figure

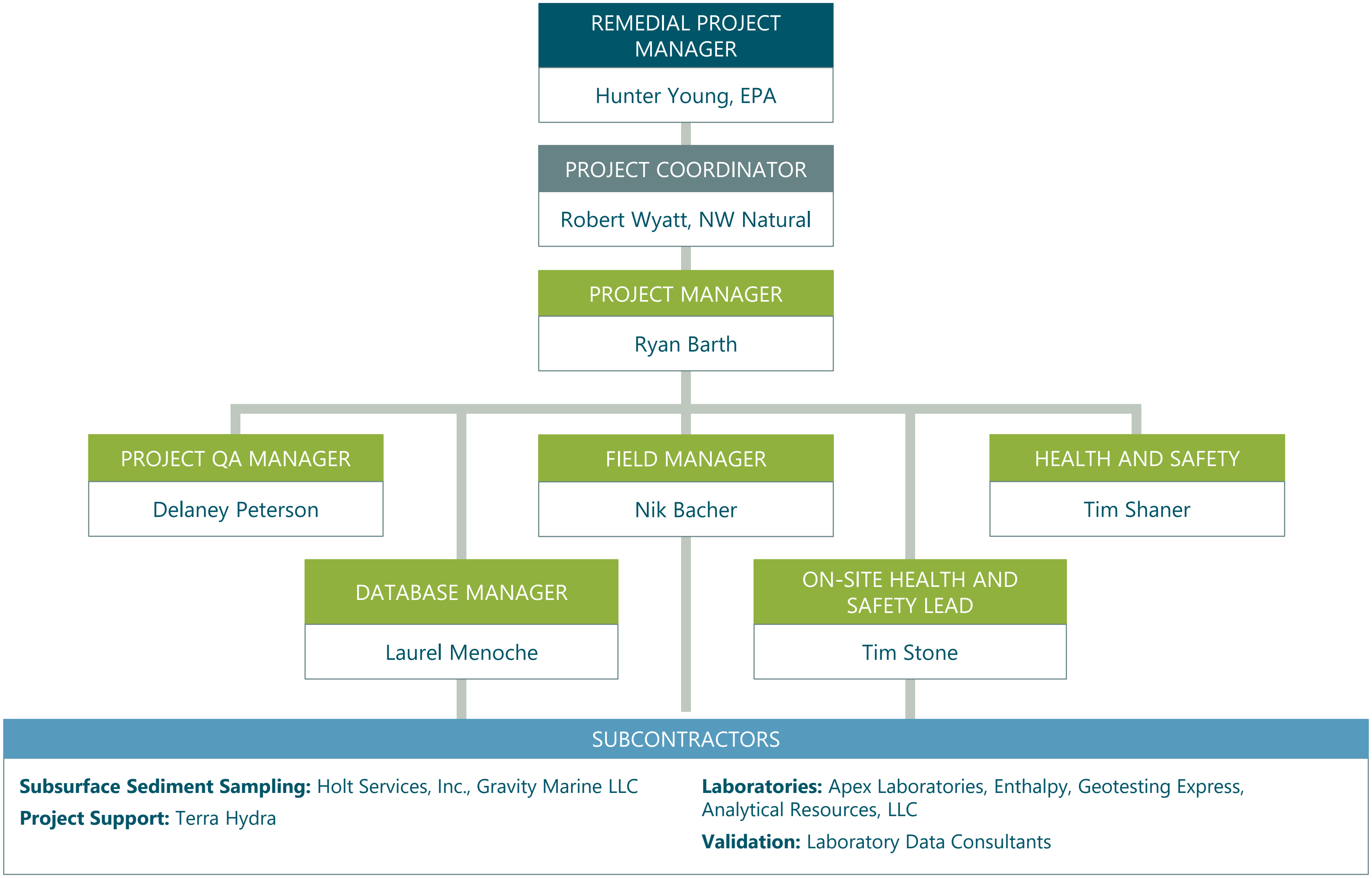

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Figure B-1
Project Organizational Chart
Pre-Remedial Design Data Gaps Quality Assurance Project Plan Addendum
Gasco Sediments Cleanup Action

Appendix C

Geoprobe Boring Logs

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number	Well Number	Sheet
	8128.01.08	**GP-25**	**1 of 7**

Project Name	**Siltronic Corporation**	TOC Elevation (feet above MSL)	
Project Location	**7200 NW Front Avenue**	Surface Elevation (feet above MSL)	
Start/End Date	**9/28/04 to 10/1/04**	Northing	**705,241.90**
Driller/Equipment	**Geo-Tech Explorations Inc./Geo-Probe**	Easting	**7,624,678.48**
Geologist	**MN/EB**	Hole Depth	**151.00**
Sample Method	**Geo-Probe**	Outer Hole Diam	**2-inch**

Depth (feet, BGS)	Well Details	Sample Data						Lithologic Column	Soil Description
		Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"		
0			**20%**	**GP** **GW**		**GP25-W-2**			**0.0 to 5.0 feet: NO RECOVERY.**
1									
2									
3									
4									
5									**5.0 to 16.0 feet: CLAYEY SILT (ML-CL); dark gray to black; 90% to 100% fines, medium to high plasticity; trace to 10% sand, fine to coarse; trace organics and woody debris; wet. NAPL globules with moderate odor and sheen at 6.0 feet.**
6			**60%**	**GP**		**PID = 0ppm**			
7									
8									
9									
10									
11			**50%**	**GP**		**PID = 0ppm**			
12									
13									
14									
15									
16			**70%**	**GP**		**PID = 0ppm**			**16.0 to 18.0 feet: SILTY SAND (SM); dark gray; 30% fines, medium to high plasticity; 70% sand, fine; strong odor and heavy sheen; wet.**
17									
18									**18.0 to 27.5 feet: CLAYEY SILT (ML-CL); dark gray; 95% to 100% fines, medium to high plasticity; trace to 5% sand, fine; trace organics; moderate to slight odor; wet.**
19									
20									

NOTES: *1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 9 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.*

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-25**	Sheet **2 of 7**

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
21			**80%**	**GP**		**PID = 0ppm**			
22									
23									
24									
25									
26			**100%**	**GP**		**PID = 0ppm**			
27									
28									**27.5 to 28.0 feet: SAND with SILT (SP-SM); dark gray; 10% fines, medium to high plasticity; 90% sand, fine; moderate odor and sheen; wet.** **28.0 to 29.5 feet: CLAYEY SILT (ML-CL); dark gray; 100% fines, medium to high plasticity; trace sand, fine; wet.**
29									
30									**29.5 to 30.0 feet: SAND (SP); dark gray; 100% sand, fine; trace fines; moderate odor with slight sheen; wet.** **30.0 to 31.0 feet: CLAYEY SILT (ML-CL); dark gray; 100% fines, medium to high plasticity; trace sand, fine; wet.**
31			**20%**	**GP**		**PID = 0ppm**			**31.0 to 35.5 feet: SAND (SP); dark gray; 100% sand, fine; trace fines; slight sheen; wet.**
32				**GW**					
33									
34						**GP25-W-36**			
35									
36			**25%**	**GP**		**PID = 0ppm**			**35.5 to 36.0 feet: SILT (ML); dark gray; 95% fines, low to medium plasticity; 5% sand, fine; wet.** **36.0 to 39.5 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; wet.**
37									
38									
39									**@ 39.0 feet: 1-inch layer of clayey silt.**
40									**39.5 to 40.0 feet: CLAYEY SILT (ML-CL); dark gray; 100% fines, medium to high plasticity; trace sand, fine; wet.** **40.0 to 41.0 feet: SILTY SAND (SM); dark gray; 20% fines, low plasticity; 80% sand, fine to medium; wet.**
41			**100%**	**GP**		**PID = 0ppm**			**41.0 to 43.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; wet.**
42									

NOTES: *1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 9 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.*

GBLWC GP25-32.GPJ 1/20/05

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-25**	Sheet **3 of 7**

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
									@ 42.5 feet: 3-inch layer of clayey silt.
43									**43.0 to 44.5 feet: CLAYEY SILT (ML-CL); dark gray; 100% fines, medium to high plasticity; trace sand, fine; wet.**
44									
45									**44.5 to 51.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; trace wood fibers; wet.**
46			**80%**	**GP**		**PID = 0ppm**			
47									
48									
49									
50									
51			**100%**	**GP**		**PID = 0ppm**			**51.0 to 61.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; wet.**
52									
53									
54									
55									
56			**75%**	**GP**		**PID = 0ppm**			
57									
58									
59									
60									
61			**90%**	**GP**		**PID = 0ppm**			**61.0 to 62.0 feet: SILTY SAND (SM); dark gray; 30% fines, medium plasticity; 70% sand, fine to medium; wet.**
62									**62.0 to 63.5 feet: CLAYEY SILT (ML-CL); dark gray; 95% fines, medium to high plasticity; 5% sand, fine; wet.**
63									**63.5 to 63.7 feet: WOODY DEBRIS.**
64									**63.7 to 69.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; wet.**
65									

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 9 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-25**	Sheet **4 of 7**

Depth (feet, BGS)	Percent Recovery	Collection Method	Name (Type)	Soil Description
66	100%	GP	PID = 0ppm	
67				
68				@68.5 feet: 3-inches clayey silt.
69				69.0 to 70.5 feet: SILTY SAND (SM); dark gray; 30% fines, medium plasticity; 70% sand, fine to medium; wet.
70		GW		70.5 to 72.5 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; wet.
71	100%	GP	PID = 0ppm	
72			GP25-W-74	72.5 to 74.0 feet: SILT with SAND (ML); dark gray; 70% fines, medium to high plasticity; 30% sand, fine; wet.
73				
74				74.0 to 75.5 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; trace gravel, fine, subrounded; wet.
75				75.5 to 86.0 feet: SILT (ML); dark gray; 90 to 95% fines, low to medium plasticity; 5 to 10% sand, fine; wet. Trace sandy fingers, fine.
76	100%	GP	PID = 0ppm	
77				
78				
79				
80				
81	100%	GP	PID = 0ppm	
82				
83				
84				
85		GW		
86	95%	GP	PID = 0ppm	86.0 to 91.0 feet: SAND (SP) and SILT (ML); dark gray; wet. Stratified 1/2-inch layers of alternating sands and silts.
87			GP25-W-89	

NOTES: 1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 9 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.

Maul Foster & Alongi Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.08	**GP-25**	**5 of 7**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
88									
89									
90									
91			**95%**	**GP**		**PID = 0ppm**			**91.0 to 93.0 feet: SAND (SW); dark gray; 100% sand, fine to coarse; trace fines; wet.**
92									
93									**93.0 to 95.0 feet: SILT (ML); dark gray; 90% fines, medium to high plasticity; 10% sand, fine to coarse; wet.**
94									
95									**95.0 to 95.5 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
96			**100%**	**GP**		**PID = 0ppm**			**95.5 to 98.5 feet: SILT (ML); dark gray; 100% fines, medium plasticity; trace sand and organic debris (rootlets); wet.**
97									
98									**98.5 to 99.5 feet: SILT with SAND (ML); dark gray; 80% fines, medium to high plasticity; 20% sand, fine to coarse; wet.**
99									**99.5 to 101.0 feet: SAND (SP); dark gray; 100% sand, fine to coarse; trace fines; wet.**
100									
101			**70%**	**GP**		**PID = 0ppm**			**101.0 to 106.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
102									
103									
104									
105									
106			**0%**	**GP**		**PID = 0ppm**			**106.0 to 111.0 feet: NO RECOVERY.**
107									
108									
109									
110									

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 9 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

GBLWC GP25-32.GPJ 1/20/05

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-25**	Sheet **6 of 7**

Depth (feet, BGS)	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Soil Description
111		90%	GP				**111.0 to 118.7 feet: SAND (SP); dark gray; 100% sand, fine to coarse; trace fines; micaceous; wet.**
112			GW				
113							
114					GP25-W-116		
115							
116		100%	GP		PID = 0ppm		
117							
118							
119							**118.7 to 119.0 feet: SILT (ML); dark gray; 100% fines, medium plasticity; trace sand; wet.** **119.0 to 123.5 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; micaceous; wet.**
120							**@ 120.0 feet: 1-inch layer of silt and trace woody debris.** **@ 120.5 feet: 2-inch layer of silt.**
121		90%	GP		PID = 0ppm		
122							
123							**123.5 to 126.0 feet: SANDY SILT (ML); dark gray; 70% fines, medium plasticity; 30% sand, fine to medium; wet.**
124							
125							**@ 125.0 feet: 2-inch layer of sand.**
126		50%	GP		PID = 0ppm		**126.0 to 128.0 feet: SAND (SW); dark gray; 100% sand, fine to coarse; trace fines; wet.**
127							
128							**@ 128.0 feet: 3/4-inch diameter piece of woody debris.** **128.0 to 136.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
129							**@ 129.0 feet: 2-inch layer of woody debris up to 1-inch in diameter.**
130							
131		100%	GP		PID = 0ppm		
132							

NOTES: *1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 9 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.*

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number	Well Number	Sheet
	8128.01.08	**GP-25**	**7 of 7**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
133									
134									
135									
136			**0%**	**GP**					**136.0 to 141.0 feet: NO RECOVERY.**
137									
138									
139									
140									
141			**50%**	**GP**					**141.0 to 146.0 feet: SAND (SW); dark gray; 10% fines, non plastic; 90% sand, fine to coarse; wet.**
142									
143									
144									
145									
146			**0%**	**GP**					**146.0 to 151.0 feet: NO RECOVERY.**
147				**GW**					
148									
149						**GP25-W-151**			
150									
151									**@ 151.0 feet: Equipment refusal.**

Total Depth = 151.0 feet bml.

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 9 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

GBLWC GP25-32.GPJ 1/20/05

Maul Foster & Alongi Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.08	**GP-26**	**1 of 6**

Project Name	**Siltronic Corporation**	TOC Elevation (feet above MSL)	
Project Location	**7200 NW Front Avenue**	Surface Elevation (feet above MSL)	
Start/End Date	**10/4/04 to 10/6/04**	Northing	**705,316.24**
Driller/Equipment	**Geo-Tech Explorations Inc./Geo-Probe**	Easting	**7,624,625.08**
Geologist	**MN/EB**	Hole Depth	**128.00**
Sample Method	**Geo-Probe**	Outer Hole Diam	**2-inch**

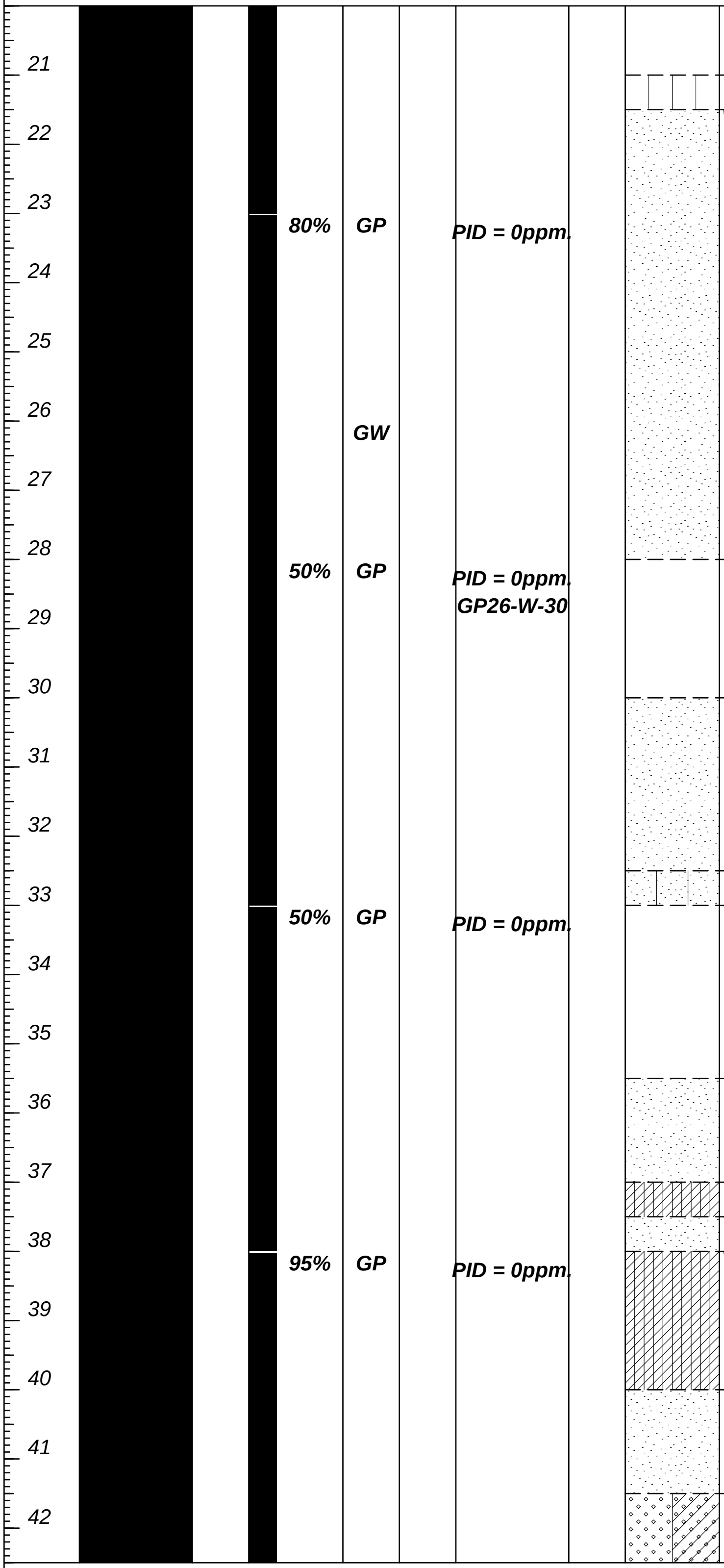
Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
			0%	GP GW		GP26-W-2			0.0 to 3.0 feet: NO RECOVERY.
			70%	GP				▨	3.0 to 8.0 feet: CLAYEY SILT (ML-CL); brownish-gray; 100% fines, medium to high plasticity, loose; heavy sheen and strong odor; wet. @ 7.0 feet: color change to dark grayish-black and NAPL present.
			50%	GP		PID = 92ppm.		▨	8.0 to 10.0 feet: NO RECOVERY. 10.0 to 18.0 feet: CLAYEY SILT (ML-CL); brownish-gray; 100% fines, medium to high plasticity, loose; heavy sheen and strong odor; wet. @ 11.0 feet: 3-inch layer of black 'tar-like' material, high plasticity and odor.
			60%	GP		PID = 41ppm.		▨	@ 13.0 feet: decreasing odor to slight/moderate. @ 13.5 feet: woody and organic debris.
			30%	GP		PID = 0ppm.			18.0 to 21.0 feet: NO RECOVERY.

NOTES: 1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 18 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.

Maul Foster & Alongi Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.08	GP-26	2 of 6



Sample Data

Depth (feet, BGS)	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"
23		80%	GP		PID = 0ppm	
26			GW			
28		50%	GP		PID = 0ppm GP26-W-30	
33		50%	GP		PID = 0ppm	
38		95%	GP		PID = 0ppm	

Soil Description

21.0 to 21.5 feet: CLAYEY SILT with SAND (ML-CL); dark brownish-gray; 80% fines, medium to high plasticity; 20% sand, fine; slight odor; wet.

21.5 to 28.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines and woody debris; slight sheen; wet.

@ 26.0 feet: 1/2-inch layer of silty sand.

28.0 to 30.0 feet: NO RECOVERY.

30.0 to 32.5 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines and woody debris; slight sheen; wet.

32.5 to 33.0 feet: SILTY SAND (SM); dark brownish-gray; 30% fines, non plastic; 70% sand, fine; wet.

33.0 to 35.5 feet: NO RECOVERY.

35.5 to 37.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.

37.0 to 37.5 feet: CLAYEY SILT (ML-CL); dark brownish-gray; 95% fines, medium to high plasticity; 5% sand, fine; wet.

37.5 to 38.0 feet: SAND(SP); dark gray; 100% sand, fine to medium; trace fines; wet.

38.0 to 40.0 feet: CLAYEY SILT (ML-CL); dark brownish-gray; 95% fines, medium to high plasticity; 5% sand, fine; wet.

@ 39.0 feet: 3-inch layer of sand.

@ 40.0 feet: 1/8-inch layer of silt or ash.

40.0 to 41.5 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.

41.5 to 43.0 feet: SAND (SP) and CLAYEY SILT (ML-CL); dark gray; wet. Stratified 2 to 4-inch layers of alternating sands and clayey silts.

NOTES: *1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 18 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.*

Maul Foster & Alongi Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.08	GP-26	3 of 6

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
43			60%	GP		PID = 0ppm.			**43.0 to 45.5 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
44									
45									**45.5 to 46.0 feet: WOODY DEBRIS.**
46									**46.0 to 48.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
47									
48			100%	GP		PID = 0ppm.			**48.0 to 53.0 feet: SANDY ORGANICS (OL/OH); dark grayish-brown; 60% sand, fine to medium; 40% organic material, fibrous; trace fines; wet.**
49									
50									
51									
52									
53			50%	GP		PID = 0ppm.			**53.0 to 53.5 feet: SILT (ML); dark gray; 100% fines, non plastic; trace organics; wet.** **53.5 to 61.0 feet: SAND (SP); dark gray; 95 to 100% sand, fine to medium; trace to 5% fines; wet.**
54									
55									
56				GW					
57									
58			90%	GP		PID = 0ppm. GP26-W-60			
59									
60									
61									**61.0 to 63.0 feet: SILT with SAND (ML); dark gray; 80% fines, medium plasticity; 20% sand, fine; wet.**
62									
63			90%	GP		PID = 0ppm.			**63.0 to 66.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
64									
65									

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 18 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-26**	Sheet **4 of 6**

Depth (feet, BGS)	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Soil Description
66							**66.0 to 67.5 feet: SILT with SAND (ML); dark gray; 80% fines, medium plasticity; 20% sand, fine to medium; wet.**
67.5							**67.5 to 69.5 feet: SILT (ML); dark gray; 100% fines, low to medium plasticity; trace sand, fine; wet.**
68		**90%**	**GP**		**PID = 0ppm**		
69.5							**69.5 to 71.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
71.0							**71.0 to 73.0 feet: SILT with SAND (ML); dark gray; 85% fines, low to medium plasticity; 15% sand, fine to medium; wet.**
73.0		**100%**	**GP**		**PID = 0ppm**		**73.0 to 78.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
78.0		**90%**	**GP**		**PID = 0ppm**		**78.0 to 81.0 feet: GRAVELLY SAND (SP); dark gray; 5% fines, medium to high plasticity; 80% sand, fine to medium; 15% gravels, fine to medium, subangular to subrounded; wet.**
79			**GW**				
81.0					**GP26-W-83**		**81.0 to 82.5 feet: SILT (ML); dark gray; 100% fines, medium to high plasticity; wet.**
82.5							**82.5 to 83.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**
83.0		**100%**	**GP**		**PID = 0ppm**		**83.0 to 85.0 feet: NO RECOVERY.**
85.0							**85.0 to 88.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.**

NOTES: **1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 18 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.**

GBLWC GP25-32.GPJ 1/20/05

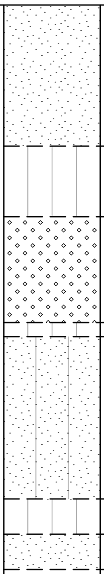
Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-26**	Sheet **5 of 6**

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
88			95%	GP					88.0 to 93.0 feet: SILT with SAND (ML); dark gray; 70% fines, medium plasticity; 30% sand, fine to medium; wet.
89									
90									
91									
92									
93			90%	GP		PID = 0ppm			93.0 to 96.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; wet.
94									
95									
96									96.0 to 98.0 feet: SILT (ML); dark gray; 90% fines, medium to high plasticity; 10% sand, fine to medium; wet.
97									
98			60%	GP		PID = 0ppm			98.0 to 100.0 feet: SAND (SP); dark gray; 100% sand, fine to coarse; trace fines; wet.
99									
100									100.0 to 103.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines and organics; wet.
101									
102									@ 102.0 feet: 3-inch layer of silt.
103			60%	GP		PID = 0ppm			103.0 to 112.0 feet: SAND (SP); dark gray; 100% sand, fine; trace fines; wet.
104									
105									@ 105.5 feet: 3-inch layer of silt with rootlets.
106				GW					
107									
108			90%	GP		PID = 0ppm			
109						GP26-W-110			
110									

NOTES: 1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 18 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-26**	Sheet **6 of 6**

Depth (feet, BGS)	Well Details	Sample Data						Lithologic Column	Soil Description
		Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"		
111									**@ 111.0 feet: 2-inch layer of silt with woody debris.**
112									**112.0 to 113.0 feet: SILT (ML); dark gray; 90% fines, low plasticity; 10% sand, fine to medium; wet.** **@ 112.5 feet: 1-inch layer of sand.**
113			**100%**	**GP**		**PID = 0ppm**			**113.0 to 114.5 feet: SAND (SW); dark gray; 100% sand, fine to coarse; trace fines; wet.**
114									
115									**114.5 to 114.7 feet: SILT (ML); dark gray; 100% fines, medium plasticity; wet.** **114.7 to 117.0 feet: SILTY SAND (SM); dark gray; 20% fines, non plastic; 80% sand, fine; wet.**
116									
117									**117.0 to 117.5 feet: SILT (ML); dark gray; 100% fines, medium plasticity; wet.** **117.5 to 118.0 feet: SAND (SP); dark gray; 100% sand, fine to coarse; trace fines; wet.**
118			**0%**	**GP**					**118.0 to 128.0 feet: NO RECOVERY.**
119									
120									
121									
122									
123									
124				**GW**					
125									
126						**GP26-W-128**			
127									
128									**@ 128.0 feet: Equipment refusal.**



Total Depth = 128.0 feet bml.

NOTES: *1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 18 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.*

GBLWC GP25-32.GPJ 1/20/05

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number	Well Number	Sheet
	8128.01.08	**GP-28**	**1 of 8**

Project Name	**Siltronic Corporation**	TOC Elevation (feet above MSL)	
Project Location	**7200 NW Front Avenue**	Surface Elevation (feet above MSL)	
Start/End Date	**10/13/04 to 10/15/04**	Northing	**705,168.68**
Driller/Equipment	**Geo-Tech Explorations Inc./Geo-Probe**	Easting	**7,624,798.89**
Geologist	**MN/AC**	Hole Depth	**160.00**
Sample Method	**Geo-Probe**	Outer Hole Diam	**2-inch**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
1 2 3 4 5			**20%**	**GP GW**		**GP28-W-2**			**0.0 to 5.0 feet: NO RECOVERY.**
6 7 8 9 10			**50%**	**GP**		**PID = 0ppm**			**5.0 to 10.0 feet: SILT (ML); dark gray; 90% fines, non plastic; 10% sand, fine; NAPL globules with strong odor and heavy sheen; trace gravel, coarse; wet.**
11 12 13 14 15			**50%**	**GP**		**PID = 0ppm**			**10.0 to 15.0 feet: SILT with SAND (ML); dark brownish-gray; 80% fines, non plastic; 20% sand, fine; slight odor; wet.** **@ 14.0 feet: Increase in stiffness.**
16 17 18 19 20			**50%**	**GP**		**PID = 0ppm**			**15.0 to 28.5 feet: SILT (ML); dark brownish-gray; 85 to 90% fines, non plastic; 10 to 15% sand, fine; slight to moderate odor; trace woody debris; wet. Black tar-like fines from 20.0 to 25.0 feet.**

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

Maul Foster & Alongi Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.08	**GP-28**	**2 of 8**

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
			90%	**GP**		**PID = 0ppm**			
21									
22									
23									
24									
25			**90%**	**GP**		**PID = 0ppm**			
26									
27									
28									**28.5 to 34.5 feet: SILTY SAND (SM); dark grayish-brown; 25 to 35% fines, non plastic; 65 to 75% sand, fine; micaceous; slight odor; moist to wet.**
29									
30			**100%**	**GP**		**PID = 0ppm**			
31									
32				**GW**					
33									
34						**GP28-W-36**			**34.5 to 45.0 feet: SAND (SP); dark brownish-gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet.**
35			**70%**	**GP**		**PID = 0ppm**			
36									
37									
38									
39									
40			**100%**	**GP**		**PID = 0ppm**			**@ 40.0 feet: 1-foot layer of sand, fine to coarse.**
41									
42									

NOTES: **1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.**

GBLWC GP25-32.GPJ 1/20/05

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-28**	Sheet **3 of 8**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
43									
44									
45			**100%**	**GP**		**PID = 0ppm**			**45.0 to 50.5 feet: SAND (SP); dark brownish-gray; 5% fines, non plastic; 95% sand, fine; micaceous; trace woody debris; wet.**
46									
47									
48									
49									
50			**90%**	**GP**		**PID = 0ppm**			**50.5 to 51.0 feet: SILT (ML); dark grayish-brown; 85% fines, non plastic; 15% sand, fine; slight odor; wet.**
51									**51.0 to 53.5 feet: SAND (SP); dark brownish-gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet.**
52									
53									**53.5 to 55.0 feet: SILTY SAND (SM); dark brownish-gray; 30% fines, non plastic; 70% sand, fine; micaceous; wet.**
54									
55			**50%**	**GP**		**PID = 0ppm**			**55.0 to 60.5 feet: SAND (SP); dark brownish-gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet.**
56									
57									
58									
59									
60			**100%**	**GP**		**PID = 0ppm**			**60.5 to 61.5 feet: SILTY SAND (SM); dark brownish-gray; 30% fines, non plastic; 70% sand, fine; micaceous; wet.**
61									**61.5 to 64.5 feet: SILT (ML); dark brownish-gray; 85% fines, non plastic; 15% sand, fine; wet.**
62									
63									
64									**64.5 to 75.0 feet: SAND (SP); dark brownish-gray; 5% fines,**
65									

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-28**	Sheet **4 of 8**

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
			90%	GP		PID = 0ppm			non plastic; 95% sand, fine; micaceous; trace gravels; wet.
66									
67									
68									
69									
70			100%	GP GW		PID = 0ppm			
71									
72						GP28-W-74			
73									
74									
75			0%	GP		PID = 0ppm			@ 74.5 feet: 1/2-foot zone with trace silt nodules, 1/4 to 1/2-inch in diameter. 75.0 to 80.0 feet: NO RECOVERY.
76									
77									
78									
79									
80			90%	GP					80.0 to 85.0 feet: SAND (SP); dark gray to dark brownish-gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet.
81									
82									
83									
84									
85			0%	GP GW		PID = 0ppm			85.0 to 90.0 feet: NO RECOVERY.
86									
87						GP28-W-89			

NOTES: 1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-28**	Sheet **5 of 8**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
88									
89									
90			**80%**	**GP**					**90.0 to 95.0 feet: SAND (SP); dark gray to dark brownish-gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet. Trace silt nodules, 1/4 to 1/2-inch diameter.**
91									
92									
93									
94									
95			**95%**	**GP**		**PID = 0ppm**			**95.0 to 100.0 feet: SILT (ML); dark brownish-gray; 85% fines, medium plasticity; 15% sand, fine to medium; wet.**
96									
97									
98									
99									
100			**95%**	**GP**		**PID = 0ppm**			**100.0 to 125.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; micaceous; wet.**
101									
102									
103									
104									
105			**30%**	**GP**		**PID = 0ppm**			
106									
107									
108									
109									
110									

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

Maul Foster & Alongi Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.08	**GP-28**	**6 of 8**

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
			95%	**GP**		**PID = 0ppm.**			
111									
112				**GW**					
113									
114						**GP28-W-116**			
115			**50%**	**GP**		**PID = 0ppm.**			
116									
117									
118									
119									
120			**60%**	**GP**					
121									
122									
123									
124									
125			**80%**	**GP**					***125.0 to 126.0 feet: SAND with SILT (SP-SM); dark gray; 10% fines, non plastic; 90% sand, fine to medium; micaceous; wet.***
126									***126.0 to 137.0 feet: SAND (SP); dark gray; 100% sand, fine to medium; trace fines; micaceous; wet.***
127									
128									
129									
130			**80%**	**GP**		**PID = 0ppm.**			
131									
132									

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

GBLWC GP25-32.GPJ 1/20/05

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number	Well Number	Sheet
	8128.01.08	GP-28	7 of 8

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
133									
134									
135			90%	GP					
136									
137									137.0 to 138.0 feet: SILT (ML); dark gray; 100% fines, medium plasticity; trace sand; wet.
138									138.0 to 143.0 feet: SAND with SILT (SP-SM); dark gray; 15% fines, non plastic; 85% sand, fine to medium; micaceous; wet.
139									
140			100%	GP					
141									
142									
143									143.0 to 150.0 feet: SILT with SAND (ML); dark gray; 75 to 85% fines, medium plasticity; 15 to 25% sand, fine; wet.
144									
145			100%	GP					
146									
147									
148									
149									
150			0%	GP					150.0 to 160.0 feet: NO RECOVERY.
151									
152									
153									
154									
155									

NOTES: *1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.*

Maul Foster & Alongi Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.08**	Well Number **GP-28**	Sheet **8 of 8**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Sample Data: Percent Recovery	Sample Data: Collection Method	Sample Data: Number	Sample Data: Name (Type)	Sample Data: Blows/6"	Lithologic Column	Soil Description
156				**GW**					
157									
158						**GP28-W-160**			
159									
160									**@ 160.0 feet: Equipment refusal.**

Total Depth = 160.0 feet bml.

NOTES: ***1) Sample depths are relative to feet below mud line (bml). 2) GP = Geo-Probe, 2-inch Macro Core soil sampler. 3) PID = Photo ionization detector, soil head space reading. 4) ppm = parts per million. 5) bgs = below ground surface. 6) GW = groundwater sample, dashed graphic indicates screened interval. 7) NA = not available. 8) Odor characteristic of manufactured gas plant waste. 9) Geoprobes GP-25 through GP-32 drilled from barge. 10) Depth to mudline approximately 5 feet below barge deck. 11) NAPL = Non-aqueous phase liquid.***

Appendix D

Response to EPA Comments on the Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area Memorandum

6720 South Macadam Avenue, Suite 125
Portland, Oregon 97219
503.670.1108

Memorandum

March 23, 2023

To: Hunter Young, U.S. Environmental Protection Agency

From: Ryan Barth, Anchor QEA

cc: Bob Wyatt, NW Natural; Patty Dost, Pearl Legal Group; Lance Peterson, CDM Smith;
Joe Smith and Jen Mott, Anchor QEA

Re: NW Natural Response to EPA's Comments on the *Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area*

This memorandum was prepared by Anchor QEA on behalf of NW Natural and provides responses to the U.S. Environmental Protection Agency's (EPA's) comments dated February 16, 2023, on the *Additional Depth of Contamination Characterization Addendum within the Gasco Sediments Site Project Area* (DOC Addendum) dated January 13, 2023 for the Gasco Sediments Site Project Area (Project Area). Any necessary revisions associated with these responses are incorporated into the Final Revised DOC Addendum.

EPA General Comments on DOC Addendum

EPA General Comment 1

Sediment Management Area (SMA) Uncertainty Evaluation: A SMA uncertainty evaluation for the Gasco Project Area has not been provided for EPA review at this time. Therefore, it is possible that additional sampling to address data gaps identified by the uncertainty analysis may be required at a later date.

> **NW Natural Response**
>
> Comment noted. An SMA uncertainty evaluation for the Project Area will be developed in consultation with EPA and provided in the forthcoming *Revised Basis of Design Report*. NW Natural assumes this comment pertains to EPA Comment 215 on the Combined BOD-PDR and will respond to that comment in the *Revised Basis of Design Report*.

EPA General Comment 2

Data Replacement: The DOC Addendum proposes "data replacement" for three geobprobe cores: GP25, GP26, and GP28. The main objective of these cores is to confirm the DOC at these locations due to the concerns with the geoprobe samples discussed in the DOC Addendum. EPA does not consider this to be data replacement and maintains that only surface sediment data replacement is allowed due to potentially changing surface conditions. However, similar to EPA's guidelines for surface sediment data replacement (Remedial Design Guidelines and Considerations, Appendix B, Topic 10), arguments that lead to dramatically smaller remediation volumes would require higher data densities. Additionally, it is noted that the rationale provided for data replacement at GP25, GP26, and GP28 is focused primarily on speculation about sampling issues with these geoprobe cores. The DOC Addendum should be revised as follows:

a. Revise the text and tables to identify the objectives of these cores to data confirmation. Any modifications to the remedial design dataset can be discussed with EPA after the new data becomes available.

b. Revise the rationale provided to include additional discussion of the quality of data compared to other cores in the area and site-specific conceptual site model based rationale (e.g., the anticipated DOC based on site operations and data from surrounding areas). In addition, a full comparison of the lines of evidence used to question the validity of data from GP25, GP26, and GP28 should be applied to all the historical geoprobe cores. This would allow for a determination whether any or all of these attributes apply to other geoprobe cores not proposed for resampling.

c. Collect at least three cores at each of the three locations requiring DOC confirmation (i.e., GP25, GP26, and GP28) so that a statistically significant number of samples can be used to verify the subsurface conditions at these locations. Each of the new cores should sample the depth consistent with DOC identified in historical cores.

NW Natural Response

a. The text and tables have been revised consistent with the comment.

b. The text and tables have been revised consistent with the comment. Other historical geoprobe borings are not proposed for resampling because they are located proximate to more recent cores collected during the 2019/2020 pre-design investigation within the Project Area, and the DOCs for the borings and cores were similar.

c. The text and tables have been revised consistent with the comment.

EPA General Comment 3

Contingency Cores: The intended purpose of the contingency coring locations PDI-212 and PDI-213 included in Figure 2, Figure A-2, and Table A-1 should be discussed in the main DOC Addendum text, along with the criteria to be used to trigger sampling at these locations.

NW Natural Response

The objective of the contingency coring locations, PDI-212 and PDI-213, was revised such that these proposed locations will be collected to support data verification at GP25, GP26, and GP28. See response to EPA General Comment 2c.

EPA General Comment 4

Visual/Olfactory Signs of Contamination: Visual and olfactory signs of contaminations used to identify samples to be analyzed should include observations of any material meeting the ASOAC definition of 'substantial product' (e.g., immobile tar deposit) as it is expected that substantial product will be included within the in situ stabilization and solidification (ISS) treatment prism. Field observations recorded in core logs should specifically identify the presence of substantial product as defined by in the ASAOC as well as mobile PTW-NAPL defined in Section 3.1.

NW Natural Response

NW Natural agrees that the sediments and riverbank soils containing "substantial product," as defined in the Administrative Settlement Agreement and Order on Consent (ASAOC), would achieve the criteria for visual or olfactory signs of contamination to be used to identify samples to be analyzed for analytes with a ROD Table 21 RAL or PTW threshold.

Revisions were made to Sections 3.2.3 and 3.3.3 of Appendix A to note that field observations of substantial product will be recorded in the core logs.

EPA Specific Comments on DOC Addendum

EPA Specific Comment 1

Introduction, page 2: NW Natural proposes collecting a subsurface sediment core in close proximity to cores SC-S113 (collected in 2018 as part of the Pre-Remedial Design Group's harbor-wide baseline sampling) and PDI-029 (collected in 2019 as part of the Gasco Pre-Design Investigation (PDI) sampling). The DOC at cores SC-S113 and PDI-029 was 13 feet and 2 feet, respectively, despite the cores being only several feet apart. The DOC Addendum does not specify how a third DOC determined by the proposed core would be used relative to the existing DOCs. Revise the DOC Addendum to clarify how the collective DOCs identified by the proposed additional core, SC-S113 and PDI-029, will be used to determine the DOC to be applied to this portion of the project area during remedial design. Also see general comment 2 regarding data replacement.

NW Natural Response

The referenced text has been removed from the Final Revised DOC Addendum. The additional proposed core at this location (PDI-193) will be collected to vertically bound SC-S113 (unbounded at 13 feet). Samples will either be collected from the 13- to 14-foot and 14- to 15-foot depth intervals unless visual or olfactory signs of contamination are observed at deeper depths, in which case samples will be collected at the deeper depths consistent with the Final Revised DOC Addendum.

EPA Specific Comment 2

Subsurface Sediment and Riverbank Soils Characterization Locations and Sampling Technologies, pages 2 and 3: In addition to the sampling scheme shown in Figure 3, core intervals corresponding to the DOC in historical cores GP25, GP26, and GP28 should also be submitted for analysis. Additionally, because NW Natural is proposing to confirm the DOC at these locations based on newer data, additional cores in the vicinity of these locations should be considered to confirm lateral distribution of contamination in these areas (see general comment 2c).

NW Natural Response

The text has been revised consistent with the comment. A new schematic was added for these scenarios (see Figure 4 of the Final Revised DOC Addendum).

EPA Specific Comment 3

Subsurface Sediment and Riverbank Soils Characterization Locations and Sampling Technologies, pages 2-4: EPA has the following comments on this section and the text should be revised accordingly:

a. The hypothesis presented in the first bullet point is unsupported. Chemical analysis of samples at the historical DOC in each of the three cores should be conducted to evaluate this hypothesis.

b. Add a bullet point to clarify that these cores were not sampled for chemical analysis throughout the length of the core as evidenced by the sample depths shown on Table 3a.

c. Revise the text to clarify that the 25 locations that are to be reoccupied and sampled in 1-foot intervals will not replace the existing sediment cores except to delineate DOC based on two consecutive 1-ft intervals. Data from both historical and newly collected subsurface samples will be used for remedial design purposes.

d. The first sentence of the last paragraph on page 3 states: "At an additional four locations, the DOC is vertically bounded by only a single 1-foot interval, which is inconsistent with EPA's RDGC (EPA 2021)." Add the following to the end of the sentence: "which defines the boundary as two consecutive clean 1-foot intervals."

e. **Footnote 2:** Clarify whether the locations where DOC is not determined using vibracoring will be revisited under the currently proposed Sonic drilling deployment or at a later date.

f. See EPA general comment 2 on data replacement.

NW Natural Response

a. The text has been revised consistent with the comment.

b. The text has been revised consistent with the comment.

c. The text has been revised consistent with the comment.

d. The text has been revised consistent with the comment.

e. The text has been revised consistent with the comment.

f. See response to EPA General Comment 2.

EPA Specific Comment 4

Sample Collection, Processing and Handling Procedures, Top of Riverbank Angled Borings, page 5: EPA has the following comments on this section and the text should be revised accordingly:

a. Clarify the target depth for angled riverbank borings. EPA assumes the deepest adjacent sediment remedial action level/principal threat waste exceedance will be targeted like previous riverbank angles borings.

b. **Bullet point 2:** Revise the text to justify the exclusion of record of decision Table 17 analytes for riverbank sampling, especially as it relates to the proposed ISS remedial technology.

NW Natural Response

a. The text has been revised consistent with the comment.

b. The text has been revised consistent with the comment.

EPA Specific Comment 5

Laboratory Analyses, Scenario 2, page 6: In the case of vertically bounded locations without two consecutive 1-foot intervals, the previous DOC sample interval should also be submitted for analysis.

NW Natural Response

The text has not been revised because there is no identified data use for remedial design associated with resampling a historical sample depth interval at these locations. If this comment pertains to historical sample intervals that are greater than 1 foot thick (e.g., a 4-foot sample interval), please refer to the approach presented in the text in the Laboratory Analysis section regarding “At Vertically Unbounded Locations with Greater Than 1-Foot-Thick Sample Intervals.”

EPA Specific Comment 6

Laboratory Analyses, At Vertically Unbounded Locations with Historical Geoprobe Borings, Step 1 pages 7 and 8: The sample intervals from the DOC identified by the historical geoprobe samples should be submitted for analysis regardless of depth or visual/olfactory signs of contamination.

NW Natural Response

The text has been revised consistent with the comment.

EPA Specific Comment 7

Table 3a: Table 3a should be revised to show all of the analyzed COCs (VOCs and SVOCs).

NW Natural Response

The table presents COCs with ROD Table 21 RALs or PTW thresholds; therefore, the table has not been revised because there are no ROD Table 21 RALs or PTW thresholds associated with the other VOCs and SVOCs. Consistent with the ROD and EPA's *Remedial Design Guidelines and Considerations* (EPA 2021), DOC is defined as two consecutive 1-foot intervals without a ROD Table 21 RAL exceedance or the presence of PTW.

EPA Specific Comments on DOC Addendum Appendix A (Pre-Remedial Design Data Gaps Field Sampling Plan Addendum)

EPA Appendix A General Comment 1

Purpose and Objectives of the Field Sampling Plan Addendum, Section 1.1, page 1: this section notes that the Field Sampling Plan (FSP) Addendum has been slightly modified from the EPA-approved Pre-Remedial Design Data Gaps FSP submitted as Appendix A of the DGWP (Anchor QEA 2019). This section should specify the nature of the modifications.

NW Natural Response

The text has been revised consistent with the comment.

EPA Appendix A General Comment 2

Riverbank Angled Borings Sampling Plan, Section 3.2.1, pages 3 and 4: Revise the text to include information on the target sample interval depth the proposed angled borings intend to achieve. The DGWP FSP previously included depth of boring information.

NW Natural Response

The text has been revised consistent with the comment.

EPA Appendix A General Comment 3

Soil Logging and Processing Procedures, Section 3.2.3, pages 4 and 5: EPA has the following comments on this section and the text should be revised accordingly:

a. Clarify whether AutoCAD calculations to correct vertical sample depth are based on the same equation provided in Section 3.3.3, Appendix A of the DGWP.

b. Revise the text to include information on the target depth of the proposed sampling intervals as previously included in the corresponding section of the DGWP FSP.

NW Natural Response

a. The text has been revised consistent with the comment.

b. A reference has been added to Section 5.1, where the analytical sampling approach is presented in detail.

EPA Appendix A General Comment 4

Vibratory Core Sampling, Section 3.3.2.1, pages 7 and 8: Revise the following text to include the option for utilizing sonic drilling methods as previously discussed in the section when refusal or poor recovery impacts the ability to identify the DOC: "If multiple core rejections (three attempts) occur within a 20-foot radius of the planned location, the core with the best recovery will be deemed acceptable and processed. If moving a core location (location X) due to refusal, low recovery, or obstruction results in that location being collected within 50 feet of another proposed core location (location Y), then the second proposed location (location Y) may not be collected."

NW Natural Response

The text has been revised consistent with the comment.

EPA Appendix A General Comment 5

Subsurface Sediment Core Logging and Processing Procedures, Section 3.3.3, pages 8 and 9: EPA has the following comments on this section and the text should be revised accordingly:

a. Core processing procedures should include the use of a sediment/water shake test when visually assessing for the presence of PTW-NAPL to be in agreement with ASTM standards.

b. Revise the text to include information on sampling intervals as previously included in the corresponding section of the DGWP FSP.

NW Natural Response

a. The text has not been revised because, as discussed in the FSP Addendum, the presence of PTW-NAPL will be determined based on the Project Area-specific definition of PTW-NAPL that requires NAPL to "ooze" or "drip" out of the core during core observations. These determinations will be made after a small depression(s) has been made in each core to determine if NAPL freely flows into the depression(s). This procedure is consistent with the approach presented in Section 3.1.1 of the EPA-approved *Revised Pre-Remedial Design Data Gaps Work Plan* (Anchor QEA 2019). Using shake tests to make PTW-NAPL designations would be inconsistent with all previous EPA approvals performed in the Project Area.

b. A reference has been added to Section 5.1, where the analytical sampling approach is presented in detail.

EPA Appendix A General Comment 6

Chemical and Physical Testing, Section 5, page 17/Table A-1: The text states that "the anticipated sampling intervals for the chemical and physical testing are shown in Table A-1". Table A-1 does not include this information, revise Table A-1 to include the anticipated sampling intervals for the chemical and physical testing.

NW Natural Response

This text has been removed from the FSP Addendum. Sample intervals cannot be included in Table A-1 because they will be determined in the field based on visual and olfactory signs of contamination within each individual core and characteristics of the vertically unbounded cores (e.g., thickness of previously sampled intervals). A detailed discussion of the sample analysis plan is discussed in Section 5.1 of the FSP Addendum.

EPA Appendix A General Comment 7

Table A-2: The corresponding version of Table A-2 from the DGWP FSP included information on depth intervals. Revise Table A-2 to include the depth information.

NW Natural Response

Sample intervals cannot be included because they will be determined in the field based on visual and olfactory signs of contamination within each individual riverbank angled boring. A detailed discussion of the sample analysis plan is discussed in Section 5.1 of the FSP Addendum.

EPA To Be Considered Comment on DOC Addendum Appendix A (Pre-Remedial Design Data Gaps Field Sampling Plan Addendum)

EPA Appendix A To Be Considered Comment 1

Table A-1: Table A-1 provides the locations and proposed coring technology for each proposed sampling location. It would be helpful for this table to identify the undelineated DOC observed at the nearest historical core and the target penetration depth for each location.

NW Natural Response

The nearest adjacent vertically unbounded core ID and the vertically unbounded DOC have been added to Table A-1. For proposed vibracores, the entire 30-foot core barrel will be advanced. Sonic cores will be advanced beyond the vertically unbounded DOC until sufficient material has been recovered to achieve the sample analysis schemes detailed in Section 5.1 of the FSP Addendum.

References

Anchor QEA, 2019. *Revised Pre-Remedial Design Data Gaps Work Plan*. Gasco Sediments Cleanup Action. Prepared for U.S. Environmental Protection Agency, Region 10. Prepared on behalf of NW Natural. September 11, 2019.

EPA, 2021. *Remedial Design Guidelines and Considerations, Portland Harbor Superfund Site, Portland, Oregon*. April 23, 2021.