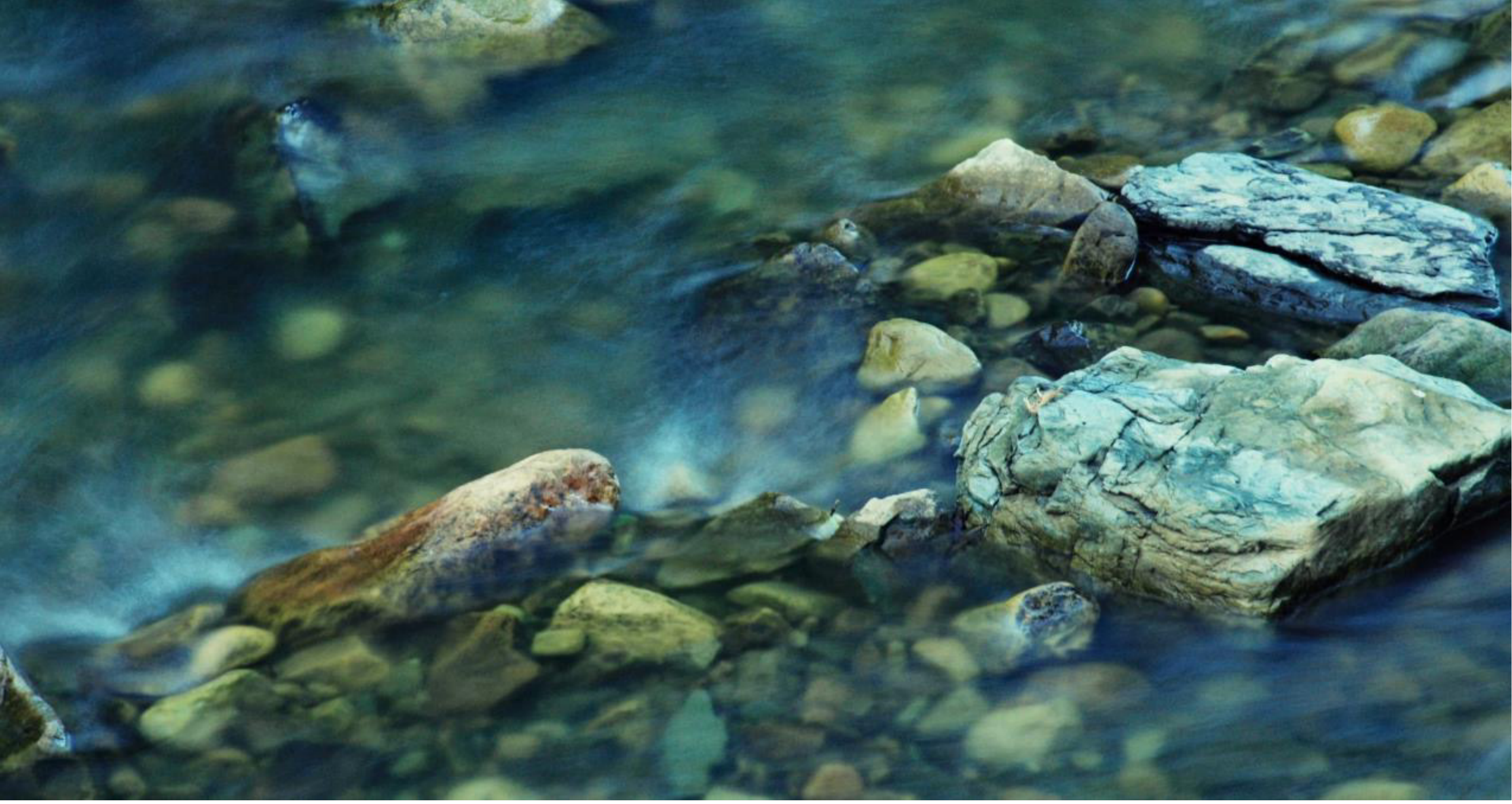

August 2025
Tru-Grit Site Data Gaps Field Investigation

Sampling and Quality Assurance Project Plan Addendum #2

Prepared for Port of Tacoma

August 2025
Tru-Grit Site Data Gaps Field Investigation

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Prepared for
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Project Number: 240092-03.06

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ABBREVIATIONS

CanAm	CanAm Minerals, Inc.
CSL	Cleanup Screening Level
Ecology	Washington State Department of Ecology
FNC	federal navigation channel
FS	feasibility study
H:V	horizontal to vertical
IDW	investigation-derived waste
MLLW	mean lower low water
MSS	Marine Sampling Systems, LLC
PCB	polychlorinated biphenyl
PM	project manager
Port	Port of Tacoma
QA/QC	quality assurance/quality control
SCO	Sediment Cleanup Objective
SCUM	*Sediment Cleanup User's Manual*
Site	Tru-Grit site
SMS	Sediment Management Standards
SQAPP	Sampling and Quality Assurance Project Plan
SVOC	semivolatile organic compound
Tru-Grit	Tru-Grit Abrasives, Inc.
USACE	U.S. Army Corps of Engineers

1 Introduction

On behalf of the Port of Tacoma (Port), Anchor QEA has prepared this Sampling and Quality Assurance Project Plan Addendum #2 (Addendum) that details sample collection methods and analytical protocols for additional subsurface sediment data collection in the Tru-Grit Abrasives, Inc. (Tru-Grit) site (Site) at 1110 East Alexander Avenue, Tacoma, Washington.

Investigation of the Site was conducted under an Agreed Order (No. DE-8978; Ecology 2012) executed between the Washington State Department of Ecology (Ecology) and CanAm Minerals, Inc. (CanAm; parent company of Tru-Grit). CanAm was identified by Ecology as a potentially liable person under the Washington State Model Toxics Control Act due to releases of an ore-derived grit material containing elevated concentrations of copper and zinc. Work completed to date by CanAm includes a remedial investigation (Landau 2021) and draft feasibility study (FS; Landau 2019). Cleanup of Site-related contaminated sediments has not yet been implemented.

The U.S. Army Corps of Engineers (USACE) is planning to deepen the federal navigation channel (FNC) in the Blair Waterway. In 2024, further sampling was conducted to delineate the extent of Site-associated contaminated sediments that could be impacted by the deepening project (Anchor QEA 2024). The Port plans to remove those contaminated sediments prior to the FNC deepening conducted by USACE. Based on review of the 2024 data and limited core penetration and associated sample recovery, further investigation was conducted to evaluate the vertical extent of contamination and further delineate the eastern boundary of the Site (Anchor QEA 2025). Based on review of the 2024 and 2025 data, additional investigation is needed to evaluate the horizontal extent of contamination along the eastern Site boundary.

This Addendum expands on the original Sampling and Quality Assurance Project Plan (SQAPP; Anchor QEA 2024) and SQAPP Addendum (Anchor QEA 2025) and includes additional testing along the eastern boundary of the Site in the vicinity of the former A.H. Powers Dock (Powers Dock); Figure 1). Planned testing includes the following:

- Three new subsurface sediment sampling locations for chemical testing
- Eight surface grab sampling locations in the Upper Slope area for chemical testing and contingent bioassay testing

Sampling is anticipated to occur in August 2025.

This Addendum was prepared based on Anchor QEA's understanding of USACE's plan to deepen the FNC to -57 feet mean lower low water (MLLW), plus a 2-foot overdredge (final elevation to -59 feet MLLW). The side slopes for the dredging were calculated using a 10-foot buffer landward of the FNC boundary identified by USACE in the FS phase (feasibility boundary) and a 2 horizontal to 1 vertical (2H:1V) slope ratio.[1]

- Lower Slope Testing: One new core and grab sample (TG-SC30 and TG-SG30, respectively) are proposed to characterize material contained within the Lower Slope areas adjacent to the side slopes of the FNC deepening program (Figure 1).
- Upper Slope Testing: The remaining samples are to be collected in areas of the Upper Slope that are not expected to be affected by the deepening program. Testing in these Upper Slope areas is being performed to confirm the limits of Site-associated sediment contaminants along the eastern edge of the Tru-Grit Site to inform Port remediation planning.

1.1 Site History

For a detailed summary of Site history, please see the original SQAPP (Anchor QEA 2024).

The additional sampling described in this Addendum #2 extends to the east in the areas surrounding the former Powers Dock. The Powers Dock area was historically used by the former property owner and their tenants for staging of marine construction equipment. The contaminants detected in subsurface testing completed in portions of this area (heavy metals and blasting grit) are similar to those present in the former Tru-Grit operational areas. However, the contamination in these eastern areas may include contributions from other operations that historically occurred around the Powers Dock.

1.2 Document Organization

This SQAPP Addendum was prepared in accordance with Ecology guidance, as described in the *Sediment Cleanup User's Manual* (SCUM; Ecology 2021). This SQAPP Addendum is organized into the following sections:

- Section 2: Existing Data and Data Gaps
- Section 3: Project Management
- Section 4: Sample Collection Modifications
- Section 5: Quality Assurance/Quality Control
- Section 6: Contingent Biological Testing
- Section 7: Assessments and Response Actions
- Section 8: Data Validation, Usability, and Reporting
- Section 9: References

[1] The feasibility boundary is a conservative boundary that assumes a wider navigation channel closer to the Site, but the preliminary engineering and design evaluations by USACE may result in a narrower FNC boundary farther from the Site. The 2H:1V side slope line is also conservative because deepening the FNC is expected to result in side slopes outside the FNC that are steeper than 2H:1V.

Table 1 summarizes the sample locations, coordinates, sample intervals, and planned analyses. Figure 1 shows target sample locations. Table 2 is included in this Addendum to reflect the parameters for analysis updated from the original SQAPP. Table 3 is included in this Addendum to reflect sample handling and storage guidelines for new analyses that were not included in the original SQAPP. Bioassay performance standards and evaluation guidelines are included in Table 4. Field forms are included in Appendix A.

2 Existing Data and Data Gaps

Refer to the original SQAPP (Anchor QEA 2024) for a detailed summary of the previous in-water and upland investigations conducted at the Site.

3 Project Management

This section discusses updates from the original SQAPP (Anchor QEA 2024) to the proposed project team and team member responsibilities for conducting the field investigation. Refer to the original SQAPP (Anchor QEA 2024) for the training and certification requirements for sampling personnel and documentation and recordkeeping procedures.

3.1 Project and Task Organization

Quality Assurance/Quality Control (QA/QC) Manager Ali Judkins will provide QA/QC oversight for both the field sampling and laboratory programs, ensure samples are collected and documented appropriately, coordinate with the analytical laboratories, ensure data quality, oversee data validation, and supervise project QA coordination and data validation.

4 Sample Collection Modifications

The rationale for the sample collection modifications for the SQAPP Addendum is provided in this section. The original SQAPP (Anchor QEA 2024) includes design assumptions for locating and selecting samples, as well as methods and procedures for the collection of field samples. Sampling will be conducted following standard procedures documented in the original SQAPP (Anchor QEA 2024). In general, all sampling procedures will also comply with previously approved sample collection standards established for the study area. Sampling for this addendum will be conducted with Marine Sampling Systems, LLC (MSS). Sediment cores and grab samples will be collected aboard the marine sampling vessel owned and operated by MSS. The marine sampling vessel will operate using a hydraulically actuated vibracore (for collection of subtidal core samples) and a hydraulically powered sediment grab sampler (for collection of intertidal grab samples).

4.1 Sampling Design Modifications

Preliminary Tier 1 data from the 2024 and 2025 field investigations were screened against Washington State Sediment Management Standards (SMS) Sediment Cleanup Objectives (SCOs) and Cleanup Screening Levels (CSLs; Ecology 2021). Based on screening results, additional sampling and testing are needed to delineate the extent of SCO and CSL exceedances. Table 1 summarizes the sample locations, coordinates, sample intervals, and planned analyses. Figure 1 shows target sample locations.

Preliminary Tier 1 data from the 2025 field investigation indicate elevated concentrations for metals that have not been bounded on the eastern edge of the Site. Rationale for adding new locations is described in the following sections.

4.1.1 Subsurface Sediment Collection

The sampling for this Addendum includes the collection of subsurface sediment core samples using MSS's hydraulically actuated vibracorer, which is expected to have greater penetration and recovery compared to the mechanical vibracore collection equipment used in the 2024 field investigation.

The following three new subsurface locations will be sampled and tested: TG-SC29, TG-SC30, and TG-SC31. These locations have been added to laterally delineate arsenic and zinc SCO exceedances measured at TG-SC27, from 0 to 4 feet below the mudline.

The target core penetration depth is 14 feet below the mudline, using 15-foot core tubes or until refusal. Core samples will be sectioned into 2-foot intervals to the bottom of the core. All intervals from 0 to 12 feet will be analyzed for Tier 1 analyses. Tier 1 testing of metals and total solids with the collection of archives for potential Tier 2 testing will be conducted as described in Table 1. Tier 2 analyses will be performed on the shallowest interval from each core that does not exceed metals screening criteria to estimate leave surface (Z-layer) conditions.

4.1.2 Surface Sediment Collection

This Addendum includes the collection of surface sediment samples using a power grab sampler.

Eight surface grabs are proposed in the vicinity of the Powers Dock. Three of the surface grab sample locations (TG-SG29, TG-SG30, and TG-SG31) are colocated with the three new subsurface locations detailed in Section 4.1.1.1.

Three of the surface grab locations (TG-SG06, TG-SG12, and TG-SG25) are also colocated with existing subsurface sampling locations where previous exceedances were identified:

- **TG-SG06**: SCO exceedance of polychlorinated biphenyl (PCB) Aroclors from 0 to 2 feet below the mudline at TG-SC06.
- **TG-SG12**: Zinc SCO exceedance from 0 to 2 feet, and arsenic SCO exceedance from 0 to 4.5 feet below the mudline at TG-SC12.
- **TG-SG25**: Copper SCO and CSL exceedances from 0 to 2 feet and zinc SCO and CSL exceedances from 0 to 4 feet below the mudline at TG-SC25.

One additional surface grab location (TG-SG32) will be positioned on the shoreline side of the Powers Dock. This location is proposed to better characterize sediment conditions adjacent to the Powers Dock area, closer to the bank.

All grab locations will undergo Tier 1 analyses, which includes testing for metals, total solids, semivolatile organic compounds (SVOCs), pesticides, PCBs, butyltins, dioxin/furans, total organic carbon, and total volatile solids. Archive samples will also be collected for potential Tier 2 bioassay testing, which will be triggered pending Tier 1 results.

4.2 Sampling Methods

This section describes updates to the sampling methods from the original SQAPP (Anchor QEA 2024), including sample identification and surface and subsurface sediment collection. Refer to the original SQAPP (Anchor QEA 2024) for the methods related to station positioning, subsurface sediment processing, and archaeological observations.

4.2.1 Sample Identification

Each surface and subsurface sediment sample will be assigned a unique alphanumeric identifier according to the following method:

- Each sample ID will be identified by the overall Site ("TG") and location within the Site, as well as the sample collection method.

  - "SC" for subsurface sediment core
  - "SG" for surface sediment grabs
- Station numbers will be added after the collection method identifier and are listed in Table 1 and shown in Figure 1.
- Subsurface sample IDs will have the two-digit depth intervals (in feet) below mudline surface added after the station number.
- The date in YYMMDD format will be appended to the end of the sample ID.
- Example sample identification nomenclature includes the following:
  - **Subsurface Core:** TG-SC06-02-04-250826 for the subsurface core sample collected from the 2- to 4-foot interval from location "SC06" on August 26, 2025.
    - A field duplicate will be identified by the addition of "100" to the sample station number. A duplicate sample collected from this example would be TG-SC106-02-04-250826, collected on August 26, 2025.
  - **Surface Grabs:** TG-SG31-250827 for a composited surface grab sample (made up of two discrete samples: TG-SG31a-250827 and TG-SG31b-250827) collected at location "SG31" on August 27, 2025.
    - A duplicate sample collected from this example would be TG-SG131-250827, collected on August 27, 2025.
- Rinsate blank samples will use the overall Site identifier and collection method, followed by "RB" and the date. The resulting nomenclature of a rinsate blank of the decontaminated core sample processing equipment collected on August 26, 2025, would be TG-SC-RB-250826.

4.2.2 Subsurface Sediment Collection

Subsurface sediment cores will be collected from a sufficiently outfitted marine sampling vessel. Core samples will be collected using a vibracore advanced to 14 feet or refusal depth. Samples will be collected from target locations shown in Figure 1, and locations and coordinates are listed in Table 1. Refer to the original SQAPP (Anchor QEA 2024) for vibracore sediment sample collection methods.

4.2.2.1 Sample Acceptance Criteria

Cores will be evaluated to determine whether they meet acceptability requirements for the project. Acceptance criteria for sediment core samples are as follows:

- Overlying water is present, and the surface is intact.
- The core tube appears intact without obstruction or blocking.
- Recovery is greater than 75% of the drive length.
- Penetration is deep enough to collect all target depth intervals, unless refusal is encountered based on substrate conditions that consistently limit penetration.

If sample acceptance criteria are not achieved, the sample will be rejected unless modified acceptance criteria (i.e., lower percent recovery after multiple attempts) are approved by the field coordinator in consultation with the project manager (PM). Locations may be adjusted within up to a 10-foot radius. If there is little to no penetration at a location, or recovery is less than 75% of the drive length, up to three attempts will be made before abandoning the sample location and selecting a new location in coordination with the PM.

Refer to the original SQAPP (Anchor QEA 2024) for field log procedures.

4.2.2.2 Sample Processing Procedures

Refer to the original SQAPP (Anchor QEA 2024) for subsurface sediment processing methods.

4.2.3 Surface Sediment Sample Collection Procedures

At eight target locations, a one- to two-point composite surface grab sample for the 0- to 10-centimeter (cm; 0.3 feet) biologically active zone will be collected for chemical analysis and bioassay testing using a 0.06-cubic meter, hydraulically driven power grab from the boat. The target locations are shown in Figure 1, and locations and coordinates are listed in Table 1. Samples will be collected in the following manner:

- The sampler will be decontaminated prior to use and between each sampling location. The power grab is washed with a cleaning detergent (e.g., Alconox®), and rinsed with Site water. Within a specific sample location, the power grab will simply be rinsed with Site water between individual grab samples.
- Once the boat is in the general proximity of the planned sampling location, the power grab is lowered vertically through the water column until just above the sediment surface. The boat is positioned to within ± 3 feet of the designated target coordinates for the specific station, and the power grab is set on the sediment surface.
- Collection of samples at nearshore locations (e.g., TG-SG06 and TG-SC06, TG-SG31 and TG-SC31, and TG-SG32) should be attempted at high tide to allow vessel access.
- The jaws of the sampler are closed, at that time, the station name, latitude/longitude, time of collection, and water depth-to-mudline are noted in the field log. The water depth-to-mudline will be taken with a lead line or depth sounder.
- Retrieval of the grab should initially occur no faster than 1-foot per second.
- At the water surface, the winch should then be throttled down to slowly bring the grab into the boat with minimal swinging.
- The sediment sample will be retrieved aboard the vessel and evaluated against the acceptability criteria as stated in Section 4.2.3.2.

Anchor QEA personnel will record field conditions and collection notes on a standard surface sediment field log (see Appendix A). If collection occurs from the bank, the bank sample collection and processing log will be used (Appendix A). Logs will include the following information:

- Grab sample recovery depth
- Water depth-to-mudline at each station using lead line or depth sounder at point of sampling station
- Coordinates of each station as determined by differential global positioning system (DGPS)
- Date and time of collection of each sediment grab sample
- Names of field personnel collecting and handling the samples
- Observations made during sample collection, including weather conditions, complications, ship traffic, and other details associated with the grab sampling effort:
  - Jaws closed properly
  - Good seal observed
  - Evidence of winnowing, if present
  - Overlying water present
  - Surface of sample remained intact
- The sample station ID
- Grab sample recovery depth
- Physical soil description in accordance with ASTM procedures (ASTM D 2488 and ASTM D 2487 – Unified Soil Classification System) including soil type, density/consistency of soil, and color
- Odor (e.g., hydrogen sulfide and petroleum)
- Visual stratification, structure, and texture
- Vegetation and debris (e.g., wood chips or fibers, concrete and metal debris, paint chips, sand blast grit, slag, and creosote)
- Biological activity (e.g., detritus, shells, tubes, bioturbation, and live or dead organisms)
- Presence of oily sheen or non-aqueous phase liquids
- Any deviation from the approved SQAPP

If tides preclude vessel access for collection of nearshore target sample locations, surface grab samples will be collected on foot at low tide from the toe of the bank using decontaminated shovels or trowels, as close to the target location as possible without wading.

Additionally, due to volume requirements for the proposed testing program, multiple grab attempts with the grab sampler may be required. See Section 4.2.3.1 for further information on the surface sediment composite procedures.

4.2.3.1 Sample Composite Procedures

Due to volume requirements for the proposed testing program, each surface sediment sample location may be composed of a one- to two-point composite surface sediment grab sample to obtain sufficient volume of 14 liters for both bulk chemistry and bioassay analyses.

For the initial discrete sample collected at each sampling station, the sampling field team will navigate to the target coordinates presented in Table 1. After collecting an accepted grab, the recovery volume will be approximated to determine if a second sample is required. If more volume is necessary, a second discrete sample for the two-point composite sample will be taken with a separation distances less than 5 feet (1.5 meters) from the original target location.

If sampling locations are restricted due to changing tidal water depths, obstructions (e.g., debris and/or riprap), or other conditions that make sampling unsafe or inaccessible, modifications to the sample compositing and/or positioning approach for two-point composite surface sediment samples will be discussed with the PM.

4.2.3.2 Sample Acceptance Criteria

After the power grab has been secured, the upper access doors of the sampler should be opened, and the sediment sample should be inspected carefully before being accepted. The following acceptability criteria should be satisfied:

- The jaws of the sampler will be fully closed; no protruding rock, branches, or other debris that may prevent a clean and complete closure.
- Grab sampler is not overfilled (i.e., the sediment surface is not against the top of the sampler).
- Sediment surface is relatively flat, indicating minimal disturbance or winnowing during retrieval.
- Overlying water is present, indicating minimal leakage.
- Overlying water has low turbidity, indicating minimal sample disturbance.
- Penetration depth greater than 10 cm is achieved to provide an undisturbed layer of the sample interval.

4.2.3.3 Contingency Plan for Field Condition Impediments to Surface Grab Collection

Grab samples not meeting the acceptance criteria will be rejected and returned as near to the location of sample collection as possible. The vessel will be adjusted so as not to collect from the same exact location. The process will be repeated until criteria have been met or three attempts have been made. Attempts will be repeated within a 10-foot radius of the proposed sample location. If adequate penetration is not achieved after three attempts, the location of the sample station may be adjusted, or a shallower depth of penetration may be accepted in coordination with the PM.

If tides preclude vessel access for collection of nearshore target sample locations, collection using decontaminated shovels/trowels will occur on foot from the toe of the bank at low tide as close to the target location as possible without wading.

4.2.3.4 Surface Sediment Sample Processing Procedures

For sediment grabs collected aboard the sampling vessel, processing will also be conducted aboard the vessel. All working surfaces and instruments will be thoroughly cleaned, decontaminated, and covered with aluminum foil when not in use to minimize potential contamination between sampling stations. Disposable gloves will be discarded after processing each sample and replaced prior to handling decontaminated instruments or work surfaces. Discrete surface grab samples that meet project acceptance criteria will be processed as follows:

- Overlying water will be siphoned off.
- Prior to sampling, color photographs will be taken, and a description of each grab sample will be recorded on a sediment sampling form (Appendix A); this will include observations of texture, odor, presence of vegetation or biota, anthropogenic debris, sheen or other visual evidence of contamination, and any other distinguishing characteristics.
- Equal amounts of material from each discrete grab sample will be combined and homogenized in a separate bowl to represent the composite sample (SG##).
- Using a clean, stainless-steel spoon, sample material from the top 10 cm (0.3 foot) will be placed into a clean, stainless-steel bowl. To avoid cross-contamination, only sediment that has not contacted the sides or bottom of the grab sampler will be removed and processed.
- The sample will be homogenized until a uniform color and consistency are achieved.
- Samples will be spooned into the appropriate, laboratory-supplied sample containers, as identified in Table 3, and submitted to the laboratories identified in Table 3 for analyses or archival. The sample jars should be pre-labeled (with sample ID, date/time, and analysis) prior to filling.
- The screw cap will be placed on the sample containers, and the lids will be tightened.
- All sample containers will be double-checked for proper identification and secure lid closure.
- Each container will be packed carefully to prevent breakage and placed inside a cooler with ice for proper storage (at 4°C ± 2°C).
- A total of 14 liters is required; approximately 2 liters will be required for chemical analysis, and 12 liters are required for bioassays. Sample handling requirements are presented in Table 3.
- Unused surface sediment will be returned to the water (or shoreline, for samples collected from shore); because it was collected from the mudline/shoreline, it does not need to be considered investigation-derived waste (IDW).

4.3 Sample Handling Requirements

Refer to the original SQAPP (Anchor QEA 2024) for sample handling requirements.

IDW samples will use the prefix "IDW" and the overall Site identifier, followed by "ADD2," the drum number (if applicable), material type (e.g., sediment or water), and the date. The resulting nomenclature for an IDW sample collected from a specific drum on August 28, 2025, would be as follows:

- Sediment IDW sample from drums 1 and 2: IDW-TG-ADD2-D1-2-Sediment-250828
- Water IDW sample from drum 3: IDW-TG-ADD2-D3-Water-250828

Analytical testing of IDW samples will be conducted per the IDW analytes listed in Table 2. IDW samples will be submitted to Analytical Resources, LLC, for analysis.

4.4 Laboratory Methods

Refer to the original SQAPP (Anchor QEA 2024) for laboratory methods. Table 2 is included in this Addendum to reflect the parameters for analysis updated from the original SQAPP. Table 3 is included in this Addendum to reflect sample handling and storage guidelines for new analyses that were not included in the original SQAPP.

5 Quality Assurance/Quality Control

Field duplicates will be collected at a frequency of 1 per 20 samples collected per sample collection method, provided sufficient sample mass can be collected. Refer to the original SQAPP (Anchor QEA 2024) for QA/QC procedures.

6 Contingent Biological Testing

Bioassay samples will be collected from surface sediment grab locations and may be triggered for toxicity testing if sediment chemical concentrations exceed the SMS SCOs. Bioassay testing will be performed by EcoAnalysts, Inc., in Port Gamble, Washington. Following SCUM (Ecology 2021), three contingent bioassay tests are planned: the 10-day amphipod mortality test, 20-day juvenile polychaete growth test, and the sediment larval development test.

Bioassay testing will be performed in accordance with *Recommended Protocols for Conducting Laboratory Bioassays on Puget Sound Sediments* (PSEP 1995) and SCUM (Ecology 2021). Modifications from the Seattle District Dredge Material Management Program may also be incorporated as appropriate, including protocols from the *Dredged Material Evaluation and Disposal Procedures User Manual* (DMMP 2021) and white papers published on the USACE Seattle District website. All bioassay analyses, including retests, are required to commence within 56 days after collection to meet holding times.

Twelve liters of sediment for each sample will be collected for contingent bioassay testing. This volume allows for side-by-side unpurged and purged bioassays should they be needed based on pre-test porewater ammonia and sulfide concentrations as further discussed in Sections 6.1.1 to 6.1.3. Bioassay testing volume will be stored in a laboratory-approved plastic bag at approximately 4°C±2°C until analysis, if required. Temperatures will be monitored, and chain-of-custody procedures will be followed throughout sample handling by the laboratory.

Bioassay testing requires that test sediments be matched and conducted simultaneously with reference sediment to factor out sediment grain size effects on bioassay organisms. The selection of the reference sediment will be based on the percent fines determined from wet sieve analyses conducted during sample processing procedures. According to Section 5.4.5.1 of SCUM, the fines content of reference sediments should ideally fall within 20% of the fines content in the test sediments (Ecology 2021). Multiple reference sediments will be used to match sample fines if needed.

This section describes bioassay testing procedures, QA/QC, test result interpretative criteria, and reporting.

6.1 Bioassay Testing Procedures

Specific procedures for each sediment bioassay are summarized in the following sections. As indicated above, the bioassay methodologies will follow those described in PSEP 1995, as modified by DMMP.

6.1.1 Amphipod Bioassay

The acute amphipod survival bioassay will be performed using the amphipod *Eohaustorius estuarius*, *Rhepoxynius abronius*, or *Ampelisca abdita*. The cultured amphipod *Leptocheirus plumulosus* may also be considered when the other species are not available for field collection or not in a healthy condition suitable for testing (Hester et al. 2024). Appropriate negative control sediment must be used for the test species selected. Species selection will be based upon grain size, salinity, and collection season prior to test initiation. Amphipods will be exposed to test, control, and reference sediments for a 10-day period. After 10 days, organisms will be sieved from the sediment and survivorship will be recorded. Test acceptability will be evaluated by mortality in the control, which should be less than or equal to 10%. Additionally, mean mortality for the reference sediment should be less than 25%. If the test does not meet control and reference acceptability criteria, it should be repeated. Ammonia and sulfide concentrations in the exposure medium will be measured on project sediments prior to testing and at test termination. If pre-test ammonia and sulfide concentrations exceed purging triggers identified in the DMMP User Manual (DMMP 2021), EcoAnalysts will contact the Anchor QEA QA/QC Manager prior to setting up the tests to discuss the need for purging. If purging is recommended, bioassays using purged sediment to remove or decrease sulfide and/or ammonia concentrations should be done side-by-side with non-purged sediment bioassays so results can be compared (Ecology 2021).

6.1.2 Larval Bioassay

The acute larval survival and development bioassay will be conducted with the bivalve species *Mytilus galloprovincialis*, echinoderm species *Dendraster excentricus*, or an alternative species such as the bivalve *Crassostrea gigas* based on availability. For the bioassay, adult test organisms will be allowed to spawn and the resulting embryos will be exposed to a seawater control, along with test and reference sediments, until formation into the larval stage occurs in 90% of the control organisms (typically 48 to 60 hours). At the end of the test, larvae from each test sediment exposure are examined to quantify abnormality and mortality. Test acceptability will be evaluated by normal development in the control, which should be at least 70%. Additionally, the reference sediment should have at least 65% of normal individuals as compared to the control. If the test does not meet control and reference acceptability criteria, it should be repeated. Ammonia and sulfide concentrations in the exposure medium will be measured in the overlying water prior to testing and at test termination. If pre-test ammonia and sulfide concentrations exceed purging triggers identified in the DMMP User Manual (DMMP 2021), EcoAnalysts will contact the Anchor QEA QA/QC Manager prior to setting up the tests to discuss the need for purging. If purging is recommended, bioassays using purged sediment to remove or decrease sulfide and/or ammonia concentrations should be done side-by-side with non-purged sediment bioassays so results can be compared (Ecology 2021). The recommended pH range for the bioassay test is 7.5 to 9. Low pH may be a confounding factor to interpret larval bioassay test results. If pH drops below 7.5 at any point during the test, results may be rejected.

The resuspension protocol (DMMP 2013) may be used in place of the standard PSEP protocol if dredged material encountered has high concentrations of fines, wood waste, or other flocculent material. The standard protocol may result in false positives from normally developing larvae being entrained in the flocculent material. The decision to use the resuspension protocol will be made in coordination with the Anchor QEA QA/QC Manager for approval before use.

6.1.3 Juvenile Polychaete Bioassay

The chronic juvenile polychaete growth bioassay will be conducted with the worm species *Neanthes arenaceodentata*. Polychaetes will be exposed to test, control, and reference sediments for a 20-day period. After 20 days, organisms will be sieved and survivorship will be recorded. The ash-free dry weight of the test organisms, along with the ash-free dry weight of time zero organisms, will be used to calculate the growth rate. Test acceptability will be evaluated by mortality in the control, which should be less than 10%, as well as a growth rate greater than 0.38 milligrams per individual per day (dry weight). Additionally, the mean reference growth rate should be greater than or equal to 80% of the mean negative control growth rate. If the test does not meet control and reference acceptability criteria, it should be repeated. Ammonia and sulfide concentrations in the exposure medium will be measured on project sediments prior to testing and at test termination. If pre-test ammonia and sulfide concentrations exceed purging triggers identified in the DMMP User Manual (DMMP 2021), EcoAnalysts will contact the Anchor QEA QA/QC Manager prior to setting up the tests to discuss the need for purging. If purging is recommended, bioassays using purged sediment to remove or decrease sulfide and/or ammonia concentrations should be done side-by-side with non-purged sediment bioassays so results can be compared (Ecology 2021).

6.2 Test Quality Assurance/Quality Control

Sediment toxicity tests will incorporate standard QA/QC procedures to ensure that the test results are valid. Standard QA/QC procedures include the use of negative controls, positive controls, reference sediment samples, replicates, and measurements of water quality during testing.

6.2.1 Negative Controls

A negative control will be run for each bioassay to estimate the general health of test organisms during the test exposure period. For the amphipod and juvenile polychaete bioassays, the negative control will be sediment from the amphipod collection site and seawater. The negative control for the larval bioassay will be a seawater control. Negative control performance standards for this bioassay program are presented in Table 4 and Table 8-2 of the SCUM (Ecology 2021).

6.2.2 Positive Controls

A positive control will be run for each bioassay to establish the relative sensitivity of the test organisms by exposing the organisms to a reference toxicant. The positive control for sediment tests is typically conducted with diluent freshwater and without sediment. The LC_{50} or the EC_{50} must be within the 95% confidence interval of responses (calculated using a minimum of the most recent 12 monthly positive control tests) expected for the toxicant used.[2] Reference toxicants are typically metals, such as cadmium chloride.

6.2.3 Reference Sediment

Reference sediment will also be included with each bioassay, tested concurrently with test sediments to provide data that can be used to separate toxicant effects from unrelated effects, such as those of sediment grain size. Reference sediment samples should be collected from an area documented to be free from chemical contamination and should represent the range of important natural, physical, and chemical characteristics of the test sediments (e.g., sediment grain size and total organic carbon). For this study, reference sediment samples will be collected from Carr Inlet in Puget Sound, Washington. Reference sediment performance standards for this bioassay program are presented in Table 4 and Table 8-2 of the SCUM (Ecology 2021). Failure to meet these standards may result in the requirement to retest.

6.2.4 Replicates

Five replicate chambers for each test sediment, reference sediment, and negative controls treatment will be run for each bioassay. A water quality replicate will also be run for each treatment.

6.2.5 Water Quality Monitoring

Water quality monitoring will be conducted for the amphipod, larval, and juvenile polychaete bioassays and reference toxicant tests. This monitoring consists of daily measurements in the water quality replicate of salinity, temperature, pH, and dissolved oxygen for the amphipod and larval tests. These measurements will be made at a minimum of every 3 days for the juvenile polychaete bioassay, with the exception of dissolved oxygen, which will be measured daily. Ammonia and sulfides in the overlying water and sediment porewater from a separate beaker will be determined at test initiation and termination for all three tests. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls).

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[2] LC_{50} is the lethal concentration of toxicant killing 50% of exposed organisms. EC_{50} is the concentration of test substance in dilution water that is calculated to affect 50% of a test population during continuous exposure over a specified time period.

6.3 Interpretation

Test interpretation consists of endpoint comparisons of test sediments to the measurements observed in the controls and in reference sediments on an absolute percentage basis, as well as statistical comparison between the test and reference endpoints, where appropriate. Test interpretation will follow the guidelines established through the SMS review process, which are identified in Table 4 and Table 8-2 of the SCUM (Ecology 2021).

6.4 Bioassay Retest

If there are issues (e.g., positive or negative control failure) with the bioassay QA/QC tests described previously that result in erroneous findings or failure to meet data quality control objectives provided in Table 4, then the bioassay samples will be retested.

6.5 Data Deliverables

The laboratory conducting the bioassay tests will be responsible for internal checks on data reporting and will correct errors identified during the QA review. The bioassay laboratory for this study will be required to provide a biological testing report that includes all information recommended by PSEP protocols for QA review, as follows:

- A description of any deviations from the methodology or problems with the process and procedures of analyses
- Test methods used for bioassay testing and statistical analyses
- Results for survival, growth, abnormalities, water quality parameters, reference toxicant, and statistical analyses
- Original data sheets for water quality, survival, growth, abnormalities, reference toxicant, and statistical analyses
- Chain-of-custody records

Close contact with the laboratory will be maintained to resolve any QA/QC problems in a timely manner.

7 Assessments and Response Actions

Refer to the original SQAPP (Anchor QEA 2024) for assessments and response actions.

8 Data Validation, Usability, and Reporting

Refer to the original SQAPP (Anchor QEA 2024) for data validation, usability, and reporting. Data validation will be conducted either by Anchor QEA or Laboratory Data Consultants.

9 References

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PSEP (Puget Sound Estuary Program), 1995. *Recommended Protocols for Conducting Laboratory Bioassays in Puget Sound*. Prepared for the Puget Sound Estuary Program, U.S. Environmental Protection Agency Region 10, Office of Puget Sound, Seattle, Washington. July 1995.

Tables

Table 1
Sample Locations, Coordinates, Intervals, and Analyses Summary

Location/Purpose	Location ID	Station Coordinates (Washington SP NAD83 South Zone) Easting (feet)	Station Coordinates (Washington SP NAD83 South Zone) Northing (feet)	Mudline Elevation (feet MLLW)	Sample[1] Upper Depth (feet)	Sample[1] Lower Depth (feet)	Sample ID[1]	Analyses[2]
Tier 1 Testing								
Surface Sediment Grabs	TG-SG06 *	1168871	712374	-9.8	0	0.3	TG-SG06-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
	TG-SG12	1168829	712330	-20.2	0	0.3	TG-SG12-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
	TG-SG25	1168921	712242	-19.7	0	0.3	TG-SG25-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
	TG-SG27	1169013	712153	-24.6	0	0.3	TG-SG27-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
	TG-SG29	1169098	712072	-22.9	0	0.3	TG-SG29-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
	TG-SG30	1169064	712021	-33.3	0	0.3	TG-SG30-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
	TG-SG31 *	1169055	712197	-10.6	0	0.3	TG-SG31-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
	TG-SG32 *	1168964	712287	-6.2	0	0.3	TG-SG32-0.0-0.3-YYMMDD	Total solids, metals, SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS, chemistry archive, bioassay archive
Subsurface Sediment Cores	TG-SC29	1169098	712072	-22.9	00	02	TG-SC29-00-02-YYMMDD	Total solids, metals, chemistry archive
					02	04	TG-SC29-02-04-YYMMDD	Total solids, metals, chemistry archive
					04	06	TG-SC29-04-06-YYMMDD	Total solids, metals, chemistry archive
					06	08	TG-SC29-06-08-YYMMDD	Total solids, metals, chemistry archive
					08	10	TG-SC29-08-10-YYMMDD	Total solids, metals, chemistry archive
					10	12	TG-SC29-10-12-YYMMDD	Total solids, metals, chemistry archive
					12	14	TG-SC29-12-14-YYMMDD	Chemistry archive
	TG-SC30	1169064	712021	-33.3	00	02	TG-SC30-00-02-YYMMDD	Total solids, metals, chemistry archive
					02	04	TG-SC30-02-04-YYMMDD	Total solids, metals, chemistry archive
					04	06	TG-SC30-04-06-YYMMDD	Total solids, metals, chemistry archive
					06	08	TG-SC30-06-08-YYMMDD	Total solids, metals, chemistry archive
					08	10	TG-SC30-08-10-YYMMDD	Total solids, metals, chemistry archive
					10	12	TG-SC30-10-12-YYMMDD	Total solids, metals, chemistry archive
					12	14	TG-SC30-12-14-YYMMDD	Chemistry archive
	TG-SC31	1169055	712197	-10.6	00	02	TG-SC31-00-02-YYMMDD	Total solids, metals, chemistry archive
					02	04	TG-SC31-02-04-YYMMDD	Total solids, metals, chemistry archive
					04	06	TG-SC31-04-06-YYMMDD	Total solids, metals, chemistry archive
					06	08	TG-SC31-06-08-YYMMDD	Total solids, metals, chemistry archive
					08	10	TG-SC31-08-10-YYMMDD	Total solids, metals, chemistry archive
					10	12	TG-SC31-10-12-YYMMDD	Total solids, metals, chemistry archive
					12	14	TG-SC31-12-14-YYMMDD	Chemistry archive
Tier 2 Testing								
Surface Sediment Grabs[3]	TBD[3]	TBD[3]	TBD[3]	TBD[3]	TBD[3]	TBD[3]	TBD[3]	Bioassay[3]
Subsurface Sediment Cores[2]	TBD[2]	TBD[2]	TBD[2]	TBD[2]	TBD[2]	TBD[2]	TBD[2]	SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, TVS

Table 1
Sample Locations, Coordinates, Intervals, and Analyses Summary

Notes:
1. Actual sample depths and IDs may vary based on evidence of contamination, observed depth to native alluvium, and sample recovery depth.
2. The shallowest-bounded interval sample from each core that does not exceed metals screening criteria will be triggered for Tier 2 analyses (SVOCs, pesticides, PCBs, butyltins, dioxin/furans, TOC, and TVS) to estimate leave surface (Z-layer) conditions.
3. Bioassay samples will be collected from surface sediment grab locations and may be triggered for toxicity testing if sediment chemical concentrations exceed the SMS SCOs.
* Sample collection at this location should be targeted during high tide.
ID: identification
MLLW: mean lower low water
PCB: polychlorinated biphenyl
SCOs: Sediment Cleanup Objectives
SMS: Sediment Management Standards
SVOC: semivolatile organic compound
TBD: to be determined
TOC: total organic carbon
TVS: total volatile solids
Washington SP NAD83: Washington State Plane North American Datum 1983

Table 2
Parameters for Analysis, Methods, Screening Levels, and Target Quantitation Limits

				Marine DMMP Guidelines			SMS Marine Sediment		Marine SMS AET		CLARC
Parameter	Analytical Method	Method Detection Limit	Reporting Limit	Screening Level	Bioaccumulation Trigger	Maximum Level	Sediment Cleanup Objective	Cleanup Screening Level	Sediment Cleanup Objective	Cleanup Screening Level	Surface Water Cleanup Level
Conventional Parameters (%)											
Total solids	SM 2540G/PSEP	--	0.1	--	--	--	--	--	--	--	--
Total volatile solids	SM 2540G/PSEP	--	0.1	--	--	--	--	--	--	--	--
Total organic carbon	EPA 9060A Mod	--	0.1	--	--	--	--	--	--	--	--
Metals (mg/kg dry weight)											
Antimony	EPA 6020B	0.10	0.20	150	--	200	--	--	--	--	--
Arsenic	EPA 6020B	0.038	0.20	57	507.1	700	57	93	57	93	--
Cadmium	EPA 6020B	0.040	0.10	5.1	--	14	5.1	6.7	5.1	6.7	--
Chromium (total)	EPA 6020B	0.26	0.50	260	--	--	260	270	260	270	--
Chromium (VI)[a]	EPA 7196A	0.40	0.40	--	--	--	--	--	--	--	--
Copper	EPA 6020B	0.35	0.50	390	--	1,300	390	390	390	390	--
Lead	EPA 6020B	0.052	0.10	450	975	1,200	450	530	450	530	--
Mercury	EPA 7471B	0.0053	0.025	0.41	1.5	2.3	0.41	0.59	0.41	0.59	--
Selenium[b]	EPA 6020B	0.18	0.50	--	3	--	--	--	--	--	--
Silver	EPA 6020B	0.022	0.20	6.1	--	8.4	6.1	6.1	6.1	6.1	--
Zinc	EPA 6020B	2.9	6.0	410	--	3,800	410	960	410	960	--
Butyltins (µg/kg dry weight)											
Tributyltin ion	Krone/8270E-SIM	0.5	3.9	--	73	--	--	--	--	--	--
Semivolatile Organic Compounds (µg/kg dry weight)											
Polycyclic Aromatic Hydrocarbons							**mg/kg OC**		**µg/kg dry weight**		--
1-methylnaphthalene	EPA 8270E	5.3	20	--	--	--	--	--	--	--	--
2-methylnaphthalene	EPA 8270E	4.5	20	670	--	1,900	38	64	670	670	--
Acenaphthene	EPA 8270E	5.2	20	500	--	2,000	16	57	500	500	--
Acenaphthylene	EPA 8270E	6.2	20	560	--	1,300	66	66	1,300	1,300	--
Anthracene	EPA 8270E	7.2	20	960	--	13,000	220	1,200	960	960	--
Benzo(a)anthracene	EPA 8270E	6.0	20	1300	--	5,100	110	270	1,300	1,600	--
Benzo(a)pyrene	EPA 8270E	4.2	20	1600	--	3,600	99	210	1,600	1,600	--
Benzo(b,j,k)fluoranthenes	EPA 8270E	10	40	3200	--	9,900	230	450	3,200	3,600	--
Benzo(g,h,i)perylene	EPA 8270E	14	20	670	--	3,200	31	78	670	720	--
Chrysene	EPA 8270E	6.1	20	1400	--	21,000	110	460	1,400	2,800	--
Dibenz(a,h)anthracene	EPA 8270E-SIM	0.91	5.0	230	--	1,900	12	33	230	230	--
Fluoranthene	EPA 8270E	6.1	20	1700	4,600	30,000	160	1,200	1,700	2,500	--
Fluorene	EPA 8270E	15	20	540	--	3,600	23	79	540	540	--
Indeno(1,2,3-cd)pyrene	EPA 8270E	15	20	600	--	4,400	34	88	600	690	--
Naphthalene	EPA 8270E	4.2	20	2100	--	2,400	99	170	2,100	2,100	--
Phenanthrene	EPA 8270E	8.7	20	1500	--	21,000	100	480	1,500	1,500	--
Pyrene	EPA 8270E	5.7	20	2600	11,980	16,000	1,000	1,400	2,600	3,300	--
Total LPAH (U = 0)[c]	EPA 8270E	--	--	5200	--	29,000	370	780	5,200	5,200	--

Table 2
Parameters for Analysis, Methods, Screening Levels, and Target Quantitation Limits

Parameter	Analytical Method	Method Detection Limit	Reporting Limit	Marine DMMP Guidelines: Screening Level	Marine DMMP Guidelines: Bioaccumulation Trigger	Marine DMMP Guidelines: Maximum Level	SMS Marine Sediment: Sediment Cleanup Objective	SMS Marine Sediment: Cleanup Screening Level	Marine SMS AET: Sediment Cleanup Objective	Marine SMS AET: Cleanup Screening Level	CLARC: Surface Water Cleanup Level
Total HPAHs (U = 0)[d]	EPA 8270E	--	--	12000	--	69000	960	5,300	12,000	17,000	--
Total PAHs (U = 0)[e]	Calculated	--	--	--	--	--	--	--	--	--	--
Chlorinated Hydrocarbons							mg/kg OC		µg/kg dry weight		--
1,4-dichlorobenzene	EPA 8270E-SIM	0.6	5.0	110	--	120	3.1	9	110	110	--
1,2-dichlorobenzene	EPA 8270E-SIM	0.7	5.0	35	--	110	2.3	2.3	35	50	--
1,2,4-trichlorobenzene	EPA 8270E-SIM	2.7	5.0	31	--	64	0.81	1.8	31	51	--
Hexachlorobenzene	EPA 8270E-SIM	0.7	5.0	22	168	230	0.38	2.3	22	70	--
Phthalates							mg/kg OC		µg/kg dry weight		--
Dimethyl phthalate	EPA 8270E-SIM	1.0	5.0	71	--	1,400	53	53	71	160	--
Diethyl phthalate	EPA 8270E-SIM	4.8	20	200	--	1,200	61	110	200	>1,200	--
Di-n-butyl phthalate	EPA 8270E	5.6	20	1,400	--	5,100	220	1,700	1,400	1,400	--
Butyl benzyl phthalate	EPA 8270E-SIM	0.68	5.0	63	--	970	4.9	64	63	900	--
Bis(2-ethylhexyl) phthalate	EPA 8270E	5.5	50	1,300	--	8,300	47	78	1300	1900	--
Di-n-octyl phthalate	EPA 8270E	4.4	20	6,200	--	6,200	58	4,500	6,200	6,200	--
Phenols (µg/kg dry weight)							µg/kg dry weight		µg/kg dry weight		
Phenol	EPA 8270E-SIM	2.2	5.0	420	--	1,200	420	1,200	420	1,200	--
2-methylphenol	EPA 8270E-SIM	1.1	5.0	63	--	77	63	63	63	63	--
4-methylphenol	EPA 8270E-SIM	0.9	5.0	670	--	3,600	670	670	670	670	--
2,4-dimethylphenol	EPA 8270E-SIM	2.2	20	29	--	210	29	29	29	29	--
Pentachlorophenol	EPA 8270E-SIM	2.1	20	400	504	690	360	690	360	690	--
Miscellaneous Extractables (µg/kg dry weight)							mg/kg OC (unless noted)		µg/kg dry weight		--
Benzyl alcohol	EPA 8270E-SIM	2.5	20	57	--	870	57 dry weight	73 dry weight	57	73	--
Benzoic acid	EPA 8270E-SIM	13	100	650	--	760	650 dry weight	650 dry weight	650	650	--
Dibenzofuran	EPA 8270E	14	20	540	--	1,700	15	58	540	540	--
Hexachlorobutadiene	EPA 8270E-SIM	0.72	5.0	11	--	270	3.9	6.2	11	120	--
N-Nitrosodiphenylamine	EPA 8270E-SIM	1.3	5.0	28	--	--	11	11	28	40	--
Carbazole	EPA 8270E	4.3	20	--	--	--	--	--	--	--	--
Pesticides (µg/kg dry weight)											
2,4'-DDD	EPA 8081B	0.20	1.0	--	--	--	--	--	--	--	--
2,4'-DDE	EPA 8081B	0.25	1.0	--	--	--	--	--	--	--	--
2,4'-DDT	EPA 8081B	0.19	1.0	--	--	--	--	--	--	--	--
4,4'-DDD	EPA 8081B	0.32	1.0	16	--	--	--	--	--	--	--
4,4'-DDE	EPA 8081B	0.14	1.0	9	--	--	--	--	--	--	--
4,4'-DDT	EPA 8081B	0.32	1.0	12	--	--	--	--	--	--	--
2,4'-DDD and 4,4'-DDD	Calculated	--	--	--	--	--	--	--	--	--	--
2,4'-DDE and 4,4'-DDE	Calculated	--	--	--	--	--	--	--	--	--	--
2,4'-DDT and 4,4'-DDT	Calculated	--	--	--	--	--	--	--	--	--	--
Total DDT (U = 0)[f]	Calculated	--	--	--	50	69	--	--	--	--	--
Aldrin	EPA 8081B	--	--	9.5	--	--	--	--	--	--	--
beta-HCH	EPA 8081B	0.09	0.50	--	--	--	--	--	--	--	--
Dieldrin	EPA 8081B	0.12	1.0	1.9	--	1,700	--	--	--	--	--
Endrin ketone	EPA 8081B	0.28	1.0	--	--	--	--	--	--	--	--

Table 2
Parameters for Analysis, Methods, Screening Levels, and Target Quantitation Limits

Parameter	Analytical Method	Method Detection Limit	Reporting Limit	Marine DMMP Guidelines			SMS Marine Sediment		Marine SMS AET		CLARC
				Screening Level	Bioaccumulation Trigger	Maximum Level	Sediment Cleanup Objective	Cleanup Screening Level	Sediment Cleanup Objective	Cleanup Screening Level	Surface Water Cleanup Level
Heptachlor	EPA 8081B	0.05	0.50	1.5	--	270	--	--	--	--	--
cis-chlordane	EPA 8081B	0.1	0.5	--	--	--	--	--	--	--	--
trans-chlordane	EPA 8081B	0.3	0.5	--	--	--	--	--	--	--	--
cis-nonachlor	EPA 8081B	0.2	0.5	--	--	--	--	--	--	--	--
trans-nonachlor	EPA 8081B	0.2	0.5	--	--	--	--	--	--	--	--
oxychlordane	EPA 8081B	0.1	0.5	--	--	--	--	--	--	--	--
Total chlordane (U = 0)[g]	EPA 8081B	--	--	2.8	37	--	--	--	--	--	--
PCBs (µg/kg dry weight)							mg/kg OC		µg/kg dry weight		
Aroclor 1016	EPA 8082A	8.0	20	--	--	--	--	--	--	--	--
Aroclor 1221	EPA 8082A	8.0	20	--	--	--	--	--	--	--	--
Aroclor 1232	EPA 8082A	8.0	20	--	--	--	--	--	--	--	--
Aroclor 1242	EPA 8082A	8.0	20	--	--	--	--	--	--	--	--
Aroclor 1248	EPA 8082A	8.0	20	--	--	--	--	--	--	--	--
Aroclor 1254	EPA 8082A	8.0	20	--	--	--	--	--	--	--	--
Aroclor 1260	EPA 8082A	9.3	20	--	--	--	--	--	--	--	--
Total Aroclor PCBs (U = 0)	EPA 8082A	9.3	20	130	38 mg/kg OC	3,100	12	65	130	1,000	--
Dioxin/Furans (ng/kg dry weight)[h]											
Dioxins											
2,3,7,8-TCDD	EPA 1613B	0.19	0.5	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDD	EPA 1613B	0.784	2.5	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDD	EPA 1613B	0.633	2.5	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDD	EPA 1613B	0.64	2.5	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDD	EPA 1613B	0.717	2.5	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDD	EPA 1613B	0.706	2.5	--	--	--	--	--	--	--	--
OCDD	EPA 1613B	1.62	5.0	--	--	--	--	--	--	--	--
Furans											
2,3,7,8-TCDF	EPA 1613B	0.183	0.5	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDF	EPA 1613B	0.576	2.5	--	--	--	--	--	--	--	--
2,3,4,7,8-PeCDF	EPA 1613B	0.686	2.5	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDF	EPA 1613B	0.659	2.5	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDF	EPA 1613B	0.621	2.5	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDF	EPA 1613B	0.661	2.5	--	--	--	--	--	--	--	--
2,3,4,6,7,8-HxCDF	EPA 1613B	0.716	2.5	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	EPA 1613B	0.649	2.5	--	--	--	--	--	--	--	--
1,2,3,4,7,8,9-HpCDF	EPA 1613B	0.818	2.5	--	--	--	--	--	--	--	--
OCDF	EPA 1613B	3.84	5.0	--	--	--	--	--	--	--	--
Total TEQ (U = 0)	--	--	--	4.0	--	--	--	--	--	--	--
Total TEQ (U = 1/2 EDL)	--	--	--	4.0	--	--	--	--	--	--	--
Bioassay											
10-day Amphipod Mortality	PSEP	--	--	--	--	--	--	--	--	--	--
Larval Development	PSEP	--	--	--	--	--	--	--	--	--	--
20-day *Neanthes* Growth	PSEP	--	--	--	--	--	--	--	--	--	--
Investigation Derived Waste											
Metals (mg/kg dry weight)											
Arsenic	EPA 6020B	0.038	0.20	--	--	--	--	--	--	--	--
Barium	EPA 6020B	0.250	0.500	--	--	--	--	--	--	--	--
Cadmium	EPA 6020B	0.040	0.10	--	--	--	--	--	--	--	--
Chromium	EPA 6020B	0.26	0.50	--	--	--	--	--	--	--	--

Table 2
Parameters for Analysis, Methods, Screening Levels, and Target Quantitation Limits

Parameter	Analytical Method	Method Detection Limit	Reporting Limit	Marine DMMP Guidelines			SMS Marine Sediment		Marine SMS AET		CLARC
				Screening Level	Bioaccumulation Trigger	Maximum Level	Sediment Cleanup Objective	Cleanup Screening Level	Sediment Cleanup Objective	Cleanup Screening Level	Surface Water Cleanup Level
Copper	EPA 6020B	0.35	0.50	--	--	--	--	--	--	--	--
Lead	EPA 6020B	0.052	0.10	--	--	--	--	--	--	--	--
Mercury	EPA 7471B	0.0053	0.025	--	--	--	--	--	--	--	--
Nickel	EPA 6020B	0.250	0.500	--	--	--	--	--	--	--	--
Selenium	EPA 6020B	0.18	0.50	--	--	--	--	--	--	--	--
Silver	EPA 6020B	0.022	0.20	--	--	--	--	--	--	--	--
Zinc	EPA 6020B	2.9	6.0	--	--	--	--	--	--	--	--

Table 2
Parameters for Analysis, Methods, Screening Levels, and Target Quantitation Limits

Notes:
Greater than (>) values indicate that the upper bound of toxicity level is unknown but that it is known to be above the concentration shown.
a. Chromium VI will be analyzed on a subset of eight samples collected from known areas of grit. Actual sample locations and depths will be determined based on field observations.
b. Because no screening level value exists for toxicity testing, selenium will only be evaluated for its bioaccumulation potential.
c. Total LPAH consists of the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene.
d. Total HPAH consists of the sum of fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b,j,k)fluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
e. Total PAHs consists of the sum of all PAHs listed.
f. Total DDT consists of the sum of 4,4'-DDD; 4,4'-DDE; and 4,4'-DDT.
g. Chlordane includes cis-chlordane, trans-chlordane, cis-nonaclor, trans-nonaclor, and oxychlordane.
h. Dioxin/furan results will be reported to sample and analysis-specific estimated detection limits.
i. Value for chromium III.
-- not applicable
μg/kg: microgram per kilogram
AET: Apparent Effects Threshold
ASTM: ASTM International
CLARC: Ecology MTCA Cleanup Levels and Risk Calculation
Ecology: Washington State Department of Ecology
DDD: dichlorodiphenyldichloroethane
DDE: dichlorodiphenyldichloroethylene
DDT: dichlorodiphenyltrichloroethane
DMMP: Dredged Material Management Program
EDL: estimated detection limit
EPA: U.S. Environmental Protection Agency
HPAH: high-molecular-weight PAHs
LPAH: low-molecular-weight PAHs
MTCA: Model Toxics Control Act
mg/kg: milligram per kilogram
mg/L: milligram per liter
ng/kg: nanograms per kilogram
OC: organic carbon-normalized
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated bipheynl
PSEP: Puget Sound Estuary Program
SMS: Sediment Management Standards
TEQ: toxic equivalency
U: undetected

Table 3
Sample Handling and Storage Guidelines

Parameter	Sample Size	Container Size and Type[a]	Holding Time	Preservative	Lab
Total metals	10 g	4-oz glass	6 months; 28 days for mercury	4°C ± 2°C	ARL
			2 years; 1 year for mercury	-18°C ± 2°C	
Total solids	30 g		14 days	4°C ± 2°C	
			6 months	-18°C ± 10°C	
Chemistry archive for untested intervals	500 g	16-oz glass	varies	-18°C ± 2°C	
Dioxin/furan archive for untested intervals	10 g	4-oz amber glass	1 year	-18°C ± 2°C	
Total organic carbon, total solids, total volatile solids	30 g	From chemistry archive jar	14 days	4°C ± 2°C	ARL
			6 months	-18°C ± 10°C	
SVOCs, PCBs, pesticides, butyltins	200 g		14 days until extraction	4°C ± 2°C	
			1 year until extraction	-18°C ± 2°C	
			40 days after extraction	4°C ± 2°C	
Dioxins/furans	10 g	From dioxin/furan archive jar	1 year until extraction	-18°C ± 2°C	
			1 year after extraction		
PSEP bioassay archive	12 L[b]	Plastic bag, no headspace	8 weeks	4°C ± 2°C	EA

Notes:

a. Sample containers may vary based on availability at the time of sample collection.

b. 12 L bioassay volume is being collected to allow for side-by-side purged and unpurged testing if needed.

ARL: Analytical Resources, LLC

EA: EcoAnalysts Inc.

g: grams

L: liter

oz: ounce

PCB: polychlorinated biphenyl

PSEP: Puget Sound Estuary Program

SVOC: semivolatile organic compound

Table 4
Bioassay Performance Standards and Evaluation Guidelines

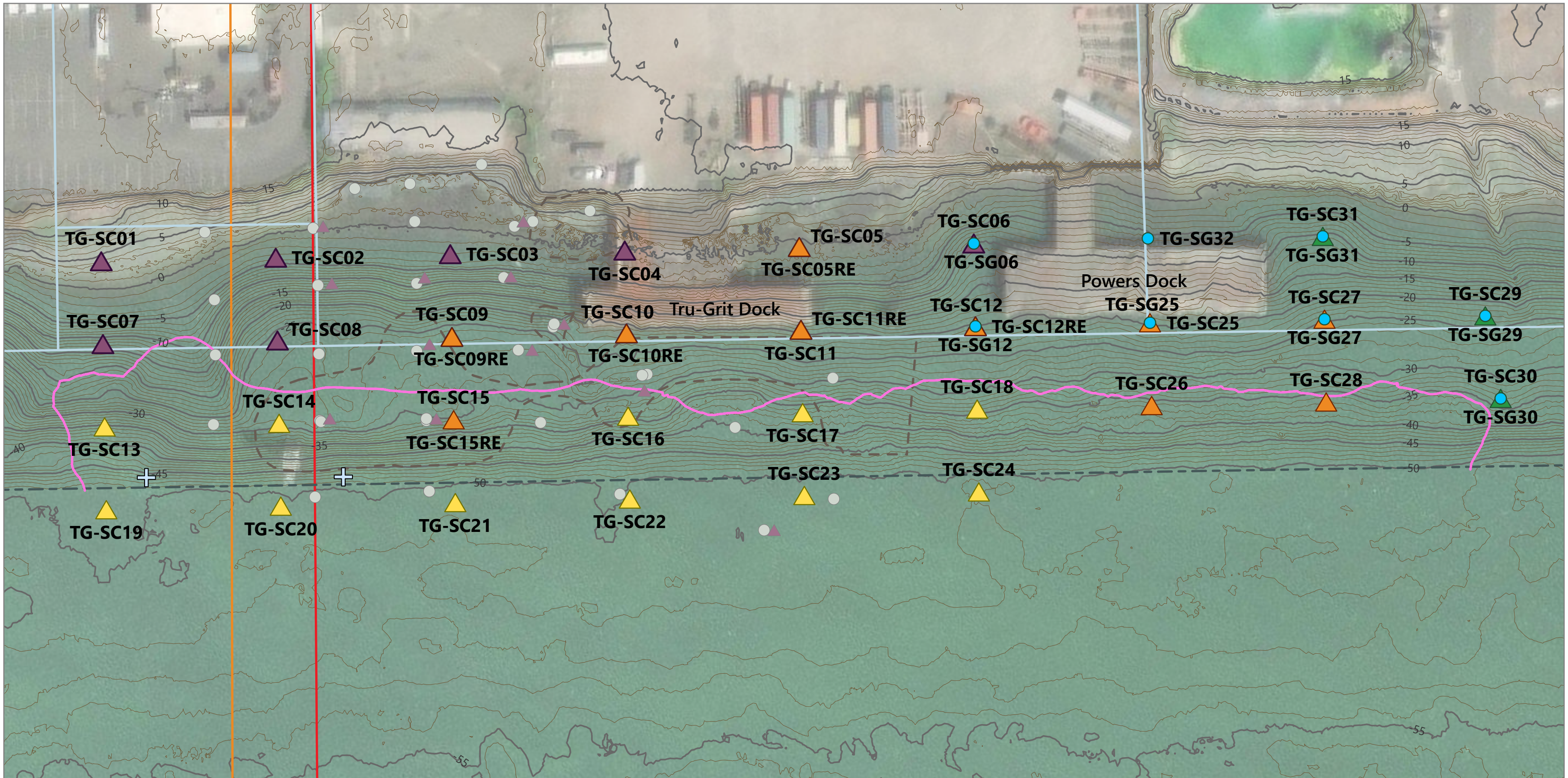
Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	SCO/SQS[a]	CSL[a]
Amphipod Mortality	$M_C \leq 10\%$	$M_R \leq 25\%$	M_T > 25% Absolute and M_T vs. M_R SD ($p < 0.05$)	$M_T - M_R \geq 30\%$ and M_T vs. M_R SD ($p < 0.05$)
Larval Development	N_C / $I \geq 0.70$	N_R / $N_C \geq 0.65$	N_T / N_R < 0.85 and N_T vs. N_R SD ($p < 0.10$)	N_T / N_R < 0.70 and N_T vs. N_R SD ($p < 0.10$)
Neanthes Growth	$M_C \leq 10\%$ and $MIG_C \geq 0.38$	MIG_R / $MIG_C \geq 0.80$	MIG_T / MIG_R < 0.70 and MIG_T vs. MIG_R SD ($p < 0.05$)	MIG_T / MIG_R < 0.50 and MIG_T vs. MIG_R SD ($p < 0.05$)

Notes:

a. Marine biological criteria (SCO & CSL and performance standards) for each biological test. Adverse effects are defined when any of the biological tests show the results in the table.

C: negative control
CSL: cleanup screening level
I: initial count
M: mortality
MIG: mean individual growth rate (milligrams/individual/day)
N: normal larvae
R: reference sediment
SCO: sediment cleanup objective
SD: statistically significant difference
SQS: Sediment Quality Standard
T: test sediment

Figure



LEGEND:

- Feasibility Study Navigation Channel Boundary
- Parcel Boundary
- Navigational Aid
- Elevation (MLLW, 5-Foot Interval)
- >5% Grit Boundary
- Proposed Overdredge Daylight Extent (-59.0' MLLW)
- Underwater Communications Crossing
- Underwater Watermain Crossing

Previous Sample Location

- Surface Sediment
- Subsurface Sediment

Proposed Sample Location

- Previous Upper Slope Core Sample Location
- Previous Lower Slope Core Sample Location
- Previous SQAPP Addendum Sampling Locations
- New Subsurface Sampling Locations (SQAPP Addendum #2)
- New Surface Sampling Locations (SQAPP Addendum #2)

NOTES:

1. Aerial imagery: Esri (2022)
2. Contour Source: Survey by USACE, dated October 27, 2021, and David Evans Associates Inc., dated May 27, 2022, with data gaps filled from survey by USACE dated November 14, 2022
3. Horizontal Datum: NAD83 State Plane Washington South, U.S. feet
4. Vertical Datum: MLLW, feet

MLLW: mean lower low water
NAD83: North American Datum of 1983
SQAPP: Sampling and Quality Assurance Project Plan
USACE: U.S. Army Corps of Engineers

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Feet

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ANCHOR QEA

Figure 1
Proposed Sampling Locations
Sampling and Quality Assurance Project Plan Addendum #2
Tru-Grit Site Data Gaps Field Investigation

Appendix A
Field Forms

Surface Sediment Collection Log

Job:	Station:
Job No:	Date:
Field Staff:	Sample Method:
Contractor:	Proposed Coordinates: Lat.
	Long.

Water Height
DTM Depth Sounder: ____________
DTM Lead Line: ____________
Mudline Elevation (datum): calculated after sampling ____________

Tide Measurements
Time: ______
Height: ______

Sample Acceptability Criteria:
1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: ______________________________

Grab #	Time	Confirmed Coordinates (datum)		Sample Accept (Y/N)	Recovery Depth (in)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
		NAD 83 (N)	NAD 83 (E)			

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Sample Depth:

Field Measurements: temperature: °C; pH: std units; electrical conductivity (salinity): dS/m

Sample Containers:

Analyses:

BANK SAMPLE COLLECTION AND PROCESSING LOG

Job Name:	Station:
Job No:	Date:
Field Staff:	Time:
Attempt No:	Total Depth:
Excavation Method: Hand Trowel / Hand Auger	NORTHING: EASTING:

DEPTH SAMPLED (cm)	SAMPLE	**CLASSIFICATION AND REMARKS** (MAJOR Constituent, Minor Constituent, Moisture, Density, Color, Additional Constituents, Sheen, Odor)
10		
20		
30		
40		
50		
60		
70		
80		
90		

Notes