

Memorandum

To: Mark Adams, Washington State Department of Ecology
Copies: Doug and Mike Ciserella, Cantera Development Group, LLC
From: Lynn Grochala, Floyd|Snider
Date: October 20, 2020
Project No: Cantera-TOC
Re: Pre-Remedial Design Work Plan

This Pre-Remedial Design Work Plan (PD Work Plan) has been prepared for Cantera Development Group, LLC (Cantera) for the Time Oil Bulk Terminal Site (the Site) located on W. Commodore Way in Seattle, Washington. It presents proposed additional sample collection to inform the design of the cleanup action for certain portions of the Site (the Property) in accordance with the Washington State Department of Ecology (Ecology) Cleanup Action Plan (CAP; Ecology 2020a), which was issued on September 28, 2020.

The results of the pre-design investigation described herein will be used to finalize the design for the cleanup action and will be included in the Engineering Design Report (EDR).

BACKGROUND

The Property is the location of the former Time Oil Company (TOC) Holdings Co. Seattle Terminal and is composed of four upland parcels, identified as Bulk Terminal; ASKO Hydraulic (ASKO); East Waterfront; and West Waterfront. W. Commodore Way, a City of Seattle perpetual use easement right-of-way, separates the Bulk Terminal and ASKO parcels located on the south side of W. Commodore Way from the East Waterfront and West Waterfront parcels, which are located on the north side of W. Commodore Way adjacent to Salmon Bay.

Cantera is engaged in negotiations with Ecology for the entry of a Prospective Purchaser Consent Decree (PPCD) for the Property. Cantera will be assigning its rights to the Property under an asset purchase agreement to a new entity, TOC Seattle Terminal, LLC, at the time of closing. TOC Seattle Terminal, LLC, will perform the cleanup action detailed in the CAP in accordance with the PPCD. The CAP was developed by Ecology using information presented in the Supplemental Upland Remedial Investigation/Feasibility Study (Supplemental Upland RI/FS) for the Property (Floyd|Snider 2020) and previous remedial investigations by others.

The cleanup action selected by Ecology and presented in the CAP consists of multiple technologies to address the indicator hazardous substances (IHSs) present in soil and groundwater at concentrations greater than remediation levels (RELs) or cleanup levels (CULs) in seven identified cleanup action areas (CAAs). The IHSs include arsenic, benzene, gasoline-range organics (GRO), sum total of diesel-range organics (DRO) and oil-range organics (ORO), trichloroethene (TCE), and vinyl chloride.

The following is a summary of the cleanup action for portions of the Property¹:

- Excavation and offsite disposal of soil with IHS concentrations greater than RELs and soil with IHS concentrations greater than the CUL and less than the REL where there are groundwater impacts greater than 2 times the groundwater CUL using normally accepted engineering practices in CAA-1, CAA-2.b, CAA-3, and CAA-5
- Light non-aqueous-phase liquid removal using normally accepted engineering practices in CAA-1.a and CAA-2
- In situ solidification and stabilization (ISS) to address source area soil with IHS concentrations greater than RELs in CAA-2.a and CAA-4
- In situ treatment and enhanced reductive dechlorination of the TCE groundwater plume using a trademarked colloidal biomatrix (PlumeStop™) mixed with sulfidated microscale zero-valent iron (mZVI) injected along the northern border of CAA-5
- Installation of an interceptor trench adjacent to and upgradient of the ISS monolith in CAA-4.a and CAA-4.b and permeable reactive barrier (PRB) wall with zero-valent iron
- Excavation and offsite disposal of contaminated soil with IHS concentrations greater than CULs using normally accepted engineering practices in CAA-6 and CAA-7
- Capping and institutional controls for the Upland Area of Concern

PURPOSE

This PD Work Plan was developed to provide details for additional soil and groundwater data collection to fill data gaps necessary to finalize the engineering design of the cleanup action prior to remedy implementation for selected CAAs. The following additional data needs have been identified and will be detailed in this PD Work Plan:

- **CAA-4:** Additional soil testing is needed to verify the design parameters of the interceptor trench and PRB wall and hydrogeological parameters of the Perched Water-Bearing Zone (WBZ). These data were collected in consultation with Ecology

¹ The portion of the Property where cleanup actions will be implemented in accordance with the CAP is referred to as the Remedial Action Area.

ahead of the other pre-design data collection, and the scope of the data collection is summarized below.

- **CAA-5:** Additional soil and groundwater testing is needed to verify the design parameters of the PlumeStop injections.
- **CAA-7:** The vertical and lateral extent of arsenic concentrations greater than its CUL in shallow soils has not been fully delineated, and the potential presence of tributyltin (TBT), an organometallic paint additive, requires further investigation in shallow soils per Ecology's request. Additional data are necessary to delineate the extent of shallow arsenic impacts requiring excavation in CAA-7 and to determine if TBT is present at concentrations that warrant cleanup.

The additional data collection proposed in this PD Work Plan will be conducted in accordance with the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) provided in the Supplemental Upland Remedial Investigation Work Plan (RIWP, Floyd|Snider 2019). The SAP provides details regarding sampling and analysis methods and field procedures, and the QAPP provides details about the organization, objectives, and quality assurance (QA) and quality control (QC) procedures for field and laboratory activities developed for this Property. A supplemental SAP and QAPP section is included in this PD Work Plan to provide details specific to the pre-remedial design investigation that were not previously included in the RIWP SAP/QAPP.

The results of the data collected in accordance with this PD Work Plan will be provided in the EDR.

PROPOSED CAA-4 PRE-DESIGN DATA COLLECTION

Additional data were collected on October 7, 2020 to assess the soil characteristics in the Perched WBZ and refine the groundwater model. These data and the results of the groundwater modeling will be incorporated into the EDR and used to estimate the flow of groundwater collected by the interceptor trench and routed through the PRB.

Soil Sample Collection and Analysis

Soil samples were collected from one soil boring on the southern portion of the ASKO parcel (ISS-ASKO); the approximate location of this boring is shown on Figure 1. The soil data collection was targeted within the zone for construction of the interceptor trench and PRB (approximately 5 to 15 feet below ground surface [bgs]) to provide information about soil composition. Continuous soil samples were collected using hollow stem augers with split spoons to a depth of 15 feet bgs. The silt layer underlying the Perched WBZ was observed at approximately 11 feet bgs and may have been fully penetrated at 14.5 feet bgs.

Soil samples were collected by Holocene Drilling, a Washington State licensed driller. Oversight of the soil boring and sample collection was performed by Crete Consulting, Inc. Soils were

logged, photographed, and screened for evidence of contamination including staining, sheen, odor, and elevated headspace volatiles concentrations using a photoionization detector (PID). Four soil samples were collected for grain size analysis (ASTM D422) at approximately 1.5-foot increments from the top of the saturated zone of the perched WBZ (4.5 feet bgs) to slightly above the contact with the underlying silt layer (10.5 feet bgs). In addition, two representative samples were collected and submitted for analysis of total organic carbon by USEPA Method 9060. All samples were submitted to Friedman & Bruya, Inc. (FBI) and subsequently transferred to Fremont Analytical, Inc. (Fremont), in Seattle, Washington, for analysis. The borehole was backfilled with bentonite following sample collection.

Groundwater Elevation Measurement

Depth to water was measured in Perched WBZ wells in the vicinity of CAA-4 concurrently with the soil sample collection. The elevations of groundwater in the Perched WBZ will be used to refine the understanding of the groundwater flow direction and horizontal gradients. Groundwater elevations may be measured again during future mobilizations as needed to confirm design parameters.

PROPOSED CAA-5 PRE-DESIGN INVESTIGATION

Additional investigation will be performed by Floyd|Snider and Regensis (the manufacturer of PlumeStop) to verify the final design parameters of the PlumeStop in situ treatment barrier. These tests include measurement of the contaminant mass flux, soil grain size, soil and groundwater mass characterization, and water injection rate testing.

Passive Flux Meter Installation

Passive flux meters (PFMs) are devices installed in monitoring wells to measure the vertical profile of horizontal contaminant flux through the groundwater table. PFMs are constructed from a long outer mesh liner filled with a mixture of sorbent and tracer material that are placed into monitoring wells and later retrieved for analysis after a set amount of time. The chosen sorbent material in the PFM, typically activated carbon for measurement of chlorinated volatile organic compounds (cVOCs), adsorbs to the passing contaminants in groundwater while the tracer chemicals are leached away at a steady rate based on the groundwater flow. After the PFM is retrieved and tested for the cumulative concentration of cVOCs adsorbed and the concentration of tracer chemical remaining, the time-averaged flux of cVOCs through the vertical profile of the groundwater table can be calculated.

PFMs will be installed in monitoring wells MW06 and 01MW80 shown on Figure 1. These wells were selected based on their location relative to the proposed PlumeStop barrier and the elevated concentrations of cVOCs measured in groundwater at these locations. Groundwater at these wells is anticipated to be encountered between 23 to 25 feet bgs, and the length of saturated well screen less than 5 feet; therefore, one PFM will be sufficient per location to cover the full groundwater vertical profile. PFMs will be left in these wells for 2 to 3 weeks.

Procedures for installing, retrieving, and sampling the PFMs are included in the PFM Protocol Manual (Attachment 1).

Groundwater Sample Collection

Groundwater samples will be collected from monitoring wells MW06, 01MW46, and 01MW80 (refer to Figure 1) to analyze groundwater characteristics that can impact the effectiveness of the PlumeStop and mZVI materials to adsorb and break down cVOCs. As part of this assessment, it is important to understand the total organic mass that will flow through the treatment zone to appropriately design the passive treatment zone. A full screen of volatile organic compounds (VOCs) in groundwater is included to understand whether organic compounds other than the target cVOCs are present that can be adsorbed to the PlumeStop matrix.² In addition, the natural groundwater chemistry impacts the rate at which the PlumeStop polymer transitions from being mobile at the injection point to stabilizing as it adheres to the surrounding soil. Therefore, measurement of groundwater hardness characteristics, including calcium and magnesium concentrations, is also important for design. The following constituents will be analyzed in groundwater to support design:

- VOCs by USEPA Method 8260
- Total calcium and magnesium by USEPA Method 200.7/200.8
- Hardness by SM 2340B
- Alkalinity by SM 2320 B
- Biochemical oxygen demand by SM 5210 B
- Total organic carbon by USEPA Method 9060
- Dissolved organic carbon by SM 5310 B
- Sulfate and nitrate by USEPA Method 300.3

In addition, the following parameters will be measured using a water quality meter and documented prior to sample collection:

- Temperature
- Total dissolved solids
- pH
- Oxidation-reduction potential
- Dissolved oxygen

² Sufficient GRO, DRO, and ORO data from the target monitoring wells is available from the 2019 groundwater sampling event completed by Floyd|Snider and will also be used as part of this assessment.

- Conductivity
- Turbidity

Soil Sample Collection and Grain Size Analysis

Soil samples will be collected from three proposed soil borings along the PlumeStop barrier installation (PDSB01 through PDSB03) as shown on Figure 1. The soil data collection is targeted within the zone for PlumeStop injection (approximately 20 to 30 feet bgs) to provide information about constituents in soil that can be adsorbed to the PlumeStop matrix or affect the PlumeStop's physical characteristics. Soil borings will be advanced to a maximum depth of 30 feet bgs using direct push drilling methods.

Regenesis will oversee the soil boring and grain size analysis. Starting at 15 feet bgs, about 5 feet above the target PlumeStop zone, soil samples will be collected in 1-foot increments to the bottom depth of each soil boring to determine the approximate fractions of clays, silts, fine sands, coarse sands, and gravels present in each interval. Samples for grain size approximation will be collected to the top of the silt layer that defines the base of the Shallow WBZ, which is expected to be approximately 28 feet bgs. Grain size approximation will be performed by filling 40-milliliter vials one-third full with soil, topping with water, agitating, and allowing the samples to sit overnight. Grain size percentages will be estimated by Regenesis using visual analysis.

Soil will additionally be screened in 2-foot increments using a PID from 15 feet bgs to the base of the Shallow WBZ. Representative samples of likely contaminated soil based on the highest VOC concentrations measured by a PID will be collected to evaluate the presence of organic compounds that can be adsorbed to the PlumeStop. If no VOCs are detected by the PID, then a sample will be collected from the top 1-foot interval of the water table. Total calcium will also be measured in soil because calcium has a high impact on the rate that the PlumeStop mixture stabilizes in the soil column. Selected soil samples will be collected for laboratory analysis of the following:

- GRO by NWTPH-Gx
- DRO and ORO by NWTPH-Dx
- Total organic carbon by USEPA Method 9060
- VOCs by USEPA Method 8260
- Total calcium by USEPA Method 6020

Injection Testing

Injection testing will be conducted by Regenesis to measure pressures and flows of the aquifer while being injected upon to determine the target injection rates and volumes that can be supported by the soils in the proposed PlumeStop injection area.

An injection point will be advanced to the top of the silt layer defining the bottom limit of the Shallow WBZ (approximately 28 feet bgs) using direct-push methodology approximately 5 feet from monitoring well MW06. Approximately 40 gallons per vertical foot of potable water will be injected through a 3-foot retractable screen. The screen will initially be set at the base of the Shallow WBZ and continuously be pulled in a bottom-up fashion to inject potable water across the target treatment interval.

While the injection is proceeding, the total volumes, injection pressures, flow rates, and the rise in groundwater level in MW06 will be recorded at 5-minute intervals. The injection data will be used by Regensis to recommend a site-specific mixing and injection program to achieve the remediation goals for groundwater treatment for CAA-5. Procedures for injection testing are included in The Clear Water Injection Test – Direct Push Method (Attachment 2).

PROPOSED CAA-7 PRE-DESIGN INVESTIGATION

Additional characterization of arsenic and TBT in surface soils is proposed in CAA-7 and surrounding areas of the East Waterfront parcel to delineate the lateral and vertical extents of excavation for arsenic impacts and to determine if TBT is present at concentrations that would warrant cleanup.

The Initial Study Area for pre-remedial design investigation within and surrounding CAA-7 includes potentially erodible soils in the upper 2 feet bgs in unpaved areas where Icicle Seafoods previously operated.³ The potentially erodible former operational areas were located north of a historically landscaped slope, as shown on Figure 2.

In the Supplemental Upland RI/FS, arsenic was identified as an IHS and CAA-7 was designated as a cleanup area to remediate arsenic in surface soil collocated with arsenic-contaminated groundwater. Based on former operations and the source of metals in surface soils (sandblast grit), other metals are collocated with arsenic.⁴ To address Ecology comments on the Supplemental Upland RI/FS (Ecology 2020b), additional characterization for certain metals that may be of concern for erosion into Salmon Bay (cadmium and silver), will be further evaluated in surface soils in CAA-7. In addition, at Ecology's request, additional metals related to sandblast grit (copper, lead, and zinc) will also be further characterized. Evaluation of these metals will be used to determine whether other metals are present when arsenic is present and, when arsenic is present at concentrations less than the CUL (natural background), whether other metals are present at concentrations that could pose potential risk to human health or the environment. Ecology also requested additional characterization of mercury at a lower practical quantitation

³ Metals and TBT may be present in shallow soils on the East Waterfront parcel associated with historical sandblasting and marine maintenance operations performed by Icicle Seafoods, a prior tenant of a portion of the parcel.

⁴ Arsenic was the only metal that was detected in groundwater at concentrations greater than the preliminary CULs.

limit than was achieved during previous data collection. This evaluation of other metals will be used to support design and to confirm that excavation of arsenic will also concurrently address other collocated metals.

Ecology's comments additionally identified TBT, which was historically used in marine paints, as a potential contaminant that may also be of concern for erosion into to Salmon Bay. TBT was not evaluated in the Supplemental Upland RI/FS, but limited characterization within and surrounding CAA-7 completed in May 2020⁵ did not detect TBT in surface soils at concentrations exceeding the targeted REL established in the CAP.⁶ Previous soil results for arsenic and TBT in the Initial Study Area are shown on Figure 3 for reference.

Metals and TBT Soil Sample Collection

Initial soil characterization within and surrounding CAA-7 will be completed using hand sampling methodology in accordance with the RIWP. It is anticipated that step-out and step-down samples, if needed to define the CAA-7 excavation extents, will be collected during a second mobilization using either hand sampling or direct-push drilling methodology. Field sampling procedures for soil sampling using drilling methods are also presented in the RIWP. Sufficient soil will be collected from each location to allow a phased approach for decision making regarding appropriate selection of sample locations and depths for any subsequent analyses.

Additional soil samples will be collected to delineate the excavation base and sidewalls of CAA-7 and to further investigate the presence of arsenic and TBT surrounding CAA-7 as shown on Figure 4 and described below:

CAA-7 Delineation and Confirmation Samples

- Excavation base samples will be collected at a frequency of one sample per 400 square feet of excavation area to determine the depth of excavation. Sampling stations established during the 2020 TBT investigation will be re-occupied for confirmation sample collection. Base samples will be collected from the 1 to 1.25 feet bgs and 2 to 2.25 feet bgs intervals.
- Excavation sidewall samples will be collected at a frequency of one sample per 20 linear feet of sidewall. Sidewall samples will be collected from the 0.25 to 0.75 feet bgs interval of soil underlying recent duff/vegetation where previous arsenic detections exceeded the CUL.

⁵ Note these sample were collected during finalization of the Supplemental RI/FS and CAP, and results were not included in these documents.

⁶ Refer to Section 3.4 of the CAP for details regarding TBT data screening and evaluation.

- The upper base samples and sidewall samples will be analyzed for arsenic, which was determined in the CAP to be an IHS for the presence of other metals potentially associated with sandblast grit based on its frequency of exceedances of the CUL in soil relative to other metals and collocated CUL exceedances in groundwater. If arsenic is not present at concentrations greater than the CUL, which is consistent with background soil concentrations, then it is presumed that other metals would also not be present at elevated concentrations, as long as the other metals data supports this presumption.
 - After review of the arsenic results, a subset of these initial samples will be selected for analyses of other metals (cadmium, copper, lead, mercury, silver, zinc) to document their presence in surface soils. Representative samples of the range of potential arsenic results will be selected for additional metals analyses, including (if available): a non-detect result, the lowest detected concentration, a detected concentration at or near the CUL for arsenic, and the greatest detected concentration. Additional soil samples may be selected for additional metals analyses as warranted based on the initial results.
 - The lower base samples will be archived and analyzed for arsenic only if needed to delineate the vertical extents of excavation to achieve the arsenic CUL of 7.3 mg/kg specified in the CAP.
- Additional step-out sidewall or step-down base samples will be collected for arsenic or the other metals as needed (as a second mobilization) to adequately define the lateral and vertical extent of the excavation after receipt of initial sampling results. Sidewall step-out samples will be collected at approximate 10-foot lateral intervals where accessible, and base step-down samples will be collected at 1-foot vertical intervals. If additional samples are deemed necessary in the area beneath the existing warehouse, then additional confirmation data will be collected during remedy implementation.

Additional Arsenic and TBT Characterization

The area of potentially erodible soil in the Initial Study Area (outside of CAA-7) was divided into seven composite areas (COMP-1 through COMP-7) that were subdivided into approximate 400-square-foot discrete sampling zones. Approximate discrete sample locations and composite areas are shown on Figure 4; locations may be adjusted as needed in the field depending on accessibility. Soil samples will be collected to better characterize arsenic and TBT in surface soil outside CAA-7 using a phased approach with initial analysis of composite samples and follow-up analysis of discrete samples based on composite results as follows:

- Discrete soil samples will be collected from the erodible soil interval at 0.5-foot intervals (i.e., from 0 to 0.5 feet bgs and 0.5 to 1 foot bgs), excluding any vegetation/duff or recently placed gravel overlying the soil surface. Equal volumes of samples collected from 0 to 0.5 feet bgs and 0.5 to 1 foot bgs will be combined into

four- or five-point composites as shown on Figure 4. Sufficient volume from the 0 to 0.5 feet bgs and 0.5 to 1 foot bgs intervals from each of the 29 sample locations will also be retained and processed as discrete samples.

- The composite samples from the 0.5 to 1 foot bgs interval will be archived at the laboratory for future analyses as needed.
- Discrete samples from 0 to 0.5 feet bgs and 0.5 to 1 foot bgs from each sampling station will also be archived for potential follow-up analyses as needed.

Sample analyses of composite samples, with follow-up analysis of discrete samples as needed, will be conducted in a phased approach as follows:

- Initially, all composite samples from the 0 to 0.5 feet bgs interval will be analyzed for arsenic and TBT to identify potential area-wide issues and determine where follow-up analyses of discrete samples are needed.
- If a composite sample concentration from the 0 to 0.5 foot bgs interval exceeds a concentration one-fourth of either the CUL for arsenic, the target REL of 0.047 mg/kg for TBT, or the Model Toxics Control Act (MTCA) Method B Direct Contact CUL of 24 mg/kg for TBT, which is an indication that at least one of the discrete samples in the composite may contain arsenic or TBT at a concentration exceeding the above-referenced criteria, then the following additional samples may be analyzed in consultation with Ecology:
 - Discrete samples for that 0 to 0.5 feet bgs composite will be analyzed for arsenic and/or TBT, depending on which exceeds the relevant criteria. Note that discrete samples analyzed for arsenic will be compared to the CUL of 7.3 mg/kg, and discrete samples analyzed for TBT will be compared to the target REL of 0.047 mg/kg and the MTCA Method B Direct Contact CUL of 24 mg/kg.
 - The underlying 0.5 to 1 foot bgs composite sample will be analyzed if arsenic or TBT exceed the previously mentioned criteria in the 0 to 0.5 feet bgs interval.
 - If the 0.5 to 1 foot bgs composite sample also exceeds the relevant criteria for arsenic or TBT, the discrete samples comprising the 0.5 to 1 foot bgs composite will also be analyzed. This may include a subset of the discrete samples based on the results of the discrete analyses from the 0 to 0.5 feet bgs interval.
 - Additional metals (cadmium, copper, lead, mercury, silver, or zinc) may also be analyzed as needed to confirm their presence in areas where arsenic concentrations are elevated relative to surrounding areas (i.e., hot spot).
- Step-down samples will be collected as needed (as a second mobilization) to define the vertical extent of arsenic and TBT relative to the relevant criteria provided above. Step-down samples will be collected at 1-foot intervals below 1 foot bgs.

SUPPLEMENTAL SAMPLING AND ANALYSIS AND QUALITY ASSURANCE PROJECT PLAN

Sample collection, analysis, and data validation for the pre-remedial design investigation will be performed in accordance with the SAP/QAPP presented in the RIWP, with supplemental information as described below for additional data collection procedures and additional and updated analytical methods.

Passive Flux Meter Installation and Injection Testing

Procedures for installing, retrieving, and sampling the PFMs is included in the PFM Protocol Manual (Attachment 1), and procedures for injection testing are included in The Clear Water Injection Test – Direct Push Method (Attachment 2).

Sample Identification and Labeling

Samples collected as part of this investigation will be identified and labeled as followed:

- CAA-4 Subsurface Soil Samples: Pre-design soil boring number (ISS-ASKO) - depth interval. For example, the soil sample collected from location ISS-ASKO from 8 to 9 feet bgs would be labeled ISS-ASKO 8-9’.
- CAA-5 Groundwater Samples: monitoring well number - month/day/year of collection. For example, a groundwater sample collected from 01MW01 on November 20, 2018, would be labeled 01MW01-112018
- CAA-5 Subsurface Soil Samples: Pre-design soil boring number (PDSB##) - depth interval. For example, the soil sample collected from location PDSB01 from 15 to 16 feet bgs would be labeled PDSB01-15-16.
- CAA-7 Confirmation Samples: CAA location (CAA7) - SW for sidewall or B for base and sample number - depth interval. For example, the first base sample collected from 1.0 to 1.25 feet bgs would be labeled CAA7-B01-1-1.25.
- East Waterfront Potentially Erodible Soil Initial Study Area: composite area number (COMP#) and discreet sample letter - depth interval. For example, the first sample collected from composite area 1 from 0.5 to 1 foot bgs would be labeled COMP-1a-0.5-1.

Laboratory Methods, Quality Assurance, and Quality Control

Soil and groundwater samples will be submitted to FBI for laboratory analyses as described in previous sections of this PD Work Plan. Soil and groundwater samples for selected conventional analytes and geotechnical parameters will be transferred by FBI to Fremont, and soil samples for TBT analysis will be transferred by FBI to Analytical Resources, Inc. (ARI) under chain-of-custody procedures. Supplemental QAPP details, including additional analytes, are included in the following tables:

- Table 1 includes sample container and preservation requirements

- Table 2 includes analytical methods and quantitation limits for FBI, Fremont, and ARI
- Table 3 presents data QA and QC criteria

REFERENCES

Floyd|Snider. 2019. Time Oil Bulk Terminal PPA Supplemental Upland Remedial Investigation Work Plan. March.

_____. 2020. Time Oil Bulk Terminal PPA Supplemental Upland Remedial Investigation and Feasibility Study. September.

Washington State Department of Ecology (Ecology). 2020a. Cleanup Action Plan, Time Oil Bulk Terminal, Seattle, WA. September.

_____. 2020b. Ecology comments on Time Oil Bulk Terminal PPA Supplemental Upland Remedial Investigation and Feasibility Study. April.

LIST OF ATTACHMENTS

Table 1	Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times
Table 2	Analytical Methods, Detection Limits, and Reporting Limits
Table 3	Data Quality Assurance Criteria
Figure 1	Design Verification Sampling Locations—ASKO Hydraulic
Figure 2	Historical Ground Cover and Features—East Waterfront
Figure 3	Existing Initial Study Area Soil Results for Arsenic and Tributyltin—East Waterfront
Figure 4	Proposed Soil Sample Locations—East Waterfront
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Attachment 2	The Clear Water Injection Test – Direct Push Method

Tables

Table 1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Chemical	Analytical Method	Bottle Type	Preservative	Holding Time
Soil				
Grain size with hydrometer	ASTMD422	One 32-oz WMG	None, cool to <6 °C	28 days
Total organic carbon	USEPA 9060	One 4-oz WMG	None, cool to <6 °C	28 days
Metals (arsenic, cadmium, calcium, copper, lead, mercury, silver, zinc)	USEPA Method 6020B	One 4-oz WMG	None, cool to <6 °C	6 months
Mercury	USEPA 1631E (mercury)	One 4-oz WMG	None, cool to <6 °C	28 Days
Total petroleum hydrocarbons: gasoline-range and volatile organic compounds	NWTPH-Gx/ USEPA Method 8260C	Four pre-tared 40-mL VOA	None, cool to <6 °C for up to 48 hours	Freeze to <-7 °C within 48 hours, 14 days to analyze
Total petroleum hydrocarbons: diesel- and oil-range	NWTPH-Dx	One 4-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze
Tributyltin	USEPA 8270D-SIM	One 8-oz WMG	None, Cool <6°C	14 days to extract, then 40 days to analyze
Groundwater				
Metals (calcium, magnesium)	USEPA Method 6020B	One 500-mL HDPE	HDPE: HNO ₃ to pH<2 Cool to <4 °C	6 months
Total petroleum hydrocarbons: gasoline-range	NWTPH-Gx	Three 40-mL VOA	Cool to <4 °C, HCl to pH<2, no headspace	14 days
Total petroleum hydrocarbons: diesel- and oil-range	NWTPH-Dx	One 500-ml amber glass	Cool to <4 °C, HCl to pH<2	14 days to extract, then 40 days to analyze
Volatile organic compounds	USEPA Method 8260D	Three 40-mL VOA	Cool to <4 °C, HCl to pH<2, no headspace	14 days
Hardness	SM2340B	500 mL HDPE	1 mL 1:1 HNO ₃	6 months
Alkalinity	SM2320B	500 mL HDPE	Cool to <4 °C	14 days
Biochemical oxygen demand	SM5210B	1 L HDPE	Cool to <4 °C	48 hours
Total and dissolved organic carbon	SM5310B	500 mL HDPE	Cool to <4 °C, HCl to pH<2	28 days
Sulfate	SM4500	500 mL HDPE	Cool to <4 °C	7 days
Nitrate	USEPA 353.2	500 mL HDPE	Cool to <4 °C	48 hours

Abbreviations:

- °C Degrees Celsius
- HCl Hydrogen chloride
- HDPE High-density polyethylene
- mL Milliliters
- oz Ounces
- USEPA U.S. Environmental Protection Agency
- VOA Volatile organic analysis
- WMG Wide-mouth glass jar

Table 2
Analytical Methods, Detection Limits, and Reporting Limits

Chemical	Units	Analytical Method	Method Detection Limit	Practical Quantitation Limit
Soil				
Conventionals				
Grain size with hydrometer	g/cm ³	ASTMD422	NA	NA
Total organic carbon	% dry	USEPA 9060	0.0075	0.075
Metals				
Arsenic	mg/kg	USEPA 6020B	0.150	1.0
Cadmium	mg/kg	USEPA 6020B	0.020	0.5
Calcium	mg/kg	USEPA 6020B	50	50
Copper	mg/kg	USEPA 6020B	0.26	5
Lead	mg/kg	USEPA 6020B	0.0495	1
Mercury	mg/kg	USEPA 1631E	0.0023	0.05
Silver	mg/kg	USEPA 6020B	0.04	0.10
Zinc	mg/kg	USEPA 6020B	0.69	5
Total Petroleum Hydrocarbons				
Gasoline-range organics	mg/kg	NWTPH-Gx	0.19	5.0
Diesel-range organics	mg/kg	NWTPH-Dx	1.3	50
Oil-range organics	mg/kg	NWTPH-Dx	39	250
Volatile Organic Compounds (VOCs)				
cis-1,2-Dichloroethene	mg/kg	USEPA 8260	0.003	0.050
trans-1,2-Dichloroethene	mg/kg	USEPA 8260	0.003	0.050
Trichloroethene	mg/kg	USEPA 8260	0.013	0.020
Vinyl chloride	mg/kg	USEPA 8260	0.013	0.050
Other VOCs	mg/kg	USEPA 8260	0.01 to 0.3	0.05 to 0.5
Semivolatile Organic Compounds				
Tributyltin	mg/kg	8270D-SIM	450	3,900
Groundwater				
Metals				
Calcium	µg/L	USEPA 6020B	21	50
Magnesium	µg/L	USEPA 6020B	4.7	50
Total Petroleum Hydrocarbons				
Gasoline-range hydrocarbons	µg/L	NWTPH-Gx	11	100
Diesel-range hydrocarbons	µg/L	NWTPH-Dx	5.3	50
Oil-range hydrocarbons	µg/L	NWTPH-Dx	52	250
Volatile Organic Compounds (VOCs)				
1,2-Dichloroethene	µg/L	USEPA 8260D	0.035	1.0
Trichloroethene	µg/L	USEPA 8260D	0.037	0.5
Vinyl chloride	µg/L	USEPA 8260D	0.067	0.2
Other VOCs	µg/L	USEPA 8260D	0.01 to 0.5	0.2 to 5.0
Conventionals				
Hardness	mg/L	SM2340B	0.072	0.80
Alkalinity	mg/L	SM2320B	1.3	2.5
Biochemical oxygen demand	mg/L	SM5210B	1.0	2.0
Total and dissolved organic carbon	mg/L	SM5310B	0.070	0.50
Sulfate	mg/L	USEPA 300.0	0.0046	0.30
Nitrate	mg/L	USEPA 300.0	0.0015	0.10

Abbreviations:

- g/cm³ Grams per cubic centimeter
- NA Not applicable
- µg/L Micrograms per liter
- mg/kg Milligrams per kilogram
- mg/L Milligrams per liter

Table 3
Data Quality Assurance Criteria

Chemical	Precision ⁽¹⁾	Accuracy	Completeness	Reference
Soil				
Grain size with hydrometer	NA	NA	95%	ASTMD422
Total organic carbon	±20% RPD	50-150%	95%	USEPA 9060
Metals	±20% RPD	80–120%	95%	USEPA 6020B/1631E
Total petroleum hydrocarbons gasoline-range	±30% RPD	65–135%	95%	NWTPH-Gx
Total petroleum hydrocarbons: diesel- and oil-range	±30% RPD	65–135%	95%	NWTPH-Dx
Volatile organic compounds	±30% RPD	65–135%	95%	USEPA 8260D
Tributyltin	±30% RPD	30-160%	95%	USEPA 8270 SIM
Groundwater				
Metals	±20% RPD	80–120%	95%	USEPA 6020B/1631E
Total petroleum hydrocarbons: gasoline-range	±30% RPD	65–135%	95%	NWTPH-Gx
Total petroleum hydrocarbons: diesel- and oil-range	±30% RPD	65–135%	95%	NWTPH-Dx
Volatile organic compounds	±30% RPD	65–135%	95%	USEPA 8260D
Hardness	≤20% RPD	50-150%	95%	SM2340B
Alkalinity	≤20% RPD	94.3-116%	95%	SM2320B
Biochemical oxygen demand	NA	NA	95%	SM5210B
Total and dissolved organic carbon	≤20% RPD	90.2-110%	95%	SM5310B
Sulfate	≤20% RPD	90-110%	95%	USEPA 300.0
Nitrate	≤20% RPD	90-110%	95%	USEPA 300.0

Note:

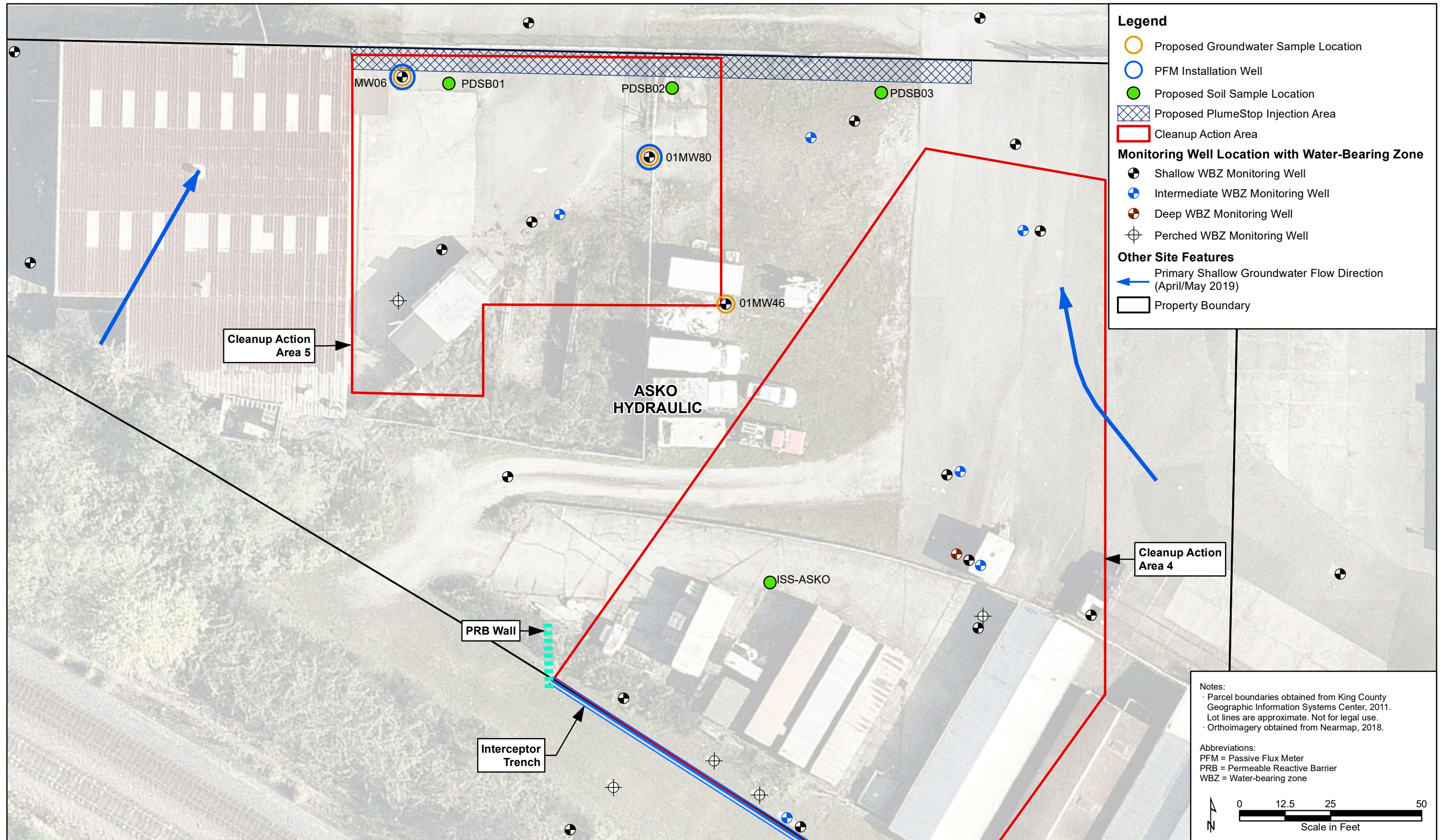
1 Precision criteria apply to analytical precision only. Field duplicate precision will be screened against an RPD of 75%.

Abbreviations:

NA Not applicable

RPD Relative percent difference

Figures



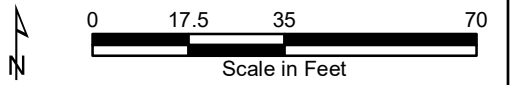
Legend

- Former Grit Pile Excavation
- Historically Gravel
- Historically Paved
- Historically Vegetated
- Boundary Between TOC and Icicle Seafoods Operations
- Initial Study Area Boundary
- Cleanup Action Area 7
- Property Boundary



Notes:

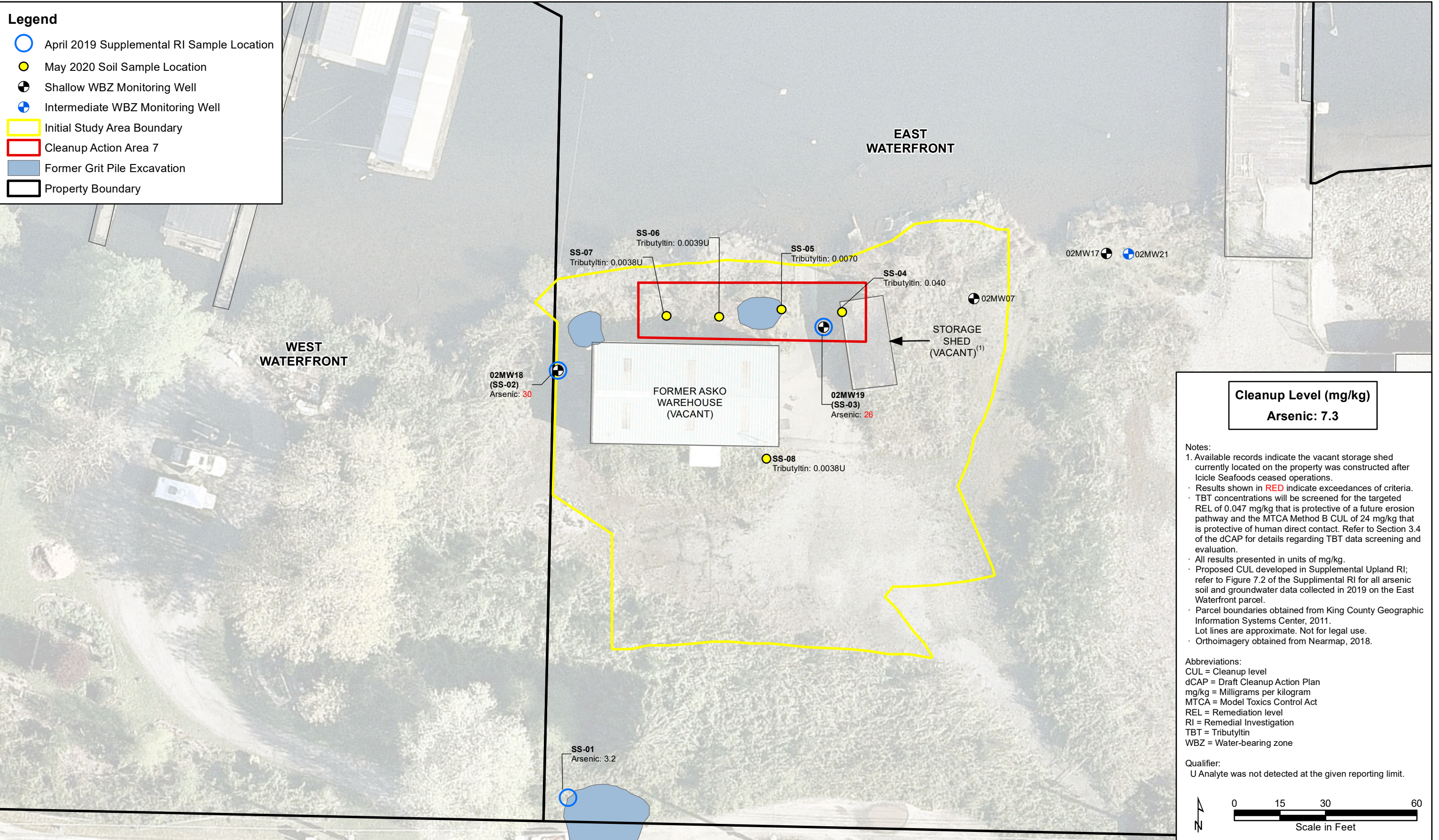
- 1. Available records indicate the vacant storage shed currently located on the property was constructed after Icicle Seafoods ceased operations.
- Ground surface coverings are approximated based on historical aerial photographs and current observed Property conditions.
- Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
- Orthoimagery obtained from the University of Washington map library, 1989.



H:\GIS\Projects\Cantera-TOC\IMXD\Pre-Engineering Design\Figure 2 Historical Ground Cover and Features-East Waterfront.mxd
10/16/2020

Legend

- April 2019 Supplemental RI Sample Location
- May 2020 Soil Sample Location
- ⊕ Shallow WBZ Monitoring Well
- ⊕ Intermediate WBZ Monitoring Well
- Initial Study Area Boundary
- Cleanup Action Area 7
- Former Grit Pile Excavation
- Property Boundary

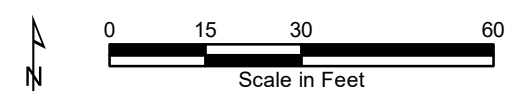


Cleanup Level (mg/kg)
Arsenic: 7.3

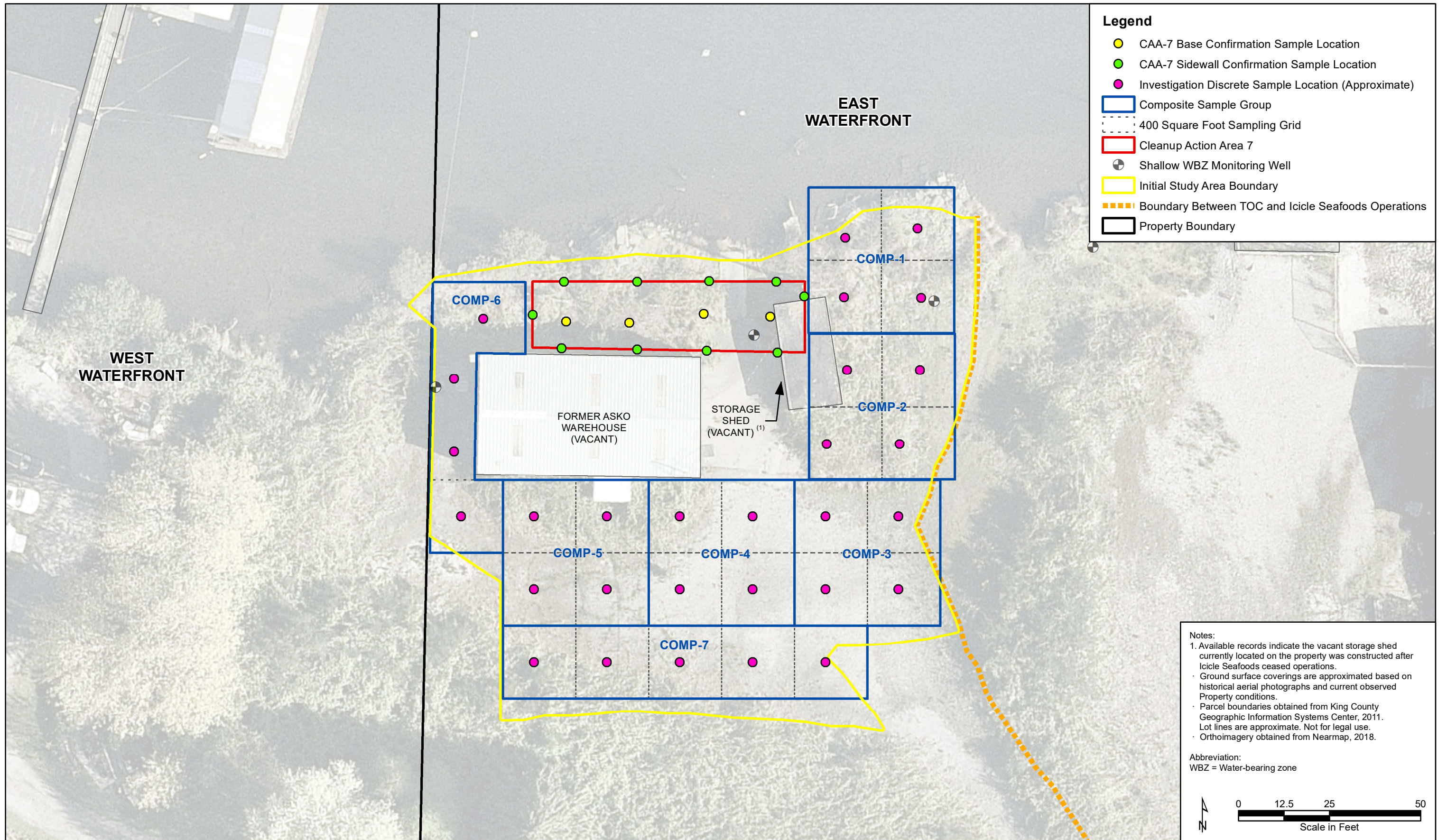
- Notes:
- Available records indicate the vacant storage shed currently located on the property was constructed after Iccicle Seafoods ceased operations.
 - Results shown in **RED** indicate exceedances of criteria.
 - TBT concentrations will be screened for the targeted REL of 0.047 mg/kg that is protective of a future erosion pathway and the MTCA Method B CUL of 24 mg/kg that is protective of human direct contact. Refer to Section 3.4 of the dCAP for details regarding TBT data screening and evaluation.
 - All results presented in units of mg/kg.
 - Proposed CUL developed in Supplemental Upland RI; refer to Figure 7.2 of the Supplemental RI for all arsenic soil and groundwater data collected in 2019 on the East Waterfront parcel.
 - Parcel boundaries obtained from King County Geographic Information Systems Center, 2011. Lot lines are approximate. Not for legal use.
 - Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
 CUL = Cleanup level
 dCAP = Draft Cleanup Action Plan
 mg/kg = Milligrams per kilogram
 MTCA = Model Toxics Control Act
 REL = Remediation level
 RI = Remedial Investigation
 TBT = Tributyltin
 WBZ = Water-bearing zone

Qualifier:
 U Analyte was not detected at the given reporting limit.



I:\GIS\Projects\Cantera-TOC\MXD\Pre-Engineering Design\Figure 3 Existing Initial Study Area Soil Results for Arsenic and Tributyltin-East Waterfront.mxd
 10/16/2020

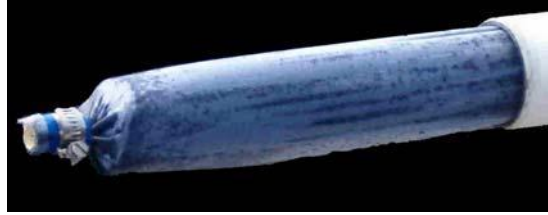


Attachment 1
Passive Flux Meter Protocol Manual



Passive Flux Meter Protocol Manual

EnviroFlux, LLC



The following documents current methods for construction, storage, transport, deployment, sampling and analysis of passive flux meters for site assessment.

PFM CONSTRUCTION

PFM Storage: If the PFMs are constructed for transport to the field site, the PFMs will be stored in tubes and cooled. PFM storage tubes are constructed using PVC pipe the same diameter as the packing tube. The bottom of storage tube is sealed by a gas tight mechanical plug. The PFM is then extruded from the packing tube into the storage tube. A section of threaded rod or PVC pipe is used to push the PFM out of the packing tube and into the storage tube. The top of the storage tube is then sealed. The PFM are then placed in cold storage (4 C) until transport.

PFM Transport: The PFMs are transported in cardboard boxes to the site for FedEx shipments.

INSTALLATION PROCEDURES

PFM Deployment: At the field site the PFM in the packing tube or storage tube is prepared for PFM insertion into the well casing. A rope (or in some cased a steel cable) is attached to the top of the PFM using a safety carabineer. The tube is lined up with the top of the well casing and a section of push rod is used to push the PFM from the tube into the top section of well casing. Additional push rods are attached to continue pushing the PFM to the screen interval. If multiple PFMs are deployed on a single line, short sections of cable (about 5.5ft long) are thread through the upper PFM to link the PFMs together well. When inserting the PFM some back pressure may build since the water in the well casing must flow through the center tube as the PFM is inserted. Proceed slowly as pressure builds. The PFM rope (or steel cable) attached to the sock assembly is then secured to the well lid or others to ensure that it will not be lost to the well head.

- 1) PFMs are shipped to the site via FedEx Overnight.



- 2) Lay the PFMs for the first well onto saw horse legs.



- 3) Remove end caps from PVC transport tubes.



- 4) Remove well lid and cap.



- 5) Attach retrieval rope (or wires) to the top of each PFM using a carabineer connector.



- 6) Install PFMs by setting transport tube over monitoring well and using Geoprobe rods to push PFM out of the transport tube and into the well.



- 7) Push PFM into position in the well using Geoprobe rods while holding retrieval wire tight.



- 8) Repeat steps 5 through 7 for each PFM that is to be installed in the well.
- 9) Replace well lid and cap (wire ropes are cut to a length such that two feet of each retrieval wire will remain outside the well).
- 10) Repeat steps 2 through 9 for each well.

RETRIEVAL AND SAMPLING PROCEDURES

Preparation of Sampling Vials: 120 ml jars are used for AC sampling. Jars are filled with activated carbon making sure to seal tightly with no carbon grains on the lip of the jar.

PFM Retrieval: PFMs are retrieved using the rope. The top PFM in the well is extracted first by gently pulling up on the rope (heavy work gloves should be worn when pull on rope or stainless wire cable). The PFM should be pulled to the top of the well casing. When the PFM is at the top of the well casing untangle any rope (or wires) that are twisted at the well head. Thread the retrieval cable through a 5ft storage (or transport) PVC pipe and place the pipe over the well to guide and contain the extruded PFM. Move the PFM to the sampling work station.

PFM Sampling: A tarpaulin acts as a ‘protective flooring’ for the work zone. A portable table is used as a work zone for sampling the PFMs. Nitrile protective gloves and necessary other protective clothing will be worn by all samplers. A lined bucket (5gal) is placed under the work area to capture un-sampled residual activated carbon from the retrieved PFM. The sock is extruded from the PVC pipe to the sampling interval extent. The flexible mesh packing material is cut and the sorbent (activated carbon) captured in plastic or stainless steel mixing bowls for homogenization using a stainless steel spatula. A sub-sample is then transferred into 120 mL jars. The jars are stored in a cooler for transport back to the laboratory for analysis. The center tube and viton washers are measured to obtain the sample interval lengths in the PFM. Sampling materials, spatula, scissors, mixing bowls are wiped clean to remove carbon particles prior to retrieving the next PFM.

Transportation and Storage: Sorbent (GAC) samples are stored on-site in coolers then shipped via overnight air express (e.g., FedEx) to the EnviroFlux laboratory. Samples are stored in a cold storage room or refrigerator at 4^o C until extraction and analysis.

- 1) Retrieve PFM from well by pulling up on the attached rope (or wire). The PFM is pulled from the well pipe directly into a PVC tube of the same diameter.



- 2) Place tube on table and expose the first segment by pulling on the bottom end of the PFM.



- 3) Using scissors, cut open the nylon socks and flexible red mesh covering the first segment and pour the exposed sorbent(GAC) mixture into a mixing bowl.



- 4) Stir the mixture vigorously in the bowl to homogenize
- 5) Sub-sample the mixture and place into 120mL jar and seal tightly (make sure no carbon particles are on the lip of the jar).



- 6) Measure the interval length of the PFM segment
- 7) Repeat for steps 3-8 for remaining segments of PFM
- 8) After all PFMs are sampled, place 120 mL jars into cooler(s) and ship back for analysis
- 9) Excess sorbent is collected in a plastic-lined container for proper hazardous waste disposal.

Attachment 2
The Clear Water Injection Test –
Direct Push Method

The Clear Water Injection Test – Direct Push Method

The clear water injection test is used to characterize how conducive a site is for injection. The test goes above and beyond what a hydraulic conductivity test can tell us about the site and give us the insight on probable injection rates, pressures, volume and distribution. Contrary to our understanding of a site's geology, occasionally sands and even gravels can be very difficult to inject into and surprisingly some clays and silts can be easily injected. Aside from determining injection rates and pressures, the test also uncovers if daylighting will be an issue and what additional measures might be needed to seal injection points. The test also helps to identify if confined or unconfined aquifer conditions exist at a site which will limit pore volume. So there are benefits on many levels to performing the clear water injection test to confirm the actual site injection conditions.



A link to an excel spreadsheet is attached below. [DVT Clear Water Data Form.xlsx](#) Download the spreadsheet onto your Ipad for recording data during the clear water injection test. The spreadsheet might need to be modified or expanded to fit the needs of your particular DVT.

The test takes approximately 1-4 hours to complete per injection point. Some sites need only one clear water injection point, other sites may require 3-4 injection points. The test can also be completed on injection wells or monitoring wells.

Prior to conducting the test four things need to be determined:

1. The test location(s). Sometimes the clear water test boring locations can be pre-determined; however, the DVT boring logs may reveal some concerns about the site geology; therefore, you will want to optimally position the clear water injection point to possibly address these concerns identified during the DVT.
2. Expected radius of influence (ROI). Review the design included in DesignForce. If a 12-foot grid spacing is proposed for the injection project then placing the clear water injection point 6 feet from a monitoring well is recommended. Ideally, if the same scenario exists and two wells are near the proposed clear water injection point location, then place the injection point between the two wells while keeping the injection point 6 feet from one of the wells.
3. Well screen. Make sure the well screen covers your proposed injection interval. If a portion of the test interval does not overlap with the well screen then make note of that in the comments section of the notes.

4. Injection methodology a top-down or bottom –up injection method. Bottom up injection method with a retractable screen is preferred. Occasionally the injection method will be determined before the clear water test; however, the results of the DVT usually influence which method is completed. For some sites both methods are attempted to determine the effects of each method on distribution.

Procedures for Clear Water Injection Test-Direct Push Method

1. Install the retractable screen to the first targeted depth interval.
2. While the injection point is being installed, connect the flow meter assembly to water source but do not connect it to the pull cap or direct push rod.
3. If it's not known test the maximum flow rate and pressure of the water source. First turn the water source on, but keep the outgoing valve closed so the gauge reads the pressure. Once the pressure stabilizes, note it on the form. Then fully open the valve and measure the maximum flow rate and note it on the form.
4. Reset the "Total Batch 2" value on the flow meter.
5. Measure the depth to groundwater in nearby wells within 20 feet of the clear water injection test location.
6. Connect the flow meter assembly to the pull cap and the pull cap to the direct push rod.
7. Turn on the flow of water and allow the pressure to stabilize and the flow to stop. Some fluid can leak past the retractable screen, so flow might not completely stop. When you are sure that the direct push rods are full of water have the driller slowly lift the rods to expose the retractable screen.
8. Record the start time and then the time, flow rate, pressure and total flow every 1-3 minutes until the interval is completed. Attempt to inject a volume of water that is consistent with the design. For example, if the design calls for 40 gallons injected per foot and you are using a 2 ft screen, then attempt to inject 80 gallons before lifting the rods to the next interval. Unless you need to break rod it is best to continue injecting while the rods are lifted upward.
9. Record the depth to groundwater and other parameters in nearby monitoring wells one every 5 minutes during the beginning of the test and once every 10 minutes after the first ½ hour. If there is more than one well it is best to obtain one full round. Also continue to record depth to water in the monitoring wells if the test is stopped due to equipment problems or other reasons.
10. When the injection test(s) are complete continue to monitor groundwater elevations in all monitoring wells. The groundwater recovery rate back to static conditions will tell us additional information about the aquifer.