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May 31, 2024
Project No. M0615.20.014

Steve Teel, LHG, Cleanup Project Manager/Hydrogeologist
Washington State Department of Ecology
Toxics Cleanup Program, Southwest
P.O. Box 47775
Olympia, WA 98504

Re: Hylebos Marsh: Subsurface Investigation Work Plan

Dear Steve Teel:

Maul Foster & Alongi, Inc. (MFA) has prepared this work plan on behalf of the Port of Tacoma (the Port) to guide sampling and analysis of environmental media at the Hylebos Marsh property, located at 1212 Taylor Way in Tacoma, Washington (the Property; see Figure 1). The purpose of the investigation is to characterize and refine the boundaries of the automobile shredder fluff (referred to as auto fluff in this work plan) present beneath the Property, which is part of the Taylor Way and Alexander Avenue Fill Area (TWAAFA) site (Washington State Department of Ecology [Ecology] facility ID no. 1403183; cleanup site ID no. 4692).

This work plan describes methods that will be used for sampling environmental media, decontaminating equipment, and managing investigation-derived waste (IDW). It also includes procedures for collecting, analyzing, evaluating, and reporting data. This work plan is updated to incorporate Ecology's review comments provided to the Port via email on May 14, 2024.

Background

The Property is currently vacant and undeveloped with low-lying vegetated areas and wetlands present. The Port has been working with Washington State Department of Agriculture and the United States Department of Agriculture to eradicate an invasive species of snail present on the Property, *Cernuella virgata* (Vineyard Snail). The invasive snails are currently limited to the Property.

Auto fluff originating from General Metals of Tacoma operations on the neighboring Stericycle property potentially extends onto the Property forming an area of sloped topography along the eastern border of the Property (See Figure 2). Elevated concentrations of arsenic, cadmium, chromium, copper, lead, zinc, petroleum hydrocarbons, and polychlorinated biphenyls have been detected in auto fluff samples collected on other parcels within the TWAAFA site (DOF 2020).

Previous investigations on the Property and Stericylce property have encountered auto fluff in the sloped area fill material along the eastern parcel boundary. Thicknesses of auto fluff ranged from 0.75 feet thick in boring SRI-13 to 12 feet thick in boring SRI-15 (DOF 2020). Auto fluff was not identified in soil borings SRI-19, SB-3A, and TWA-SB3 located near the base of the sloped area (DOF 2020, 2022). Contaminants detected above screening levels in soil on the Stericycle Property near this sloped area included oil-range hydrocarbons, arsenic, and lead; however, no soil samples have been collected from the sloped area fill on the Hylebos Marsh Property (DOF 2020, 2022). COC concentrations in soil collected elsewhere from the Hylebos Marsh Property are below data gaps screening criteria (DOF 2020, 2022).

Scope of Work

This work plan describes the proposed sampling approach to refine the extent of auto fluff and characterize it for associated contaminants in soil on the Property. Sampling methods, analytical methods, and media of interest are described below and are summarized in Table 1.

Preparation and Coordination

Before subsurface field sampling programs begin at the Property, public and private utility locates will be conducted to identify underground utilities or obstructions near the proposed sample locations (see standard operating procedure [SOP] 18, Attachment A).

Geophysical Surveys

Electromagnetic induction (EM) and ground-penetrating radar (GPR) surveys of the sloped area will be conducted by hydroGEOPHYSICS, Inc. (HGI), to determine the approximate extent of auto fluff prior to subsurface exploration. The geophysical survey scope of work prepared by HGI is provided in Attachment B.

The EM survey will be used to delineate the extent of ferrous and non-ferrous metallic fragments associated with auto fluff with an effective investigation depth of 10 to 15 feet. The GPR survey will be used to identify areas of buried debris with a higher resolution and more accurate depth determination than the EM survey.

EM and GPR survey data will be acquired along parallel survey lines spaced approximately 10 feet apart; however, this spacing may vary depending on site logistics or the presence of dense vegetation. Grids for each site will be set up on a local basis before data acquisition begins and will be surveyed in using a handheld GPS device.

The findings of the EM and GPR surveys will be used to determine the final locations of the proposed borings and hand auger test pits.

Hand Auger Borings

Following the geophysical surveys, three hand auger borings (TWA-HA-01 through TWA-HA-03) will be advanced up to two feet below ground surface (bgs) just outside the estimated extent of the auto fluff identified by the geophysical surveys to confirm the western extent of auto fluff via visual observations. A stainless-steel hand operated soil auger will be used to advance these borings. Other hand tools may be used if refusal is encountered. The hand auger borings may be reattempted at locations further west if auto fluff is encountered at the initial locations to further bound the material. The soil lithology encountered in these hand auger borings will be logged on field sampling data sheets (FSDSs; see Attachment C).

Borings

Subsurface soils will be collected from borings advanced with a track-mounted direct-push drill rig operated by a Washington State-certified driller using industry-standard sampling techniques (see SOPs 02, 03, 04, 05 and 07 in Attachment A). Eight soil borings (TWA-SB-09 through TWA-SB-16) will be advanced along the eastern boundary of the Property on the sloped topography corresponding to the fill material extending from the neighboring Stericycle property (see Figure 3). The boring locations positioned at the northernmost and southernmost extents of auto fluff may be adjusted following the geophysical survey to better delineate the lateral extent of auto fluff in these areas.

Based on the approximate auto fluff extents identified in the data gaps work plan for the TWAAFA site (DOF 2020), borings TWA-SB-11, TWA-SB-12, and TWA-SB-13 are anticipated to be within the auto fluff and will be used to inform the vertical extent of auto fluff. These borings will be advanced up to 20 feet bgs. The remaining five borings (TWA-SB-09, TWA-SB-10, TWA-SB-14, TWA-SB-15, and TWA-SB-16) will be advanced up to the depth of native material, anticipated to be the Silt Unit, observed during the drilling of TWA-SB-11, TWA-SB-12, and TWA-SB-13.

Soil conditions will be noted on boring logs and/or FSDSs (see Attachment C). Soil logging will include identification of auto fluff, if observed. Auto fluff consists of silty sand mixed with automobile waste, including glass, wire, metal, foam, or various automobile parts (DOF 2020). Soil samples will be field screened for the presence of volatiles using a photoionization detector. Visual or olfactory observations will also be noted.

Sample Procedures

Up to three soil samples will be analyzed from each boring in which auto fluff is identified during drilling of the borings. One sample will be collected from each boring from vadose zone soil at the depth of observed auto fluff, if encountered. One sample will be collected from each boring at the depth of any observed impacts, if present. One sample will be collected from soil underlying the auto fluff or observed impacts, whichever is deeper. If auto fluff is not encountered in a borehole and there are no observed impacts, one sample of vadose zone soil will be collected for analysis from the boring.

All soil samples will be collected following the procedures in SOP 04 (Attachment A). Samples will be collected using dedicated single-use equipment. Field personnel will avoid large, heterogenous debris in the samples, and the laboratory will remove additional debris prior to preparation and analysis. Samples will be collected in containers supplied by the analyzing laboratory to ensure that the container has been properly cleaned and that sufficient sample material is collected. Sample container, preservation, and holding time requirements for the analytes of interest are listed in Table 2.

Sample Nomenclature

The field personnel will clearly label each sample container, using permanent ink on a waterproof sample label, with the unique sample identification code, time and date of collection, project number, and preservative, if appropriate.

The unique sample identification code will consist of a prefix to describe the location identification number, an “S” to indicate a soil sample matrix, and the sample depth in feet bgs. The depth interval should be specified as the middle of the sampling interval. For example, a soil sample collected from location TWA-SB-10 with a sampling interval from 9 to 10 feet bgs will have the sample nomenclature of TWA-SB-10-S-9.5.

Field duplicate soil samples will append the location number with “-9” and the sample will have the same sample time as the primary sample. A duplicate sample of the abovementioned sample would appear as TWA-SB-10-9-S-9.5.

Relevant soil sample information will be documented on soil FSDSs and/or boring logs (see Attachment C).

Equipment Decontamination

Non-disposable sampling equipment and reusable materials that contact the soil will be decontaminated on Property and before and after each sample collection (see SOP 01 in Attachment A). Decontamination will consist of the following:

- Tap-water rinse. Visible soil to be removed by scrubbing.
- Non-phosphate detergent wash, consisting of a dilute mixture of Liqui-Nox (or equivalent) and tap water.
- Distilled-water rinse.
- Allow equipment to air dry or dry it with paper towels.

Decontamination fluids will be transferred to drums and managed as described below.

Management of Investigation-Derived Waste

Soil cuttings, decontamination fluids, and sampling debris will be treated as investigation-derived waste at the Property. All investigation-derived waste will be containerized in Washington State Department of Transportation-approved 55-gallon drums for characterization and offsite disposal at a permitted facility.

Analytical Methods and Quality Control Samples

In accordance with the quality assurance/quality control (QA/QC) requirements set forth in this work plan, Friedman & Bruya, a laboratory accredited by the State of Washington and the National Environmental Laboratory Accreditation, will perform the laboratory analyses for the soil samples collected at the Property. Soil samples collected at the Property will be analyzed for the following chemicals associated with auto fluff and/or the TWAAFA site (see Table 1):

- Total metals (arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc) by EPA Method 6020B.
- Gasoline-range hydrocarbons by Northwest Total Petroleum Hydrocarbons (NWTPH)-Gx.
- Diesel- and oil-range hydrocarbons by NWTPH-Dx.
- Polychlorinated biphenyls (PCBs) as Aroclors by EPA Method 8082A.
- Semivolatile organic compounds (SVOCs) by EPA Method 8270E.
- Volatile organic compounds (VOCs) by EPA Method 8260D.

Table 3 identifies the specific analytical methods, performance criteria, and method reporting limits for the soil sample analyses. The requested method reporting limits and method detection limits will be consistent with Model Toxics Control Act cleanup levels (where practicable).

A trip blank will accompany the samples throughout collection, shipment, and storage. One trip blank will be included with each cooler in which samples for VOC analyses are stored. Additionally, each cooler containing samples that require temperature preservation will contain a temperature blank. The laboratory will verify that the temperature blank measurement is within the acceptable range specific to the analytical method.

Schedule and Reporting

MFA will implement the scope of work described in this work plan following its approval by Ecology. Field activities are anticipated to be conducted in the dry summer season to allow to minimize impacts to the wetlands and associated buffers on the Property and reduce the likelihood of encountering Vineyard Snails. The schedule will also be dependent on availability of the driller and is anticipated to occur in Summer 2024. Ecology will be provided 48 hours' notice prior to the commencement of fieldwork.

MFA will provide preliminary data deliverables to Ecology upon receipt. Following receipt of data, MFA will perform data quality review and validation consistent with DOF's Data Gaps Work Plan (Appendix L, DOF 2020). MFA will prepare a report summarizing the field program and results of analysis, including screening the data against the applicable screening level criteria. All validated data will be uploaded to Ecology's environmental information management system within 30 days of receipt of data and no later than 120 days from the date of sampling, in accordance with the Order.

Audrey Hackett
Senior Environmental Scientist

Carolyn Wise, LHG
Project Hydrogeologist

Attachments

References

Limitations

Figures

Tables

A—Standard Operating Procedures

B—Geophysical Survey Scope of Work

C—Field Sampling Data Sheets

cc: Scott Hooton, Port of Tacoma
Tasya Gray, Dalton, Olmsted & Fuglevand, Inc.
Kim Seely, Coastline Law Group PLLC
Douglas Steding, Northwest Resource Law PLLC

References

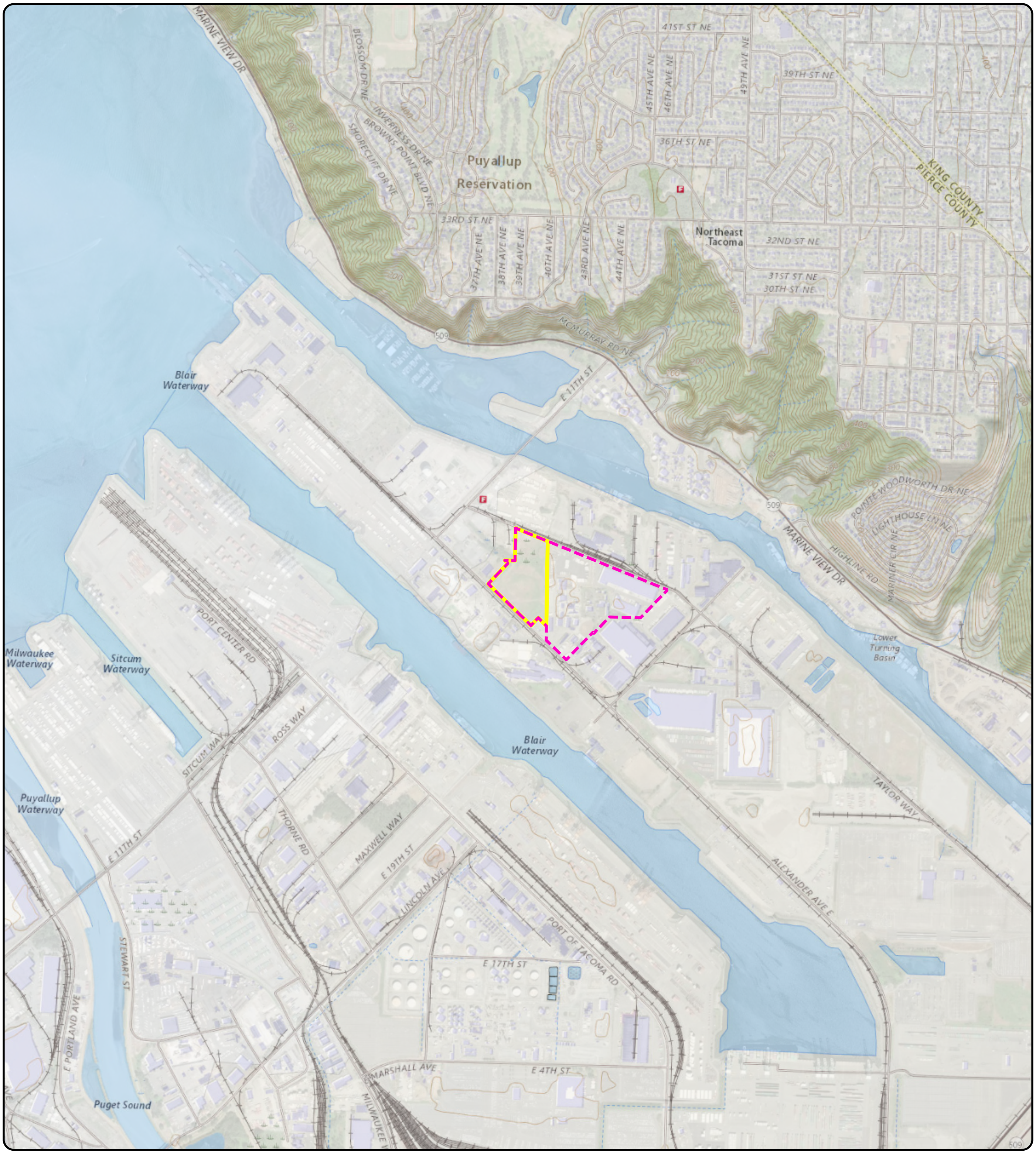
DOF. 2020. *Final Data Gaps Work Plan, Taylor Way and Alexander Avenue Fill Area Site, Tacoma, Washington.* Dalton, Olmsted & Fuglevand: Seattle, WA. July.

Limitations

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

Figures



Notes
U.S. Geological Survey (2021) 7.5-minute topographic quadrangle: Tacoma.
Township 21 North, Range 3 East, Section 35.
TWAAFA = Taylor Way and Alexander Avenue Fill Area.

Data Source
Tax parcel obtained from Pierce County; TWAAFA site boundary obtained from Exhibit A of Agreed Order No. DE 14260.

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Legend

- TWAAFA Boundary
- Hylebos Marsh Property

Figure 1
Property Location

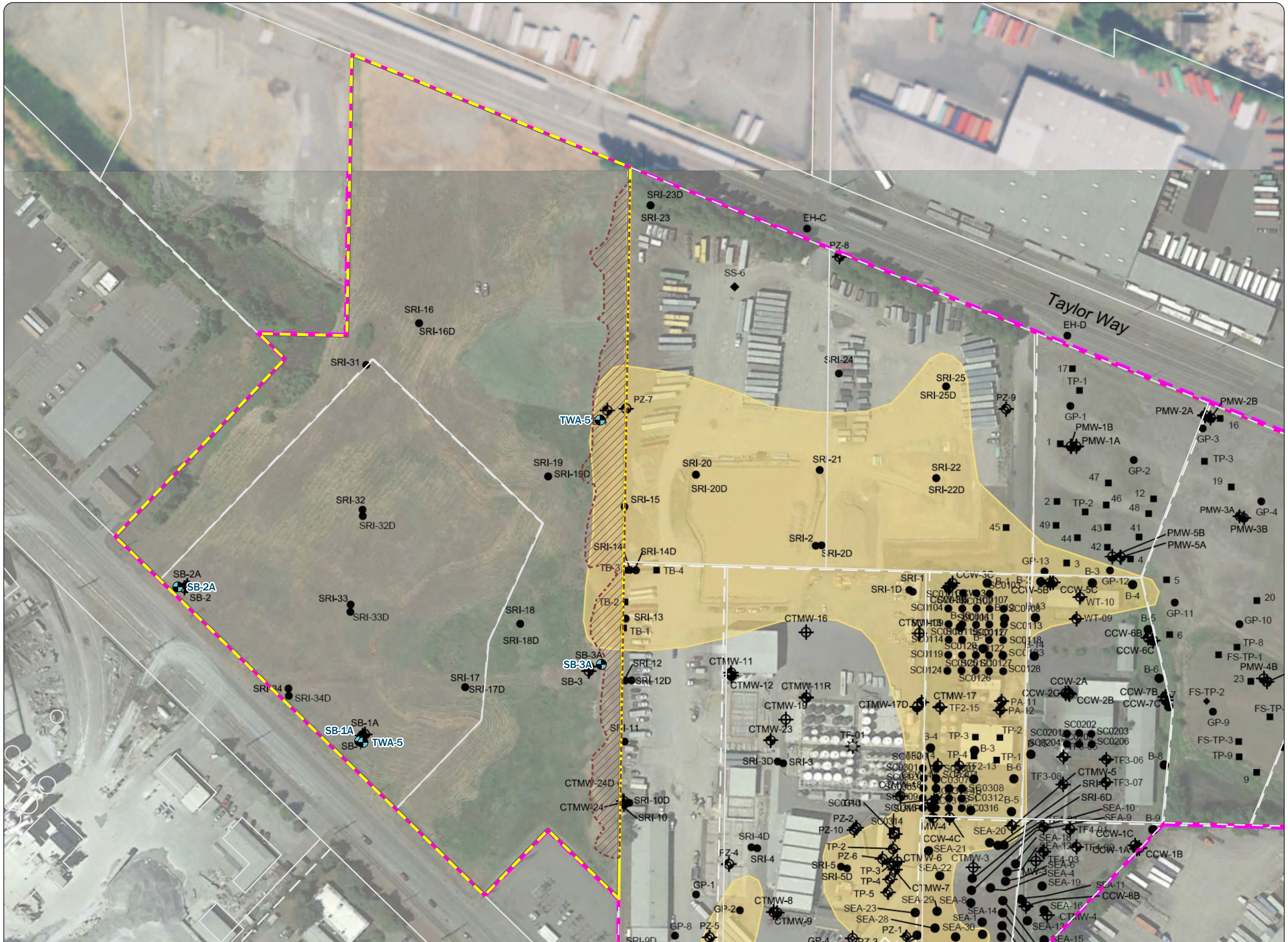
Hylebos Marsh Property
1212 Taylor Way
Tacoma, WA

0 1,000 2,000
Feet

Path: X:\0615.20\10\Pro\M0615_20_010_100.aprx\Fig 1-1 Property Location
Print Date: 6/21/2023
Reviewed By: jlenahansen
Produced By: sturner
Project: M0615.20.010

Figure 2
Previous Sample Locations

Hylebos Marsh Property
1212 Taylor Way
Tacoma, WA



Legend

- Monitoring Well
- Extent of Sloped Topography
- Approximate Extent of Auto Fluff Fill
- TWAAFA Boundary
- Hylebos Marsh Property
- Parcel

Note
TWAAFA = Taylor Way and Alexander Avenue Fill Area.

0 100
Feet

Data Sources
Background image, featuring approximate extent of auto fluff fill and previous sample locations (in black), obtained from DOF Data Gaps Work Plan; parcels obtained from Pierce County; TWAAFA site boundary obtained from Exhibit A of Agreed Order No. DE 14260; extent of sloped topography on the Property was approximated by Maul Foster Alongi, Inc. based on elevated topography shown in lidar data.

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Print Date: 4/18/2024
Reviewed By: csifford
Produced By: jroberts
Project: M0615.20.014

Figure 3
Proposed Sample Locations

Hylebos Marsh Property
1212 Taylor Way
Tacoma, WA

Legend

- Proposed Hand Auger Location
- Proposed Soil Boring
- Monitoring Well
- Approximate Delineated Wetland Boundary
- Extent of Sloped Topography
- Approximate Extent of Auto Fluff Fill
- TWAAFA Boundary
- Hylebos Marsh Property
- Parcel

Note
TWAAFA = Taylor Way and Alexander Avenue Fill Area.

0 100
Feet

Data Sources
Parcels obtained from Pierce County; approximate extent of auto fluff fill obtained from DOF Data Gaps Work Plan; TWAAFA site boundary obtained from Exhibit A of Agreed Order No. DE 14260; delineated wetland boundaries obtained from *Wetland Delineation Report* (10/24/2013); extent of sloped topography on the Property was approximated by Maul Foster Alongi, Inc. based on elevated topography shown in lidar data.

GeoEngineers. 2013. *Wetland Delineation Report, Former TPU Property Wetland Delineation, Tacoma, Washington.* Prepared for the Port of Tacoma. October 24.

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Project: M0615.20.014 Produced By: gjaravata Reviewed By: csifford Print Date: 5/21/2024 Path: X:\0615.20\14\Pro\M0615_20_014_001.aprx\Fig 3 Proposed Sample Locs Hylebos Marsh

Tables

Table 1
Proposed Sampling and Analysis Summary
Hylebos Marsh
Port of Tacoma

Location ID	Location Type	Total Depth (ft bgs)	Sample Matrix	Number of Samples	Sample Collection Depth	Analytical Suite[a]					
						Metals	TPH		PCB Aroclors	SVOCs	VOCs
							DRO/ORO	GRO			
TWA-SB-09	Boring	20[b]	Soil	Up to 3	One sample from the depth of observed auto shredder fluff, if present, within the vadose zone. One from soil underlying the auto fluff or observed impacts. One from the depth of any observed impacts, if present. If no auto fluff or impacts are observed, one sample will be collected from the vadose zone.	X	X	X	X	X	X
TWA-SB-10	Boring	20[b]	Soil	Up to 3		X	X	X	X	X	X
TWA-SB-11	Boring	20	Soil	Up to 3		X	X	X	X	X	X
TWA-SB-12	Boring	20	Soil	Up to 3		X	X	X	X	X	X
TWA-SB-13	Boring	20	Soil	Up to 3		X	X	X	X	X	X
TWA-SB-14	Boring	20[b]	Soil	Up to 3		X	X	X	X	X	X
TWA-SB-15	Boring	20[b]	Soil	Up to 3		X	X	X	X	X	X
TWA-SB-16	Boring	20[b]	Soil	Up to 3		X	X	X	X	X	X
TWA-HA-01	Hand Auger	2	--	--	For material observation only.	--	--	--	--	--	--
TWA-HA-02	Hand Auger	2	--	--		--	--	--	--	--	--
TWA-HA-03	Hand Auger	2	--	--		--	--	--	--	--	--
TWA-HA-04	Hand Auger	2	--	--		--	--	--	--	--	--

Notes

-- = not applicable.

DRO/ORO = diesel- and oil-range organics/hydrocarbons.

ft bgs = feet below ground surface.

GRO = gasoline-range organics/hydrocarbons.

PCB = polychlorinated biphenyl.

SVOC = semivolatile organic compound.

TPH = total petroleum hydrocarbons.

VOC = volatile organic compound

X = analyze.

[a]Analyte lists for each parameter group (where applicable) are listed on Table 3.

[b]TWA-SB-09, TWA-SB-10, TWA-SB-14, and TWA-SB-15 will be advanced up to the depth of native material or a fine-grained lithologic unit identified during the drilling of TWA-SB-11, TWA-SB-12, and TWA-SB-13.

Table 2
Containers, Preservation, and Holding Times
Hylebos Marsh
Port of Tacoma

Matrix	Method	Parameter or Parameter Group[a]	Sample Container	Preservation (store all at 4°C)	Holding Time[b]
Soil	EPA 6020B	Total metals (except mercury)	4-oz glass jar	None	6 months
		Total mercury		None	28 days
	EPA 8082A	PCB Aroclors	4-oz glass jar	None	1 year
	NWTPH-Dx	Diesel- and oil-range hydrocarbons	4-oz glass jar	None	14 days
	EPA 8270E	SVOCs	4-oz glass jar	None	14 days
	EPA 8260D	VOCs	EPA 5035 kit[c]	Methanol	14 days
	NWTPH-Gx	Gasoline-range hydrocarbons			

Notes

Various sample analyses can be combined in same container. Field samplers will consult with laboratory prior to combining sample volumes.

°C = degrees Celsius.

EPA = U.S. Environmental Protection Agency.

mL = milliliter.

NWTPH = Northwest Total Petroleum Hydrocarbons.

oz = ounce.

PCB = polychlorinated biphenyl.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

[a]Analyte lists for each parameter group (where applicable) are listed on Table 3.

[b]Time by which the sample is to be analyzed or extracted, as dictated by the analytical method. The extraction holding time begins once the sample has been extracted. The laboratory is responsible for testing extracts within the method-specified extraction holding times.

[c]5035 sample kit includes two prepared 40-mL volatile organic analysis vials with 5 mL of methanol and one 2-oz jar for moisture content determination.

Table 3
Preferred Analytical Methods and Performance Criteria
Hylebos Marsh
Port of Tacoma

Analyte	Analytical Method	MRL[a]	LCS Accuracy (%)	MS/MSD Accuracy (%)	Precision (RPD)	Completeness (%)
Total Metals (mg/kg)						
Arsenic	EPA 6020B	1	80-120	75-125	20	90
Cadmium		0.2	80-120	75-125	20	90
Chromium		0.5	80-120	75-125	20	90
Copper		5	80-120	75-125	20	90
Lead		0.2	80-120	75-125	20	90
Manganese		1	80-120	75-125	20	90
Mercury		1	80-120	75-125	20	90
Nickel		0.2	80-120	75-125	20	90
Selenium		1	80-120	75-125	20	90
Zinc		5	80-120	75-125	20	90
TPH (mg/kg)						
Gasoline-range hydrocarbons	NWTPH-Gx	2	69-134	NA	20	90
Diesel-range hydrocarbons	NWTPH-Dx	50	70-130	70-130	20	90
Oil-range hydrocarbons		200	NA	NA	20	90
SVOCs (mg/kg)						
1,2,4-Trichlorobenzene	EPA 8270E	0.05	58-109	41-112	20	90
1,2-Dichlorobenzene		0.05	50-110	34-114	20	90
1,2-Diphenylhydrazine		0.05	68-115	49-122	20	90
1,3-Dichlorobenzene		0.05	47-109	30-113	20	90
1,4-Dichlorobenzene		0.05	49-108	30-113	20	90
1-Methylnaphthalene		0.01	66-107	10-163	20	90
2,2'-Oxybis(1-Chloropropane)		0.05	56-112	30-122	20	90
2,4,5-Trichlorophenol		0.5	67-117	20-139	20	90
2,4,6-Trichlorophenol		0.5	65-116	16-151	20	90
2,4-Dichlorophenol		0.5	66-112	19-144	20	90
2,4-Dimethylphenol		0.5	53-119	30-127	20	90
2,4-Dinitrophenol		1.5	10-233	10-135	20	90
2,4-Dinitrotoluene		0.25	52-140	37-149	20	90
2,6-Dinitrotoluene		0.25	70-130	50-150	20	90
2-Chloronaphthalene		0.05	67-109	42-117	20	90
2-Chlorophenol		0.5	58-111	24-125	20	90
2-Methylnaphthalene		0.01	67-109	10-192	20	90
2-Methylphenol		0.5	63-112	38-120	20	90
2-Nitroaniline		0.25	46-148	50-150	20	90
2-Nitrophenol		0.5	60-121	16-148	20	90
3,3'-Dichlorobenzidine		0.5	9-115	12-137	20	90
3-Methylphenol + 4-Methylphenol		1	67-111	39-121	20	90
3-Nitroaniline		5	43-133	36-110	20	90
4,6-Dinitro-2-methylphenol		1.5	51-152	10-148	20	90
4-Bromophenyl phenyl ether		0.05	70-130	50-150	20	90
4-Chloro-3-methylphenol		0.5	70-130	36-138	20	90
4-Chloroaniline		5	10-136	23-111	20	90
4-Chlorophenyl phenyl ether		0.05	70-130	50-150	20	90

Table 3
Preferred Analytical Methods and Performance Criteria
Hylebos Marsh
Port of Tacoma

Analyte	Analytical Method	MRL[a]	LCS Accuracy (%)	MS/MSD Accuracy (%)	Precision (RPD)	Completeness (%)
SVOCs, continued (mg/kg)						
4-Nitroaniline	EPA 8270E	5	28-121	10-150	20	90
4-Nitrophenol		1.5	16-187	24-159	20	90
Acenaphthene		0.01	66-112	36-125	20	90
Acenaphthylene		0.01	70-130	45-128	20	90
Anthracene		0.01	70-130	50-150	20	90
Benz(a)anthracene		0.01	70-130	50-150	20	90
Benzo(a)pyrene		0.01	68-120	50-150	20	90
Benzo(b)fluoranthene		0.01	69-125	50-150	20	90
Benzo(g,h,i)perylene		0.01	64-127	33-131	20	90
Benzo(k)fluoranthene		0.01	70-130	50-150	20	90
Benzoic acid		2.5	13-223	10-101	20	90
Benzyl alcohol		0.5	36-147	36-121	20	90
Benzyl butyl phthalate		0.5	65-132	50-150	20	90
Bis(2-chloroethoxy)methane		0.05	65-108	37-121	20	90
Bis(2-chloroethyl) ether		0.05	35-131	33-120	20	90
Bis(2-ethylhexyl) phthalate		0.8	59-116	45-130	20	90
Carbazole		0.05	70-130	50-150	20	90
Chrysene		0.01	70-130	50-150	20	90
Dibenz(a,h)anthracene		0.01	67-128	44-130	20	90
Dibenzofuran		0.05	63-117	44-125	20	90
Diethyl phthalate		0.5	64-120	48-126	20	90
Dimethyl phthalate		0.5	70-130	50-150	20	90
Di-n-butyl phthalate		0.5	54-127	43-124	20	90
Di-n-octyl phthalate		0.5	46-129	25-161	20	90
Fluoranthene		0.01	70-130	50-150	20	90
Fluorene		0.01	67-117	48-121	20	90
Hexachlorobenzene		0.05	70-130	50-150	20	90
Hexachlorobutadiene		0.05	55-108	39-112	20	90
Hexachlorocyclopentadiene		0.15	46-127	10-136	20	90
Hexachloroethane		0.05	46-112	10-207	20	90
Indeno(1,2,3-cd)pyrene		0.01	67-129	41-134	20	90
Isophorone		0.05	52-128	29-155	20	90
Naphthalene		0.01	58-108	28-125	20	90
Nitrobenzene		0.05	63-112	10-186	20	90
N-Nitrosodimethylamine		0.05	42-110	34-109	20	90
N-Nitroso-di-n-propylamine		0.05	70-130	50-150	20	90
N-Nitrosodiphenylamine		0.05	70-130	10-190	20	90
Pentachlorophenol		0.25	60-133	18-159	20	90
Phenanthrene		0.01	70-130	50-150	20	90
Phenol		0.5	47-128	39-127	20	90
Pyrene		0.01	70-130	40-134	20	90

Table 3
Preferred Analytical Methods and Performance Criteria
Hylebos Marsh
Port of Tacoma

Analyte	Analytical Method	MRL[a]	LCS Accuracy (%)	MS/MSD Accuracy (%)	Precision (RPD)	Completeness (%)
VOCs (mg/kg)						
1,1,1,2-Tetrachloroethane	EPA 8260D	0.005	64-121	31-143	20	90
1,1,1-Trichloroethane		0.005	62-131	10-156	20	90
1,1,2,2-Tetrachloroethane		0.005	56-143	28-140	20	90
1,1,2-Trichloroethane		0.005	64-115	10-205	20	90
1,1-Dichloroethane		0.005	68-115	19-140	20	90
1,1-Dichloroethene		0.005	47-128	10-160	20	90
1,1-Dichloropropene		0.005	69-128	17-140	20	90
1,2,3-Trichlorobenzene		0.005	NA	20-144	20	90
1,2,3-Trichloropropane		0.005	61-137	25-144	20	90
1,2,4-Trichlorobenzene		0.005	64-135	22-142	20	90
1,2,4-Trimethylbenzene		0.005	76-125	10-182	20	90
1,2-Dibromo-3-chloropropane		0.005	58-138	11-161	20	90
1,2-Dibromoethane (EDB)		0.005	74-132	28-142	20	90
1,2-Dichlorobenzene		0.005	76-121	31-132	20	90
1,2-Dichloroethane (EDC)		0.003	56-135	12-160	20	90
1,2-Dichloropropane		0.005	72-127	30-135	20	90
1,3,5-Trimethylbenzene		0.005	76-126	18-149	20	90
1,3-Dichlorobenzene		0.005	75-121	30-131	20	90
1,3-Dichloropropane		0.005	72-130	31-137	20	90
1,4-Dichlorobenzene		0.005	74-117	29-129	20	90
2,2-Dichloropropane		0.005	52-170	10-158	20	90
2-Butanone (MEK)		0.005	30-197	19-147	20	90
2-Chlorotoluene		0.005	74-121	31-134	20	90
2-Hexanone		0.005	33-152	15-166	20	90
4-Chlorotoluene		0.005	75-122	31-136	20	90
4-Methyl-2-pentanone		0.005	45-145	24-155	20	90
Acetone		0.005	52-141	10-163	20	90
Benzene		0.005	71-118	29-129	20	90
Bromobenzene		0.005	72-122	34-130	20	90
Bromodichloromethane		0.005	57-126	23-155	20	90
Bromoform		0.005	56-132	21-156	20	90
Bromomethane		0.005	38-114	10-163	20	90
Carbon tetrachloride		0.005	60-139	9-164	20	90
Chlorobenzene		0.005	76-111	32-129	20	90
Chloroethane		0.005	9-163	10-176	20	90
Chloroform		0.005	66-120	21-145	20	90
Chloromethane		0.005	27-133	10-126	20	90
cis-1,2-Dichloroethene		0.005	72-127	25-135	20	90
cis-1,3-Dichloropropene		0.005	67-122	28-144	20	90
Dibromochloromethane		0.005	55-121	28-150	20	90
Dibromomethane		0.005	62-123	23-145	20	90
Dichlorodifluoromethane		0.005	10-146	10-142	20	90
Ethylbenzene		0.005	64-123	32-137	20	90
Hexachlorobutadiene		0.005	50-153	10-142	20	90
Hexane		0.25	43-142	10-137	20	90

Table 3
Preferred Analytical Methods and Performance Criteria
Hylebos Marsh
Port of Tacoma

Analyte	Analytical Method	MRL[a]	LCS Accuracy (%)	MS/MSD Accuracy (%)	Precision (RPD)	Completeness (%)
VOCs, continued (mg/kg)						
Isopropylbenzene	EPA 8260D	0.005	76-127	31-142	20	90
m,p-Xylene		0.005	78-122	34-136	20	90
Methyl t-butyl ether (MTBE)		0.002	60-123	21-145	20	90
Methylene chloride		0.005	10-184	10-156	20	90
Naphthalene		0.005	63-140	14-157	20	90
n-Propylbenzene		0.005	74-124	23-146	20	90
o-Xylene		0.005	77-124	33-134	20	90
p-Isopropyltoluene		0.005	70-132	21-149	20	90
sec-Butylbenzene		0.005	71-130	23-145	20	90
Styrene		0.005	74-126	35-137	20	90
tert-Butylbenzene		0.005	73-130	30-137	20	90
Tetrachloroethene		0.005	72-114	20-133	20	90
Toluene		0.005	66-126	35-130	20	90
trans-1,2-Dichloroethene		0.005	67-129	14-137	20	90
trans-1,3-Dichloropropene		0.005	72-132	26-149	20	90
Trichloroethene		0.005	63-121	21-139	20	90
Trichlorofluoromethane		0.005	10-196	10-176	20	90
Vinyl chloride		0.005	22-139	10-138	20	90
PCB Aroclors (mg/kg)						
Aroclor 1016	EPA 8082A	0.02	55-137	44-107	20	90
Aroclor 1221		0.02	NA	NA	NA	90
Aroclor 1232		0.02	NA	NA	NA	90
Aroclor 1242		0.02	NA	NA	NA	90
Aroclor 1248		0.02	NA	NA	NA	90
Aroclor 1254		0.02	NA	NA	NA	90
Aroclor 1260		0.02	51-150	38-124	20	90

Notes

Limits for all methods are provided by Friedman & Bruya, Inc, except EPA Method 1668C which are provided by Eurofins Environment Testing Northern California, LLC.

EPA = U.S. Environmental Protection Agency.

LCS = laboratory control sample.

mg/kg = milligrams per kilogram.

MRL = method reporting limit.

MS/MSD = matrix spike/matrix spike duplicate.

NA = not applicable.

NWTPH = Northwest Total Petroleum Hydrocarbons.

PCB = polychlorinated biphenyl.

pg/g = picograms per gram.

RPD = relative percent difference.

SVOC = semivolatile organic compound.

TPH = total petroleum hydrocarbons.

VOC = volatile organic compound.

[a] The laboratory's MRLs have been updated from the previous version of this table and reviewed against Ecology's recommended PQLs provided in the 2016 *Guidance for Remediation of Petroleum Contaminated Sites*. The updated MRLs are consistent or lower than the reporting limits in the DOF 2022 *Data Gaps Data Report, Taylor Way and Alexander Avenue Fill Area Site, Tacoma, Washington*.

Attachment A

Standard Operating Procedures

MAUL
FOSTER
ALONGI

Standard Operating Procedure

Decontamination of Field Equipment

SOP Number: 1
Date: 03/09/2021
Revision Number: 0.1

Scope and Application

This standard operating procedure (SOP) describes the decontamination procedure for field equipment that may come in contact with contaminated media and that Maul Foster & Alongi, Inc. (MFA) staff may reuse at multiple sample locations or sites. Decontamination is performed to reduce the potential for cross-contamination of samples that will be collected with multiuse equipment and that will undergo physical or chemical analyses. Other equipment that is multiuse—not used specifically for sample collection (e.g., water level meter, pump used for well development)—also requires decontamination. Finally, decontamination is necessary to minimize the potential for MFA staff's exposure to chemicals.

Typically, decontamination is not necessary for field equipment that is disposable and intended to be used only once (e.g., disposable bailer). Additionally, this SOP does not apply to equipment used by subcontractors, such as drilling equipment. However, MFA staff should confirm that subcontractors are implementing appropriate decontamination procedures to minimize the potential for cross-contamination of samples or MFA staff's exposure to chemicals.

Equipment and Materials Required

The following materials are necessary for this procedure:

- Nonphosphate detergent solution (e.g., Alconox, Liquinox)
- Distilled and potable water
- Personal protective equipment (as specified in the site-specific health and safety plan)
- Buckets to contain rinsate, brushes, paper towels

Depending on the site conditions and the types of contaminants that may be present, the use of other decontamination materials, such as deionized water, methanol, hexane, or isopropyl alcohol, may be necessary. The need for other materials should be determined prior to fieldwork. The decontamination procedures using other materials should be described in a site-specific sampling and analysis plan (SAP).

Methodology

When the site-specific SAP specifies additional or different requirements for decontamination, it takes precedence over this SOP. In the absence of a SAP, the following procedures shall be used.

General Sampling Procedure:

1. Rinse the equipment with potable water to remove visible soil, petroleum sheen, or contamination.

2. Scrub the equipment with a brush and solution of distilled water and nonphosphate detergent.

3. Rinse the equipment with distilled water.

4. Allow equipment to air dry, or dry it with paper towels.

5. At all times, ensure that the decontaminated equipment is stored so as to prevent it from becoming contaminated while not in use. Depending on the size of the equipment, it can be wrapped with new aluminum foil or placed in a new plastic bag.

Rinsate Storage:

All fluids resulting from equipment decontamination shall initially be contained in a bucket and then transferred to a Department of Transportation-approved container (e.g., 55-gallon drum) stored on site at a location that does not interfere with on-site activities (e.g., vehicle traffic, pedestrian areas). Place a label on each container and include the following information:

- The date on which fluids were placed in the container
- Contents (e.g., “water from equipment decontamination”)
- Contact information, including MFA staff or client phone number

Note that labels on containers exposed to sunlight or precipitation are prone to fading. Use a waterproof, indelible ink pen (e.g., Sharpie®) whenever possible. In the field notebook, keep a detailed inventory of all containers, including the number of containers, the approximate quantity of liquids generated, and a description of the source of the fluids. Provide this information to the MFA project manager. For future reference, take photographs of (1) each drum label, (2) the drum(s), and (3) the drum storage vicinity on site.

Note that some clients and site owners have specific requirements for labeling and storage of containers. The requirements should be determined in advance of the fieldwork.

Scope and Application

This standard operating procedure (SOP) describes the methods for observing and documenting the physical characteristics of unconsolidated geologic materials (soil and sediment) encountered during field investigations. If a Maul Foster & Alongi, Inc. (MFA) project requires hard rock drilling and description of rock core or cuttings, procedures for describing rock should be specified in a project-specific sampling and analysis plan (SAP).

Equipment and Materials Required

The following materials are necessary for this procedure:

- Blank field forms (e.g., boring logs) for documenting observations
- Dry-erase board
- Camera
- Munsell soil color chart (where required)
- MFA field logging checklist

Methodology

When the project-specific SAP specifies additional or different requirements for lithologic logging, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used. MFA uses a combination of the Unified Soil Classification System (USCS) and the ASTM International method D2487 for describing and classifying soil and sediment by visual and manual examination. Before beginning fieldwork, verify with the project manager the logging standard to be used.

Logging Process:

The objective of lithologic logging is to document the physical characteristics of soil and sediment encountered and the changes in characteristics with depth. Typically, changes with depth will define the strata encountered. Therefore, each stratum encountered should be identified and the following characteristics described in the order given:

- Depth interval of each stratum to the nearest tenth of a foot below ground surface
- USCS classification Group Name and Symbol
- Color, using the Munsell color chart
- Grain-size distribution, as percentages of fines (silt and clay combined), sand, and gravel
- Percentages of larger gravels (cobbles and boulders) if present.
- Consistency when the content of fines is 50 percent or greater

- Density when the combined percentage of sand and gravel is 50 percent or greater
- Sand and gravel grain shapes
- Chemical odors, if noticeable
- Structures, if present (e.g., laminae, pores)
- Presence of organic matter (e.g., roots, leaves, twigs, wood fragments)
- Moisture content as “dry,” “moist,” or “wet”
- If possible, a description of the origin of each stratum (e.g., fill, alluvium)

Scope and Application

This standard operating procedure (SOP) describes the use of a photoionization detector (PID) to field screen soil for evidence of organic vapors. The PID measures the organic vapor concentration in parts per million, is not compound-specific.

Never rely on a stand-alone PID reading to identify organic chemical contamination in soil. Always collect multiple PID readings (e.g., at multiple depths along the length of a soil core), since it is the relative difference in concentration between multiple readings (e.g., a sudden increase in concentration at a certain depth interval) that is the typical indictor of contamination. Additionally, PID readings should always be accompanied by observation of the soil samples for other indictors of contamination, such as soil staining or chemical odors, so that these multiple lines of evidence can be used together to identify potential organic chemical contamination in the field.

Equipment and Materials Required

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the health and safety plan)
- PID with calibration gas
- Ziploc®-type bags
- Field forms or notebook for documenting PID readings

Methodology

When the project-specific sampling and analysis plan (SAP) specifies additional or different requirements for organic vapor field screening, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

The electron volt (eV) rating for the PID lamp (e.g., 9.8, 10.6, 11.7) must be greater than the ionization potential (in eV) of a compound in order for the PID to detect the compound. A lamp of at least 9.8 eV should be used for petroleum hydrocarbons. A lamp of at least 10.6 eV should be used for typical chlorinated alkenes. If the project health and safety plan does not specify the lamp size, verify the compatibility of the lamp size with the anticipated compounds expected to be present in soil prior to the field activities, and confirm with the project manager.

General Sampling Procedure (Heading 3 No Number Style):

Calibration:

- The PID should be calibrated daily (or more frequently, as needed).
- Calibrate the PID according to the manufacturer's instructions.

- Document the calibration activities and results in the field notebook.

Measuring organic vapor content:

- Place a representative volume (generally, a "handful") of freshly exposed soil into a Ziploc-type bag.
- Seal the bag and gently knead the bag to loosen the soil.
- Let the bag set for several minutes to allow organic vapors, if present, to volatilize from the soil into the headspace of the bag.
- Partially open the bag so that the tip of the PID intake tube can be inserted into the bag but is not in contact with the soil, then close the bag seal around the intake tube.
- Record the PID measurement and document results in the field notes or boring log.

Static Sheen Test Procedure and Observations:

Sheen Test Procedure:

- Following the PID screen discussed above, add enough water to cover the soil in the container.
- Observe the water for signs of discoloration/sheen and characterize per the table below.

When static sheen testing is required or when making observations of a water surface the following table presents descriptions to be used (consistent with Department of Ecology Guidance)[1].

No Sheen (NS)	No visible sheen on the water surface
Slight Sheen (SS)	Light, colorless, dull sheen; spread is irregular, not rapid. Natural organic oils or iron bacteria in the soil may produce a slight sheen.
Moderate Sheen (MS)	Pronounced sheen over limited area; probably has some color/iridescence; spread is irregular, may be rapid; sheen does not spread over entire water surface.
Heavy Sheen (HS)	Heavy sheen with pronounced color/iridescence; spread is rapid; the entire water surface is covered with sheen.
Biogenic Film (BF)	False positive results may be generated by the presence of decaying organic matter and iron bacteria, which can produce a rainbow-like sheen similar to an oil sheen. These sheens, unlike oil sheens, can typically be broken up creating platy or blocky fragments when agitated or disturbed. Biogenic films can also be foamy.

[1] Department of Ecology. 2016. Guidance for remediation of petroleum contaminated sites. June.

Scope and Application

This standard operating procedure (SOP) describes the use of hand tools for obtaining surface and subsurface soil samples for physical and/or chemical analysis.

Equipment and Materials Required

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the Health and Safety Plan)
- Tools appropriate for the conditions that may be encountered (e.g., spoon, trowel, shovel, hand auger); tools constructed of stainless steel are preferred.
- Stainless steel bowls
- Tape measure with increments in feet and tenths of a foot.
- Laboratory-supplied sample containers
- Laboratory chain-of-custody form and cooler with ice.
- Equipment decontamination supplies if sampling equipment will be reused between sample locations (see SOP 1 for equipment decontamination procedures).
- Field forms or notebook for documenting the sampling procedures.

Methodology

When the project-specific sampling and analysis plan (SAP) specifies additional or other requirements for soil sampling, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

General Sampling Procedure:

- Don gloves as specified in the Health and Safety Plan; replace gloves with new gloves after each sample is collected.
- Clear the ground surface of brush, root mat, grass, leaves, and other debris.
- Use the selected hand tool to remove soil to the targeted sample depth. Use a measuring tape to verify that the sample depth is correct and record the depth in the field notebook or boring log.
- Describe and document the soil lithology in accordance with SOP 2.
- Use the selected hand tool to collect soil and homogenize in a decontaminated stainless-steel bowl or a dedicated Ziploc® bag and then transfer the sample to the sample container using hand tools.

- Before sample collection, and to the extent possible, use the selected hand tool to remove organic debris, anthropogenic material (e.g., brick, metal, glass), and gravels larger than 4 millimeters, unless a project-specific SAP directs otherwise.
- When sampling for gasoline-range total petroleum hydrocarbons (gasoline) or volatile organic compounds (VOCs), a subsample will be obtained from a discrete portion of the collected sample. To minimize the potential loss of volatiles during sampling, the subsample shall not be composited or homogenized. The sample container for gasoline and/or VOC analysis will be filled first if additional containers are necessary for other analysis. Specific procedures for collecting samples for gasoline and/or VOC analysis using the U.S. Environmental Protection Agency Method 5035 are specified in SOP 5.
- The sampling device and field equipment will be decontaminated between sample locations in accordance with SOP 1. Alternatively, new, disposable equipment can be used to collect each sample to preclude the need for equipment decontamination.

Backfilling Sample Locations:

Backfill in accordance with federal and state regulations (e.g., Oregon bentonite requirements per OAR 690-240-0035). Otherwise, manual excavations can be backfilled with excess soil remaining after sample collection, unless the project-specific SAP requires a different backfill procedure.

Standard Operating Procedure

EPA Method 5035 Soil Sampling

SOP Number: 5
Date: 03/09/2021
Revision Number: 0.1

Scope and Application

This standard operating procedure (SOP) describes the methods for obtaining soil samples for chemical analysis for gasoline-range petroleum hydrocarbons (gasoline) and volatile organic compounds (VOCs) by U.S. Environmental Protection Agency Method 5035A.

Equipment and Materials Required

The following materials are necessary for this procedure:

- Sampling equipment (e.g., Terra Core Sampler™ or similar sampler capable of collecting a 5-gram soil sample).
- Laboratory-supplied sample containers:
  - Preweighed and labeled 40-milliliter volatile organic analysis (VOA) vials, including preservative (typically methanol)
  - Two-ounce jar for percent total solids/moisture (if required, confirm with the laboratory)
- Laboratory chain-of-custody form and cooler with ice.
- Equipment decontamination supplies if sampling equipment will be reused between sample locations (see SOP 1 for equipment decontamination procedures).
- Field forms or notebook for documenting the sampling procedures.

Methodology

When the site-specific sampling and analysis plan (SAP) specifies additional or different requirements for soil sampling, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

Laboratory Analytical Considerations:

- VOCs must be analyzed within 14 days of sample collection.
- Samples must be maintained at less than 4°±2°C.
- Discrete VOC samples may be composited at the laboratory.

General Procedure:

- When using the Terra Core Sampler, seat the plunger in the handle.
- Collect the sample by pushing the sampler into the soil until the soil has filled the sampler.
- Remove the sampler and confirm that the soil in it is flush with the mouth of the sampler.

- Wipe all debris from the outside of the sampler. Remove any excess collected soil that extends beyond the mouth of the sampler.
- Rotate the plunger handle 90 degrees until it is aligned with the slots in the body of the sampler. Place the mouth of the sampler into the sample container and extrude the sample into the sample container by pushing the plunger down. Hold the sample at an angle when extruding to minimize splashing of the preservative.
- Immediately remove any soil or debris from the threads of the vial and place the lid on the vial.
- Gently swirl the vial (do not shake) to allow the preservative to uniformly penetrate and wet the soil.
- Repeat process for each additional sample container.
- If required by the laboratory, fill a 2-ounce container to capacity for percent total solids determination.

Scope and Application

This standard operating procedure (SOP) describes the use of a push probe (i.e., Geoprobe™) to observe subsurface conditions and collect samples of various environmental media (e.g., soil, sediment, groundwater, soil vapor) for laboratory analysis. Push-probe drilling is generally not suitable for soils with gravel/rock clast larger than about 4 inches in diameter. If gravelly/rocky soils are expected at the project site, consider use of the sonic drilling method described in SOP 8.

Push-probe drilling can be used for a variety of purposes, including:

- Retrieving cores to document subsurface soil or sediment conditions and to obtain samples for physical and/or chemical evaluation
- Sampling soil vapors, using temporary well points
- Collecting reconnaissance groundwater samples from temporary well screens
- Installing permanent monitoring wells

Equipment and Materials Required

The following equipment and materials are necessary for this procedure:

- Push-probe drill rig and operator provided by a subcontractor to MFA. Ensure that the subcontractor is licensed to perform the drilling work.
- Sampling equipment appropriate for the media to be sampled (e.g., water level meter, pumps, hand tools, and pump tubing).
- Laboratory-supplied sample containers.
- Traffic cones, measuring tape, buckets.
- Department of Transportation (DOT)-approved containers (e.g., 55-gallon drum) for storing excess soil and decontamination water; the drums are typically provided by the drilling subcontractor.
- Boring log form and notebook.
- Equipment decontamination supplies if sampling equipment will be reused between sample locations (see SOP 1 for equipment decontamination procedures).
- Personal protective equipment (as required by the project health and safety plan).

Methodology

When the project-specific sampling and analysis plan (SAP) provides additional or different requirements for push-probe drilling, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

Utility Locate:

- Before beginning the fieldwork, assess the proposed drilling location(s) for the presence of overhead and underground utilities, and adjust the locations, as needed, to avoid identified utilities.
- See SOP 18 for the utility locating procedures.

Push-Probe Drilling Process:

- The push-probe drilling rig is equipped with a soil sampling device that retrieves a continuous soil core. A combination of static force and percussion is used to drive the soil sampler into unconsolidated geologic material. A plastic liner placed inside the sampler contains the soil core and permits its removal from the sampler for examination. The sampler is driven into the subsurface, typically in 4- or 5-foot intervals, depending on the length of the sampling device. When each interval depth is reached, the soil sampler is removed from the ground, and the liner is removed to facilitate soil observation and sampling.
- This process is repeated for each soil sample interval until the targeted boring depth is reached.
- Ensure that the drilling subcontractor decontaminates all subsurface equipment before and after each boring. Document the decontamination procedures in the field notebook. Store decontamination water in DOT-approved containers for later off-site disposal.

Logging and Soil Sampling Process:

- Remove the soil core from the sampler for field screening, description, and sampling.
- Describe the lithology in accordance with SOP 2.
- Confirm the required depth interval(s) for soil sample collection and field screening with the MFA project manager, or conduct the work in accordance with the SAP. The sample interval may require adjustment based on core recovery, soil stratigraphy and characteristics, and evidence of contamination. Confirm any adjustments to the sample intervals with the project manager.
- If the project requires field screening for organic vapor, conduct it in accordance with SOP 3.
- If the project requires laboratory analyses for gasoline-range petroleum hydrocarbons or volatile organic compounds, conduct the sampling in accordance with SOP 5.
- Contain all soil core remaining after sample collection in DOT-approved containers for later off-site disposal. See SOP 1 for drum storage, labeling, and documentation procedures.

Reconnaissance Groundwater Sampling Process:

- Typically, reconnaissance groundwater samples are collected at the first occurrence of groundwater in a boring. Confirm the required depth and procedures for groundwater sample collection with the MFA project manager, or conduct the work in accordance with the SAP. If the project requires use of the low-flow sampling method, refer to SOP 9 for the low-flow sampling procedures.
- Reconnaissance groundwater samples are collected using a decontaminated stainless steel or disposable, temporary polyvinyl chloride well screen placed in the boring. If the soils in the boring are fine-grained and may cause excessive turbidity in groundwater, consider using a filter pack

around the screen to reduce turbidity. Alternatively, purging the well screen of groundwater prior to sample collection may also reduce the turbidity. See SOP 9 for purging procedures.

- Purging and sampling will be conducted using a peristaltic pump unless otherwise specified in the SAP. New tubing will be used for each boring. Field parameters (e.g., temperature, conductivity, and pH) will be recorded in accordance with SOP 9 during purging and sampling.

Monitoring Well Installation:

- If the project requires installation of a monitoring well in the boring, refer to SOP 11 for the well installation procedures. Confirm the procedures with the MFA project manager.

Borehole Abandonment Process:

- Abandon each borehole in accordance with local and state regulations/procedures. The abandonment will be performed by the drilling subcontractor.
- The abandonment procedure typically consists of backfilling the boring with granular bentonite and hydrating the bentonite with potable water.
- If the boring was advanced through concrete or asphalt, backfill the boring to about 6 inches below grade to allow for placement of asphalt or concrete in the remaining 6 inches to match the surface conditions.

Scope and Application

This standard operating procedure (SOP) describes the practices for locating underground utilities. Refer to the MFA health and safety plan (HASP) for additional information regarding communication procedures to be followed when an inadvertent utility strike occurs, as well as regarding methods for mitigating hazards during a utility strike.

Equipment and Materials Required

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the HASP)
- Marking materials (e.g., marking paint, stakes, flags)
- Field documentation materials

Methodology

When the project-specific sampling and analysis plan (SAP) specifies additional or different requirements for underground utility locates, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

Before Conducting Utility Locates:

- Ensure that the locate will be conducted reasonably soon before the excavation work begins, e.g., within 48 hours. There may be project-specific conditions, e.g., weather and/or ground features that could cause markings to fade, which would require scheduling of the excavation work sooner than 48 hours after the locate.
- Clearly define the boundary of the work and the locations of all proposed excavations. Prepare a map of the project area showing the excavation locations.
- Interview site managers/property owners and obtain plans or drawings, if available, showing on-site utilities.
- For project work that will not take place in the public right-of-way, ensure that the public rights-of-way nearest to the project are identified and communicated during the one-call notification.
- Identify the township and range of the project area. This information can be easily attained by a quick email to MFA's GIS Exchange.
- If feasible, conduct a site visit to identify site conditions that could cause fading or disruption of marking paint. Such conditions could include gravel or ground sensitive to erosion and high traffic.
- Check the weather forecast to assess the potential for snow or rain to make marking utilities difficult or cause the markings to fade.

One-Call Utility Notification:

- If possible, initiate the one-call utility notification at least one week before the proposed work begins.
- Include a map or GPS coordinates when submitting the notification.
- Before conducting any excavation activities, confirm with each public utility that the utility locate has been completed.
- On remote or complicated sites, consider meeting public locators on site.
- Document the one-call ticket number and results in the project files.
- Provide the one-call ticket number to subcontractors who will be doing the excavations.

Private Utility Locate:

- Conduct the private utility locate only after confirmation that the public utility locate has been completed and all public utilities have been marked and the results reviewed by MFA staff who will be overseeing the excavations.
- Meet the private locator on site and participate in the entire private utility locate. Be engaged in the process, ask questions, and take time to walk the site thoroughly with the locator.
- Bring a copy of the one-call utility ticket and results of the one-call utility locater to check against the utility markings on the ground.
- If possible, have a site/property representative knowledgeable of on-site utilities participate in the private utility locate.
- If paint alone may not suffice to ensure clear marking of utilities, add vertical markers such as stakes or flags.
- Visually assess the area of the proposed excavation(s) to identify features potentially indicative of buried utilities. Have the private utility locator examine each feature identified below to assess the presence of buried utilities.
  - Examine adjacent public rights-of-way where public utilities have been marked for evidence of utilities that may extend onto the project site.
  - Identify nearby light poles, telephone poles, electrical utility poles, or other overhead utility poles with wires or conductors that run from the overhead utility, down the pole, and into the ground.
  - Identify the location of gas meters, water meters, or other aboveground junction boxes for evidence of utilities extending from these features into the ground.
  - Examine asphalt and concrete ground surfaces for discontinuities in the surface indicative of utility installations. Discontinuities may include recent patches of asphalt or concrete inlaid within older concrete or asphalt surfaces.
  - Identify manholes and catch basins indicative of buried storm or sanitary sewer pipes. Open manholes to examine the orientation of associated pipes to assess whether the utilities may be present near proposed excavations.
  - Identify tank ports and vent pipes.

- Identify irrigation systems and associated features such as valve boxes and controllers.
- Identify any other signs indicating the presence of buried utilities.
- Be wary of utility marks that suddenly begin or dead end.

Preparing to Perform Subsurface Activities after a Locate:

- Ensure that the markings are still visible when the work begins.
- Adjust locations, as needed, to avoid identified utilities, or use alternative methods such as nonmechanical excavation means (i.e., manual excavation or air-knifing) to a minimum depth of 5 feet.

Table
APWA UNIFORM COLOR CODE

	WHITE—Proposed Excavation
	PINK—Temporary Survey Markings
	RED—Electric Power Lines, Cables, Conduit and Lighting Cables
	YELLOW—Gas, Oil, Steam, Petroleum or Gaseous Materials
	ORANGE—Communication, Alarm or Signal Lines, Cables or Conduit
	BLUE—Potable Water
	PURPLE—Reclaimed Water, Irrigation and Slurry Lines
	GREEN—Sewers and Drain Lines

Source: Uniform Color Codes, ANSI Standard Z535.1. American Public Works Association. Revised 1999.

Attachment B

Geophysical Survey Scope of Work

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P-2024-074

Geophysical Site Clearance Investigation – Hylebos Marsh Property, Tacoma, Washington

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Date Submitted: April 22, 2023

Validity Period: 60 days from submittal date

PROPOSAL CONTENTS

1.0 PROBLEM STATEMENT

hydroGEOPHYSICS, Inc (HGI) has been requested by Maul Foster Alongi, Inc. (client) to provide a proposal for a geophysical site investigation of an area at the Hylebos March Property in Tacoma, Washington. The objective of the investigation is to detect the presence and extent of auto fluff (buried car parts) that remains in the subsurface over the approximately 1.2 acre survey area highlighted in Figure 1.

HGI has prepared this proposal, which contains a detailed scope of work (SOW), cost proposal, schedule in order to address client's request.

2.0 DESIGNED SOLUTION

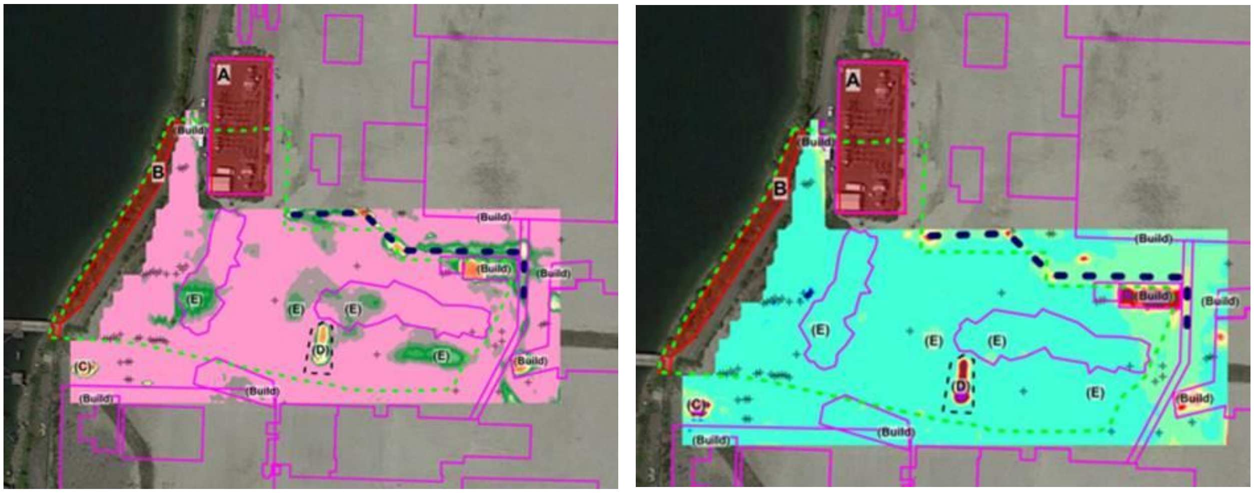
Based on previous geophysical site clearance experience at former industrial sites we recommned a combined electromagnetic induction (EM) and ground penetrating radar (GPR) survey to cover the proposed survey area. The EM method is applicable because it can detect both ferrous and non-ferrous metallic objects (Figure 2). EM field data are typically collected using portable ground conductivity instrumentation (Figure 3). A transmitting coil induces an electromagnetic field and a receiving coil at a (usually) fixed separation measures the amplitudes of the in-phase and quadrature components of the electromagnetic field. Various instruments have different coil spacing's and operating frequencies. Spacing and frequency affect depth of signal penetration.

The recorded electromagnetic field is separable into two sub-components; in-phase and conductivity (also referred to as quadrature). The in-phase component is most sensitive to **metallic objects** and is measured in parts per million (ppm). The conductivity component is sensitive to soil condition variations and is measured (for the GEM-2 instrument) in Siemens per meter (S/m). Soil conductivity is a function of soil type, porosity, permeability, and dissolved salts. Soil conductivity methods seek to identify various earth materials by measuring their electrical characteristics and interpreting results in terms of those characteristics.

The EM method was chosen due to the capability of mapping metallic objects (both ferrous and non-ferrous) in the subsurface and the relatively rapid rate of data acquisition. The depth of investigation for the EM unit for this survey using a Geophex GEM-2 ground conductivity meter is approximately 10-15 feet (depending on soil conditions).

Figure 1. Overview of the proposed survey area (orange outlined area) on the Hylebos Marsh Property of the geophysical site clearance investigation.

Figure 2. Example from a previous EM survey conducted at a former mill operation in Everett, WA. While the structures have since been demolished and the site cleared the results indicate that building foundations and infrastructure remain in the subsurface.



The benefits of EM surveying are:

- Large areas can be covered in a short time period.
- High density data can be achieved along survey lines.
- It is sensitive to changes in soil conductivity and buried metallic objects.
- Can investigate down to depths of approximately 15 feet, depending on soil conditions and chosen frequency.

The potential drawbacks of EM surveying are:

- Susceptible to electromagnetic noise within the area.
- Buried infrastructure such as utility lines or above ground conductive objects can make interpretation difficult.
- If there is not enough physical property contrast between the "target" material and the surrounding soil, then the target may not be detectable.

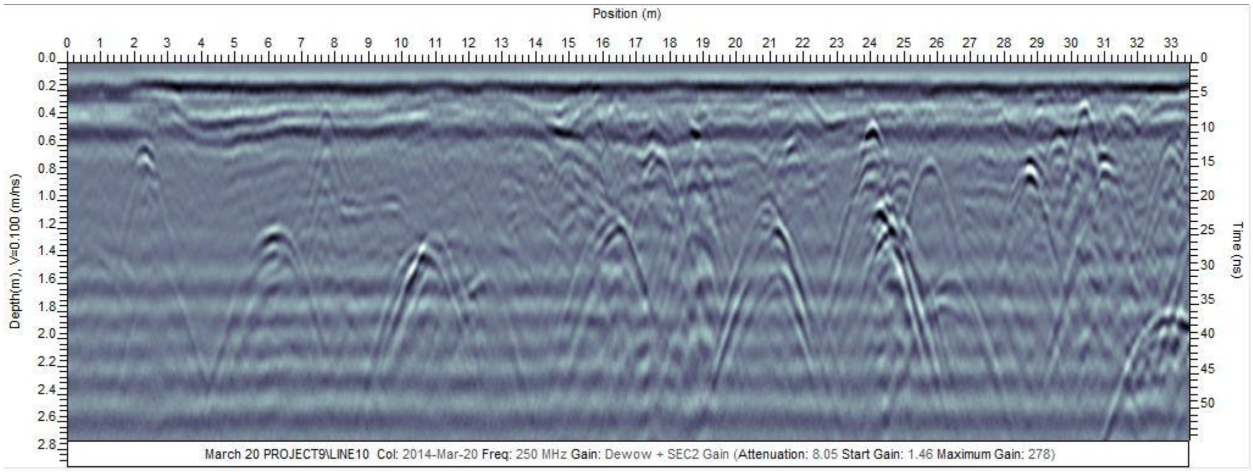
EM data will be acquired along parallel survey lines across the approximately 800 by 50 feet survey area highlighted in Figure 1. Typically, a line spacing of approximately 10 feet would be suitable for defining lateral changes in subsurface conditions to locate buried auto fluff, but may vary depending on actual site logistics (Figure 1). Any areas that contain buildings, vehicles, and/or debris piles will not be surveyed. Grids for each site will be set up on a local basis using measuring tapes and surveying paint before data acquisition begins, and will be surveyed in using a handheld GPS device.

Figure 3. The Geophex GEM-2 Electromagnetic Instrument collecting data at a UST Site in Tacoma, WA.

In many projects involving site clearance, we use the GPR method as a complementary tool to the EM method (Figure 4). The GPR data provides higher resolution, allowing for the higher definition of smaller targets such as pipelines and debris, and is not as sensitive to above ground noise and interference as the EM method (and so can provide coverage in proximity to the chain link fence along the eastern edge of the survey area). In addition, it provides for a more accurate determination of the depth of any targets in the subsurface. HGI has significant experience performing GPR surveys on residential and industrial areas, such as the Hanford Nuclear Reservation Tank Farms. The equipment to be used is a Sensors and Software Noggin 250 Smartcart, which includes a 250 MHz shielded antenna. This configuration has a maximum depth of penetration of 8 to 10 feet, and varies based on soil conductivity. The more conductive the soil, the shallower the depth of investigation will be. It is possible to miss a target due to depth of investigation if it is located beneath the depth capability of the GPR unit. In addition, it can be difficult to determine if a GPR anomaly is caused by a man-made object or a natural geologic target, such as large boulders.

GPR data will be acquired along parallel survey lines across the approximately 800 by 50 feet survey area highlighted in Figure 1. Typically, a line spacing of approximately 10 feet would be suitable for defining lateral changes in subsurface conditions to locate buried auto fluff, but may vary depending on actual site logistics (Figure 1).

Figure 4. Example GPR Profile for a utility mapping survey at the Hanford Nuclear Reservation, WA, illustrating the anomalies (hyperbola features) detected off subsurface pipelines.



3.0 SURVEY DESIGN

The proposed survey area at the Hylebos Marsh Property for the geophysical site clearance investigation has dimensions of approximately 800 by 50 feet. The EM and GPR data will be collected along parallel survey lines, with a line spacing of approximately 10 feet.

Limitations: HGI has not conducted a site visit to the two properties, but based on inspection of aerial photographs there could be a number of areas where geophysical survey coverage may be limited or absent within the survey area due to the presence of dense vegetation.

4.0 COMMUNICATIONS

4.1 PROGRESS REPORTS

Our field crew chief will submit a daily progress report describing a brief summary of daily activities, current status, and planned field activities for the following field day.

4.2 DELIVERABLES

A final report will be provided that discusses details on the methodology, results, interpretations, conclusions, and recommendations derived from the study. The report and all figures, tables, geophysical data, and appendices will be delivered to client electronically in Adobe PDF format. The final report will be provided within two to three (2-3) weeks from the completion of the field survey.

Attachment C

Field Sampling Data Sheets

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Maul Foster & Alongi, Inc.	Geologic Borehole Log/Well Construction		
	Project Number	Well Number	Sheet

Project Name	TOC Elevation (feet)
Project Location	Surface Elevation (feet)
Start/End Date	Northing
Driller/Equipment	Easting
Geologist/Engineer	Hole Depth
Sample Method	Outer Hole Diam

Depth (feet, BGS)	PID (ppm)		Sample Data						Lithologic Column	Soil Description
			Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"		
1										
2										
3										
4										
5										
6										
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MAUL FOSTER ALONGI

109 East 13th Street, Vancouver, Washington 98660 (360) 694-2691 www.maulfoster.com

Soil Field Sampling Data Sheet

Client Name		**Sample Location**	
Project Number		**Sampler**	
Project Name		**Sampling Date**	
Sampling Event		**Sample Name**	
Sub Area		**Sample Depth (ft)**	
FSDS QA:		**Easting**	

Northing		**TOC**			

Sample Information

Sampling Method	Sample Type	Sample Category	PID/FID	Sampling Time	Container Code	#
					2 oz. soil	
					4 oz. soil	
					8 oz. soil	
					Other	
					Total Containers	

Sample Description:

General Sampling Comments

Sampling Method Code:

(1) Backhoe, (2) Hand Auger, (3) Drill Bit Cutting Head, (4) Geoprobe, (5) Split Spoon, (6) Shelbey Tube, (7) Grab, (8) Other (Specify)

Signature ______________________________