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June 5, 2024
Project No. M0615.20.013

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

Re: Vapor Intrusion Data Gaps Work Plan
Taylor Way and Alexander Fill Area—Former Potter Property

Dear Steve Teel:

Maul Foster & Alongi, Inc. (MFA) has prepared this vapor work plan on behalf of the Port of Tacoma (the Port) to guide sample collection during the additional data gaps assessment at the former Potter property, located at 1801 E Alexander Avenue in Tacoma, Washington (the Property; see Figure 1). The Property 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 has been prepared to satisfy Ecology's request for additional sampling to obtain vapor data from the vadose zone along the Property boundary between the Shop Building and the adjacent Emerald Services building, as described its letter dated January 4, 2024.

Background

The approximately 1.7-acre Property is currently used for shipping container repair and vehicle maintenance operations by the Port's tenant, Handan Containers. The Property is situated between two large-quantity hazardous waste generator facilities that treat, handle, and/or store hazardous waste (see Figure 2). Releases from unlined waste-oil storage and -treatment ponds from what is now the adjacent Burlington Environmental (BE) Tacoma property extend onto the Property. According to Ecology, the Property subsurface conditions (soil and/or groundwater) are known to be impacted by metals, petroleum fuels mixtures, volatile organic compounds (VOCs), and semivolatile organic compounds (Ecology 2020).

In July 2022, MFA completed a Tier I vapor intrusion (VI) investigation consisting of sub-slab soil vapor sampling in three buildings at the Property (MFA 2022). Total petroleum hydrocarbons and multiple VOCs exceeded applicable MTCA Method B and/or Method C cleanup levels (CULs). Following that investigation, MFA completed a Tier II VI investigation in June 2023 consisting of indoor air, ambient air, and additional sub-slab vapor sampling at the Property, including two new vapor pin locations in the Shop Building, to further assess potential for VI (MFA 2023). Numerous VOCs exceeded sub-slab vapor CULs in the Shop Building, including the two vapor pins installed during the 2023 event. Most VOCs that exceeded sub-slab vapor CULs were not detected in indoor air.

Ecology provided comments on the Tier II VI assessment in a letter dated January 4, 2024 (Ecology 2024a). In the letter, Ecology requested additional investigation work to complete the remedial investigation.

Scope of Work

This work plan describes the Port's proposed approach to address the data gaps adjacent to Emerald Services building complex related to the releases from BE Tacoma's former waste oil pond. The proposed scope of work includes conducting soil vapor sampling near the Emerald Services building along the Property line and in the Shop Building, consistent with the approach Ecology specified in its January 4 and April 3, 2024, letters (Ecology 2024a, 2024b), and has been updated to address Ecology's comments in its May 16, 2024, letter (Ecology 2024c).[1] The scope was developed in general accordance with the VI guidance published by Ecology (Ecology 2022), vapor intrusion guidance published by Interstate Technology & Regulatory Council (ITRC 2007, 2014), and passive soil gas testing technical memorandum by Beacon Environmental (Beacon 2024).

Vapor Point Installation

MFA will oversee the installation of three permanent vapor sampling points outside of the Shop Building (TWA-SV-46 through TWA-SV-48). The approximate locations of the permanent vapor points are shown on Figure 3, and may be altered in the field based on accessibility, potential underground utilities, and information and/or feedback from the Tenant, Port, and/or Ecology. Permanent soil vapor points will be installed by a licensed driller in the state of Washington with a limited access, track-mounted direct push drill rig[2], at a depth of 2 feet (ft) below ground surface (bgs). Appendix D of Ecology's vapor intrusion guidance indicates these shallower depths are necessary when access to the building of concern cannot be obtained and depth to groundwater is less than five feet, as demonstrated by depth to groundwater measurements ranging between approximately 1 and 3.5 ft bgs in CTMW-20 on the Property near the proposed vapor point sampling locations (DOF 2022a, 2022b). The soil vapor sampling points will be constructed using a 6-inch stainless-steel screen connected to nylon tubing equipped with a 1/4 turn shutoff valve. The casing will be packed with 10/20 sand up to approximately 2 inches above the screen, followed by a 6-inch casing seal of bentonite chips, and completed with bentonite grout to the surface. Each new vapor sampling point location will be completed with a stickup monument to improve visibility of the vapor points and prevent debris buildup.

Prior to drilling, MFA will identify access constraints and evaluate suitable drilling methods with a driller. Public and private utility-locating services and a review of available site plans will be performed to check for underground utilities or obstructions before installing soil vapor points (see Standard Operating Procedure [SOP] 18 in Attachment A).

Following completion of the permanent vapor sampling points, a minimum of an 8-hour equilibration period will be observed. Following equilibration, MFA will collect sub-slab vapor samples at the five existing sub-slab vapor pin locations, TWA-SV-41 through TWA-SV-45, inside the Shop Building, all of which exceeded sub-slab vapor CULs during either the 2022 or 2023 sampling events. Three soil vapor samples will be collected from proposed permanent soil vapor monitoring points along the southeast Property boundary, adjacent to the Shop Building. A duplicate sample will be collected from TWA-SV-41.

[1] Ecology's comments were also provided via email from Steve Teel, LHG, on May 14, 2024.
[2] A handheld drill may be used if the track-mounted rig is unable access the proposed sample locations.

Prior to vapor sample collection, MFA will install a data-logging manometer in at least one sub-slab vapor pin to collect differential pressure measurements between sub-slab vapor and indoor air in the Shop Building. Pressure differential data will be collected for 72 hours prior to sampling, as well as during the vapor sample collection period.

Passive Soil Vapor Sampling

A total of five (5) passive soil vapor samplers will be deployed adjacent to each newly installed permanent vapor point and at two intervals between TWA-SV-46 and TWA-SV-47 (see Figure 3). The purpose of the passive sampling is to serve as a verification of the vapor point sample representativeness. The approximate locations of the passive soil vapor samples may be altered in the field based on accessibility, potential underground utilities, and information and/or feedback from the Tenant, Port, and/or Ecology.

After completion of the sub-slab vapor point installation, MFA will deploy five passive soil vapor samplers at the proposed passive soil vapor sampling locations (see Figure 3). At each location, a 1.5-inch diameter hole will be advanced to 1-foot depth using a handheld rotary hammer drill and a drill bit. The hole will then be extended to a 2-foot depth using a 0.5-inch diameter drill bit. Prior to drilling, MFA will conduct a review of available site plans and have public and private utility-locating services check for underground utilities or obstructions (see SOP 18 in Attachment A).

Beacon Passive Samplers provided through Beacon Environmental BESURE Sample Collection Kit[3] will be placed in each hole and sealed in accordance with the passive soil vapor sampling procedures described in Attachment C. The Beacon Passive Samplers will be deployed for 14 days to measure soil vapor VOC concentrations at each location. The procedures and a schematic diagram of the passive sampler are provided in Attachment C.

Sample Procedures

Sub-Slab and Vapor Point

Vapor samples will be collected in accordance with MFA's SOP 16 (see Attachment A). The samples will be collected in 1-liter, stainless steel Summa canisters with 5-minute flow controllers at a flow rate of 200 milliliter per minute (ml/min). A helium shroud will be contained over the sampling apparatus and sampling pin to serve as a leak-check compound (see SOP 16 in Attachment A) and to verify the vacuum applied to the soil vapor points outside the building is not significant enough to draw in atmospheric air. The samples will also be collected in Tedlar bags for analysis of gasses.

Duplicate vapor samples for TO-15 and air-phase hydrocarbon (APH) analyses shall be collected by using a T-splitter at the point of sample collection to divide the sample stream into two separate canisters.

MFA will record field data before and after the sampling, including the sampling start and stop times, the initial and final canister vacuum readings, temperature, relative humidity, barometric pressure, wind speed and direction, and observations of conditions that may influence sampling results (e.g., industrial activities and presence or use of chemicals in the vicinity) (see field sampling data sheets in Attachment B). The sample will be rejected if the initial canister vacuum is less than 25 inches of mercury or if the final canister vacuum is less than 0.1 inch of mercury.

[3] Beacon Environmental passive samplers were selected for site investigation because APH compounds are included in the analysis and 14-day quantitation limits are sufficiently low to meet project objectives.

Passive Soil Vapor

Passive soil vapor sample installation and retrieval will be conducted in accordance with MFA's passive soil sampling procedures using Beacon Passive Samplers provided through Beacon Environmental BESURE Sample Collection Kit. The procedures and a schematic diagram of the passive sampler are provided in Attachment C. Duplicate soil vapor samples for TO-17 analyses will be conducted by analyzing the second adsorbent cartridges at one of the sample locations.

MFA will record field data during sample deployment and again during sample retrieval. This will include the deployment and retrieval date and times, temperature, relative humidity, barometric pressure, wind speed and direction, and observations of conditions that may influence sampling results (e.g., industrial activities and presence or use of chemicals in the vicinity) (see field sampling data sheets in Attachment B).

Sample Nomenclature

Sub-Slab and Vapor Point Sample Nomenclature

Permanent soil vapor points will be labeled TWA-SV-46 through TWA-SV-48 to indicate the TWAAFA site, the sample matrix (soil vapor), and the location identification number. All vapor samples will be labeled with the date in MMDDYY format. Field duplicate samples will use "DUP" in place of the sample identification number. For example, a sample collected on August 1, 2024, from location TWA-SV-46 will be labeled TWA-SV-46-080124. A field duplicate sample collected at that same location would be named TWA-SV-DUP-080124.

Passive Sampler Nomenclature

Passive soil vapor samples will be labeled TWA-PSV-01 through TWA-PSV-05 to indicate the TWAAFA site, the sample matrix (passive soil vapor), and the location identification number. All passive soil vapor samples will be labeled with the date in MMDDYY format to represent the date of deployment. Field duplicate samples will use "DUP" in place of the sample identification number. For example, a sample deployed on August 1, 2024, from location TWA-PSV-01 will be labeled TWA-PSV-01-080124. A field duplicate sample collected at that same location would be named TWA-PSV-DUP-080124.

Analytical Methods

Sub-Slab and Vapor Point Sampling

Petroleum hydrocarbons and VOCs were identified as chemicals of interest for the Property. Friedman & Bruya, Inc., a laboratory accredited by the State of Washington and the National Environmental Laboratory Accreditation Program, will perform the following analyses for the samples collected from the permanent vapor points:

- APH by Massachusetts APH Method
- VOCs by Toxics Organics-15 Method[4]
- Methane by U.S. Environmental Protection Agency (EPA) 3C
- Oxygen by EPA 3C

[4] The July 2015, California Active Soil Gas Investigations guidance document notes that naphthalene analysis by US EPA Method TO-15 can be affected by contaminant carryover and variability in recovery unless special protocols are followed. Therefore, the recommendations and protocols in the California Active Soil Gas Investigations guidance document Attachment E (Naphthalene Soil Gas Collection) shall be followed (CalEPA 2015).

- Carbon dioxide by EPA 3C

Analytical methods and performance criteria will also follow the Ecology-approved Vapor SAP for the TWAAFA site (DOF 2020). In the laboratory, QC samples may include laboratory control samples (LCSs), surrogate spike samples, and method blanks, as well as other QC samples and procedures as required by the individual methods (see Table 1). Sampling handling procedures will be consistent with the previous SAP (MFA 2021). Sample container and holding information is provided in Table 2.

Passive Soil Vapor Sampling

To verify the representativeness of the samples collected from the soil vapor monitoring points, VOC concentrations will be measured through passive soil vapor sampling. The passive soil vapor collection device will be the Beacon Passive Sampler and analyzed by Beacon Environmental, a laboratory accredited by the State of Washington and the National Environmental Laboratory Accreditation Program. They will perform the following analyses for the passive soil vapor samples:

- VOCs and APH by Toxics Organics-17 Method

Analytical methods, performance criteria, and sampling handling procedures are described in Attachment C. Field and laboratory QC samples are summarized in Table 1. will be consistent with the previous SAP (MFA 2021). Sample container and holding information is provided in Table 2. The limits of quantitation are summarized in Table 3.

Schedule and Reporting

MFA will implement the scope of work described in this work plan following its approval by Ecology. The schedule will be dependent on availability of the driller and the groundwater table elevation. Due to the high groundwater table at the Property, the vadose zone must be sufficiently exposed (e.g., at least 2.5 feet-thick) to allow for vapor sampling. MFA anticipates sampling in August 2024. MFA will notify Ecology at least 48 hours prior to the commencement of field activities.

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.

Closing

Please contact Audrey Hackett at (206) 556-2015 if you have any questions related to the proposed scope of work presented above.

Sincerely,

Maul Foster & Alongi, Inc.

Audrey Hackett
Senior Environmental Scientist

Brenden Murphy
Staff Environmental Scientist

Attachments

References

Limitations

Figures

Tables

A—Standard Operating Procedures

B—Field Sampling Data Sheets

C—Passive Soil Vapor Sampling Procedures

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

Beacon. 2024. *Passive Soil Gas Testing: Standard for Site Characterization, Technical Memorandum*. Beacon Environmental: Bel Air, Maryland. January 26.

CalEPA. 2015. *Advisory Active Soil Gas Investigations*. California Environmental Protection Agency, Department of Toxics Substances Control, Los Angeles Regional Water Quality Control Board. San Francisco Regional Water Quality Control Board. July.

DOF. 2020. *Final Data Gaps Work Plan, Taylor Way and Alexander Avenue Fill Area Site, Tacoma, Washington*. Prepared for General Metals, Glenn Springs Holdings, Port of Tacoma, Clean Earth (formerly Stericycle Environmental Solutions). Dalton, Olmsted & Fuglevand, Inc.: Seattle, WA. July.

DOF. 2022a. *First Quarter 2022 Groundwater Data Analysis Report, Taylor Way and Alexander Avenue Fill Area Site, Tacoma, Washington*. Prepared for General Metals, Glenn Springs Holdings, Port of Tacoma, Clean Earth. Dalton, Olmsted & Fuglevand, Inc.: Seattle, WA. May 6.

DOF. 2022b. *Third Quarter 2022 Groundwater Data Analysis Report, Taylor Way and Alexander Avenue Fill Area Site, Tacoma, Washington*. Prepared for General Metals, Glenn Springs Holdings, Port of Tacoma, Clean Earth. Dalton, Olmsted & Fuglevand, Inc.: Seattle, WA. November 23.

Ecology. 2020. *Enforcement Order No. DE 19410: In the matter of remedial action by: the Port of Tacoma at the Taylor Way and Alexander Avenue Fill Area (TWAAFA) Site* to Eric Johnson, Port of Tacoma. December 4.

Ecology. 2022. *Guidance for Evaluating Vapor Intrusion in Washington State, Investigation and Remedial Action.* Washington State Department of Ecology, Toxics Cleanup Program: Olympia, WA. March.

Ecology. 2024a. Steve Teel, LHG, Washington State Department of Ecology. *Re: Comments on Investigation Reports and requirement for work plan.* Letter to Tasya Gray, LG, Dalton, Olmsted & Fuglevand, and Scott Hooton, Port of Tacoma. January 4.

Ecology. 2024b. Steve Teel, LHG, Washington State Department of Ecology. *Re: Response to February 16, 2024.* Letter to Tasya Gray, LG, Dalton, Olmsted & Fuglevand, and Scott Hooton, Port of Tacoma. April 3.

Ecology. 2024c. Steeve Teel, LHG, Washington State Department of Ecology. *Re: Comments on Former Potter Property Vapor Intrusion Data Gaps Work Plan.* Letter to Tasya Gray, LG, Dalton, Olmsted & Fuglevand, and Scott Hooton, Port of Tacoma. May 16.

EPA. 2017. *EPA contract laboratory program, national functional guidelines for Superfund organic methods data review.* EPA 540-R-2017-002. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. January.

ITRC. 2007. *Petroleum Vapor Intrusion, Fundamentals of Screening, Investigation, and Management*. Interstate Technology & Regulatory Council: Washington DC. October.

ITRC. 2014. *Vapor Intrusion Pathway: A Practical Guideline*. Interstate Technology & Regulatory Council: Washington DC. January.

MFA. 2021. *Final Vapor Sampling and Analysis Plan, Taylor Way and Alexander Avenue Fill Area, Former Potter Property, 1801 E Alexander Avenue, Tacoma, Washington*. Prepared for Port of Tacoma. Maul Foster & Alongi, Inc.: Seattle, WA. December 16.

MFA. 2022. *Vapor Intrusion Assessment Report, Taylor Way and Alexander Avenue Fill Area, Former Potter Property, 1801 E Alexander Avenue, Tacoma, Washington*. Prepared for Port of Tacoma. Maul Foster & Alongi, Inc.: Seattle, WA. October 6.

MFA. 2023. Tier II *Vapor Intrusion Assessment Report, Taylor Way and Alexander Avenue Fill Area, Former Potter Property, 1801 E Alexander Avenue, Tacoma, Washington*. Prepared for Port of Tacoma. Maul Foster & Alongi, Inc.: Seattle, WA. August 23.

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

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Note
TWAAFA = Taylor Way and Alexander Avenue Fill Area.

Legend

- Potter Property
- TWAAFA Site Boundary

Figure 1
Property Location

Port of Tacoma
Former Potter Property
1801 E Alexander Avenue
Tacoma, Washington

0 1,000 2,000
Feet

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Data Sources
U.S. Geological Survey (2021) 7.5-minute topographic quadrangle: Tacoma, Washington.
Township 21 North, Range 3 East, Section 35.
Tax parcel obtained from Pierce County Assessor.
TWAAFA site boundary obtained from Exhibit A of Agreed Order No. DE 14260.

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Figure 2
Property Features

Port of Tacoma
Former Potter Property
1801 E Alexander Avenue
Tacoma, Washington

Legend

- Chain Link Gate
- Door
- Features
- Buildings
- Property

Notes
All features are approximate.
Potter property boundary is approximate.

0 40
Feet

Data Sources
Aerial photograph obtained from Google Earth.

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Figure 3
Proposed Sample Locations

Port of Tacoma
Former Potter Property
1801 E Alexander Avenue
Tacoma, Washington

Legend

- Sub-slab vapor pin, to be sampled
- Proposed permanent soil vapor monitoring location
- Proposed passive soil vapor sample location
- Sub-slab vapor pin
- Chain link gate
- Exterior door
- Building
- Property

Notes
All features are approximate.
Potter property boundary is approximate.

0 20
Feet

Data Sources
Aerial photograph obtained from Google Earth.

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Produced By: stumer
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Tables

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Table 1
QC Sample Summary
Port of Tacoma
Former Potter Property

QC Check Sample	Frequency
Field QC	
Field Duplicate	One sample per 20 (or fewer) samples
Trip Blank	One sample per 30 (or fewer) samples included in each Beacon BESURE Sample Collection Kit[(a)]
Laboratory QC	
Surrogate Spiking	Added to all project and QC samples (for organic analyses only)
Method Blanks	Each analytical batch of samples of every 20 (or fewer) samples received
Laboratory Control Sample	Each analytical batch of samples of every 20 (or fewer) samples received
Notes QC = quality control. [(a)]Trip blanks are included for passive soil vapor sampling only.	

Table 2
Containers, Preservation, and Holding Times
Port of Tacoma
Former Potter Property

Method	Analysis	Field Container Preservative	Holding Time (Days)	Sample Container
MA DEP-APH	APH	None	30	1-L Summa Canister[a]
ASTM D1946	Helium	None	30	1-L Summa Canister[a]
TO-15	VOCs	None	30	1-L Summa Canister[a]
EPA 3C	Methane	None	3	Tedlar bag
EPA 3C	Oxygen	None	3	Tedlar bag
EPA 3C	Carbon dioxide	None	3	Tedlar bag
TO-17	VOCs	None	30	Beacon Passive Sampler[b]
TO-17	APH	None	30	Beacon Passive Sampler[b]

Notes

APH = air-phase hydrocarbons.

ASTM = ASTM International.

L = liter.

MA DEP = Massachusetts Department of Environmental Quality.

TO = toxic organics.

VOC = volatile organic compound.

[a]Subslab vapor samples will be collected in 1-L Summa canisters.

[b]Passive soil vapor samples will be collected in Beacon Passive Sampler adsorbent tubes.

Table 3
Passive Soil Vapor Sampler Quantitation Limits
Port of Tacoma
Former Potter Property

	Beacon Environmental Passive Sampler Quantitation Limits[(a)] (ug/m^3)
VOCs (ug/m^3)	
1,1,1,2-Tetrachloroethane	1.22
1,1,1-Trichloroethane	0.47
1,1,2-Trichloroethane	1.50
1,1,2-Trichlorotrifluoroethane	0.56
1,1-Dichloroethane	0.58
1,1-Dichloroethene	1.50
1,2,3-Trichlorobenzene	1.27
1,2,3-Trichloropropane	0.66
1,2,4-Trichlorobenzene	1.27
1,2,4-Trimethylbenzene	1.49
1,2-Dibromoethane	1.29
1,2-Dichlorobenzene	0.66
1,2-Dichloroethane	0.89
1,3,5-Trimethylbenzene	1.49
1,3-Dichlorobenzene	0.66
1,4-Dichlorobenzene	0.66
1,4-Dioxane	1.21
2-Methylnaphthalene	0.65
Benzene	2.34
Carbon tetrachloride	1.17
Chlorobenzene	0.58
Chloroform	1.42
cis-1,2-Dichloroethene	0.94
Ethylbenzene	1.46
Isopropylbenzene	1.49
m,p-Xylene	1.41
Methyl tert-butyl ether	2.48
Methylene chloride	1.42
Naphthalene	0.62
o-Xylene	1.41
Tetrachloroethene	1.21
Toluene	3.10
trans-1,2-Dichloroethene	1.13
Trichloroethene	1.50

Table 3
Passive Soil Vapor Sampler Quantitation Limits
Port of Tacoma
Former Potter Property

	Beacon Environmental Passive Sampler Quantitation Limits[(a)] (ug/m^3)
Vinyl chloride	0.61
APH (ug/m^3)	
C5-C8 Aliphatic hydrocarbons	4.59
C9-C12 Aliphatic hydrocarbons	3.31
C9-C10 Aromatic hydrocarbons	0.62

Notes

Beacon Environmental passive samplers were selected for site investigation because APH compounds are included in the analysis and 14-day quantitation limits are sufficiently low to meet project objectives.

APH = air-phase hydrocarbons.

ug/m3 = micrograms per cubic meter.

VOC = volatile organic compound.

[(a)]Quantitation limits provided by Beacon Environmental are based on 14-day deployment of BESURE Sample Collection Kit.

Attachment A

Standard Operating Procedures

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Standard Operating Procedure

Soil Vapor Sampling

SOP Number: 16
Date: 03/09/2021
Revision Number: 0.1

Scope and Application

This standard operating procedure (SOP) describes the methods for collecting soil vapor samples from temporary or permanent equipment installed in unsaturated subsurface soil. Sample collection may require drilling through concrete or asphalt to gain access to subsurface soils.

Equipment and Materials Required

- The following materials are necessary for this procedure:
- Personal protective equipment (as specified in the health and safety plan)
- Measuring tape, Teflon™ tape, wrenches
- Laboratory-supplied sample canister (e.g., Summa), manifolds, and flow controllers
- Leak-detection equipment (helium tank, two-stage regulator, and gas-flow-control valve; and helium leak detector)
- Vacuum (purge) pump
- Laboratory chain-of-custody form
- Equipment decontamination supplies if vapor-sampling equipment[instruments?] will be reused between sample locations (see SOP 1 for equipment decontamination procedures)
- Soil vapor field sampling datasheet and notebook

Methodology

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

Complete the attached questionnaire before beginning vapor-sampling activities. The intent of this questionnaire is to document potential sources of vapors that could require the collection of vapor samples that are not representative of vapors present in subsurface soil.

General Sampling Procedure:

Sample collection from a temporary or permanent boring

- Installation of the sample point may be completed manually or by a drilling subcontractor. See SOPs 7 and 8 for drilling procedures.
- Vapor point construction details, including screen length and depth placement, annular material, and seal specifications, may be project-specific and should be described in the project SAP.
- Clear the ground surface of brush, root mat, grass, leaves, and other debris.

- Remove soil to the target depth, verify that the sample depth is correct, and record the depth in the field notebook and the boring log (see SOP 2).
- Assemble and attach the sampling equipment as described below. Before sampling, temporary sampling points must equilibrate for at least 30 minutes. Permanent points should equilibrate for at least 48 hours.

Sample collection from a subslab sample point

Subslab soil-gas sampling points consist of a Cox-Colvin & Associates, Inc. (Cox-Colvin) Vapor PinTM system. The procedures developed by Cox-Colvin for installing and removing the Vapor Pin system, including the secure cover, are attached.

Assembly and attachment of sampling equipment

- Connect the sampling equipment as shown in the attached figure such that the equipment can be purged, leak tested, shut-in tested, and sampled in the field.
- The vapor pin installed in an asphalt or cement slab will be connected to the ¼ turn Swagelok® ball valve (Valve #1—sampling valve), using appurtenant stainless steel or Tygon® tubing. The sampling valve is connected to a vacuum gauge, which is attached to the flow controller.
- At the flow controller, a Swagelok tee connection will be fitted to the canister and to a second ¼ turn Swagelok ball valve (Valve #2—purge valve) used to isolate the purging equipment during actual sampling.
- The canister has a built-in valve that allows isolation of the canister during purging and leak-checking activities. On the other side of the purge valve (#2), a vacuum pump will be connected in order to induce vacuum for purging and shut-in testing.

Leak detection

- Helium will be contained around the sampling apparatus and sampling pin to serve as a leak-check compound. Helium will be released into a small structure (shroud) that is placed over the sampling pin and sampling train.
- With the canister valve closed, a sample of the soil gas collected during purging (described below) will be contained in a Tedlar® bag.
- A field helium detector will be used to sample the air purged through the sampling train to verify the presence or absence of helium. A helium concentration greater than 10 percent of the concentration in the containment structure indicates that a leak is occurring.
- If a leak is detected, the sampling and purging train fittings will be tightened and the leak check will be repeated.
- The absence of helium during the purging process verifies the integrity of the sampling system before the sample is collected.
- The canister will also be analyzed for helium by the analytical laboratory as a quality assurance measure.

Sampling

- After the sampling train is purged and no leaks are detected in the sampling train, close the valve leading to the vacuum pump (Valve #2—purge valve), open the valve leading to the

sampling pin (Valve #1—sample valve), and then open the valve on the canister to collect the sample over a 30-minute period or the duration of time required for the specific test.

- Record field data during the sampling on the soil vapor field sampling datasheet, including the sampling start and stop times, the initial and final canister vacuum readings, and weather conditions.
- The sample will be rejected if the initial canister pressure is not at least -25 inch of mercury or if the final canister pressure is greater than -0.1 inch of mercury. The final canister pressure is recommended at or near -5 inch of mercury.

Data Recording

In a field log notebook and soil vapor field sampling datasheet, record the following:

- Project name, sample date, sampling location, canister serial number, initial vacuum reading, final pressure reading, and sampling time.
- Weather conditions during sampling (temperature, barometric pressure, humidity, sunny/cloud cover, wind).
- Date and amount of most recent prior rainfall.

Abandonment of Sampling Points

- Temporary Borings: Abandon each borehole in accordance with local and state regulations/procedures. See SOPs 7 and 8 for borehole abandonment procedures. The abandonment procedure typically consists of filling the boring with granular bentonite and hydrating the bentonite with water. Match the surface completion to the surrounding materials.
- Subslab Vapor Pin: The subslab vapor pin will be properly decommissioned consistent with the attached Cox-Colvin procedure. The slab borehole will be filled with grout and/or concrete. Surface restoration may include a follow-up visit for final sanding and finish work to restore the floor slab, and associated coverings, to their original condition as required.

QUESTIONNAIRE

Preparer's Name:_____

Date/Time Prepared: _____

Preparer's Affiliation:_____

1. OCCUPANT:

Last Name:_____First Name:_____

Building / Suite:_____

Number of occupants/persons at this location:_____

2. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. **Are petroleum-powered machines or vehicles stored in the building or attached garage?** (e.g., lawnmower, ATV, car) Y / N
   Please specify _____
b. **Has the building ever had a fire?** Y / N
   When?_____
c. **Is a kerosene or unvented gas space heater present?** Y / N
   Where & Type?_____
d. **Is there a workshop or hobby/craft area?** Y / N
   Where & Type?_____
e. **Is there smoking in the building?** Y / N
   Frequency?_____
f. **Have cleaning products been used recently?** Y / N
   When & Type?_____
g. **Have cosmetic products been used recently?** Y / N
   When & Type?_____
h. **Has painting/staining been done in the last 6 months?** Y / N
   Where & When? _____
i. **Is there new carpet, drapes, or other textiles?** Y / N
   Where & When?_____
j. **Have air fresheners been used recently?** Y / N
   When & Type?_____
k. **Is there a kitchen exhaust fan?** Y / N
   If yes, where vented?_____

QUESTIONNAIRE

l. **Is there a bathroom exhaust fan?** Y / N

If yes, where vented?_____

m. **Is there a clothes dryer?** Y / N

If yes, is it vented outside? Y / N

n. **Has there been a pesticide application?** Y / N

When & Type?_____

o. **Are there odors in the building?** Y / N

If yes, please describe:_____

p. **Do any of the building occupants use solvents or volatile chemicals at work?** (e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide applicator, cosmetologist, carpet installer) Y / N

If yes, what type of solvents are used? _____

If yes, are the occupants' clothes washed at work? Y / N

3. PRODUCT INVENTORY FORM

List specific products in the building that may contain petroleum hydrocarbons. Please note that MFA will visit the site to help complete the product inventory.

Location	Product Description	Size (units)	Condition*

***Describe the condition of the product containers as unopened, used, or deteriorated.**

Standard Operating Procedure Installation and Extraction of the Vapor Pin™

May 20, 2011

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™[1] for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve (Figure 1)];
- Hammer drill;
- 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00206514 or equivalent);
- 1½-inch diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch diameter bottle brush;
- Wet/dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, as necessary;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel.

[1]Cox-Colvin & Associates, Inc., designed and developed the Vapor Pin™; a patent is pending.

Figure 1. Assembled Vapor Pin™.

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) If a flush mount installation is required, drill a 1½-inch diameter hole at least 1¾-inches into the slab.

4) Drill a 5/8-inch diameter hole through the slab and approximately 1-inch into the underlying soil to form a void.

5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.

6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the extraction/installation tool over the Vapor Pin™ to protect the barb fitting and cap, and tap the Vapor Pin™ into place using a

dead blow hammer (Figure 2). Make sure the extraction/installation tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.

Figure 2. Installing the Vapor Pin™.

For flush mount installations, unscrew the threaded coupling from the installation/extraction handle and use the hole in the end of the tool to assist with the installation (Figure 3).

Figure 3. Flush-mount installation.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 4).

Figure 4. Installed Vapor Pin™.

7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover.

8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to equilibrate prior to sampling.

9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™ (Figure 5).

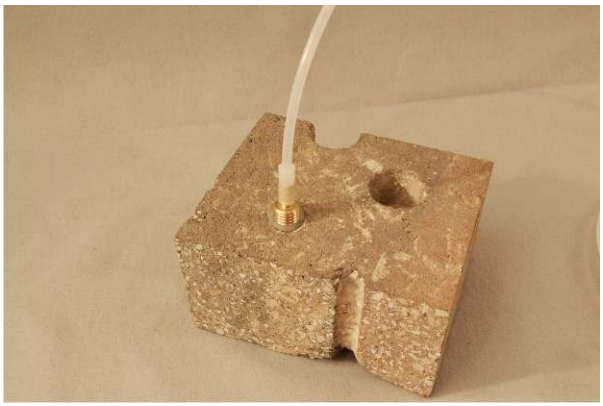

Figure 5. Vapor Pin™ sample connection.

10) Conduct leak tests [(e.g., real-time monitoring of oxygen levels on extracted sub-slab soil gas, or placement of a water

dam around the Vapor Pin™) Figure 6]. Consult your local guidance for possible tests.

Figure 6. Water dam used for leak detection.

11) Collect sub-slab soil gas sample. When finished sampling, replace the protective cap and flush mount cover until the next sampling event. If the sampling is complete, extract the Vapor Pin™.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue turning the tool to assist in extraction, then pull the Vapor Pin™ from the hole (Figure 8).

Figure 7. Removing the Vapor Pin™.

Figure 8. Extracted Vapor Pin™.

2) Fill the void with hydraulic cement and smooth with the trowel or putty knife.

3) Prior to reuse, remove the silicone sleeve and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 130° C.

The Vapor Pin™ to designed be used repeatedly; however, replacement parts and supplies will be required periodically. These parts are available on-line at www.CoxColvin.com.

Replacement Parts:

Vapor Pin™ Kit Case - VPC001
Vapor Pins™ - VPIN0522
Silicone Sleeves - VPTS077
Installation/Extraction Tool - VPIE023
Protective Caps - VPPC010
Flush Mount Covers - VPFM050
Water Dam - VPWD004
Brush - VPB026

Standard Operating Procedure Use of the Vapor Pin™ Drilling Guide and Secure Cover

July 16, 2012

Scope:

This standard operating procedure (SOP) describes the methodology to use the Vapor Pin™ Drilling Guide and Secure Cover to install and secure a Vapor Pin™ in a flush mount configuration.

Purpose:

The purpose of this SOP is to detail the methodology for installing a Vapor Pin™ and Secure Cover in a flush mount configuration. The flush mount configuration reduces the risk of damage to the Vapor Pin™ by foot and vehicular traffic, keeps dust and debris from falling into the flush mount hole, and reduces the opportunity for tampering. This SOP is an optional process performed in conjunction with the SOP entitled "Installation and Extraction of the Vapor Pin™". However, portions of this SOP should be performed prior to installing the Vapor Pin™.

Equipment Needed:

- Vapor Pin™ Secure Cover (Figure 1);
- Vapor Pin™ Drilling Guide (Figure 2);
- Hammer drill;
- 1½-inch diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent);
- 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00226514 or equivalent);
- assembled Vapor Pin™;
- #14 spanner wrench;
- Wet/Dry vacuum with HEPA filter (optional); and
- personal protective equipment (PPE).

Figure 1. Vapor Pin™ Secure Cover.

Figure 2. Vapor Pin™ Drilling Guide.

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) While wearing PPE, drill a 1½-inch diameter hole into the concrete slab to a

depth of approximately 1 3/4 inches. Pre-marking the desired depth on the drill bit with tape will assist in this process.

4) Remove cuttings from the hole and place the Drilling Guide in the hole with the conical end down (Figure 3). The hole is sufficiently deep if the flange of the Drilling Guide lies flush with the surface of the slab. Deepen the hole as necessary, but avoid drilling more than 2 inches into the slab, as the threads on the Secure Cover may not engage properly with the threads on the Vapor Pin™.

Figure 3. Installing the Drilling Guide.

5) When the 1½-inch diameter hole is drilled to the proper depth, replace the drill bit with a $^{5}/_{8}$-inch diameter bit, insert the bit through the Drilling Guide (Figure 4), and drill through the slab. The Drilling Guide will help to center the hole for the Vapor Pin™, and keep the hole perpendicular to the slab.

6) Remove the bit and drilling guide, clean the hole, and install the Vapor Pin™ in accordance with the SOP "Installation and Extraction of the Vapor Pin™.

Figure 4. Using the Drilling Guide.

7) Screw the Secure Cover onto the Vapor Pin™ and tighten using a #14 spanner wrench by rotating it clockwise (Figure 5). Rotate the cover counter clockwise to remove it for subsequent access.

Figure 5. Tightening the Secured Cover.

Limitations:

On slabs less than 3 inches thick, it may be difficult to obtain a good seal in a flush mount configuration with the Vapor Pin™.

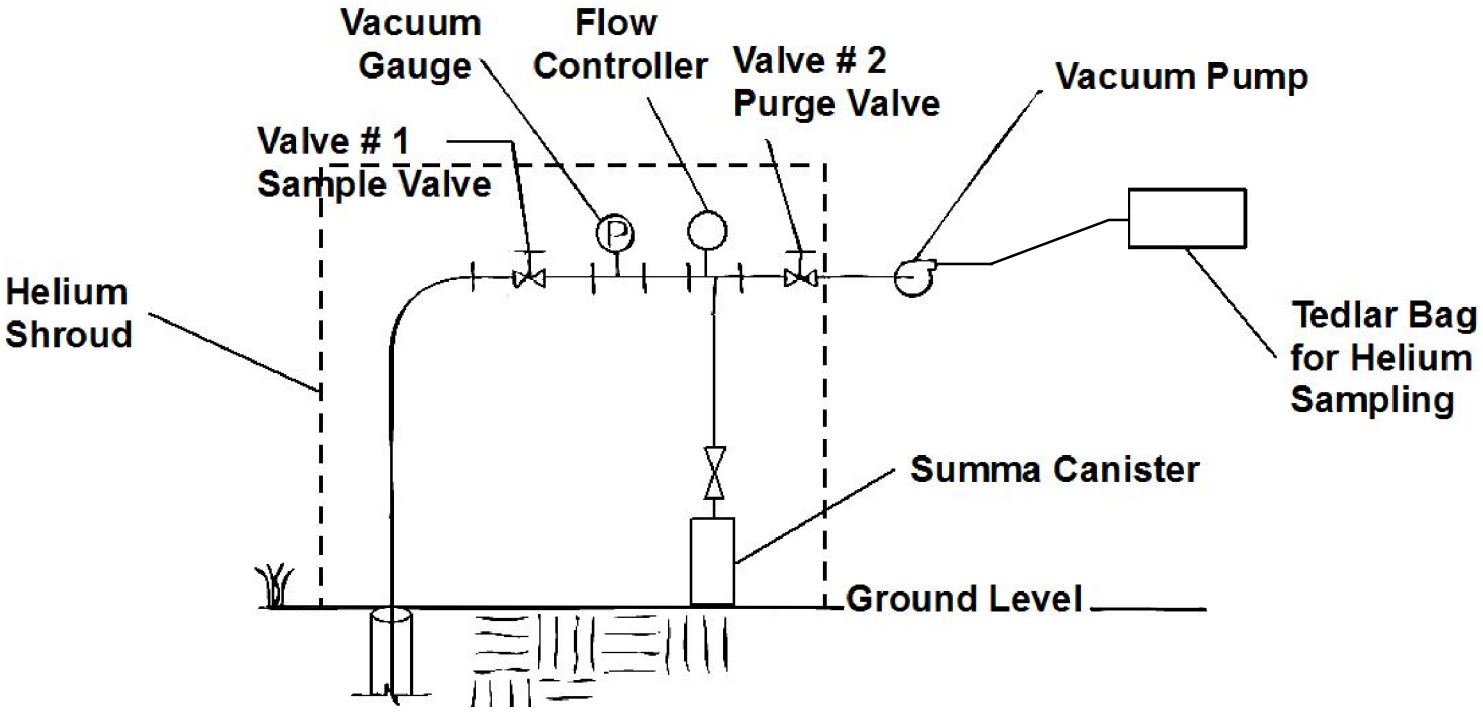

Figure
Sub-Slab Soil Gas Sampler System

Former Office Building
Port of Astoria
Astoria, Oregon

Source: CH2MHill, Corvallis Applied Sciences Laboratory

MAUL FOSTER ALONGI
p. 971 544 2139 | www.maulfoster.com

Standard Operating Procedure

Underground Utility Locates

SOP Number: 18
Date: 03/09/2021
Revision Number: 0.1

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

Field Sampling Data Sheets

MAUL FOSTER ALONGI

Sampler(s):

Passive Soil Vapor Field Sampling Data Sheet
Potter Property
Port of Tacoma

MAUL FOSTER ALONGI

Sample ID	Deployment Date	Deployment Time	Retrieval Date	Retrieval Time	Sampling Hole Depth (Inches)	Surfacing Type (Soil, Asphalt, Concrete, Gravel)	Seal in Tact?	Additional Notes
Example	4/6/2021	10:30	4/20/2021	10:30	24	Soil	Y/N	
Example	4/6/2021	10:35	4/20/2021	10:35	24	Soil	Y/N	

Notes

ID = identification.

Sampler(s):

Sub-slab and Soil Vapor Field Sampling Data Sheet
Potter Property
Port of Tacoma

MAUL FOSTER ALONGI

Sample ID	Date	Shut-in Test Pass/ Fail	Summa Canister ID	Manifold ID	Canister Type/Rate	Purge				Helium		Sample			
						Begin Time	End Time	Volume (L)	Helium (ppm)	Indoor Ambient Air (ppm)	Under Shroud (%) (ideal = 40)	Begin Time	End Time	Initial Vacuum ("Hg)	Final Vacuum ("Hg)
Example	4/6/2021	Pass	3671	225	1 L Summa	13:46	13:51	1	50	0	43.9	13:55	14:00	-30	-5
Example	4/6/2021	Pass	3347	204	1 L Summa	13:05	13:10	1	175	0	58	13:13	13:19	-29	-5

Notes

To avoid data rejection during validation, the amount of helium in the sample must be less than 5% of the helium concentration under the shroud. For example, if there is 50% helium in the shroud, your sample may contain up to 2.5%, (25,000 ppm) helium.

"Hg = inches of mercury.

ID = identification.

L = liter.

ppm = parts per million.

% = percent.

Attachment C

Passive Soil Vapor Sampling Procedures

MAUL FOSTER ALONGI

Passive Soil Vapor Sampling Procedures

Project No. M0615.20.013 | June 5, 2024 | Port of Tacoma

Introduction

Maul Foster & Alongi, Inc. (MFA) has prepared this passive soil vapor sampling procedures document as an attachment to the vapor intrusion work plan on behalf of the Port of Tacoma (the Port) to guide passive soil vapor sample collection during the additional data gaps assessment at the former Potter property, located at 1801 E Alexander Avenue in Tacoma, Washington (the Property). The Property 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).

Passive soil vapor sampling utilizes adsorbent samplers that are placed in the subsurface to adsorb volatile organic compounds (VOCs) in soil vapors over an extended time period, without forcing the flow rate of the vapors (i.e., using a pump or vacuum). Collection of passive soil vapor samples from the shallow subsurface provides data on the relative concentrations of targeted VOCs that may be present, which can be used to assess vapor intrusion risks. The passive soil vapor samplers are typically deployed for 7 to 14 days; during which the samplers adsorb chlorinated and BTEX compounds at individual verified uptake rates (Beacon 2024).

The analytical results of passive soil vapor samples are presented in units of mass (e.g., nanograms of individual compound) and can be converted to a concentration by dividing the mass by the sampler uptake rate (ml/min) and multiplying by 1,000 to convert nanograms to micrograms:

$$C = 1000 \cdot \frac{M}{U \cdot T}$$

Where:
C = concentration (micrograms/cubic meter)
M = mass (nanograms)
U = uptake rate (milliliter/minute)
T = sampling time (minutes)

The concentrations reported represent the concentration of the identified compounds under steady state conditions, which accounts for daily and even hourly fluctuations. Additionally, the adsorbent cartridges inside the passive samplers are hydrophobic, which allows the samplers to be effective in high moisture conditions without affecting the uptake rate. Results from a passive soil vapor study can be compared to soil vapor screening criteria to assess vapor intrusion risks (Beacon 2024).

Passive samplers will be used to verify the representativeness of soil vapor samples collected from the existing sub slab vapor pins and proposed permanent monitoring points at the Property. The following sections describe the field and analytical methods to be used for the passive soil vapor sampling survey.

Field Methods

MFA will collect a total of five (5) passive soil vapor samples at the Property. The samples will be collected using Beacon Passive Samplers supplied by Beacon Environmental BESURE Sample Collection Kit. Instructions and diagrams for the deployment and retrieval of the passive soil vapor

samplers are provided by Beacon Environmental as an attachment to this document; however, a summary of the steps is provided below.

Passive Soil Vapor Sampling Deployment

At each sample location, a 1.5-inch diameter hole will be advanced to 1-foot depth using a hammer drill and a drill bit. The hole will then be extended to a 2-foot depth using a 0.5-inch diameter drill bit to create a soil vapor pathway. The hole will be sleeved with a pre-cleaned 12-inch metal pipe by pushing or tapping the pipe until it is 0.5 inches below grade.

A Beacon Passive Sampler will be prepared for deployment, which includes switching the shipping cap with the sampling cap. The sampler will be lowered approximately 4 inches into the pipe using the retrieval wire. The end of the retrieval wire will remain above the surface while the pipe is covered and plugged with a balled-up wad of aluminum foil. The hole will then be covered to grade with local soils or sand and packed down, leaving the end of the wire exposed above the surface. If surfacing is asphalt or concrete, the hole will be covered with a 0.25-inch concrete patch using dry concrete mortar mix.

MFA will record field data during sample deployment. This will include the deployment date and times, temperature, relative humidity, barometric pressure, wind speed and direction, and observations of conditions that may influence sampling results (e.g., industrial activities and presence or use of chemicals in the vicinity). After deploying all samplers, a trip blank will be placed in an individual sampler bag and stored in the return shipment bag.

Passive Soil Vapor Sampling Retrieval

After 14 days of sampler deployment at each sample location, the soil will be cleared, and the aluminum foil will be removed using a small screwdriver. At concrete or asphalt locations, the concrete patch will be removed with a hammer and chisel. The sampler will be retrieved from the hole using the retrieval wire and the sides of the sampler will be cleaned with a towel.

After removing the sampling cap, the wire will be cut from the sampler and the vial threads will be cleaned with a cloth. A shipping cap will be placed back onto the sampler and labeled with a ballpoint pen. The sealed and labeled sampler will then be placed into the individual sample bag and stored inside the larger return shipment bag.

MFA will record field data during sample retrieval. This will include the retrieval date and times, temperature, relative humidity, barometric pressure, wind speed and direction, and observations of any changes in conditions that may influence sampling results. Duplicate soil vapor samples for Toxics Organics (TO)-17 and APH analyses will be conducted by analyzing the second adsorbent cartridges in one of the sampler vials at one of the sample locations.

Analytical Methods

Laboratory Test Methods and Reporting Limits

The passive soil vapor collection device will be the Beacon Passive Sampler and analyzed by Beacon Environmental, a laboratory accredited by the State of Washington and the National Environmental Laboratory Accreditation Program. They will perform the following analyses for the passive soil vapor samples:

- VOCs and APH by TO-17 Method

The limits of quantitation are summarized in Table 3 of Work Plan.

Laboratory Operations

In the laboratory, QC elements will include laboratory control samples (LCSs), surrogate spike results, and method blanks, as well as other QC samples and procedures as required by the individual methods (see Table 1 of Work Plan).

Sample Handling

Passive soil vapor samples will be collected in Beacon Passive Samplers which do not require special preservation or temperature storage. All passive soil vapor samples will be delivered to the lab via courier. Sample custody will be tracked from point of origin through analysis and disposal, using a chain-of-custody (COC) form, which will be filled out with standard sample and analytical information. Sample container and holding information is provided in Table 2 of Work Plan.

Instrumentation

Field Instrumentation

The use of field instruments is not anticipated for passive soil vapor sampling.

Laboratory Instrumentation

Laboratory instrument calibration procedures, frequency of calibration, and preparation of calibration standards will be according to the method requirements.

Laboratory Calibration and Preventive Maintenance

Preventive maintenance of laboratory equipment will be the responsibility of the laboratory personnel and analysts. This maintenance includes routine care and cleaning of instruments and inspection and monitoring of laboratory equipment used in analyses. The preventive-maintenance approach for specific equipment should follow the manufacturers' specifications, good laboratory practices, and industry standard techniques.

Precision and accuracy data will be examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance should be performed when an instrument begins to change, as indicated by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet any of the QC criteria.

Laboratory Quality Assurance/Quality Control Samples

The laboratory QC samples will be used to assess the accuracy and precision of the laboratory analysis. Each category of laboratory QA/QC will be performed by the laboratory as required by method-specific guidelines. The acceptance criteria presented in the guidelines will be adhered to, and samples that do not meet the criteria will be reanalyzed or qualified, as appropriate.

Calibration Verification

Instruments will initially be calibrated at the start of the project or sample run, as required, and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in the analytical method. Calibration will be continued as specified in the analytical method to track instrument performance. If a continuing calibration does not meet control limits, analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications.

Method Blanks

Method blanks are Beacon Passive Samplers prepared and processed by the laboratory in a similar manner to those used for field sample collection. Method blanks are used to document contamination resulting from the laboratory's analytical process. A method blank shall be prepared and analyzed for every analytical batch. The method blank results are used to verify that laboratory preparation does not impart unacceptable bias to the investigative sample results. The presence of analytes in the method blank sample will be evaluated against method-specific thresholds. If analytes are present in the method blank above the method-specific threshold, corrective action will be taken to eliminate the source of contamination before proceeding with analysis. Investigative samples of an analytical batch associated with method blank results outside acceptance limits will be qualified, as appropriate, by the data validation contractor.

Laboratory Control Samples

LCSs are prepared by spiking prepared Beacon Passive Samplers with the known quantities of the analytes of interest. The result for percent recovery of the LCS is a data quality indicator of the accuracy of the analytical method and laboratory performance.

Field QC

A trip blank will accompany the Beacon Passive Samplers during shipment, sample collection, and storage, and will be analyzed for the same compounds as the investigative samples. Trip blank results are used to verify that investigative sample results are not impacted by contamination from outside air during storage and transportation. Investigative samples associated with trip blank detected results will be qualified, as appropriate, by the data validation contractor.

A field duplicate will be collected to assess reproducibility of field procedures and sample homogeneity. Field duplicate precision will be evaluated during data validation by calculating the relative percent difference between paired sample results.

$$RPD = \frac{2(x_s - x_d)}{x_s + x_d} \times 100\%$$

Where:
RPD = relative percent difference
x_s = result for primary sample.
x_d = result for duplicate sample.

Data Reduction, Validation, and Reporting

The analytical laboratory will submit analytical data packages that include laboratory QA/QC results to permit independent and conclusive determination of data quality. MFA will determine the data quality, using the data evaluation procedures described in this section. The results of the MFA evaluation will be used to determine if the project data quality objectives have been met.

Field Data Reduction

Daily internal QC checks will be performed for field activities. Checks will consist of reviewing field notes and field activity memoranda to confirm that the specified measurements, calibrations, and procedures are being followed. The need for corrective action will be assessed on an ongoing basis, in consultation with the project manager.

Laboratory Evaluation

Initial data reduction, evaluation, and reporting at the analytical laboratory will be carried out consistent with the laboratory's internal QA manual. Additional laboratory data qualifiers may be defined and reported to further explain the laboratory's QC concerns about a particular sample result. These additional data qualifiers will be defined in the laboratory's case narrative reports.

Data Deliverables

Laboratory data deliverables are listed below. Electronic deliverables will contain the same data that are presented in the hard-copy report.

- Transmittal cover letter
- Case narrative
- Analytical results
- COC
- Surrogate recoveries
- Method blank results
- LCS results

MFA Evaluation

Data QA/QC Review

MFA will evaluate the laboratory data for precision, completeness, accuracy, and compliance with the analytical method. MFA will review data according to applicable sections of U.S. Environmental Protection Agency (EPA) organics and inorganics procedures (EPA 2017), as well as appropriate laboratory method-specific guidelines.

Data qualifiers, as defined by EPA, are used to classify sample data according to their conformance to QC requirements. Common qualifiers are listed below:

- J—Estimate, qualitatively correct but quantitatively suspect.
- R—Reject, data not suitable for any purpose.
- U—Not detected at a specified reporting limit.

Poor surrogate recovery, blank contamination, or calibration problems, among other things, can require qualification of the sample data. The reasons for qualification will be stated in the data evaluation report. QC criteria not defined in the guidelines for evaluating analytical data are adopted, where appropriate, from the analytical method. The results of the data evaluation review will be summarized for each data package. Data qualifiers will be assigned to sample results based on EPA guidelines, as applicable.

Data Management and Reduction

MFA uses a database (i.e., EQuIS™) to manage laboratory data. The laboratory will provide the analytical results in electronic, EQuIS-compatible format. Following data evaluation, data qualifiers will be entered into the database.

Data may be reduced to summarize particular data sets and to aid interpretation of results. Statistical analyses may also be applied to results. Data reduction QC checks will be performed on

hand-entered data, calculations, and data graphically displayed. Data may be further reduced and managed using one or more of the following computer software applications:

- Microsoft® Excel (spreadsheet)
- EQuIS (database)
- AutoCAD® and/or ArcGIS (graphics)
- EPA ProUCL (statistical software)

References

Beacon. 2024. *Passive Soil Gas Testing: Standard for Site Characterization, Technical Memorandum*. Beacon Environmental: Bel Air, Maryland. January 26.

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Attachment

Beacon Passive Sampling Instructions and Diagram

MAUL FOSTER ALONGI

Sampler Deployment

Need help? Call 1-410-838-8780
or email help@beacon-usa.com

PSG KIT INSTRUCTIONS

SOIL / VEGETATION

1 Use a hammer drill and drill bits to create the soil vapor pathway. Drill a 1 1/4 inch to 1 1/2 inch diameter hole to a depth of 12-14 inches. Using a 1/2-inch drill bit, drill a hole to a depth of 30-36 inches.

See diagram on pg. 4

2 Place the sampling kit and these materials within easy access:

- 12-inch length of pipe
- Pipe cutter / Hack saw
- Tapping dowel
- Hammer
- Sampling cap
- Aluminum foil
- Beacon Sampler

3 Lower the pipe into the hole and push or tap the pipe 1/2 inch below grade using the tapping dowel and a hammer. If necessary, first cut the pipe so that it is flush or just below grade before tapping the pipe into the hole.

4 Remove a Beacon Sampler and unwind the retrieval wire wrapped around it, leaving a small coil of wire at the end. Extend the wire so that the Sampler will easily go into the pipe.

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Sampler Deployment

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PSG KIT INSTRUCTIONS

SOIL / VEGETATION

5 Replace the solid white shipping cap with a Sampling Cap (black cap with screened hole). Place the solid cap in the Cap Storage container.

IMPORTANT: Make sure the black sampling cap is on the vial before installing the sampler.

6 Lower the Sampler, open-end down, into the metal pipe approximately four inches so that the retrieval wire sticks out of the hole.

7 Make sure the end of the retrieval wire remains above the surface.

IF ASPHALT / CONCRETE
Hook the end of the wire (with small coil) and hang it over the top and outside of the pipe.

8 Cover and plug the open end of the pipe with a balled-up wad of aluminum foil, pressing it tightly on top of the pipe with the tapping dowel so it forms a flattened seal on the pipe approximately 1/4 inch below grade.

ASPHALT / CONCRETE

Sampler Deployment

SOIL / VEGETATION

9 Cover the hole to grade with local soils or sand, leaving the end of the wire exposed above the surface of the ground. Use a hammer to collapse/pack the soil above the sampler. Coil the wire and lay it flat on the ground surface.

IF ASPHALT / CONCRETE
Cover the hole to grade with a 1/4 inch thick concrete patch. (If it is thicker it will be difficult to remove during retrieval.)

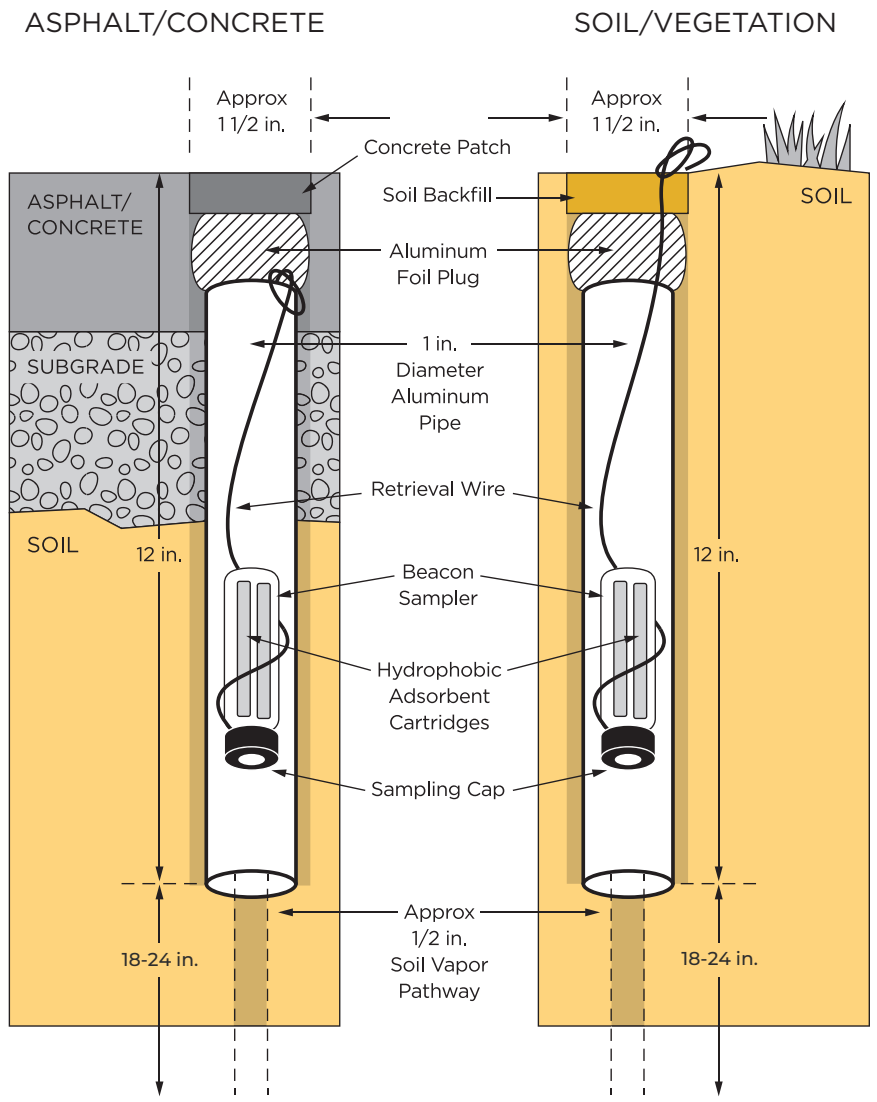
IMPORTANT: Only use Dry Concrete Mortar Mix. Do Not use Premixed Patching Compounds. They contain solvents.

ASPHALT / CONCRETE

10 Close the Field Kit and record the following info on the Chain-of-Custody: location ID, date/time of deployment (to the nearest minute) and other relevant information.

Repeat steps 1-10 until all samplers have been installed.

After deploying all samplers, place each Trip Blank in an Individual Sampler Bag. Store the Trip Blank(s) in the Return Shipment Bag(s) until retrieval. Make sure there is 1 Trip Blank in each Return Shipment Bag.



Sampler Retrieval

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PSG KIT INSTRUCTIONS

SOIL / VEGETATION

1 Place the sampling kit and these materials within easy access:

- Small screwdriver
- Wire cutters
- White solid Shipping Cap
- Towel
- Gauze cloth
- Individual Sampler Bag
- Return Shipment Bag

IF ASPHALT / CONCRETE

- Hammer & chisel

2 Clear the soil and gently remove the aluminum foil plug using a small screwdriver, if necessary. Retrieve the Sampler from the hole by gently pulling the wire.

IF ASPHALT / CONCRETE
Remove the concrete plug with the hammer and chisel. Carefully remove the aluminum foil plug using the screwdriver. Retrieve the Sampler from the hole by gently pulling the wire.

3 Clean the sides of the Sampler with the towel and remove the black Sampling Cap. Do not return the used Sampling Caps.

Transport vials (green labels) are only used if a Sampler is broken during retrieval. If this occurs, transfer all contents from the broken Sampler to the transport vial.

4 Cut ALL wire from the Sampler using wire cutters, and clean the vial threads completely with the gauze cloth.

ASPHALT / CONCRETE

Sampler Retrieval

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SOIL / VEGETATION

5 Firmly screw the solid cap onto the vial. Use a ballpoint pen to write the sample ID on the cap's label.

IMPORTANT: Do not use a Sharpie to mark the caps. It can contaminate the samples.

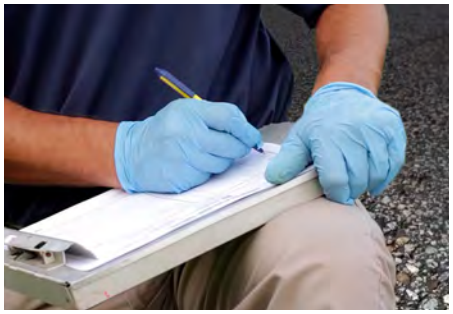
6 Place the sealed and labeled Beacon Sampler into the individual Sampler Bag. Write the sample ID on the white block on the bag using a ballpoint pen. Place the individually bagged and labeled sampler into the larger bag labeled "Return Shipment Bag."

7 Close the Field Kit and on the Chain-of-Custody, record the ID, date/time of retrieval (to the nearest minute) and other relevant information.

Move to next location. Repeat steps 1-7, until all Samplers are retrieved. Patch or back-fill holes as necessary.

8 To prepare for return shipment, verify that all Samplers are stored in the Return Shipment Bag, containing an adsorbent pak and a Trip Blank.

ASPHALT / CONCRETE



Sampler Retrieval

SOIL / VEGETATION

9 Seal the Return Shipment Bag and place it in the upper tray of the Field Kit and place the provided tools and materials below the tray, in the lower compartment (blocks, extra samplers, tools, etc.)

IMPORTANT: Do not return used sampling caps, used pipe, or wire with the field kit. They may bias the samplers.

10 Close the Field Kit, and secure it with the provided Custody Seal. Sign and date the Chain-of-Custody. Take a picture, scan or make a photocopy for your records.

11 Package the Field Kit into the original shipment box. Place the Chain of Custody on top of the kit. Seal the box, affix a FedEx Airbill and send to the address noted below:

Beacon Environmental
Attn: Sample Receiving
526 Underwood Lane
Bel Air, Maryland 21014, USA
1-410-838-8780

IMPORTANT: Do not use styrene peanuts, newspaper or other packing materials. They may contaminate the samples.

For questions or assistance
Call 1-410-838-8780 or
email help@beacon-usa.com

ASPHALT / CONCRETE

FAQs

Does Beacon receive samples on Weekends? No. If possible, store the samples in a clean environment until Monday and then ship.

How large of a diameter hole should I make? The preferred diameter is 3-4 cm. If you must make a hole larger than 4 cm, please contact Beacon.

Can I install samplers in the rain? Beacon's sorbent is hydrophobic. The only issues with precipitation are:

1. If the vadose zone is saturated and vapors are not able to migrate.
2. If there is so much rain during install that the holes are being filled with water.

   In these situations, please contact Beacon to discuss.

Can I install samplers in gravel? Yes, make sure that you clear away enough surface gravel until you reach soil that will stay open as you create your hole. If this is not possible, please contact Beacon to discuss options.

Tips

- Remember to remove all the wire during retrieval. There should be no wire on the Beacon Sampler.
- Return all extra Samplers, tools, wood blocks, and unused pipe to avoid replacement fees.
- Note any duplicates on the CoC.