



**COVERSHEET  
STANDARD OPERATING PROCEDURE**

**Operation Title:** PROTOCOL FOR COLLECTING SOIL GAS SAMPLES

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## **1.0 APPLICABILITY**

This Standard Operating Procedure (SOP) applies to all programs in the Maine Department of Environmental Protection's (MEDEP) Division of Remediation (DR). It is also applicable to all parties that may submit data that will be used by the DEP/DR.

This SOP is not a rule and is not intended to have the force of law, nor does it create or affect any legal rights of any individual, all of which are determined by applicable statutes and law. This SOP does not supersede statutes or rules.

## **2.0 PURPOSE**

The purpose of this document is to describe the MEDEP/DR procedure for collecting soil gas samples.

## **3.0 RESPONSIBILITIES**

All MEDEP/DR Staff must follow this procedure when performing this task. All Managers and Supervisors are responsible for ensuring that their staff are familiar with and adhere to this procedure. MEDEP/DR staff reviewing data by outside parties are responsible for assuring that the procedure (or an equivalent) was utilized appropriately.

## **4.0 GUIDANCE AND PROCEDURES**

### **4.1 SAMPLING PLAN**

A well developed Conceptual Site Model (CSM) is imperative for effective soil gas sampling. Prior to conducting any sampling event, a sampling plan should be developed (see SOP# RWM-DR-014 - Development of a Sampling and Analysis Plan). Included in the sampling plan should be specifics regarding the anticipated contaminants of concern, data quality objectives, the laboratory conducting analysis, sample containers and tubing for collection, and Quality Assurance/Quality Control (QA/QC).

When evaluating vapor transport it is important to identify preferential vapor pathways that are created by relatively permeable non-native fill associated with site development. Utility trenches are of particular importance because they can facilitate transport of both vapor and groundwater. At a minimum a CSM should identify potential site sources (e.g. current and former USTs, petroleum dispensers, dry cleaning machines, and ventilation hoods), preferential pathways (and interrelationships), surface water drainage patterns (both natural and man made or influenced), and closest receptors in all directions from the site.

In certain situations sewer utilities may be secondary vapor sources as a result of chemical handling and disposal and the age of the sewer. Vapor samples from the utility corridor will provide information on the strength of the secondary source.



## **4.2 SCHEDULING**

It should be noted that sampling during times when soil pores are water filled (spring thaw, extended rain events, or heavy short duration rain events greater than 0.25 inches over an 8 hour period) may negatively affect collection of soil gas samples. For this reason rain dates should be planned in the proposed field work schedule. The exception may be when the site is located in an area with little exposed soils and adequate storm water drainage that restrict soil pores from becoming water filled.

## **4.3 EQUIPMENT**

### **4.3.1 EQUIPMENT LIST**

The Equipment used for the collection of soil gas samples when following with this this SOP may include:

- Direct push probing equipment and soil gas collection system (Geoprobe™)
- Hand Tool equipment (cordless hand hammer rotary drill, slam bar, push point samplers)
- Vacuum pump, such as peristaltic;
- Bentonite clay or modeling clay;
- Cold patch (for pavement penetrations)
- Differential Pressure Gage (optional);
- Polyethylene tubing (see Section 5.2.3)
- Photo-ionization Detector (ppb level);
- Multi-gas meter for oxygen and carbon dioxide;
- Soil gas sampling field sheet (updated as of Effective Date or newer);
- Camera;
- Teflon lined tubing (see Section 5.2.3);
- Containers and flow controllers (Summa Canister or Tedlar Bags, see Section 5.2.1)

### **4.3.2 Specific Container and Tubing Considerations for Soil Gas Sampling**

Due to the nature of soil gas sampling, additional planning must be undertaken in order to assure the appropriate sample collection/analysis methods and appropriate containers for a sampling event. Two types of sample containers are described in this SOP, Summa Canisters and Tedlar Bags. When deciding which container to use, staff should consider the data quality objectives (DQOs) for the sample and the availability of a laboratory capable of analyzing the sample that is both State certified and capable of reaching required detection limits. Additional container types will be considered on a case-by-case basis.

#### **4.3.2.1 Summa Canisters**

A Summa canister is a clean metal container sealed with a vacuum; this vacuum is then used to draw in the gas sample. Summa canisters must be ordered from a laboratory in advance of the sampling event and are available from a limited number of labs. Samples from Summa



canisters are analyzed by certified labs only, and by methods which have been approved by EPA and have detection limits that generally meet the ambient air guidelines. On a case-by-case basis non-certified laboratories with appropriate quality control procedures may be used for screening soil gas samples for the presence or absence of VOCs.

Summa canister samples can collect two types of samples; grab, and time elapsed. Grab samples are collected utilizing the vacuum of the canister for a sample with a collection time of less than 30 minutes. Time elapsed are samples collected utilizing the vacuum of the canister over an extended period of time, up to and beyond 24 hours. Both sample types require a regulator between the tubing and canister to control the length of time the sample is collected. The regulator will be provided and calibrated by the laboratory conducting the analysis of the sample. The type and duration of sample should be indicated as part of the SAP.

The laboratory certifies the summa canister has been appropriately cleaned prior to shipment. Laboratory certification can be done on individual canisters or from one representative can in a batch. **For soil gas sample collection personnel may use either individually certified clean canisters or batch certified clean canisters depending on the DQOs for the project.**

Clean Summa canisters must be obtained from the laboratory providing the analysis for each sampling event. Unused canisters will be sent back to the laboratory. The laboratory will need to be informed as to the sample collection method used and the duration of collection time prior to shipping the Summa canisters and regulators for the sampling event.

#### 4.3.2.2 Tedlar Bag

A tedlar bag is a bag manufactured from Tedlar (Polyvinyl fluoride) with a two way valve. Tedlar bag samples require less time for planning because they can be ordered in advance and kept on hand until they are needed. However, the bags must be stored in a clean location. Laboratories capable of analyzing these samples are even more limited than the Summa Canisters. Holding time for tedlar bag samples is 48 hours. However, tedlar bags can be analyzed in the field with a mobile laboratory (that is capable of providing the analysis), providing real time data. Due to detection limits for this analytical method (generally 10 times the indoor air standard for most compounds), tedlar bag collection is most often used for screening purposes. There is not an USEPA approved method; samplers using tedlar bag collection must communicate with the laboratory conducting the analysis, prior to sampling, to be sure (DQOs) will be met. Due to the potential for cross-contamination each group of tedlar bags that are stored together for more than 1-hour should be accompanied with a zero-VOC field blank and at least one field duplicate. The field blank and duplicate should be analyzed after all the other environmental samples in the group.

#### 4.3.2.3 Tubing Selection

Certain volatile chemicals (especially those found in petroleum products) may interact with certain types of tubing used for collecting samples. Tubing used for vapor sampling is usually a flexible, polyethylene based tubing. These interactions will affect the quality of sample results, and may require a contaminant specific tubing, such as a Teflon lined tubing (e.g. when sampling for petroleum vapors). Therefore, contaminants of concern for the site should be



determined before collecting samples (refer to the Site's CSM). If tubing interaction is a concern, the laboratory and /or the DEP Chemist in the DEP's Division of Technical Services should be consulted prior to sample collection to assure appropriate tubing is used. The type of tubing used should be noted in the field notes of the samplers.

#### **4.3.2.4 Sample Collection Duration/Rate**

The sample collection duration and rate will depend on the DQO for the project. Subslab soil gas sample rates should not exceed 200 mL/min. In general, the collection of subslab samples usually takes less than 30-minutes.

### **4.4 SAMPLE COLLECTION**

Soil gas samples should be collected as follows:

- 1) Drill a hole in soil and set soil gas sampler using one of the following methods:
  - a. Using direct push equipment (e.g. Geoprobe™) and steel rods with post run tubing (PRT);
  - b. Using hand held tools, such as a hammer drill, slam bar, and/or tile probe, then inserting push point sampler (PPS) to desired depth;
  - c. Using direct push or other hand held tools to install soil gas implant device and attached tubing;
- 2) Apply surface seal around sampling device using bentonite or modling clay
- 3) Connect appropriate sample tubing to sample device
- 4) Purge sample tubing and device with peristaltic pump for approximately 1-minute per foot
- 5) Record sample data on updated Soil Gas Sample Field Sheet, including: ambient O<sub>2</sub>, CO<sub>2</sub>, PID (optional): pre-sample PID, O<sub>2</sub>, and CO<sub>2</sub>
- 6) Connect Sample Device. Record initial vacuum, start time, canister ID, and controller ID as appropriate.
- 7) Sketch accurate sample location using available landmarks and site features so others not present can find the sample location with ease.
- 8) When appropriate, stop sample collection with -1 to -4 in.H<sub>2</sub>O pressure in canister and record final vacuum and sample end time.
- 9) Record post-sample O<sub>2</sub>, CO<sub>2</sub>, PID (optional)
- 10) Remove Sampler or secure permanent sampler and backfill as appropriate using sand, bentonite, and cold patch where pavement penetration is completed.

### **4.5 QUALITY CONTROL**

Due to cross contamination and carry-over issues inherent with air collection and analysis, more rigorous quality control sampling may be required than the sampling of other media. Data quality objectives should be stated in the sampling plan. Quality Assurance/Quality Control (QA/QC) samples may be collected if needed to meet your data quality objectives. The following typical types of QA/QC samples should be collected as part of the QA/QC program for



soil gas sample collection. For an additional discussion of QA/QC, please refer to the MEDEP/DR Quality Assurance Plan.

#### **4.5.1 EQUIPMENT BLANKS**

When tedlar bags are used equipment blanks should be collected at a rate of 5%, which is equivalent to one equipment blank every twenty samples collected. The equipment blank will consist of purging a complete drive rod and closed point system with zero air and collecting the air for analysis in a Tedlar bag.

#### **4.5.2 DUPLICATE SAMPLES**

It is recommended that duplicate samples be collected at a rate of 10% to assess sample location variability.

#### **4.5.3 BACKGROUND/AMBIENT AIR SAMPLES**

Depending on data quality objectives, one to two ambient air samples per day should be collected at the sampling locations to assess ambient air conditions.

#### **4.5.4 TRIP BLANK**

A trip blank should be collected when utilizing tedlar bags as sample containers. The trip blank will consist of a tedlar bag filled from a canister of zero air.

#### **4.5.5 TRACER GAS DISPERSION**

This SOP relies on the use of carbon dioxide and to a lesser degree oxygen as tracer gases for surface leakage. Under normal situations, ambient air concentrations of carbon dioxide are an order of magnitude less (~500 ppm) than soil gas carbon dioxide concentrations (5,000+ ppm). The contrast between ambient air concentrations and soil gas concentrations in addition to pre-sample and post-sample soil gas concentrations provides sufficient information on leakage from the surface into the soil gas. Under certain situations a helium shroud may be used in lieu of carbon dioxide to determine the level of leakage.

#### **4.6 SYSTEM DECONTAMINATION**

In an effort to provide the most representative soil vapor samples possible, all tooling and materials in contact with the site soils will be cleaned with a detergent wash and potable water rinse prior to re-use, as outlined in MEDEP/DR SOP# RWM-DR-017 –Equipment Decontamination Protocol. Additional cleaning of the tooling with steam cleaning may be warranted depending on the site contamination.



New, flexible tubing (i.e. dedicated) will be used at each different sample location, regardless as to the type of tubing used.

## **5.0 DOCUMENTATION/CHAIN OF CUSTODY**

All sampling activities must be documented as outlined in MEDEP/DR SOP# RWM-DR-013 - Documentation of Field Activities and Development of a Trip Report. The Soil Gas Sampling Field Sheet (updated as of the effective date of this SOP) should be used each time a soil gas sample is collected. Sample custody must be followed as outlined in MEDEP/DR SOP# RWM-DR-012 – Chain of Custody Protocol. Samplers should contact the selected laboratory to determine the most appropriate method for avoiding carry-over of highly contaminated samples during the laboratory analyses. Due to the nature of soil gas sampling, attention should be made to the following:

- 1) Weather conditions particularly precipitation within past 3 days;
- 2) Depth of sample collection;
- 3) Possible sources of off site contamination (gas stations, dry cleaners, automotive body shops, etc.) in the vicinity of the investigation field work;
- 4) Possible sources of cross contamination (fueling vehicles/equipment, etc)
- 5) Length of time of sample collection.

## **6.0 REFERENCES**

1. Geoprobe Soil Vapor Sampling, Standard Operating Procedure, Technical Bulletin No. 93-660, 9/21/93.
2. USEPA, Environmental Response Team, Soil Gas Sampling, SOP #2042, 6/1/96.
3. Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling and Monitoring. Technical Bulletin NO. MK3098. Prepared May, 2006.