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New York State Electric & Gas Corporation

Soil Vapor Intrusion Evaluation Work Plan

Goshen Former Manufactured Gas Plant Site

January 2008

ARCADIS

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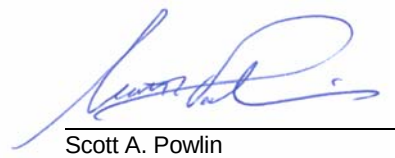

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Soil Vapor Intrusion Evaluation Work Plan

Goshen Former Manufactured Gas Plant Site

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Introduction

This document describes the work that will be performed to evaluate potential soil vapor intrusion (SVI) into New York State Electric & Gas Corporation's (NYSEG's) service-center building located on West Main Street in Goshen, New York. This building was built over a portion of a former manufactured gas plant (MGP). A sketch of the building layout is shown on the attached figure. The SVI evaluation will entail sampling air inside the building, soil vapor beneath the building floor, and ambient air outside the building. The scope of work described herein is based on discussions held during a recent site meeting between NYSEG, the New York State Department of Environmental Conservation (NYSDEC), the New York State Department of Health (NYSDOH), and ARCADIS.

Proposed Sampling Program

Representatives from NYSEG, the NYSDEC, the NYSDOH, and ARCADIS performed a building walk-over on October 31, 2007 to identify sampling locations. The following samples will be collected based on that building walk-over:

- Co-located sub-slab and indoor-air samples will be collected from three locations on the ground floor of the building (locations SS-1/IA-1, SS-2/IA-2, and SS-3/IA-3).
- Two indoor air samples will be collected on the 2nd floor of the building (IA-4 and IA-5) in the partitioned offices.
- An ambient air sample will be collected outside of the building (location AA-1).

Proposed sub-slab and indoor air sampling locations are shown on the attached figure. The ambient air sample will be collected upwind of the building and the location will be determined by field personnel the day of sampling based on the wind direction.

Sampling Methodology

The sampling is proposed to be conducted in January or February 2008. NYSEG will ensure that the building's heating system is operating at least 24 hours prior to and during sampling. On the day of sampling, ARCADIS personnel will walk through the building to complete the NYSDOH Indoor Air Quality Questionnaire and Building Inventory form (Appendix B of the NYSDOH Guidance for Evaluating SVI), which is included as Attachment A to this letter. Samples will be collected in accordance with

ARCADIS's standard operating procedures (SOPs), which are in general accordance with the NYSDOH "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" (NYSDOH, October 2006). The SOPs for sub-slab, indoor air and ambient air sample collection are included as Attachments B, C and D, respectively. Helium will be used as a tracer gas during sub-slab sample collection in accordance with ARCADIS SOP, which is included as Attachment E.

As detailed in the SOPs, each sample will be collected using a 6-liter SUMMA® canister with an attached, pre-set flow regulator. The laboratory will provide batch-certified-clean canisters with and initial vacuum of approximately 29 inches of mercury (in. of Hg) for sample collection. Flow regulators will be pre-set by the laboratory to provide uniform sample collection over an approximate 24-hour sampling period. The valve on the SUMMA® canisters will be closed when approximately 2 in. of Hg vacuum remains in the canister, leaving a vacuum in the canister as a means for the laboratory to verify that the canister does not leak while in transit.

Samples will be submitted for laboratory analysis in accordance with the United States Environmental Protection Agency (USEPA) Compendium Method TO-15, titled "Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)". In addition to the TO-15 Target Analyte List, the samples will be submitted for analysis for the following constituents:

N-Alkanes:

- n-Butane
- n-Decane
- n-Dodecane
- n-Heptane
- n-Hexane
- Nonane
- N-Octane
- Pentane
- N-Undecane

Tentatively Identified Compounds:

- Butylcyclohexane
- 2,3-Dimethylheptane
- 2,3-Dimethylpentane
- Isopentane
- 2,2,4-Trimethylpentane
- Indane
- Indene
- Tetramethylbenzene isomers
- Thiopenes
- 1,2,3-Trimethylbenzene
- 1-Methylnaphthalene
- 2-Methylnaphthalene

The proposed analyte list and reporting limits are presented in Table 1. The sample analyses will be performed by TestAmerica, Inc. (TA) located in Knoxville, Tennessee. The proposed TA laboratory is certified in the State of New York to perform air analyses. The data report will be an Analytical Services Protocol Category B-equivalent package to allow completion of a Data Usability Summary Report (DUSR), if necessary.

Schedule and Reporting

NYSEG is prepared to implement this work plan within a few weeks following NYSDEC and NYSDOH approval. Inventory and sampling activities are expected to require two days to complete. Sampling analytical results are expected to be available approximately four weeks after the samples are submitted to the laboratory.

Following receipt of the laboratory analytical results, ARCADIS will prepare a summary letter report. The letter report will include:

- A summary of work performed and analytical results obtained for the sub-slab vapor, indoor air, and ambient air samples.
- A completed Indoor Air Quality Questionnaire and Building Inventory form (Appendix B of the NYSDOH Guidance for Evaluating SVI).
- Data table(s) presenting laboratory analytical results in $\mu g/m^3$.
- Figure showing the sampling locations.
- Copy of the DUSR.

The summary letter report will be submitted to the NYSDEC and NYSDOH approximately one month after receipt of analytical results.

Table

Table 1. Proposed Analyte List and Reporting Limits, Soil Vapor Intrusion Evaluation
New York State Electric & Gas Corporation, Goshen Former MGP Site

I. Target Analytes

Compound	RL ppb (v/v)	RL (ug/m3)	Compound	RL ppb (v/v)	RL (ug/m3)
Benzene	0.2	0.63	1,1,2,2-Tetrachloroethane	0.2	1.37
Bromomethane	0.2	0.77	Tetrachloroethene	0.2	1.35
Carbon tetrachloride	0.2	1.25	Toluene	0.2	0.75
Chlorobenzene	0.2	0.92	1,2,4-Trichlorobenzene	1	7.42
Chloroethane	0.2	0.52	1,1,1-Trichloroethane	0.2	1.09
Chloroform	0.2	0.97	1,1,2-Trichloroethane	0.2	1.09
Chloromethane	0.5	1.03	Trichloroethene	0.2	1.07
1,2-Dibromoethane (EDB)	0.2	1.53	Trichlorofluoromethane	0.2	1.12
1,2-Dichlorobenzene	0.2	1.2	1,1,2-Trichloro-1,2,2-trifluoroethane	0.2	1.53
1,3-Dichlorobenzene	0.2	1.2	1,2,4-Trimethylbenzene	0.2	0.98
1,4-Dichlorobenzene	0.2	1.2	1,3,5-Trimethylbenzene	0.2	0.98
Dichlorodifluoromethane	0.2	0.98	Vinyl chloride	0.2	0.51
1,1-Dichloroethane	0.2	0.8	m-Xylene & p-Xylene	0.2	0.86
1,2-Dichloroethane	0.2	0.8	o-Xylene	0.2	0.86
1,1-Dichloroethene	0.2	0.79			
cis-1,2-Dichloroethene	0.2	0.79	**Alkanes:**		
1,2-Dichloropropane	0.2	0.92			
cis-1,3-Dichloropropene	0.2	0.9	n-Butane	0.4	0.95
trans-1,3-Dichloropropene	0.2	0.9	n-Decane	1	5.81
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.2	1.39	n-Dodecane	1	6.96
Ethylbenzene	0.2	0.86	n-Heptane	0.5	2.04
Hexachlorobutadiene	1	10.66	n-Hexane	0.5	1.76
Isopropylbenzene	0.4	1.96	Nonane	0.5	2.62
Methylene chloride	0.5	1.73	n-Octane	0.4	1.86
Methyl tert-butyl ether	1	3.6	Pentane	1	2.95
Naphthalene	0.5	2.62	n-Undecane	1	6.39
Styrene	0.2	0.85			

II. Tentatively Identified Compounds (TICs)

Branched Alkanes:

Butylcyclohexane
2,3 Dimethylheptane
2,3 Dimethylpentane
Isopentane
2,2,4 Trimethylpentane

Other:

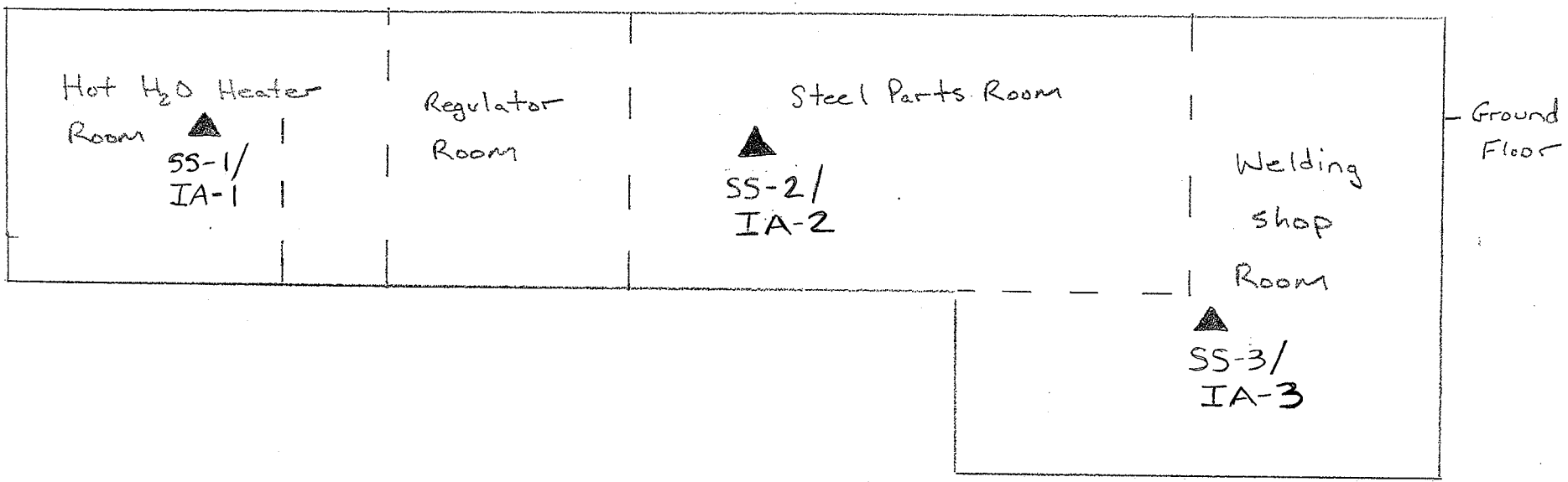
Indane
Indene
Tetramethylbenzene isomers
Thiopenes
1,2,3-trimethylbenzene
1-Methylnaphthalene
2-Methylnaphthalene

Notes:
1. Analyses to be performed by TestAmerica, Inc. (TA) of Knoxville, TN using United States Environmental Protection Agency (USEPA) Method TO-15 for volatile organic compounds (VOCs) and ASTM Method D1946 for helium.
2. RL = proposed reporting limit.
3. ppb (v/v) = parts per billion volumetric basis.
4. ug/m3 = micrograms per cubic meter.

Figure

Former Goshen MGP - Site Sketch
Vapor Intrusion Investigation (Figure 1)

LN



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Attachment A

NYSDOH Indoor Air Quality Questionnaire

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name _____ Date/Time Prepared _____

Preparer's Affiliation _____ Phone No._____

Purpose of Investigation_____

1. OCCUPANT:

Interviewed: Y / N

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants _____

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: _____First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) _____

Does it include residences (i.e., multi-use)? Y / N If yes, how many? _____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

_____

_____

_____

Airflow near source

_____

_____

_____

Outdoor air infiltration

_____

_____

_____

Infiltration into air ducts

_____

_____

_____

5. **BASEMENT AND CONSTRUCTION CHARACTERISTICS** (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other _____
c. Basement floor:	concrete	dirt	stone	other _____
d. Basement floor:	uncovered	covered	covered with _____	
e. Concrete floor:	unsealed	sealed	sealed with _____	
f. Foundation walls:	poured	block	stone	other _____
g. Foundation walls:	unsealed	sealed	sealed with _____	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: _____(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

_____

_____

6. **HEATING, VENTING and AIR CONDITIONING** (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Boiler/furnace located in: Basement Outdoors Main Floor Other_____

Air conditioning: Central Air Window units Open Windows None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	_____
1st Floor	_____
2nd Floor	_____
3rd Floor	_____
4th Floor	_____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / NA Please specify_____

d. Has the building ever had a fire? Y / N When?_____

e. Is a kerosene or unvented gas space heater present? Y / N Where?_____

f. Is there a workshop or hobby/craft area? Y / N Where & Type? _____

g. Is there smoking in the building? Y / N How frequently? _____

h. Have cleaning products been used recently? Y / N When & Type? _____

i. Have cosmetic products been used recently? Y / N When & Type? _____

j. Has painting/staining been done in the last 6 months? Y / N Where & When? _____

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _____

l. Have air fresheners been used recently? Y / N When & Type? _____

m. Is there a kitchen exhaust fan? Y / N If yes, where vented? _____

n. Is there a bathroom exhaust fan? Y / N If yes, where vented? _____

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type? _____

Are there odors in the building? Y / N
If yes, please describe: _____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No
Yes, use dry-cleaning infrequently (monthly or less) Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: _____
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _____
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

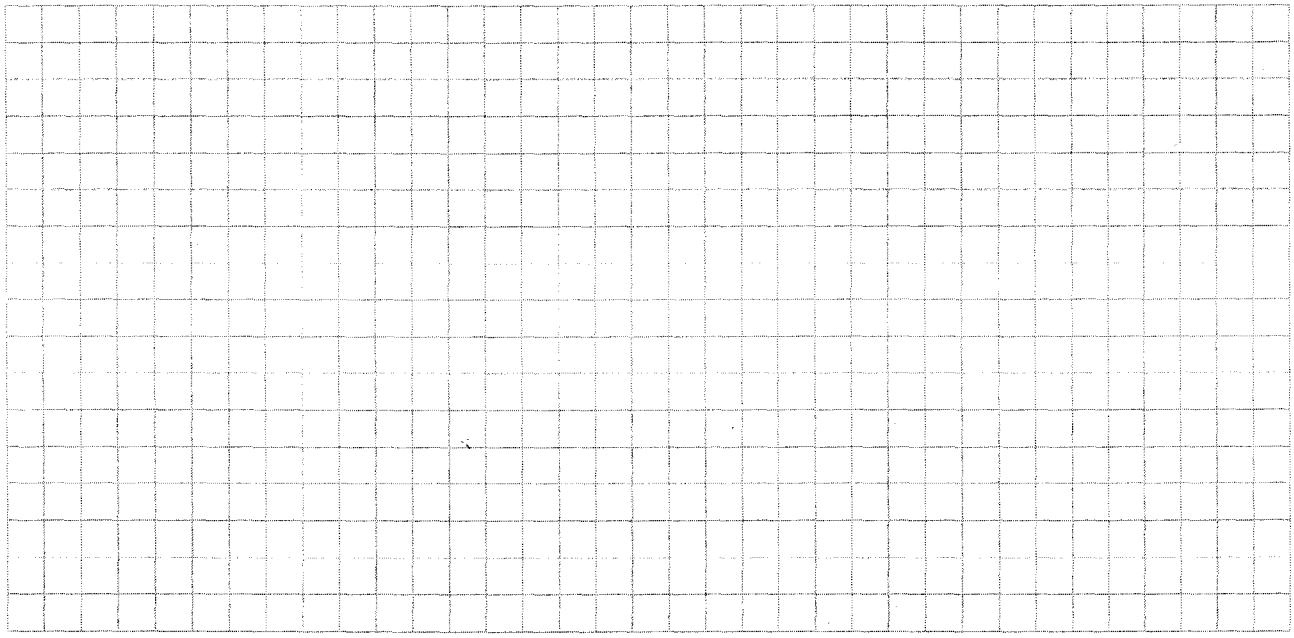
c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

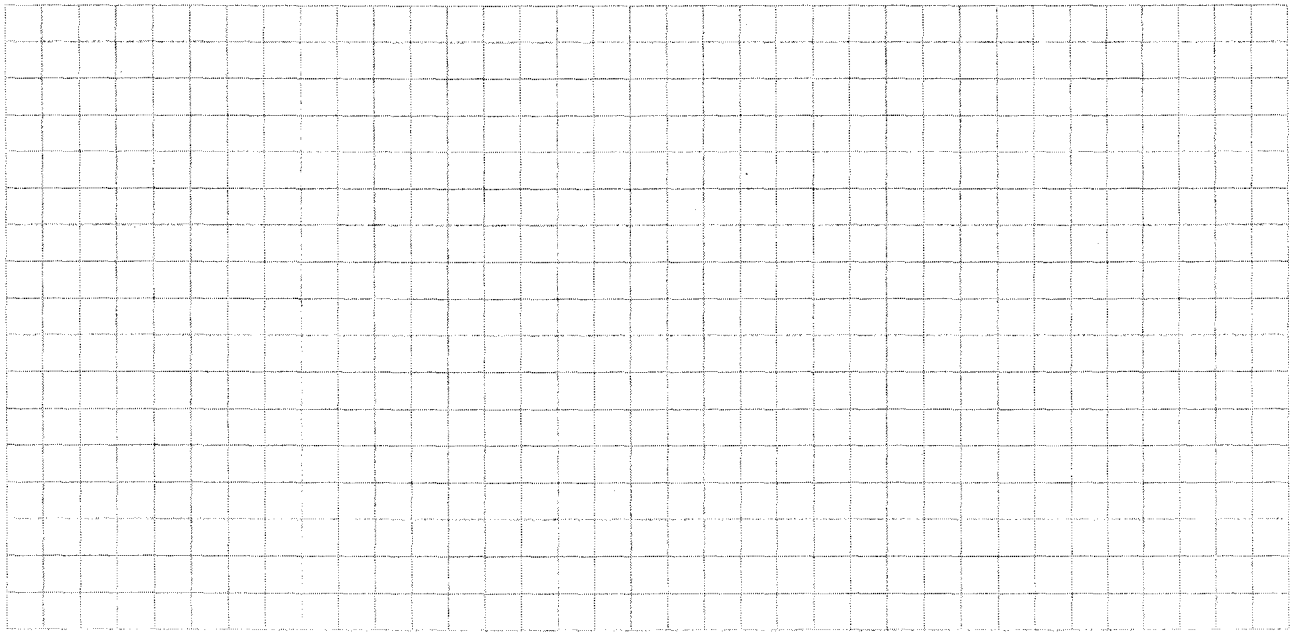
11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:



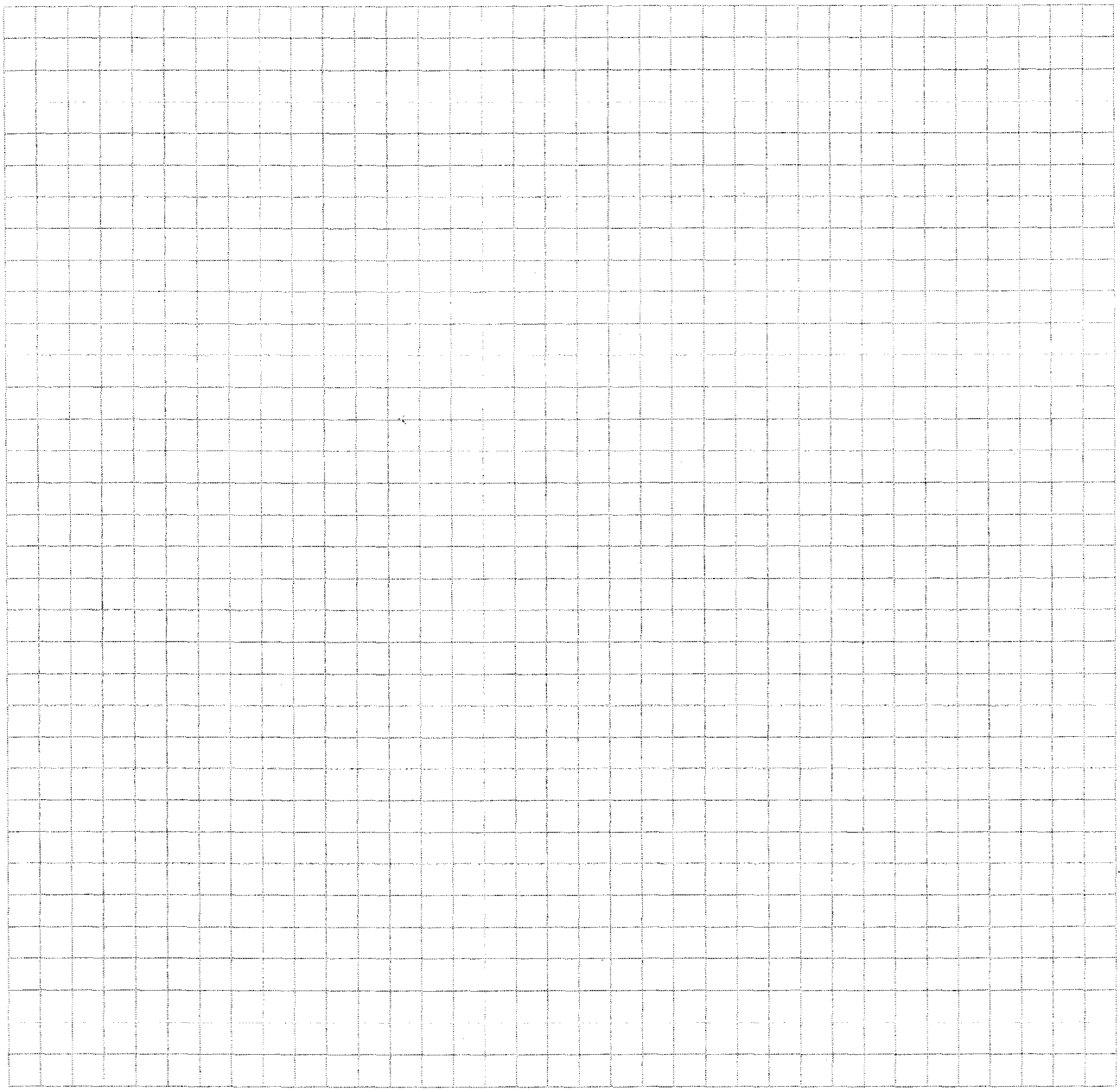
First Floor:



12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.



13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: _____

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y / N

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

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Attachment B

Standard Operating Procedure:
Sub-Slab Soil Vapor Sampling
and Analysis

Standard Operating Procedure: Sub-Slab Vapor Sampling and Analysis Using USEPA Method TO-15

I. Scope and Application

This document describes the procedures to install a sub-slab sampling port and collect sub-slab vapor samples for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA canister (less than 28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and detailed instructions for installing sub-slab vapor probes and collecting samples for VOC analysis.

II. Personnel Qualifications

ARCADIS BBL field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS BBL field sampling personnel will be well versed in the relevant standard operating procedures (SOPs) and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS BBL personnel responsible for leading sub-slab vapor sample collection activities must have previous sub-slab vapor sampling experience.

III. Equipment List

The equipment required to install a permanent sub-slab vapor probe is presented below:

- Electric impact drill
- 5/8-inch and 1-inch-diameter concrete drill bits for impact drill

- Stainless steel vapor probe (typically 3/8-inch outside diameter [OD], 2- to 2.5-inch long [length will ultimately depend on slab thickness], 1/8-inch inside diameter [ID] pipe, stainless steel pipe nipples with 0.5-inch OD stainless steel coupling, and recessed stainless steel plugs per DiGiulio et. al., 2003)
- Photoionization detector (PID)
- Polyethylene tubing
- Quick-setting hydraulic cement powder

The equipment required to install a temporary sub-slab vapor probe is presented below:

- Electric impact drill
- 5/8-inch-diameter concrete drill bit for impact drill
- 3/8-inch tubing (Teflon®, polyethylene, or similar)
- PID
- Hydrated bentonite
- Teflon® tape

The equipment required for vapor sample collection is presented below:

- Stainless steel SUMMA® canisters (order at least one extra, if feasible)
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible)
- 1/4-inch ID tubing (Teflon®, polyethylene, or similar)
- Twist-to-lock fittings

- Stainless steel “T” fitting (if collecting duplicate [i.e., split] samples)
- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 mL/min)
- Rotameter or an electric flow sensor if vacuum pump does not have a flow gauge
- Tracer gas source (e.g., helium)
- PID
- Appropriate-sized open-end wrench (typically 9/16-inch)
- Chain-of-custody (COC) form
- Sample collection log (attached)
- Field notebook

IV. Cautions

Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

Care must be taken to properly seal around the vapor probe at slab surface to prevent leakage of atmosphere into the soil vapor probe during purging and sampling. Temporary points are fit snug into the pre-drilled hole using Teflon® tape and a hydrated bentonite seal at the surface. Permanent points are fit snug using quick-setting hydraulic cement powder.

V. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. For sub-slab vapor probe installation, drilling with an electric concrete impact drill should be done only by personnel with prior experience using such a piece of equipment.

VI. Procedures

Temporary Vapor Probe Installation

Temporary sub-slab soil vapor probes are installed using an electric drill and manual placement of tubing. The drill will be advanced to approximately 2 inches beneath the bottom of the slab. A 3/8-inch ID hole is installed through the slab. The tubing, wrapped in Teflon® tape, is inserted into the hole. The tubing is purged prior to collection of a vapor sample. Probe locations are resealed after sampling is complete.

1. Remove, only to the extent necessary, any covering on top of the slab (e.g., carpet).

2. Drill a 3/8-inch-diameter hole through the concrete slab using the electric drill.

3. Advance the drill bit approximately 2 inches into the sub-slab material to create an open cavity.

4. Wrap the tubing with Teflon® tape, to the extent necessary, for a snug fit of tubing and hole.

5. Insert the tubing approximately 1.5 inches into the sub-slab material.

6. Prepare a hydrated bentonite mixture and apply bentonite at slab surface around the tubing.

7. Purge the soil vapor probe and tubing with a portable sampling pump prior to collecting the vapor sample (see sample collection section below).

8. Proceed to vapor sample collection.

9. When the sub-slab vapor sampling is complete, remove the tubing and grout the hole in the slab with quick-setting hydraulic cement powder or other material similar to the slab.

Sub-Slab Vapor Sample Collection

Preparation of SUMMA®-Type Canister and Collection of Sample

1. Record the following information in the field notebook, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, weatherunderground.com] to obtain the information):

    a. wind speed and direction

    b. ambient temperature

    c. barometric pressure

    d. relative humidity

2. Connect a portable vacuum pump to the sample tubing. Purge 1 to 2 (target 1.5) volumes of air from the vapor probe and sampling line using a portable pump [purge volume = 1.5 Pi r^2h] at a rate of approximately 100 mL/min. Measure organic vapor levels with the PID.

3. If necessary, check the seal established around the soil vapor probe by using a tracer gas (e.g., helium) or other method established in the state guidance documents. [Note: Some states (e.g., New York) may not require use of a tracer gas in connection with sub-slab sampling. Refer to the Administering Tracer Gas SOP, adapted from NYSDOH 2006, for how to use a tracer gas.]

4. Remove the brass plug from the SUMMA® canister and connect the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister. Do not open the valve on the SUMMA® canister. Record in the field notebook and on the COC form the flow controller number with the appropriate SUMMA® canister number.

5. Connect the polyethylene sample collection tubing to the flow controller and the SUMMA® canister valve. Record in the field notebook the time sampling began and the canister pressure.

6. Open the SUMMA® canister valves. Record in the field notebook the time sampling began and the canister pressure.

7. Take a photograph of the SUMMA® canister and surrounding area.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the required sampling interval.

2. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (approximately 2 inches of Hg or slightly greater).

3. Record the date and local time (24-hour basis) of valve closing in the field notebook, sample collection log (attached), and COC form.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string).

7. Complete the COC form and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory via overnight carrier (e.g., Federal Express) for analysis.

Vapor Monitoring Point Abandonment

Once the vapor samples have been collected, a temporary vapor monitoring point will be abandoned by removing the sampling materials and filling the resulting hole with concrete. Replace the surface covering (e.g., carpet) to the extent practicable.

VII. Waste Management

No specific waste management procedures are required.

VIII. Data Recording and Management

Measurements will be recorded in the field notebook at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., GPS coordinates, distance from permanent structure [e.g., two walls, corner of room]), canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the Project Manager.

IX. Quality Assurance

Vapor sample analysis will be performed using USEPA TO-15 methodology. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5-ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

X. References

DiGiulio et. al. 2003. Draft Standard Operating Procedure (SOP) for Installation of Sub-Slab Vapor Probes and Sampling Using EPA TO-15 to Support Vapor Intrusion Investigations. http://www.cdphe.state.co.us/hm/indoorair.pdf (Attachment C).

New York State Department of Health (NYSDOH). 2006. “Guidance for Evaluating Soil Vapor Intrusion in the State of New York” October 2006.

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Attachment C

Standard Operating Procedure:
Indoor Air Sampling and Analysis

Standard Operating Procedure: Indoor Air Sampling and Analysis Using USEPA Method TO-15

I. Scope and Application

This standard operating procedure (SOP) describes the procedures to collect indoor air samples for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA® canister (<28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and provide detailed instructions for placing the sampling device and collecting indoor air samples for VOC analysis.

II. Personnel Qualifications

ARCADIS BBL field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS BBL field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS BBL personnel responsible for leading indoor air sample collection activities must have previous indoor air sampling experience.

III. Equipment List

The equipment required for indoor air sample collection is presented below:

- Photoionization detector (PID) with VOC detection limit capabilities in the ppb range
- 6-liter, stainless steel SUMMA® canisters (order at least one extra, if feasible)
- Flow controllers with in-line particulate filters and vacuum gauges (flow controllers are pre-calibrated by the laboratory to a specified sample duration [e.g., 8-hour, 24-hour]). Confirm with lab that flow controller comes with in-line

particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible)

- Stainless steel "T" fitting (for connection to SUMMA® canisters and Teflon® tubing to collect split [i.e., duplicate] samples)
- Appropriate-sized open-end wrench (typically 9/16-inch)
- Chain-of-custody (COC) form
- Building survey and product inventory form
- Sample collection log
- Field notebook
- Camera
- Lock and chain
- Ladder or similar to hold canister above the ground surface

IV. Cautions

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, care must be taken to keep the canister away from heavy pedestrian traffic areas (e.g., main entranceways, walkways). If the canister is not to be overseen for the entire sample duration, precautions should be taken to maintain the security of the sample (e.g., do not place in areas regularly accessed by the public, fasten the sampling device to a secure object using lock and chain, label the canister to indicate it is part of a scientific project, place the canister in secure housing that does not disrupt the integrity/validity of the sampling event). Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample

integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

V. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances.

VI. Procedures

Initial Building Survey

1. Complete the appropriate building survey form and product inventory form (e.g., state-specific form or ARCADIS BBL form) at least 48 hours in advance of sample collection.

2. Survey the area for the apparent presence of items or materials that may potentially produce or emit constituents of concern and interfere with analytical laboratory analysis of the collected sample. Record relevant information on survey form and document with photographs.

3. Using the PID, screen indoor air in the location intended for sampling and the vicinity of potential VOC sources to preliminarily assess for the potential gross presence of VOCs.

4. Record date, time, location, and PID readings in the field notebook.

5. Items or materials that contain constituents of concern and/or exhibit elevated PID readings shall be considered probable sources of VOCs. Request approval of the owner or occupant to have these items removed at least 48 hours prior to sampling.

6. Set a time with the owner or occupant to return for placement of SUMMA® canisters.

Preparation of SUMMA®-Type Canister and Collection of Sample

1. Record the following information in the field notebook (contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the following information):

   a. ambient temperature

   b. barometric pressure

   c. relative humidity

2. Choose the sample location in accordance with the sampling plan. Place the canister on a ladder, tripod, or other similar stand to locate the canister orifice 3 to 5 feet above ground or floor surface. If the canister will not be overseen for the entire sampling period, secure the canister as appropriate (e.g., lock and chain). Canister may be affixed to wall/ceiling support with nylon rope or placed on a stable surface. In general, areas near windows, doors, air supply vents, and/or other potential sources of “drafts” shall be avoided.

3. Record SUMMA® canister serial number and flow controller number in the field notebook and COC form. Assign sample identification on canister ID tag, and record in the field notebook, sample collection log, and COC form.

4. Remove the brass dust cap from the SUMMA® canister. Attach the flow controller with in-line particulate filter and vacuum gauge (leave swage-lock cap on the vacuum gauge during this procedure) to the SUMMA® canister with the appropriate-sized wrench. Tighten with fingers first, then gently with the wrench.

5. Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening in the field notebook, sample collection log, and COC form. Collection of duplicate/split samples will include attaching a stainless steel “T” to split the indoor air stream to two SUMMA® canisters, one for the original investigative sample and one for the duplicate/split sample.

6. Record the initial vacuum pressure in the SUMMA® canister in the field notebook and COC form. If the initial vacuum pressure does not register less

than -28 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

7. Take a photograph of the SUMMA® canister and surrounding area.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the sampling interval (e.g., 8-hour).

2. Stop collecting the sample when the canister vacuum reaches approximately 2 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample time has elapsed.

3. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valve. Record the date, local time (24-hour basis) of valve closing in the field notebook, sample collection log, and COC form.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install brass plug on canister fitting, and tighten with wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string).

7. Complete COC form and place requisite copies in shipping container. Close shipping container and affix custody seal to container closure. Ship to laboratory via overnight carrier (e.g., Federal Express) for analysis.

VII. Waste Management

No specific waste management procedures are required.

VIII. Data Recording and Management

PID measurements taken during the initial building survey will be recorded in the field notebook, with notations of project name, sample date, sample time, and sample location (e.g., description and GPS coordinates if available). A building survey form and product inventory form will also be completed for each building within the facility being sampled during each sampling event.

Measurements will be recorded in the field notebook at the time of measurement, with notations of project name, sample date, sample start and finish times, sample location (e.g., description and GPS coordinates if available), canister serial number, flow controller number, initial vacuum reading, and final vacuum reading. Field notebooks and COC records will be transmitted to the Project Manager.

IX. Quality Assurance

Indoor air sample analysis will be performed using USEPA Method TO-15. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5 ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

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Attachment D

Standard Operating Procedure:
Ambient Air Sampling and
Analysis

Standard Operating Procedure: Ambient Air Sampling and Analysis Using USEPA Method TO-15

I. Scope and Application

This standard operating procedure (SOP) describes the procedures to collect ambient air samples for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA® canister (<28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and provide detailed instructions for placing the sampling device and collecting ambient air samples for VOC analysis.

II. Personnel Qualifications

ARCADIS BBL field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS BBL field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS BBL personnel responsible for leading ambient air sample collection activities must have previous ambient air sampling experience.

III. Equipment List

The equipment required for ambient air sample collection is presented below:

- 6-liter, stainless steel SUMMA® canisters (order at least one extra, if feasible)
- Flow controllers with in-line particulate filters and vacuum gauges (flow controllers are pre-calibrated by the laboratory to a specified sample duration [e.g., 8-hour, 24-hour]). Confirm with lab that flow controller comes with in-line particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible)
- Appropriate-sized open-end wrench (typically 9/16-inch)

- Chain-of-custody (COC) form
- Sample collection log
- Field notebook
- Camera
- Lock and chain
- Ladder or similar to hold canister above the ground surface

IV. Cautions

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, care must be taken to keep the canister away from heavy pedestrian traffic areas (e.g., main entranceways, walkways). If the canister is not to be overseen for the entire sample duration, precautions should be taken to maintain the security of the sample (e.g., do not place in areas regularly accessed by the public, fasten the sampling device to a secure object using lock and chain, label the canister to indicate it is part of a scientific project, place the canister in secure housing that does not disrupt the integrity/validity of the sampling event). Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

V. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances.

VI. Procedures

Preparation of SUMMA®-Type Canister and Collection of Sample

1. Record the following information in the field notebook (contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the following information):

    a. ambient temperature

    b. barometric pressure

    c. relative humidity

2. Choose the sample location in accordance with the sampling plan. Place the canister on a ladder, tripod, or other similar stand to locate the canister orifice 3 to 5 feet above ground or floor surface. If the canister will not be overseen for the entire sampling period, secure the canister as appropriate (e.g., lock and chain).

3. Record SUMMA® canister serial number and flow controller number in the field notebook and COC form. Assign sample identification on canister ID tag, and record in the field notebook, sample collection log, and COC form.

4. Remove the brass dust cap from the SUMMA® canister. Attach the flow controller with in-line particulate filter and vacuum gauge (leave swage-lock cap on the vacuum gauge during this procedure) to the SUMMA® canister with the appropriate-sized wrench. Tighten with fingers first, then gently with the wrench.

5. Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening in the field notebook, sample collection log, and COC form.

6. Record the initial vacuum pressure in the SUMMA® canister in the field notebook and COC form. If the initial vacuum pressure does not register less than -28 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

7. Take a photograph of the SUMMA® canister and surrounding area.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the sampling interval (e.g., 8-hour).

2. Stop collecting the sample when the canister vacuum reaches approximately 2 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample time has elapsed.

3. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valve. Record the date, local time (24-hour basis) of valve closing in the field notebook, sample collection log, and COC form.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install brass plug on canister fitting, and tighten with wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string).

7. Complete COC form and place requisite copies in shipping container. Close shipping container and affix custody seal to container closure. Ship to laboratory via overnight carrier (e.g., Federal Express) for analysis.

VII. Waste Management

No specific waste management procedures are required.

VIII. Data Recording and Management

Measurements will be recorded in the field notebook at the time of measurement, with notations of project name, sample date, sample start and finish times, sample location (e.g., description and GPS coordinates if available), canister serial number, flow controller number, initial vacuum reading, and final vacuum reading. Field notebooks and COC records will be transmitted to the Project Manager.

IX. Quality Assurance

Ambient air sample analysis will be performed using USEPA Method TO-15. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5 ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

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Attachment E

Standard Operating Procedure:
Administering Tracer Gas

Standard Operating Procedure: Administering Tracer Gas

When collecting subsurface vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control device to verify the integrity of the vapor probe seal. Without the use of a tracer, verification that a soil vapor sample has not been diluted by surface air is difficult.

Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer. Typically, sulfur hexafluoride (SF_6) or helium are used as tracers because they are readily available, have low toxicity, and can be monitored with portable measurement devices. Butane and propane (or other gases) could also be used as a tracer in some situations. Helium is the preferred tracer gas and will generally be used unless site conditions require use of an alternate tracer gas.

The protocol for using a tracer gas is straightforward: simply enrich the atmosphere in the immediate vicinity of the area where the probe intersects the surface with the tracer gas and measure a vapor sample from the probe for the presence of high concentrations (> 10%) of the tracer. A cardboard box, plastic pail, or even a plastic bag can serve to keep the tracer gas in contact with the probe during the testing.

There are two basic approaches to testing for the tracer gas:

1. Include the tracer gas in the list of target analytes reported by the laboratory; or

2. Use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to and after sampling for the compounds of concern. (Note that tracer gas samples can be collected via syringe, Tedlar bag, etc. They need not be collected in SUMMA® canisters or minicans.)

The advantage of the second approach is that the real-time tracer sampling results can be used to confirm the integrity of the probe seals prior to formal sample collection.

Because minor leakage around the probe seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 10%) of tracer gas are observed in a sample, the probe seal should be enhanced to reduce the infiltration of ambient air.

During the initial stages of a subsurface vapor sampling program, tracer gas samples should be collected at each of the sampling probes. If the results of the initial samples indicate that the probe seals are adequate, the Project Manager can consider reducing the number of locations at which tracer gas samples are used. At a minimum, at least 10% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor probes as part of a long-term monitoring program, annual testing of the probe integrity is recommended.