Arcadis U.S., Inc.
6723 Towpath Road
P.O. Box 66
Syracuse
New York 13214-0066
Tel 315.446.9120
Fax 315.449.0017
www.Arcadis-us.com

ENVIRONMENTAL

John C. Sheehan
Engineering Geologist 2
Division of Environmental Remediation
New York State Department of Environmental Conservation
50 Circle Road
Stony Brook, NY 11790-3409

Subject:

OU-3 Vapor Intrusion Evaluation Work Plan
50 Marcus Drive, Farmingdale, NY

Date:
October 15, 2019

Contact:
Christopher Engler

Phone:
315-409-6579

Email:
christopher.engler@arcadis.com

Dear Mr. Sheehan:

Arcadis on behalf of Stellae International, Inc. (Stellae), is providing this document to identify the upcoming activities associated with vapor intrusion sampling at their facility located at 50 Marcus Drive in Farmingdale, NY. Stellae purchased the property from Ivy Realty and has now completed construction activities associated with two new warehouse buildings and renovation of the original on-site structure.

Consistent with correspondence between the New York State Department of Environmental Conservation (NYSDEC) and the Stellae team, Arcadis has prepared this Vapor Intrusion Evaluation Work Plan in accordance with requirements of the NYSDEC and New York State Department of Health (NYSDOH). This plan will include a building evaluation and chemical inventory, indoor air, sub-slab, and outside ambient air sampling, inspection and performance testing of the existing sub-slab depressurization system (SSDS), and confirmation that the building HVAC is maintaining a positive pressure inside the building relative to outside ambient air pressure.

A detailed description of each of these tasks are presented below:

Building Evaluation:

Arcadis will utilize previously obtained information to evaluate the existence of sub-surface utilities that included the review of building construction plans, a walk-through inspection of the building, and the use of ground penetrating radar (GPR) to identify utilities and determine slab thickness in order to aid in sample collection activities. With regards to the new buildings, it is our understanding that there are no sub-slab utilities in the vicinity of the proposed vapor intrusion sampling locations and will confirm this assumption by reviewing recently completed as-built record drawings of these buildings.

Arcadis will conduct a building inspection and chemical inventory for each building as required by the NYSDOH prior to initiating vapor intrusion related sampling activities. The sampling questionnaire and building inventory (as provided in **Attachment A),** consists of a review of the building construction, current and past occupancy and usage, heating fuels, HVAC settings and chemicals used within the building. Any products that have the potential to effect indoor air sample results will be identified and, if possible, removed at least 48 hours prior to sample collection.

Upon completion of the building inventory, Arcadis will also collect information regarding the functionality of heating, ventilation, and air conditioning (HVAC) systems for each building.

Vapor Sampling and Analysis:

Sampling locations within the original building will be consistent with the pre-occupancy vapor intrusion sampling activities performed by Arcadis in June 2016. A total of five sample locations are proposed to be installed in each of the recently constructed (i.e., eastern and western) building additions. One indoor air and one sub-slab sample will be collected at each sample location for a total of 10 samples throughout the newly constructed buildings. In addition to the co-located indoor air and sub-slab samples, two ambient air sample will be collected from an upwind location to be identified on the day of sampling. All vapor monitoring points (VMPs) will be tested for usability prior to sample collection by a helium tracer gas test. If VMPs are found usable, samples would be collected from a batch certified pre-cleaned evacuated 6-L Summa® canister.

Proposed locations for vapor samples are shown in **Figure 1**.

In the original building, sub-slab samples will be collected through existing vapor monitoring points where possible. In areas where existing points are no longer accessible in the original building and throughout the eastern and western building additions, new 3/8" diameter holes will be drilled through the floor. A tube will be inserted into the temporary hole for sample collection. The locations will be filled with non-shrink concrete grout following the testing period. Since these locations in the original building were previously cleared of subgrade utilities using ground penetrating radar (GPR), and as-built drawings of the recently constructed building additions are assumed to be available to confirm there are no sub-grade utilities, additional GPR testing has not been included in this scope of work. At the present time, sub-slab depressurization systems in each of the three buildings are operational and will remain operational for the foreseeable future including for the duration of sampling activities.

Samples will be collected consistent with the Arcadis standard operating procedure (SOP) for TO-15 sampling, **Attachment B-1 and B-2.** All vapor monitoring points (VMPs) will be tested for usability prior to sample collection by a helium tracer gas test per the Tracer Testing SOP located in **Attachment B-3**. Each sample will be collected using a batch certified pre-cleaned evacuated 6-Liter Summa® canister. Samples will be analyzed under USEPA Method TO-15 for volatile organic carbons (VOCs).

The reported compound list from the analytical data will be consistent with the TO-15 sampling compound list as shown on **Attachment C**. Upon receipt of the analytical data, Arcadis will evaluate the results relative to NYSDOH Soil Vapor/Indoor Air Decision Matrix 1 and 2 to assess the effectiveness of the SSDS as well as the potential for impacts from background ambient air conditions.

Performance Verification of the Existing SSDS

Arcadis will evaluate the effectiveness of the SSDS in each of the three buildings by physical inspection of the SSDS components (i.e., blower, moisture separator, control panel, and suction piping) and operational performance characteristics of the equipment (i.e., flow rate and pressure differential across the fan) compared to manufacturer's specifications. Inspections will follow the steps outlined in the Vapor Intrusion Mitigation System Operation and Maintenance (SOP), presented in **Attachment D**. Arcadis will also perform differential pressure testing to evaluate the pressure difference between the indoor air space and the sub-slab using Infiltec® hand held micromonometers (or similar) and/or an OmniGuard® 4 data-recording micromanometer. This data will be compared to the historic data and the typical NYSDOH guidance criteria of negative 0.004 inches of water column. Pressure differential measurements would be collected from the VMPs described above to verify an effective radius of influence (ROI) and the overall system effectiveness. All manual pressure readings will be collected and recorded on **Attachment E** (Field Log).

In addition to the sub-slab differential pressure testing, differential pressure testing between the building interior and outside ambient pressure will be performed on each of the building's four sides. This test will evaluate the ability of the HVAC system to maintain positive pressure in the interior of the building. Testing will be performed using a micro-manometer and atmospheric conditions including temperature, atmospheric pressure, and wind speed and direction will be recorded at the time test data is recorded.

Summary Report

Once the activities described above are completed, Arcadis will submit the findings in a Summary Report to NYSDEC and NYSDOH. This report will detail results of the inspection activities, analytical results, and propose any repairs or modifications to the various building systems (if necessary) for compliance with NYSDEC/NYSDOH requirements. The report will be submitted to the NYSDEC and NYSDOH for review and approval.

Schedule

Arcadis anticipates the start of field activities to commence within one week following NYSDOH/NYSDEC approval of the Vapor Intrusion Evaluation Work Plan and field activities will be completed within 4 days of mobilization. Submittal of the Summary Report to NYSDEC/NYSDOH would be completed within one week of receipt of laboratory data results.

Field personnel associated with sample collection activities will have current training meeting the requirements of 29 CFR 1910.120 governing Hazardous Waste and Emergency Response (HAZWOPER) operations and a site-specific health and safety plan will be prepared for the field work to be performed.

If you have any questions or require additional information, please feel free to call me at 315-409-6579.

Sincerely,

Arcadis of New York, Inc.

Christopher D. Engler

Christopher Engler, P.E.
Vice President

Copies:
Carl Daguillard, Stellae International
George Daguillard, Stellae International

Attachments
A- NYSDEC Structure Sampling Questionnaire and Building Inventory

- B- B-1: Soil-Gas Sampling and Analysis Using USEPA Method TO-17 and TO-15
  B-2: Indoor Air or Ambient Air Sampling and Analysis Using USEPA Method TO-15
  B-3: Administering Helium Tracer Gas for Leak Checks of Soil Gas or Sub-slab
- C- TO-15 Sampling Compound List
- D- Vapor Intrusion Mitigation System Operation and Maintenance SOP
- E- Differential Pressure Monitoring Log

Figures

- 1- Site Plan
- 2- Monitoring Point Detail

ATTACHMENT A

NYSDEC Structure Sampling Questionnaire and Building Inventory

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Site Name: ______ Site Code: ______ Operable Unit: ______

Building Code: ______ Building Name: ______

Address: ______ Apt/Suite No: ______

City: ______ State: ______ Zip: ______ County: ______

Contact Information

Preparer's Name: ______ Phone No: ______

Preparer's Affiliation: ______ Company Code: ______

Purpose of Investigation: ______ Date of Inspection: ______

Contact Name: ______ Affiliation: ______

Phone No: ______ Alt. Phone No: ______ Email: ______

Number of Occupants (total): ______ Number of Children: ______

☐ Occupant Interviewed? ☐ Owner Occupied? ☐ Owner Interviewed?

Owner Name (if different): ______ Owner Phone: ______

Owner Mailing Address: ______

Building Details

Bldg Type (Res/Com/Ind/Mixed): ______ Bldg Size (S/M/L): ______

If Commercial or Industrial Facility, Select Operations: ______

If Residential Select Structure Type: ______

Number of Floors: ______ Approx. Year Construction: ______ ☐ Building Insulated? ☐ Attached Garage?

Describe Overall Building 'Tightness' and Airflows(e.g., results of smoke tests): ______

Foundation Description

Foundation Type: ______ Foundation Depth (bgs): ______ Unit: FEET

Foundation Floor Material: ______ Foundation Floor Thickness: ______

Foundation Wall Material: ______ Foundation Wall Thickness: ______ Unit: INCHES

☐ Floor penetrations? Describe Floor Penetrations: ______

☐ Wall penetrations? Describe Wall Penetrations: ______

Basement is: ______ Basement is: ______ ☐ Sumps/Drains? Water In Sump?: ______

Describe Foundation Condition (cracks, seepage, etc.) : ______

☐ Radon Mitigation System Installed? ☐ VOC Mitigation System Installed? ☐ Mitigation System On?

Heating / Cooling / Ventilation Systems

Heating System: ______ Heat Fuel Type: ______ ☐ Central A/C Present?

Vented Appliances

Water Heater Fuel Type: ______ Clothes Dryer Fuel Type: ______

Water Htr Vent Location: ______ Dryer Vent Location: ______

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

PRODUCT INVENTORY

Building Name: ______________________ Bldg Code: ______________ Date: ______________

Bldg Address: ______________________________________ Apt/Suite No: ______________

Bldg City/State/Zip: ____

Make and Model of PID: ______________________________ Date of Calibration: ______________

Location	Product Name/Description	Size (oz)	Condition *	Chemical Ingredients	PID Reading	COC 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.

Product Inventory Complete? ☐ Were there any elevated PID readings taken on site? ☐ ☐ Products with COC?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Site Name: __________ Site Code: __________ Operable Unit: __________

Building Code: __________ Building Name: __________

Address: __________ Apt/Suite No: __________

City: __________ State: _____ Zip: _____ County: __________

Factors Affecting Indoor Air Quailty

Frequency Basement/Lowest Level is Occupied?: [ ] Floor Material: [ ]

☐ Inhabited? ☐ HVAC System On? ☐ Bathroom Exhaust Fan? ☐ Kitchen Exhaust Fan?

Alternate Heat Source: [ ] ☐ Is there smoking in the building?

☐ Air Fresheners? Description/Location of Air Freshener: __________

☐ Cleaning Products Used Recently?: Description of Cleaning Products: __________

☐ Cosmetic Products Used Recently?: Description of Cosmetic Products: __________

☐ New Carpet or Furniture? Location of New Carpet/Furniture: __________

☐ Recent Dry Cleaning? Location of Recently Dry Cleaned Fabrics: __________

☐ Recent Painting/Staining? Location of New Painting: __________

☐ Solvent or Chemical Odors? Describe Odors (if any): __________

☐ Do Any Occupants Use Solvents At Work? If So, List Solvents Used: __________

☐ Recent Pesticide/Rodenticide? Description of Last Use: __________

Describe Any Household Activities (chemical use,/storage, unvented appliances, hobbies, etc.) That May Affect Indoor Air Quality:

☐ Any Prior Testing For Radon? If So, When?: __________

☐ Any Prior Testing For VOCs? If So, When?: __________

Sampling Conditions

Weather Conditions: [ ] Outdoor Temperature: [ ] °F

Current Building Use: [ ] Barometric Pressure: [ ] in(hg)

Product Inventory Complete? [ ] ☐ Building Questionnaire Completed?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Building Code: ____________________ Address: ____

Sampling Information

Sampler Name(s): ______________________________ Sampler Company Code: __________________

Sample Collection Date: [ ] Date Samples Sent To Lab: __________________

Sample Chain of Custody Number: ______________________ Outdoor Air Sample Location ID: ______________

SUMMA Canister Information

Sample ID:					
Location Code:					
Location Type:					
Canister ID:					
Regulator ID:					
Matrix:					
Sampling Method:					

Sampling Area Info

Slab Thickness (inches):					
Sub-Slab Material:					
Sub-Slab Moisture:					
Seal Type:					
Seal Adequate?:	☐	☐	☐	☐	☐

Sample Times and Vacuum Readings

Sample Start Date/Time:					
Vacuum Gauge Start:					
Sample End Date/Time:					
Vacuum Gauge End:					
Sample Duration (hrs):					
Vacuum Gauge Unit:					

Sample QA / QC Readings

Vapor Port Purge:	☐	☐	☐	☐	☐
Purge PID Reading:					
Purge PID Unit:					
Tracer Test Pass:	☐	☐	☐	☐	☐

Sample start and end times should be entered using the following format: MM/DD/YYYY HH:MM

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

LOWEST BUILDING LEVEL LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the lowest building level .
The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sketc
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	xxxxxxx	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	######	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

FIRST FLOOR BUILDING LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the first floor of the building. The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sketc
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

OUTDOOR PLOT LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the outdoor plot of the building as well as the surrounding area. The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sket(
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

ATTACHMENT B

B-1: Soil-Gas Sampling and Analysis Using USEPA Method TO-17 and TO-15

B-2: Indoor Air or Ambient Air Sampling and Analysis Using USEPA Method TO-15

B-3:Administering Helium Tracer Gas for Leak Checks of Soil Gas or Sub-slab Sampling Points

ARCADIS

Infrastructure · Water · Environment · Buildings

Imagine the result

Soil-Gas Sampling and Analysis Using USEPA Method TO-17 and TO-15

SOP #112409

Rev. #: 2

Rev Date: August 11, 2014

Approval Signatures

Prepared by: Mitch Wacksman Date: 8/11/2014

Mitch Wacksman, Eric Epple and Andrew Gutherz

Approved by: Nadine Weinberg Date: 8/11/2014

Nadine Weinberg

I. Scope and Application

This document describes the procedures to collect subsurface soil-gas samples from sub-slab sampling ports and soil vapor monitoring points for the analysis of volatile organic compounds (VOCs) including volatile polyaromatic hydrocarbons (PAHs) by United States Environmental Protection Agency (USEPA) Method TO-17 (TO-17) and USEPA Method TO-15.

The TO-17 method uses a glass or stainless steel tube packed with a sorbent material. Sorbents of increasing strength and composition are packed within the tube. The specific sorbent material packed within each tube is selected based on the target compounds and desired reporting limits. A measured volume of soil-gas is passed through the tube during sample collection.

The TO-15 method uses 1-liter 3-liter or 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 liters when allowed to fill to a vacuum of approximately 6 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). Optionally the canister sample can also be analyzed for fixed gasses such as Helium, Carbon dioxide and oxygen. .

Following sample collection the TO-17 tube and TO-15 canister is sent to the laboratory where the sampling media is analyzed for the target compounds.

The following sections list the necessary equipment and provide detailed instructions for the collection of soil-gas samples for analysis using TO-17 and TO-15.

Soil vapor samples can be collected from sub-slab sample probes or soil-vapor ports. Refer to the appropriate standard operating procedure (SOP) from the ARCADIS SOP library for a description of construction methods.

II. Personnel Qualifications

ARCADIS 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 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 personnel responsible for leading soil-gas sample collection activities must have previous soil-gas sampling experience.

III. Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job loss analysis (JLA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. 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 and with the appropriate health and safety measures in place as presented in the JLA

IV Equipment List

The equipment required for collect soil-gas samples for analysis using method TO-15 and TO-17 is presented below:

- Appropriate personal protective equipment (PPE; as presented in the site specific HASP and the JLA)
- TO-17 tubes pre-packed by the laboratory with the desired sorbent. Specific sorbents will be recommended by the laboratory considering the target compound list and the necessary reporting limits;
- TO-17 sample flow rate calibration tubes (provided by the laboratory);
- Stainless steel SUMMA® canisters (1-liter, 3-liter, or 6-liter; order at least 5% extra, if feasible) (batch certified canisters or individual certified canisters as required by the project)
- 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 5% extra, if feasible). Flow rate should be selected based on expected soil type (see below).
- Two decontaminated Swagelok or stainless-steel or comparable two-way ball or needle valve (sized to match sample tubing).
- 1/4-inch outer diameter (OD) tubing (Teflon® or Teflon-lined polyethylene);
- Stainless steel or comparable Swagelok® or equivalent compression fittings for 1/4-inch OD tubing;

- Stainless steel “T” fitting (if sample train will be assembled with an inline vacuum gauge a four-way fitting will be needed);
- Three Stainless steel duplicate “T” fittings ;
- 2 Portable vacuum pumps capable of producing very low flow rates (e.g., 10 to 200 mL/min) with vacuum gauge;
- Vacuum gauge if monitoring vacuum reading during sample collection is necessary and portable vacuum pump is not equipped with a vacuum gauge;
- Rotameter or an electric flow sensor if vacuum pump does not have a flow gauge (Bios DryCal or equivalent);
- Tracer gas testing supplies (refer to Adminstering Tracer Gas SOP #41699);
- Photoionization Detector (PID) (with a lamp of 11.7 eV);
- Appropriate-sized open-end wrench (typically 9/16-inch, 1/2-inch , and 3/4-inch);
- 2 Tedlar bags;
- Portable weather meter, if appropriate;
- Chain-of-custody (COC) form;
- Sample collection log;
- Gel ice; and
- Field notebook.

V. Cautions

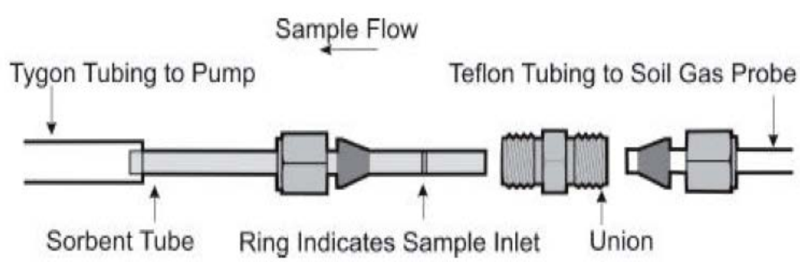
The following cautions and field tips should be reviewed and considered prior to collecting soil-gas samples.

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

- Care should be taken to ensure that the appropriate sorbent is used in the TO-17 tube preparation. Sorbent should be selected in consultation with the analytical laboratory and in consideration of the target compound list, the necessary reporting limits and the expected range of concentrations in field samples. The expected range of concentrations in field samples may be estimated from previous site data, release history and professional judgment informed by the conceptual site model.

- Flow rates for sample collection with TO-17 sorbent tubes should be determined well in advance of field work in consultation with the laboratory.

- Flow direction on the TO-17 sorbent tubes must be considered. Sorbent tubes are specifically designed to absorb lighter end compound at the influent side of the tube and heavier compounds toward the effluent side of the sorbent tube. Confirm flow direction with analytical laboratory or supplier. The picture below shows a ring indicator on a sorbent tube; this indicates the influent end of the sorbent tube. This ring may also hold labeling clips used to identify the sample. If removed during sample collection or to identify flow direction, remember to replace upon completion. An arrow indicating flow direction may also be printed on the sorbent tube.



- TO-17 sorbent tubes must be oriented vertically during sampling to ensure equal distribution of compounds along the sorbent media.

- A Shipping Determination must be performed, by DOT-trained personnel, for all environmental samples that are to be shipped, as well as some types of environmental equipment/supplies that are to be shipped.

- At the sampling location, keep the tubes in their storage and transportation container to equilibrate with ambient temperature prior to attaching to the sample train.

- Always use clean gloves when handling sampling tubes.

- Seal clean, blank sorbent tubes and sampled tubes using inert, Swagelok®-type fittings and PTFE ferrules. Wrap capped tubes individually in uncoated aluminum foil. Use clean, sealable glass jars or metal cans containing a small packet of activated charcoal or activated charcoal/silica gel for storage and transportation of multiple tubes. This activated charcoal is not analyzed, but serves as a protection for the analytical sorbent tube. Store the multi-tube storage container in a clean environment at 4ºC.

- Keep the sample tubes inside the storage container during transportation and only remove them at the monitoring location after the tubes have reached ambient temperature. Store sampled tubes in a refrigerator at 4ºC inside the multi-tube container until ready for analysis.

- The purge flow rate of 100 ml/min should be suitable for a variety of silt and sand conditions but will not be achievable in some clays without excessive vacuum. A low vacuum (<10" of mercury) should be maintained. Record the measured flow rate and vacuum pressure during sample collection.

  The cutoff value for vacuum differs in the literature from 10" of water column (ITRC 2007) to 136" of water column or 10" of mercury (http://www.dtsc.ca.gov/lawsregspolicies/policies/SiteCleanup/upload/SMBR_ADV_activesoilgasinvst.pdf). A detailed discussion of the achievable flow rates in various permeability materials can be found in Nicholson 2007. Related issues of contaminant partitioning are summarized in ASTM D5314-92. Passive sampling approaches can be considered as an alternative for clay soils. However most passive sampling approaches are not currently capable of quantitative estimation of soil gas concentration.

- It is important to record the canister pressure, start and stop times and ID on a proper field sampling form. You should observe and record the time/pressure at a mid-point in the sample duration. It is a good practice to lightly tap the pressure gauge with your finger before reading it to make sure it isn't stuck.

- Ensure that there is still measureable vacuum in the SUMMA® after sampling. Sometimes the gauges sent from labs have offset errors, or they stick.

- When sampling carefully consider elevation. If your site is over 2,000' above sea level or the difference in elevation between your site and your lab is more than 2,000' then pressure effects will be significant. If you take your samples at a high elevation they will contain less air for a given ending pressure reading. High elevation samples analyzed at low elevation will result in more dilution at the lab, which could affect reporting limits. Conversely low elevation samples when received at high elevation may appear to not have much vacuum left in them. http://www.uigi.com/Atmos_pressure.html.

- If possible, have equipment shipped a two or three days before the sampling date so that all materials can be checked. Order replacements if needed.
- Requesting extra canisters and extra sorbent tubes from the laboratory should also be considered to ensure that you have enough equipment on site in case of an equipment failure.
- Shallow exterior soil-gas sampling should not proceed within 5 days following a significant rain event (1/2-inch of rainfall or more).

VI. Procedure

Soil-Gas Sample Preparation

Selection of Sorbent and Sampling Volume (to be completed prior to sampling event)

1. Identify the necessary final reporting limit for the target compound(s) in accordance with the project quality assurance plan and/or in consultation with the data end user.

2. Identify the necessary method reporting limit(s). The laboratory will be helpful in providing this information as it is typically specific to the sensitivity of the instrumentation.

3. The minimum sampling volume is the volume of soil-gas sample that must be drawn through the sorbent in order to achieve the desired final reporting limit. Calculate the minimum sampling volume using the following equation:

$$Minimum\ Sampling\ Volume\ (L) = \frac{Final\ Reporting\ Limit\ (\mu g)}{Action\ Level\ (\mu g/m^3)} \times \frac{1{,}000\ L}{m^3}$$

Where:

L = liters

µg = microgram

m = meter

4. If a timed sample duration is specified in the work plan, calculate the minimum flow rate. The minimum flow rate is the flow rate necessary to achieve the minimum sampling volume using the following formula:

$$Minimum\ Flow\ Rate\ (L/min) = \frac{Minimum\ Sampling\ Volume\ (L)}{Sample\ Duration\ (min)}$$

Where:

min = minutes

Then compare the minimum flow rate calculated to the requirements for maximum soil gas sampling without excessive danger of short circuiting, normally stated as 0.2 liters/minute, although it can be lower in tight soils. Soil vapor sampling flow rates should not exceed 200 ml/min.

5. Compare the minimum sampling volume to the safe sampling volume (SSV) for the sorbents selected. SSV for specific sorbents can be provide by the manufacture or the laboratory, being used (Table 1 and Appendix 1 in Method TO-17). Ensure that the compound will not breakthrough when sampling the volume calculated above.

Soil-Gas Sample Collection

<u>Calibration of the sample pump prior to assembly of sampling train</u>

1. Attach the sample flow rate calibration tube provided by the laboratory to the inlet of the sample pump using a section of tubing. Attach the flow calibrator to the inlet of the sample flow rate calibration tube. The sample flow rate calibration tube should be clearly marked by the laboratory with an arrow indicating flow direction (or as otherwise specified by the laboratory).

2. Turn on the sample pump and adjust the flow rate on the sample pump to achieve the desired minimum flow rate (calculated above) as measured by the flow calibrator.

3. Repeat until each sampling pump has been properly calibrated to its appropriate flow rate.

Assembly of combined TO-17 and TO-15 sampling train

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; and

    d. relative humidity.

2. If samples are being collected from temporary or permanent soil vapor points simply remove the cap or plug and proceed to step 3. When collecting samples from a sub-slab port remove the cap or plug from the sampling port. Connect a short piece of Teflon or Teflon-lined tubing to the sampling port using a Swagelok or equivalent stainless-steel or comparable compression fitting.

3. Connect the Teflon or Teflon-lined tubing to a stainless steel T fitting using a Swagelok or equivalent stainless-steel or comparable compression fitting.

4. Remove the brass cap 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 COC form the flow controller number with the appropriate SUMMA® canister number.

5. Connect the flow controller to the stainless steel T fitting using a Swagelok or equivalent stainless-steel or comparable compression fitting. The TO-15 leg of the combined sampling train is now complete.

6. Attach a length of Teflon or Teflon-lined tubing to the free end of the stainless steel T fitting using a Swagelok or equivalent stainless-steel or comparable compression fitting.

7. Connect TO-17 sorbent tubes with vertical orientation and the correct flow direction using compression fittings and appropriate T’s.

8. Complete the remainder of the sampling train as depicted in Figure 1.

Purge Sampling Assembly and Sampling Point Prior to Sample Collection.

1. Ensure the two-way valve next to the flow rate calibration tube is open and the two way valve next to the TO-17 sampling tubes is closed. Purge three volumes of air from the vapor probe and sampling line using the portable pump. Measure organic vapor levels with the PID. Lower flow rates may be necessary in silt or clay to avoid excessive vacuum. Vacuum reading greater than 136 inches of water column are clearly excessive. Other available sources cite a cutoff of greater than 10 inches of water column.

2. Check the seal established around the soil vapor probe and the sampling train fittings by using a tracer gas (e.g., helium) or other method established in applicable regulatory guidance documents. [Note: Refer to ARCADIS SOP "Administering Tracer Gas," adapted from NYSDOH 2005, for procedures on tracer gas use.]

3. When three volumes of air have been purged from the vapor probe and sampling line stop the purge pump and close the valve next to the flow rate calibration tube.

TO-15 Sample Collection

1. Open the SUMMA® canister valve to initiate sample collection. Record on the sample log (attached) the time sampling began and the canister pressure.

   If the initial vacuum pressure registered is not between -30 and -25 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

2. Take a photograph of the SUMMA® canister and surrounding area (unless photography is restricted by the property owner).

3. Check the SUMMA canister approximately half way through the sample duration and note progress on sample logs.

TO-15 Sample Termination

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the 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 6 inches of Hg or slightly greater).

3. Record the date and time of valve closing in the field notebook, sample collection log, and COC form.

TO-17 Sample Collection

1. Record in the field notebook and COC form the tube number on the TO-17 tube.

2. Open the two-way valve next to the TO-17 tubes

3. Turn on the sample pump to begin sample collection. Use a stopwatch to ensure accuracy in pumping time. Record in the field notebook and the field sample log the time sampling began and the flow rate from each of the sample pumps.

Termination of Sample Collection

1. Stop the sample pumps after the desired volume of soil-gas has passed through the sorbent, and close the two-way valves next to the TO-17 sample tubes.

2. Record the stop time.

3. Detach the Tedlar bag from each sample pump and measure the helium concentration in the soil-gas collected by the Tedlar bag. Record any detections in the field book and sample collection log.

4. Open the two-way valve to permit flow through the flow rate calibration tube. Reconnect each of the sampling pumps and measure the flow rate. Record the post-sampling flow rates in the field log book and the sample collection logs. The post-sampling flow rate should match within 10% of the pre-sample flow rate. Average the pre-sampling and post-sampling flow rate and record in the field log book, and the sample collection log.

5. Calculate the sample volume using the average of the pre-sample and post-sample flow rate. Record the sample volume in the field log book, the sample collection log, and on the COC.

6. Package the tubes according to laboratory protocol on gel ice and ship to the laboratory for analysis.

VII. Waste Management

The waste materials generated during sampling activities should be minimal. PPE, such as gloves and other disposable equipment (i.e., tubing), will be collected by field personnel for proper disposal.

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), tube type and number and sample volume. Field sampling logs and COC records will be transmitted to the Project Manager.

IX. Quality Assurance

Duplicate samples should be collected in the field as a quality assurance step. Generally, duplicates are taken of 10% of samples, but project specific requirements should take precedence. Duplicate soil gas samples should be collected via a split sample train, allowing the primary and duplicate sample to be collected from the soil-gas probe simultaneously.

Quality assurance planning for method TO-17 should take careful note of the method requirement for distributed volume pairs. Although in some circumstances this requirement may be waived, this does constitute a deviation from the method as written. It is wise to discuss this decision with clients and/or regulators before sampling.

Soil-gas sample analysis will be performed using USEPA TO-17 methodology for a site specific constituent list defined in the work plan. Constituent lists and reporting limits must be discussed with the laboratory prior to mobilizing for sampling. Quality assurance parameters should be confirmed with the laboratory prior to sampling. Field quality assurance parameters should be defined in the site-specific work plan. A trip blank sample should accompany each shipment of soil-gas samples to the laboratory for analysis. Trip blanks assess potential sample contamination resulting from the transportation and storing of samples. Soil-gas sample analysis will generally be performed using USEPA TO-15 methodology or a project specific constituent list. Method TO-15 uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits (typically 0.5-ppbv for most VOCs).

X. References

New York State Department of Health (NYSDOH). 2005. DRAFT “Guidance for Evaluating Soil Vapor Intrusion in the State of New York” February 23, 2005.

AirToxics Ltd. “Sorbent & Solution Sampling Guide.”

Infrastructure, environment, facilities

Imagine the result

Indoor Air or Ambient Air Sampling and Analysis Using USEPA Method TO-15

SOP # 765199

Rev. #: 2

Rev Date: July 7, 2010

Approval Signatures

Prepared by: ______________________ Date: 07/07/2010
Mitch Wacksman and Andrew Gutherz

Approved by: ______________________ Date: 07/07/2010
Christopher Lutes and Nadine Weinberg

I. Scope and Application

This standard operating procedure (SOP) describes the procedures to collect indoor air or 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 liters when allowed to fill to a vacuum of 6 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 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 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 personnel responsible for leading indoor air sample collection activities must have previous indoor air sampling experience.

III. Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. The following are examples of hazards that are often encountered in conducting indoor air sampling:

- In crawl spaces, hazards often include low head room, limited light, poisonous insects, venomous snakes, and sharp debris.
- In residential buildings and neighborhoods unfamiliar dogs can pose a hazard. Even though proper permission for sampling may have been secured, it is still possible to encounter persons suspicious of or hostile to the sampling team.
- In occupied industrial buildings be aware of the physical hazards of ongoing industrial processes. Examples include moving forklifts and equipment pits.

IV. Equipment List

The equipment required for indoor 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]). Confirm with lab that flow controller is equipped with an in-line particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible);
- Appropriate-sized open-end wrenches (typically 9/16-inch);
- Chain-of-custody (COC) form;
- Building survey and product inventory form (example attached);
- Portable photoionization detector (PID) (for use identifying potential background sources during building survey described below);
- Sample collection log (attached);
- Camera if photography is permitted at sampling locations;
- Portable weather meter, if appropriate;
- Box, chair, tripod, or similar to hold canister above the ground surface; and
- Teflon sample tubing may be used to sample abnormal situations (i.e., sumps, where canisters must be hidden, etc.). In these situations ¼-inch Swagelok fittings or other methods may be appropriate to affix tubing to canister. Staff should check this before heading out into field.

V. Cautions

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, keep ambient air canisters away from heavy pedestrian traffic areas (e.g., main entranceways, walkways) if possible. If the canisters are 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, notify local authorities, 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 (sharpies), wear/apply fragrances, or smoke cigarettes before and/or during the sampling event.

Ensure that the flow controller is pre-calibrated to the proper sample collection duration (confirm with laboratory). Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target duration and a measurable vacuum (e.g., 5–inches Hg) remains in the canister when sample collection is terminated.

VI. Procedure

Initial Building Survey for Indoor Air Samples (if applicable to project)

1. Complete the appropriate building survey form and product inventory form (e.g., state-specific form, USEPA form, or ARCADIS form, [Attachment A]) as necessary 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. Record date, time, location, and other relevant notes on the sampling form.

4. 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 to a structure not attached to the target structure at least 48 hours prior to sampling if possible.

5. Set a date and 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 on the sampling form (use a hand-held weather meter, contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the following information):

   - ambient temperature;

- barometric pressure;
- wind speed; and
- relative humidity.

2. Choose the sample location in accordance with the sampling plan. If a breathing zone sample is required, place the canister on a ladder, tripod, box, 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 canisters 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 on the sampling log and chain of custody (COC) form. Assign sample identification on canister ID tag, and record on the sample collection log (Attachment B), 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 to the SUMMA® canister with the appropriate-sized wrench. Tighten with fingers first, then gently with the wrench. Use caution not to over tighten fittings.

5. Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening on the sample collection log, and COC form. Collection of duplicate samples will include collecting two samples side by side at the same time.

6. Record the initial vacuum pressure in the SUMMA® canister on the sample log and COC form. If the initial vacuum pressure registers less than -25 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, if possible.

8. Check the SUMMA canister approximately half way through the sample duration and note progress on sample logs.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 1-2 hours prior to the end of the sampling interval (e.g., 8-hour, 24-hour).

2. Stop collecting the sample when the canister vacuum reaches approximately 7 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 on the sample collection log, and COC form.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install brass cap 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

Notes taken during the initial building survey will be recorded on the sample log, with notations of project name, sample date, sample time, and sample location (e.g., description and GPS coordinates if available) sample start and finish times, canister serial number, flow controller number, initial vacuum reading, and final vacuum reading. Sample logs and COC records will be transmitted to the Task Manager or Project Manager. A building survey form and product inventory form (Attachment A) may also be completed for each building within the facility being sampled during each sampling event as applicable.

IX. Quality Assurance

Indoor air or 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.

Duplicate samples should be collected in the field as a quality assurance step. Generally, duplicates are taken of 10% of samples, but project specific requirements should take precedence.

Building Survey and Product Inventory Form

Directions: This form must be completed for each residence or area 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 / NA

Basement/lowest level depth below grade: ________(feet)

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

____

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? Y / N

6. HEATING, VENTILATING, 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 base	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

General Use of Each Floor (e.g., family room, 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 ___________________

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?______________________

q. Are there odors in the building? Y / N

If yes, please describe: ____

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

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

Are there any Outside Contaminant Sources? (circle appropriate responses)

Contaminated site with 1000-foot radius? Y / N Specify ________________________________

Other stationary sources nearby (e.g., gas stations, emission stacks, etc.): ___________________

____

Heavy vehicle traffic nearby (or other mobile sources): __________________________________

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 and Model of field instrument used: ____

List specific products found in the residence or area that have the potential to affect indoor air quality (e.g., gasoline or kerosene storage cans, glues, paints, cleaning solvents/products, polishes/waxes, new furniture/ carpet, nail polish/hairspray/cologne).

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

Indoor Air/Ambient Air Sample Collection Log

ARCADIS

		Sample ID:	
Client:		**Outdoor/Indoor:**	
Project:		**Sample Intake Height:**	
Location:		**Tubing Information:**	
Project #:		**Miscellaneous Equipment:**	
Samplers:		**Time On/Off:**	
Sample Point Location:		**Subcontractor:**	

Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)

(a) Record canister information at a minimum at the beginning and end of sampling

SUMMA Canister Information:

Size (circle one):	**1 L** **6 L**
Canister ID:	
Flow Controller ID:	
Notes:	

General Observations/Notes:

ARCADIS
Infrastructure, environment, facilities

Imagine the result

Administering Helium Tracer Gas for Leak Checks of Soil Gas or Sub-slab Sampling Points

SOP #416199

Rev. #: 3

Rev Date: July 7, 2010

Approval Signatures

Prepared by: ______________________________ Date: 07/07/2010
Mitch Wacksman and Andrew Gutherz

Approved by: ______________________________ Date: 07/07/2010
Christopher Lutes and Nadine Weinberg

I. Scope and Application

When collecting subsurface vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control method to verify the integrity of the vapor port seal and the numerous connections comprising the sample train. Without the use of a tracer, verification that a soil vapor sample has not been diluted by ambient or indoor air is difficult.

This standard operating procedure (SOP) focuses on using helium as a tracer gas. However, depending on the nature of the contaminants of concern, other compounds can be used as a tracer including sulfur hexafluoride (SF6), butane and propane (or other gases). In all cases, the protocol for using a tracer gas is consistent and includes the following basic steps: (1) enrich the atmosphere in the immediate vicinity of the sample port where ambient air could enter the sampling train during sampling with the tracer gas; and (2) measure a vapor sample from the sample tubing for the presence of elevated concentrations (> 10%) of the tracer. A plastic pail, bucket, garbage can or even a plastic bag can serve to keep the tracer gas in contact with the port 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; and/or

2. Use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to 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.)

This SOP focuses on monitoring helium using a portable sampling device, although helium can also be analyzed by the laboratory along with other volatile organic compounds (VOCs). Real-time tracer sampling is generally preferred as the results can be used to confirm the integrity of the port seals prior to formal sample collection.

During the initial stages of a subsurface vapor sampling program, tracer gas samples should be collected at each of the sampling points. If the results of the initial samples indicate that the port seals are adequate, the Project Manager can consider reducing the number of locations at which tracer gas samples are used in future monitoring rounds. At a minimum, at least 5% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor points as part of a long-term monitoring program, the port should be tested prior to the first sampling event. Tracer gas testing of subsequent sampling events may often be reduced or eliminated unless conditions have changed at the site. Soil gas port integrity should certainly be rechecked with Tracer gas if land clearing/grading activities, freeze thaw cycles, or soil dessication may have occurred. Points should also be rechecked if more than 2 years have elapsed since the last check of that port.

II. Personnel Qualifications

ARCADIS 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 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 personnel responsible for leading the tracer gas testing must have previous experience conducting similar tests.

III. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field staff should review the attachment on safely handling compressed gas cylinders prior to commencing field work.

IV. Equipment List

The equipment required to conduct a helium tracer gas test is presented below:

- Appropriate PPE for site (as required by the Health and Safety Plan)
- Helium (laboratory grade)
- Regulator for helium tank
- Shroud (plastic bucket, garbage can, etc)
    - The size of the shroud should be sufficient to fit over the sample port. It is worth noting that using the smallest shroud possible will miminze the volume of helium needed; this may be important when projects require a large number of helium tracer tests.
    - The shroud will need to have three small holes in it. These holes will include one on the top (to accommodate the sample tubing), and two

on the side (one for the helium detector probe, and one for the helium line).

- The shroud should ideally enclose the sample port and as much as possible of the sampling train.

- Helium detector capable of measuring from 1 - 100% (Dielectric MGD-2002, Mark Model 9522, or equivalent)
- Tedlar bags
- Seal material for shroud (rubber gasket, modeling clay, bentonite, etc) to keep helium levels in shroud high in windy conditions. Although the sealing material is not in direct contact with the sample if leakage does not occur, sealing materials with high levels of VOC emissions should be avoided, since they could contaminate a sample if a leak occurs.
- Sample logs
- Field notebook

V. Cautions

Helium is an asphyxiant! Be cautious with its use indoors! Never release large volumes of helium within a closed room!

Compressed gas cylinders should be handled with caution; see attachment on the use and storage of compressed gasses before beginning field work.

Care should be taken not to pressurize the shroud while introducing helium. If the shroud is completely air tight and the helium is introduced quickly, the shroud can be over-pressurized and helium can be pushed into the ground. Provide a relief valve or small gap where the helium can escape.

Because minor leakage around the port 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 port seal should be enhanced and fittings within the sampling train should be should be checked and/or tightened to reduce the infiltration of ambient air and the tracer test readministered. If the problem cannot be rectified, a new sample point should be installed or an alternate sampling train used.

VI. Procedure

The procedure used to conduct the helium tracer test should be specific to the shroud being used and the methods of vapor point installation. The helium tracer test can be conducted when using temporary or permanent sampling points and inside or outside a facility. When using the tracer gas within indoor areas you must provide adequate ventilation as helium is an asphyxiant.

1. Attach Teflon or nylon (Nylaflow) sample tubing to the sample point. This can be accomplished utilizing a number of different methods depending on the sample install (i.e., most typically Swage-Lok brand compression fittings, but some quick release fittings could also be used etc.).

2. Place the shroud over the sample point and tubing.

3. Pull the tubing through hole in top of shroud. Seal opening at top of shroud with modeling clay.

4. Place weight on top of shroud to help maintain a good seal with the ground.

5. Insert helium tubing and helium detector probe into side of shroud. Seal both with modeling clay to prevent leaks.

6. Fill shroud with helium. Fill shroud slowly, allowing atmospheric air to escape either by leaving a gap where the shroud meets the ground surface or by providing a release value on the side of the shroud.

7. Use the helium detector to monitor helium concentration within the shroud from the lowest hole drilled in the shroud (bottom of the shroud nearest where the sample tubing intersects the ground). Helium should be added until the environment inside the shroud has > 60% helium.

8. Purge the sample point through the sample tubing into a Tedlar bag using a hand held sampling pump. The purge rate should at least match the sample collection rate but not exceed 100 ml/min. Test the air in the Tedlar bag for helium using portable helium detector. If the point is free of leaks there should be very low helium in the purge air from the soil. The natural concentration of helium in the atmosphere is 0.00052% by volume and there are few if any natural sources of helium to soil gas.

9. If > 10% helium is noted in purge air, add more clay or other material to the seal the sample port and repeat the testing procedure. If the seal cannot be fixed, re-install sample point.

10. Monitor and record helium level in shroud before, during and after tracer test.

11. Monitor and record helium level in purge exhaust.

12. At successful completion of tracer test and sample point purging, the soil vapor sample can be collected (if the helium shroud must be removed prior to sample collection be mindful not disturb the sample tubing and any established seals).

VII. Data Recording and Management

Measurements will be recorded on the sample logs at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location, and the helium concentrations in both the shroud and the purge air before, during, and after tracer testing. Any problems encountered should also be recorded in the field notes.

ATTACHMENT: Compressed Gases—Use and Storage

In general, a compressed gas is any material contained under pressure that is dissolved or liquefied by compression or refrigeration. Compressed gas cylinders should be handled as high-energy sources and therefore as potential explosives and projectiles. Prudent safety practices should be followed when handling compressed gases since they expose workers to both chemical and physical hazards.

Handling

- Safety glasses with side shields (or safety goggles) and other appropriate personal protective equipment should be worn when working with compressed gases.
- Cylinders should be marked with a label that clearly identifies the contents.
- All cylinders should be checked for damage prior to use. Do not repair damaged cylinders or valves. Damaged or defective cylinders, valves, etc., should be taken out of use immediately and returned to the manufacturer/distributor for repair.
- All gas cylinders (full or empty) should be rigidly secured to a substantial structure at 2/3 height. Only two cylinders per restraint are allowed in the laboratory and only soldered link chains or belts with buckles are acceptable. Cylinder stands are also acceptable but not preferred.
- Handcarts shall be used when moving gas cylinders. Cylinders must be chained to the carts.
- All cylinders must be fitted with safety valve covers before they are moved.
- Only three-wheeled or four-wheeled carts should be used to move cylinders.
- A pressure-regulating device shall be used at all times to control the flow of gas from the cylinder.
- The main cylinder valve shall be the only means by which gas flow is to be shut off. The correct position for the main valve is all the way on or all the way off.
- Cylinder valves should never be lubricated, modified, forced, or tampered with.
- After connecting a cylinder, check for leaks at connections. Periodically check for leaks while the cylinder is in use.
- Regulators and valves should be tightened firmly with the proper size wrench. Do not use adjustable wrenches or pliers because they may damage the nuts.
- Cylinders should not be placed near heat or where they can become part of an electrical circuit.
- Cylinders should not be exposed to temperatures above 50 °C (122 °F). Some rupture devices on cylinders will release at about 65 °C (149 °F). Some small cylinders, such as lecture bottles, are not fitted with rupture devices and may explode if exposed to high temperatures.

- Rapid release of a compressed gas should be avoided because it will cause an unsecured gas hose to whip dangerously and also may build up enough static charge to ignite a flammable gas.
- Appropriate regulators should be used on each gas cylinder. Threads and the configuration of valve outlets are different for each family of gases to avoid improper use. Adaptors and homemade modifications are prohibited.
- Cylinders should never be bled completely empty. Leave a slight pressure to keep contaminants out.

Storage

- When not in use, cylinders should be stored with their main valve closed and the valve safety cap in place.
- Cylinders must be stored upright and not on their side. All cylinders should be secured.
- Cylinders awaiting use should be stored according to their hazard classes.
- Cylinders should not be located where objects may strike or fall on them.
- Cylinders should not be stored in damp areas or near salt, corrosive chemicals, chemical vapors, heat, or direct sunlight. Cylinders stored outside should be protected from the weather.

Special Precautions

Flammable Gases

- No more than two cylinders should be manifolded together; however several instruments or outlets are permitted for a single cylinder.
- Valves on flammable gas cylinders should be shut off when the laboratory is unattended and no experimental process is in progress.
- Flames involving a highly flammable gas should not be extinguished until the source of the gas has been safely shut off; otherwise it can reignite causing an explosion.

Acetylene Gas Cylinders

- Acetylene cylinders must always be stored upright. They contain acetone, which can discharge instead of or along with acetylene. Do not use an acetylene cylinder that has been stored or handled in a nonupright position until it has remained in an upright position for at least 30 minutes.
- A flame arrestor must protect the outlet line of an acetylene cylinder.
- Compatible tubing should be used to transport gaseous acetylene. Some tubing like copper forms explosive acetylides.

Lecture Bottles

- All lecture bottles should be marked with a label that clearly identifies the contents.
- Lecture bottles should be stored according to their hazard classes.
- Lecture bottles that contain toxic gases should be stored in a ventilated cabinet.
- Lecture bottles should be stored in a secure place to eliminate them from rolling or falling.
- Lecture bottles should not be stored near corrosives, heat, direct sunlight, or in damp areas.
- To avoid costly disposal fees, lecture bottles should only be purchased from suppliers that will accept returned bottles (full or empty). Contact the supplier before purchasing lecture bottles to ensure that they have a return policy.
- Lecture bottles should be dated upon initial use. It is advised that bottles be sent back to the supplier after one year to avoid accumulation of old bottles.

ATTACHMENT C

TO-15 Sampling Compound List

Attachment C
TO-15 Sampling Compound List

OU-3 Pre-Occupancy Work Plan
50 Marcus Drive, Farmingdale, NY

1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,1,2-Trichloro-1,2,2-trifluoroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dibromoethane
1,2-dichloro- 1,1,2,2-tetrafluoroethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Butadiene
1,3-Dichlbrobenzene
1,4-Dichlorobenzene
1,4-Dioxane
2-Butanone (MEK)
2-Chlorotoluene
2-Hexanone
2-Propanol
3-Chloropropene
4-Ethyltoluene
4-Methyl-2-pentanone (MIBK)
Acetone
Benzene
Benzyl chloride
Bromodichloromethane
Bromoethene
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chlorofom
Chloromethane
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Cyclohexane
Dibromochloromethane
Dichlorodifluoromethane
Ethyl acetate
Ethylbenzene
Hexachlorobutadiene
Isooctane
m&p-Xylene
Methylene chloride
MTBE
n-Heptane
n-Hexane
o-Xylene
Propene
Stylene
t-Butyl Alcohol
Tetrachloroethene
Tetrahydrofuran
Toluene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane
Vinyl acetate
Vinyl chloride

ATTACHMENT D

Vapor Intrusion Mitigation System Operation and Maintenance SOP

ARCADIS

Infrastructure, environment, buildings

Imagine the result

SOP 06132012_A

Vapor Intrusion Mitigation System Operation and Maintenance

Date: May 6, 2011

Revised: May 31, 2012

Approval Signatures

Prepared by: ____________________ Date: April 26, 2011

Rebecca Robbennolt

Reviewed by: ____________________ Date: May 3, 2011

Rachel Saari

Approved by: ____________________ Date: May 6, 2011

Carolyn Grogan

Modified by: ____________________ Date: May 27, 2011

Rachel Saari

Modified by: ____________________ Date: September 12, 2011

Carolyn Grogan

Modified by: ______________________ Date: May 31, 2012

Rachel Saari

I. Scope and Application

This Standard Operating Procedure (SOP) describes the procedures for operation and maintenance (O&M) of active vapor intrusion mitigation systems at structures with three different foundation types: basement, crawlspace, and slab-on-grade, or any combination of these three. The O&M procedures are based on Sub-Slab Depressurization System (SSDS) and Sub-Membrane Depressurization System (SMDS) design criteria found in American Society for Testing and Materials (ASTM) Designation: E2121-03, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings (ASTM, 2008); United States Environmental Protection Agency (U.S. EPA) 625, Radon Reduction Techniques for Existing Detached Houses (U.S. EPA, 1993); and U.S. EPA Region 5, Vapor Intrusion Guidebook (U.S. EPA, 2010).

The following sections list the necessary equipment and materials and provide O&M instructions for the active vapor intrusion mitigation systems for the above mentioned foundation types.

Site specific requirements and/or field conditions may require modifications to some of the procedures outlined in this SOP. Alterations to the SOP may be completed per approval of the Project Manager.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training including 40-hour HAZWOPER training and site-specific training as needed. ARCADIS field 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 personnel are responsible for the coordination and oversight of the vapor intrusion mitigation system O&M activities. ARCADIS personnel leading the O&M activities will have previous vapor intrusion mitigation system O&M oversight experience.

III. Health and Safety Considerations

Materials and equipment must be carefully handled to minimize the potential for injury. All O&M personnel should review the appropriate health and safety plan (HASP) and job loss analysis (JLA) prior to beginning work to be aware of potential hazards associated with the job site and the specific O&M.

IV. Equipment and Materials List

The equipment required for O&M of active vapor intrusion mitigation systems is presented below:

- Appropriate PPE (as required by the Health and Safety Plan)
- Micromanometer
- Flashlight
- Inspection form (included at the end of this SOP)
- Camera

V. Procedure

Annual Operation and Maintenance (US EPA Region 5 Vapor Intrusion Handbook, U.S. EPA 625, and ASTM E2121-03)

Inspections will be conducted by ARCADIS to ensure that it is functioning properly. The inspections will cover the following items:

1. The manometer reading will be recorded and checked against the operating value recorded at the completion of the system installation and the fan's operating range to ensure the system is operating in the design range.

2. The sub-slab pressure field extension readings will be recorded at the sub-slab points that were installed during system construction. The recorded values will be compared to the values recorded at the completion of the system installation.

3. The condition of the fan and disconnect switch lock will be recorded.

4. The condition of the system piping, fittings, and pipe supports will be recorded.

5. The condition of the foundation sealing including crawlspace sheeting will be recorded.

6. Confirmation that the system O&M manual is present will be recorded.

7. Any changes to the building structure or areas in need of additional sealing will be recorded.

If any deficiencies are found, corrective actions will be undertaken as soon as possible.

VII. Safety Considerations

ARCADIS will comply with all OSHA, state, and local standards or regulations relating to worker safety during the O&M of vapor intrusion mitigation systems. All necessary PPE will be worn during annual inspection.

VIII. Waste Management

The waste materials generated by these activities should be minimal. Personal protective equipment, such as gloves and other disposable equipment (i.e. tubing) should be collected by field personnel for proper disposal.

IX. Data Recording and Management (ASTM E2121-03 Section 7.7)

1. ARCADIS will keep records of all mitigation work performed and maintain those records for three years.
2. Health and safety records shall be maintained for a minimum of 20 years.
3. ARCADIS will provide clients with information that includes the following:
    a. Inspection forms
    b. Documentation of corrective actions completed

X. Quality Assurance

After any corrective actions have been implemented, manometer readings and sub-slab pressure field extension readings will be recorded as necessary to document the corrective actions have been successfully implemented.

XI. References

ASTM Designation: E2121-03, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings. March 2001.

U.S. EPA 625, Radon Reduction Techniques for Existing Detached Houses. October 1993.

U.S. EPA Region 5, Vapor Intrusion Guidebook. October 2010.

Sub-Slab, Sub-Membrane, and Crawlspace Depressurization Systems - Initial O&M Inspection Form

Property Address: ______________________ Temperature (Ambient): ______________ °F
Tenant's Name: ______________________ Temperature (House): ______________ °F
Owner's Name: ______________________ Barometric Pressure: ______________ "Hg
Owners Address (If Different from Property): Weather Conditions: ______________

Inspector Name: ______________________
Date: ______________
Time: ______________

System Inspection

Is Fan Operating? Yes No NA
Any Unusual Fan Noises? Yes No
Are Vent Piping and Piping Joints Intact? Yes No
Any Caulking Required Around Piping Penetrations? Yes No
Is System Padlock Intact (System ON/OFF Switch)? Yes No NA
Is O&M Manual Present? Yes No
Any Areas In Need of Additional Sealing? Yes No
List Areas to be Sealed: ______________________
List Any Necessary System Repairs: ______________________

Tenant Observations

Any Change in Fan Noise or Vibration? Yes No
Have you Turned the Fan OFF for Any Period of Time? Yes No NA
Reason? ______________________
Is Differential Pressure in the Manometer Outside of Normal Operating Range? Yes No NA
Is the System Manometer Steady? Yes No NA
Have You or the Owner Made any Changes to the Basement or Other Foundation? Yes No
Is So, What Were the Changes: ______________________

Measurements

Sample Point ID	Post Install Pressure (in w.c.)		Inspection				Post Repair (If Necessary)		
			Date	Time	Pressure (in w.c.)		Date	Time	Pressure (in w.c.)
Manometer									

Comments (Any Repairs Made While Visiting, etc.): ______________________

Repairs

Additional Sealing Completed: ______________________ Date: ______________
System Repairs Completed: ______________________

Comfort Parameters	
CO (ppm)	
CO2 (ppm)	
O2 (%)	
Rh (%)	

Note: The active mitigation system design is based on the sub-slab depressurization system (SSDS), sub-membrane depressurization system (SMDS), and crawlspace depressurization system (CSDS) design criteria found in American Society for Testing and Materials (ASTM) Designation: E2121-03, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings (ASTM, 2008), United States Environmental Protection Agency (U.S. EPA) Region 5, Vapor Intrusion Guidebook (U.S. EPA, 2010), and U.S. EPA 625, Radon Reduction Techniques for Existing Detached Houses (U.S. EPA, 1993), and U.S. EPA, Indoor Air Vapor Intrusion Mitigation Approaches (U.S. EPA, 2008).

ATTACHMENT E

Differential Pressure Monitoring Log

Table 1

Differential Pressure Monitoring Log

Sub-Slab Depressurization Systems

System Type: ______________________

Date:_____________

Personnel:______

HVAC Settings:____

Barometric Pressure (in Hg)	
Indoor Temperature (F)	
Outdoor Temperature (F)	

SDS/ VMP ID:	Void Space Depth (in)	Test Intervals (1) (2)								AMB PID (ppm)	Eff PID (ppm)	Comments/Notes (4)
		Initial		30 minutes		60 minutes		120 minutes				
		Time	Pressure(3) (in wc)/[cfm]	Time	Pressure(3) (in wc)/[cfm]	Time	Pressure (in wc)/[cfm]	Time	Pressure(3) (in wc)/[cfm]			
Blower Velocity												
Inf PID												
Inf Temp												

Notes:

(1) Vacuum recorded as negative pressure.

(2) Record range of pressure values if applicable.

(3) Note the pressure reading for the SDS point is the applied vaccume reading, for VMPs it is the differential pressue reading.

(4) Note any conditions that may affect pressure differential such as atmospheric pressure, HVAC operations, doors open/closed.

Abbreviations:

in HG	Inches of mercury
in wc	Inches of water column
PID	Photo Ionization Detection
PPM	Parts Per Million
scfm	Standard cubic feet per minute

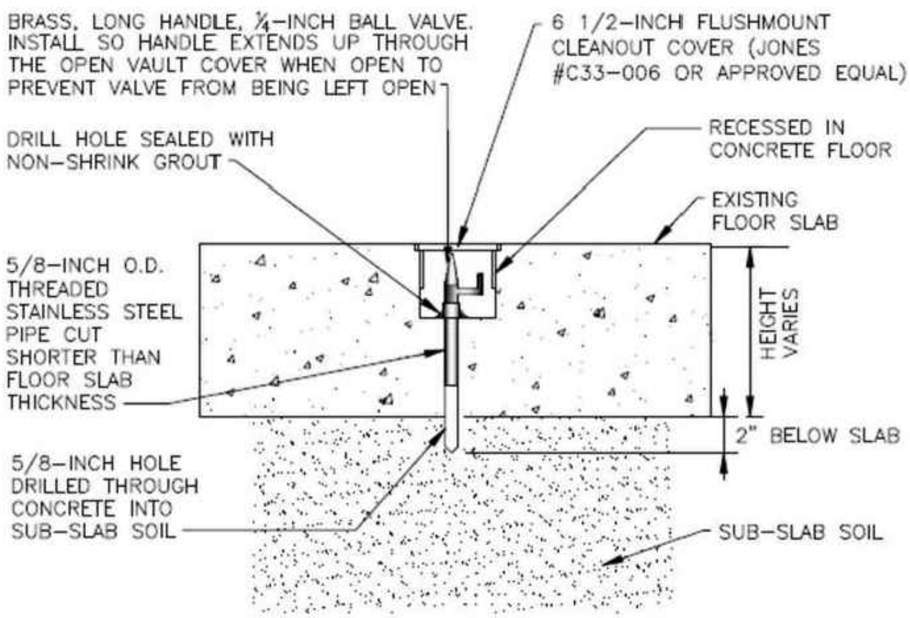
FIGURES

STELLAE INTERNATIONAL, INC.
50 MARCUS DRIVE
MELVILLE, NEW YORK

VAPOR INTRUSION SAMPLE LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1



MONITORING POINT DETAIL

NOT TO SCALE

STELLAE, 50 MARCUS DRIVE
FARMINGDALE, NEW YORK
OU-3 PRE-OCCUPANCY WORK PLAN

MONITORING POINT DETAIL

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2