Soil Vapor Intrusion Investigation
Sampling and Analysis Plan
Gowanus Canal Site
Site No. 224133
Brooklyn, Kings County
New York

October 2023

Prepared for:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
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List of Abbreviations and Acronyms

BCP	Brownfield Cleanup Program
COC	chain of custody
DER	Division of Environmental Remediation
DUSR	data usability summary report
E & E	Ecology and Environment Engineering and Geology, P.C.
EDD	electronic data deliverable
EPA	(U.S.) Environmental Protection Agency
EQuIS	Environmental Quality Information System
FAP	Field Activities Plan
HASP	Health and Safety Plan
in Hg	inches of mercury
MGP	manufactured gas plant
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	polycyclic aromatic hydrocarbon
PID	photoionization detector
QA	quality assurance
QC	quality control
QAPP	Quality Assurance Program Plan
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
SVI	soil vapor intrusion
VOC	volatile organic compound

1 Introduction

Ecology and Environment Engineering and Geology, P.C. (E & E) has prepared this Sampling and Analysis Plan (SAP) for soil vapor intrusion (SVI) investigation in the Gowanus Canal area of Brooklyn, New York (see Figure 1). The objective of this investigation is to assess if legacy contamination may affect indoor air quality in buildings in the Gowanus Canal Area.

1.1 Site Location and Background Information

The Gowanus Canal is an approximately 1.8-mile-long man-made navigational waterway in southeastern Brooklyn, Kings County, New York, and is a U.S. Environmental Protection Agency (EPA) National Priorities List site. EPA's primary remedy is to dredge contaminated upper sediments from the canal bed and place a cap on top of deeper contaminated sediments. As part of EPA's remediation plan, most of the canal has been bounded by "hard" urban shorelines in the form of bulkheads, moorings, and retaining walls.

The New York State Department of Environmental Conservation (NYSDEC) is the lead agency responsible for oversight of the investigation and remediation of upland facilities/properties adjacent to both sides of the Gowanus Canal. There are approximately 45 sites surrounding Gowanus Canal that are enrolled in the NYSDEC Division of Environmental Remediation (DER) remedial programs that include the State Superfund Program, Brownfield Cleanup Program (BCP), Environmental Restoration Program, Resource Conservation and Recovery Program, and the Voluntary Cleanup Program.

The neighborhood surrounding Gowanus Canal is a mix of industrial, commercial, and residential properties. Portions of the Gowanus Canal area have recently been rezoned and many residential buildings are in the process of being constructed.

There is substantial contamination from former manufactured gas plants (MGPs) and industrial facilities located in the immediate vicinity of the Gowanus Canal. Former MGP sites converted coal and petroleum products to gas that was used for heating, cooking, and lighting purposes. The process produced wastes including coal tar, an oily, viscous, dense liquid that does not readily mix with water. Coal tar waste contaminated subsurface soils and groundwater with a variety of volatile

organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polycyclic aromatic hydrocarbons (PAHs).

The non-MGP sites (sites primarily in the BCP) may have contaminated subsurface soils and groundwater with various petroleum-related and chlorinated VOCs, SVOCs, PAHs, polychlorinated biphenyls, per-and polyfluoroalkyl substances, and metals.

1.2 SVI Investigation Objectives and Methodology

The primary objectives of the SVI investigation are to:

- Determine if pathways exist for contaminants in soil vapor to impact indoor air quality of buildings due to legacy contamination from the various sites in the area; and
- Establish whether contaminant concentrations in soil vapor and/or indoor air, if present, pose a risk to human health for building occupants at adjacent properties.

The primary elements of this investigation include:

- E & E will use online resources to develop a database of addresses and owner information for the properties and buildings within the study area;
- E & E will assist NYSDEC with mailing property owner notification letters and developing a database and visual tracking system to schedule and track SVI sampling efforts.
- E & E will perform SVI sampling efforts in up to 300 structures during the 2023-2024 heating season. Sampling efforts will include:
  - Pre-sampling site inspection, property owner interviews, and completion of the New York State Department of Health (NYSDOH) *Indoor Air Quality Questionnaire and Building Inventory Forms*;
  - Materials inventory of all chemicals within the sampling areas of each structure that could interfere with interpretation of SVI results;
  - Installation of sub-slab sample points and collection of soil vapor samples;
  - Collection of indoor air samples; and
  - Collection of outdoor ambient air samples.

This SVI investigation will be conducted in a phased approach, focusing first on areas immediately surrounding sites in the northern half of the study area where contamination is known or suspected to be present. These results will be used to inform selection of subsequent areas or phases of the SVI investigation based on the presence of indoor air impacts. NYSDEC and E & E will mail notification letters to the first phase of property owners in October 2023 to seek access to these properties as part of the 2023-2024 heating season SVI investigation. While the time period for the 2023-2024 heating season is weather dependent, it is expected the heating season will start in early November 2023 and continue until

March 31, 2024. NYSDEC will direct additional sampling in the larger Gowanus Canal area depicted on the map (see pink outline on Figure 1) during this or future heating seasons based on the results from the initial phase(s) of SVI sampling.

2 SVI Sampling Activities and Procedures

This section provides a summary of the activities to be performed and procedures to be employed during the SVI investigation efforts. The proposed scope of work of the SVI investigation includes:

- Notifications regarding the SVI investigation and scheduling and tracking sampling efforts for property owners that choose to participate in the study.
- Building investigation and completion of NYSDOH's *Indoor Air Quality Questionnaire and Building Inventory Form* that includes an inventory of chemicals within the sampling areas of the building.
- Collection of concurrent 24-hour sub-slab and indoor air (e.g., basement indoor air and/or first-floor indoor air) samples at buildings within the sampling program.
- Collection of ambient outdoor air samples around buildings in the sampling program to establish background concentrations of contaminants from non-subsurface sources which may impact indoor air quality.

Unless otherwise specified herein for this project, all field activities will be performed in accordance with E & E's Master Quality Assurance Project Plan (QAPP) (E & E 2020a), E & E's Field Activities Plan (FAP) (E & E 2020b), and NYSDOH's Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH 2006).

Multiple laboratories will be used for this project (see Section 2.10). Therefore, sampling teams must ensure that all samples from a building (i.e., sub-slab vapor, indoor air, outdoor air, and/or water) are submitted to the same laboratory. Additionally, the sampling teams cannot mix sample canisters and flow controllers from different laboratories; both must be from the same laboratory.

2.1 Notification Procedures

NYSDEC will provide a letter requesting access to perform SVI sampling to building owners within the SVI investigation area. The letters will include the purpose and general process for the SVI investigation, site background information, and an access agreement to be signed by property owner to allow sampling to be performed.

E & E is developing a database to track and maintain contact with building owners that return access forms to NYSDEC indicating they wanted to be included in the SVI program. When a signed access agreement is received by NYSDEC, it will be communicated to E & E and E & E will contact the building owner (or their representatives) to provide building and occupant details, and to schedule SVI sampling. SVI sampling is a two-day process with two consecutive appointments scheduled for each building (set up of sampling canisters and gathering building data on the first day and sample canister retrieval on the second day). Appointments are expected to range in length from 1 to 12 hours depending on a variety of factors including but not limited to access limitations, building type and construction, building size, and the amount of chemicals stored within the building.

The scheduling database will include dates of when letters were mailed to owners, receipt of letter acceptance or declination of sampling, when owners are contacted to schedule sampling appointments, the sampling dates, and status of the sample results (e.g., receipt of laboratory data and data validation status).

The building owner, if not the occupant of the property, will be responsible for informing the tenants of the sampling program and arranging for access to the property, unless the property owner authorizes E & E to initiate contact directly with the tenants or another authorized representative.

2.2 Health and Safety Plan

The Gowanus Canal site-specific Health and Safety Plan (HASP) is provided in Appendix A. The HASP identifies the work performed for this investigation and provides the route to hospital maps for six different areas surrounding the Gowanus Canal.

2.3 Building Inspection, NYSDOH Questionnaire, and Chemical Inventory

A pre-sampling building inspection of potential sampling locations and a chemical materials inventory will be conducted to identify and minimize conditions that may interfere with the tests being performed and the interpretation of the results. If chemicals are identified inside the building that may interfere with SVI sampling and photoionization detector (PID; RAE Systems ppbRAE or equivalent) readings indicate potential leakage, the containers will be securely closed, sealed in plastic bags, and/or removed from the building entirely, with the owner's permission and assistance. Sampling may be delayed for at least 24 hours and the impacted area will be ventilated, if appropriate, to minimize residual indoor air contamination from those sources.

The chemicals and equipment of concern include, but are not limited to, petroleum products, gas-powered equipment, paints, varnishes, products containing petroleum distillates or solvents, and pesticides. In general, the volatile ingredients of each chemical, if available, will be photographed or recorded on the inventory

form, and the containers will be scanned with a PID for potential vapor emissions. If the contents of a container are not listed on the label, the product name and manufacturer's name and address (if available) will be recorded on the inventory form for later determination of the contents as needed.

During the building inspection, E & E will evaluate building layout and construction through visual examination, conduct an inventory of chemicals and equipment stored in the building (as discussed above), and record all pertinent information on the *Indoor Air Quality Questionnaire and Building Inventory Form* (see Appendix B) for each building.

The inspection will include a general evaluation of potential preferential pathways for VOCs to enter the structure including areas of exposed subsurface, cracks in the slab and foundation, elevator pits, utility corridors or tunnels, and utility penetrations. Other general factors to be determined include the presence of an attached garage, whether recent renovations or maintenance were performed, the presence of mechanical equipment that may impact air flow (e.g., heating, ventilation, and air conditioning; exhaust fans; and dryers), and use or storage of petroleum products (including home heating oil).

Photographs of the building layout and construction, pre- and post-sampling conditions, and any notable features will be taken. If practicable, photographs will be collected with a dry erase board in view to provide context for the photograph. A ruler or similar may be utilized as necessary to convey scale on close-up features such as cracks and slab penetrations.

2.4 Sub-slab Vapor Sampling

2.4.1 Sample Point Installation

Temporary sub-slab soil vapor probes will be installed through the basement floor (or slab-on-grade, if applicable) of each building (see Appendix C). In general, only one sub-slab sample will be collected per building unless this basement exceeds 4,000 square feet in area or multiple slabs/basement areas are present. Sub-slab sample location should be near the center of the basement floor when possible, but 5 feet away from foundation footings at a minimum.

At each sampling location, a hammer drill (or similar) will be used to drill the hole through the floor and a Vapor Pin device will be installed in accordance with the manufacturer's instructions (see Appendix D). In situations where a thin slab or other issues precluding use of a Vapor Pin are encountered, sample tubing may be installed directly into the hole and sealed with hydrated bentonite clay or equivalent. Basement floor material, thickness, and any other notable conditions will be recorded in the field logbook and/or building questionnaire.

Soil vapor samples will not be collected from crawlspaces with a dirt or other unsealed floor (see Section 2.5 for more details).

Some of the buildings within the SVI study area may have standing water in the basement after large rain events, in part due to a shallow groundwater table. If standing water is present in a significant portion of the basement or within 6 inches below the basement floor, sub-slab vapor samples will not be collected, and a water sample will be collected and analyzed for VOCs and SVOCs (see Section 2.7).

2.4.2 Leak Detection Test

A leak detection test will be performed at each sub-slab vapor sampling location to evaluate the integrity of the sub-slab probe seal and ensure that the soil vapor samples will not be diluted by indoor air. There are two type of leak detection tests that may be performed with detailed test procedures for each test provided in Appendices C and D. Both tests will also include a pressure check (shut-in test) on the connections between the Vapor Pin and sampling canister.

2.4.2.1 Water Dam Test

This is the preferred test to verify an adequate seal between the indoor air and sub-slab environment. Procedures are provided in Appendices C and D. To perform this test, a water dam will be constructed around the Vapor Pin using a PVC collar sealed to the floor with modeling clay, hydrated bentonite, or equivalent. After the soil vapor tubing connections are made, the collar is then filled with deionized or distilled water to a point above the Vapor Pin/sample tubing connection. Purging of the Vapor Pin/sample tubing is then performed (see Appendix C for purging requirements) and the water level inside the dam is monitored for changes in level. Monitor for about 2 minutes. If the water level does not drop, then the Vapor Pin seal through the floor is adequate. Once the test is complete and the seal passes the test, the PVC collar will remain in place but the water from inside the PVC collar will be removed, and the vapor point will be set up for sample collection. If the seals do not pass the test, the tubing and/or Vapor Pin will be removed, reset, and re-tested until an adequate seal is obtained.

2.4.2.2 Helium Bucket Test

To perform this test, an enclosure or shroud (commonly a 5-gallon bucket) will be placed over the sub-slab sample probe and tubing from the Vapor Pin probe will pass through an opening in the enclosure. Procedures are provided in Appendix C. Helium will then be slowly released into the bucket until a minimum 50% concentration (80% is the target) is present inside the bucket as measured by an electronic helium detector (Dielectric Technologies-brand Electronic Leak Detector, or equivalent). Once the helium concentration is acceptable, a minimum of three volumes of air in the tubing is purged (see Appendix C) to determine if the vapor pin/sample tubing system is short-circuiting to the helium-enriched atmosphere above the concrete slab. If the sample tube purge vapor has greater than 10% helium, the probe hole will be resealed with bentonite and the purge/helium test process again will be repeated. Once the test is complete and the seal passes the test, the bucket will be removed, and the vapor point will be set up for sample collection.

2.4.2.3 Shut-in Pressure Leak Test and Pre-sample Purging

After determining that the Vapor Pin through the slab is adequately sealed and testing materials have been removed, a shut-in pressure check will be performed to verify all tubing connections are leak-free. Procedures are included in Appendix C. The process involves creating a vacuum in the sample tubing between closed valves at the Vapor Pin and the sampling canister. A vacuum is created in the tubing with a syringe or hand vacuum pump and the vacuum pressure is monitored for 1 to 2 minutes using the canister regulator (canister valve remains off during the test). If the vacuum pressure within the system changes, all tubing connections (e.g., add or tighten clamps) are resealed and the test is repeated until successful.

2.4.3 Sub-slab Vapor Sample Collection

Summa passivated stainless-steel sample canisters will be used for sample collection. Depending on the laboratory, canister sizes can range from 1- to 6-liters, but all canisters will be equipped with a mass flow controller pre-set for a 24-hour sampling duration. The sample teams cannot mix sample canisters and flow controllers from different laboratories, both must be from the same laboratory.

The sample canister with flow controller and pressure gauge will be situated on a stable surface (ground) adjacent to the Vapor Pin. The flow controller and gauge will be secured to the sampling canister following the laboratory's instructions and will not be overtightened.

After confirming a leak-free setup as described above, the sample canister valve will be opened to verify the vacuum gauge pressure reads -25 inches of mercury (in Hg) or less. The gauge pressure will be observed for the first minute of initial sampling and rechecked 15 to 30 minutes into the sampling to ensure the pressure does not significantly change. For a 24-hour sampling duration, the gauge pressure should only change by about 1 in Hg per hour. If the pressure increases too rapidly, there may be a leak in the system or failure of the flow controller, so sample collection would be terminated, the source of the leak identified, and sample collection restarted using a new cylinder and flow controller.

Digital photographs of the sub-slab sample canister setup will be collected and the canister and regulator number, time and date of sample initiation, initial vacuum reading, and other pertinent information on the building inspection questionnaire/sampling form will be recorded once sampling is underway.

Sample collection will be stopped approximately 24 hours (+/- 1 hour) after initiation, with the final pressure ideally between 1 to 5 in Hg on the pressure gauge. The final time and date of sample completion and vacuum reading will be recorded, and sample collection will be completed by closing the canister valve. The sample train will then be disassembled and the Vapor Pin will be removed. Hydraulic cement will be used to patch the drill hole after sampling is complete.

Consumables from sampling such as the Vapor Pin Sleeves, Vapor Pin Caps, and associated tubing and fittings will be considered non-contaminated solid waste

and shall be disposed of as municipal garbage. Used Vapor Pins will be decontaminated for reuse after decontaminating with Alconox wash, rinsed with deionized or distilled water, and allowed to air dry.

2.5 Indoor Air Sampling

Indoor air samples will be collected concurrently (i.e., as feasibly close in time while minimizing the potential for release of vapors into indoor air during sub-slab vapor sampling) of sub-slab soil vapor samples in each building. Locations will include crawlspace/basement and/or the first floor of each structure. If the basement is an occupiable area that may be routinely used by residents (such as for storage, laundry, and exercise), even if it is not continuously habited, then indoor air sampling may only be performed in the basement unless an owner or tenant requests to conduct air sampling in first floor or higher apartments, with NYSDEC's approval sought prior to sampling. If a basement is not present, is only a crawlspace, or is otherwise not generally occupiable, then first-floor air sample(s) will also be collected.

Ambient indoor air samples will be collected from crawlspaces with a dirt or other unsealed floor, but soil vapor samples will not be collected.

Basement indoor air samples will generally be collected in the vicinity of the sub-slab soil vapor sample points at a height of about 3 to 5 feet above the floor. First-floor indoor air samples will be set up at approximately the same height in active areas of a living space. In apartment buildings, permission will be sought from a tenant to sample inside a first-floor apartment. If E & E is unable to sample inside an apartment, samples will be set up in a common space that is not directly affected by opening and closing of exterior doors, if possible.

After connecting the flow controller and pressure gauge to the sampling canister, the sample canister valve will be opened to verify the vacuum gauge pressure reads -25 in Hg or less and the pressure is recorded. The gauge pressure will be observed for the first minute of initial sampling and rechecked 15 to 30 minutes into the sampling to ensure the pressure does not significantly change. For a 24-hour sampling duration, the gauge pressure should only change by about 1 in Hg per hour. If the pressure increases too rapidly, there may be a leak in the system or failure of the flow controller, so sample collection should be terminated, the source of the leak identified, and sample collection restarted using a new cylinder and flow controller.

Collect digital photographs of the indoor air sample canister setup(s) and record the canister and regulator number, time and date of sample initiation, initial vacuum reading, and other pertinent information on the building inspection questionnaire/sampling form once sampling is underway.

Sample collection will be stopped approximately 24 hours (+/- 1 hour) after initiation, with the final pressure ideally between 1 to 5 in Hg on the pressure gauge.

The final time and date of sample completion and vacuum reading will be recorded, and sample collection will be completed by closing the canister valve.

2.6 Outdoor Air Sampling

Outdoor ambient air sample(s) will be collected concurrently with the indoor air samples to assess site-specific background outdoor air quality. The outdoor air sample locations will be selected in the field based on the wind direction and how securely the sample equipment can be staged, but it is preferred to be upwind of building when possible. When possible, upwind ambient outdoor air samples will be collected for each cluster of associated buildings sampled concurrently. Physical and visual barriers may be placed around the canisters, if necessary, so that they are not disturbed during sample collection; these barriers will be placed in a manner that will not obstruct air flow around the canisters.

Sample collection procedures, including initial and final pressure requirements and checks, are the same as described above for indoor air samples.

2.7 Indoor Water Sampling

Some residents within the SVI study area have notified NYSDEC that they periodically have standing water in their basement, commonly after large rain events. If significant standing water (more than 0.5 inch) is present in a significant portion of the basement floor or if water upwells from the subsurface when the sub-slab hole is drilled, then a sub-slab SVI will not be collected and a water sample for VOCs and SVOCs will be collected instead. If more than 1 inch of water is present, sample bottles may be filled directly, otherwise a peristaltic pump with dedicated sample tubing or syringe will be used to collect the water sample.

Digital photographs of the basement water and the sample collection time will be recorded in the field notebook/sampling form.

2.8 Project Logbook and Photo-documentation

Photos of each building and sample location will be taken and managed on an individual property basis, and associated notes will be recorded in field logbooks and on the building questionnaire. A logbook will be maintained to record general activities conducted by the sampling team.

2.8.1 Sample Labeling

All buildings will be assigned a unique building identifier that will not include the building address to maintain privacy to the extent practicable. The building code will be recorded on each page of the building inspection questionnaire form, and sampling forms. The unique building code will include “GC” to identify the project site, followed by a sequential four-digit number. An example of the building identifier is as follows:

- GC#### (i.e., GC0001 will be used for the first building sampled)

E & E will maintain an internal database associating building codes with street addresses and owners.

Each sampling location associated with a particular building will be assigned a unique location code. Locations will be identified by sample type and labeled with a sequential number. Examples are as follows:

- SV## for sub-slab vapor samples;
- BA## for basement air vapor samples;
- FA## for first floor air vapor samples;
- OA## for outdoor air samples; and
- WG## for water samples.

Samples collected from each location will be identified using the building code, location code, and the month and year of sampling in order to distinguish individual samples. For example, the sample identifier for the second sub-slab vapor sample collected from the 15th building sampled in February 2024 would be GC0015-SV02-0224.

2.8.2 Sample Packaging

Samples will be picked up by courier for hand delivery to the laboratory or shipped by the sample teams to the laboratory utilizing a shipping service (i.e., FedEx or UPS). Each sample container will be accompanied by a chain-of-custody (COC) record to document the transfer of custody from the field to the laboratory. All information requested in the COC record will be completed. A copy of the COC record will be retained by the samplers and placed in the project records file. The original will be sealed in a plastic bag and placed inside the cooler.

Each COC will include the sample code discussed above, date and time of sample collection, and requested analyses. The requested turnaround time will be 10 business days. Soil vapor samples will be specifically identified and PID readings from pre-sample purging will be included on the COC to assist the laboratory in identifying those samples that may contain elevated contaminant concentrations and require dilutions to protect instrumentation.

2.9 Quality Assurance and Quality Control

Quality assurance (QA) and quality control (QC) procedures will be performed in accordance with E & E's *Master Quality Assurance Project Plan (QAPP) for New York State Department of Environmental Conservation Projects*, *Contract No. D009807* (E & E 2020a). Specific activities that apply to the implementation of this SAP include:

- Collecting field duplicates at a rate of 1 per 20 samples per matrix at the same time as the original sample. For soil vapor samples, duplicate samples will be collected from the same vapor pin location using a "T-splitter" provided by the laboratory. For indoor and outdoor samples, a second sample canister/

flow controller setup will be situated no more than 2 feet from the original sample location. Field duplicates will not be identified as such on the COC.

- Documenting all data and observations on field data sheets and/or in the field logbooks.
- Operating and calibrating all field instruments in accordance with operating instructions as supplied by the manufacturer unless otherwise specified. At a minimum, ppbRAE and/or helium detector will be calibrated per week of use.
- Ensuring all laboratory deliverables are validated by an E & E chemist prior to release.

The canisters used for the sampling activities will be batch certified as clean by the laboratory by analyzing the ambient air inside a clean canister by EPA Method TO-15. If no target compounds are detected at concentrations above the reporting limits, then the canister is evacuated again, and the canister is available for sampling. If target compounds are detected at concentrations above the reporting limits, then the canister must be recleaned and reanalyzed for the target compounds.

2.10 Laboratory Analysis

All samples will be sealed, labeled, and placed in a shipping container for transport under strict COC procedures to one of following four laboratories under contract to E & E.

Centek Laboratories LLC
Samples will be shipped to the following address:

143 Midler Park Drive
Syracuse, NY 13206
Lab Contact: Russ Pellegrino
Office: (315) 431-9730 Ext. 401
Cell: (315) 416-2752

SGS North America, Inc.
A courier service will be provided by the lab. If needed, the lab address is:

2235 Route 130
Dayton, NJ 08810
Lab Contact: Tammy McCloskey
Office- (908) 421-3861

York Analytical Laboratories, Inc.
A courier service will be provided by the lab. If needed, the lab address is:

132-02 89th Ave. Suite 217
Richmond Hill, NY 11418
Lab Contract: Nicolette Lovari
Office: (203) 325-1371 Ext 851

TestAmerica Laboratories, Inc. (Eurofins Burlington)
Samples will be shipped to the following address:

30 Community Drive Suite 11
South Burlington, VT 05403
Lab Contact: Don Dawicki/Betsy Nye
Office: (802)-923-1029

The laboratories will analyze all air/vapor samples for VOCs using EPA Method TO-15. The laboratories will provide method detection limits that meet or are close to the concentrations in the NYSDOH SVI decision matrices per analyte (with NYSDEC approval). Water samples will be analyzed for VOCs by EPA SW-846 Method 8260 (latest update).

The laboratories will provide NYSDEC DER-10 Category B deliverables as PDF files and EQuIS-style (NYSDEC format) electronic data deliverables (EDDs) as Microsoft Excel files. An E & E chemist will review the report for completeness and process the EDDs to assign appropriate location codes, sample matrices, and parent sample codes. The laboratory data will be validated by E & E and will include review of the deliverables, assessment of the validity and usability of the results, and preparation of data usability summary reports (DUSRs) in accordance with Appendix 2B of DER-10 (NYSDEC 2010). EPA Region 2 standard operating procedures will be used for data validation guidance. The validator will update the EDDs with validator qualifiers, prepare and submit an EQuIS EDD to NYSDEC, and prepare final report tables.

2.11 Reporting

E & E will submit to NYSDEC EDDs for all required data. This will include the eight tables in the vapor intrusion EDD group.

Upon receipt of draft summary data from the laboratory (Category A/Level 2 report), E & E will forward the draft results to NYSDEC and NYSDOH. Data validation will be performed after receipt of the Category B/Level 4 lab report and associated EDD.

E & E will prepare a brief report for each structure sampled that will include the following:

- Address and associated building/location codes;
- The building inspection questionnaire, sampling forms, chemical inventory, and building sketches;
- Photolog;
- Description of the sampling procedures;
- A summary table of analytical results;
- An evaluation of the results in relation to NYSDOH SVI decision matrices and air guideline values; and
- Final laboratory reports and DUSRs.

E & E will not submit laboratory data or reports directly to property owners. Transmission of such data to the property owners will be the responsibility of NYSDEC or NYSDOH.

Within three months of completion of all SVI sampling for the heating season, E & E will prepare a report summarizing the work completed during the prior heating season. This will include maps showing property status (those contacted, declined, and sampled) and general analytical data. This report will not include addresses or site-specific analytical results, except for visual map depictions, to the extent practicable, for the protection of individual privacy.

3 References

Ecology and Environment Engineering and Geology, P.C. (E & E). 2020a. *Master Quality Assurance Project Plan (QAPP) for New York State Department of Environmental Conservation Projects*, May 2020.

_____. 2020b. *Field Activities Plan (FAP) for the Division of Environmental Remediation Standby Engineering Services Contract D009807*, May 2020.

New York State Department of Environmental Conservation (NYSDEC). 2010. *DER-10, Technical Guidance for Site Investigation and Remediation*, May 2010.

New York State Department of Health (NYSDOH) 2006. *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, with updates.

Figures

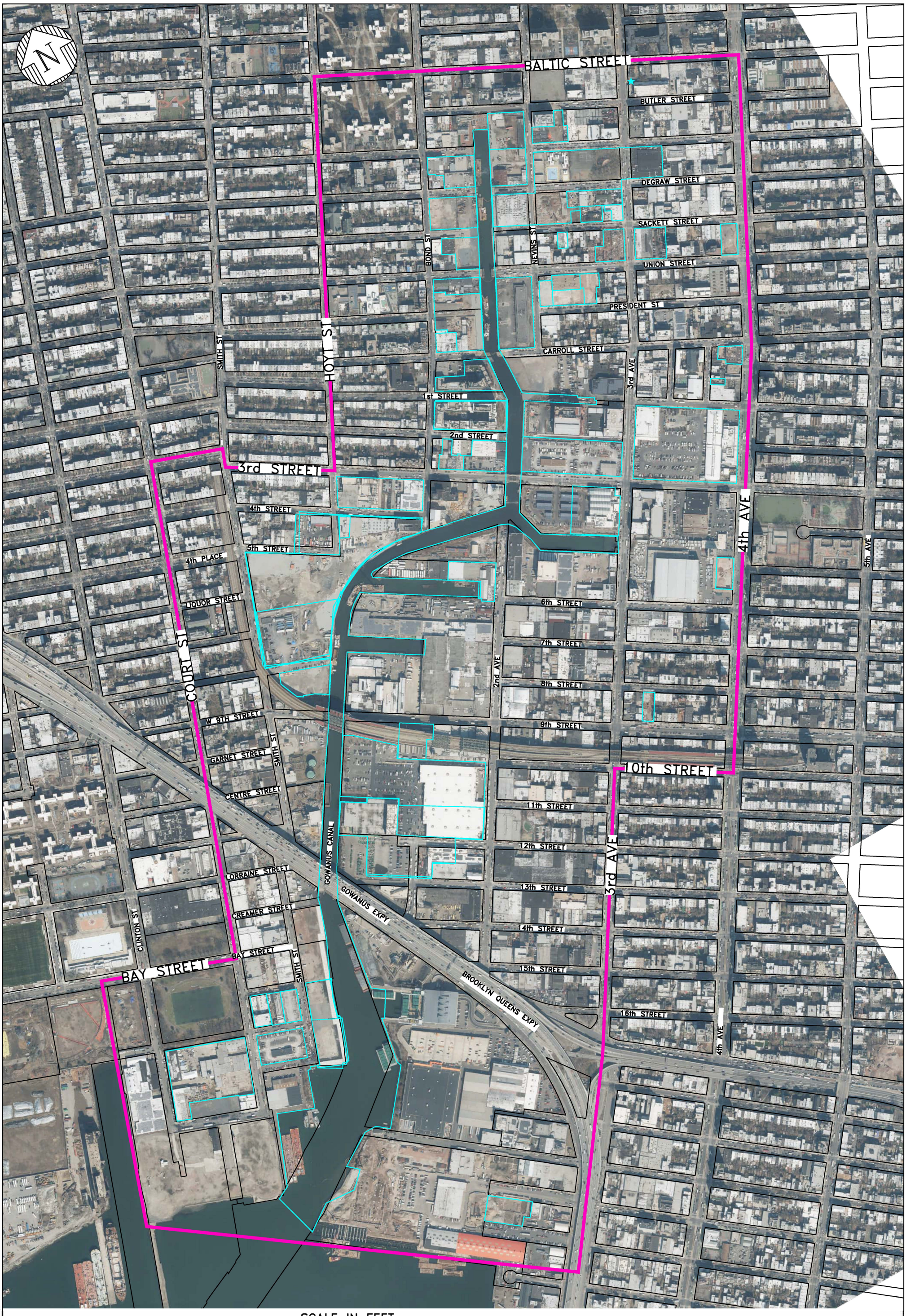


FIGURE 1 GOWANUS CANAL SVI INVESTIGATION AREA
GOWANUS CANAL SITE
KINGS COUNTY, NEW YORK

A Gowanus Canal Health and Safety Plan

Provided under separate cover.

B

Indoor Air Quality Questionnaire and Building Inventory Form

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_____

Property Address:_____

Location/Sample ID:_____

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	Municipal / Government

Other (Describe): _____

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 Building Characteristics:

Number of floors_____ Approx. building age_____

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

4. AIRFLOW
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	other _____
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				
l. Sump covered/sealed?	Y / N / NA				
m. Floor drains present?	Y / N / NA				
n. Perimeter trench drains present?	Y / N / NA				
o. Indoor cisterns/drywell?	Y / N / NA				
p. Laundry chute to 1st or 2nd Floors?	Y / N / NA				

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

Identify and describe potential soil vapor entry points and approximate size (e.g., floor cracks, utility ports, floor drains, wall cracks, weeps, or indoor wells)

_____

_____

_____

Other Comments: _____

_____

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 _____

Approximate age of heating system(s): _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Fuel oil storage location/condition/size, if applicable: _____

Boiler/furnace located in: Basement Outdoors Main Floor Other _____

Storage wood or coal: Basement Outdoors Main Floor Other _____

Fireplace(s) located in: Basement Main Floor Other _____

Air conditioning: Central Air Window units Open Windows None

Dehumidification: Stand alone unit Located on central air system

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., 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, boat) 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? ☐ Basement ☐ First floor Y / N If yes, where vented? _____

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

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

q. Basement windows? Type: Casement Awning Glass block Condition: _____

r. Are there exterior doors in the basement (e.g. "Bilco") Y / N / NA

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. OTHER ENVIRONMENTAL HAZARDS OBSERVED

Note factors that may impact vapor mitigation system installation or other construction activities:

A. Asbestos: □**Yes** **No** **Suspected**

1. Location & Estimated Quantity: _____

_____

2. General Condition: Good Fair Poor

3. Other Comments: _____

_____

B: Lead Paint: **Yes** **No** **Suspected**

1. Location & Estimated Quantity: _____

_____

2. General Condition: Good Fair Poor

3. Other Comments: _____

_____

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. **Include compass orientation or reference to street or front of house.**

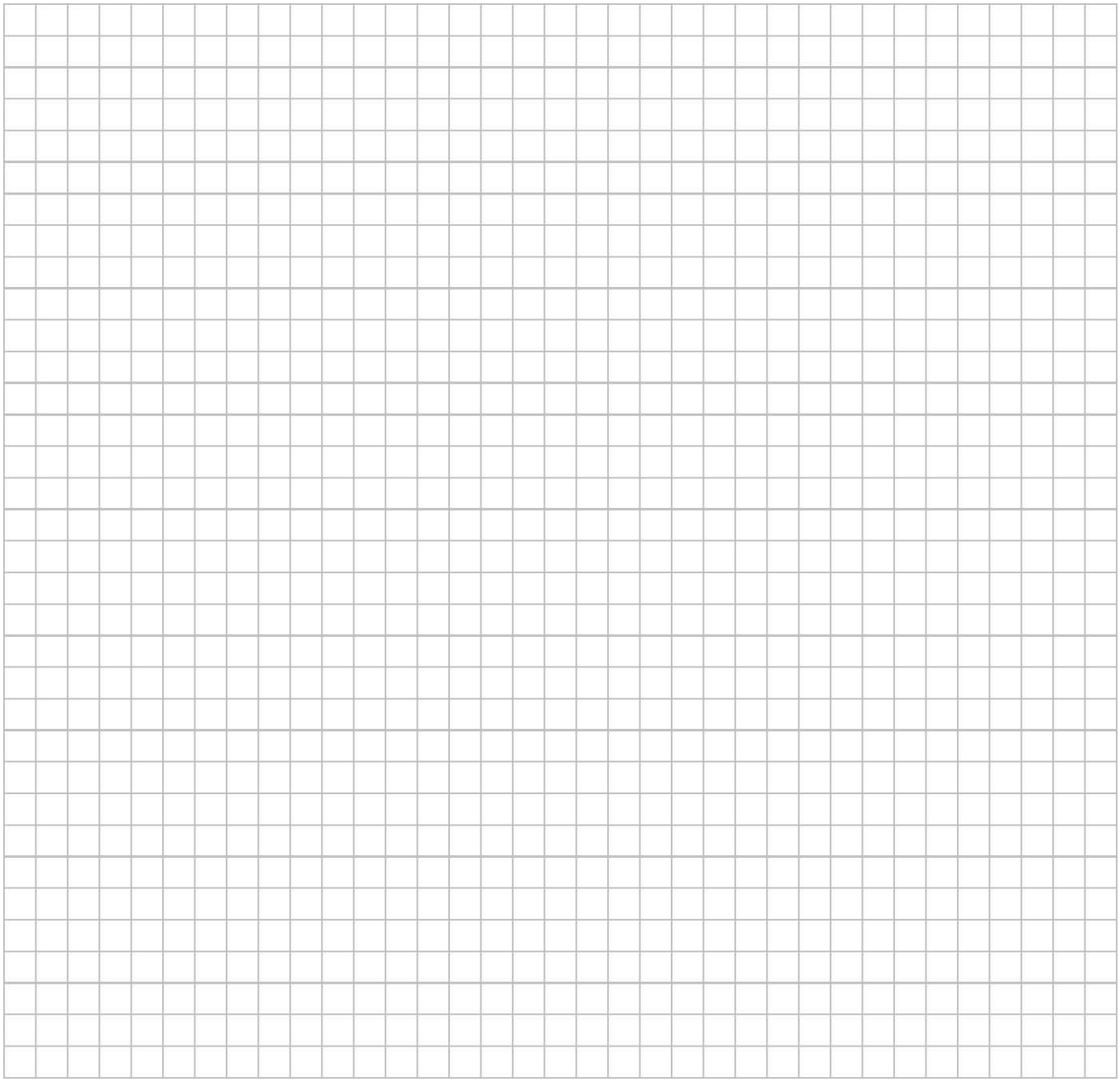
Basement:

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 **Page ___ of ___**

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.

C Soil Vapor Intrusion Sampling Procedures

Chemical Inventory Procedures

A chemical materials inventory verifies that chemicals inside the building will not interfere with the performance of soil vapor intrusion (SVI) tests.

Equipment

- Photoionization detector (PID), parts-per-billion-range organic vapor monitor (RAE Systems ppbRAE or equivalent).
- Digital camera.

Chemical Inventory

- Calibrate PID according to manufacturer's specifications on a weekly basis (or sooner as needed).
- Zero the PID reading outside the structure, if needed.
- Conduct a preliminary pre-sampling indoor air inspection of building rooms with the PID prior to setting up sample equipment to identify if high levels of volatile organic compounds (VOCs) are present in the indoor air that may affect or interfere with the proposed testing.
    - Record ambient readings in spaces where sampling will be performed. If significant VOC-containing sources (e.g., gasoline storage and gasoline powered equipment) are identified within the building and are in a condition allowing them to emit VOCs, remove these products from the building or seal them in plastic bags, with the owner's permission.
    - Allow sufficient time for VOCs emitted from these products to dissipate. This may require rescheduling the SVI sampling event (discuss this with the project manager and/or New York State Department of Environmental Conservation representative prior to rescheduling).
- As sampling canisters are set up, or after sampling has started, conduct a thorough inventory of all the chemicals on the floor in each room of the building being tested, if possible, as products stored in another area of a building can affect the testing of air in the room undergoing the test. Identify products including household and commercial products containing VOCs; petroleum products including fuel from gasoline-operated equipment, unvented space heaters, and heating oil tanks; finishes and paints; and products containing petroleum distillates. Record this information on a product inventory form.
- The product inventory form must include the following: building name/code, address, date, product location, product name/description, condition (i.e., unopened, used, or deteriorated), and PID reading. List the size and chemical ingredients (specifically volatile constituents) on the form or include reference to a specific photo of the product's ingredient list on the packaging.
- It is not necessary to provide detailed information for each individual container of "like" items, but it is necessary to indicate that "three containers of Air Wick Scented Oil air fresheners, lavender" or "12 cans of Dutch Boy Forever™ Interior latex paint" were present and their condition.

- If additional indoor sources of air contamination were identified during the inventory that were not identified during the initial screening that may interfere with the objectives of the investigation, the following measures should be implemented:
  - Remove products (with the owner's permission) or eliminate activities that may result in the release of volatile chemicals from the indoor environment prior to testing.
  - Ensure all containers storing volatile chemicals are tightly sealed.
  - Note any measures taken to control indoor air interferences on the building inspection form.

- After sampling is complete for a structure, all associated paper forms, including the *Indoor Air Quality Questionnaire and Building Inventory Form*, the chemical inventory list, and chain-of-custody (COC) records, must be scanned and saved in the project folder or submitted to the designated task manager. Save all photos in the project folder or submit to the designated task manager. When using paperless data collection forms, ensure that the data is saved to your device and synchronized to the data server as soon as a Wi-Fi connection is available. Specific instructions regarding paperless data collection are provided separately.

FOR 24 HOURS PRIOR TO SAMPLING AND DURING THE 24-HOUR SAMPLING PERIOD, ALL REASONABLE MEASURES SHALL BE TAKEN BY OWNER AND/OR TENANT TO AVOID:

- Opening any windows, fireplace dampers, openings, or vents;
- Operating ventilation fans unless special arrangements are made;
- Smoking in the house;
- Painting;
- Using wood stoves, fireplaces, or other auxiliary heating equipment (e.g., kerosene heaters);
- Operating or storing automobiles in an attached garage;
- Allowing containers of gasoline or oil to remain within the house, except for fuel oil tanks;
- Cleaning, waxing, or polishing furniture or floors with petroleum- or oil-based products;
- Using air fresheners or odor eliminators;
- Engaging in any hobbies that use materials containing VOCs;
- Using cosmetics, including hairspray, nail polish, nail polish removers, perfume/cologne, etc.; and
- Storing recently dry-cleaned clothing and materials.

Sub-Slab SVI Sampling Procedures

Equipment

- Battery powered hammer drill (two batteries);
- Drill bits, 5/8-inch diameter by 8 inches long (minimum usable length);
- Vacuum with high efficiency particulate air (HEPA) filtration or dustpan and brush for dust and debris cleanup;
- Vapor Pin, Vapor Pin silicone sleeves, Vapor Pin caps, Vapor Pin installation/extraction tool, bottle brush, and dead blow hammer;
- Inert laboratory- or food-grade-quality sample tubing (e.g., polyethylene, Teflon-lined polyethylene, or stainless steel), typically ¼- to ⅜-inch diameter;
- PID, parts per billion range organic vapor monitor (RAE Systems ppbRAE or similar);
- PVC collar, typically with a 4- to 6-inch diameter and 3 to 4inches tall for water dam leak detection testing;
- Bentonite (fine granular or powder), non-oil-based clay, play dough, or equivalent for water dam leak detection testing;
- Deionized or distilled water for water dam leak detection testing;
- Enclosure/shroud such as a 5-gallon bucket with rubber gasket around the rim and three, ⅜- to ½-inch-diameter holes with rubber grommets and plugs (for helium leak detection testing);
- Helium gas tank with low pressure tank regulator for leak detection testing*;*
- Portable helium detector (such as Mark Model 9822) for helium leak detection testing*;*
- Low flow air pump that fits ¼- to ⅜-inch ID tubing for air purge;
- Tedlar bags or equivalent;
- One-inch worm gear hose clamps with adjustable wrench and screwdriver/nutdriver;
- Certified, passivated canister (provided by independent laboratory) with vacuum gauge and flow controller. Canisters may be 1-liter (L), 1.4 L, or 6 L Summa canisters. Canister must be under a vacuum pressure of no more than -25 inches of mercury (in Hg) and flow controllers must be set for a 24-hour collection period (flow rate is dependent upon size of canister);
- Hydraulic cement and mixing tools for sub-slab hole repair; and
- Digital camera.

Selection of Sampling Locations

Centrally locate sub-slab samples when possible, but space them at least 5 feet away from foundation footings. The number of sub-slab vapor samples required in a building depends upon the number of slabs (e.g., multiple slabs-on-grade in a large warehouse) and foundation types (e.g., combined basement and slab-on-grade in a residence), so collect multiple samples in

basement areas greater than 4,000 square feet or in a building with multiple slabs-on-grade/elevation changes. Contact the project manager to discuss conditions and the appropriate number of samples where necessary.

Installation of Sub-Slab Sampling Point

- Take a digital photograph of the sampling location and surrounding area prior to drilling.
- Prior to drilling the hole, observe utility penetrations and the sump location to determine whether sub-slab utilities may be present.
- Drill a 5/8-inch-diameter hole completely through the concrete floor slab using a rotary hammer drill and masonry bit, but make sure not to drill more than 6 inches below concrete. Record the approximate thickness and condition of the slab.
- If water upwells from the hole or the drill bit is wet from water in the borehole do not install the sub-slab Vapor Pin, but instead collect a sample of the water for VOC analysis.
- Vacuum or brush the concrete dust away from the hole.
- Remove loose dust from the sidewalls of the hole with a bottle brush.
- Insert the Vapor Pin with silicon sleeve into the hole and hammer/set the Vapor Pin into the concrete using the installation/extraction tool and dead blow hammer. There should be a slight silicone "bubble" at the top of the concrete when the Vapor Pin is fully set and sealed.
- Install an approximately 6-inch-long sample tube to the top of the Vapor Pin, secure in place with a hose clamp if needed, and add a shut off-valve at the end in the closed position.
- Refer to the manufacturer's installation instructions for additional details.

Water Dam Leak Detection Testing

- Affix a string of modeling clay (or play dough) or bentonite to the bottom of the PVC collar and press the collar firmly to the concrete around the Vapor Pin.
- Connect the pressure gauge and flow control device to the sampling canister in accordance with the laboratory's instructions. DO NOT OVERTIGHTEN the connections on the canister. Typically, Swagelok or similar compression-style fittings require that the connection is tightened by hand plus one-quarter turn with a wrench (use an adjustable or box end wrench; do not use pliers or other toothed tools). ***Ensure that the canister valve remains closed at this time.***
- Connect additional sample tubing connected to a "T" fitting with a section of tubing that connects the sample canister flow controller with compression fittings and a section of tubing connected to a three-way valve, see Figure 1.

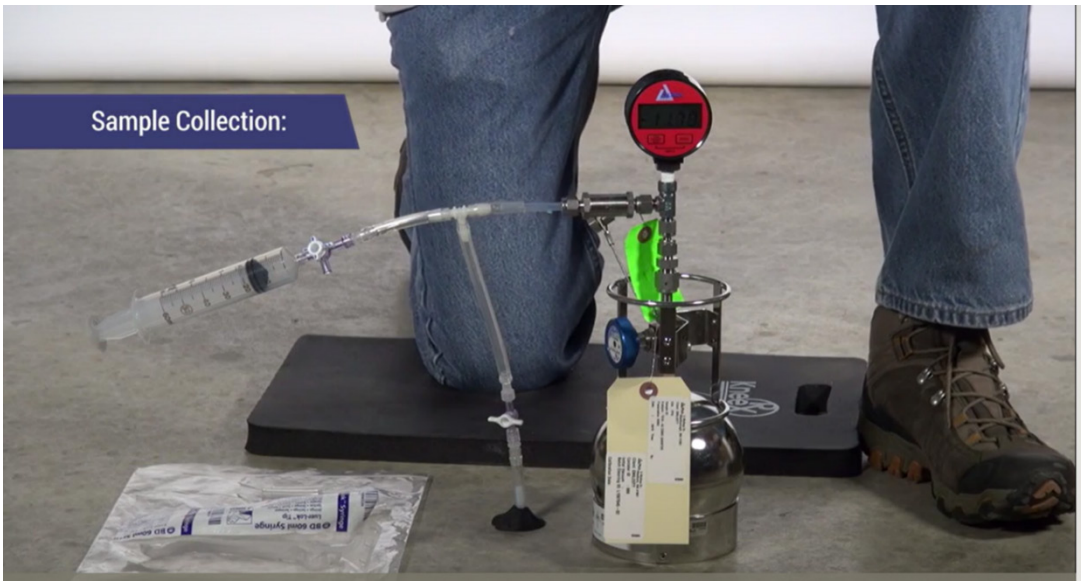


Figure 1: Tubing connections for sub-slab vapor sampling.
(Photo credit: Alpha Analytical Laboratory)

- Pour distilled or deionized water into the PVC collar so the water level is above the Vapor Pin/sample tube connection, see Figure 2.

Figure 2: Filling water dam.

- Connect a syringe or manual pump to the sample tubing as shown on Figure 1; open all valves ***except the main valve on the sampling canister***. Purge approximately three volumes of air in the sample tubing (approximately 10 milliliters (mL) per foot for ¼-inch inner diameter [ID] tubing or 15 mL per foot for ⅜-inch ID tubing) at a flow rate not to exceed

200 mL per minute. Use a Tedlar bag (or equivalent) to contain the purged air. Turn off the three-way valve after purging. Take the Tedlar bag outside the building and screen the contents with a PID. Record the PID readings on the building questionnaire/sampling form and the lab COC records.

- During purging and for at least 2 minutes thereafter, watch the water inside the PVC collar to make sure the level does not drop or bubble. If no change or bubbles are observed, the vapor seal is considered adequate.
- If the water level does change or bubbles are observed, dismantle the water dam set up, add bentonite around the probe hole, check or retighten the sample tube connection, and repeat the water dam test. If the sample tube penetration cannot be thoroughly sealed after two successive attempts, move to a new location and patch the original hole.
- Once the test is complete, close the valve just above the Vapor Pin, leave the collar and all the tubing connections in place, and remove the water from inside the collar using a sponge or syringe. The water may be left in place beyond the time of the initial test while the sampling team is completing other activities. Check the water level and remove water from the dam prior to departing the building.

Helium Bucket Leak Detection Testing

- Add 1.5 to 2.0 feet of sample tubing to the shut off-valve above the Vapor Pin, open the shut-off valve, place the bucket enclosure over the Vapor Pin gasket side down, and slip the sample tube through one of the ¼- to ⅜-inch grommets/holes in the bucket.
- Insert ⅜-inch sample tubing from the low-pressure tank regulator on top of the helium tank through the remaining grommet/hole a few inches into the bucket. If a good seal cannot be obtained between the bucket gasket and the ground surface, place a bentonite seal around the bucket and a place few pounds of weight to the top of the bucket.
- Insert the helium detector probe into the third grommet hole and slowly release helium into the bucket until the helium concentration inside the bucket is greater than 50% (80% is ideal), then pull the probe and plug the grommet hole, see Figure 3.
- Connect a syringe or hand vacuum pump to the sample tube and purge at least three volumes of air in the sample tubing directing the discharge to a Tedlar bag. Take the Tedlar bag outside the building and screen the contents with a helium detector. If a concentration of less than 10% helium is detected in the sample tube purge vapor, then the vapor seal is considered adequate.
- If the purged vapor contains greater than 10% helium, reseal around the probe hole with bentonite and repeat the purge/helium test process again. If the sample tube penetration cannot be thoroughly sealed after two successive attempts, move to a new location.
- Remove the bucket and helium supply when purging is complete and connect additional sample tubing, “T” fitting, and three-way valve as described above; see Figure 1.

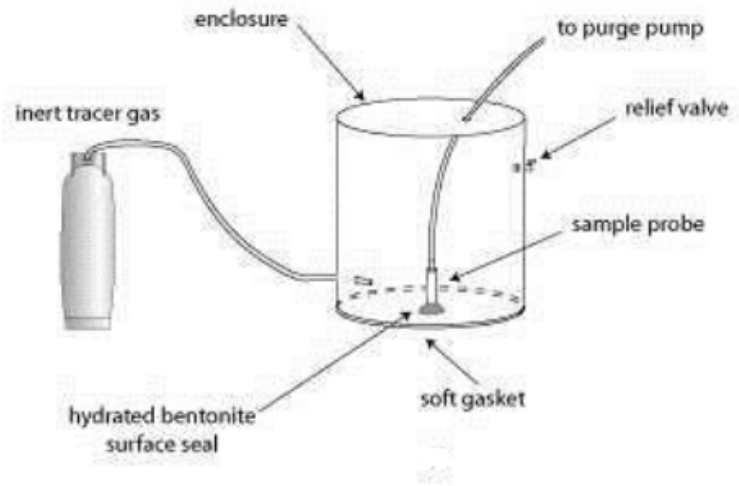


Figure 3: Helium leak detection test setup.
(Photo credit: NYSDOH Soil Vapor Intrusion Guidance, 2006)

Shut-in Pressure Leak Testing

- After the water dam or helium tests are complete, ensure that the sample canister is on a stable surface (ground) adjacent to the sample tube, the sample tubing is securely connected to the flow controller, and all valves are closed.
- Open only the three-way valve to allow the syringe or hand vacuum pump to be used to create a small vacuum pressure inside the sample tubing. Close the three-way valve and monitor the vacuum pressure for 1 to 2 minutes using the canister regulator (canister valve remains off during the test). If the vacuum pressure within the system changes, reseal all tubing connections (e.g., add or tighten clamps) and repeat the test until successful.

Sample Collection Initiation

- After all leak testing is complete, leave the three-way valve closed such that the tubing is not exposed to ambient air. Open and close the canister valve quickly to check canister pressure. The vacuum gauge pressure must read -25 in Hg or less to use the canister for sampling. Replace canister as needed.
- Assign sample identification on canister ID tag and record the sample identification, canister's serial number, flow controller serial number, and initial canister gauge pressure on the COC records, field notebook, and sample form.
- Open the valve at the top of the Vapor Pin to allow for sampling of sub-slab vapor. Open the canister valve to initiate sample collection. Observe the gauge pressure for approximately 1 to 2 minutes for noticeable pressure changes. For 24-hour collection periods, the pressure should only change by about 1 in Hg per hour. If the pressure noticeably changes, there may be a leak in the system or there could be a problem with the flow regulator. Either way, the sample collection should be terminated, the leak identified (if present), and sampling shall be

performed using a new sample canister and flow controller. If a new canister is used, check the connections using the shut-in pressure check procedure above.

- After sampling begins, recheck the gauge pressure after 15 to 30 minutes as described above to determine that the flow rate is appropriate.
- Take digital photograph of canister setup and surrounding area.
- Draw a plot sketch of the sampling area that includes room layouts, sample locations, locations of windows, doors, and staircases; location of utility floor/wall penetrations, and any major features (e.g., furnace, boilers, and chemical storage areas).
- Record the sample start time on COC records and in the field notebook/sample form.

Sample Collection Termination

- Arrive back at the sample location approximately 24 hours after test initiation, close the canister valve, and record the final gauge pressure and time on the COC records, field notebook, and sample form. Vacuum gauge pressure should read between approximately -5 and 0 in Hg, but not greater than or equal to 0 in Hg. If the gauge pressure is 0 in Hg or greater, discuss the situation with the laboratory and project manager to determine whether additional sample collection may be necessary.
- Disconnect the sample tubing and pressure gauge/flow controller from canister.
- Install plug on canister inlet fitting and place the sample canister in the original box.
- All canisters will be returned at the completion of the field sampling to the laboratory by shipment or courier. No work or shipment of samples will be expected on weekends or holidays.
- Remove and discard all tubing and valves.
- Remove the Vapor Pin using the extraction tool. Decontaminate the Vapor Pin prior to reuse.
- Mix hydraulic cement with enough water to form a putty-like consistency. Thoroughly fill the hole in the slab flush with the surface.
- Ensure that the area is returned to original conditions prior to leaving the building.

Indoor Air Sampling Procedures (Basement and First Floor)

Equipment

- Certified, passivated canisters (provided by independent laboratory) with a vacuum gauge and flow controller. Canisters may be 1 L, 1.4 L, or 6 L Summa canisters. Canisters must be under a vacuum pressure of no more than -25 in Hg and flow controllers must be set for a 24-hour collection period (flow rate dependent upon size of canister).
- Digital camera.

Selection of Sampling Locations

Indoor air samples may be collected from the following areas of a building to characterize contaminant concentrations and potential exposures within a building:

- From the basement (near the sub-slab sample location or in a central location) at a height approximately 3 to 5 feet above the floor to represent a height at which occupants normally are seated and/or sleep;
- From the lowest level living space if the basement is not a useable, habitable space (even if not continuously occupied), in centrally located, high-use areas away from exterior doors at a height approximately 3 to 5 feet above the floor to represent a height at which occupants normally are seated and/or sleep; and
- From a location where workers are expected to interact on semi-regular basis (behind counter, on shelf, or in back room) if in a commercial setting (e.g., a grocery or other type of store), at a height ranging from 3 to 7 feet above the floor to represent a height at which occupants normally are seated or standing.

Sample Collection Initiation

- Connect the pressure gauge and flow control device to the sampling canister in accordance with the laboratory's instructions. DO NOT OVERTIGHTEN the connections on the canister. Typically, Swagelok or similar compression-style fittings require that the connection are hand tightened plus one-quarter turn with a wrench (use an adjustable or box end wrench; do not use pliers or other toothed tools). ***Ensure that the canister valve remains closed at this time.***
- Place the canister on a stable surface at the appropriate height.
- Open the canister valve to initiate sampling and check the canister pressure. The vacuum gauge pressure must read -25 in Hg or less to use the canister for sampling. Replace the canister as needed.
- Assign sample identification on canister ID tag and record the sample identification, canister's serial number, flow controller serial number, and initial canister gauge pressure on the COC records, field notebook, and sample form.
- Observe the gauge pressure for approximately 1 to 2 minutes for noticeable pressure changes. For 24-hour collection periods, the pressure should only change by about 1 in Hg per hour.

If the pressure noticeably changes, there may be a leak in the system or there could be a problem with the flow regulator. Either way, sample collection should be terminated, and the leak identified (if present), and sampling shall be performed using a new sample canister and flow controller.

- After sampling begins and prior to leaving the building, recheck the gauge pressure after approximately 15 minutes as described above to determine that the flow rate is appropriate.
- Take digital photograph of canister setup and surrounding area.
- Draw a plot sketch of the sampling areas that includes room layouts and expected uses; sample locations; locations of windows, doors, and staircases; locations of utility floor/wall penetrations; and any major features.
- Record the sample start time on COC records and in the field notebook/sample form.

Sample Collection Termination

- Arrive back at the sample location approximately 24 hours after test initiation, close the canister valve, and record the final gauge pressure and time on the COC records, field notebook, and sample form. Vacuum gauge pressure should read between approximately -5 and 0 in Hg, but not greater than or equal to 0 in Hg. If the gauge pressure is 0 in Hg or greater, discuss the situation with the laboratory and project manager to determine whether additional sample collection may be necessary.
- Disconnect the pressure gauge and flow controller from canister.
- Install plug on canister inlet fitting and place the sample canister in the original box.

All canisters will be returned at the completion of the field sampling to the laboratory by shipment or courier.

Outdoor Air Sampling Procedures

Outdoor ambient air samples should be collected at the rate of at least one per day in the vicinity of indoor air sample locations.

Equipment

- One-inch worm gear hose clamps with adjustable wrench and screwdriver/nutdriver.
- Certified, passivated canister (provided by independent laboratory) with vacuum gauge and flow controller. Canisters may be 1 L, 1.4 L, or 6 L Summa canisters. Canister must be under a vacuum pressure of no more than -25 in Hg and flow controllers must be set for 24-hour collection period (flow rate dependent upon size of canister).
- Inert laboratory- or food-grade-quality sample tubing (e.g., polyethylene, Teflon-lined polyethylene, or stainless steel), typically ¼- to ⅜-inch ID.
- Digital anemometer to measure wind speed (maximum and average), wind direction, barometric pressure, and temperature.
- Digital camera.

Selection of Sampling Locations

Collect outdoor air samples from an upwind location of buildings where active SVI sampling occurs to characterize "background" contaminant concentrations in ambient air. Outdoor air samples shall be collected concurrently (+/- 6 hours of building sample time) and within 300 feet of the SVI building being sampled. Outdoor air sample shall be collected at:

- At a secure location when possible (e.g., fenced backyard);
- Away from wind obstructions (e.g., trees or bushes); and
- At a height above the ground to represent breathing zones (3 to 5 feet).

Sample Collection Initiation

- Connect the pressure gauge and flow control device to the sampling canister in accordance with the laboratory's instructions. DO NOT OVERTIGHTEN the connections on the canister. Typically, Swagelok or similar compression-style fittings required that the connection is hand tightened plus one-quarter turn with a wrench (use an adjustable or box end wrench; do not use pliers or other toothed tools). ***Ensure that the canister valve remains closed at this time.***
- Point the inlet of the air sampling canister down to avoid interference from precipitation and condensation. If the sampling canister is equipped with a "U" tube, connect it according to the laboratory's instructions. If not present, connect a short piece of sample tubing and arrange the inlet to point downwards to the extent practicable.
- Place the canister on a stable surface at the appropriate height.

- Open the canister valve to initiate sampling and check the canister's pressure. The vacuum gauge pressure must read -25 in Hg or less to use the canister for sampling. Replace canister as needed.
- Assign sample identification on canister ID tag and record the sample identification, canister's serial number, flow controller serial number, and initial canister gauge pressure on the COC records, field notebook, and sample form.
- Observe the gauge pressure for approximately 1 to 2 minutes for noticeable pressure changes. For 24-hour collection periods, the pressures should only change by about 1 in Hg per hour. If the pressure noticeably changes, there may be a leak in the system or there could be a problem with the flow regulator. Either way, terminate sample collection, identify the leak (if present), and take the sample using a new sample canister and flow controller.
- Take digital photograph of canister setup and surrounding area.
- Draw a plot sketch of the sampling area that includes nearby buildings and other structures, possible sources of outdoor air pollution (e.g., gas stations and repair shops), and wind direction.
- Record weather (e.g., precipitation, temperature, and barometric pressure).
- Record the sample start time on COC records and in the field notebook/sample form.
- Time permitting and before departing the area, recheck the gauge pressure after approximately 15 minutes as described above to determine that the flow rate is appropriate.

Sample Collection Termination

- Arrive back at the sample location approximately 24 hours after test initiation, close the canister valve, and record the final gauge pressure and time on the COC records, field notebook, and sample form. Vacuum gauge pressure should read between approximately -5 and 0 in Hg, but not greater than or equal to 0 in Hg. If the gauge pressure is 0 in Hg or greater, discuss the situation with the laboratory and project manager to determine whether additional sample collection may be necessary.
- Record weather (e.g., precipitation, temperature, and barometric pressure) and wind direction.
- Disconnect the sample tubing/"U" tube, pressure gauge, and flow controller from the canister.
- Install plug on canister inlet fitting and place the sample canister in the original box.

All canisters will be returned at the completion of the field sampling to the laboratory by shipment or courier.

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Vapor Pin Standard Operating Procedures

Standard Operating Procedure Installation and Extraction of the Vapor Pin®

Updated March 16, 2018

Scope:

This standard operating procedure describes the installation and extraction of the VAPOR PIN® for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the VAPOR PIN® for the collection of sub-slab soil-gas samples or pressure readings.

Equipment Needed:

- Assembled VAPOR PIN® [VAPOR PIN® and silicone sleeve(Figure 1)]; Because of sharp edges, gloves are recommended for sleeve installation;
- Hammer drill;
- 5/8-inch (16mm) diameter hammer bit (hole **must** be 5/8-inch (16mm) diameter to ensure seal. It is recommended that you use the drill guide). (Hilti™ TE-YX 5/8" x 22" (400 mm) #00206514 or equivalent);
- 1½-inch (38mm) diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch (19mm) diameter bottle brush;
- Wet/Dry vacuum with HEPA filter (optional);
- VAPOR PIN® installation/extraction tool;
- Dead blow hammer;
- VAPOR PIN® flush mount cover, if desired;
- VAPOR PIN® drilling guide, if desired;
- VAPOR PIN® protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel for repairing the hole following the extraction of the VAPOR PIN®.

Figure 1. Assembled VAPOR PIN®

Installation Procedure:

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

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

3) If a flush mount installation is required, drill a 1½-inch (38mm) diameter hole at least 1¾-inches (45mm) into the slab. Use of a VAPOR PIN® drilling guide is recommended.

4) Drill a 5/8-inch (16mm) diameter hole through the slab and approximately 1-inch (25mm) into the underlying soil to form a void. Hole **must** be 5/8-inch (16mm) in diameter to ensure seal. It is recommended that you use the drill guide.

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

6) Place the lower end of VAPOR PIN® assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool over the vapor pin to protect the barb fitting, and tap the vapor pin into place using a dead blow hammer (Figure 2). Make sure the installation/extraction tool is aligned parallel to the vapor pin to avoid damaging the barb fitting.

Figure 2. Installing the VAPOR PIN®

During installation, the silicone sleeve will form a slight bulge between the slab and the VAPOR PIN® shoulder. Place the protective cap on VAPOR PIN® to prevent vapor loss prior to sampling (Figure 3).

Figure 3. Installed VAPOR PIN®

7) For flush mount installations, cover the vapor pin with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover (Figure 4).

Figure 4. Secure Cover Installed

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

9) Remove protective cap and connect sample tubing to the barb fitting of the VAPOR PIN®. This connection can be made using a short piece of Tygon™ tubing to join the VAPOR PIN® with the

Nylaflow tubing (Figure 5). Put the Nylaflow tubing as close to the VAPOR PIN® as possible to minimize contact between soil gas and Tygon™ tubing.

Figure 5. VAPOR PIN® sample connection

10) Conduct leak tests in accordance with applicable guidance. If the method of leak testing is not specified, an alternative can be the use of a water dam and vacuum pump, as described in SOP Leak Testing the VAPOR PIN® via Mechanical Means (Figure 6). For flush-mount installations, distilled water can be poured directly into the 1 1/2 inch (38mm) hole.

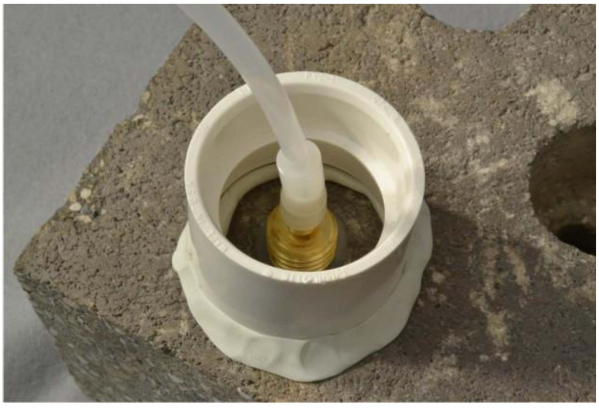

Figure 6. Water dam used for leak detection

11) Collect sub-slab soil gas sample or pressure reading. When finished, replace the protective cap and flush mount cover until the next event. If the sampling is complete, extract the VAPOR PIN®.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the VAPOR PIN® (Figure 7). Turn the tool clockwise continuously, don't stop turning, the VAPOR PIN® will feed into the bottom of the installation/extraction tool and will extract from the hole like a wine cork, DO NOT PULL.

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

Figure 7. Removing the VAPOR PIN®

- Prior to reuse, remove the silicone sleeve and protective cap and discard. Decontaminate the VAPOR PIN® in a hot water and Alconox® wash, then heat in an oven to a temperature of 265° F (130° C) for 15 to 30 minutes. For both steps, **STAINLESS – ½ hour, BRASS 8 minutes**

Standard Operating Procedure

Leak Testing the Vapor Pin® Sampling Device Via Water Dam

Scope & Purpose

Scope

The operating procedure describes the methodology to test a Vapor Pin® Sampling Device or equivalent sub-slab sampling device for leakage of indoor air.

Purpose

The purpose of this procedure is to assess the potential for indoor air to leak past the Vapor Pin® Sampling Device.

Equipment Needed

- Water Dam
- Distilled water
- VOC free modeling clay or equivalent
- Vapor Pin® Sampling Device and associated sample tubing

Procedure

1. Drill a ⅝-inch (16mm) hole in the concrete slab and install the Vapor Pin® Sampling Device as per the Standard Operating Procedure (SOP).
2. Clean the slab within a 2-inch radius of the Vapor Pin® Sampling Device to remove dust. Avoid wetting the concrete or wait until the concrete is dry before proceeding and avoid cleaning with VOC-containing substances. A whisk broom or shop vacuum is recommended. Remaining dust can be picked up with a piece of scrap modeling clay.
3. Roll a 1-inch diameter ball of modeling clay between your palms to form a “snake” approximately 7 inches long and press it against the end of the water dam. Push the water dam gently against the slab to form a seal with the concrete.
4. Attach the sample tubing to the top of the Vapor Pin® Sampling Device and pour enough distilled water into the water dam to immerse the base of the Vapor Pin® and the tubing connection at the top of the Vapor Pin® Sampling Device.
5. Purge the sample point as required by the data quality objectives. Concrete will absorb some of the water, which is normal; however, if water is lost to the sub-slab, stop, remove the water from the water dam, and reposition the Vapor Pin® Sampling Device to stop the leakage. Reseat the leak test equipment, if needed.
6. If the Vapor Pin® Sampling Device is installed in the flush-mount configuration, the larger hole can be filled with water in place of the water dam modeling clay.

Figure 1. Water dam used for leak detection