FIELD SAMPLING PLAN
FOR THE
VOGUE CLEANERS SITE
WAUWATOSA, MILWAUKEE COUNTY, WISCONSIN

REVISION 0

Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 5
Emergency Response Branch
77 West Jackson Boulevard
Chicago, Illinois 60604-3507

Prepared by:

WESTON SOLUTIONS, INC.
20 North Wacker Drive, Suite 2035
Chicago, Illinois 60606

April 17, 2014

Approved by: ______________________________ Date: ______________
EPA Region V
On-Scene Coordinator

Project Dates of Sampling:	April 22-24, 2014
Site Spill Identifier No.:	05ZZ
Contract Name:	START III
Contract No.:	EP-S5-06-04
Technical Direction Document No.:	S05-0001-1401-001
Document Control No.:	2301-4H-BLRJ

ACRONYM LIST

µg/kg	Microgram per kilogram
µg/L	Microgram per liter
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
DCE	Dichloroethene
ESA	Environmental Site Assessment
FSP	Field sampling plan
GPS	Global Positioning System
OSC	On-Scene Coordinator
PCE	Tetrachloroethene
PID	Photoionization detector
PPE	Personal protective equipment
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCL	Residual Contaminant Level
SOP	Standard operating procedure
START	Superfund Technical Assessment and Response Team
TCE	Trichloroethene
VOC	Volatile organic compound
WAC	Wisconsin Administrative Code
WESTON	Weston Solutions, Inc.

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1. INTRODUCTION

This Field Sampling Plan (FSP) identifies the data collection activities and associated quality assurance/quality control (QA/QC) measures specific to the sampling event at the Vogue Cleaners Site (the Site) located in Wauwatosa, Milwaukee County, Wisconsin. All data will be generated in accordance with the quality requirements described in the Weston Solutions, Inc. (WESTON®)Superfund Technical Assessment and Response Team *(START) III Generic Quality Assurance Project Plan (QAPP)*, dated June 2006. The purpose of this FSP is to describe site-specific tasks that will be performed in support of the stated objectives. The FSP will reference the QAPP for generic tasks common to all data collection activities including routine procedures for sampling and analysis, sample documentation, equipment decontamination, sample handling, data management, assessment, and data review. Additional site-specific procedures and/or modifications to procedures described in the *START III Generic QAPP* are described in the following FSP elements.

This FSP is prepared, reviewed, and approved in accordance with the procedures detailed in the *START III Generic QAPP*. Any deviations or modifications to the approved FSP will be documented using Table 1: FSP Revision Form.

2. PROJECT MANAGEMENT, FSP DISTRIBUTION, AND PROJECT TEAM MEMBER LIST

Management of the Site will be as documented in the *START III Generic QAPP*. Refer to the *START III Generic QAPP* for an organizational chart, communication pathways, personnel responsibilities and qualifications, and special personnel training requirements.

The following personnel will be involved in planning and/or technical activities performed for this data collection activity. Each will receive a copy of the approved FSP. A copy of the FSP will also be retained in the site file.

Personnel	Title	Organization	Phone Number	Email
Steven Faryan	OSC	EPA	312-802-0507	Faryan.Steven@epa.gov
Jim Ursic	Geoprobe® Operator	EPA	312-353-1526	ursic.james@epa.gov
Lisa Graczyk	Project Manager/QA Reviewer	START	312-424-3339	lgraczyk@css-dynamac.com
Brennan Johnson	Site Lead	START	312-424-3335	brennan.johnson@westonsolutions.com
Tim Papan	Field Team Member	START	847-918-4049	TJ.Papan@WestonSolutions.com
Linda Korobka	Health and Safety	START	517- 381-5936	linda.korobka@WestonSolutions.com

NOTES:
OSC – On-Scene Coordinator
QA – Quality Assurance
START – Superfund Technical Assessment and Response Team

3. PLANNING AND PROBLEM DEFINITION

3.1 PROBLEM DEFINITION

The former Vogue Cleaners site was sampled by Symbiont, a subcontractor to the City of Wauwatosa. Symbiont advanced soil borings and collected soil and groundwater samples from the borings. The analytical results revealed tetrachloroethene (PCE) in the soil and groundwater at concentrations which exceeded the applicable Wisconsin Administrative Code (WAC) NR 720 non-industrial residual contaminant levels (RCL). EPA is to advance soil borings on the Site and in the area of the Site to determine soil gas volatile organic compound (VOC) concentrations and the extent of groundwater and soil gas contamination.

3.2 SITE HISTORY AND BACKGROUND

The Site is located at 2578 N Wauwatosa Avenue, Wauwatosa, Milwaukee County, Wisconsin (**Figure 1**) and contained a former dry cleaning facility. The Site's geographic coordinates are 43° 03' 57.83" North latitude and 88° 00' 25.82" West longitude. The Site is located in a mixed commercial and residential area. The Site is bordered to the north by Clarke Street, a veterinary clinic, and residential properties; to the east by residential properties; to the south by residential properties; and to the west by N Wauwatosa Avenue and residential properties. The site contains a two-story building and paved parking lot (**Figure 2**). The Menomonee River is located approximately 1.3 miles south of the Site.

On January 30, 2014, Symbiont conducted a Phase II Environmental Site Assessment (ESA) which consisted of advancing eight soil borings on the site property with the use of a Geoprobe® rig. The soil borings were advanced to a total depth of 6 to 15 feet below ground surface (bgs) and the depth to water ranged from 1 to 12 feet bgs. One groundwater and two soil samples were collected from each boring. PCE was detected in soil at concentrations ranging from 36.6 to 76,600 micrograms per kilogram (µg/kg) and in groundwater at concentrations ranging from 0.57 to 10,900 micrograms per liter (µg/L). PCE results in soil and groundwater exceeded the applicable WAC NR 720 non-industrial RCLs. PCE breakdown products were also detected in soil and groundwater including trichloroethylene (TCE); vinyl chloride; and cis-1,2-dichloroethene (DCE). Results for some of these compounds also exceeded applicable WAC NR 720 non-industrial RCLs. Symbiont surveyed the installed temporary monitoring wells and collected water level measurements. Groundwater was determined to flow to the south of the Site.

3.3 CONTAMINANTS OF CONCERN/TARGET ANALYTES

The contaminants of concern in groundwater and soil gas at the Site are VOCs, primarily PCE, TCE, cis-1,2-DCE, and vinyl chloride.

4. PROJECT DESCRIPTION AND SCHEDULE

Planning and Mobilization

Site work is currently scheduled to occur on April 22-24, 2014. START will have two personnel performing the site assessment activities. Level D Personal Protective Equipment (PPE) is anticipated based on the known physical and chemical hazards at the Site.

Prior to conducting any intrusive activities at the Site, Diggers Hotline will be called and EPA representatives will meet with the City to locate utilities.

Groundwater and Soil Gas Sampling

EPA will advance three soil borings on the Site property and up to six soil borings in the public right-of-ways in front of residential and commercial structures located within areas surrounding the Site (**Figure 3**). One groundwater and one soil gas sample will be collected from each boring. EPA will be operating a Geoprobe drill rig for all boring locations. All of the sampling locations will be recorded with a global positioning system (GPS) unit. The sampling design is provided below in **Section 6.0**.

Sub-Slab Vapor and Indoor Air Sampling (as needed)

If analytical laboratory results of soil gas exceed residential chemical-specific screening levels specified by the Agency for Toxic Substances and Disease Registry (ATSDR), EPA may evaluate the potential for vapor intrusion into residential structures through the sampling of sub-slab vapor and indoor air. A total of one indoor air sample will be collected from the living quarters and one indoor air sample or sub-slab sample will be collected from the substructure (i.e.; crawlspace or basement). If the substructure is a basement and the owner allows a port to be installed through the basement floor, then a sub-slab sample will be collected. If the owner does not allow a port to be installed, then an indoor air sample will be collected in the basement. If the substructure is a crawlspace, then an indoor air sample will be collected in the crawlspace. The addresses of the properties have yet to be determined. The samples will be analyzed for VOCs using EPA Method TO-15.

5. PROJECT QUALITY OBJECTIVES

5.1 PROJECT OBJECTIVES

The objective of the site assessment is to collect samples to evaluate potential threats to human health, human welfare, and the environment posed by current Site conditions. The objectives for this investigation include:

- Identify the constituents and/or characteristic properties of soil gas and groundwater
- Conduct a subsequent vapor intrusion investigation based on soil gas results and other available background data

- Rapidly assess and evaluate the urgency, magnitude, extent, and effects of a release, or threatened release, of hazardous substances, pollutants or contaminants identified and their effects on human health and/or the environment
- Supply the ATSDR or others with information about the nature and magnitude of any health threats associated with the identified threats
- Support subsequent public health advisories
- Determine a remedy to eliminate, reduce, or control risks to human health and the environment and to support an Action Memorandum documenting the identified removal approach.

5.2 MEASUREMENT AND PERFORMANCE CRITERIA

Generic measurement and performance criteria described in the *START III Generic QAPP* will be used. These criteria will ensure that data are sufficiently sensitive, precise, accurate, and representative to support site decisions.

5.3 DATA QUALITY OBJECTIVES

Data quality objectives address requirements that include when, where, and how to collect samples; the number of samples; and the limits on tolerable error rates. These steps should periodically be revisited as new information about a problem is learned. Sections 4.0 and 6.0 address these objectives.

The groundwater sampling results will be used to determine if VOCs (PCE, TCE, vinyl chloride, and cis-1,2-DCE) are present in the groundwater. The soil gas samples will be analyzed for VOCs. The sampling results for soil gas VOC sampling results will be compared to 10 times the respective VOC sub-slab screening level concentration which will be developed by ATSDR.

6. SAMPLING DESIGN

6.1 GROUNDWATER AND SOIL GAS SAMPLING

Site work is currently scheduled to occur April 22-24, 2014. The site assessment will be performed in Level D PPE in accordance with the approved site specific health and safety plan. Air monitoring will be conducted throughout the site assessment using a MultiRAE Plus five-gas meter outfitted with a photoionization detector (PID) to screen for organic vapors.

EPA will operate a Geoprobe® to advance up to nine soil borings on the Site property and in public right-of-ways (see **Figure 3**). Sample SB-9 is an upgradient sample as groundwater flow was determined to be to the south during the Phase II ESA. Borings will be advanced to one foot below the zone of saturation which is expected to range from 2 to 12 feet bgs at the Site. A soil boring log will be filled out for each borehole (**Appendix A**).

Representative soil from each 3-foot macrocore sampler (equipped with plastic liners) will be screened with a PID by breaking open a fresh portion of the soil and quickly placing the PID probe adjacent to the opening, creating an enclosure with a nitrile-gloved hand for vapor accumulation. PID readings will be recorded on the soil boring log.

Groundwater samples will be collected from the Geoprobe® rod. Groundwater will be purged using low-flow techniques until relatively sediment-free using disposable poly tubing and a 2-inch bladder pump or peristaltic pump. Field parameters will not be measured during this sampling event. Grab groundwater samples will be collected in laboratory provided containers. All sample bottles will be pre-preserved by the analytical laboratory. Any reusable sampling equipment that contacts the samples will be decontaminated between sample collections in accordance with the requirements outlined in Section 7.2 of this FSP. Disposable equipment will be utilized when available.

One soil gas probe will be installed immediately above the saturated zone at each boring location. The tip of each soil gas probe will be placed within a sand or glass bead pack extending 6 inches above the sampling interval. The borehole will then be grouted to the surface or to the upper sampling location with hydrated bentonite to ensure adequate sealing of the soil gas sampling probes and to minimize the exchange of atmospheric air. The soil gas sites will then be allowed to equilibrate for 24 hours after which a PID will be used to measure organic vapor concentrations and to purge the line for approximately 30 seconds. The soil gas samples will be collected using a 1-liter Summa canister with a 10-minute flow regulator and submitted for laboratory analysis for VOCs.

Requirements for the sample container, volume, preservation, and QC samples are presented in **Table 2.**

6.2 SUB-SLAB VAPOR PROBE AND INDOOR AIR SAMPLING

At this time, it is not known if sub-slab or indoor air sampling will be required. If analytical laboratory results of soil gas exceed screening levels specified by ATSDR, EPA may evaluate the potential for vapor intrusion into residential and commercial structures through the sampling of sub-slab vapor and indoor air. The collection of sub-slab vapor probe and indoor air samples are described below.

Sub-slab Vapor Probe Air Sampling. If the substructure is a basement and the owner allows a port to be installed through the basement floor, then the appropriate location will be determined. If the owner does not allow a port to be installed, then an indoor air sample will be collected in the basement. If the substructure is a crawlspace, then an indoor air sample will be collected within the crawlspace. The sub-slab vapor probe will be placed at a feasible location on the lowest level and preferably in the middle footprint of the basement. The sub-slab vapor probe will be installed in accordance with EPA Standard Operating Procedure (SOP) 2082. The sub-slab vapor probe air sample will be collected over a 24-hour period. The locations sampled will be marked clearly on a Site drawing and noted in the field logbook/field collection sheets. Requirements for the sample container, volume, preservation, and QC samples are presented in **Table 2.**

Indoor Air Sampling. Prior to sampling, the appropriate location for indoor air sampling will be determined. The air will be screened for interferences using a ppbRAE. A ppbRAE is a PID that provides continual air monitoring of VOCs at part per billion concentrations. All inferences will be removed from the sample area prior to sample collection. The indoor air sample will be collected in accordance with EPA SOP 1704. The indoor air sample will be collected over a 24-hour period. The locations sampled will be marked clearly on a Site drawing and noted in the field logbook/field collection sheets. Requirements for the sample container, volume, preservation, and QC samples are presented in **Table 2**.

6.3 SAMPLE NUMBERING SYSTEM

All samples for analysis, including QC samples, will be given a unique sample number. The sample numbers will be recorded in the field logbook and on the chain-of-custody paperwork.

WESTON START will assign each sample its unique number. The sample number highlights the suspected contaminated area and location, and will be used for documentation purposes in field logbooks, as well as for presentation of the analytical data in memoranda and reports.

The project samples will be identified using the following format:

VC-SBX-MatrixXX(Z-Z)-mmddyy

Where:

- "VC" indicates that the sample was collected from the Vogue Cleaners Site.
- "SBX" indicates the soil boring number that the sample is being collected from (SB1-SB9)
- "Matrix" indicates the sample matrix (GW = groundwater, SG = soil gas, SS = sub-slab vapor, IA = indoor air).
- "XX" indicates the sequential name of the sample for sub-slab and indoor air samples.
- ZZ indicates the sample depth, if applicable
- "mmddyy" indicates the date

Field duplicate samples will be designated with a "D" suffix. An example of sample identification:

- VC-SB2-GW(8-9')-042214: Groundwater sample collected from soil boring SB-2 at a depth of 8 to 9 feet bgs, collected on April 22, 2014.

- VC-SB2-SG(7-8')-042214: Soil gas sample collected from boring SB-2 at a depth of 7 to 8 feet bgs, collected on April 22, 2014.

6.4 Management of Investigation-Derived Wastes

For purposes of this FSP, investigation-derived wastes are defined as any byproduct of the field activities that is suspected or known to be contaminated with hazardous substances. The performance of field activities will produce waste products, such as spent sampling supplies and expendable PPE. Decontamination water will be generated from the cleaning of the Geoprobe rods and will be disposed on-site. Soil cuttings generated during the advancement of soil borings will be staged in 55-gallon drums and staged at a location to be determined by EPA. Disposal arrangements will be executed in accordance with appropriate local, state, or federal regulations. EPA will refer to the EPA's *Management of Investigation-Derived Wastes During Site Inspections* (EPA, 1991) guidance on off-site disposal policies.

7. SAMPLING PROCEDURES

7.1 SAMPLING STANDARD OPERATING PROCEDURES

The procedures detailed in Section 6 will be followed for groundwater and soil gas sampling. The following Standard Operating Procedures (**Appendix B**) will be used for the sub-slab and indoor air sampling with any necessary modifications that are needed:

- SOP 1704 – Summa Canister Sampling
- SOP 2082 - Construction and Installation of Permanent Sub-Slab Soil Gas Wells

7.2 DECONTAMINATION PROCEDURES

General decontamination procedures are described in Section B.2 of the *START III Generic QAPP*.

- All disposable sampling supplies and PPE will be bagged and removed from the Site in an area specified by the EPA.
- All reusable Geoprobe sampling equipment, trowels, and any other non-disposable sampling supplies will be decontaminated with a steam cleaner or scrubbed with Alconox and rinsed with potable water.

8. SAMPLE HANDLING, TRACKING, AND CUSTODY PROCEDURES

All samples will be identified, handled, shipped, tracked, and maintained under chain-of-custody, in accordance with *START III Generic QAPP* Section B.3.

9. FIELD ANALYTICAL METHODS AND PROCEDURES

9.1 FIELD ANALYTICAL METHODS AND STANDARD OPERATING PROCEDURES

Field analytical methods will not be employed during the sampling events at the Site.

9.2 FIELD TESTING LABORATORY

A field testing laboratory will not be used during the sampling events at the Site.

10. FIXED LABORATORY ANALYTICAL METHODS AND PROCEDURES

An EPA-certified commercial laboratory will be used. The laboratory name, address, contact person, and telephone number are as follows:

STAT Analysis Corporation,
2242 W. Harrison, Suite 200,
Chicago, IL 60612-3766
312-733-0551

The laboratory analytical methods are detailed in **Table 2** of this FSP.

11. QUALITY CONTROL ACTIVITIES

11.1 FIELD QUALITY CONTROL

The number of QC samples collected for each analytical parameter and concentration level are listed in Table 2: FSP Summary. The QC sample determination and frequency is in accordance with the *START III Generic QAPP*, Table 4.

11.2 ANALYTICAL QUALITY CONTROL

QC for analytical procedures will be performed at the frequency described in the *START III Generic QAPP*, Tables 5 and 6. In addition, method-specific QC requirements will be used to ensure data quality.

11.3 PERFORMANCE EVALUATION SAMPLES

Performance Evaluation Samples will not be collected during this sampling event.

12. DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

Documentation, record keeping, and data management activities will be conducted in accordance with the *START III Generic QAPP*, Section B.10.

13. QUALITY ASSURANCE ASSESSMENT AND CORRECTIVE

ACTIONS

No field audits will be conducted during the sampling event.

14. REPORTS TO MANAGEMENT

Reports to management will be written and distributed in accordance with the *START III Generic QAPP,* Section C.

15. STEPS 1, 2 AND 3: DATA REVIEW REQUIREMENTS AND PROCEDURES

Step 1: Data collection activities, including sample collection and data generation, will be verified in accordance with the *START III Generic QAPP*, Section D.

Step 2: Data will be validated by WESTON START.

Step 3: Data will be reviewed for usability in accordance with the *START III Generic QAPP*, Section D.

Table 1
FSP Revision Form

Site: Vogue Cleaners Site
OSC: Steven Faryan
TDD: S05-0001-1403-001

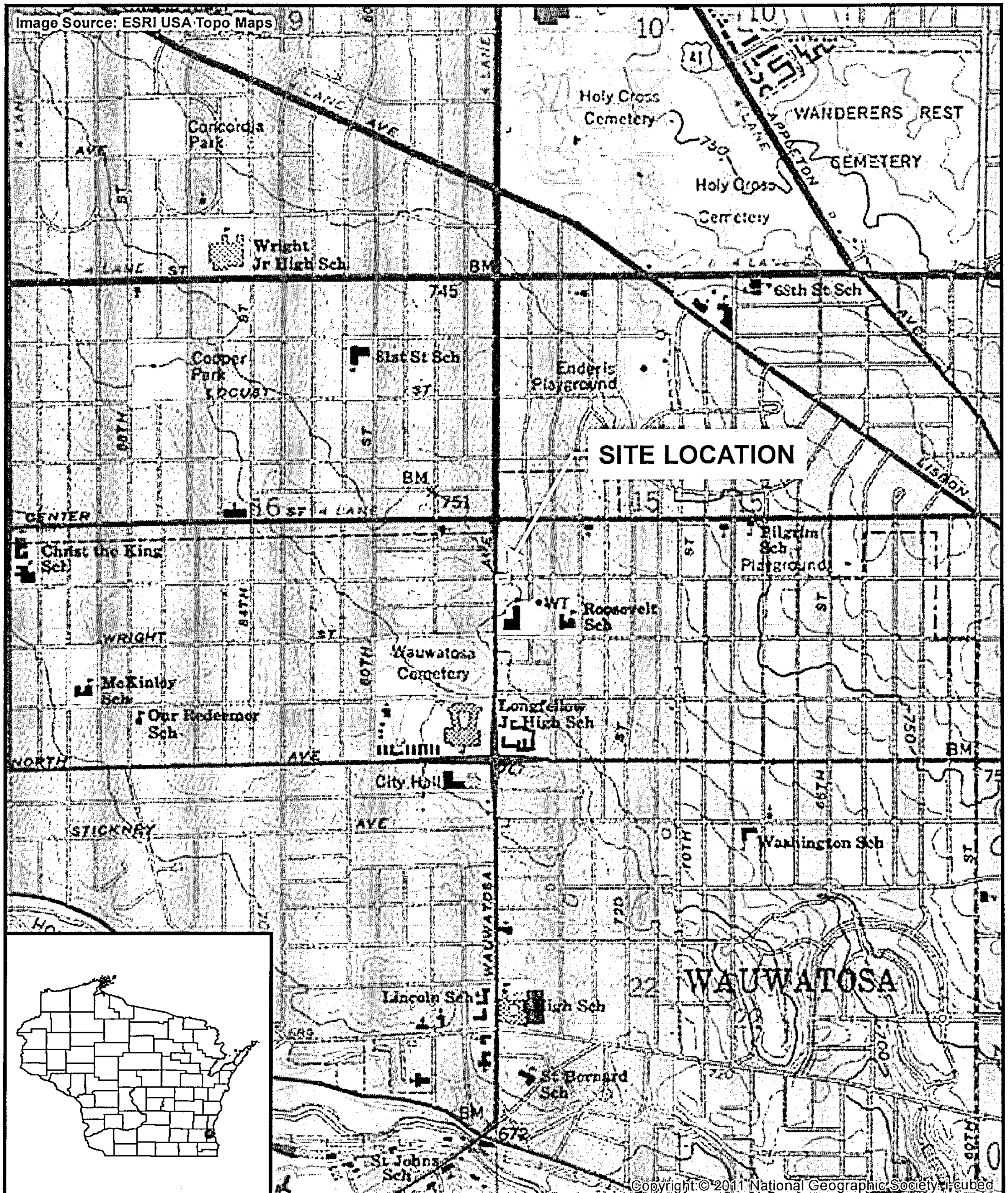
Date	Revision Number	Proposed Change to FSP/QAPP	Reason for Change of Scope/Procedures	FSP Section Superseded	Requested By	Approved By

Table 2
Sampling and Analysis Summary

Site: Vogue Cleaners Site
OSC: Steven Faryan
TDD: S05-0001-1403-001

Matrix	Analytical Parameter	Analytical Method	Containers (Numbers, Size, and Type)	Preservation Requirements	No. of Samples Collected	No. of Field Duplicates	No. of MS/MSD	No. of Trip Blanks	Total No. of Samples to Lab	Holding Time
Surface Water	VOCs	8260B	Three 40-ml VOC Vials	HCl, Cool to 4°C	9	1	1	1	11	14 days
Soil Gas	VOCs	TO-15	One 1-L Summa Canister	None	9	0	0	0	9	30 days
Sub-Slab Gas	VOCs	TO-15	One 6-L Summa Canister	None	TBD	TBD	TBD	TBD	TBD	30 days
Indoor Air	VOCs	TO-15	One 6-L Summa Canister	None	TBD	TBD	TBD	TBD	TBD	30 days

Notes:
*Subject to change based on number of properties investigated.
L - Liter
MS/MSD – Matrix spike/matrix spike duplicate
TBD – To Be Determined
VOC – Volatile Organic Compound



Legend

Parcel Boundary

0 2,000 Feet

N

Prepared for:
U.S. EPA REGION V

Contract No.: EP-S5-06-04
TDD: S05-0001-1403-001
DCN: 2301-4H-BLRJ

Prepared By:
WESTON SOLUTIONS, INC
20 North Wacker Drive
Suite 2035
Chicago, IL 60606

Figure 1
Site Location Map
Vogue Cleaners
Wauwatosa, Milwaukee County, Wisconsin

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FILE: D:\Vogue_Cleaners\mxd\FSP\F2_Site_Features.mxd 4/14/2014 11:16:34 AM wojdakon

Legend

Parcel Boundary

0 200 Feet

N

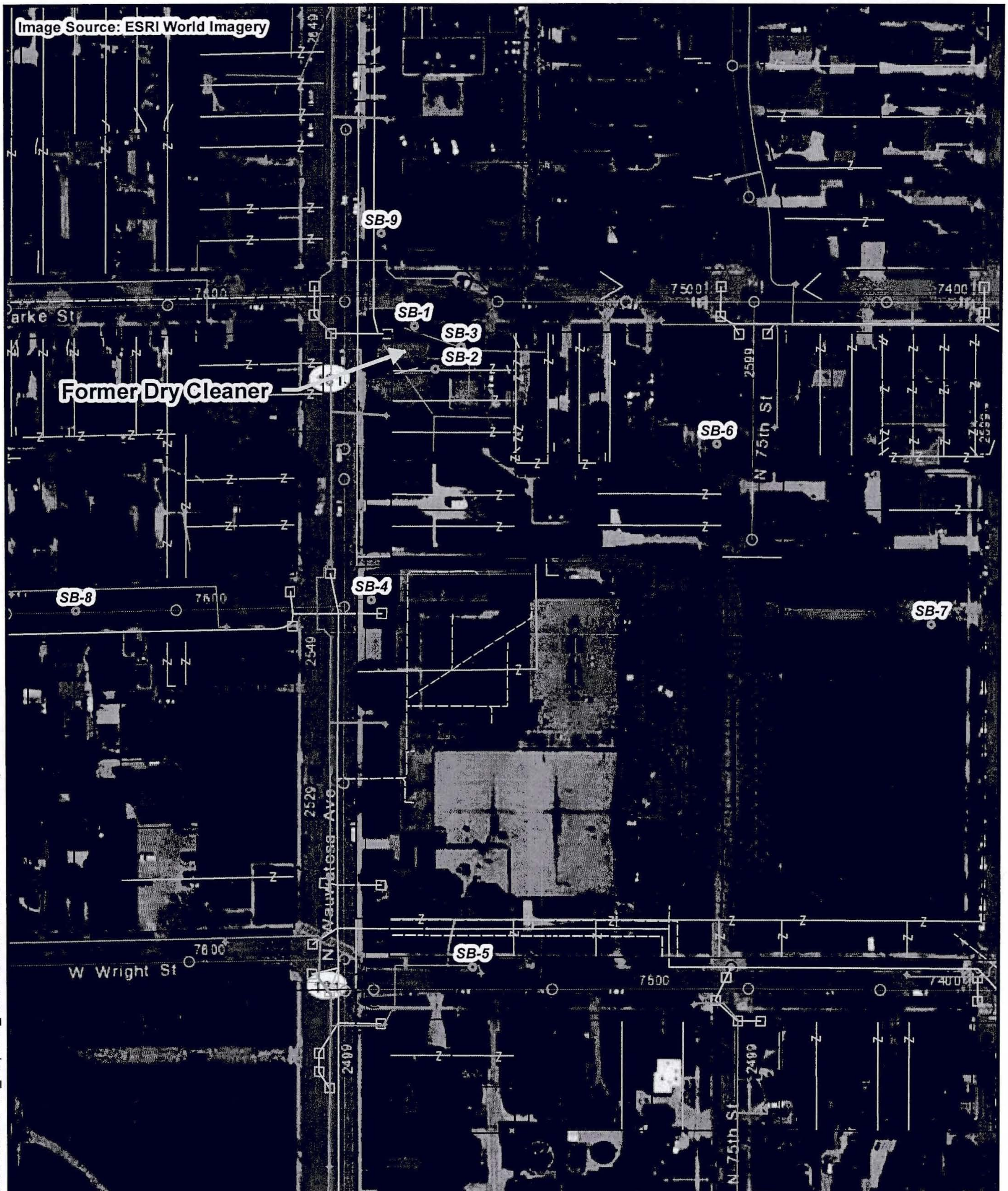
Prepared For:
U.S. EPA REGION V

Contract No.: EP-S5-06-04
TDD: S05-0001-1403-001
DCN: 2301-4H-BLRJ

Prepared By:
WESTON SOLUTIONS, INC

20 North Wacker Drive
Suite 2035
Chicago, IL 60606

Figure 2
Site Features Map
Vogue Cleaners
Wauwatosa, Milwaukee County, Wisconsin



Legend

Proposed Sampling Locations

0 175 Feet

N

Prepared For:
U.S. EPA REGION V

Contract No.: EP-S5-06-04
TDD: S05-0001-1403-001
DCN: 2301-4H-BLRJ

Prepared By:
WESTON SOLUTIONS, INC

20 North Wacker Drive
Suite 2035
Chicago, IL 60606

Figure 3
Proposed Soil Boring Location Map
Vogue Cleaners Site
Wauwatosa, Milwaukee County, Wisconsin

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WESTON SOLUTIONS, INC.		Drilling/Lithologic Log	PAGE 1 OF
Job Name	Wedron GW Contam. RV	**Boring No.**	
Job No.	20405.012.001.2061.00	**Logged By**	
Date Drilled		**Completion Depth**	
Drilling Co.	Illinois EPA	**Location**	Wedron, Illinois
Drill Foreman	Jim Salch	**Drill Rig Type**	Geoprobe

Depth (ft bgs)	Time	% Rec.	Classification	Description	Headspace Reading	Other Observations

APPENDIX B

STANDARD OPERATING PROCEDURES

Response Engineering and Analytical Contract

STANDARD OPERATING PROCEDURES

SOIL GAS SAMPLING

CONTENTS

* These sections are affected by Revision 0.0

CONTENTS (Cont'd)

* These sections are affected by Revision 0.0

CONTENTS (Cont'd)

* These sections are affected by Revision 0.0

SUPERCEDES: SOP #2042; Revision 0; 6/1/96; U.S. EPA Contract 68-C4-0022.

1.0 SCOPE AND APPLICATION

Soil gas monitoring provides a quick means of detecting volatile organic compounds (VOCs) in the soil subsurface. Using this method, underground VOC contamination can be identified, and the source, extent, and movement of pollutants can be traced.

This standard operating procedure (SOP) outlines the methods used for the installation of soil gas wells; the collection of soil gas using Tedlar® bags, sorbent tubes, and/or Summa canisters; and measurement of organic vapor levels in the soil gas using a Photo Ionization Detector (PID), Flame Ionization Detector (FID) and/or other air monitoring devices.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

A d-inch (")diameter hole is driven into the ground using manual (i.e., slam bar) or power driven mechanical (i.e., Geoprobe) methods. Soil gas can be sampled at specific depths by controlled penetration and/or the use of a longer bar or bar attachments. A ¼"outer diameter (O.D.) stainless steel probe is inserted into the hole. The hole is sealed around the top of the probe using clean modeling clay. The gas contained in the interstitial spaces of the soil is pulled through the probe using an air sampling pump. The sample may be stored in Tedlar® bags, drawn through sorbent cartridges, or analyzed directly using a field portable instrument such as a PID. An air sampling pump is not used for Summa® canister sampling of soil gas; sampling is achieved by soil gas equilibration with the evacuated Summa® canister.

Power driven mechanical devices may be used to make holes when conditions make the use of manual devices unfeasible (i.e., frozen ground, very dense clays, pavement, etc.). Commercially available soil gas sampling probes (hollow, ½" O.D. steel probes) can be driven to the desired depth using a power hammer (e.g., demolition hammer or Geoprobe™). Soil gas samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described below.

Other field air monitoring devices, such as the Combustible Gas Indicator (CGI) and the Organic Vapor Analyzer (OVA), can also be used, depending on specific site conditions. Measurement of soil temperature using a temperature probe may also be desirable. Bagged samples may be analyzed in a field laboratory using portable gas chromatography (GC) instrumentation, or shipped to a laboratory using an overnight service.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Tedlar® Bags

Soil gas samples are generally collected in 1.0-liter (L) Tedlar® bags. Bagged samples should be stored in the dark (i.e., in opaque containers) and protected from mechanical damage during transit to the laboratory. Further, bagged samples should be maintained at ambient temperature by placing them in coolers and out of direct sunlight. Samples should be analyzed as soon as possible, preferably within 24 to 48 hours following sample collection. Refer to ERT/REAC SOP# 2102, *Tedlar® Bag Sampling*, for additional information.

3.2 Sorbent Tubes

Soil gas can be drawn directly onto sorbent tubes (i.e., Tenax tubes) and analyzed by Gas Chromatography/Mass Spectrometer (GC/MS) methodologies. Bagged samples can also be drawn onto tubes. If sorbent tubes are to be used, special care must be taken to avoid contamination. Refer to ERT/REAC SOP# 2104, *Tenax/CMS Tube Sampling*, for additional information. Samples should be refrigerated at 4 °C during storage and analyzed within 30 days of collection. Samples taken on multi-sorbent tubes should be analyzed as soon as possible after sampling.

3.3 Summa® Canisters

The Summa® canisters used for soil gas sampling have a 6-L sample capacity and are certified clean by GC/MS analysis before being used in the field. After sampling is completed, they are stored and shipped in travel cases. Most volatile organic compounds (VOCs) can be recovered from canisters with minimal loss up to thirty days. Refer to ERT/REAC SOP# 1704, *Summa Canister Sampling,* for additional information.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 PID Measurements

A number of factors specific to soil gas can affect the response of a PID (e.g., HNu® PI 101). High humidity can cause lamp fogging and decreased sensitivity. This can occur when soil moisture levels are high, or when a soil gas probe is in the saturated zone. High concentrations of methane can cause a downscale deflection of the meter. High and low temperature, electrical fields, FM radio transmission, and naturally occurring compounds, such as terpene hydrocarbons in wooded areas, will affect instrument response. Refer to ERT/REAC SOP# 2114, *Photoionization Detector (PID) HNu®* for additional information.

4.2 FID Measurements

A number of factors specific to soil gas can affect the response of an FID (e.g., OVA Model 128). High humidity can cause the FID to flame out or not ignite at all. This can be significant when soil moisture levels are high, or when a soil gas probe is in the saturated zone. The FID can only read organic based compounds (they must contain carbon in the molecular structure). The FID also responds poorly to hydrocarbons and halogenated hydrocarbons (such as gasoline, propane fuel). High and low temperature, electrical fields and FM radio transmission will also affect instrument response. Consult the instrument manual for additional information.

4.3 Factors Affecting the Concentrations of Organic Compounds in Soil Gas

Concentrations of organic compounds in soil gas can be affected by the physical and chemical characteristics of the soil and by soil moisture. Organic molecules can be tightly adsorbed to the surface of chemically active soil particles, such as clays, thus reducing the concentration in the soil interstitial spaces. Similarly, some organic compounds can be dissolved in the soil water or associated with soil organic components (i.e., humic acids).

Soil porosity and permeability will affect the movement of soil gas and the recharge rate of the soil gas well. The movement of organic vapors through fine textured soil may be very slow, thus limiting the sample volume available and the use of this technique. Existing information and soil surveys prepared by the Soil Conservation Service should be consulted prior to planning and designing a soil gas survey.

The presence of a high, or perched water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with the movement and sampling of the soil gas. Knowledge of site geology is useful in such situations, and can prevent inaccurate sampling.

4.4 Soil Probe Clogging

A common problem with the soil gas sampling is clogging of the probe. A clogged probe can be identified by using an in-line vacuum gauge or by listening for the sound of the pump laboring. This problem can usually be eliminated by using a wire cable to clear the probe (see Section 7.1.3.).

4.5 Underground Utilities

Prior to selecting sample locations, an underground utility search must be completed. The local utility companies can be contacted and requested to mark the locations of their underground lines. Each sample location should also be screened with a metal detector or magnetometer to verify that no underground metallic or ferro-magnetic pipes or drums are present.

5.0 EQUIPMENT/APPARATUS

5.1 Slam Bar Method

- Slam bar
- Soil gas probes: stainless steel tubing, 1/4" O.D., 5-foot (ft) length
- Flexible wire or cable

- "Quick Connect" fittings
- Modeling clay.
- Vacuum box
- Pumps, capable of drawing approximately 3.0 L/min
- ¼" Teflon® tubing, 2-ft to 3-ft lengths
- ¼" Tygon tubing
- Tedlar® bags, 1.0-L
- Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- PID/FID, or other field air monitoring devices
- Cooler(s)
- Metal detector or magnetometer
- Portable GC instrument
- Summa® canisters (plus shipping cases)
- Large dark plastic bags

5.2 Power Hammer Method

- Power (Demolition) hammer
- ½" O.D. steel probes, extensions, and points
- Dedicated aluminum sampling points
- ¼" Teflon® tubing, 2-ft to 3-ft lengths
- "Quick Connect" fittings
- Modeling clay.
- Vacuum box
- Pumps, capable of drawing approximately 3.0 L/min
- ¼" Tygon tubing
- Tedlar® bags, 1.0-L
- Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- PID/FID or other field air monitoring devices
- Cooler(s)
- Metal detector or magnetometer
- Portable GC instrument
- Summa® canisters (plus shipping cases)
- Generator w/extension cords.
- High lift jack assembly
- Large dark plastic bags

5.3 Direct-Push (Geoprobe™) Method

- Tubing; polyethylene, Teflon®, or stainless steel
- Gas sampling cap
- Probe rods
- Tubing adaptor(s)

- Expendable point holder, threaded
- Expendable drive point(s)
- O-rings for expendable point holder
- O-rings for adaptor
- O-rings for probe rods
- O-rings for gas sampling cap
- Vacuum pumps
- Tape
- Tedlar® bags, 1.0-L
- Summa® canisters (plus shipping cases)
- Sample documentation (soil gas labels, field data sheets, logbook, etc.)
- Metal detector or magnetometer
- Cooler(s)
- Large dark plastic bags
- Portable GC instrument

6.0 REAGENTS

- Calibration and spike gases
- Deionized, organic-free water
- Methanol, High Performance Liquid Chromatography (HPLC) grade
- Ultra-zero grade compressed air
- Propane torch

7.0 PROCEDURES

7.1 Soil Gas Probe Installation

7.1.1 Slam Bar Method

1. A hole slightly deeper than the desired sampling depth is made. For sampling up to 5 feet, a 5-ft single piston slam bar is used. For deeper depths, a piston slam bar with threaded 4-ft-long extensions is used.

2. The tip of the rod is placed on the ground and the piston of the slam bar is used to drive the rod to the desired depth. The number of blows required to reach the desired depth is recorded.

3. After the hole is made, the slam bar is carefully withdrawn to prevent the collapse of the walls.

4. The soil gas probe is carefully inserted into the hole. To prevent plugging of the probe, a decontaminated metal wire or cable, slightly longer than the probe and with

an O.D. slightly less than the inner diameter (I.D.) of the rod, is inserted in the probe rod; 1- to 2-inches of wire should protrude from the end of the probe. The probe is inserted to full depth of the hole, then pulled up three to six inches. The probe is cleared by moving the cable up and down several times.

5. The top of the sample hole is sealed at the surface to prevent infiltration of ambient air. A golf-ball size lump of clean modeling clay is kneaded until it becomes soft. The clay is carefully molded around the probe at the soil surface to seal the space between the probe and the hole.

6. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.1.2 Power Hammer Method

1. A power hammer may be used to make holes when the soil is very hard, frozen or fine textured (clay), or when soil gas from beneath pavement or concrete is collected.

2. A power hammer is used to drive the probe to the desired depth (up to 12 feet may be attained with extensions). Threaded extensions are added until the desire depth is needed.

3. After the hole is made, the threaded rod is carefully withdrawn. This should be done in such a manner to prevent collapse of the walls. If necessary, a jack assembly may be used to retrieve the rods.

4. The soil gas probe is installed in the hole as described in Section 7.1.1, Steps 4 and 5.

5. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.1.3 Direct-Push Method

1. Direct-push sampling technology refers to soil gas samplers that are inserted into the ground without the use of slam bars, demolition hammers, or drilling rigs. The U.S. EPA/ERT utilizes a Direct-Push unit mounted on an all-terrain track mounted vehicle, and direct push tools. These tools are able to collect samples at depths greater than 50 feet, depending on soil conditions.

2. Sampling probes, consisting of 3-foot sections of flush-threaded, 1¼-inch hardened steel alloy steel rod tipped by an expendable steel point, are driven into the groung

to the target depth. The probe tools are withdrawn to release the expendable tip and allow soil gas to flow into the tool's tubing.

3. To ensure a representative soil gas sample, a discrete volume of gas is purged to rid the tubing of atmospheric air and allow the subsurface soil gas to enter the probe tubing. The volume of gas removed is determined by the volume of tubing employed in the probe. (Unlike groundwater sampling, purging of a soil gas probe is designed to remove only the ambient air within the tubing.)

4. After allowing the system to return to atmospheric pressure, an aliquot of soil gas is withdrawn from the probe. Duplicate samples are collected as necessary and required.

5. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.2 Screening with Field Instruments

1. It is recommended that any appropriate SOPs and the manufacturers' manuals be consulted for the correct use and calibration of all instrumentation. Pumps should be calibrated prior to use in the field.

2. An amount of air, equivalent to the volume of the soil gas well <u>must</u> be calculated prior to sampling. Connect a vacuum pump to the sample probe using a section of Teflon® tubing. The pump is turned on and adjusted to a flow rate of 3.0 L/minute. The calculated volume of air is evacuated from the hole by pulling a vacuum through the probe for the specified length of time. Longer time is required for sample wells of greater depths.

3. After evacuation, a monitoring instrument (i.e. HNu® or OVA) is connected to the probe using a Teflon connector. Upon stabilization, the reading is recorded on soil gas data sheets.

4. Readings may be above or below the range set on the field instruments. The range may be reset, or the response recorded as a greater than or less than figure. The recharge rate of the well with soil gas must be considered when resampling at a different range setting.

7.3 Tedlar® Bag Sampling

1. Follow step 1 of section 7.2 to evacuate well volume. If air monitoring instrument screening was performed prior to sample collection, evacuation is not necessary.

2. Use the vacuum box and sampling train (Figure 1) to collect the sample. The sampling train is designed to minimize the introduction or loss of contaminants due to adsorption and other factors. All parts used are either Teflon® or stainless steel, and a vacuum is drawn indirectly

to avoid contamination from sample pumps.

3. Place the Tedlar® bag inside the vacuum box, attach it to the sampling port and open the valve. The sample probe is attached to the sampling port via Teflon® tubing and a "Quick Connect" fitting.

4. Draw a vacuum around the outside of the bag, using a pump connected to the vacuum box evacuation port, via Tygon tubing and a "Quick Connect" fitting. The negative pressure inside the box causes the bag to inflate, drawing the sample into the bag.

5. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample fromthe box and close the valve. Record the date, time, sample location ID, and the PID/FID instrument reading(s) on sample bag label and on data sheets or in logbooks.

   Bags should not be labeled directly with a marker or pen (particularly those containing volatile solvents) or should adhesive labels be affixed directly to the bags. Inks and adhesive may diffuse through the bag material and contaminate the sample. Labels should be tied to the metal eyelets provided on the bags.

   Chain of custody sheets must accompany all samples.

7.4 Sorbent Tube Sampling

Samples collected in Tedlar® bags may be adsorbed onto sorbent tubes for further analysis by GC/MS.

7.4.1 Additional Apparatus

- Syringe, with a luer-lock tip, capable of drawing a soil gas or air sample from a Tedlar® bag onto a sorbent tube. The syringe capacity is dependent upon the volume of sample being drawn onto the tube.

- Adapters, for fitting the sorbent tube between the Tedlar® bag and the sampling syringe. The adapter attaching the Tedlar® bag to the sorbent tube consists of a reducing union (¼" to 1/16" O.D. - Swagelok cat. # SS-400-6-ILV or equivalent) and a length of ¼" O.D. Teflon® tubing, which replaces the nut on the 1/16" (Tedlar® bag) side. A ¼" I.D. Teflon® or silicone O-ring replaces the ferrules in the nut on the ¼" (sorbent tube) side of the union.

  The adapter, attaching the sampling syringe to the sorbent tube, consists of a reducing union (¼" to 1/16" O.D. - Swagelok Cat. # SS-400-6-ILV or equivalent) and a ¼" I.D. Teflon® or silicone O-ring, which replaces the ferrules in the nut on the ¼" (sorbent tube) side and the needle of a luer-lock syringe inserted into the 1/16" side (held in place with a 1/16" ferrule). The luer-lock end of the needle can be attached to the sampling syringe. It is useful to have a luer-lock on/off valve situated between the syringe and the needle.

- Two-stage glass sampling cartridge (¼" O.D. x c" I.D. x 5c") contained in a flame-sealed tube containing two sorbent sections retained by glass wool:

- Teflon-capped culture tubes or stainless steel tube containers for sorbent tube storage and shipping. These containers should be conditioned by baking at 120° C for at least two hours. The culture tubes should contain a glass wool plug to prevent sorbent tube breakage during transport. Reconditioning of the containers should occur between uses or after extended periods of disuse (i.e., two weeks or more).

- Nylon gloves or lint-free cloth. (Hewlett Packard Part # 8650-0030 or equivalent.)

7.4.2 Sample Collection

- Handle sorbent tubes with care, using nylon gloves (or other lint-free material) to avoid contamination.

- Immediately before sampling, break one end of the sealed tube and remove the sorbent cartridge.

- Connect the valve on the Tedlar® bag to the sorbent tube adapter. If using a Tenax/CMS sorbent tube, connect the sorbent tube to the sorbent tube adapter with the Tenax (white granular) side of the tube facing the Tedlar® bag. Connect the sampling syringe assembly to the carbon molecular sieve [CMS (black)] side of the sorbent tube. Fittings on the adapters should be finger-tight. Open the valve on the Tedlar® bag. Open the on/off valve of the sampling syringe. Depending on work plan stipulations, at least 10% of the soil gas samples analyzed by field screening methods must be submitted for confirmation GC/MS analysis (according to a modified TO-17method for sorbent tubes). Each soil gas sample must be absorbed on replicate sorbent tubes. The volume adsorbed on a sorbent tube is dependent on the total concentration of the compounds measured by field screening methods as follows:

Total Concentration (ppm)	Sample Volume (mL)
>10	Use Serial Dilution
10	10-50
5	20-100
1	100-250

- After sampling, remove the tube from the sampling train with gloves or a clean cloth. DO NOT LABEL OR WRITE ON THE SORBENT TUBE.

- Place the sorbent tube in a conditioned stainless steel tube holder or culture tube. Culture tube caps should be sealed with Teflon tape.

- Each sample tube container (not tube) must be labeled with the site name, sample number, date sampled, and volume sampled. Verify that all sample containers are properly labeled.

- Chain of custody sheets must accompany all samples to the laboratory.

7.5 Summa® Canister Sampling

1. Follow Section 7.2, step 1, to evacuate well volume. If PID/FID readings were taken prior to taking a sample, evacuation is not necessary.

2. Attach a certified clean, evacuated 6-L Summa® canister via the ¼" Teflon tubing.

3. Open valve on Summa® canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6-L canister is 20 minutes.

4. Sample number, sample location, date collected and work assignment number must be recorded on a chain of custody form and on a blank tag attached to the canister.

5. Chain of custody sheets must accompany all samples to the laboratory.

8.0 CALCULATIONS

8.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. In some cases, the background level at the soil gas location may be subtracted:

Final Reading = Sample Reading - Background Reading

8.2 Field Portable GC Analysis

Calculations used to determine concentrations of individual components by field portable GC analysis are beyond the scope of this SOP and are covered ERT/REAC SOP #2109, *Photovac GC Analysis for Soil, Water and Air/Soil Gas.*

9.0 QUALITY ASSURANCE/QUALITY CONTROL

9.1 Sample Sorbent Tubes

Before field use, a quality assurance (QA) check must be performed on each batch of sorbent tubes by thermal desorption/cryogenic trapping GC/MS. These tubes are prepared and cleaned in accordance with EPA Method EMSL/RTP-SOP-EMD-013 by the vendor. Prior to purchasing a lot of tubes from a vendor, ten tubes from the lot are sent to the REAC laboratory where the tubes are tested for cleanliness, precision and reproducibility.

Sample tubes should be stored out of ultraviolet (UV) light (i.e., sunlight) and kept on ice until analysis. Samples should be collected in duplicate, whenever possible.

9.2 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe using a vacuum pump (e.g., Gilian pump) and checking the response of the FID/PID. If readings are higher than background, replacement or decontamination is necessary.

Sample probes may be decontaminated simply by drawing ambient air through the probe until the HNu® reading is at background. Contamination can also be removed by decontaminating with methanol and deionized water, then air drying. For persistent contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately 1-2 minutes. Let the probe cool before handling. When using this method, make sure to wear gloves to prevent burns. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

9.3 Sample Train Contamination

The Teflon® line forming the sample train from the probe to the Tedlar® bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it must be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a vacuum pump (e.g, Gilian pump), for approximately 30 seconds between each sample. After purging, the sampling train can be checked using an FID or PID, or other field monitoring device, to establish the cleanliness of the Teflon® line.

9.4 FID/PID Calibration

The FID and PID must be calibrated at least once a day using the appropriate calibration gases.

9.5 Trip Blanks

A trip blank detects any sample contamination during shipping and storage. With the exception of Summa® canisters, the trip blank is prepared and added to the site samples after sampling has been completed and prior to shipment.

9.5.1 Tedlar® Bags

Each cooler containing Tedlar®bag samples must contain one Tedlar® bag of ultra-zero grade air, acting as a trip blank, when samples are shipped to an outside laboratory. A chain of custody record must accompany each cooler of samples and should include the blank that is dedicated to that group of samples.

9.5.2 Sorbent Tubes

At least one trip blank per cooler must be submitted with the sorbent tube samples. The ends of the sorbent tube are broken but no air is drawn through the tube.

9.5.3 Summa® Canisters

Canister trip blanks are evacuated containers that are shipped to and from the site with the canisters used for air sampling.

9.6 Field Blanks

A field blank detects sample contamination during the handling and shipping process. The field blank must be associated with an actual sampling event.

9.6.1 Tedlar® Bags

For each day of sampling, a Tedlar® bag is filled with ultra-zero air at the beginning of the day. The field blank is handled in the same manner as the samples.

9.6.2 Sorbent Tubes

For each day of sampling, a field blank must be submitted for sorbent tubes. The ends of the sorbent tube are broken at the beginning of the day but no air is drawn through the tube.

9.7 Trip Standards

If Tedlar® bags are used for sampling, each cooler containing samples should contain a Tedlar® bag of standard gas to calibrate the analytical instruments (Photovac GC, etc.). This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. A chain of custody record must accompany each cooler of samples and should include the trip standard that is dedicated to that group of samples.

9.8 Lot Blanks

9.8.1 Tedlar® Bags

Prior to use, one bag is removed from each lot of Tedlar® bags to be used for sampling and checked for possible contamination as follows: Fill the test bag with ultra-zero grade air; withdraw a sample fromthe bag and analyze using a field portable GC or any other applicable field instrument used for sample analysis. This procedure will ensure sample container cleanliness prior to the start of the sampling effort.

9.8.2 Summa® Canister Check

Fromeach lot of four cleaned Summa® canisters, one is used for a GC/MS certification check. If the canister passes certification, it is re-evacuated and all four canisters from that lot are available for sampling. If the chosen canister is contaminated, the entire lot of four Summa® canisters must be re-cleaned, and a single canister is re-analyzed by GC/MS for certification.

9.8.3 Sorbent Tubes

Provide a minimum of one sorbent tube per sampling event. Do not break the ends of the tube.

9.9 Options

9.9.1 Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate (i.e., if a total of 100 samples are to be collected, five samples should be collected in duplicate). In choosing which samples to duplicate, the following criteria applies: if, after filling the first Tedlar® bag and evacuating the well for 15 seconds, the second HNu® reading (or other field monitoring device being used) matches or is close to (within 20%) the first reading, a duplicate sample may be taken.

9.9.2 Spikes

A Tedlar® bag spike and sorbent tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (landfills, etc.). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

10.0 DATA VALIDATION

10.1 Blanks

For each target compound, the concentration found in the sample must be greater than three times the level (for that compound) found in the appropriate blank (lot, field, trip) that accompanied that sample, to be considered valid.

11.0 HEALTH AND SAFETY

Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D. Nevertheless, ambient air should be constantly monitored using the HNu® P101 to obtain background and breathing zone readings during the sampling procedure. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed.

When conducting soil gas sampling, appropriate personal protective equipment [PPE (leather gloves, steel-toed shoes, Tyvek® safety suit)] should be worn, and proper slam bar techniques should be implemented Also, an underground utility search must be performed prior to sampling (See Section 4.5).

12.0 REFERENCES

Gilian Instrument Corp. 1983. *Instruction Manual for Hi Flow Sampler: HFS113, HFS 113 T, HFS 113U, HFS 113 UT.*

HNu® Systems, Inc. 1975. *Instruction Manual for Model PI 101 Photoionization Analyzer.*

New Jersey Department of Environmental Protection. 1992. *Field Sampling Procedures Manual.*

U.S. Environmental Protection Agency. 1984. *Characterization of Hazardous Waste Sites - A Methods Manual: Volume II.* Available Sampling Methods. 2nd ed. EPA-600/4-84-076.

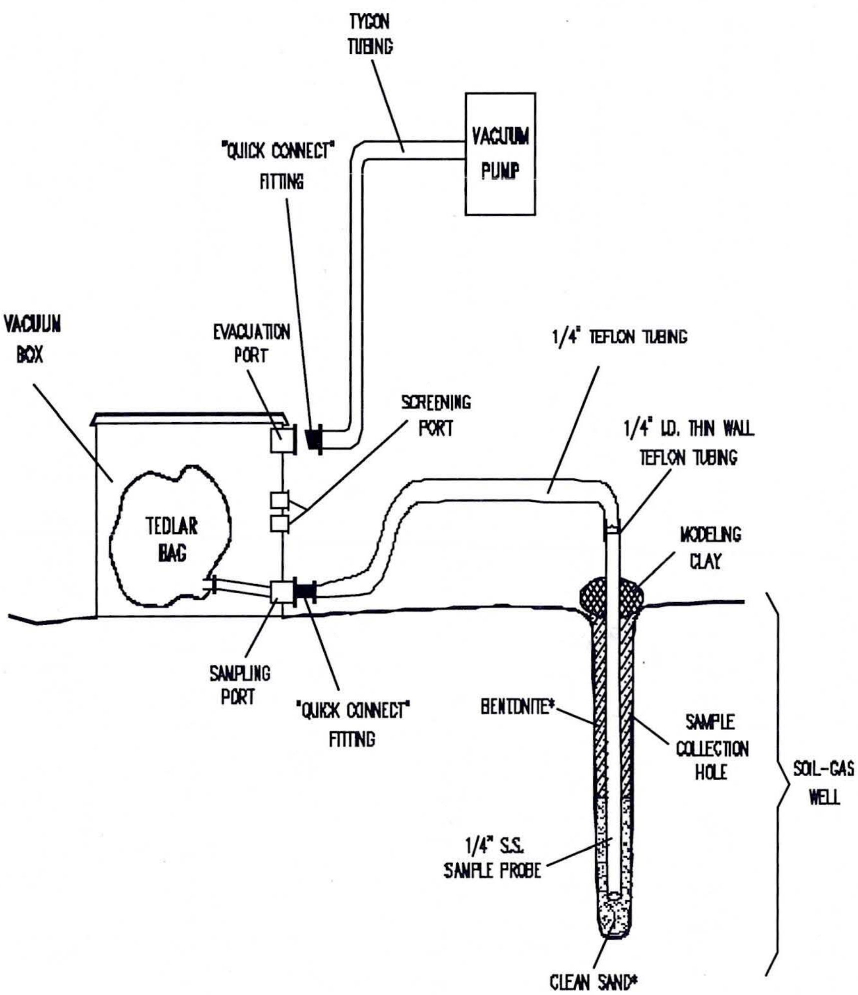
U.S. Environmental Protection Agency. 1995. *Superfund Program Representative Sampling Guidance. Volume 2: Air (Short-Term Monitoring).* EPA 540-R-95/140. Interim Final.

13.0 APPENDICES

A - Figures
B - HNu® Field Procedure

APPENDIX A
Figure
SOP # 2042
April 2001

FIGURE 1. Sampling Train Schematic



* USED ONLY FOR SEMIPERMANENT INSTALLATIONS

APPENDIX B
HNu® Field Procedure
SOP # 2042
April 2001

HNu® Field Procedure

The following sections detail the procedures that are to be followed when using the HNu® in the field.

Startup Procedure

a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug in; don't force the probe cord.

b. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery area on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging.

c. Turn the function switch to any range setting. Look into the end of the probe for no more than two to three seconds to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe any longer than three seconds. Long term exposure to UV light can damage eyes. Also, listen for the hum of the fan motor.

d. To ZERO the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed for this instrument. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the instrument to zero.

Operational Check

a. Follow the start-up procedure.

b. With the instrument set on the 0-20 ppm range, hold a solvent-based magic marker near the probe tip. If the meter deflects upscale, the instrument is working.

Field Calibration Procedure

a. Follow the start-up procedure and the operational check.

b. Set the function switch to the range setting for the concentration of the calibration gas.

c. Attach a regulator to a disposable cylinder of isobutylene gas. Connect the regulator to the probe of the HNu® with a piece of clean Tygon tubing. Turn on the regulator valve.

d. After fifteen seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used. Be careful to unlock the span dial before adjusting it. If the span has to be set below 3.0, calibrate the instrument internally or return to equipment maintenance for repair.

e. Record in the field logbook: the instrument ID no. (EPA decal or serial number if the instrument is a rental); the initial and final span settings; the date and time; concentration and type of calibration gas used; and the name of the person who calibrated the instrument.

Operation

a. Follow the start-up procedure, operational check, and calibration check.

b. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range. Adjust it if necessary.

c. While taking care not to permit the HNu® to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site specific Health and Safety Plan.

d. When the activity is completed or at the end of the day, carefully clean the outside of the HNu® with a damp disposable towel to remove any visible dirt. Return the HNu® to a secure area and place on charge.

e. With the exception of the probe's inlet and exhaust, the HNu® can be wrapped in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation.

CONSTRUCTION AND INSTALLATION OF PERMANENT SUB-SLAB SOIL GAS WELLS

CONTENTS

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) outlines the procedure used for the construction and installation of permanent sub-slab soil gas wells. The wells are used to sample the gas contained in the interstitial spaces beneath the concrete floor slab of dwellings and other structures.

Soil gas monitoring provides a quick means of detecting volatile organic compounds (VOCs) in the soil subsurface. Using this method, underground VOC contamination can be identified and the source, extent and movement of pollutants can be traced.

2.0 METHOD SUMMARY

Using an electric Hammer Drill or Rotary Hammer, an inner or pilot hole is drilled into the concrete slab to a depth of approximately 2" with the d" diameter drill bit. Using the pilot hole as the center, an outer hole is drilled to an approximate depth of 1d" using the 1" diameter drill bit. The 1" diameter drill bit is then replaced with the d" drill bit. The pilot hole is drilled through the slab and several inches into the sub-slab material. Once drilling is completed, a stainless steel probe is assembled and inserted into the pre-drilled hole. The probe is mounted flush with the surrounding slab so it will not interfere with pedestrian or vehicular traffic and cemented into place. A length of Teflon tubing is attached to the probe assembly and to a sample container or system.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

3.1 SUMMA Canister Sampling

After the sub-slab soil gas sample is collected, the canister valve is closed, an identification tag is attached to the canister and the canister is transported to a laboratory under chain of custody for analysis. Upon receipt at the laboratory, the data documented on the canister tag is recorded. Sample holding times are compound dependent, but most VOCs can be recovered from the canister under normal conditions near the original concentration for up to 30 days. Refer to SERAS SOP #1704, *SUMMA Canister Sampling* for more details.

3.2 Tedlar Bag Sampling

Tedlar bags most commonly used for sampling have a 1-liter volume capacity. After sampling, the Tedlar bags are stored in either a clean cooler or an opaque plastic bag at ambient temperature to prevent photodegradation. It is essential that sample analysis be undertaken within 24 to 48 hours following sample collection since VOCs may escape or become altered. Refer to SERAS SOP #2102, *Tedlar Bag Sampling* for more details.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The thickness of a concrete slab may vary from structure to structure. A structure may also have a single slab where the thickness varies. A slab may contain steel reinforcement (REBAR). Drill bits of various sizes and cutting ability will be required to penetrate slabs of varying thicknesses or those that are steel-reinforced.

5.0 EQUIPMENT/APPARATUS

- Hammer Drill or Rotary Hammer
- Alternating current (AC) extension cord
- AC generator, if AC power is not available on site
- Hammer or Rotary Hammer drill bit, d" diameter
- Hammer or Rotary Hammer drill bit, 1"diameter
- Portable vacuum cleaner
- 1 - ¾" open end wrench or 1-medium adjustable wrench
- 2 - 9/16" open end wrenches or 2-small adjustable wrenches
- Hex head wrench, ¼"
- Tubing cutter
- Disposable cups, 5 ounce (oz)
- Disposable mixing device (i.e., popsicle stick, tongue depressor, etc.)
- Swagelok SS-400-7-4 Female Connector, ¼" National Pipe Thread (NPT) to ¼" Swagelok connector
- Swagelok SS-400-1-4 Male Connector, ¼"NPT to ¼" Swagelok connector
- ¼" NPT flush mount hex socket plug, Teflon-coated
- ¼" outer diameter (OD) stainless steel tubing, pre-cleaned, instrument grade
- ¼" OD Teflon tubing
- Teflon thread tape
- 1/8 " OD stainless steel rod, 12" to 24" length
- Swagelok Tee, optional (SS-400-3-4TMT or SS-400-3-4TTM)

6.0 REAGENTS

- Tap water, for mixing anchoring cement
- Anchoring cement
- Modeling clay

7.0 PROCEDURES

7.1 Probe Assembly and Installation

1. Drill a d" diameter inner or pilot hole to a depth of 2" (Figure 1, Appendix A).

2. Using the d" pilot hole as your center, drill a 1" diameter outer hole to a depth of 1d". Vacuum out any cuttings from the hole (Figure 2, Appendix A).

3. Continue drilling the d inner or pilot hole through the slab and a few inches into the sub-slab material (Figure 3, Appendix A). Vacuum out any cuttings from the outer hole.

4. Determine the length of stainless steel tubing required to reach from the bottom of the outer hole, through the slab and into the open cavity below the slab. To avoid obstruction of the probe tube, ensure that it does not contact the sub-slab material. Using a tube cutter, cut the tubing to the desired length.

5. Attach the measured length (typically 12O) of ¼" OD stainless tubing to the female connector

(SS-400-7-4) with the Swagelok nut. Tighten the nut.

6. Insert the ¼" hex socket plug into the female connector. Tighten the plug. **Do not over tighten**. If excessive force is required to remove the plug during the sample set up phase, the probe may break loose from the anchoring cement.

7. Place a small amount of modeling clay around the stainless steel tubing adjacent to the Swagelok nut, which connects the stainless steel tubing to the female connector. Use a sufficient amount of modeling clay so that the completed probe, when placed in the outer hole, will create a seal between the outer hole and the inner hole. The clay seal will prevent any anchoring cement from flowing into the inner hole during the final step of probe installation.

8. Place the completed probe into the outer hole. The probe tubing should not contact the sub-slab material and the top of the female connector should be flush with the surface of the slab and centered in the outer hole (Figure 4, Appendix A). If the top of the completed probe is not flush with the surface of the slab, due to the outer hole depth being greater than 1d", additional modeling clay may be placed around the stainless steel tubing adjacent to the Swagelok nut, which connects the stainless steel tubing to the female connector. Use a sufficient amount of clay to raise the probe until it is flush with the surface of the slab while ensuring that a portion of the clay will still contact and seal the inner hole.

9. Mix a small amount of the anchoring cement. Fill the space between the probe and the outside of the outer hole. Allow the cement to cure according to manufacturers instructions before sampling.

7.2 Sampling Set-Up

1. Wrap one layer of Teflon thread tape onto the NPT end of the male connector (SS-400-1-4). Refer to Figure 5, Appendix A.

2. Remove the ¼" hex socket plug from the female connector (SS-400-7-4). Refer to Section 7.3 if the probe breaks loose from the anchoring cement during this step.

3. To ensure that the well has not been blocked by the collapse of the inner hole below the end of the stainless steel tubing, a stainless steel rod, 1/8" diameter, may be passed through the female connector and the stainless steel tubing. The rod should pass freely to a depth greater than the length of the stainless steel tubing, indicating an open space or loosely packed soil below the end of the stainless steel tubing. Either condition should allow a soil gas sample to be collected.

   If the well appears blocked, the stainless steel rod may be used as a ramrod in an attempt to open the well. If the well cannot be opened, the probe should be reinstalled or a new probe installed in an alternate location.

4. Screw and tighten the male connector (SS-400-1-4) into the female connector (SS-400-7-4). **Do not over tighten**. This may cause the probe to break loose from the anchoring cement during this step or when the male connector is removed upon completion of the sampling

event. Refer to Section 7.3 if the probe breaks loose from the anchoring cement during this step.

5. If a collocated sub-slab sample or split sample is desired, a stainless steel Swagelok Tee (SS-400-3-4TMT or SS-400-3-4TTM) may be used in place of the Swagelok male connector (SS-400-1-4).

6. Attach a length of ¼"OD Teflon tubing to the male connector with a Swagelok nut. The Teflon tubing is then connected to the sampling container or system to be used for sample collection.

7. After sample collection remove the male connector from the probe and reinstall the hex socket plug. **Do not over tighten** the hex socket plug. If excessive force is required to remove the plug during the next sampling event the probe may break loose from the anchoring cement. Refer to Section 7.3 if the probe breaks loose from the anchoring cement during this step.

7.3 Repairing a Loose Probe

1. If the probe breaks loose from the anchoring cement while removing or installing the hex head plug or the male connector (SS-400-1-4), lift the probe slightly above the surface of the concrete slab.

2. Hold the female connector (SS-400-7-4) with the ¾" open end wrench.

3. Complete the step being taken during which the probe broke loose, following the instructions contained in this SOP (i.e., **Do not over tighten** the hex socket plug or male connector).

4. Push the probe back down into place and reapply the anchoring cement.

5. Modeling clay may be used as a temporary patch to effect a seal around the probe until the anchoring cement can be reapplied.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

An additional collocated soil gas well is installed with the frequency of 10 percent (%) or as specified in the site-specific Quality Assurance Project Plan (QAPP). The following general Quality Assurance (QA) procedures apply:

1. A rough sketch of the area is drawn where the ports are installed with the major areas noted on the sketch. This information may be transferred to graphing software for incorporation into the final deliverable.

2. A global positioning system (GPS) unit may be used to document coordinates outside of a structure as

a reference point.

3. Equipment used for the installation of sampling ports should be cleaned by heating, inspected and tested prior to deployment.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and Lockheed Martin corporate health and safety procedures. All site activities should be documented in the site-specific health and safety plan (HASP).

12.0 REFERENCES

This section is not applicable to this SOP.

13.0 APPENDICES

A - Figures

APPENDIX A
Soil Gas Installation Figures
SOP #2082
March 2007

FIGURE 1

INNER or PILOT HOLE

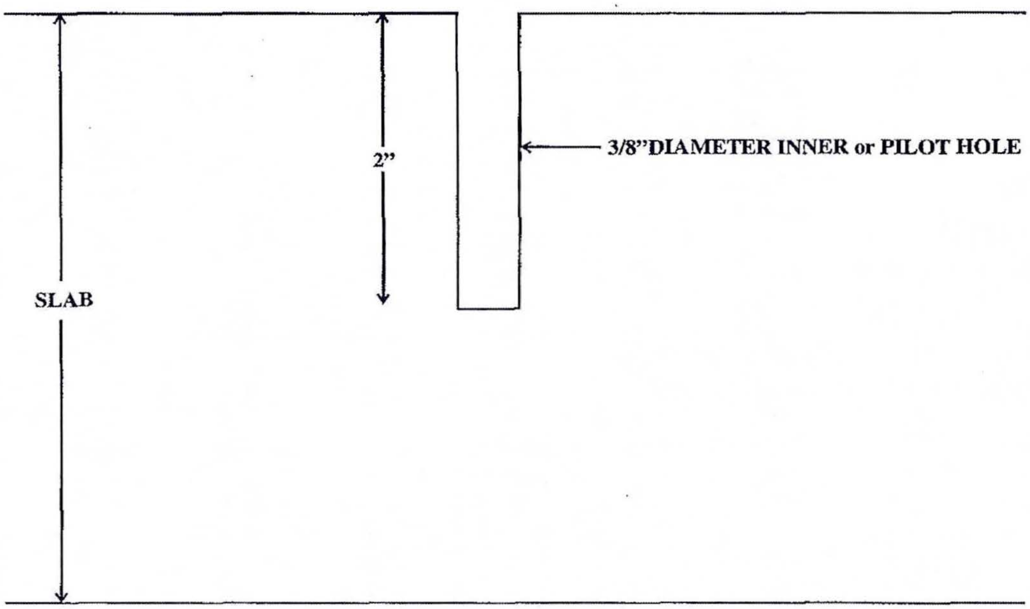


FIGURE 2

OUTER HOLE

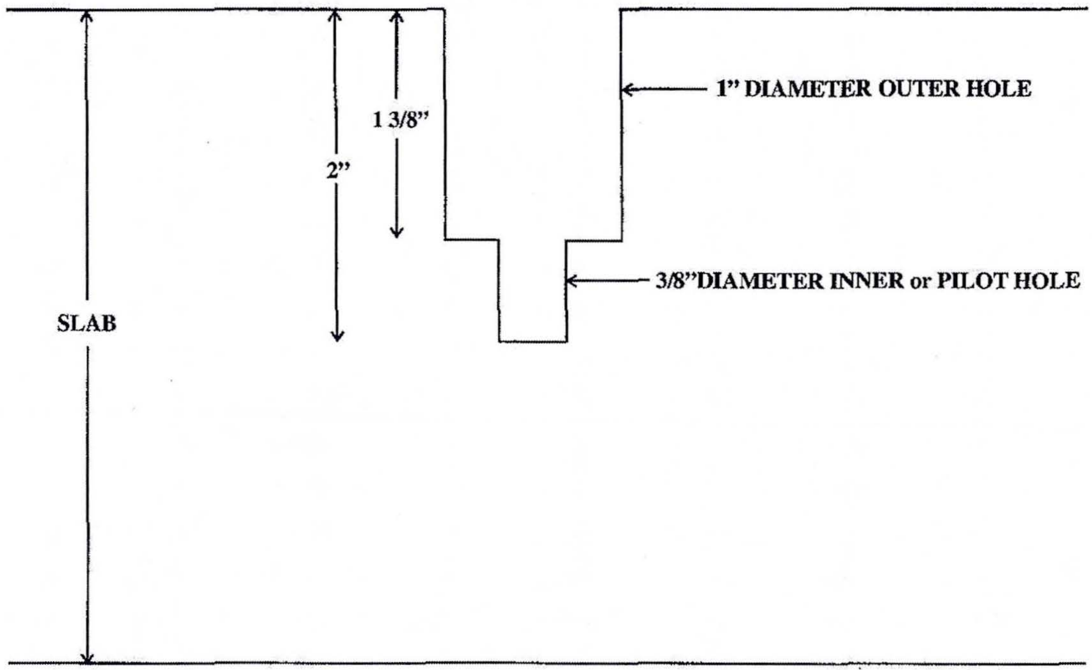


FIGURE 3

COMPLETED HOLE PRIOR to PROBE INSTALLATION

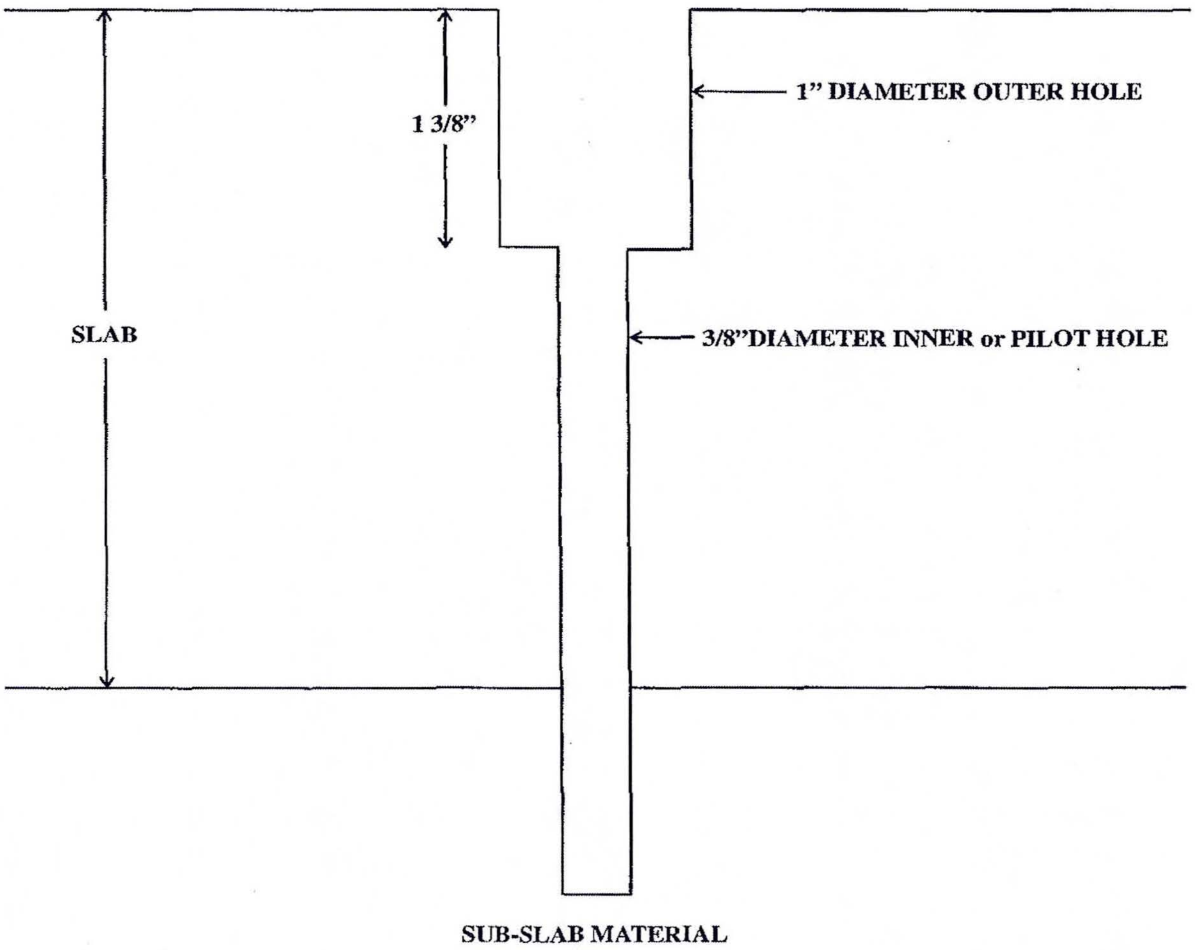


FIGURE 4

SOIL GAS PROBE INSTALLED

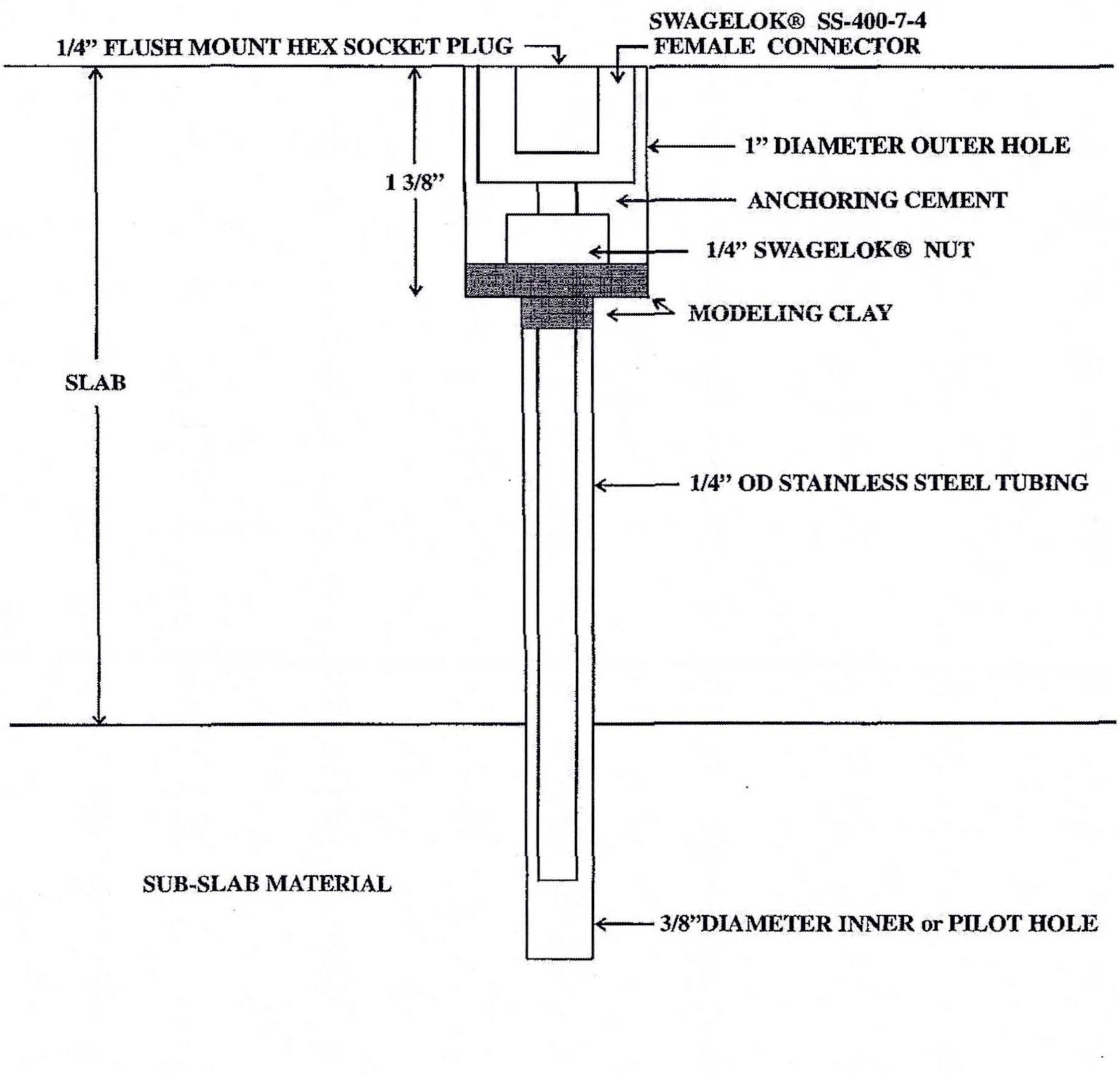


FIGURE 5
SOIL GAS PROBE PREPARED FOR SAMPLING

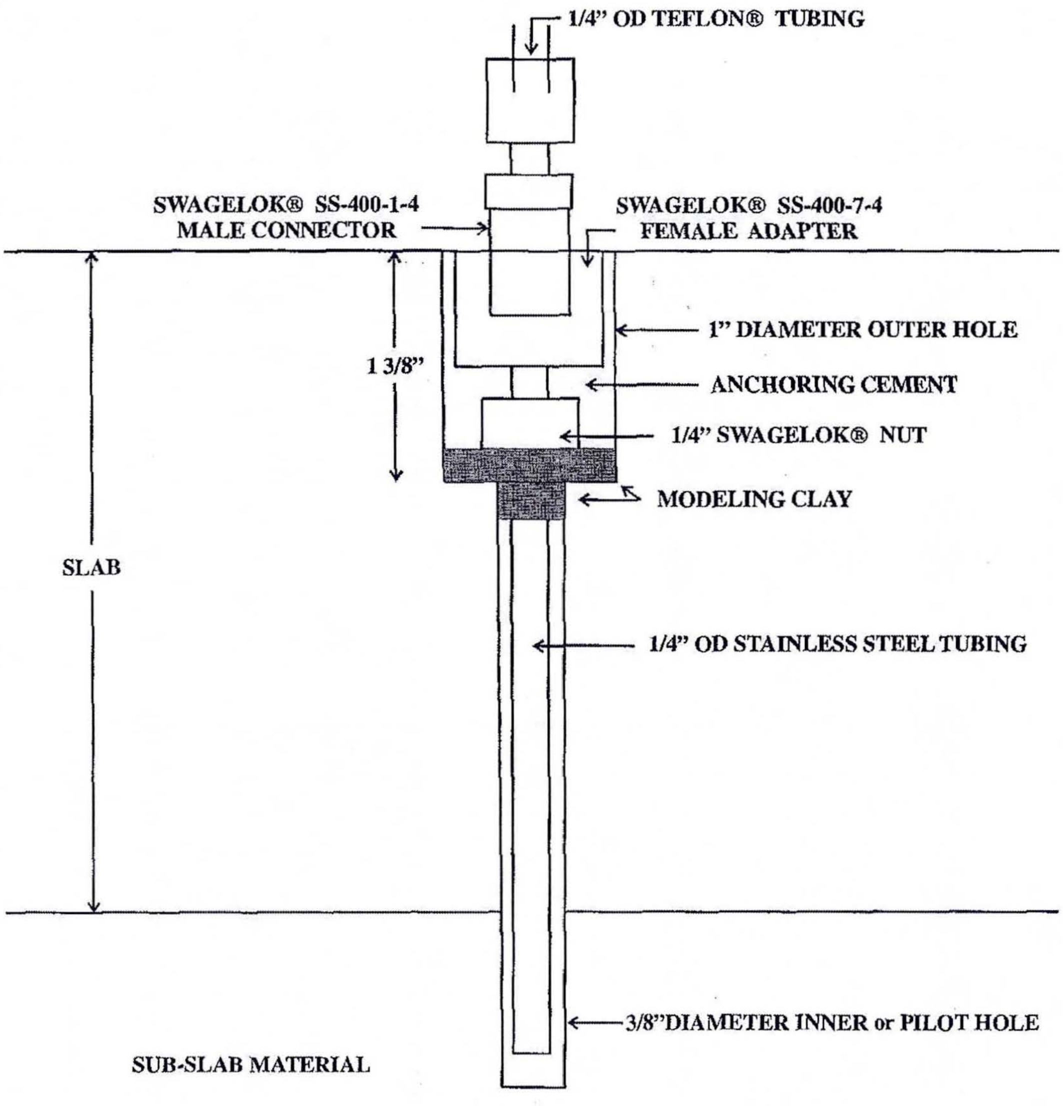
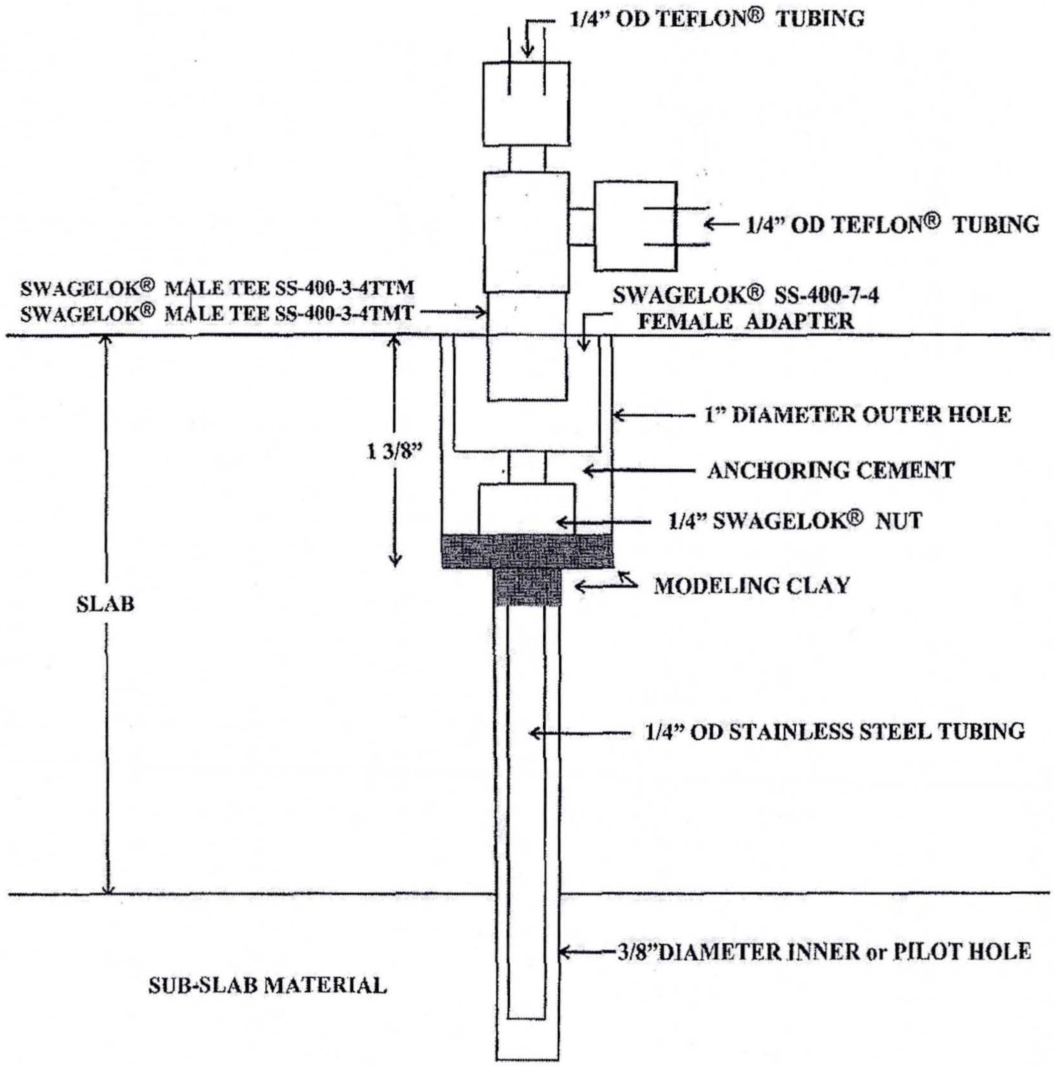


FIGURE 6
SOIL GAS PROBE PREPARED FOR SAMPLING



Agenda

Interagency Waterfront Revitalization Team

April 25, 2014 | 1-2:00pm

DNR | GEF2 | Room 813

1. Introductions and agenda repair (5 min)
2. Waterfront project updates (10 min)
3. Proposed waterfront customer service process (30 min)
4. Initiative roll-out (10 min)
5. Next steps (5 min)