



Sub-Slab Depressurization System (SSDS) Design

POPULAR HAND LAUNDRY SITE
88 Ingraham Street
Brooklyn, NY
VCP Site No. V00170

May 19, 2016

Prepared By:

**EnviroTrac Engineering PE PC
5 Old Dock Road
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CERTIFICATIONS

I, Dale Konas, certify that I am currently a NYS-registered Professional Engineer and that this Sub-Slab Depressurization System Design Plan was prepared in accordance with applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

NYS Professional Engineer #

Date

Signature

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- A. SSDS Pilot Test Report – EnviroTrac Engineering PE PC, April 2016
- B. Vapor Monitoring Point Manufacturer Installation Guide – Geoprobe Systems AT-8625S
- C. Vent Fan Manufacturer Installation Instructions – RadonAway 2000E

SUB-SLAB DEPRESSURIZATION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

Install a sub-slab depressurization system (SSDS) to allow the lateral movement, collection and venting of gas vapor from below the subject building. System components include an existing network of 2-inch schedule 40 PVC vent points installed at select locations throughout the building floor slab. Each vent point is routed through individual headers that are mounted along the first floor building ceiling and then routed through the exterior building wall. Each of the two (2) building penetrations will then combine into one 4-inch diameter common header and then continue up the exterior of the building wall. The common header will continue up to a location above the roof line, and then vent to atmosphere by mechanical means. The active sub-slab ventilation system shall be equipped with a wall mounted inline fan. All system components shall be installed as indicated, specified and required within the following sections. A site plan indicating the radius of influence of the proposed SSD system is shown in Figure 1.

This design was prepared based on the results of the SSD pilot study that was conducted on March 30, 2016. The results of this pilot test indicated that a full scale SSD system capable of a total flow rate of 40 cfm @ 13.0 "H₂O vacuum would provide sufficient vacuum to the underlying soil to provide optimal coverage. With an extraction point network consisting of two (2) points, a 38-foot radius of influence would be generated. A copy of the SSDS Pilot Study Report (EnviroTrac, April 2016) is included in Attachment A.

1.02 STANDARDS AND REGULATIONS

- A. Comply with applicable portions of the Building Code of the City of New York, regulations set forth by the New York State Department of Environmental Conservation (DEC), and New York State Department of Health (DOH). Where requirements for products, materials, equipment, methods and other portion of the work specified herein exceed minimum requirements of City of New York Building Code, contractor shall comply with such requirements specified herein, unless specifically approved otherwise.
- B. Standards listed below are referenced in this section.
 - 1. American Society for Testing and Materials (ASTM)
 - 2. American Standards Association (ASA)
 - 3. American National Standards Institute (ANSI)

PART 2 - PRODUCTS

2.01 MATERIALS AND ACCESSORIES

A. SUBSURFACE GAS VAPOR COLLECTION PIPE NETWORK, APPURTANCES, AND BUILDING PENETRATION PIPE

1. Polyvinyl Chloride (PVC) Pressure Pipe:

PVC pipe for gas vapor collection applications for underground installation shall be 2-inch diameter schedule 40 pipe for individual extraction point piping and 4-inch diameter Schedule 40 pipe for the common header. The solid header piping shall be constructed of Schedule 40 PVC and shall be installed as shown in within the design drawings. Raw, unslotted pipe shall have a wall thickness of 0.237-inches, a max working pressure of 220 psi @ 73 degrees F and weigh approximately 205 lbs/100-feet. Joints shall be solvent-welded.

B. VAPOR MONITORING POINTS

1. Monitoring Point:

The vapor monitoring points shall be a 6-inch long, 0.25-inch inside diameter sampling implant by Geoprobe Systems (sample implant model AT-8625S) or approved equal. A sample manufacturer's cut sheet can be seen in Attachment B.

2. Teflon Tubing:

The vapor monitoring point shall be connected to 0.25-inch inside diameter Teflon tubing supplied by Geoprobe Systems or approved equal.

3. Fine Sand:

The sampling point shall be surrounded by fine sand. The fine sand shall be a Morie No. 02 or approved equal.

4. Bentonite:

A 3-inch layer of bentonite shall be placed directly on top of the fine sand. The bentonite shall be Bariod Granular Bentonite or approved equal.

5. Access Manhole:

Each vapor monitoring point shall have a cast iron manhole cover fit directly on top of each vapor monitoring point to provide access to the vapor point tubing. Each manhole shall be equipped with stainless steel bolts and a 7-1/2" galvanized steel skirt. The manhole be finished flush with the top of the concrete slab. The manhole will be a 5" diameter watertight monitoring well manhole as manufactured by Morris Industries, model 318002565, or equivalent.

C. INLINE VENTILATION FAN

The inline ventilation fan required for the riser shall be RadonAway HS2000E or approved equal and shall be installed within the riser located along the building exterior wall as shown in Figure 2 and Figure 3. The Blower will be capable of producing a minimum of 72cfm @ a vacuum of 10 "H₂O. The blower will consist of an integral enclosure rated for indoor/outdoor use and an internal condensate bypass. The blower will include a 3-inch diameter PVC inlet and a 2-inch diameter PVC outlet. Contractor shall connect the inline ventilation fans to the existing building electrical service. A sample manufacturer's cut sheet can be seen in Attachment C.

D. FITTINGS

1. Fittings for PVC Pipe:
 - a. All fittings shall be of the same manufacturer, material, class, and schedule as the pipe. Any required threaded joints shall be provided with Teflon tape or flange joints with nitrile or urethane gaskets.
 - b. Solvent cement joints for the pipe and pipe installation shall be made in accordance with the manufacturer's recommendations and ASTM D2855.

E. SLEEVES FOR PIPES

1. Sheet metal sleeves shall be 20 gauge.
2. Pipe sleeves shall be service weight cast iron pipe or schedule 40 galvanized steel pipe.
3. Fire stop penetration materials for sealing sleeves shall be listed by Underwriters Laboratories and shall have Material and Equipment Acceptance (MEA) approval.
4. Material for sealing spaces between pipe and sleeve through foundation walls below grade shall be Link- Seal Type "C" as manufactured by Thunderline Corp; Belleville, Mich. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. Links shall be loosely assembled with bolts to form a continuous rubber bolt around the pipe with a pressure plate under each bolt head and nut. Link-Seal pressure plates shall be Type "C" (insulating type) to provide for electrical insulation and cathodic protection.

5. Materials for sealing space between each pipe and sleeve through non-fire rated exterior walls above grade shall be Non-shrinking cement.
6. Waterproof sleeves shall be Link-Seal Wall Sleeve as manufactured by Thunderline Corp, or MetraSeal wall sleeve by the Metraflex Co.

F. GENERAL

Provide additional installation accessories as necessary.

Ensure accessories are from same manufacturer as product.

PART 3 - EXECUTION

3.01 INSTALLATION

All components of the SSDS shall be installed as specified in the within these Specifications and Plans.

A. INSTALLATION OF EXTRACTION POINTS

A total of two (2) existing soil vapor extraction (SVE) wells shall be converted and utilized as SSDS extraction points in the building as shown in Figure 1. At a minimum, each well will consist of a 2-inch diameter schedule 40 PVC pipe well riser that extends to a depth of 5-feet below the bottom elevation of the existing concrete basement floor slab at each location. From a depth of 5-feet to 20-feet bgs, the well will consist of 2-inch diameter schedule 40 PVC well slotted screen (0.020 slot). Further details of the existing well construction can be seen in Figure 3.

Any excess soil that is generated during the installation of the extraction points will be collected and then properly disposed of in accordance to any governing regulations.

B. INSTALLATION OF THE VENT RISER AND INLINE VENTILATION FAN

Vent risers shall extend from each of the extraction points and route to a common header located on the exterior of the building. The header will be routed along the first floor ceiling to a location near the north exterior wall of the building. Care will be made to ensure that all interior piping is placed and routed in a best effort to reduce intrusion into the interior space of the building. Each of the two (2) extraction pipes will penetrate the exterior wall and will exit the building approximately 9-feet above the existing exterior grade on the north side (front) of the building. Each extraction pipe will then combine into one 4-inch diameter riser and then extend vertically up the exterior wall of the building, where it will connect to the inlet of the vent fan. The vent fan will be mounted to the exterior of the building at an elevation such that the fan will be accessible from the roof of the first floor garage section of the building. The outlet of the vent fan will then be extended to a location above the roof line of the building to its discharge point. The vent riser will terminate at least 1-foot above the surface of the roof at a location at least 10-feet away from any window or other opening into the conditioned space of the building that is less than 2-feet below the

exhaust point, and 10-feet away from any adjoining or adjacent buildings. All piping shall be schedule 40 PVC pipe.

All interior riser pipe, beginning at the floor slab elevation and continuing to the point where the pipe penetrates the building exterior foundation wall, shall be clearly and permanently labeled and read as such:

“CAUTION: ACTIVE VENT SYSTEM”

C. INSTALLATION OF THE VAPOR MONITORING POINTS

It is estimated that no additional vapor monitoring points will be required for this installation. Testing of the proposed SSD system will utilize the existing network of vapor monitoring points in order to demonstrate adequate performance of the proposed system. The existing vapor monitoring point locations are shown in Figure 1. In the event additional vapor monitoring points are required, they shall be installed as specified below.

Each vapor monitoring point shall consist of one 6-inch long, 0.25-inch inside diameter sampling implant by Geoprobe Systems (sample implant model AT-8625S) or approved equal. The sample implant shall be attached to 0.25-inch inside diameter Teflon tubing from Geoprobe Systems. The Implant will be installed in accordance with the manufacturer's instructions. This will include driving a macrocore probe rod with a handheld unit, attaching the sample implant to the drive tip, and placing fine sand (Morie No. 02) around the sample implant while retracting the macrocore rods. The 5-inch manhole shall be placed over the tubing. Approximately 3-inches of hydrated bentonite will be placed within the curb box liner and directly on top of the fine sand. Concrete will be placed on top of the hydrated bentonite to within 3-inches of the top of the curb box.

D. PIPING (GENERAL)

1. The run and arrangements of all pipes shall be approximately as shown in the Figures or specified and as directed during installation, and shall be as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and neatly spaced. No pipe shall be installed where the headroom will be interfered with unless the conditions are such that it is unavoidable and permission is obtained from the property owner. Offsets will be permitted where walls reduce in thickness or beams interfere with direct runs; offsets shall be made at an angle of 45 degrees to the vertical; in no case shall the space between the pipes, partitions, walls, etc., exceed 5". All exposed risers shall be erected plumb, standing free, close to and parallel with walls and other pipes and be uniformly spaced. All horizontal runs of piping hung from structural floor, slab or floor beams shall be erected as closely as possible to bottom of floor slabs, ceilings, or I-beams as the case may be. In no case shall the headroom, beneath the pipe, be less than (7'-0") where the pipe is installed more than (1'-0") from wall, partition, etc., except where piping is required to be installed in Boiler Room and Mechanical spaces above

floor. Horizontal piping shall be so graded as to drain back to each individual extraction point. All piping shall be installed with ample space for pipe covering.

2. Roughing underground or concealed in the floor or wall construction shall be properly installed, tested and inspected before any of the roughing is covered up. Should any work be covered up before being inspected and tested, it shall be uncovered and recovered at the expense of the Contractor. Plugged fittings shall be installed when called for. Reducer fittings or bushings shall be used in making reductions in sizes of pipes.

E. PIPING JOINTS

1. Threaded Joints

The joints piping shall be screwed joints of full length and threads shall be NPT. All pipes shall be screwed close up to their shoulders, not to leave more than 3 threads exposed. The use of lamp wick is prohibited in threaded joints. All burrs shall be removed. Pipe joint cement or Teflon tape shall be used only on male threads.

2. Solvent-cementing:

- a) Remove all burrs, chips, filings, and other debris from the pipe i.d. and o.d. before joining.
- b) All pipe ends should be beveled to minimize the chances of wiping the solvent cement from the i.d. of the fitting as the pipe is socketed. Beveling can be done with the coarse file or beveling tool.
- c) Using a clean, dry cotton rag, wipe away all loose dirt and moisture from the i.d. and o.d. of the pipe end and the i.d. of the fitting. Do not attempt to solvent-cement wet surfaces.
- d) Using a natural-bristle brush about one-half the width of the pipe diameter to be joined, apply primer freely to the inner fitting socket. Keep the surface wet by continuously brushing the entire surface for 5 to 15 seconds. Redip the applicators as necessary, but avoid puddling inside the fitting. Reapply primer to the fitting socket.
- e) Apply primer to the pipe surface in the same manner, making sure that the length of pipe evenly covered is at least equal to the fitting socket depth.
- f) Using a second clean natural-bristle brush one-half the size of the pipe diameter, apply a heavy coat of solvent cement to the male end of the pipe. Next apply a liberal coat of solvent cement to the inside of the socket using straight outward strokes to keep excess cement out of the socket.
- g) While both surfaces are still wet with solvent cement, insert the pipe into the socket with a twisting motion. The pipe must go to the bottom of the socket. The application of solvent cement to pipe and fitting, and the insertion of pipe into the fitting, should be completed in less than 1 minute. Hold the joints together for approximately 30 seconds until both surfaces are firmly gripped.

h) After solvent-cementing, hold joints together for 30 seconds until both surfaces are firmly gripped. Allow proper set time before disturbing joints. The initial set time prior to installation is as follows:

Temperature Range	Pipe Sizes 1/4" - 1/2"	Pipe Sizes 1 1/2" - 3"	Pipe Sizes 4" - 8"	Pipe Sizes 10" - 16"	Pipe Sizes 18" - 24"
60°-100°F	15 Min.	30 Min.	1 Hr.	2 Hr.	3 Hr.
40°-60°F	1 Hr.	2 Hr.	4 Hr.	8 Hr.	12 Hr.
0°-40°F	3 Hr.	6 Hr.	12 Hr.	24 Hr.	36 Hr.

F. SLEEVES FOR PIPES

1. General: All plumbing pipes passing through floors, roofs, walls, partitions, furring, beams, trenches, and wherever else indicated on the drawings shall be provided with sleeves. Where plumbing pipes pass through potentially wet floors that do not have membrane waterproofing such as toilet rooms, cafeteria kitchens, serving areas, dish washing room, janitor's sink closet, mechanical equipment rooms, pipe chases and areas that are provided with fire protection sprinkler systems, the Contractor shall install sleeves of galvanized steel pipe with welded clips or equivalent at bottom ends for securing sleeves to form work and shall project one inch above finished floors, and shall be caulked watertight.
2. For interior walls and floors and for pipes through roof, the space between each installed pipe and its sleeve shall be sealed with a three hour rated fire stop penetration material. Fire stop materials shall be installed in accordance with the instructions of the manufacturer.
3. Sheet Metal Sleeves
 - a. Sleeves for pipes passing through floors, partitions, hung or furred ceilings, shall be installed with 1/2" maximum clearance all around pipes. Each sleeve for a pipe passing through an interior floor slab shall be fitted with a one-inch flange, or equivalent, at the bottom end for the purpose of securing it to the form work or sheet metal deck.

 The sleeve shall finish flush with the top of the finished floor. Sleeves for pipes passing through partitions, hung or furred ceilings shall be of one-piece construction and shall finish flush with the finished surface.
 - b. Sleeves installed for pipes passing through vent ducts shall be securely fastened, soldered and made airtight.

4. Pipe Sleeve: Install pipe sleeves for pipes passing through roofs, concrete beams, utility trenches, grade beams, brick walls, foundation walls and floor slabs on earth. Sleeves shall be installed with 1/2" maximum clearance all around pipe and shall finish flush with the surfaces penetrated. Pipe sleeves for pipes through roof shall be made of service weight cast iron only.

G. GENERAL

All system components shall be installed in accordance to ASTM 2121-12 "Standard Practices for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings"

3.02 **PIPE AND FITTING SCHEDULE**

A. Sub-Slab Depressurization System

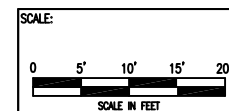
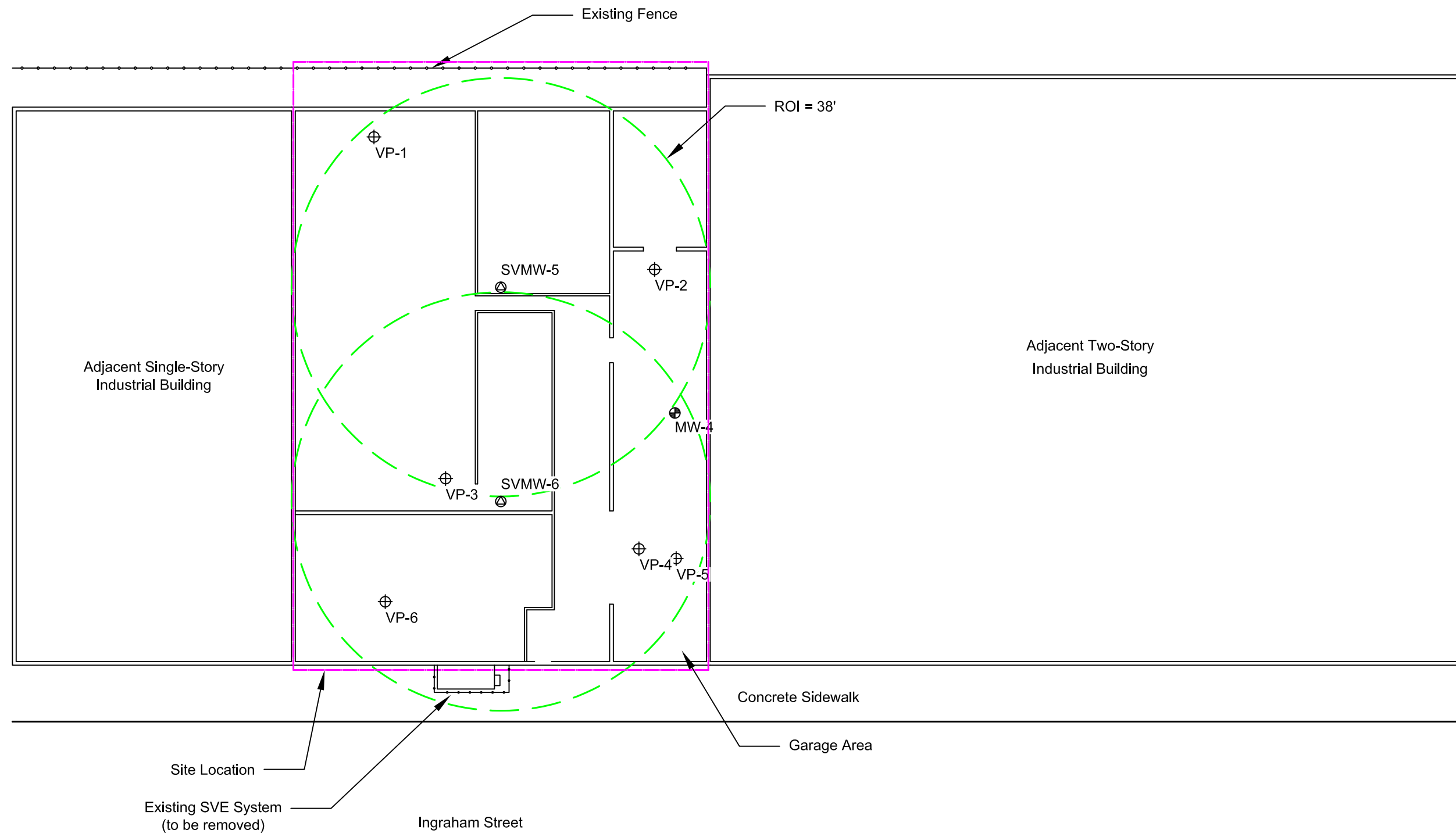
PVC pipe Schedule 40 with welded joints (Interior & Exterior)

3.03 **PROTECTION**

It is the responsibility of the Contractor to ensure that no damage occurs to components of the SSDS prior to, during or following installation of system, or during any subsequent performance of construction for the facility as identified on the drawings and specifications. This includes the installation of all subsurface utilities required for the operation of building systems.

END OF SECTION

FIGURES

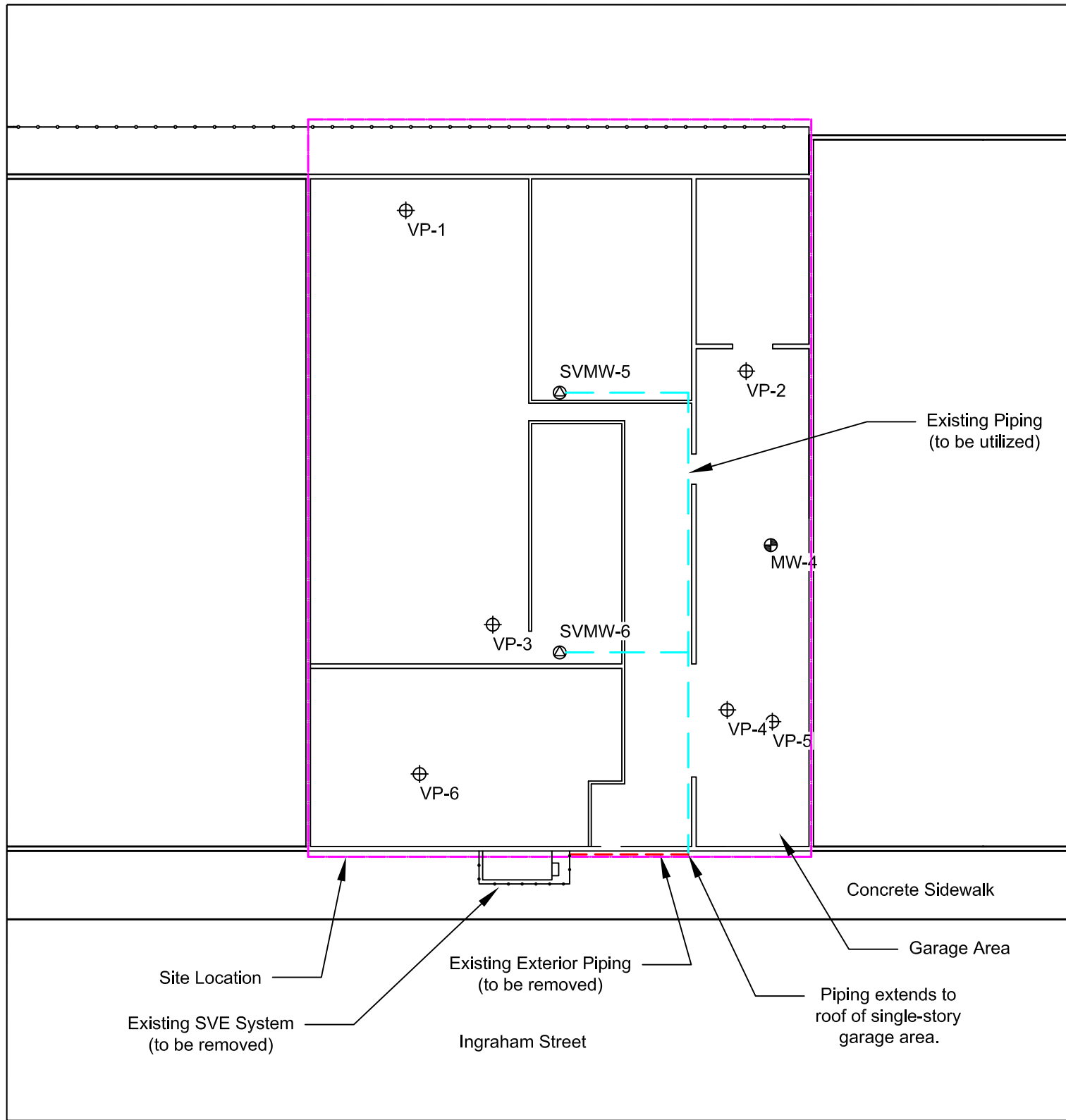


- LEGEND:
- Radius of Influence
 - Existing Monitoring Well Location
 - Existing Vapor Extraction Location
 - Existing Vapor Point Location

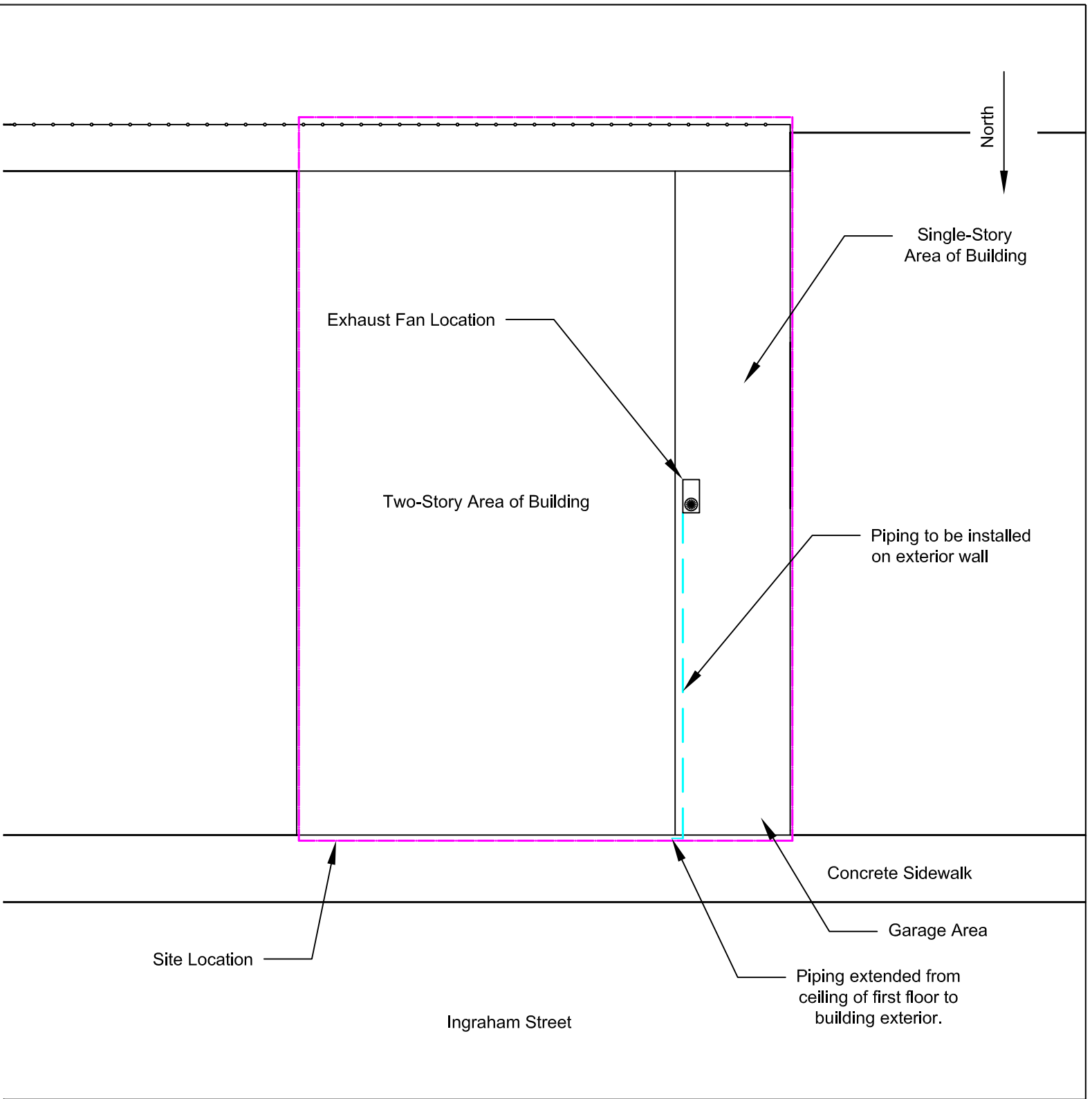
DATE:	5/17/16	FIGURE:	1	DRAFTED BY:	NC/DK
MAP:	Site Plan with SSDS Radius of Influence				
SITE:	Popular Hand Laundry 88 Ingraham Street Brooklyn, NY 10452				

EnviroTrac
Environmental Services

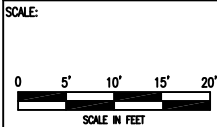
5 Old Dock Road
Yaphank, NY 11980
P: 631.924.3001 F: 631.924.5001



First Floor Piping Plan



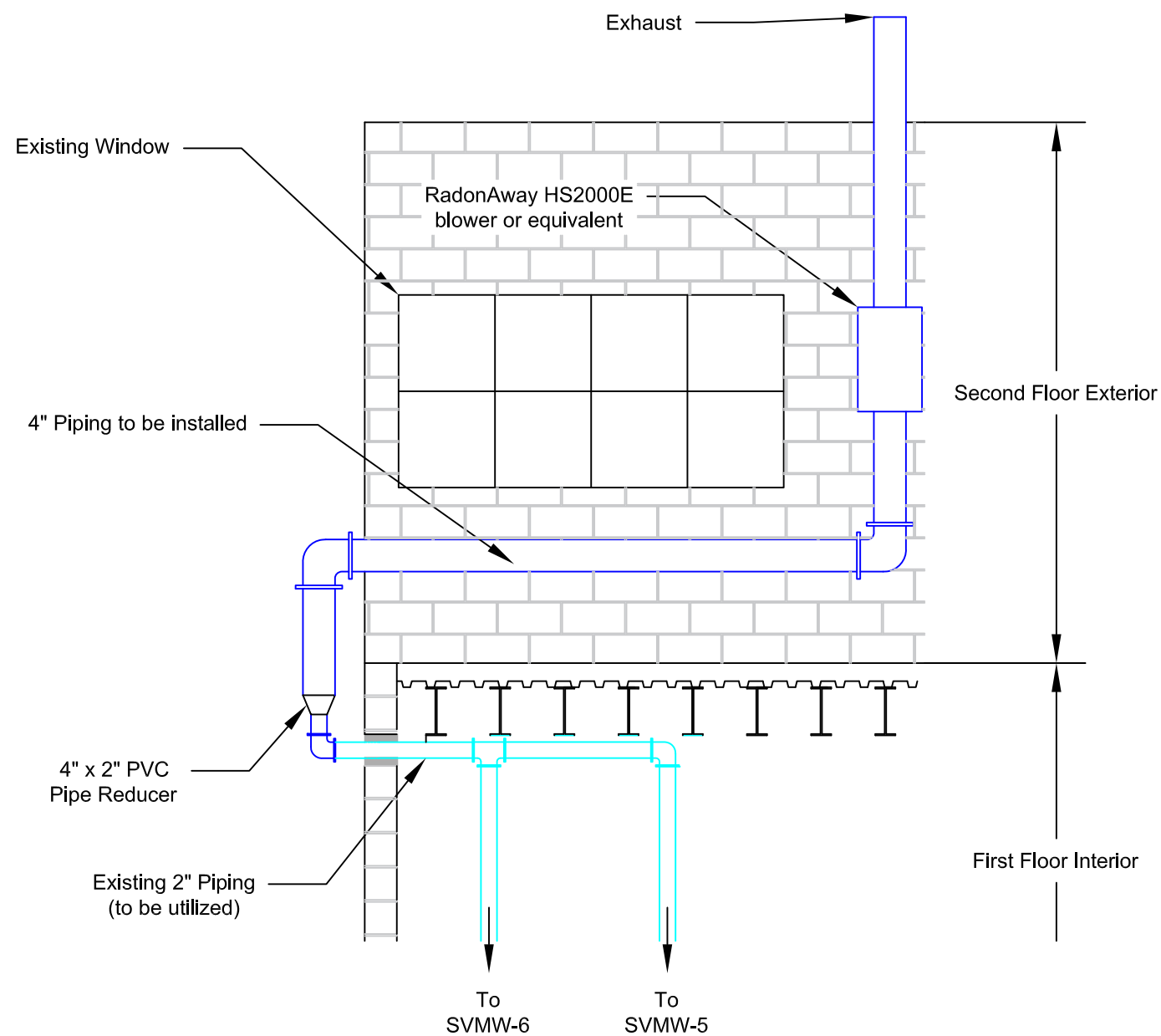
Second Floor Piping Plan



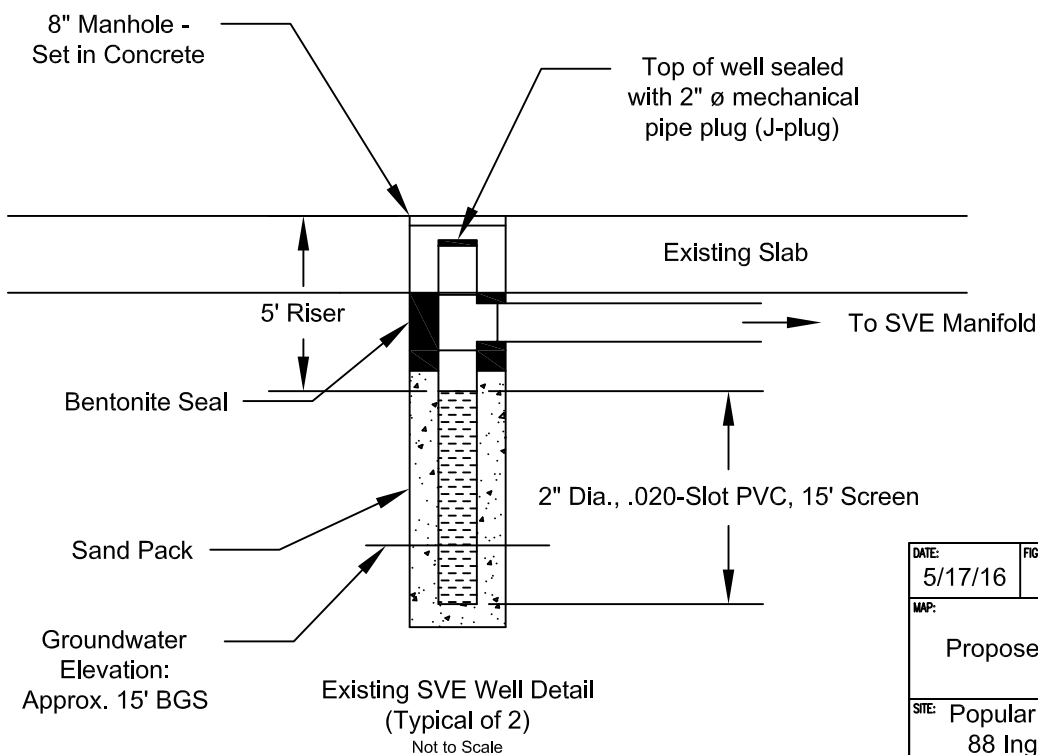
DATE:	5/17/16	FIGURE:	2	DRAFTED BY:	NC/DK
MAP:	Proposed SSDS Piping Layout				
SITE:	Popular Hand Laundry 88 Ingraham Street Brooklyn, NY 10452				

EnviroTrac
Environmental Services

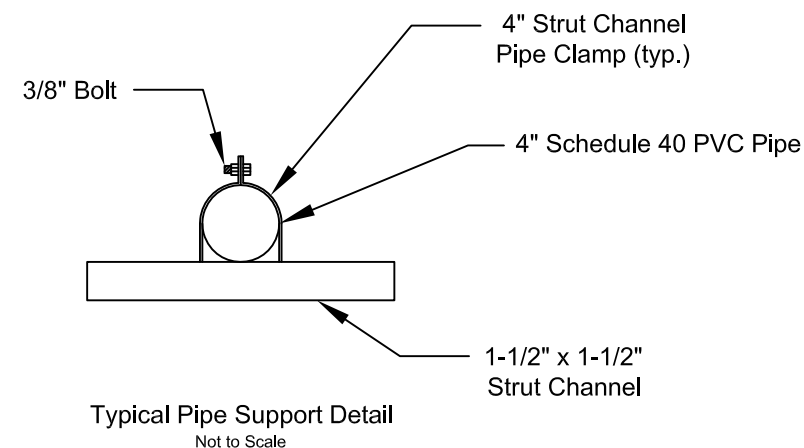
5 Old Dock Road
Yaphank, NY 11980
P: 631.924.3001 F: 631.924.5001



SSDS Point Detail
(Typical of 2)
Not to Scale



Existing SVE Well Detail
(Typical of 2)
Not to Scale



General Notes:

1. To retard soil gas entry, large openings through concrete slabs, wood, and other floor assemblies in contact with the soil, such as spaces around bathtub, shower, or toilet drains, will be filled or closed with materials that provide a permanent airtight seal such as non-shrink mortar, grouts, expanding foam, or similar material designed for such application. Smaller gaps around all pipes, wire, or other objects that penetrate the concrete slab or other floor assembly will be made airtight with an elastomer joint sealant or polyethylene tape, as defined in ASTM C920-87, and applied in accordance with the manufacturer's recommendations. All control joints, isolation joints and any other joints in concrete slabs or between slabs and foundation walls will be sealed. Joints, cracks, or other openings around all penetrations exterior walls below the ground surface will be sealed with an elastomeric sealant that provides an airtight seal.
2. Exhaust piping will terminate at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building or any adjoining or adjacent building that is less than 2 feet below the exhaust point.
3. The in-line vacuum blower will be installed on the western exterior wall as depicted in "Proposed SSDS Piping Layout", Figure 2. The blower will be a RadonAway HS2000E blower with electrical switch box capable of 72 CFM at 10" WC, or equivalent. The fan is to be installed as per the manufacturer's specifications.
4. All components of the sub slab depressurization system will be in accordance with ASTM E 2121-12 "Standard Practice for Installing Radon Mitigation Systems in Existing Low-rise Residential Buildings".

DATE:	5/17/16	FIGURE:	3	DRAFTED BY:	NC/DK
MAP:	Proposed SSDS Piping Details				
SITE:	Popular Hand Laundry 88 Ingraham Street Brooklyn, NY 10542				

ATTACHMENT A



Sub-Slab Depressurization System (SSDS) Pilot Test Report

Popular Hand Laundry Site
88 Ingraham Street
Brooklyn, New York
VCP Site No. V00170

Prepared by:

EnviroTrac Engineering PE PC
5 Old Dock Road
Yaphank, NY 11980

April 2016

Sub-Slab Depressurization System (SSDS) Pilot Study Report

Popular Hand Laundry, Brooklyn, New York.

PURPOSE

This report is intended to summarize the results of the SSDS pilot study that was conducted by EnviroTrac on March 30, 2016. The purpose of the test was to determine the feasibility of implementing an SSD system as a viable means of mitigation throughout the existing building structure, as well as determining the required operating parameters and layout of such a system.

TECHNICAL SCOPE OF WORK PERFORMED

1. Pilot Test Equipment

For the purpose of the pilot test, the existing onsite Soil Vapor Extraction (SVE) system equipment was utilized to conduct the test at two representative locations. The existing system consists of two (2) SVE extraction points located on the interior of the building, which provides SVE coverage for the entire footprint of the building. Prior to starting the test, the system piping leading to the SVE wells was temporarily modified to allow for the operation of one single SVE point at a time. Major system components of the existing SVE system are described below.

Soil Vapor Extraction Equipment:

- Extraction Blower – Roots Model #: 47 URAI-J-DSL, Positive Displacement Rotary Lobe Vacuum Pump (10 HP, 230/460V, 3 Phase, 1740 RPM).
 - Max Flow: 523 SCFM
 - Max Vac: 15 "Hg

Additional Test Equipment

- TSI Handheld Air Velocity/Vacuum Meter – Model 8386A

SSDS TESTING METHODOLOGY

The existing SVE system currently consist two (2) SVE extraction wells that are connected to individual piping headers, that are routed to a single manifold located in the existing system shed that houses the vacuum blower. For the purpose of the pilot study, each extraction well was isolated by temporarily modifying the system piping within the system shed, to allow for the bleeding of excess air flow. This allowed each extraction well to be exposed to a greater range of test air flow and vacuum. In order to monitor the sub-slab vacuum response of the test, several temporary vacuum monitoring points were installed through the concrete floor slab, extending radially outward from each test point. These newly installed temporary points were used in conjunction with the network of existing monitoring points. During the test, the vacuum blower was configured to operate at four different steps of increasing flow and vacuum. Throttling of the blower was carried out by making adjustments to the system manifold control valve as well as bleeding excess flow through the temporary system fresh air inlet valve. During each step, operating parameters such as applied flow and vacuum, and sub-slab vacuum responses were recorded. The applied extraction well flow and vacuum were measured from a monitoring point located in the extraction piping several feet above where the piping penetrates the floor slab. The wellhead vacuum and extraction flow rate for each step were recorded as the following:



SV/MW-5

- Step 1 – 4.0 "H₂O Wellhead Vacuum, 8.5 scfm Extraction Flow Rate.
- Step 2 – 8.0 "H₂O Wellhead Vacuum, 16.0 scfm Extraction Flow Rate.
- Step 3 – 15.0 "H₂O Wellhead Vacuum, 24.0 scfm Extraction Flow Rate.
- Step 4 – 20.0 "H₂O Wellhead Vacuum, 40.0 scfm Extraction Flow Rate.

SV/MW-6

- Step 1 – 4.0 "H₂O Wellhead Vacuum, 13.0 scfm Extraction Flow Rate.
- Step 2 – 8.0 "H₂O Wellhead Vacuum, 16.5 scfm Extraction Flow Rate.
- Step 3 – 15.0 "H₂O Wellhead Vacuum, 24.0 scfm Extraction Flow Rate.
- Step 4 – 20.0 "H₂O Wellhead Vacuum, 45.0 scfm Extraction Flow Rate.

During each step vacuum influence was recorded from all monitoring points utilizing a handheld digital manometer. For each step the operating conditions were allowed to sufficiently stabilize at a steady state condition prior to the recording of any readings.

PILOT TESTING RESULTS

The field data collected during the SSDS pilot test is included as an attachment to this report. Flow and vacuum readings were recorded during each step of the SSDS test, while vacuum influence was measured at each observation point. A copy of the pilot test data analysis from each test well, along with a plot of sub-slab vacuum response vs. distance, is also provided as an attachment. From this plot the effective Radius of Influence (ROI) of each of the four test steps of the pilot study is determined by finding the radial distance where a best fit logarithmic line plot of the data intersects the line $y = 0.04 \text{ "H}_2\text{O}$ (~1 pascal) vacuum response. For SVE/MW-5 and SVE/MW-6 a minimum of 9.0 "H₂O vacuum at a minimum flow rate of 20 cfm, from each well, would be required to meet the minimum radius of influence (ROI) (~38 feet) to achieve complete coverage of the building footprint.

CONCLUSIONS

Based on the results tabulated, the pilot testing performed demonstrates that a full scale SSD system can serve as an effective means of mitigation for the existing site building. If a target ROI of 38 feet is selected for each proposed extraction point, it was determined that a minimum vacuum of ~9 "H₂O and an air flow rate of ~20 CFM would need to be applied at each point. Appropriate consideration will be addressed concerning the number and spacing of the extraction points.

Recommended Design Parameters (each extraction point):

- Target Radius of Influence (ROI): 38 feet
- Applied Vacuum: 13.0 "H₂O (40% SF for system losses)
- Applied Flow Rate: 20 CFM

ATTACHMENTS

1. SVE/MW-5: Pilot Test Data – Field Measurements
2. SVE/MW-5: SSD Test Data Analysis
3. SVE/MW-5: Plot: Vacuum Response vs. Monitoring Point Distance
4. SVE/MW-5: Plot: Radius of Influence vs. Applied Vacuum
5. SVE/MW-5: Plot: Applied Flow vs. Applied Vacuum
6. SVE/MW-6: Pilot Test Data – Field Measurements
7. SVE/MW-6: SSD Test Data Analysis
8. SVE/MW-6: Plot: Vacuum Response vs. Monitoring Point Distance
9. SVE/MW-6: Plot: Radius of Influence vs. Applied Vacuum
10. SVE/MW-6: Plot: Applied Flow vs. Applied Vacuum



REFERENCES

1. ASTM E1465-08a "Standard Practice for Radon Control Options"
2. ASTM E2121-13 "Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings"

ATTACHMENTS

Site Name: 88 INGRAHAM ST. BROOKLYN, NY					(SSDS) Pilot Test Data						
					Extraction Well						
Test Date: 3/30/2016					SV/MW 5						
Observation Well	Observation Well	Observation Well	Observation Well	Observation Well	Observation Well	Observation Well					
Weather: Clear 44 DEG F					VP2	VP3	VP4	VP?	VP5	VP6	BASEMENT
					Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)
					48	22	22	25	32	23	24
Time	Well Head Vac "H2O		Flow (scfm)		Vacuum"H ₂ O	Vacuum"H ₂ O	Vacuum"H ₂ O	Vacuum"H ₂ O	Vacuum"H ₂₁	Vacuum"H ₂₂	Vacuum"H ₂₃
	4.0		8.5		0.000	-0.004	-0.005	-0.040	-0.009	-0.001	NM
	8.0		16		-0.010	-0.011	-0.012	-0.062	-0.026	-0.019	NM
	15.0		24		-0.003	-0.008	-0.014	-0.090	-0.019	-0.033	NM
	20.0		40		-0.040	-0.022	-0.033	-0.122	-0.016	-0.056	NM
Comment / Notes:											
Used existing SVE System blower for test. Roots 47 URAI-J-DSL 10HP											

Summary of Sub Slab Depressurization Pilot Test Data
88 INGRAHAM ST.
BROOKLYN, NY

Test Date: 3/30/2016
Performed By: EnviroTrac - DW
Extraction Point: SV/MW-5
Test Duration (min.): NA
Wellhead Vacuum ("H2O): 4 to 20
Wellhead Flow (scfm): 8.5 to 40

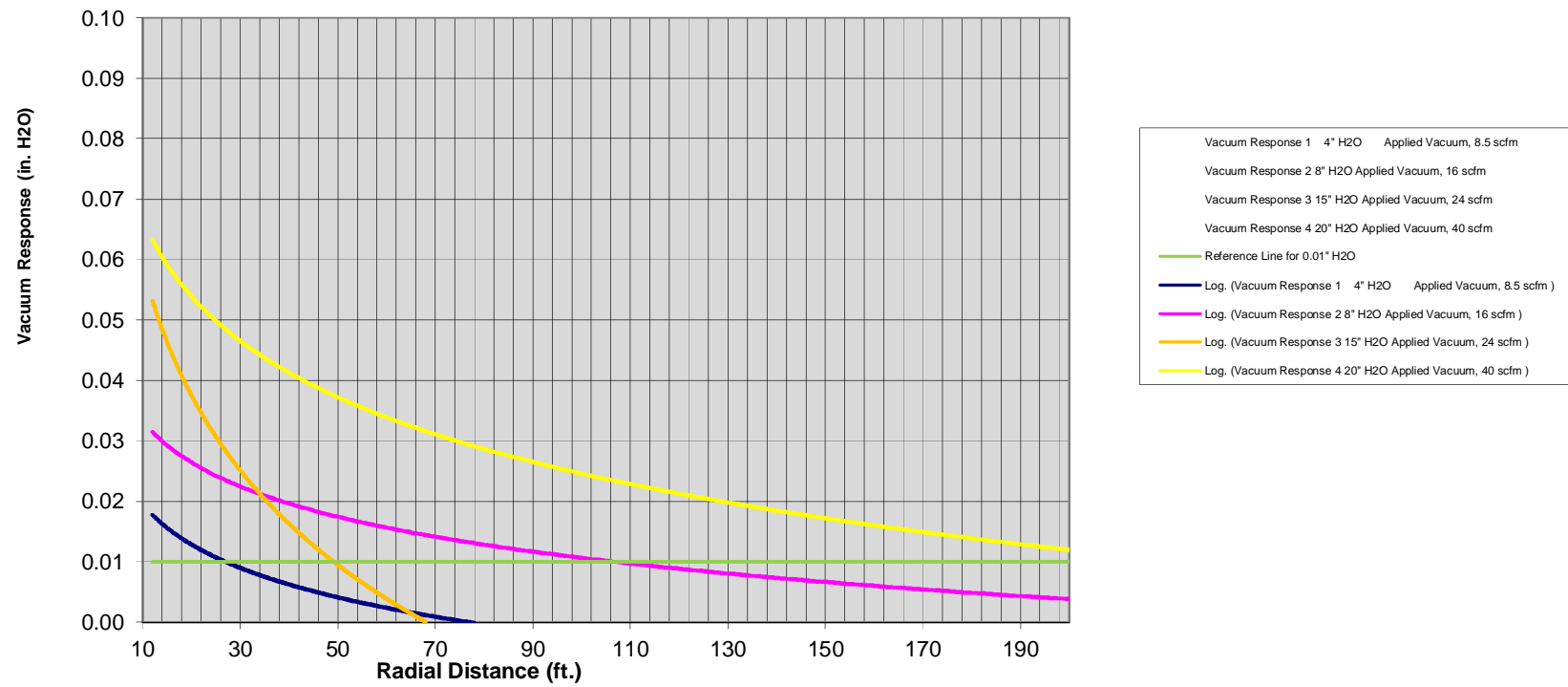
SSDS Design Data

Radial Distance (ft.)	Vacuum Response 1 4" H2O Applied Vacuum, 8.5 scfm	Vacuum Response 2 8" H2O Applied Vacuum, 16 scfm	Vacuum Response 3 15" H2O Applied Vacuum, 24 scfm	Vacuum Response 4 20" H2O Applied Vacuum, 40 scfm	Reference Line for 0.01" H2O	TEST POINT ID
22	0.004	0.011	0.008	0.022	0.01	VP3
22	0.005	0.012	0.014	0.033	0.01	VP4
23	0.001	0.019	0.033	0.056	0.01	VP6
25	0.040	0.062	0.090	0.122	0.01	VP?
32	0.009	0.026	0.019	0.016	0.01	VP5
48	0.000	0.010	0.003	0.040	0.01	VP2

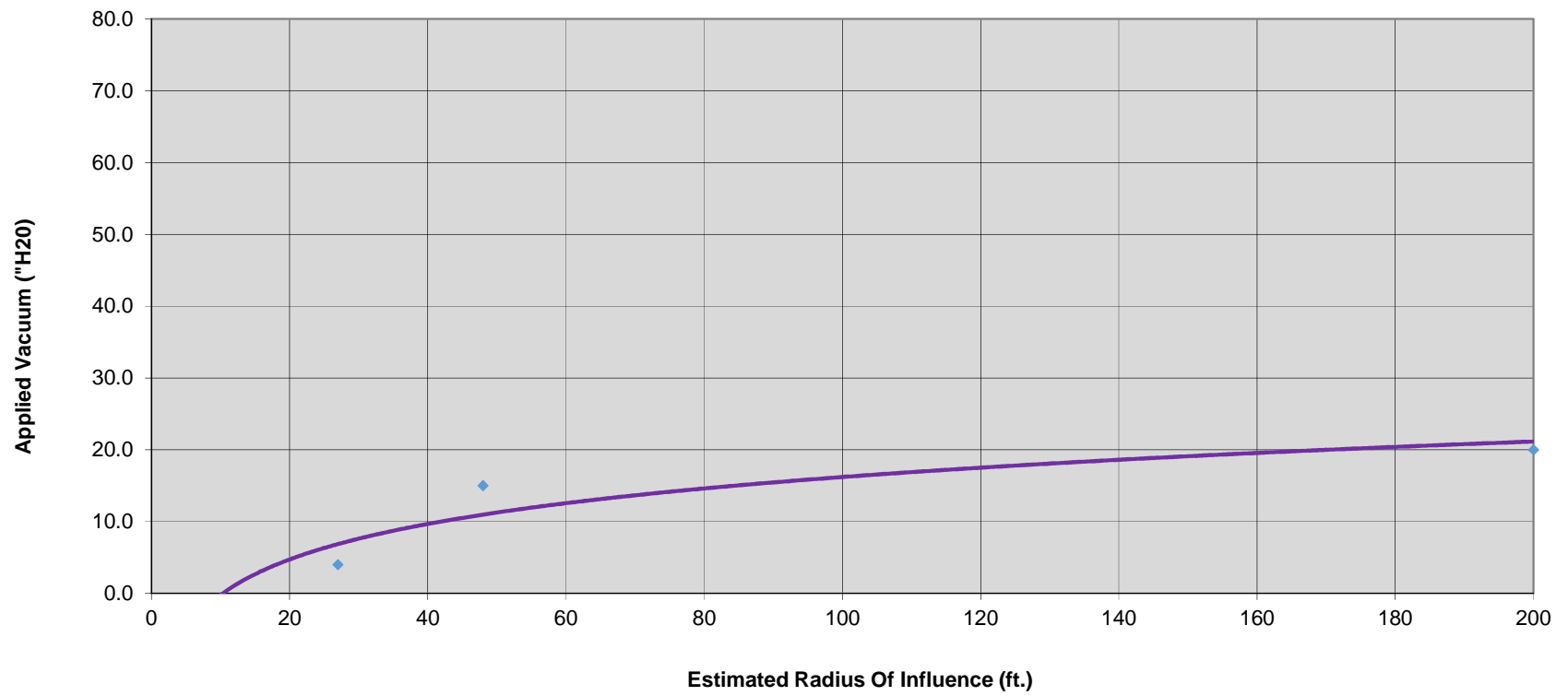
Est. ROI (ft.)	Vacuum ("H2O)	Flow (scfm)
27	4.0	9
48	15.0	24
200	20.0	40

Design Parameters	
Flow (cfm):	18
Vacuum ("H2O):	9

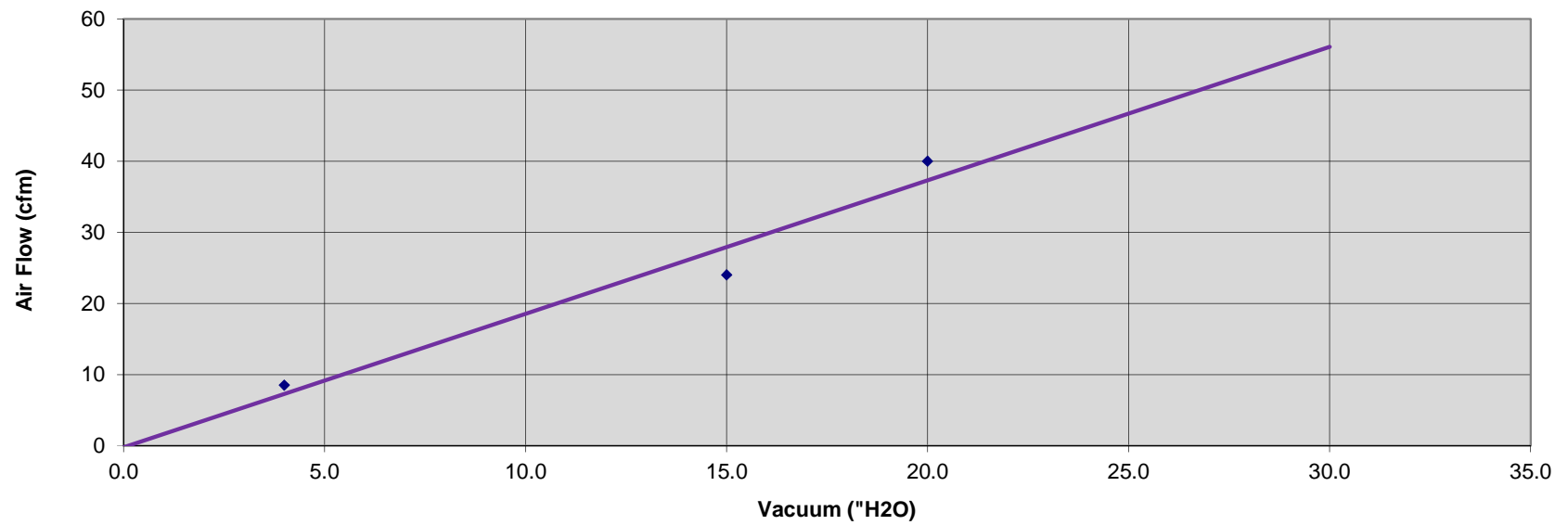
Effective Radius Of Influence SV/MW 5



Vacuum vs. Radius Of Influence



Air Flow vs. Vacuum Graph: SV/MW 5



Site Name: 88 INGRAHAM ST. BROOKLYN, NY					(SSDS) Pilot Test Data						
					Extraction Well						
Test Date: 3/30/2016					SV/MW 6						
Personnel: DW											
Weather: Clear 44 DEG F					Observation Well	Observation Well	Observation Well	Observation Well	Observation Well	Observation Well	Observation Well
					VP2	VP3	VP4	VP?	VP5	VP6	BASEMENT
					Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)
					64	45	15	34	22	38	32
Time	Well Head Vac "H2O		Flow (scfm)		Vacuum"H ₂ O	Vacuum"H ₂ O	Vacuum"H ₂ O	Vacuum"H ₂ O	Vacuum"H ₂₁	Vacuum"H ₂₂	Vacuum"H ₂₃
	4.0		13		0.000	0.000	-0.007	-0.012	-0.057	-0.002	-0.011
	8.0		16.5		-0.012	0.000	-0.031	-0.021	-0.011	0.000	-0.011
	15.0		24		0.000	-0.003	-0.032	-0.036	-0.029	-0.006	-0.012
	20.0		45		-0.011	-0.021	-0.044	-0.064	-0.073	-0.024	-0.015
Comment / Notes:											
Used existing SVE System blower for test. Roots 47 URAI-J-DSL 10HP											

Summary of Sub Slab Depressurization Pilot Test Data
88 INGRAHAM ST.
BROOKLYN, NY

Test Date: 3/30/2016
 Performed By: EnviroTrac - DW
 Extraction Point: SV/MW-6
 Test Duration (min.): NA
 Wellhead Vacuum ("H2O): 4 to 20
 Wellhead Flow (scfm): 13 to 45

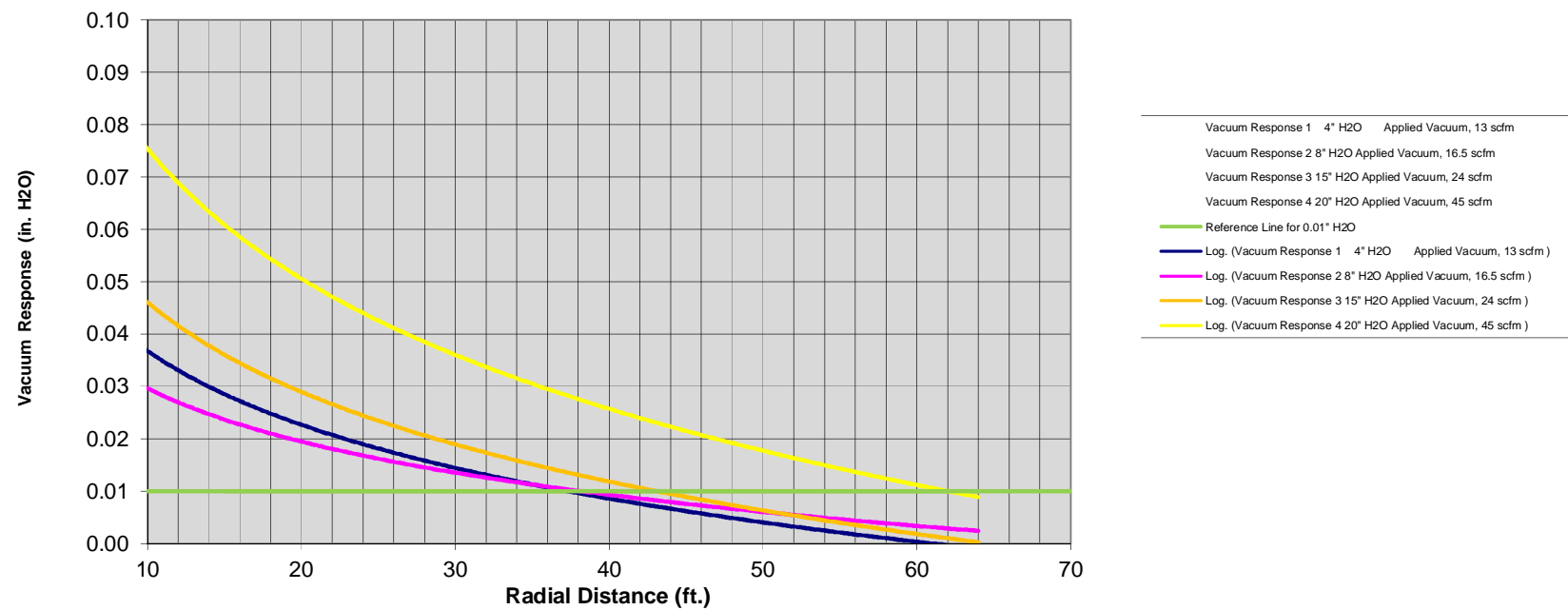
SSDS Design Data

Radial Distance (ft.)	Vacuum Response 1 4" H2O Applied Vacuum, 13 scfm	Vacuum Response 2 8" H2O Applied Vacuum, 16.5 scfm	Vacuum Response 3 15" H2O Applied Vacuum, 24 scfm	Vacuum Response 4 20" H2O Applied Vacuum, 45 scfm	Reference Line for 0.01" H2O	TEST POINT ID
15	0.007	0.031	0.032	0.044	0.01	VP4
22	0.057	0.011	0.029	0.073	0.01	VP5
32	0.011	0.011	0.012	0.012	0.01	BASEMENT
34	0.012	0.021	0.036	0.064	0.01	VP?
38	0.002	0.000	0.006	0.024	0.01	VP6
45	0.000	0.000	0.003	0.002	0.01	VP3
64	0.000	0.012	0.000	0.012	0.01	VP2

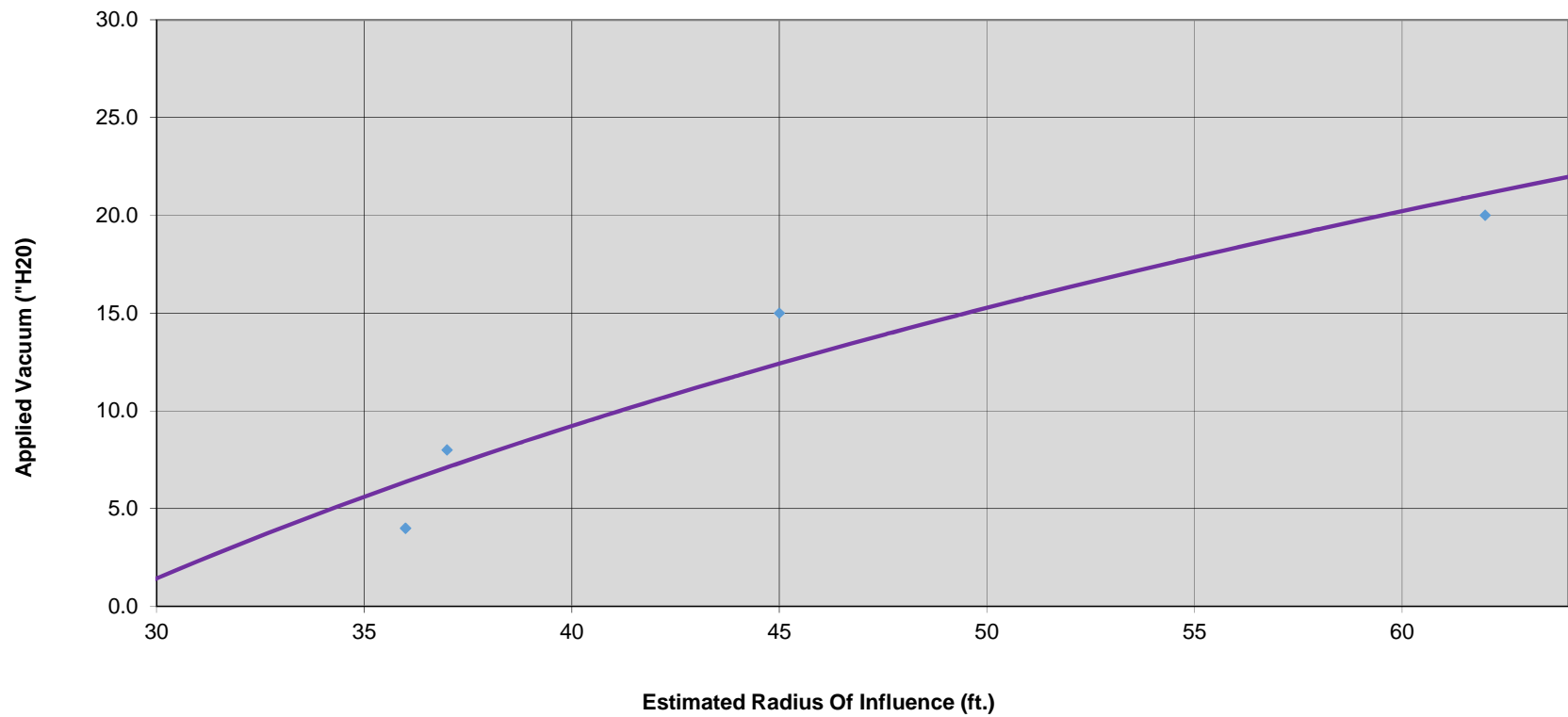
Est. ROI (ft.)	Vacuum ("H2O)	Flow (scfm)
36.0	4.0	13.0
37.0	8.0	16.5
45.0	15.0	24.0
62.0	20.0	45.0

Design Parameters	
Flow (cfm):	19
Vacuum ("H2O):	8

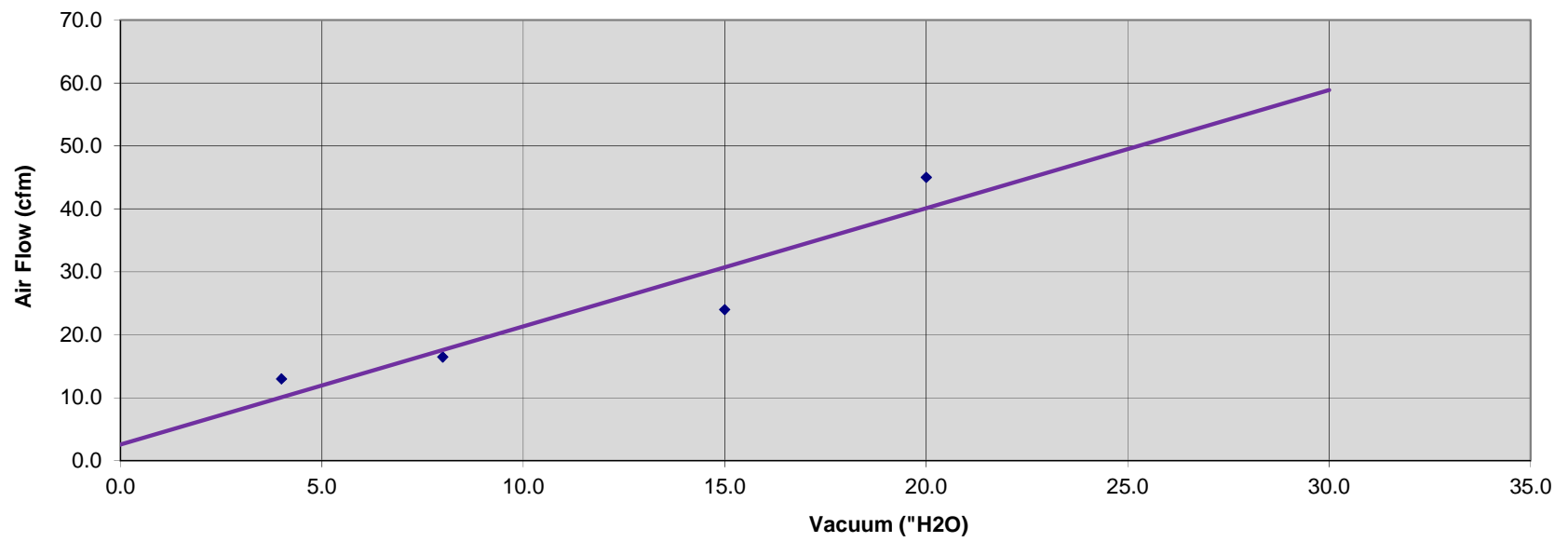
Effective Radius Of Influence SV/MW 6



Vacuum vs. Radius Of Influence



Air Flow vs. Vacuum Graph: SV/MW 6



ATTACHMENT B

Implants Operation

from Geoprobe Systems®

www.geoprobe.com

1-800-436-7762



Attaching polyethylene tubing to the sampling implant.



Sampling Implants – Operation

Installation Instructions for Soil Gas Implants

1. Drive probe rods to the desired depth using a Point Holder (AT-13B) and an Implant Anchor/Drive Point (PR-14). DO NOT disengage the drive point when depth has been reached.
2. Attach appropriate tubing to the implant (**Figure 1**). If tubing is pre-cut, allow it to be approximately 48 in. (1219 mm) longer than the required depth of the implant. Cover or plug the open end of the tubing.
3. Remove pull cap and lower the implant and tubing down inside the diameter of the probe rods until the implant hits the top of the Anchor/Drive Point. Note the length of the tubing to assure that proper depth has been reached.
4. Rotate tubing counterclockwise while exerting a gentle downward force to engage the PRT threads (**Figure 2**). Pull up on the tubing lightly to test the connection. DO NOT cut excess tubing.
5. Position a Probe Rod Pull Plate or Manual Probe Rod Jack on the top probe rod. Exert downward pressure on the tubing while pulling the probe rods up. Pull up about 12 in. (305 mm).
6. If using 1/4-in. (6,4 mm) O.D. tubing or smaller, thread the excess tubing through the Implant Funnel and position it over the top probe rod. If using larger tubing, it may not be possible to install the glass beads.



Figure 1. Attaching tubing to the sampling implant.

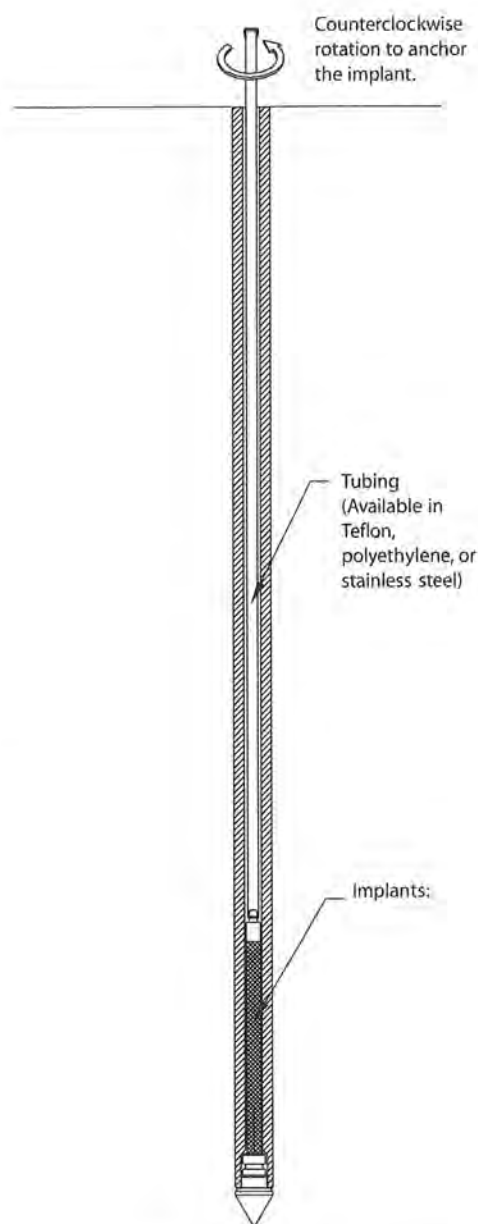


Figure 2. Once depth is achieved, the selected implant and tubing are inserted through the rods. The tubing is rotated to lock the implant into the drive point.

Sampling Implants – Operation

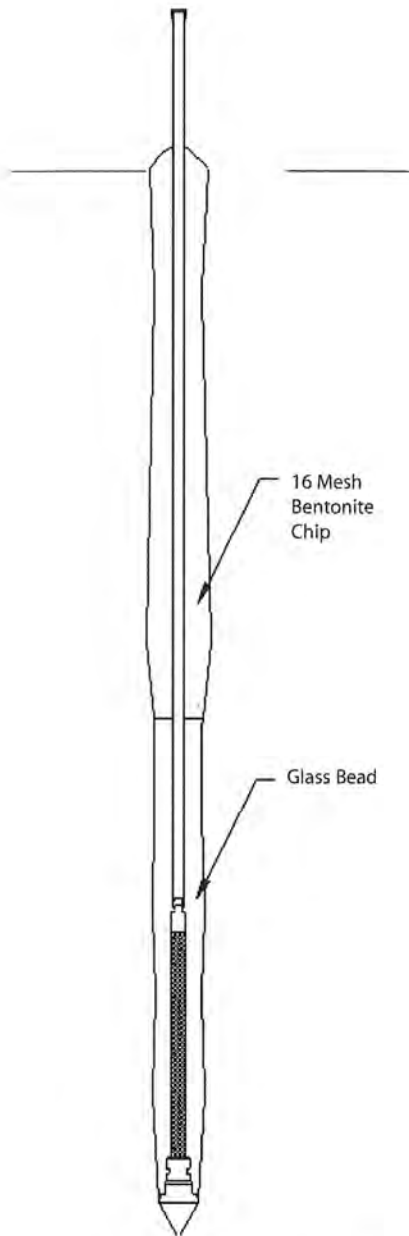


Figure 4. After the implant has been secured, the rods are removed and the annulus backfilled as appropriate.

7. Pour glass beads down the inside diameter of the probe rods around the outside of the tubing. Use the tubing to "stir" the glass beads into place around the implant. Do not lift up on tubing. It should take less than 150 mL of glass beads to fill the space around the implant.

NOTE: Backfilling through the rods with glass beads or glass beads/bentonite mixes can only be performed in the Vadose Zone, not below the water table.

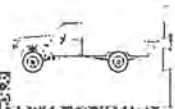
8. Lift up an additional 18 to 24 in. (457 to 610 mm) and pour the bentonite seal mixture into place as in Step 7. The volume to be filled is about 154 mL per foot. It may be necessary to "chase" the seal mixture with distilled water to initiate the seal.
9. Pull the remaining rods out of the hole as in Step 5. Backfilling with sackcrete (cement/sand) or bentonite/sand may be done while removing the rods (Figure 4). If the PR-14 Implant Anchor is used, the tubing may be cut flush with the top probe rod and a regular pull cap may be used to remove the remaining probe rods after Step 8.
10. After the probe rods have been removed, cut the tubing at the surface, attach a connector or plug, and mark the location with a pin flag or stake. The point is ready for sampling now.



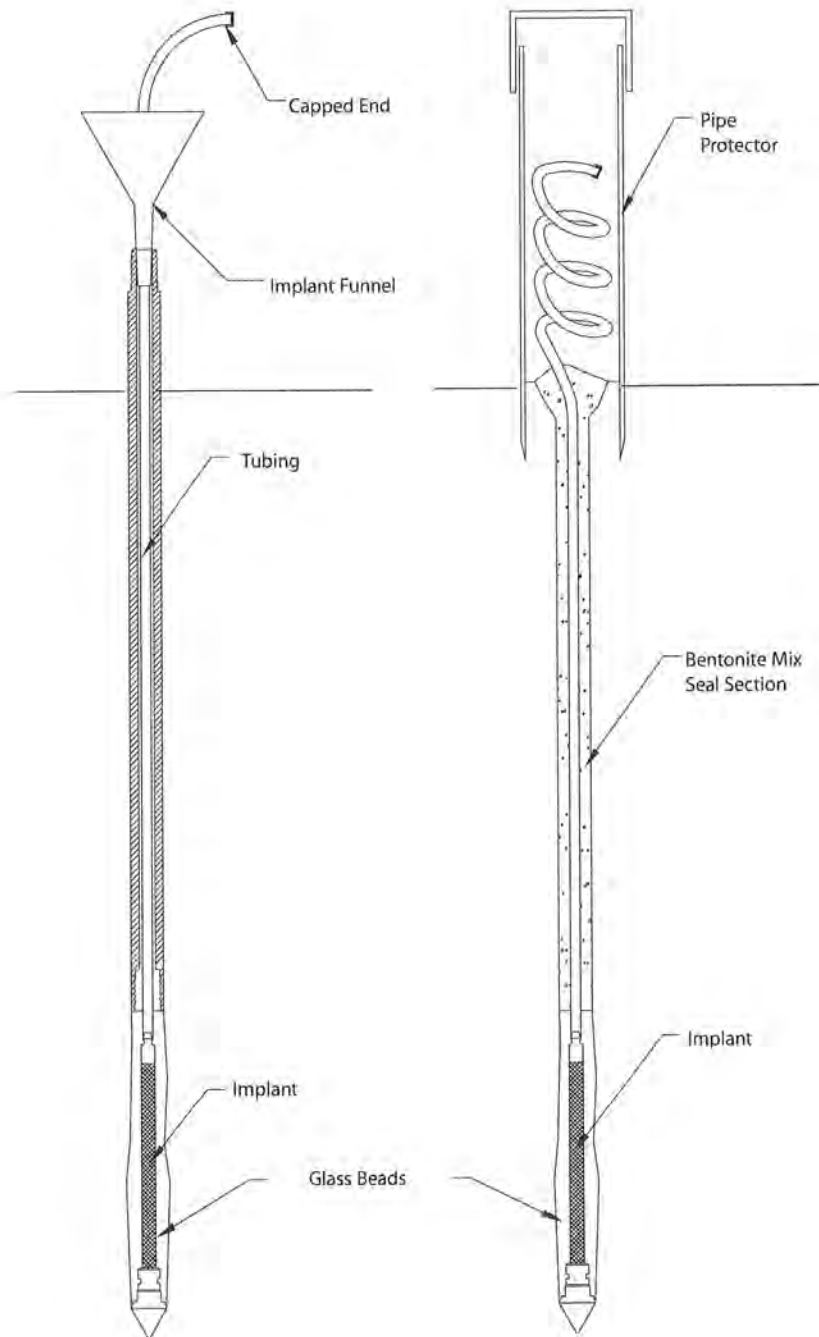
Figure 3. Glass Beads create a permeable layer around vapor sample implants.



A vapor implant location.



Sampling Implants – Operation



Backfill materials include glass beads and bentonite sealants.

Example of completed permanent soil gas monitoring point.

ATTACHMENT C



The World's Leading
Radon Fan Manufacturer



HS Series

Installation & Operating Instructions

RadonAway

3 Saber Way | Ward Hill, MA 01835
www.radonaway.com



RadonAway Ward Hill, MA.

HS Series Fan Installation & Operating Instructions

Please Read and Save These Instructions.

DO NOT CONNECT POWER SUPPLY UNTIL FAN IS COMPLETELY INSTALLED. MAKE SURE ELECTRICAL SERVICE TO FAN IS LOCKED IN "OFF" POSITION. DISCONNECT POWER BEFORE SERVICING FAN.

1. **WARNING!** Do not use fan in hazardous environments where fan electrical system could provide ignition to combustible or flammable materials.
2. **WARNING!** Do not use fan to pump explosive or corrosive gases.
See Vapor Intrusion Application Note #AN001 for important information on VI applications. RadonAway.com/vapor-intrusion
3. **WARNING!** Check voltage at the fan to insure it corresponds with nameplate.
4. **WARNING!** Normal operation of this device may affect the combustion airflow needed for safe operation of fuel burning equipment. Check for possible backdraft conditions on all combustion devices after installation.
5. **NOTICE!** There are no user serviceable parts located inside the fan unit.
Do NOT attempt to open. Return unit to the factory for service.
6. All wiring must be performed in accordance with the National Fire Protection Association's (NFPA) "National Electrical Code, Standard #70"-current edition for all commercial and industrial work, and state and local building codes. All wiring must be performed by a qualified and licensed electrician.
7. **WARNING!** In the event that the fan is immersed in water, return unit to factory for service before operating.
8. **WARNING!** Do not twist or torque fan inlet or outlet piping as Leakage may result.
9. **WARNING!** Do not leave fan unit installed on system piping without electrical power for more than 48 hours. Fan failure could result from this non-operational storage.
10. **WARNING! TO REDUCE THE RISK OF FIRE, ELECTRIC SHOCK, OR INJURY TO PERSONS, OBSERVE THE FOLLOWING:**
 - a) Use this unit only in the manner intended by the manufacturer. If you have questions, contact the manufacturer.
 - b) Before servicing or cleaning unit, switch power off at service panel and lock the service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.



INSTALLATION & OPERATING INSTRUCTIONS (Rev K)
for High Suction Series
HS2000 p/n 23004-1
HS3000 p/n 23004-2
HS5000 p/n 23004-3

1.0 SYSTEM DESIGN CONSIDERATIONS

1.1 INTRODUCTION

The HS Series Fan is intended for use by trained, certified/licensed, professional Radon mitigators. The purpose of this instruction is to provide additional guidance for the most effective use of the HS Series Fan. This instruction should be considered as a supplement to EPA/Radon Industry standard practices, state and local building codes and state regulations. In the event of a conflict, those codes, practices and regulations take precedence over this instruction.

1.2 ENVIRONMENTALS

The HS Series Fan is designed to perform year-round in all but the harshest climates without additional concern for temperature or weather. For installations in an area of severe cold weather, please contact RadonAway for assistance. When not in operation, the HS Series Fan should be stored in an area where the temperature is never less than 32 degrees F. or more than 100 degrees F. The HS Series Fan is thermally protected such that it will shut off when the internal temperature is above 104 degrees F. Thus if the HS Series Fan is idle in an area where the ambient temperature exceeds this shut off, it will not restart until the internal temperature falls below 104 degrees F.

1.3 ACOUSTICS

The HS Series Fan, when installed properly, operates with little or no noticeable noise to the building occupants. There are, however, some considerations to be taken into account in the system design and installation. When installing the HS Series Fan above sleeping areas, select a location for mounting which is as far away as possible from those areas. Avoid mounting near doors, fold-down stairs or other uninsulated structures which may transmit sound. Insure a solid mounting for the HS Series Fan to avoid structure-borne vibration or noise.

The velocity of the outgoing air must also be considered in the overall system design. With small diameter piping, the "rushing" sound of the outlet air can be disturbing. The system design should incorporate a means to slow and quiet the outlet air. The use of the RadonAway Exhaust Muffler, p/n 24002, is strongly recommended.

1.4 GROUND WATER

Under no circumstances should water be allowed to be drawn into the inlet of the HS Series Fan as this may result in damage to the unit. The HS Series Fan should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the HS Series Fan with water in installations with occasional high water tables.

In the event that a temporary high water table results in water at or above slab level, water will be drawn into the riser pipes thus blocking air flow to the HS Series Fan. The lack of cooling air will result in the HS Series Fan cycling on and off as the internal temperature rises above the thermal cutoff and falls upon shutoff. Should this condition arise, it is recommended that the HS Series Fan be disconnected until the water recedes allowing for return to normal operation.

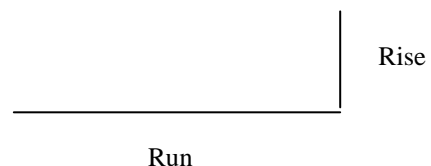
1.5 CONDENSATION & DRAINAGE

(WARNING!: Failure to provide adequate drainage for condensation can result in system failure and damage the HS Series Fan).

Condensation is formed in the piping of a mitigation system when the air in the piping is chilled below its dew point. This can occur at points where the system piping goes through unheated space such as an attic, garage or outside. The system design must provide a means for water to drain back to a slab hole to remove the condensation.

The use of small diameter piping in a system increases the speed at which the air moves. The speed of the air can pull water uphill and at sufficient velocity it can actually move water vertically up the side walls of the pipe. This has the potential of creating a problem in the negative pressure (inlet) side piping. For HS Series Fan inlet piping, the following table provides the minimum recommended pipe diameters as well as minimum pitch under several system conditions. Use this chart to size piping for a system.

Pipe Diam.	Minimum Rise per Foot of Run*		
	@ 25 CFM	@ 50 CFM	@ 100 CFM
4"	1/32 "	3/32 "	3/8 "
3"	1/8 "	3/8 "	1 1/2 "



*Typical operational flow rates:

HS3000, or HS5000	20 - 40 CFM
HS2000	50 - 90 CFM

All exhaust piping should be 2" PVC.

1.6 SYSTEM MONITOR AND LABEL

A properly designed system should incorporate a "System On" Indicator for affirmation of system operation. A Magnehelic pressure gauge is recommended for this purpose. The indicator should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the gauge with water in installations with occasional high water tables. A System Label (P/N 15022) with instructions for contacting the installing contractor for service and also identifying the necessity for regular radon tests to be conducted by the building occupants, must be conspicuously placed where the occupants frequent and can see the label.

1.7 SLAB COVERAGE

The HS Series Fan can provide coverage of well over 1000 sq. ft. per slab penetration. This will, of course, depend on the sub-slab aggregate in any particular installation and the diagnostic results. In general, sand and gravel are much looser aggregates than dirt and clay. Additional suction points can be added as required. It is recommended that a small pit (2 to 10 gallons in size) be created below the slab at each suction hole.

1.8 ELECTRICAL WIRING

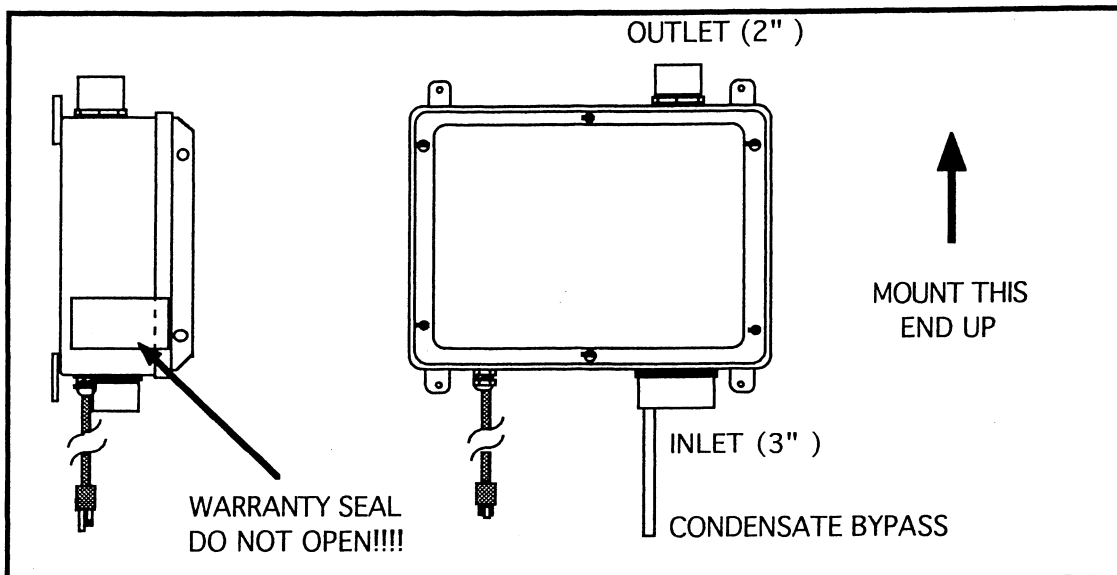
The HS Series Fan plugs into a standard 120V outlet. All wiring must be performed in accordance with the National Fire Protection Association's (NFPA) "National Electrical Code, Standard #70"-current edition for all commercial and industrial work, and state and local building codes. All wiring must be performed by a qualified and licensed electrician. Outdoor installations require the use of a U.L. listed watertight conduit. Ensure that all exterior electrical boxes are outdoor rated and properly caulked to prevent water penetration into the box. A means, such as a weep hole, is recommended to drain the box.

1.8a ELECTRICAL BOX (optional)

The optional Electrical Box (p/n 20003) provides a weather tight box with switch for outdoor hardwire connection. All wiring must be performed in accordance with the National Fire Protection Association's (NFPA) "National Electrical Code, Standard #70"-current edition for all commercial and industrial work, and state and local building codes. All wiring must be performed by a qualified and licensed electrician. Outdoor installations require the use of a U.L. listed watertight conduit. Ensure that all exterior electrical boxes are outdoor rated and properly caulked to prevent water penetration into the box. A means, such as a weep hole, is recommended to drain the box.

1.9 SPEED CONTROLS

Electronic speed controls can **NOT** be used on HS Series units.



2.0 INSTALLATION

2.1 MOUNTING

Mount the HS Series Fan to the wall studs, or similar structure, in the selected location with (4) 1/4" x 1 1/2" lag screws (not provided). Insure the HS Series Fan is both plumb and level.

2.2 DUCTING CONNECTIONS

Make final ducting connection to HS Series Fan with flexible couplings. Insure all connections are tight. Do not twist or torque inlet and outlet piping on HS Series Fan or leaks may result.

2.3 VENT MUFFLER INSTALLATION

Install the muffler assembly in the selected location in the outlet ducting. Solvent weld all connections. The muffler is normally installed above the roofline at the end of the vent pipe.

2.5 OPERATION CHECKS & ANNUAL SYSTEM MAINTENANCE

___ Make final operation checks by verifying all connections are tight and leak-free.

___ Insure the HS Series Fan and all ducting is secure and vibration-free.

___ Verify system vacuum pressure with Magnehelic. Insure vacuum pressure is within normal operating range and less than the maximum recommended as shown below:

HS2000	14" WC
HS3000	21" WC
HS5000	40" WC

(Above are based on sea-level operation, at higher altitudes reduce above by about 4% per 1000 Feet.)
If these are exceeded, increase number of suction points.

___ Verify Radon levels by testing to EPA protocol.

PRODUCT SPECIFICATIONS

Model	Maximum Static Suction	Typical CFM vs Static Suction WC (Recommended Operating Range)						Power* Watts @ 115 VAC
		0"	10"	15"	20"	25"	35"	
HS2000	18"	110	72	40	-	-	-	150-270
HS3000	27"	40	33	30	23	18	-	105-195
HS5000	50"	53	47	42	38	34	24	180-320

*Power consumption varies with actual load conditions

Inlet: 3.0" PVC

Outlet: 2.0" PVC

Mounting: Brackets for vertical mount

Weight: Approximately 18 lbs.

Size: Approximately 15"W x 13"H x 8"D

Minimum recommended inlet ducting (greater diameter may always be used):

HS3000, HS5000 --- 2.0" PVC Pipe

HS2000 --- Main feeder line of 3.0" or greater PVC Pipe

Branch lines (if 3 or more) may be 2.0" PVC Pipe

Outlet ducting: 2.0" PVC

Storage temperature range: 32 - 100 degrees F.

Thermally protected

Locked rotor protection

Internal Condensate Bypass

IMPORTANT INSTRUCTIONS TO INSTALLER

Inspect the HS Series Fan for shipping damage within 15 days of receipt. Notify **RadonAway®** of any damages **immediately**. RadonAway® is not responsible for damages incurred during shipping. However, for your benefit, RadonAway® does insure shipments.

There are no user serviceable parts inside the fan. **Do not attempt to open.** Return unit to factory for service.

Install the HS Series Fan in accordance with all EPA standard practices, and state and local building codes and state regulations.

Provide a copy of this instruction or comparable radon system and testing information to the building occupants after completing system installation.

WARRANTY

RadonAway® warrants that the HS Series Fan (the "Fan") will be free from defects in materials and workmanship for a period of 90 days from the date of purchase (the "Warranty Term").

RadonAway® will replace any Fan which fails due to defects in materials or workmanship during the Warranty Term. The Fan must be returned (at Owner's cost) to the RadonAway® factory. Any Fan returned to the factory will be discarded unless the Owner provides specific instructions along with the Fan when it is returned regardless of whether or not the Fan is actually replaced under this warranty. Proof of purchase must be supplied upon request for service under this Warranty.

This Warranty is contingent on installation of the Fan in accordance with the instructions provided. This Warranty does not apply where any repairs or alterations have been made or attempted by others, or if the unit has been abused or misused. Warranty does not cover damage in shipment unless the damage is due to the negligence of RadonAway®.

1 YEAR EXTENDED WARRANTY WITH PROFESSIONAL INSTALLATION.

RadonAway® will extend the Warranty Term of the fan to one (1) year from date of purchase or fifteen (15) months from the date of manufacture, whichever is sooner, if the Fan is installed in a professionally designed and professionally installed active soil depressurization system or installed as a replacement fan in a professionally designed and professionally installed active soil depressurization system by a qualified installer. Proof of purchase and/or proof of professional installation may be required for service under this warranty. Outside the Continental United States and Canada the extended Warranty Term is limited to one (1) year from the date of manufacture.

RadonAway® is not responsible for installation, removal or delivery costs associated with this Warranty.

LIMITATION OF WARRANTY

EXCEPT AS STATED ABOVE, THE HS SERIES FANS ARE PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT SHALL RADONAWAY BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR RELATING TO, THE FAN OR THE PERFORMANCE THEREOF. RADONAWAY'S AGGREGATE LIABILITY HEREUNDER SHALL NOT IN ANY EVENT EXCEED THE AMOUNT OF THE PURCHASE PRICE OF SAID PRODUCT. THE SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY SHALL BE THE REPAIR OR REPLACEMENT OF THE PRODUCT, TO THE EXTENT THE SAME DOES NOT MEET WITH RADONAWAY'S WARRANTY AS PROVIDED ABOVE.

For service under this Warranty, contact RadonAway for a Return Material Authorization (RMA) number and shipping information. No returns can be accepted without an RMA. If factory return is required, the customer assumes all shipping costs, including insurance, to and from factory.

*RadonAway® 3 Saber Way
Ward Hill, MA 01835 USA TEL (978) 521-3703
FAX (978) 521-3964
Email to: [Returns@RadonAway.com](mailto>Returns@RadonAway.com)*

Record the following information for your records:

Serial No. _____ Purchase Date _____