Workplan for the Installation of a Sub-Slab Depressurization/Ventilation System

S-Building at 100 East Patterson Street
Tecumseh, Michigan

September 2011

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September 2011

Prepared For
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TRC Environmental | Tecumseh Products Company
Final
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Section 1
Introduction

This Workplan is for the Installation of a Sub-Slab Depressurization/Ventilation System in S-Building at 100 East Patterson Street (Workplan) describes the proposed sub-slab depressurization/ventilation (SSDV) system design, installation, and associated performance monitoring for the portion of the former Tecumseh Products Company (TPC) site known as S-Building (guard house). The former TPC site is located at 100 East Patterson Street in Tecumseh, Michigan (Figure 1).

1.1 Background

In 2009, TPC retained TRC Environmental Corporation (TRC)[1] to investigate soil and groundwater conditions at the former TPC site located at 100 East Patterson Street in Tecumseh, Michigan. These investigation activities indicate that on-site soil and shallow groundwater are affected by chlorinated volatile organic compounds (CVOCs). As a presumptive remedy to address the potential volatilization to indoor air migration pathway, TPC has opted to install a SSDV in the occupied portion of the former TPC site known as S-Building.

1.2 Purpose and Scope

This Workplan is designed to provide SSDV system design and installation details, and includes the following:

- A brief summary of the project background and scope;
- A brief description of the building;
- A description of the proposed SSDV system;
- A brief description of how the system will be installed; and
- A summary of the performance verification program.

[1] On June 6, 2011 TRC acquired the Environmental Business Unit of RMT, Inc. For purposes of this and future reports, references to TRC are inclusive of RMT, Inc., prior to its acquisition by TRC.

Section 2
Site Conditions

2.1 Site Location

The proposed SSDV system will be installed at S-Building located along the northern perimeter of the former TPC site located at 100 East Patterson Street in Tecumseh, Michigan. S-Building occupies approximately 2,800 square feet. The eastern wall of S-Building is shared with P-Building. However, there are no doors or windows from S-Building directly into P-Building. As such, S-Building is physically isolated from P-Building and the remainder of the former TPC manufacturing facility (Figure 1).

2.2 Building Description

The building footprint is approximately 2,800 square feet. The basement area is approximately 300 square feet. The basement area abuts the telecommunications room (a portion of P-Building) but does not have any walls along the exterior of the building. A sketch showing building layout is shown on Figure 2.

The basement floor is composed of concrete and appears to be in good condition. A sump is located in the northeast corner of the basement. The basement walls are composed of concrete block. The basement houses a hot water heater for bathrooms located on the ground floor. The basement is used for miscellaneous storage. The remainder of the building is slab-on-grade construction. The concrete slab encompasses the basement area, as such the basement ceiling is composed of reinforced concrete.

Photographs taken during on-site reconnaissance on April 13, 2011 are included in Appendix A.

Section 3
System Design and Installation

3.1 Introduction

Active SSDV systems are the most common and most reliable mitigation systems used to address the potential for migration of constituents of concern from the sub-slab soil gas into indoor air. SSDV systems use a fan-powered vent to remove soil gas from beneath the building slab. By removing soil gas from beneath the slab, the sub-slab pressures are reduced relative to indoor air pressures. If the pressure in the sub-slab is lower than the pressure in the indoor air, the driving force for vapor intrusion is eliminated, and the soil gas to indoor air migration pathway is effectively eliminated. In some cases, particularly in highly permeable soils, a SSDV system may be effective through ventilation rather depressurization. In these cases, the fan-powered vent achieves adequate advective air flow under the building slab to dilute volatile organic compounds (VOCs) diffusing from soil and groundwater without achieving a negative pressure gradient throughout the building footprint.

The SSDV system will be installed by a National Environmental Health Association (NEHA) certified technician from Air Quality Control.

3.2 Suction Point

A single, centrally located, suction point is expected to be sufficient to mitigate S-Building. The SSDV suction point will be installed along the east wall of the basement at the approximate location shown on Figure 2. The effectiveness of the suction point will be evaluated using differential pressure gages as described in Section 3.5 below. Details of the SSDV system detail including a typical suction point are shown in Figure 3.

The suction point will be constructed by drilling a 6-inch diameter hole through the existing concrete slab. One to two cubic feet of soil will be removed from beneath the slab to create the suction point sump. The sump will then be left open to create a void from which sub-slab soil gas is drawn away from the foundation. The vent pipe riser will be secured to a PVC cover plate over the suction point. Silicone caulk will be used to seal the cover plate in place to minimize leakage of indoor air into the SSDV system.

3.3 Vent Pipe

3.3.1 Vent Pipe Riser

The vent pipe riser design will be generally consistent with USEPA (2008) and ASTM (2009) design parameters. The proposed vent pipe riser will be composed of 4-inch Schedule 20 PVC pipe. The bottom of the vent pipe riser will be secured to prevent downward migration of the vent pipe riser into the suction point. From the suction point, the vent pipe riser will extend vertically up the eastern basement wall. PVC joints will be used to route the vent pipe riser through the eastern basement wall and into the telecommunications room. Along the western wall of the telecommunications room, the vent pipe riser will extend vertically up to the fan located on the roof of the building. PVC joints will be used as needed to route the vent pipe riser around utilities or other building features. Supports for the vent pipe riser will be installed adjacent to the wall and roof penetration and at least every eight feet along the vertical length of the riser pipe. All joints will be permanently sealed with PVC pipe cement to prevent leakage from the vent pipe riser.

3.3.2 Vent Pipe Discharge

The vent pipe riser will discharge at least two feet above the top of the roof, and at least ten feet from the nearest window.

3.3.3 Sample Port

The vent pipe riser will be equipped with a sample port to monitor sub-slab soil gas removed by the system.

3.3.4 Bypass for Condensation Drainage

The vent pipe riser will be equipped with a bypass for condensation drainage to prevent freezing and blockage of the exhaust fan.

3.3.5 Differential Pressure Gage

The vent pipe riser will be equipped with a differential pressure gage. This pressure gage will be a U-tube filled with colored fluid. This gage will allow quick and easy confirmation that the system fan remains operational. An alarm will also be installed to alert building occupants if the system fails. A sticker with TPC contact information will be fixed on the vent pipe riser adjacent to the differential pressure gage with instructions to contact TPC if the differential pressure gage or alarm indicates that the system is not operating as intended.

3.4 Exhaust Fan

The SSDV fan will be a Fan Max radon fan. This corrosion resistant fan is 110 watts and is rated to pull up to 630 cubic feet per minute. The fan curve for the proposed fan is included as Appendix B. The exhaust fan will be hard wired into the building's existing electrical system to help ensure that the fan remains in continuous operation. For system safety and maintenance, a disconnect switch will be located within sight of the fan.

3.5 Cross Slab Differential Pressure Points

Cross slab differential pressure gages will be installed near the two corners of the S-Building furthest from the suction point, as shown on Figure 2. Figure 4 depicts the cross slab differential pressure point detail. Differential pressure point extensions will be composed of ¼-inch galvanized steel pipe. Pipe connections will be made with threading joints and fitting sealed with Teflon tape. The exterior measurement points will be equipped with a stainless steel ball release valve, or equivalent, which seals when not in use.

3.6 Elimination of Preferential Migration Pathways

The building has or will be evaluated for preferential migration pathways including:

- Sump – the sump in the northeast corner of the basement will be evaluated as a migration pathway.
- Open utility conduits - during installation activities TRC and Air Quality Control will evaluate the slab and basement walls for open utility conduits. If present open conduits will be filled with expanding polyurethane foam.
- Large cracks and expansion joints in the basement floor and walls – If cracks/joints are large enough to affect system performance, they will be filled with expanding polyurethane foam.

3.7 System Initiation

3.7.1 Verification of System Integrity

Following installation of the SSDV system components, caulked joints and seals may require a day or more to set before the system is turned on. Turning the system on immediately could compromise the integrity of caulk used to seal system joints and connections, particularly around the suction point where caulk is used to prevent the system from pulling air directly from the basement.

The system will be turned on within one week of installation. Joints and seals will be visually and audibly inspected for leaks. If no leaks are detected, an initial round of differential pressure readings will be collected from the sample port after the SSDV system is turned on as described in Sections 4.2. If leaks are detected, the system will be turned off so that leaks can be repaired and allowed to set. The system will be initiated again as soon as feasible after leak repair (small leaks may only require a few minutes to set sufficiently for system start-up).

3.7.2 Backdraft Evaluation

Backdrafting occurs if the building is depressurized to the extent that the suction in the building overcomes the thermal effects that draw the products of combustion (e.g. from gas powered appliances) from the flues, causing combustion products including carbon monoxide to flow into the building instead of up the flue. Unless the basement and building are particularly tight, sub-slab systems do not typically create a pressure differential that causes back-drafting. However a SSDV may exacerbate an existing problem with backdrafting.

To evaluate and mitigate potential backdrafting, TRC will complete the following:

- TRC will identify any gas powered appliances or other heating units that have the potential to backdraft, if any.
- If any potential for backdrafting is identified, the exhaust of each unit will be visibly inspected to verify the unit exhaust is flowing up the flue. This test will be conducted as follows:
    - Close all interior and exterior windows and doors.
    - Turn on all exhaust fans, i.e., bathroom exhaust fans.
    - Ensure the SSDV system is running.
    - Turn on the unit with a potential backdraft problem.
    - Use a cold chemical smoke pen to visually confirm that the unit exhaust is drawn distinctly up the hood or flue.
- If smoke does not draw distinctly up the hood or flue, a source of make-up air will be provided to equalize pressure between the indoors and outdoors and allow the unit exhaust to flow properly.
- If any units with the potential to backdraft are present, a carbon monoxide detector will be installed to provide a long-term, continuous meaning of determining if backdrafting occurs.

Section 4
Performance Verification

4.1 Initial Differential Pressure Readings

Following system start-up, differential pressure readings will be collected at the two differential pressure points (Figure 2). Pressure readings will be collected at approximately 10 minute intervals for a minimum of 1 hour. Additional readings will be collected until the pressure readings are reasonably stable.

At each pressure point, pressure will be considered stable when three consecutive pressure readings collected at least 10 minutes apart do not vary be more than twenty-percent. The following equation will be used to determine the percent variation in pressure readings:

$$V = \frac{P_{max} - P_{min}}{P_{avg}} \times 100\%$$

where V is percent variation, P_{max} is the maximum of the last three sub-slab pressure readings, P_{min} is the minimum of the last three sub-slab pressure readings, and P_{avg} is the average of the last three sub-slab pressure readings. If system has been operational for a minimum of 1-hour and the variation is 20-percent or less at both pressure gage locations, the sub-slab pressure is stable, and the first quarterly differential pressure readings may be conducted.

Weather conditions may affect the stability of pressure readings. If system has been operational for a minimum of 2-hours, but the variation remains more than 20-percent at either pressure gage location, the sub-slab pressure readings may be discontinued. The first quarterly differential pressure readings may be conducted.

4.2 Post-Startup Performance Verification

4.2.1 Differential Pressure Readings

Following system start-up, differential pressure readings will be collected quarterly at each of the two differential pressure points (Figure 2). Differential pressure readings will be collected and recorded quarterly for the first year of SSDV system operation to verify that the system is performing as anticipated.

If a minimum negative pressure of 0.004 inches of water is achieved, the system is successfully depressurizing the sub-slab area and the migration pathway has been eliminated. However, in some cases, particularly in highly permeable soils, a SSDV system may be effective even if a negative pressure is not achieved throughout the sub-slab area. In these cases, the fan-powered vent may achieve adequate advective air flow under the building slab to dilute VOCs diffusing from soil and groundwater without achieving a negative pressure gradient throughout the building footprint. If a minimum negative pressure of 0.004 inches of water is not achieved during one or more the of the quarterly pressure readings, further system evaluation will be conducted to determine if the system is effective through ventilation or if system improvements are needed (i.e. a higher suction fan, an additional suction point, etc.) to meet performance objectives. If TRC determines that the system functions by ventilation, indoor air sampling will be conducted to assess system performance.

4.2.2 Quarterly System Inspection and Maintenance

In addition to differential pressure readings at sub-slab pressure points, quarterly system inspection and maintenance will be conducted to verify that the system is operating as expected. An operation and maintenance checklist will be completed by the field technician. At a minimum, the inspection will include the following:

- A differential pressure gage reading will be taken and recorded.
- Differential pressure readings will be recorded at sub-slab pressure ports as described above.
- The condition of system piping, fittings, and pipe supports will be evaluated and recorded.
- The condition of foundation sealing will be evaluated and recorded.
- Changes to building structure will be evaluated and recorded.

Deficiencies identified during quarterly inspection will be corrected as soon as possible, typically within 30 days of discovery.

4.2.3 Indoor Air Sampling

If a minimum negative pressure of 0.004 inches of water is not achieved following system improvements, if any, indoor air sampling will be conducted to confirm that the SSDV system is meeting performance objectives. If a negative pressure of 0.004 inches of water is measured during all quarterly inspections, indoor air samples will not be collected.

Sample Frequency

If a minimum negative pressure of 0.004 inches of water is not achieved, an initial indoor air sample will be collected within 30 days of the quarterly inspection that triggered indoor air sample collection. A second indoor air sample will be collected concurrent with the next regular system inspection.

Sample Collection

Indoor air samples will be collected as follows:

- The sample will be collected in a laboratory supplied certified clean 6-liter SUMMA® sample canister. The flow controller will be set to a nominal 4 milliliters per minute (24-hour sample). The canister will be evacuated to a nominal 26 to 30 inches of mercury and shipped to the field under Chain-of-Custody documentation.
- The sampling apparatus will be assembled, and a vacuum shut-in test will be performed to confirm that there are no significant leaks in the sample train prior to use.
- The sample information, including canister number, flow controller number, and initial canister vacuum will be recorded on TRC standard air sampling forms.
- The sample apparatus will be placed in a central location in the basement. Buckets or other materials will be used to elevate the sample apparatus so that the sample is collected from the breathing zone.
- The valve on the sample canister will then be opened to begin sample collection. The initial canister vacuum and starting sample collection time will be recorded.
- Prior to departure from the site, the field technician will place a custody seal over the access to the basement to limit access during sample collection.
- Approximately 24-hours after sample collection is initiated, the field technician will return to the site to terminate sample collection.
- Prior to entry, the condition of the custody seal will be evaluated and recorded.
- Once the vacuum gage indicates that sample collection is complete. The valve on the sample canister will be closed. The final canister vacuum and ending sample collection time will be recorded.

Field procedures for sample documentation, handling, storage, shipment, preservation, and Chain-of-Custody will be conducted in accordance with the procedures outlined in the Quality Assurance Project Plan (QAPP) (RMT, 2010c). Field personnel will document sample collection procedures on field data forms or in field notebooks.

Data Evaluation

Concentrations of the constituents of concern (COCs), specifically 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, and vinyl chloride, will be compared to USEPA approved non-residential indoor air criteria (IAC).

If concentrations of COCs are below IAC for two consecutive sample events, the system is operating as expected and no further action is required. If the concentration of one or more COC is above IAC an evaluation will be conducted to determine the source of the COC (i.e. soil gas-migration-to-indoor air, background indoor air sources or a combination of the two). If the COC above IAC can be attributed to soil gas-migration-to-indoor air, system improvements will be made as needed to reduce indoor air concentrations.

4.3 Reporting

A memorandum/report will be prepared and submitted to the property owner and USEPA, subsequent to startup and each quarterly system inspection. This report will document work performed and the results of performance verification tests.

Section 5
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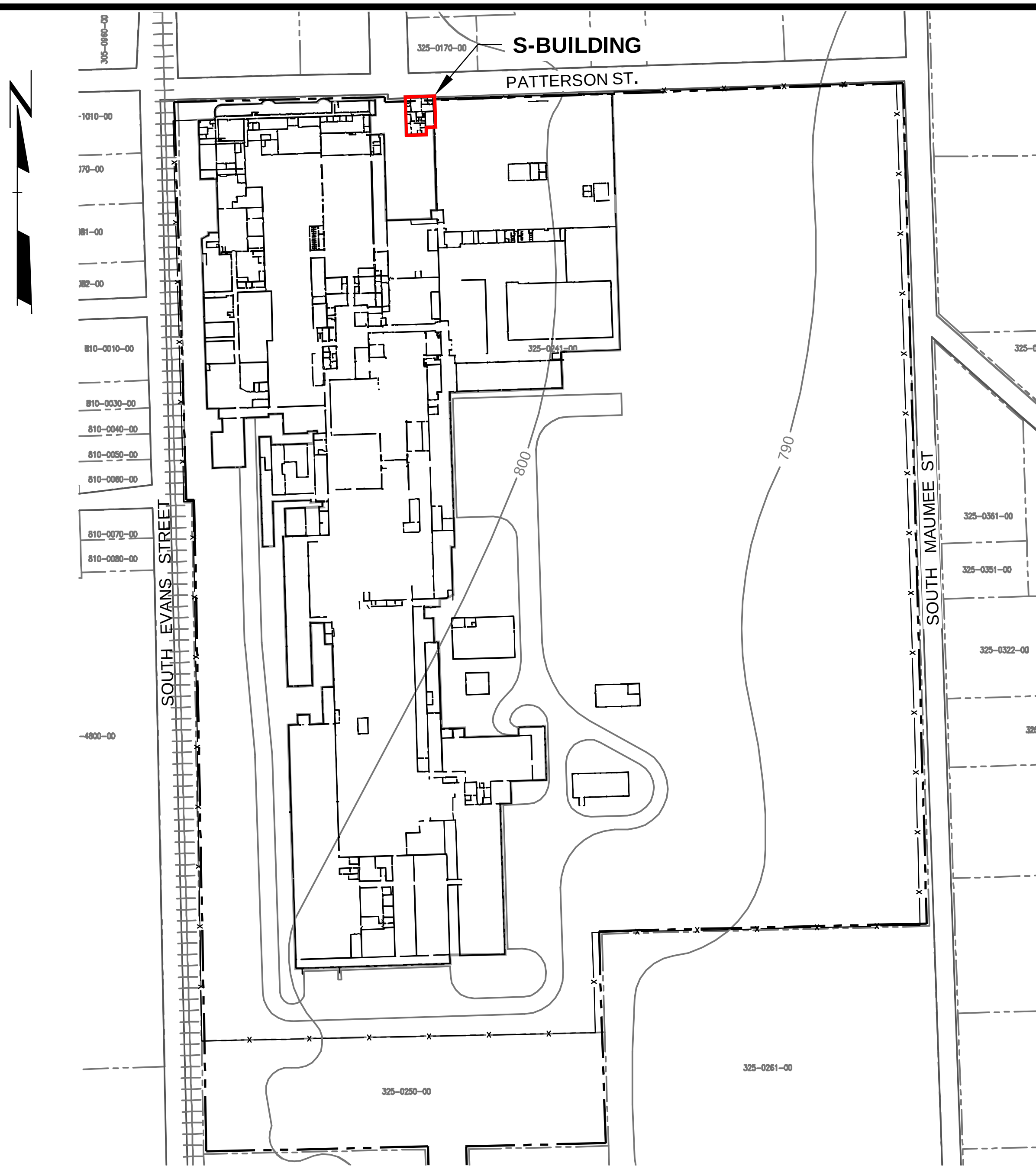
Figures



LEGEND

FORMER TECUMSEH PRODUCTS SITE BOUNDAR

PARCEL BOUNDARY

RAILROAD TRACKS (APPROXIMATE LOCATION)

NOTES

1. BASE MAP DEVELOPED FROM SITE PLAN PROVIDED BY THE CITY OF TECUMSEH, DRAWING NO. CITY.DWG, MARCH 2009.
2. GROUND TOPOGRAPHY BASED OFF 7.5 MINUTE U.S.G.S

0 300' 600'

SCALE IN FEET

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Attached Xrefs:

Attached Images: bm033109; image

Layout: FIG01 Site Location S-Bldg

TRC

3754 Ranchero Drive
Ann Arbor, MI 48108-2237
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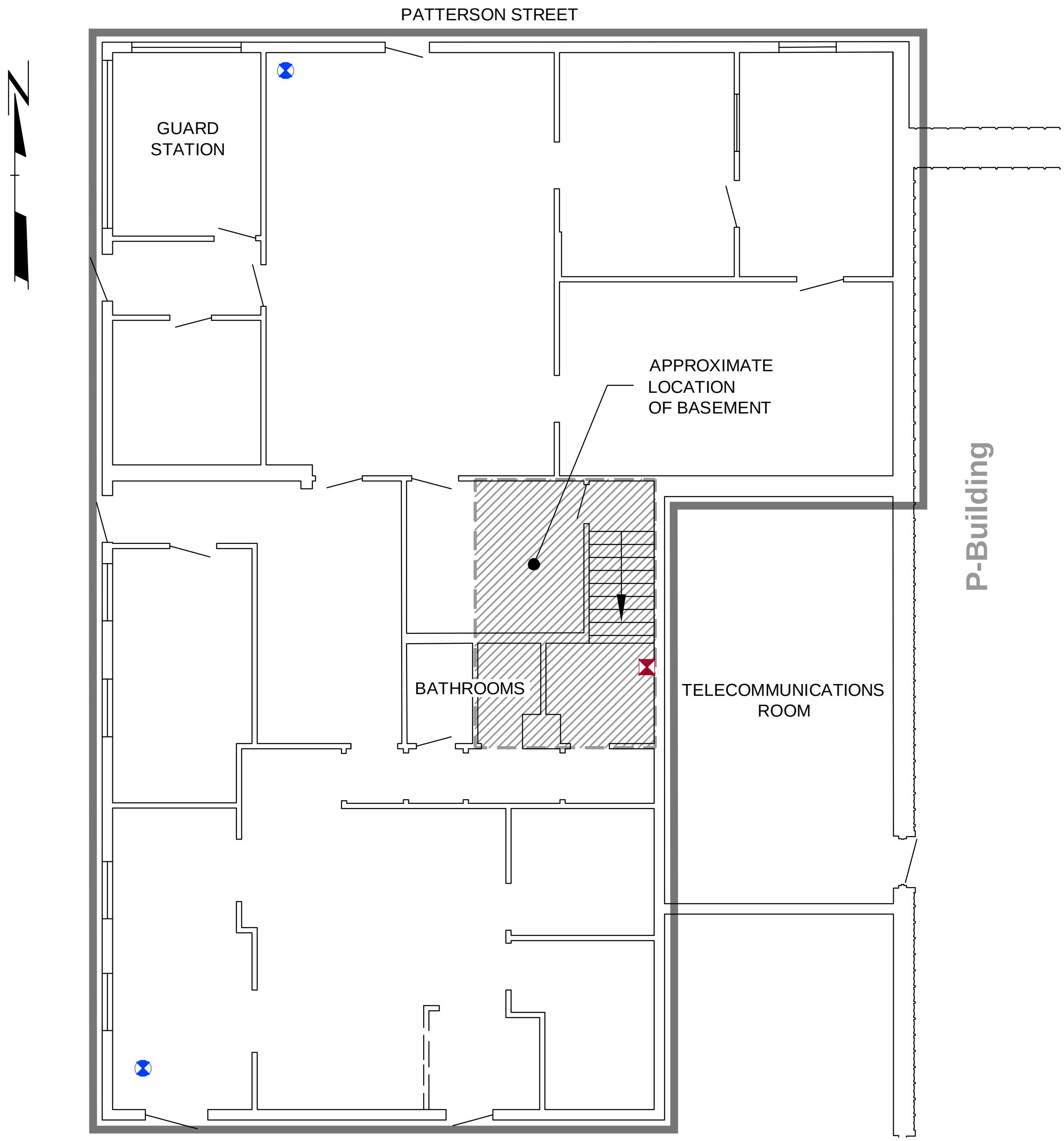
PROJECT:	TECUMSEH PRODUCTS COMPANY TECUMSEH, MICHIGAN	DRAWN BY:	DGS
		APPROVED BY:	JA
SHEET TITLE:	SITE LOCATION MAP S-BUILDING MAP	PROJ. NO.	187156.0000.0000
		FILE NO.	187156.01.dwg
		DATE:	AUGUST 2011

FIGURE 1



LEGEND

- PROPOSED SSDV SYSTEM SUCTION POINT
- PROPOSED CROSS SLAB DIFFERENTIAL PRESSURE POINT
- S-BUILDING PERIMETER

0 10' 20'

SCALE IN FEET

NOTES

1. BASE MAP DEVELOPED FROM SITE PLAN PROVIDED BY THE CITY OF TECUMSEH DRAWING NO. CITY.DWG, MARCH 2009

TRC

3754 Ranchero Drive
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PROJECT:

TECUMSEH PRODUCTS COMPANY
TECUMSEH, MICHIGAN

SHEET TITLE:

BUILDING LAYOUT
S-BUILDING

DRAWN BY:	DGS
APPROVED BY:	JA
PROJ. NO.	187156.0000.0000
FILE NO.	187156.02.dwg
DATE:	AUGUST 2011

FIGURE 2

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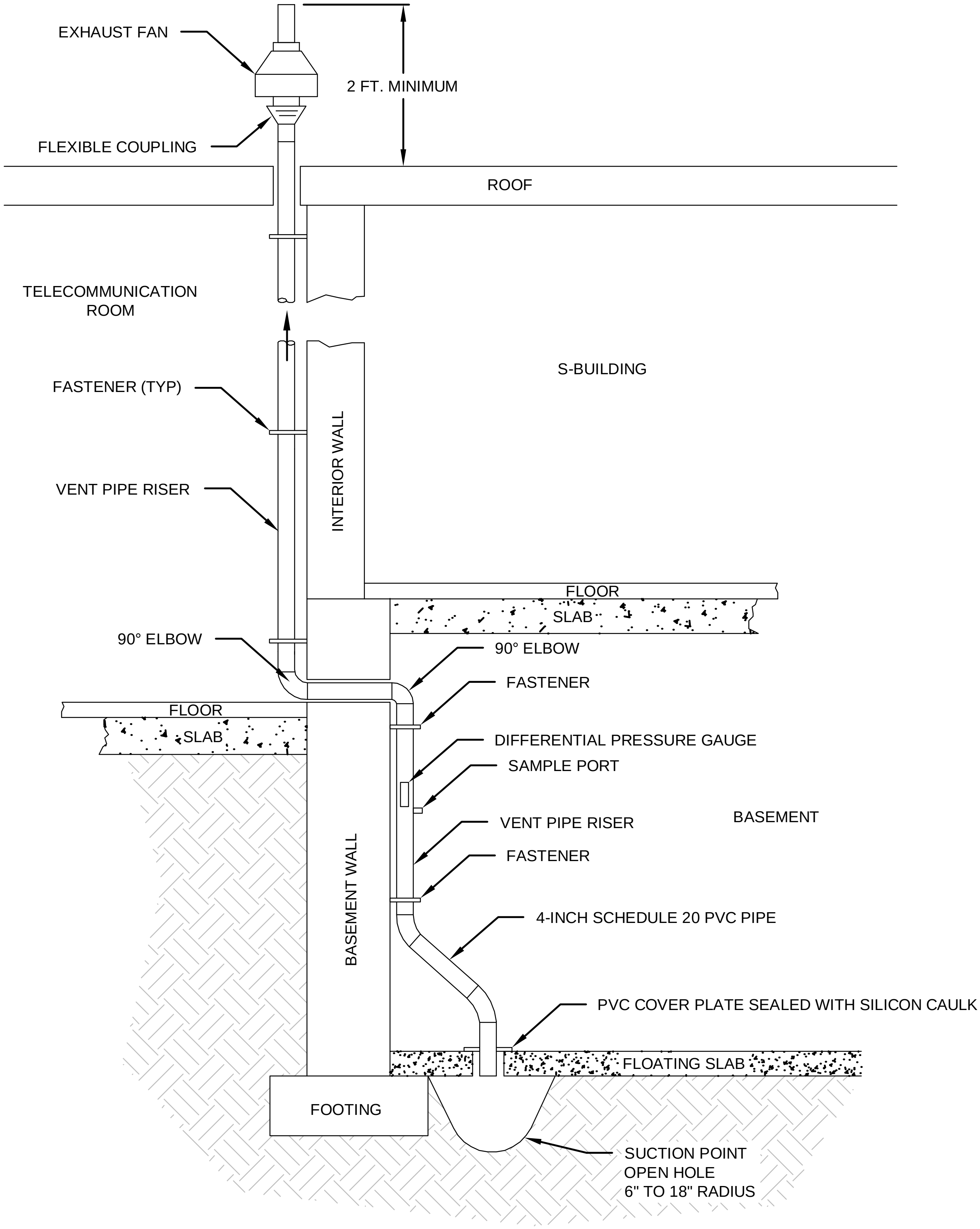

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SHEET TITLE:	SSDV SYSTEM DETAIL
DRAWN BY:	METZA/DGS
APPROVED BY:	JA
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DATE:	AUGUST 2011

FIGURE 3

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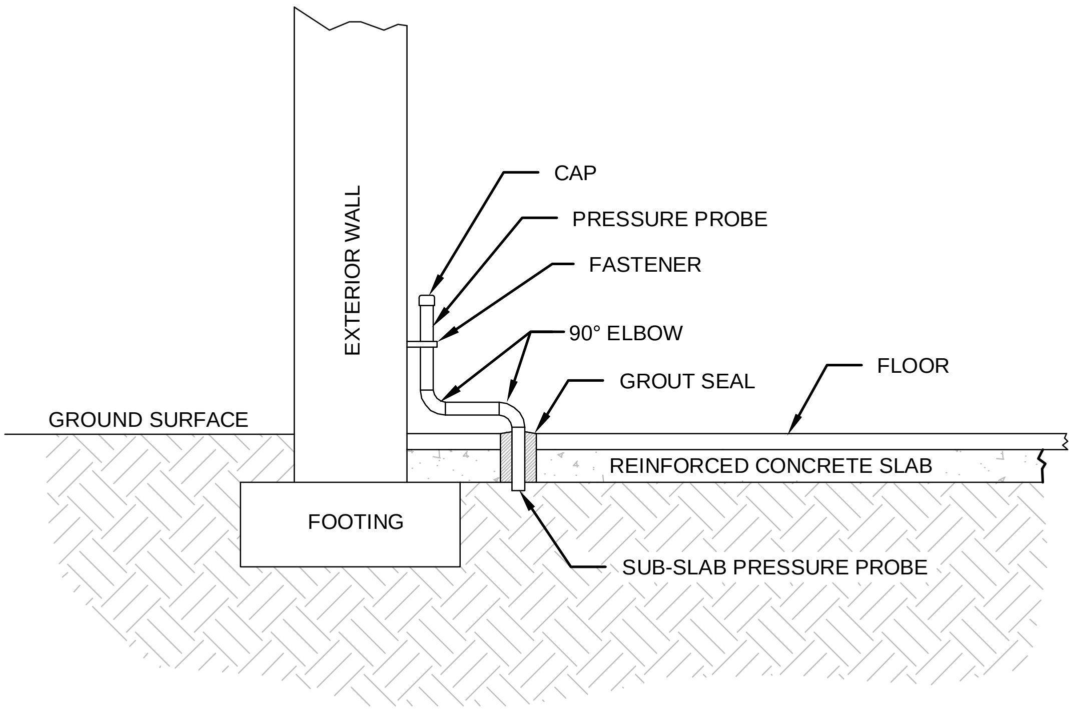

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Attached Images:
Layout: FIG04 S-Bldg X Slab Diff PPs

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PROJECT:
TECUMSEH PRODUCTS COMPANY
TECUMSEH, MICHIGAN

SHEET TITLE:
CROSS SLAB DIFFERENTIAL
PRESSURE POINTS DETAIL

DRAWN BY:	METZA/DGS
APPROVED BY:	JA
PROJ. NO.	187156.0000.0000
FILE NO.	**187156.03-04.dwg**
DATE:	AUGUST 2011

FIGURE 4

Appendix A
Photographic Log from On-Site Consultation

Photographic Log

Client Name:	Site Location:	Project No.:
Tecumseh Products Company	S-Building Tecumseh, Michigan	187156

Photo No.	Date
1	4/13/2011

Description
Basement walls composed of concrete block. Basement houses a hot water heater for bathrooms located above.

Photo No.	Date
2	4/13/2011

Description
Basement is used for miscellaneous storage.

Photographic Log

Client Name:	Site Location:	Project No.:
Tecumseh Products Company	S-Building Tecumseh, Michigan	187156

Photo No.	Date
3	4/13/2011

Description
Basement is used for miscellaneous storage.

Photo No.	Date
4	4/13/2011

Description
Proposed system would be installed along the eastern wall of the basement.

Photographic Log

Client Name:	Site Location:	Project No.:
Tecumseh Products Company	S-Building Tecumseh, Michigan	187156

Photo No.	Date
5	4/13/2011

Description
A sump is located in northeast corner of the basement.

Photo No.	Date
6	4/13/2011

Description
Close-up of sump.

Photographic Log

Client Name:	Site Location:	Project No.:
Tecumseh Products Company	S-Building Tecumseh, Michigan	187156

Photo No.	Date
7	4/13/2011

Description
Because basement has no exterior walls the exhaust pipe for the proposed system must be run through the interior of the building. Photo shows the location in the telecommunication room where the proposed suction point could exit the basement without drilling a hole in the reinforced concrete slab (basement ceiling).

Photo No.	Date
8	4/13/2011

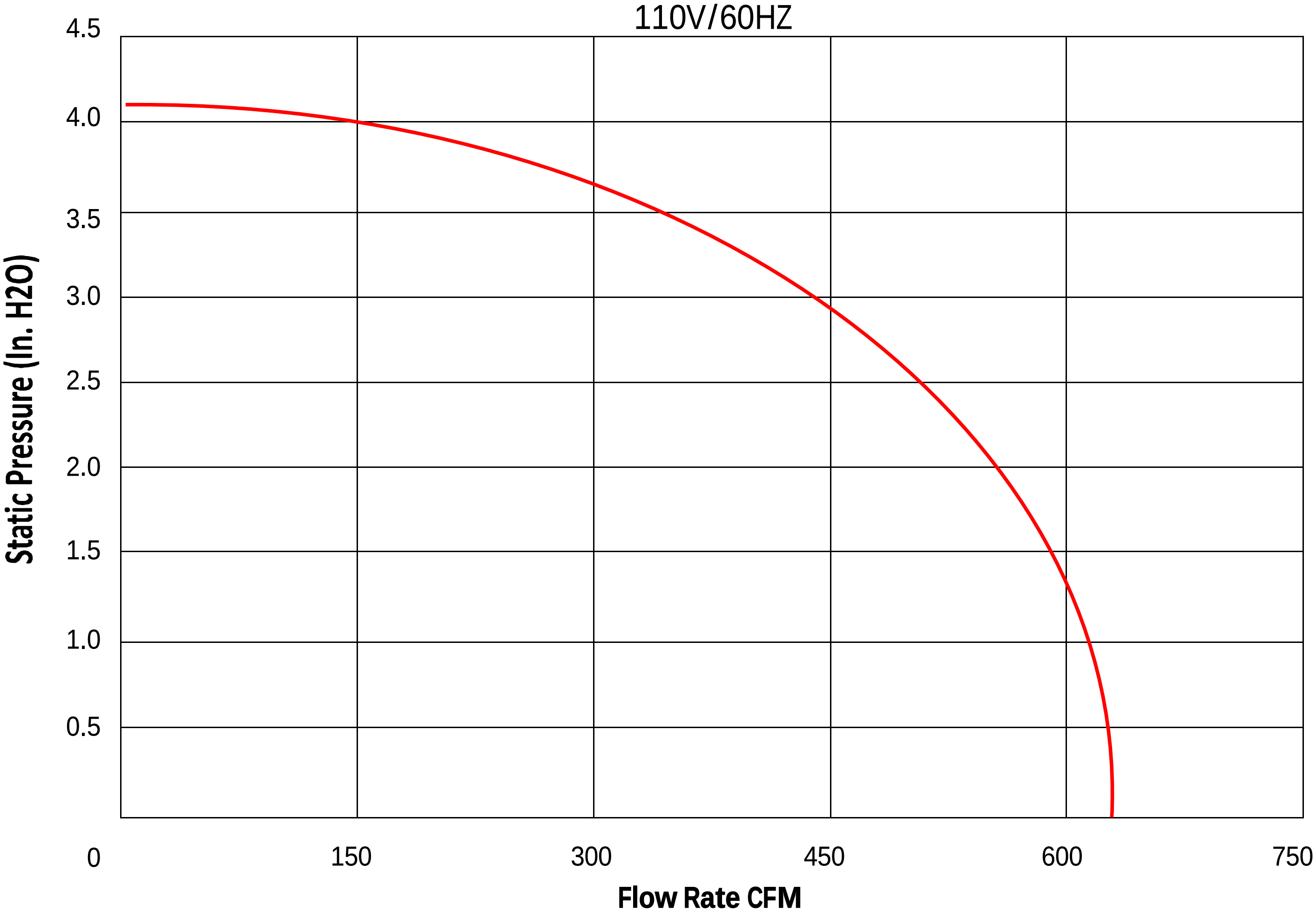
Description
Proposed location for the interior, above-grade portion of the vent pipe riser. The vent pipe riser will extend up the wall of the basement and the telecommunications room. Then through the ceiling to the roof where the exhaust fan will be located.

Appendix B
Fan Curve

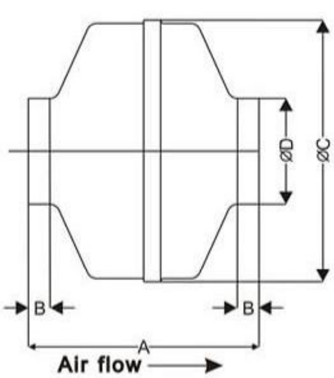
VenTech Engineering

Model: “Dominator 801”

110V/60HZ



POWER (WATTS)	SPEED (RPM)	MAX AIR FLOW(CFM)	MAX PRESSURE (In. H20)
60 - 150	2500	630	4.15



DIMENSIONS			
A	**B**	**C**	**D**
8.8”	1.0”	13.1”	4.5”