SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

August 6, 2021

Mr. Brian Haderlie
PACCAR Inc
PACCAR Building
777 106th Avenue NE
Bellevue, WA 98004

RE: FINAL ENGINEERING DESIGN FOR THE PROPOSED SUB-SLAB DEPRESSURIZATION SYSTEM AT THE 8801 PROPERTY, AGREED ORDER 6069

Dear Brian:

The purpose of this letter is to convey specifications for the sub-slab depressurization (SSD) system to be installed under the new warehouse proposed for construction by CenterPoint 8801 Marginal LLC (CenterPoint) at the property it owns located at 8801 East Marginal Way South, Tukwila, Washington (8801 property). The system would consist of a venting system and vapor barrier installed beneath the portion of the floor slab of the warehouse where the building would overlay groundwater contaminated with volatile organic compounds (VOCs) and approximately 100-foot eastwards of the limits of the groundwater plume. The configuration and specifications in this document are based on guidance provided by the U.S. Environmental Protection Agency[1] (EPA) and the Washington State Department of Ecology (Ecology).[2]

BACKGROUND

Groundwater contaminated with VOCs exists under the northwestern portion of the 8801 property (Figure 1). Elevated concentrations of trichloroethylene (TCE),

[1] U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response, 2015, OSWER technical guide for assessing and mitigating the vapor intrusion pathway from subsurface vapor sources to indoor air: Washington, D.C., OSWER Publication no. 9200.2-154, 267 p., June, available: https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf.

[2] Washington State Department of Ecology, 2018, Guidance for evaluating soil vapor intrusion in Washington State: investigation and remedial action (draft, rev. ed.): Olympia, Wash., Washington State Department of Ecology, Publication no. 09-09-047, April, available: https://fortress.wa.gov/ecy/publications/documents/0909047.pdf.

tetrachloroethylene, and vinyl chloride (VC) have also been observed in soil near the northern boundary of the 8801 property (Excavation Area 1 shown in Figure 1).

CenterPoint plans to redevelop the 8801 property by constructing an approximately 414,400-square-foot warehouse on the property. The warehouse would overlay a portion of the VOC groundwater plume. The footprint of the warehouse relative to the VOC groundwater plume is shown in Figure 1. Fill material would be used to raise the grade of the 8801 property under the warehouse so that the floor slab of the warehouse is established approximately 4 feet above the current ground surface. The purpose of the raised floor elevation is to allow trucks to directly load from the warehouse.

In April 2011, soil gas samples were collected from beneath an existing building on the north adjoining property because the VOC groundwater plume extends beyond the northern boundary of the 8801 property. Sub-slab soil gas samples from the building on the north adjoining property were significantly below regulatory indoor air concentrations protective of human health exposure. The soil gas sample results for TCE ranged from not detected at or above the analytical detection level (non-detect) to 2.9 micrograms per cubic meter ($\mu g/m^3$) (Model Toxics Control Act [MTCA] Method B sub-slab soil gas screening level for TCE is 12 $\mu g/m^3$). The TCE laboratory detection level was 0.85 $\mu g/m^3$. The VC soil gas sample results were all non-detect with a maximum laboratory detection level of 0.40 $\mu g/m^3$ (MTCA Method B sub-slab soil gas screening level for VC is 9.4 $\mu g/m^3$).

Soil gas samples have not been collected on the 8801 property and it will not be possible to collect sub-slab samples from under the proposed warehouse until after it is constructed. Although groundwater samples from the 8801 property have contained TCE and VC at concentrations greater than those considered protective of indoor air exposure thresholds, it is likely that VOCs would not be detected in soil gas under the floor slab of the warehouse at concentrations exceeding indoor air concentrations protective of human health for two primary reasons:

- The proposed warehouse is farther from the high-concentration area of TCE than the building on the north adjoining property, and
- The elevation of the floor slab of the proposed warehouse would be approximately 4_ feet higher than the elevation of the current ground surface, providing a greater physical degree of separation between the contaminated groundwater and the proposed warehouse.

Since the western edge of the proposed building footprint on the 8801 property will overlay the TCE/VC groundwater plume, engineering controls, including an SSD system will be

installed under the portion of the floor slab of the proposed warehouse that would overlay the VOC groundwater plume. The purpose of the SSD system would be to reduce VOC vapor concentrations from beneath the floor slab of the warehouse.

OVERVIEW OF SUB-SLAB DEPRESSURIZATION (SSD) SYSTEM

A SSD system is recommended for the proposed warehouse because contaminated vapors could potentially migrate upward from the VOC groundwater plume and intrude into the warehouse. TCE and VC concentrations in sub-slab soil gas are in equilibrium with groundwater TCE and VC concentrations. TCE and VC vapors are lighter than air and therefore will migrate upwards to the ground surface from the contaminated groundwater. In areas outside the footprint of the warehouse, the vapors would vent to air around the warehouse. In areas within the footprint of the warehouse, the vapors could potentially migrate upward through the underlying fill material and into the warehouse through slab penetrations.

The SSD system would consist of a venting system and vapor barrier installed beneath the portion of the floor slab of the proposed warehouse that would overlay the VOC groundwater plume and approximately 100 foot to the east. The SSD system should be designed to provide a preferential pathway for vapors that migrate through the fill and discharge them to the air above the warehouse, outside of the breathing zone. A vapor-blocking membrane (vapor barrier) below the floor slab would act to prevent the vapors from potentially migrating into the occupied space. The venting system functions by creating a negative pressure differential between the sub-slab soil gas and atmospheric air so that vapors preferentially move towards the venting system. Once within the venting system, vapors would travel via vertical pipes (risers) attached to building support columns to exhaust points above the roof of the warehouse.

POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Construction of the SSD system is a remedial action that would occur under the terms of an Agreed Order entered into with Ecology. As such, the construction of the SSD system is exempt from the procedural requirements of Chapters 70A.15, 70A.205, 70A.305, 77.55, 90.48, and 90.58 Revised Code of Washington (RCW), and the procedural requirements of any laws requiring or authorizing local government permits or approvals for construction and operation of the SSD system. Construction of the SSD system must nonetheless comply with the substantive provisions of state and local laws and regulations.

Potentially applicable or potentially relevant and appropriate requirements that might apply to construction of the SSD system include:

- Puget Sound Clean Air Agency (PSCAA) discharge permit regulations, as required by the federal Clean Air Act (42 USC 7401) and the Washington State Clean Air Act (RCW 70A.15). A "Notice of Construction Application" may be required to be provided to PSCAA in advance of constructing the SSD system. Details on the requirements for PSCAA related to this project are provided as an enclosure. After the SSD system is constructed, sampling will be conducted to estimate the chemical discharge to determine if treatment is required.

SSD SYSTEM COMPONENTS

The SSD system would consist of a network of gas-permeable geosynthetic venting layer overlain by a vapor barrier overlain by the floor slab of the proposed warehouse. Risers would connect the geosynthetic venting layer network to exhaust points above the roof. The thermal stack effect, assisted by wind-driven turbine ventilators, would create a negative pressure differential causing soil vapor to travel up the risers and exhaust at the roof above the normal outdoor breathing zone and away from windows and air supply intakes. The ventilators would also prevent introduction of ambient oxygen to the subsurface, potentially improving anerobic remediation during periods of high atmospheric pressure.

The lateral extent of the SSD system under the floor slab of the proposed warehouse would be approximately 105,000 square feet (Figure 1). Details of the geosynthetic venting layer, and risers are shown in Figures 1A, 2, 3, and 4.

SPECIFICATIONS

The following section describes the specifications that must be adhered to when constructing the SSD system to make sure it performs effectively. The specifications are based on our understanding of the specifications for the proposed warehouse. The specifications for the SSD system may need to be revised if the specifications for the warehouse are altered. The "SSD Area" is defined as the area where the SSD system will be installed and is shown in Figure 1.

Geosynthetic Venting Layer

- A layer of gas-permeable geosynthetic venting material (collector mat) shall be installed beneath the floor slab of the proposed warehouse in a grid of relatively uniformly

spaced strips placed throughout the SSD Area. The grid shall be arranged such that no point within the SSD Area is more than 50 feet away from the collector mat. The location of the grid is shown in Figure 1A.

- The geosynthetic venting material shall be the Soil Gas Collector Mat (product no. PDS 05-140-1) manufactured by Radon Professional Discount Supply of Colorado Springs, Colorado, or SiteDrain™ Strip 6400 (model 6412) manufactured by American Wick Drain of Monroe, North Carolina. Installation procedures shall conform to the manufacturer's recommendations. The product data sheets are enclosed with this letter.
- "T" fittings or flat outlets, connecting the geosynthetic venting material to polyvinyl chloride (PVC) risers, shall be installed at relatively uniform spacing throughout the SSD Area with the geosynthetic venting material (Figures 2 and 3) and located along support columns or the perimeter walls as shown in Figure 1A.

Vapor Barrier

- A vapor barrier shall be installed across the entire SSD Area (shown as the gray-shaded area in Figure 1) underneath the floor slab of the proposed warehouse and on top of the collector mat network.
- The vapor barrier shall be the 30-mil Absolute Barrier® Y-series (product no. Y30BAC) manufactured by Raven Industries of Sioux Falls, South Dakota. The product data sheet is enclosed with this letter.
- The installation and testing procedures shall conform to the manufacturer's recommendations. Sheets of the vapor barrier shall be welded together according to the manufacturer's recommendations.
- The vapor barrier shall be sealed to the perimeter wall and interior column footings of the proposed warehouse using batten strips according to the manufacturer's recommendations. The vapor barrier shall be sealed to pipe penetrations using a pipe boot according to the manufacturer's recommendations. Cross sections of the seals are shown in Figure 4.

Risers

- "T" fittings or end outlets shall connect the geosynthetic venting layer to risers installed throughout the SSD Area. The risers shall extend vertically through the proposed warehouse and terminate at least 12 inches above the upper surface of the roof in a location at least 10 feet away from any operable window, or other opening into the conditioned spaces of the warehouse that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

- The risers shall be installed next to interior support columns or along the perimeter wall of the proposed warehouse (Figures 1A, 2, and 3).
- The risers shall consist of 4-inch Schedule 40 galvanized carbon steel pipe from ground surface to at least 10 feet height and thereafter consist of 4-inch-diameter Schedule 40 PVC pipe. The metal pipe near ground level will limit the potential for accidental damage.
- The risers shall be installed in a configuration and supported in a manner that ensures that any rainwater or condensation accumulating within the risers drains downward into the ground beneath the floor slab of the proposed warehouse using a minimum of 0.5% slope toward the extraction points.
- The risers shall be secured to walls, support columns, or ceilings at least every 6 feet using pipe clamps, clevis hangers, ceiling flanges, or beam flanges.
- All exposed and visible interior components shall be identified with at least one label on each floor level. The label shall read: "Sub-Slab Depressurization System."
- Soil gas sampling ports shall be connected to selected risers as shown in Figure 1A. The sampling port system shall consist of a ¼-inch-diameter Schedule 40 PVC sample port valve with hose barb. The sampling ports shall be placed at 10 feet above floor surface to limit potential for tampering and unintentional contact. Locations of sampling ports are shown in Figures 1 through 3.

Turbine Ventilators

- Wind-driven turbine ventilators shall be installed on the roof of the proposed warehouse at the exhaust points to create a negative pressure in the venting system. A conceptual drawing showing placement of the ventilators is provided in Figures 2 and 3.
- The size and air movement capacity of the vent pipe fan shall be sufficient to create and maintain a pressure field beneath the floor slab of the proposed warehouse that is lower than the ambient pressure above the floor slab.

Construction Specifications for Proposed Warehouse

The following items are recommendations for the design of the proposed warehouse.

- Channel type (French) drains are not recommended.
- Sumps open to soil or serving as the termination point for sub-slab or exterior drain tile loops shall be covered with a gasket or otherwise sealed lid to retard soil gas entry.

ESTIMATED QUANTITIES OF KEY MATERIALS

The following Table 1 lists the estimated quantities of key materials necessary to construct the SSD system. The list is not comprehensive.

Table 1: Estimated Quantities of Key Materials

Material	Quantity (minimum)
Collector Mat	3,150 linear feet
Vapor Barrier	105,000 square feet
Vent Pipe Risers	48 risers
Wind-Driven Turbine Ventilators	48 ventilators
Soil-Gas Sampling Ports	21 ports

NOTE:
All required materials for the SSD system are not listed. Exact quantities of materials are to be determined by the Contractor.

AIR DISCHARGE SAMPLING

After construction of the SSD system, sampling will be conducted to estimate the yearly discharge of chemicals to determine if additional measures are necessary to reduce the mass of chemicals being discharged. After approximately two weeks of continuous system operation, air samples will be collected from representative discharge sampling ports located in the vent pipe risers. Samples will be analyzed for VOCs, including TCE and VC, by EPA Method TO-15 using gas chromatography/mass spectrometry in full scan mode. Vapor sampling procedures are outlined in the Compliance Monitoring Plan[3].

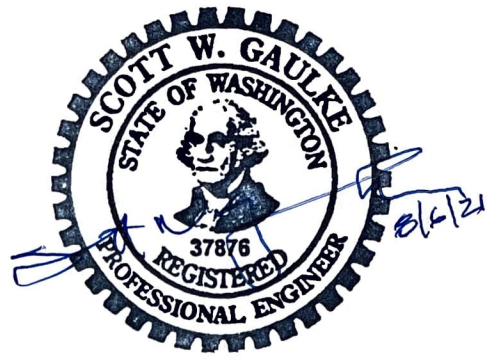
To evaluate for compliance with the PSCAA air discharge regulations, detected concentrations will be compared to PSCAA de minimis emission values stated in Washington Administrative Code 173-460-150.

[3] Shannon & Wilson, 2021, Compliance monitoring plan, 8801 East Marginal Way S., Tukwila, Wash.: Report prepared by Shannon & Wilson, Seattle, Wash., 21-1-12567-024, for PACCAR Inc, Bellevue, Wash., January (to be submitted).

SHANNON & WILSON

Sincerely,

SHANNON & WILSON



Ryan Peterson, PE
Environmental Engineer

Scott W. Gaulke, PE, LHG
Vice President

RBP:MJS:SWG/rbp

Enc. Figure 1 – Approximate Extent of Proposed Sub-Slab Depressurization System
Figure 1A – Details of Geosynthetic Venting Layer and Risers
Figure 2 – Cross-Sections at Interior Column
Figure 3 – Cross-Section of Perimeter Wall
Figure 4 – Vapor Barrier Details
Appendix A - PSCAA Permit Letter
Product Data Sheet for Soil Gas Collector Mat
Product Data Sheet for SiteDrain™ Strip 6400
Product Data Sheet for Absolute Barrier

Approximate Footprint of Existing Building on North Adjoining Property

1

Foundation Slab Underlain by Vapor Barrier, Which is Underlain by Network of Geosynthetic Venting Material Strips(Red Grid)

N

LEGEND

- 1 — Proposed Estimated Excavation Extents with Area Number Designation
- Area to be Protected for Potential Indoor Air Vapor Exposure
- Approximate Extent of VOC Groundwater Plume
- Proposed Conceptual Building Footprint
- Proposed Conceptual Building Canopy
- Proposed Column Placement *Provided by Centerpoint*
- Riser Along Building Column or Perimeter Wall
- Riser With Sampling Port Along Building Column or Perimeter Wall

NOTES

1. VOC = Volatile Organic Compound.
2. Locations and boundaries are approximate.

0 100 200

Scale in Feet

NOTE

Figure adapted from AMEC *14995-L-37.dwg* dated 05/2013.

Sub-Slab Depressurization System
8801 East Marginal Way South
Tukwila, Washington

APPROXIMATE EXTENT OF PROPOSED SUB-SLAB DEPRESSURIZATION SYSTEM

August 2021 21-1-12567-024

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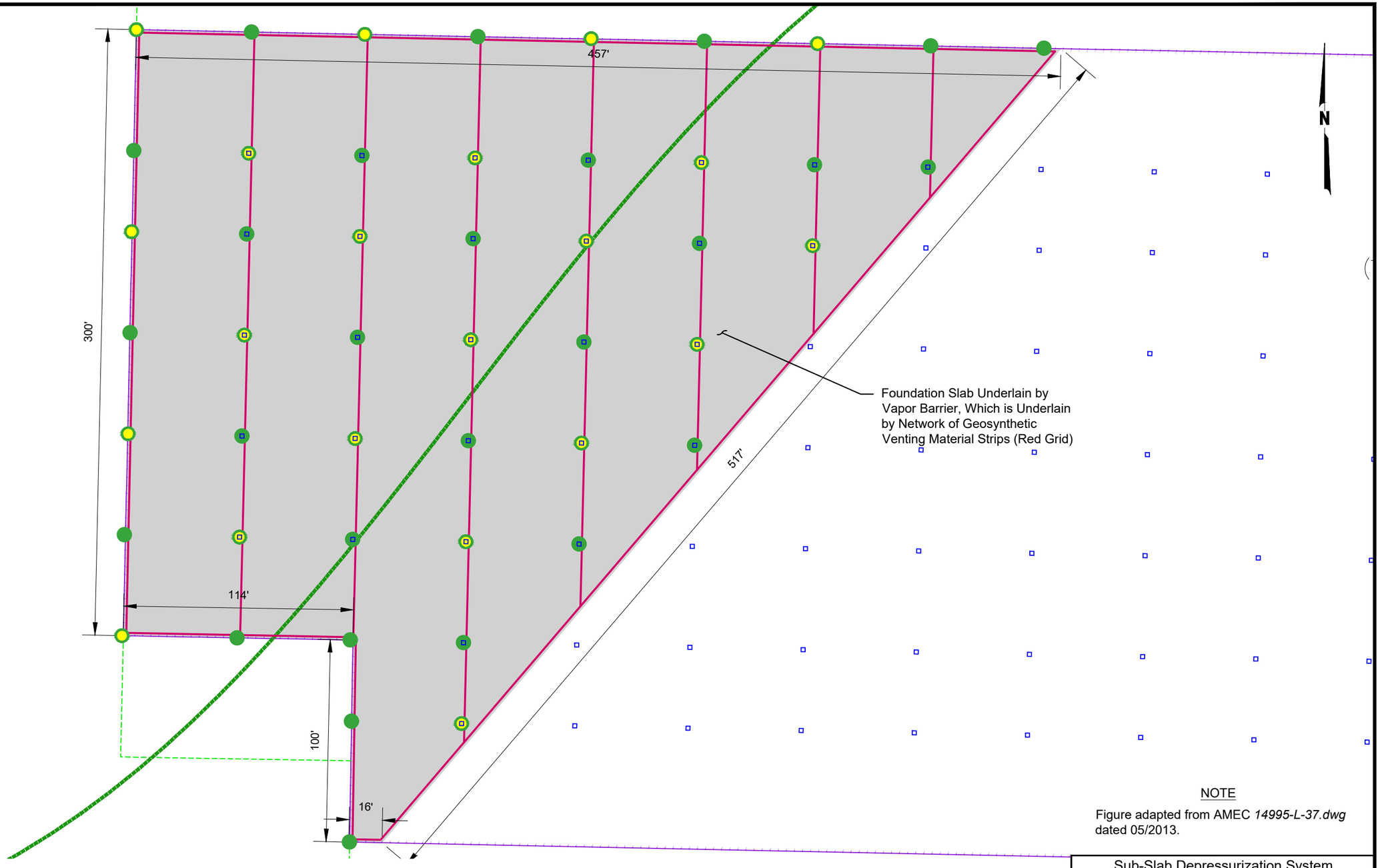
FIG. 1

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive\21\12567\024\21-1-12567-024 SDS.dwg Layout: Figure 1 Date: 01-14-2021 Login: JRS



LEGEND

- Area to be Protected for Potential Indoor Air Vapor Exposure
- Approximate Extent of VOC Groundwater Plume
- Proposed Conceptual Building Footprint
- Proposed Conceptual Building Canopy
- Proposed Column Placement *Provided by Centerpoint*
- Riser Along Building Column or Perimeter Wall
- Riser With Sampling Port Along Building Column or Perimeter Wall

NOTES

1. VOC = Volatile Organic Compound.
2. Locations and boundaries are approximate.

0 50 100

Scale in Feet

NOTE

Figure adapted from AMEC *14995-L-37.dwg* dated 05/2013.

Sub-Slab Depressurization System
8801 East Marginal Way South
Tukwila, Washington

DETAILS OF GEOSYNTHETIC VENTING LAYER AND RISERS

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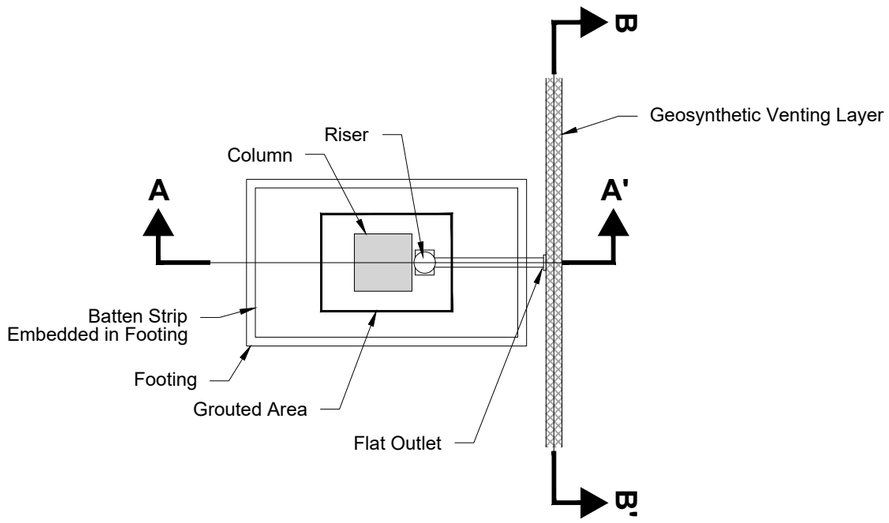
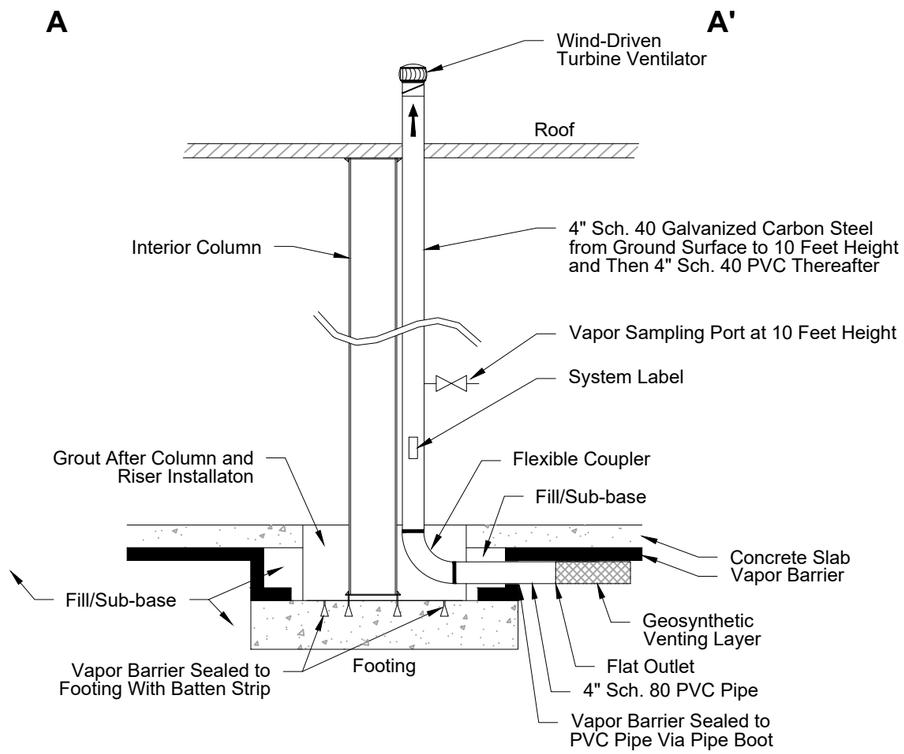
FIG. 1A

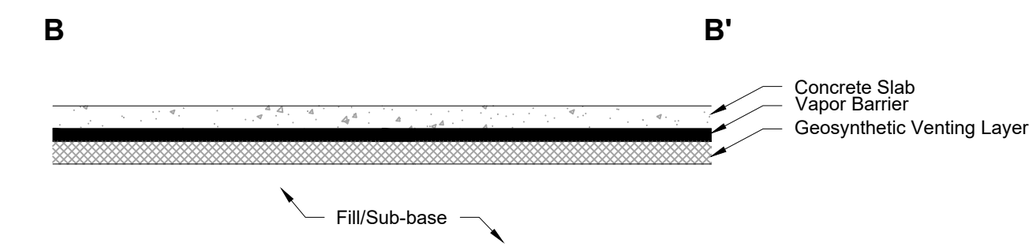
Filename: C:\Users\jrs\CAD Group Dropbox\JDrive\21\1\12567\024\21-1-12567-024 SDS.dwg Layout: Figure 1A Date: 01-14-2021 Login: JRS



PLAN VIEW
BENEATH VAPOR BARRIER



CROSS SECTION A-A'



CROSS SECTION B-B'

NOTES

1. Drawing not to scale.
2. All components not shown.

Sub-Slab Depressurization System
8801 East Marginal Way South
Tukwila, Washington

CROSS-SECTIONS
AT INTERIOR COLUMN

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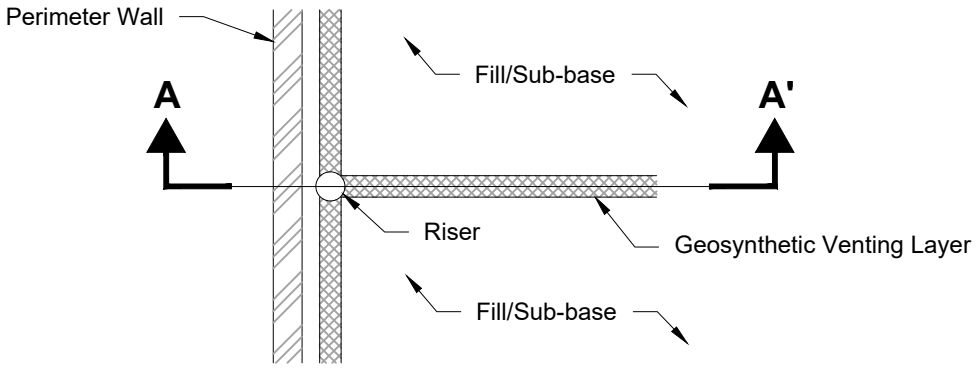
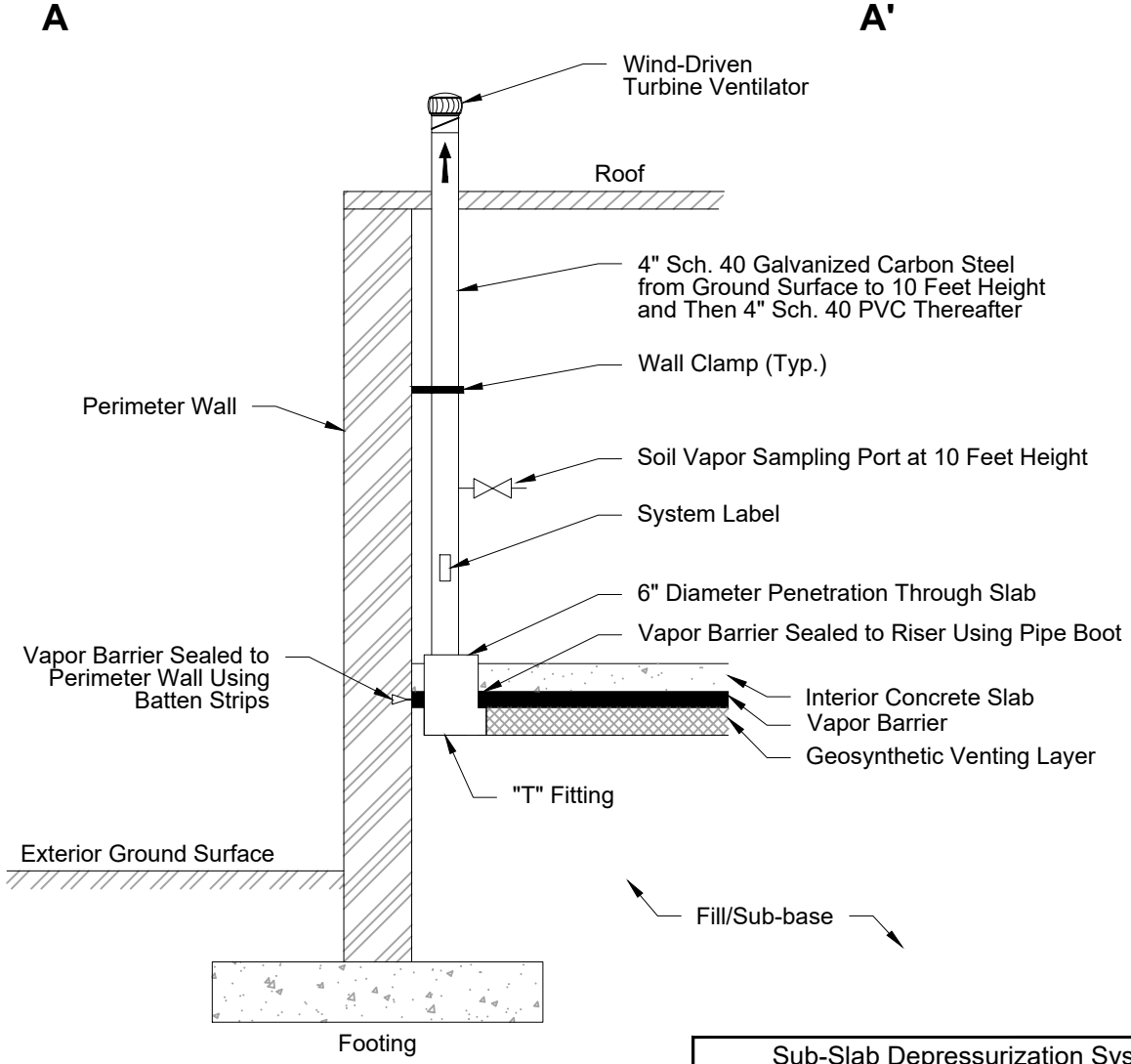
FIG. 2



PLAN VIEW
BENEATH VAPOR BARRIER



CROSS SECTION A-A'

NOTES

1. Drawing not to scale.
2. All components not shown.

Sub-Slab Depressurization System
8801 East Marginal Way South
Tukwila, Washington

CROSS-SECTION
AT PERIMETER WALL

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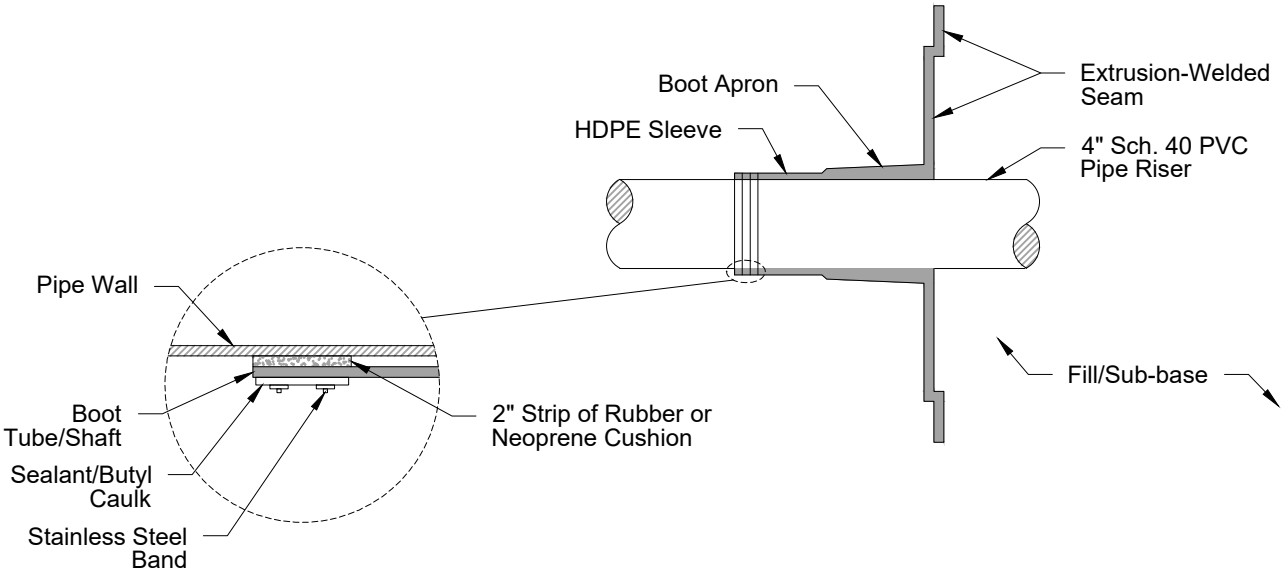
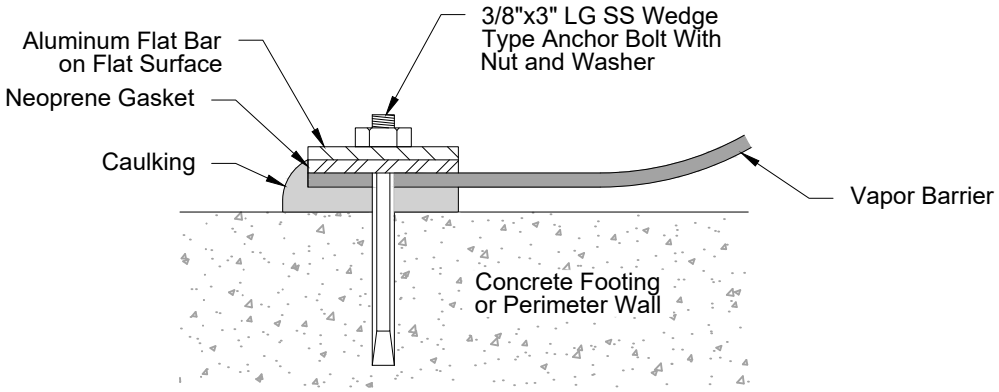
FIG. 3



HDPE 90° PIPE BOOT DETAIL



BATTEN STRIP DETAIL

NOTES

1. Drawing not to scale.
2. All components not shown.

Sub-Slab Depressurization System
8801 East Marginal Way South
Tukwila, Washington

VAPOR BARRIER DETAILS

August 2021 21-1-12567-024

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FIG. 4

APPENDIX A: PSCAA PERMIT LETTER

Appendix A

PSCAA Permit Letter

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

August 17, 2021

Mr. Brian Haderlie
PACCAR Inc

RE: PUGET SOUND CLEAN AIR AGENCY REQUIREMENTS RELATED TO THE AIR SPARING/SOIL VAPOR EXTRACTION EXTENSION AND SUB-SLAB DEPRESSURIZATION SYSTEM CONSTRUCTION

Dear Brian:

The purpose of this letter is to provide an opinion of the Puget Sound Clean Air Agency (PSCAA) requirements related the air sparging/soil vapor extraction (AS/SVE) extension and the sub-slab depressurization (SSD) system construction that are proposed at 8801 East Marginal Way South, Tukwila, Washington (8801 property).

This letter also documents the decision criteria and is designed to memorialize those decisions for the record as required by PSCAA.

This letter is organized as follows:

- Background of the 8801 property and proposed construction activities
- Estimate of emissions from the extended AS/SVE system
- PSCAA requirements for emission sources
- Summary

BACKGROUND

A volatile organic compound (VOC) groundwater plume extends from the northern property boundary of the 8801 property, downgradient (south and west) to the western boundary of the 8801 property adjacent to the Lower Duwamish Waterway. The predominant contaminants in the plume are trichloroethylene (TCE) and vinyl chloride (VC).

The VOC groundwater plume is intercepted by the existing AS/SVE system. The AS system is designed to inject pressurized air below the ground surface into the saturated zone

causing chemicals to volatilize and promoting in situ aerobic degradation. Vapors are extracted from the subsurface via vacuum created by the SVE system, then entrained water is removed prior to vapors discharging to the atmosphere.

The AS/SVE system is proposed to be extended with additional AS wells and SVE screens that will be installed parallel to and downgradient from the existing AS wells and SVE points. The SVE extension will consist of 330 feet of SVE screens added to the existing 690 feet of SVE screens.

Separate from the AS/SVE extension, a SSD system is to be installed during construction of a building at the 8801 property. The proposed system includes a vapor barrier and venting system beneath the western portion of the building slab that overlies the estimated extent of the VOC groundwater plume.

TCE and VC concentrations in sub-slab soil gas are in equilibrium with groundwater TCE and VC concentrations. TCE and VC vapors are lighter than air and therefore will migrate upwards to the ground surface from the VOC-contaminated groundwater to atmosphere. The SSD system is designed to provide a preferential pathway for vapors that migrate through the soil beneath the building and discharge them to the atmosphere above the building, outside of the breathing zone.

The SSD system consists of a vapor barrier and a venting system. A vapor-blocking membrane (vapor barrier) below the slab acts to prevent the vapors from potentially migrating into the occupied space. The venting system consists of vertical riser connecting to the sub-slab area to wind-powered turbines on the building's roof. The turbines create a negative pressure differential between the sub-slab soil gas and atmospheric air so that vapors preferentially move towards the venting system. Once within the venting system, vapors travel via vertical pipes (risers) attached to building support columns to exhaust points above the roof.

ESTIMATE OF EMISSIONS FROM EXTENDED AIR SPARING/SOIL VAPOR EXTRACTION (AS/SVE) SYSTEM

On September 7, 2017, during steady-state operation of the AS/SVE system, Shannon & Wilson performed site monitoring and collected effluent vapor samples. The effluent sample and an ambient sample were analyzed for VOCs. A description of methods and the laboratory analytical report are enclosed.

The following estimate of emission mass flow rates from the extended AS/SVE system is based on the concentration of analytes detected in the 2017 effluent sample. The new SVE screens proposed for the system extension are downgradient from the existing SVE screens and therefore VOCs at the extension are likely lower concentration than at the existing screens from which the 2017 sample was collected. Therefore, the following estimate of emission mass flow rates is likely biased high (worst case scenario).

If the contaminant was not detected at or above the reporting limit, the contaminant method reporting limit was used to calculate the emission mass flow rate. The 2017 analyte concentrations are multiplied by a scaling factor to account for the increase in SVE screen length (more area from which the system is taking suction). The scaling factor is a linear interpolation and is biased high (worst case) since the SVE system vacuum in the extended system will likely be lower than the existing system. The scaling factor is as follows:

$$Scaling\ Factor\ (SF) = \frac{Screen\ Extension\ Length + \ Existing\ Screen\ Length}{Existing\ Screen\ Length} = \frac{330 + \ 690}{690}$$
$$= 1.48$$

The estimated emission mass flow rates were compared to PSCAA exemption criteria for registration and permitting as follows. The exemption criteria are discussed in more detail in following sections.

- Regulation I, Section 5.03(a)(3) states that registration is required for sources with annual emissions greater or equal to 2.50 tons of any single hazardous air pollutant (HAP), greater than or equal to 6.25 tons of total HAPs, or greater than or equal to 25.0 tons of VOCs.
- Regulation I, Section 6.03(c)(94), states that permitting is not required for soil and groundwater remediation projects involving less than 15 pounds per year (lb/yr) of benzene or vinyl chloride, less than 500 lb/yr of perchloroethylene, and less than 1,000 lb/yr of toxic air contaminants.

As shown in the enclosed Table 1, the estimated emission mass flow rates are less than 2.1 lb/yr for any single chemical and less than 4 lb/yr of total chemicals, which are less than PSCAA exemption criteria indicating that the AS/SVE extension does not require registration or permitting with PSCAA at this time.

PUGET SOUND CLEAN AIR AGENCY (PSCAA) REQUIREMENTS

PSCAA is the regulatory authority that administers air emission source registration and permitting and has jurisdiction at the 8801 property. The following two subsections discuss the applicable regulations in more detail. Mr. Ryan Peterson of Shannon & Wilson, discussed the applicable PSCAA regulations with Mr. Steve Van Slyke, PSCAA Compliance Director, on January 7, 2021. If more technical information is required, Mr. Van Slyke recommended contacting Mr. John Dawson, PSCAA Engineering Manager, who reviews Notice of Construction applications.

Registration Requirements

Regulation I, Section 5.03 (a) requires registration of sources meeting certain criteria, including sources for certain applications (ex. refuse burning) or having certain control equipment (ex. activated carbon adsorption).

The potentially applicable criteria that would require registration of the AS/SVE system is described in Section 5.03(a)(3), which states that registration is required for sources with annual emissions greater or equal to 2.50 tons of any single HAP; greater than or equal to 6.25 tons of total HAPs; or greater than or equal to 25.0 tons of carbon monoxide, nitrogen oxides, particulate matter, or VOCs. The annual emission of HAPs is estimated in a later section of this letter and confirms that registration of the AS/SVE system is not required. Mr. Van Slyke recommended that it would be prudent to sample the SVE discharge after the extension was completed to verify emissions are less than criteria.

Based on conversation with Mr. Van Slyke, the SSD system is likely not a "reviewable source" (is not under jurisdiction of PSCAA) since it is a passive system that is not "pulling" HAPs from the soil. The system passively vents the sub-slab space to prevent buildup of HAP vapors that would migrate to the atmosphere is any case. Mr. Van Slyke said that the SSD system sounded similar to passive odor control at sewage lift stations which do not require registration with PSCAA. IF the SSD system is not a "reviewable" source, than no communication with PSCAA is required for construction of the SSD system.

Permitting Requirements

Regulation I, Section 6.03 (c), states that a "Notice of Construction Application and Order of Approval" are not required for exempt new sources, provided that sufficient records are kept to document the exemption. Exemption #94 is for soil and groundwater remediation

projects involving less than 15 lb/yr of benzene or vinyl chloride, less than 500 lb/yr of perchloroethylene, and less than 1,000 lb/yr of toxic air contaminants.

Exemption #94 applies to the AS/SVE system based on the estimation of annual emissions described in the following section of this letter. Mr. Van Slyke recommended that it would be prudent to sample the SVE discharge after the extension is completed to verify emissions are less than the exemption criteria.

Based on my conversation with Mr. Van Slyke, the SSD system would not require permitting for the same reason that it would not require registration. In summary, the SSD system is not a "reviewable" source since it is a passive system.

PSCAA OPINION LETTER

Of note, although it is not required for the AS/SVE extension or SSD system construction, Mr. Van Slyke said that property owners who desire a written determination of registration and permitting requirements for a specific system may file a notification with PSCAA pursuant to Regulation I, Section 6.03(b)(10). If the system is exempt from registration or permitting, PSCAA will provide a confirming written statement. The review fee is $1,150.

SUMMARY

The purpose of this letter is to provide an opinion of the PSCAA requirements related to the AS/SVE extension and the SSD system construction that are proposed at the 8801 property.

Based on estimated emission mass flow rates, the AS/SVE extension likely does not require registration or permitting since it does not exceed threshold values for emissions of HAPs. PSCAA requires that appropriate documentation be maintain to justify that the AS/SVE system is exempt from registration and permitting. No communication related to the AS/SVE extension is required with PSCAA.

The proposed SSD system is likely not a "reviewable" source (not under jurisdiction of PSCAA) since it is a passive system, and therefore requires no registration, permitting, or other communication with PSCAA.

Although not required, PSCAA will provide a written opinion regarding the regulatory status of each system for a $1,150 fee ($2,300 total).

If the project changes, a re-evaluation of emission rates with respect to regulatory standards may be required.

Sincerely,

SHANNON & WILSON

Ryan Peterson, PE
Environmental Engineer

Meg Strong Digitally signed by Meg Strong

Meg Strong, LG, LHG
Vice President

RBP:PJS:MJS/rbp

Enc. Table 1 – Estimated Emission Mass Flow Rates
2017 Air Sampling for Compliance with Puget Sound Clean Air Agency

Table 1 - Estimated Emission Mass Flow Rates

Analyte	Flow Rate (acfm)	Temperature (°F)	Pressure (psia)	Current Flow Rate (scfm)	Estimated Current and Extension SVE Flow Rate (scfm)	SVE Discharge Concentration (µg/m3)	Ambient Air Concentration (µg/m3)	Estimated Annual Mass Flux (lbs/yr)	Estimated Annual Mass Flux (tons/yr)	Exceeds Criteria?
Benzene	880	143.4	14.79	788	1166	0.85	1.1	0.032	1.6E-05	No
Chloroethane	880	143.4	14.79	788	1166	<0.66	<0.66	0.025	1.3E-05	No
1,1-Dichloroethane	880	143.4	14.79	788	1166	1.3	<1	0.050	2.5E-05	No
1,2-Dichloroethane	880	143.4	14.79	788	1166	<1	<1	0.038	1.9E-05	No
1,1-Dichloroethene	880	143.4	14.79	788	1166	<0.99	<0.99	0.038	1.9E-05	No
cis-1,2-Dichloroethene	880	143.4	14.79	788	1166	8.9	<0.99	0.340	1.7E-04	No
trans-1,2-Dichloroethene	880	143.4	14.79	788	1166	<0.99	<0.99	0.038	1.9E-05	No
Ethylbenzene	880	143.4	14.79	788	1166	1.7	2.7	0.065	3.2E-05	No
Naphthalene	880	143.4	14.79	788	1166	1.5	<1.3	0.057	2.9E-05	No
Percloroethylene	880	143.4	14.79	788	1166	<1.7	<1.7	0.065	3.2E-05	No
Toluene	880	143.4	14.79	788	1166	14	31	0.535	2.7E-04	No
1,1,1-Trichloroethane	880	143.4	14.79	788	1166	<1.4	<1.4	0.054	2.7E-05	No
1,1,2-Trichloroethane	880	143.4	14.79	788	1166	<1.4	<1.4	0.054	2.7E-05	No
Trichloroethene (TCE)	880	143.4	14.79	788	1166	54	<1.3	2.064	1.0E-03	No
Vinyl chloride (VC)	880	143.4	14.79	788	1166	<0.64	<0.64	0.024	1.2E-05	No
m,p-Xylene	880	143.4	14.79	788	1166	9.2	26	0.352	1.8E-04	No
o-Xylene	880	143.4	14.79	788	1166	4	10	0.153	7.6E-05	No
Total Hazardous Air Pollutants (HAPs)								3.984	2.0E-03	No

NOTES:
Analyte concentrations are reported from the September 7, 2017 SVE effluent sample.
°F = degrees Fahrenheit; acfm = actual cubic feet per minute; lbs/day = pounds per day; lbs/yr = pounds per year; µg/m3 = micrograms per cubic meter; psia = pounds per square inch absolute; scfm = standard cubic feet per minute; SVE = soil vapor extraction

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

November 28, 2017

PACCAR Inc.
777 106th Avenue N.E.
Bellevue, WA 98004

Attn: Ms. Vicki ZumBrunnen

RE: AIR SAMPLING FOR COMPLIANCE WITH PUGET SOUND CLEAN AIR AUTHORITY

In accordance with the State of Washington Administrative Code (WAC) 173-460, Controls for New Sources of Toxic Air Pollutants, we performed an air emissions evaluation of the air sparge and soil vapor extraction (AS/SVE) system located at 8801 East Marginal Way S, Tukwila, Washington. On September 7, 2017, during steady-state operation of the AS/SVE system, Shannon & Wilson performed site monitoring and collected effluent vapor samples. The SVE blower discharge velocity and temperature was measured using a Dwyer Model 471B-1 thermo-anemometer test instrument. The SVE blower discharge pressure was measured using an Extech Model 407910 heavy duty differential pressure manometer.

One vapor sample of the SVE blower discharge and one atmospheric air sample outside the treatment compound were collected in laboratory-supplied, evacuated 1-liter summa canisters. The canisters were taken, under chain-of-custody protocol, to Friedman & Bruya, Inc. of Seattle, Washington, for analysis. The two samples were analyzed for benzene, toluene, ethylbenzene, xylenes, and naphthalene and chlorinated volatile organic compounds by United States Environmental Protection Agency Method TO-15.

The analytical report and associated chain-of-custody form for the samples are included in Attachment A. The monitoring data and analytical results are included in Table 1. Detected in the SVE blower discharge sample at concentrations above the analytical method reporting limit were the following:

- Benzene - 0.85 micrograms per cubic meter ($\mu g/m^3$)
- 1,1-Dichloroethane - 1.3 $\mu g/m^3$
- cis-1,2-Dichloroethene - 8.9 $\mu g/m^3$
- Ethylbenzene - 1.7 $\mu g/m^3$
- Naphthalene - 1.5 $\mu g/m^3$

400 NORTH 34TH STREET, SUITE 100
P.O. BOX 300303
SEATTLE, WASHINGTON 98103-8636
206-632-8020 FAX: 206-695-6777
www.shannonwilson.com

- Toluene - 14 $\mu g/m^3$
- Trichloroethene - 54 $\mu g/m^3$
- m,p-Xylene - 9.2 $\mu g/m^3$
- o-Xylene - 4.0 $\mu g/m^3$

Detected in the ambient air sample at concentrations above the analytical method reporting limit were the following:

- Benzene - 1.1 $\mu g/m^3$
- Ethylbenzene - 2.7 $\mu g/m^3$
- Toluene - 31 $\mu g/m^3$
- m,p-Xylene - 26 $\mu g/m^3$
- o-Xylene - 10 $\mu g/m^3$

Benzene, ethylbenzene, toluene, m,p-xylene, and o-xylene were detected at higher concentrations in the ambient air sample than in the SVE blower discharge sample.

The contaminant mass flow rates in Table 1 have been calculated using the contaminant's SVE blower discharge sample concentration. If the contaminant was not detected at or above the method reporting limit, the contaminant method reporting limit was used to calculate the contaminant mass flow rate.

The calculated contaminant mass flow rates were compared to WAC 173-460-150 contaminant-specific de minimis emission rates. The de minimis emission rates are defined in the code as "trivial levels of emissions that do not pose a threat to human health or the environment." All sampled contaminant emission rates are below the listed de minimis emission rates.

Mr. Ralph Munoz of the Puget Sound Clean Air Agency (PSCAA) was contacted to confirm permitting was not required by PSCAA for the AS/SVE system. In addition to confirming that an air permit is not required for the site, Mr. Munoz stated the treatment equipment does not require registration with PSCAA at this time.

Records detailing the emission rates do have to be provided to a PSCAA inspector within a reasonable amount of time, if requested. If emission rates change, a re-evaluation of emission rates with respect to regulatory standards will be required.

We appreciate having the opportunity to assist you in evaluating the environmental condition of your project.

Sincerely,

SHANNON & WILSON, INC.

Peter J. Shingledecker
Senior Environmental Professional

Meg Strong
Vice President

PJS:MJS/blm:mmm

Enc: Table 1 – Contaminant Air Emission Flow Rates
Attachment A – Laboratory Analytical Results and Chain-of-Custody Form

TABLE 1
CONTAMINANT AIR EMISSION FLOW RATES

Analyte	Flow Rate (acfm)	Temperature (°F)	Pressure (psia)	Flow Rate (scfm)	SVE Discharge Concentration ($\mu g/m^3$)	Ambient Air Concentration ($\mu g/m^3$)	Calculated Daily Mass Flux (lbs/day)	Calculated Annual Mass Flux (lbs/yr)	Averaging Period (AP)	Regulatory De Mimimis (lb/AP)	Exceeds De Minimis?
Benzene	880	143.4	14.79	788	0.85	1.1	0.000060	0.022	year	0.331	No
Chloroethane	880	143.4	14.79	788	<0.66	<0.66	0.000047	0.017	24-hr	197	No
1,1-Dichloroethane	880	143.4	14.79	788	1.3	<1	0.000092	0.034	year	6	No
1,2-Dichloroethane	880	143.4	14.79	788	<1	<1	0.000071	0.026	year	0.369	No
1,1-Dichloroethene	880	143.4	14.79	788	<0.99	<0.99	0.000070	0.026	24-hr	1.31	No
cis-1,2-Dichloroethene	880	143.4	14.79	788	8.9	<0.99	0.00063	0.23	NE	NE	No
trans-1,2-Dichloroethene	880	143.4	14.79	788	<0.99	<0.99	0.000070	0.026	NE	NE	No
Ethylbenzene	880	143.4	14.79	788	1.7	2.7	0.00012	0.044	year	3.84	No
Naphthalene	880	143.4	14.79	788	1.5	<1.3	0.00011	0.039	year	0.282	No
Tetrachloroethene	880	143.4	14.79	788	<1.7	<1.7	0.00012	0.044	year	1.62	No
Toluene	880	143.4	14.79	788	14	31	0.0010	0.36	24-hr	32.9	No
1,1,1-Trichloroethane	880	143.4	14.79	788	<1.4	<1.4	0.00010	0.036	24-hr	6.57	No
1,1,2-Trichloroethane	880	143.4	14.79	788	<1.4	<1.4	0.00010	0.036	year	0.6	No
Trichloroethene	880	143.4	14.79	788	54	<1.3	0.0038	1.4	year	4.8	No
Vinyl chloride	880	143.4	14.79	788	<0.64	<0.64	0.000045	0.017	year	0.123	No
m,p-Xylene	880	143.4	14.79	788	9.2	26	0.00065	0.24	24-hr	1.45	No
o-Xylene	880	143.4	14.79	788	4.0	10	0.00028	0.10	24-hr	1.45	No

Notes:

acfm = actual cubic feet per minute

lbs/day = pounds per day

lbs/yr = pounds per year

lb/AP = pounds per averaging period

$\mu g/m^3$ = micrograms per cubic meter

NE = not established

psia = pounds per square inch absolute

scfm = standard cubic feet per minute

ATTACHMENT A

LABORATORY ANALTICAL RESULTS AND CHAIN OF CUSTODY FORM

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

September 15, 2017

Meg Strong, Project Manager
Shannon & Wilson, Inc.
400 N. 34th Street, Suite 100
Seattle, WA 98103

Dear Ms Strong:

Included are the results from the testing of material submitted on September 7, 2017 from the 8801 Remediation System, PO 21-1-12618, F&BI 709113 project. There are 6 pages included in this report.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
SWI0915R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on September 7, 2017 by Friedman & Bruya, Inc. from the Shannon & Wilson 8801 Remediation System, PO 21-1-12618 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Shannon & Wilson
709113 -01	8801 System
709113 -02	8801 Background

All quality control requirements were acceptable.

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	8801 System	Client:	Shannon & Wilson
Date Received:	09/07/17	Project:	8801 Remediation System, PO 21-1-12618
Date Collected:	09/07/17	Lab ID:	709113-01 1/2.5
Date Analyzed:	09/13/17	Data File:	091309.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	99	70	130

Compounds:	Concentration ug/m3	Concentration ppbv
Vinyl chloride	<0.64	<0.25
Chloroethane	<0.66	<0.25
1,1-Dichloroethene	<0.99	<0.25
trans-1,2-Dichloroethene	<0.99	<0.25
1,1-Dichloroethane	1.3	0.32
cis-1,2-Dichloroethene	8.9	2.2
1,2-Dichloroethane (EDC)	<1	<0.25
1,1,1-Trichloroethane	<1.4	<0.25
Benzene	0.85	0.26
Trichloroethene	54	10
Toluene	14	3.6
1,1,2-Trichloroethane	<1.4	<0.25
Tetrachloroethene	<1.7	<0.25
Ethylbenzene	1.7	0.40
m,p-Xylene	9.2	2.1
o-Xylene	4.0	0.92
Naphthalene	1.5	0.28

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	8801 Background	Client:	Shannon & Wilson
Date Received:	09/07/17	Project:	8801 Remediation System, PO 21-1-12618
Date Collected:	09/07/17	Lab ID:	709113-02 1/2.5
Date Analyzed:	09/13/17	Data File:	091310.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	102	70	130

Compounds:	Concentration ug/m3	Concentration ppbv
Vinyl chloride	<0.64	<0.25
Chloroethane	<0.66	<0.25
1,1-Dichloroethene	<0.99	<0.25
trans-1,2-Dichloroethene	<0.99	<0.25
1,1-Dichloroethane	<1	<0.25
cis-1,2-Dichloroethene	<0.99	<0.25
1,2-Dichloroethane (EDC)	<1	<0.25
1,1,1-Trichloroethane	<1.4	<0.25
Benzene	1.1	0.33
Trichloroethene	<1.3	<0.25
Toluene	31	8.2
1,1,2-Trichloroethane	<1.4	<0.25
Tetrachloroethene	<1.7	<0.25
Ethylbenzene	2.7	0.62
m,p-Xylene	26	5.9
o-Xylene	10	2.4
Naphthalene	<1.3	<0.25

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	Method Blank	Client:	Shannon & Wilson
Date Received:	Not Applicable	Project:	8801 Remediation System, PO 21-1-12618
Date Collected:	09/13/17	Lab ID:	07-1921 mb
Date Analyzed:	09/13/17	Data File:	091305.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	102	70	130

Compounds:	Concentration ug/m3	Concentration ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<0.26	<0.1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	<0.4	<0.1
1,1,1-Trichloroethane	<0.55	<0.1
Benzene	<0.32	<0.1
Trichloroethene	<0.54	<0.1
Toluene	<0.38	<0.1
1,1,2-Trichloroethane	<0.55	<0.1
Tetrachloroethene	<0.68	<0.1
Ethylbenzene	<0.43	<0.1
m,p-Xylene	<0.87	<0.2
o-Xylene	<0.43	<0.1
Naphthalene	<0.52	<0.1

Date of Report: 09/15/17
Date Received: 09/07/17
Project: 8801 Remediation System, PO 21-1-12618, F&BI 709113

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Vinyl chloride	ppbv	10	87	70-130
Chloroethane	ppbv	10	70	70-130
1,1-Dichloroethene	ppbv	10	93	70-130
trans-1,2-Dichloroethene	ppbv	10	98	70-130
1,1-Dichloroethane	ppbv	10	94	70-130
cis-1,2-Dichloroethene	ppbv	10	97	70-130
1,2-Dichloroethane (EDC)	ppbv	10	91	70-130
1,1,1-Trichloroethane	ppbv	10	97	70-130
Benzene	ppbv	10	96	70-130
Trichloroethene	ppbv	10	98	70-130
Toluene	ppbv	10	101	70-130
1,1,2-Trichloroethane	ppbv	10	100	70-130
Tetrachloroethene	ppbv	10	103	70-130
Ethylbenzene	ppbv	10	99	70-130
m,p-Xylene	ppbv	20	102	70-130
o-Xylene	ppbv	10	102	70-130
Naphthalene	ppbv	10	102	70-130

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

709113

SAMPLE CHAIN OF CUSTODY

ME

09-07-17

Page # 1 of 1

Report To Meg Strong

Company Shannon & Wilson

Address 400 N 34th Street, Suite 100

City, State, ZIP Seattle, WA, 98103

Phone 206-695-6787 Email MJS@shanwil.com

SAMPLERS (*signature*) BON

PROJECT NAME	PO #
8801 Remediation System	21-1-12618
REMARKS	INVOICE TO
PID: 2.4ppm	

TURNAROUND TIME
- [x] Standard
- [ ] RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- [x] Dispose after 30 days
- [ ] Archive Samples
- [ ] Other

ANALYSIS REQUESTED

Sample Name	Lab ID	Canister ID	Flow Contr. ID	Date Sampled	Field Initial Press. (Hg)	Field Initial Time	Field Final Press. (Hg)	Field Final Time	TO-15 Full Scan	TO-15 BTEXN	TO-15 cVOCs		Notes
8801 System	01	3677	728	9/7/17	30	2:20	8	2:29		X	X		
8801 Background	02	3312	303	9/7/17	29	2:10p	9	888		X	X		
													Samples received at 20°C

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Blaine Nesbit	SWI	9/7/17	4:09 pm
Received by:	HONG NGUYEN	FBI	"	"
Relinquished by:				
Received by:				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

FORMS\COC\COCTO-15.DOC

Product **Materials** & **Safety** Information

RADON PDS
PROFESSIONAL DISCOUNT SUPPLY

Soil Gas Collector Mat PDS 05-140-1

Made in the USA

Safety data for our custom-formed, high-impact polystyrene core is shown below.

RECOMMENDED MAXIMUM OCCUPATIONAL EXPOSURE LIMITS

Component	CAS No.	Exposure Limits OSHA—Pel.	Hazard Data
Polystyrene	9003-55-6	None established	No hazardous ingredients

PHYSICAL DATA

Properties	Data
Form	Molded Sheet
Color	Black
Odor	None
Boiling Point	Not applicable
Melting Point (°F)	270
Flash Point (°F)	Not applicable
Flammable Limits (°F)	Not applicable
VOC	0%
Volatility	<0.75% Moisture
Specific gravity	1.02–1.08
Solubility in Water	Not soluable

FIRE HANDLING MEASURES

Properties	Data
Extinguishing Media	Water Spray (except when fire is of electrical origin), Foam, Dry powder, CO_2
Fire Fighting Procedure	Self-contained breathing apparatus & suitable protective equipment

ECOLOGICAL INFORMATION & DISPOSAL

Properties	Data
Ecological information	Not associated with any known ecological problems
Toxicological	No negative effects on humans
Disposal	Polystyrene recycles well. Can be disposed of as solid waste or burned in a suitable installation subject to local regulations. Effluents disposal should also be in accordance with local legislation.

Perfect for Radon Control Systems in new home construction

The economical alternative to aggregate systems—quick and easy installation

STABILITY & REACTIVITY

Properties	Data
Stablitity	Stable
Incompatibility (Materials to avoid)	Can react with strong oxidixers
Hazardous Decomposition	Carbon dioxide, carbon monoxide, various hydrocarbons
Conditions to avoid	None

SPECIAL HANDLING INFORMATION

Description	Information
Handling & Storage Precaution	Protect against flame & intense heat. Avoid breathing hot vapors.
Eye Protection, Recommended	Use OSHA approved safety glasses when handling
Skin	Wash with soap & water. Get medical attention if irritation develops or persists.
Other Clothing & Equipment	Gloves recommended due to sharp edges.
Work Practices, Hygiene	Use standard work practices for hygienic safety.
Handling & Storage, Other	Store in well-ventillated area. Avoid extreme heat & sources of ignition or open flame.
Protective Measures, Maintenance	Not applicable

RADON PDS
PROFESSIONAL DISCOUNT SUPPLY

www.soilgasmat.com 719-444-0646 info@radonpds.com

Product
Data Sheet

RADON PDS
PROFESSIONAL DISCOUNT SUPPLY

Soil Gas Collector Mat PDS 05-140-1

The economical alternative to aggregate systems—quick and easy installation

Made in the USA

Material Physical Properties

CUSPATED PLASTIC

Property	Test Method	Value
Specific Gravity (g/cc)	ASTM D-792	1.04
Melt Flow @ 200°C/5000g (g/10 min)	ASTM D-1238	2.5
Tensile Strength @ Yield (psi)	ASTM D-638	2,900
Tensile Modulus (psi)	ASTM D-638	275,000
Elongation @ Break (%)	ASTM D-638	70
Flexural Modulus (psi)	ASTM D-790	300,000
Impact Strength, Notched Izod @ 73°F (ft-lb/in)	ASTM D-256	2.1
Heat Deflection Temperature @ 264 psi (°F)	ASTM D-648	183
Vicat Softening Point (°F)	ASTM D-1525	210

COVER FABRIC

Property	Test Method	Value
Grab Tensile (lbs)	ASTM D4632	130
Elongation (%)	ASTM D4632	> 50
Trapezoid Tear (lbs)	ASTM D4533	60
Puncture (lbs)	ASTM D4833	41
Mullen Burst (psi)	ASTM D3786	140
AOS (U.S. sieve number)	ASTM D4571	70
Permittivity (sec-1)	ASTM D4491	0.8
Permeability (cm/sec)	ASTM D4491	0.04
Water Flow (gal/min/sf)	ASTM D4491	60
UV Stability (%)	ASTM D4355	70

Material Physical Properties CONTINUED

BINDING METHOD

Property	Test Method	Value
External Binder	Standard	Sewn
Type Stitching	Standard	Lock Stitch
Type Thread	Standard	HB92 Nylon
Tensile Strength (lbs)	ASTM D4632	11
Thread Gage	Standard	2 IOx4 denier
Chemically Impervious	Standard	MI Natural

Product **Materials** & **Safety** Information

RADON PDS
PROFESSIONAL DISCOUNT SUPPLY

Soil Gas Collector Mat PDS 05-140-1

Made in the USA

Safety data for our non-woven, spun-bonded, polypropylene, gray geotextile fabric is shown below.

RECOMMENDED MAXIMUM OCCUPATIONAL EXPOSURE LIMITS

Component	CAS No.	Exposure Limits OSHA—Pel.	Hazard Data
Polystyrene	9003-07-0	None established	No hazardous ingredients

PHYSICAL DATA

Properties	Data
Form	Molded Sheet
Color	Black
Odor	None
Boiling Point	Not applicable
Melting Point (°F)	270
Flash Point (°F)	Not applicable
Flammable Limits (°F)	Not applicable
Auto ignition temperature	Not applicable
Vapor Pressure (Pascal)	Not volatile
Density (g/cm^3) @20 °C	0.91
Solubility in Water	Not soluable
Thermal decomposition (°F)	Above 570

FIRE HANDLING MEASURES

Properties	Data
Extinguishing Media	Water Spray (except when fire is of electrical origin), Foam, Dry powder of CO_2
Fire Fighting Procedure	Self-contained breathing apparatus & suitable protective equipment

ECOLOGICAL INFORMATION & DISPOSAL

Properties	Data
Ecological information	Not associated with any known ecological problems
Toxicological	No negative effects on humans
Disposal	Polystyrene recycles well. Can be disposed of as solid waste or burned in a suitable installation subject to local regulations. Effluents disposal should also be in accordance with local legislation.

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Perfect for Radon Control Systems in new home construction

The economical alternative to aggregate systems—quick and easy installation

STABILITY & REACTIVITY

Properties	Data
Stablitity	Stable
Incompatibility (Materials to avoid)	Can react with strong oxidixers, base, or acid
Hazardous Decomposition	Carbon dioxide, carbon monoxide, low molecular weight oxygenated organic
Conditions to avoid	None

SPECIAL HANDLING INFORMATION

Description	Information
Handling & Storage Precaution	Avoid breathing hot vapors, oiled mists, and airborne fibers.
Eye Protection, Recommended	Use OSHA approved safety glasses when handling rolls
Skin	Wash with soap & water. Get medical attention if irritation develops or persists.
Other Clothing & Equipment	Not applicable
Work Practices, Hygiene	Use standard work practices for hygienic safety.
Handling & Storage, Other	Store rolls In accordance with good material handling practice
Protective Measures, Maintenance	Not applicable

RADON PDS
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Product **Materials—**
Technical Specifications
& Performance

RADON PDS
PROFESSIONAL DISCOUNT SUPPLY

Soil Gas Collector Mat PDS 05-140-1

Made in the USA

Our non-woven, spun-bonded, polypropylene, gray geotextile fabric with the minimum values shown below.

Property	Test Method	Value
Grab Tensile Strength (lbs)	ASTM D 4632	130
Elongation (%)	ASTM D 4632	>50
Trapezoid Tear (lbs)	ASTM D 4533	60
Puncture (lbs)	ASTM D 4833	41
Mullen Burst (psi)	ASTM D 3786	140
AOS (U.S. sieve no.)	ASTM D 4751	70
Permittivity (sec^{-1})	ASTM D 4491	0.8
Permeability (cm/sec)	ASTM D 4491	0.04
Vertical Water Flow Rate (gal/min/sf)	ASTM D 4491	60
UV Stability (%)	ASTM D 4355	70

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Product **Materials—**
Technical Specifications
& Performance

RADON PDS
PROFESSIONAL DISCOUNT SUPPLY

Soil Gas Collector Mat PDS 05-140-1

Made in the USA

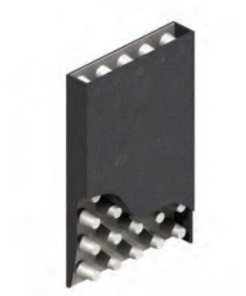
Our custom-formed, high-impact polystyrene core with the minimum values shown below.

Properties	Test Method	Value
Specific Gravity	ASTM D 792	1.04
Melt Flow (g/10min)	ASTM D 1238	2.5
Tensile @ Yield (psi)	ASTM D 638	2900
Tensile Modulus (psi)	ASTM D 638	275,000
Elongation @ Break (%)	ASTM D 638	70
Flexural Modulus (psi)	ASTM D 790	300,000
Notched Izod @ 73°F (ft-lb/in)	ASTM D 256	2.1
HDT @ 264 psi (°F)	ASTM D 648	183
Vicat Softening Point (°F)	ASTM D 1525	210

SITEDRAIN™ STRIP 6400

PREFABRICATED STRIP DRAIN

AWD
AMERICAN WICK DRAIN



PRODUCT OVERVIEW

SITEDRAIN Strip 6400 geocomposite strip drain products are composed of a dimpled polymeric perforated core fully wrapped in a nonwoven geotextile. The geotextile allows water to pass through while retaining backfill materials. The perforated core allows water collection from all sides and provides a continuous flow path to designated drainage exits.

SITEDRAIN Strip 6400 products provide a value engineered alternative to perforated pipe and aggregate subsurface drainage systems requiring moderate strength, high flow capacity, and a geotextile meeting AASHTO M288 Class 3 subsurface drainage requirements.

PROPERTY [1]	TEST METHOD	UNIT OF MEASURE	Typical Value	MARV
GEOTEXTILE				
Material [2]			PP, NPNW	PP, NPNW
Survivability	AASHTO M288	Class	3	3
Grab Tensile Strength	ASTM D4632	lbs	135	120
		N	601	534
Grab Elongation	ASTM D4632	%	60	50
CBR Puncture	ASTM D6241	lbs	365	340
		N	1,624	1,512
Trapezoidal Tear	ASTM D4533	lbs	60	50
		N	267	222
UV Resistance	ASTM D4355	% / 500 Hrs	70	70
Apparent Opening Size (AOS) [3]	ASTM D4751	sieve	70	70
		mm	0.212	0.212
Permittivity	ASTM D4491	sec^{-1}	2.4	1.7
Water Flow Rate	ASTM D4491	gpm / ft^2	175	140
		Lpm / m^2	7,130	5,704
CORE				
Compressive Strength	ASTM D6364 ASTM D1621	psf	6,000	-
		kPa	287	-
Thickness	ASTM D5199	in	1.0	-
		mm	25.4	-
In-Plane Flow Rate [4]	ASTM D4716	gpm/ft	21	-
		Lpm/m	261	-

MODEL	WIDTH	ROLL LENGTH	ROLL WEIGHT	ITEM CODE
6406	6"	150'	23 lbs	10400
6412	12"	150'	44 lbs	10410
6412	12"	500'	150 lbs	11340
6418	18"	150'	69 lbs	10420
6418	18"	500'	230 lbs	11350
6424	24"	150'	87 lbs	10430
6424	24"	500'	290 lbs	11170
6436	36"	100'	87 lbs	10440

[1] Unless otherwise noted, all physical and performance properties listed are Typical Value or Minimum Average Roll Value (MARV) as defined in ASTM D4439.
[2] PP = Polypropylene; NPNW = Needle-Punched Nonwoven; WM = Woven Monofilament; SBNW = Spunbonded Nonwoven
[3] Values for AOS represent Maximum Average Roll Value (MaxARV).
[4] In-plane flow rate measured at 3,600 psf (172 kPa) compressive load and a hydraulic gradient of 0.1.

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ABSOLUTE BARRIER® Y30BAC

HIGH PERFORMANCE LLDPE/EVOH GEOMEMBRANE GAS BARRIER

RAVEN

PRODUCT DESCRIPTION

Absolute Barrier® Y30BAC is a seven-layer co-extruded geomembrane consisting of very flexible, linear-low-density polyethylene (LLDPE) with an inner core of chemically resistant EVOH barrier resin, designed specifically as a barrier against radon, methane and VOCs. High strength LLDPE provides exceptional tear and impact resistance. A robust stabilization package that exceeds the industry standard; provides long-term protection from thermal oxidation and ultraviolet degradation in exposed applications.

PRODUCT USE

Absolute Barrier® Y-Series is designed to stop gas vapor migration on Brownfield sites, in residential and commercial buildings, as well as geomembrane containment and covering systems. When installed under concrete slabs as a gas barrier, a passive system is recommended to include a ventilated system with sump(s) that could be converted to an active control system with properly designed ventilation fans. Y30BAC is over 800 times less permeable to methane gas than LLDPE vapor barriers in a comparable thickness.

Absolute Barrier® performs extremely well preventing the degradation of EPS geofoam by protecting it from harsh VOCs including direct gasoline or diesel fuel contact.

Absolute Barrier® Y30BAC is a highly effective, temporary and long-term, landfill caps with VOC diffusion coefficients ranging from 40 to 240 times less than standard 80 mil HDPE geomembranes. Contaminants found in leachate and gas in municipal and hazardous waste landfills can migrate through standard HDPE; contributing to both atmospheric and groundwater contaminations. Absolute Barrier® Y-Series is an effective barrier to a wide range of VOCs including benzene, toluene, trichloroethylene, perchloroethylene, and many others.

SIZE & PACKAGING

Absolute Barrier® Y30BAC is available in 16' c-fold or in fabricated panels up to 50,000 sq. ft. All fabricated panels are accordion folded and tightly rolled onto a heavy-duty core for ease of handling and time saving installation.

EPS Geofoam Protection

PRODUCT	PART #
ABSOLUTE BARRIER®	Y30BAC

APPLICATIONS

- EPS Geofoam Protection
- Landfill Cap
- Temporary Landfill Gas Cover
- Floating Gas Cover
- Underslab VOC Barrier
- Underslab Radon Barrier
- Underslab Methane Barrier
- Underslab Vapor Barrier
- Remediation Cover / Liner
- Leachate Collection Ponds
- Odor Control Barrier
- Secondary Containment

Absolute Barrier®

THE ULTIMATE IN GAS CONTAINMENT

ABSOLUTE BARRIER® Y30BAC

HIGH PERFORMANCE LLDPE/EVOH GEOMEMBRANE GAS BARRIER

		ABSOLUTE BARRIER® Y30BAC			
		IMPERIAL		METRIC	
PROPERTIES	TEST METHOD	MINIMUM	TYPICAL	MINIMUM	TYPICAL
Appearance		Black		Black	
Thickness	ASTM D5199	30 Mils Average	30 Mils Nominal	0.76 mm Average	0.76 mm Nominal
Weight		150 lbs/msf		732 g/m^2	
Tensile Strength at Break	ASTM D6693	85 lbs/in	100 lbs/in	149 N/cm	175 N/cm
Tensile Elongation at Break	ASTM D6693	500 %	600 %	500 %	600 %
Tear Strength	ASTM D1004	18 lbs	22 lbs	80 N	98 N
Puncture Resistance	ASTM D4833	60 lbs	75 lbs	267 N	334 N
Oxidation Induction Time (OIT) or High Pressure OIT (HPOIT)	ASTM D3895 ASTM D5885	100 min 400 min	250 min -	100 min 400 min	250 min -
Carbon Black Content [7]	ASTM D4218	2.0 %	2.3 %	2.0 %	2.3 %
Carbon Black Dispersion	ASTM D5596	Pass			
Benzene Permeance	See Note [6]	2.13 x 10^{-10} m^2/sec or 1.93 x 10^{-13} m/s			
Toluene Permeance	See Note [6]	2.95 x 10^{-10} m^2/sec or 7.77 x 10^{-14} m/s			
Ethylbenzene Permeance	See Note [6]	2.31 x 10^{-10} m^2/sec or 1.78 x 10^{-14} m/s			
M & P-Xylenes Permeance	See Note [6]	2.19 x 10^{-10} m^2/sec or 2.03 x 10^{-14} m/s			
O-Xylene Permeance	See Note [6]	2.07 x 10^{-10} m^2/sec or 1.83 x 10^{-14} m/s			
Methane Permeance	ASTM D1434	< 4.93E^{-13} m/s			
Hydrogen Sulfide	See Note [9]	1.45E^{-09} m/s			
Trichloroethylene (TCE)	See Note [6]	1.44 x 10^{-10} m^2/sec or 5.60 x 10^{-15} m/s			
Perchloroethylene (PCE)	See Note [6]	1.35 x 10^{-10} m^2/sec or 5.57 x 10^{-15} m/s			
Cold Temperature Impact	ASTM D746	-40° F		-40° C	
Maximum Static Use Temperature		180° F		82° C	
FACTORY SEAM REQUIREMENTS					
Bonded Seam Strength	ASTM D6392 Mod. [5]	57 lbs/in.	75 lbs/in.	100 N/cm	131 N/cm
Seam Peel Adhesion	ASTM D6392 Mod. [5]	45 lbs/in.	60 lbs/in.	79 N/cm	105 N/cm

[5] Raven Industries performs seam testing at 20" per minute.

[6] Aqueous Phase Film Permeance.
Permeation of Volatile Organic Compounds through EVOH Thin Film Membranes and Coextruded LLDPE/EVOH/LLDPE Geomembranes, McWatters and Rowe, Journal of Geotechnical and Geoenvironmental Engineering© ASCE/ September 2015. (Permeation is the Permeation Coefficient adjusted to actual film thickness - calculated at 1 kg/m^3.) The study used to determine PCE and TCE is titled: Evaluation of diffusion of PCE & TCE through high performance geomembranes by Di Battista and Rowe, Queens University 8 Feb 2018.

[7] No carbon black in barrier layers.

[9] The study used to determine diffusion coefficients is titled: Hydrogen Sulfide (H_2S) Transport through Simulated Interim Covers with Conventional and Co-Extruded Ethylene-Vinyl Alcohol (EVOH) Geomembranes.

Absolute Barrier® Y30BAC is a seven-layer co-extruded geomembrane consisting of very flexible, linear-low-density polyethylene (LLDPE) with an inner core of chemically resistant EVOH barrier resin, designed specifically as a barrier against radon, methane and VOCs. High strength LLDPE provides exceptional tear and impact resistance. A robust stabilization package that exceeds the industry standard; provides long-term protection from thermal oxidation and ultraviolet degradation in exposed applications.

Scan QR Code to download technical data sheets.

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