SUBMITTED TO:
PACCAR Inc

BY:
Shannon & Wilson
400 N. 34th Street, Suite 100
Seattle, WA 98103

(206) 632-8020
www.shannonwilson.com

ENGINEERING DESIGN REPORT

AS/SVE System Extension and Modification

8801 EAST MARGINAL WAY S., TUKWILA, WASHINGTON
AGREED ORDER NO: 6069

SHANNON & WILSON

August 17, 2021

Shannon & Wilson No: 21-1-12567-024

Submitted To: PACCAR Inc

Subject: FINAL ENGINEERING DESIGN REPORT, AS/SVE SYSTEM EXTENSION AND MODIFICATION, 8801 EAST MARGINAL WAY S., TUKWILA, WASHINGTON
AGREED ORDER NO: 6069

Shannon & Wilson prepared this report and participated in this project as a consultant to PACCAR Inc. This report presents the Engineering Design Report for the extension of and modification to the existing Air Sparging and Soil Vapor Extraction System at 8801 East Marginal Way S., Tukwila, Washington.

This report is one of multiple documents that fulfills the Final Engineering Design Report requirements discussed in Task 2C of Agreed Order No. 6069.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

Ryan Peterson, PE
Environmental Engineer

Scott Gaulke Digitally signed by Scott Gaulke
Date: 2021.08.17 15:37:50 -07'00'

Scott Gaulke, PE, LHG
Vice President

RBP:PJS:SWG:MJS/rbp:pjs

EXECUTIVE SUMMARY

A trichloroethylene (TCE) groundwater plume extends from the northern boundary of the property located at 8801 East Marginal Way South, Tukwila (8801 property), downgradient (south and west) to the western boundary of the 8801 property adjacent to the Lower Duwamish Waterway (LDW). The plume is intercepted by an existing air sparging/soil vapor extraction (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 negative pressure created by the SVE system.

Vinyl chloride is present in the plume as a degradation product of TCE and is the predominant chemical of concern in groundwater to the west (downgradient) of the existing AS/SVE system. Groundwater monitoring has demonstrated that the existing AS/SVE system is effective at reducing the vinyl chloride concentration.

This Engineering Design Report (EDR) provides the specifications for extending the AS/SVE system with the objective of reducing the concentration of vinyl chloride in groundwater to the west of the existing AS/SVE system. The extension to the AS/SVE system will involve the installation of additional infrastructure to provide a parallel and downgradient alignment of AS wells and SVE screens.

This EDR also provides details on modifications to the existing AS/SVE system. The modifications are required to ensure the existing AS/SVE will continue to be operational after a clay cap, drainage blanket, landscaping and new north/south drainage line is installed in the 100-foot river buffer located along the western edge of the 8801 property.

A high-level overview of the work to be performed under this EDR includes:

- Expose existing AS/SVE lines east of the 100-foot river buffer area;
- Install the piping for the SVE extension;
- Install the points and piping for the AS extension;
- Reconnect the existing AS/SVE piping; and
- Connect all elements to the controls and commence operations of the AS/SVE system.

The Operations and Maintenance Manual for the existing AS/SVE system will be amended to incorporate the extension and modification of the system. After start-up and shake-down the system will run for approximately two weeks before an air sample is collected to evaluate the effectiveness of the expanded and modified system. Monitoring will be

undertaken to demonstrate compliance with the Model Toxics Control Act. Compliance monitoring for remedial actions described in this EDR is discussed in the Compliance Monitoring Plan.

The preceding summary is provided for introductory use only. We recommend a thorough reading of the complete report.

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ACRONYMS

AO	Agreed Order
AS	air sparging
bgs	below ground surface
CDF	controlled density fill
cfm	cubic feet per minute
CMP	Compliance Monitoring Plan
COC	chemical of concern
CUL	cleanup level
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
FS	Feasibility Study
HSP	Health and Safety Plan
IAWP	Interim Action Work Plan
ID	inner diameter
lb/yr	pounds per year
LDW	Lower Duwamish Waterway
MSL	mean sea level
MTCA	Model Toxics Control Act
O&M	Operations and Maintenance
ORP	oxidation reduction potential
PSCAA	Puget Sound Clean Air Agency
psig	pounds per square inch gauge
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
Sch	Schedule
SEPA	State Environmental Policy Act
SVE	soil vapor extraction
TCE	trichloroethylene
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

1 INTRODUCTION

This Engineering Design Report (EDR) provides the specifications for extending and modifying the existing air-sparging/soil-vapor extraction (AS/SVE) system at the upland portion of the 8801 East Marginal Way South site in Tukwila, Washington (8801 site). The upland portion of the 8801 site is referred to as the 8801 property.

Expansion and modification of the AS/SVE system is one of the remedial actions required for the 8801 property pursuant to the Final Interim Action Work Plan (Shannon & Wilson, 2020a) and Addendum to the Feasibility Study and Interim Action Work Plan (Addendum) (Shannon & Wilson, 2020b). The Final Interim Action Work Plan and Addendum together constitute the Interim Action Work Plan (IAWP) for the 8801 property. Compliance monitoring for the remedial actions described in this EDR are discussed in the Compliance Monitoring Plan (CMP) submitted as a separate document. The Sampling and Analysis Plan is an appendix of the CMP.

The 8801 site consists of an upland portion (the 8801 property) and the adjoining sediments in the Lower Duwamish Waterway (LDW). The 8801 site is subject to two separate Agreed Orders (AOs): AO No. 6069, which applies to the 8801 property, and AO No. 3599, which applies to the adjoining LDW sediments. This report is one of multiple documents that fulfills the Final Engineering Design Report requirements discussed in Task 2C of Agreed Order No. 6069.

2 SITE DESCRIPTION

This section presents an overview of the 8801 property location, history, geology, and hydrogeology. Additional information is provided in the IAWP.

2.1 Physical Description and Use

The 8801 property occupies 24.30 acres on the east bank of the LDW and is relatively flat, with a ground surface elevation of approximately 20 feet above mean sea level (MSL).

The owner, CenterPoint 8801 Marginal LLC, plans to redevelop the 8801 property by constructing an approximately 414,400-square-foot warehouse for industrial use and trailer storage on the property. The footprint of the proposed warehouse relative to the existing AS/SVE system is shown in Figure 2. The redevelopment is slated to commence in 2021. The redevelopment plans include demolition of the existing buildings except for part of a

building on the west end of the 8801 property that houses the aboveground infrastructure for the existing AS/SVE system. This building is referred to as the "Small Warehouse" and the portion of the Small Warehouse that will not be demolished is referred to as the "Equipment Room." After demolition of the Small Warehouse is complete, various remedial actions will be implemented in the vicinity of the AS/SVE system, including excavation and removal of contaminated soil from several hotspots and installation of a clay cap and drainage blanket within the 100-foot river buffer located along the western edge of the 8801 property.

2.2 Geology

The 8801 property is currently paved. Fill material underlies paved surfaces and are up to 10 feet thick in some locations. Fill material includes gravelly structural fill beneath buildings and paved areas, poorly graded sand to silty sand fill deposits, and gravelly backfill materials in excavations. Fill material at the 8801 property is underlain by a layer of fine-grained material, including silt, sandy silt, and silty sand that extends to a depth of 5 to 15 feet below ground surface (bgs). A poorly graded sand layer, which typically contains less than 10% silt, is generally present beneath the fine-grained layer beginning at 10 to 15 feet bgs, although at some locations it is present immediately beneath the pavement surface or the fill material. A layer of fine-grained materials, consisting mainly of silt and silty sand, is typically present beneath the poorly graded sandy layer at depths of approximately 30 to 50 feet bgs. The lower fine-grained layer is typically underlain by poorly graded sand to the maximum depth explored at the 8801 property (60 feet bgs).

2.3 Hydrogeology

Results of groundwater monitoring at the 8801 property indicate that the shallow aquifer is typically 8 to 10 feet bgs. Results of tidal influence analysis indicate that the maximum tidal fluctuation along the western boundary of the 8801 property ranges from -3.03 feet relative to MSL to +1.85 feet MSL in the southern portion of the 8801 property, where riprap demarcates the 8801 property boundary. Farther north, where the sheet piling bulkhead demarcates the 8801 property boundary, the maximum tidal fluctuation ranges between 1.80 feet MSL and +1.32 feet MSL.

The hydraulic gradient in the shallow aquifer is generally towards the west. Groundwater velocity is estimated to be 40 feet per year.

3 CONCEPTUAL SITE MODEL

A trichloroethylene (TCE) groundwater plume extends from the northern boundary of the 8801 property, downgradient (south and west), to the LDW. The plume is intercepted by the existing AS/SVE system, which is about 130 to 200 feet from the LDW. The AS system is designed to inject pressurized air below ground surface into the saturated zone, causing chemicals to volatilize and promoting in situ aerobic degradation. Vapors are extracted from the subsurface via negative pressure created by the SVE system.

The concentrations of TCE in the groundwater plume are being reduced through the injection of bacteria and a food source for the bacteria. A separate EDR addresses this remedial action. The injections to treat the TCE are designed to complete the degradation of the halogenated volatile organics past vinyl chloride through to ethene. The response time for the injections will be over a period of years and the AS/SVE system extension will polish any vinyl chloride that is above the cleanup levels (CULs) after passing through the existing AS/SVE system.

Vinyl chloride is present in the plume as a degradation product of TCE and is the predominant chemical of concern (COC) in groundwater to the west (downgradient) of the existing AS/SVE system. Unlike TCE, vinyl chloride degrades more effectively in an aerobic environment. Groundwater monitoring has demonstrated that the existing AS/SVE system is effective at reducing the vinyl chloride concentration.

4 DESIGN AND IMPLEMENTATION

The existing AS/SVE system will be expanded to provide a parallel and downgradient 340-foot alignment of AS wells and SVE screens (Figure 3). The existing SVE system consists of six individual 4-inch-diameter Schedule 40 polyvinyl chloride (PVC) horizontal extraction pipes with 0.020-inch slotted sections to extract soil vapor from six distinct sections of the trench. The AS delivery system includes 33 AS wells installed to total depths between 29 and 39 feet for the length of the trench (19 along the southern segment and 14 along the northern segment). The AS wells are constructed of 1-inch-diameter Schedule 40 PVC blank casing installed using direct push methods. Each of the 33 wells terminates with a 1-foot section of 0.020 slot screen. The AS/SVE system is powered by two 30-horsepower (HP) SVE regenerative blowers and five 5-HP rotary vane compressors. The compressors inject ambient air into the groundwater via the 33 vertical AS wells. The blowers extract air and entrained volatile organic compounds (VOCs) from the five horizontal SVE wells. The SVE system operates at approximately 1,100 cubic feet per minute (cfm), with one regenerative blower running at a time. Typically, four of the five compressors run at any time, with the "OFF" compressor(s) being rotated through the group. Extension of the AS/SVE system will

require installation of aboveground infrastructure inside of the Equipment Room and belowground infrastructure inside and outside of the Equipment Room (Figure 3). The existing electrical infrastructure, AS compressors, and SVE air blowers will remain in place and will be adequate to handle the increased capacity.

The expansion will be located within the 100-foot river buffer, where CenterPoint proposes to establish landscaping as part of its redevelopment. Before planting the landscaping, all portions of the Small Warehouse other than the Equipment Room will be demolished and the existing pavement and underlying soil within the 100-foot river buffer will be removed to accommodate installation of a clay cap and overlying drainage blanket. The drainage blanket will be sloped to drain eastwards and will connect with a north/south orientated drainpipe that will tie into the existing stormwater system at the 8801 property. A minimum of 60 inches of topsoil will be placed over the clay cap and drainage blanket to support the landscaping. In order to minimize disturbance of the landscaping, the expansion will be constructed before the landscaping is planted.

The expansion will connect to the existing aboveground infrastructure and will have a configuration that is similar to the existing infrastructure. Twenty-two (22) new vertical AS wells will be installed in a 340-foot alignment that is parallel and downgradient from the alignment of existing AS wells. Each well screen will consist of a 1-foot section of slotted pipe installed at approximately 28 to 32 feet below the existing surface elevation. The AS wells will connect to a new AS header on the north wall of the Equipment Room (Figures 3 and 4). Three (3) horizontal SVE screens will be installed adjacent to the new AS well alignment. The SVE screens will consist of 110-foot-long sections of slotted pipe and be installed at approximately 3 feet below the elevation of the base of the clay cap. The SVE screens will connect to a new SVE header on the north wall of the Equipment Room. Line diagrams of the AS and SVE extensions are provided in Figures 5 and 6, respectively.

In addition to expanding the AS/SVE system, the system will need to be modified to accommodate the proposed landscaping within the 100-foot river buffer. The belowground piping system from the existing AS and SVE manifolds to approximately 30 feet south and 40 feet east of the southeast corner of the Equipment Room will be excavated, replumbed, and run above ground to the control system in the Equipment Room. In order to minimize disturbance of the landscaping, the modifications will be constructed before the landscaping is planted.

4.1 Objective

The objective of the AS/SVE system extension is to mitigate the migration of vinyl chloride in groundwater to the west of the existing AS/SVE system. Expansion of the AS/SVE system advances this objective by treating groundwater that is downgradient of the existing

AS/SVE system. This objective will be further advanced by other remedial actions that are described in separate EDRs, including targeted excavations of TCE-impacted soil and enhanced reductive dechlorination of chemicals.

The objective of the AS/SVE system modifications is to relocate the infrastructure to allow for the excavation and placement of the clay cap, drainage blanket and north/south aligned drainage line.

4.2 Potentially Applicable or Relevant and Appropriate Requirements

Expansion, modification, and operation of the AS/SVE system is a remedial action that will occur under the terms of an AO entered into with the Washington State Department of Ecology (Ecology). As such, expansion, modification, and operation of the AS/SVE 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 expansion and operation of the AS/SVE system. Expansion, modification, and operation of the AS/SVE 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 expansion and modification of the AS/SVE system include:

- The State Environmental Policy Act (SEPA) as authorized by RCW 43.21C and Washington Administrative Code (WAC) 197-11. A SEPA checklist for the IAWP, which includes expansion and modification of the AS/SVE system, has been completed.
- Occupational Safety and Health Act and Washington Industrial Safety and Health Act regulations (29 Code of Federal Regulations 1910.120; WAC 296-843). Details to address this are provided in the Health and Safety Plan (HSP) attached to the CMP.
- Washington Industrial Safety and Health Act, Chapter 49.17 RCW, Safety Standards for Construction Work (WAC 296-155). Details to address this are provided in the HSP attached to the CMP.
- Underground Utilities, RCW 19.122.010, General Protection Requirements (WAC 296-155-655).
- City of Tukwila zoning, building, and construction regulations (e.g., grading, stormwater, and shoreline requirements).
- Resource Conservation and Recovery Act (RCRA) regulations for waste generation, hauling, and disposal (WAC 173-303 and WAC 173-350).
- Solid Waste Management Chapter 43.21 RCW, Minimum Functional Standards for Solid Waste Handling (WAC 173-304).

- 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 70.94). Details on the requirements for PSCAA related to this project are provided in Appendix A. After the AS/SVE system is expanded, sampling will be conducted to estimate the chemical discharge to determine if a treatment is required.
- Underground Injection Control Registration. Ecology requires any material that is injected into the subsurface be registered with Ecology's Water Quality Program as an injection control registration. All wells must be registered, and approval must be received prior to beginning operation.

4.3 Soil Vapor Extraction (SVE) System Extension

Following removal of the existing pavement and underlying soil from the 100-foot river buffer, but prior to installation of the clay cap, drainage blanket, and landscaping, three SVE screens, consisting of subsurface horizontal 110-feet-long, 4-inch-ID Sch 40 PVC 0.020 slot screens, will be installed adjacent to the AS wells (Figures 3 and 7). The screened sections will be arranged such that the entire alignment of AS wells is adjacent to the SVE screens and the screened sections do not overlap. The SVE screens will extend 10 feet beyond the farthest north and south AS wells to enhance the extraction of sparged air.

The screens will convey extracted vapor through subsurface 4-inch-ID Sch 40 blank PVC pipes until they daylight on the north side of the Equipment Room. The blank SVE lines will be sloped at least 1 inch per 100 feet towards the screens to reduce condensate accumulation and transmission. The SVE lines will have vacuum gauges and in-line gate valves prior to a manifold connection. The combined SVE lines will continue from the manifold through a single 6-inch-ID Sch 80 PVC connected to the existing SVE header piping between the Knockout Tank and the existing SVE manifold.

It is assumed that each SVE screen will have a 30-foot radius of influence based on the pilot testing undertaken to design the initial system and the ongoing operation of the existing sparge system.

Vacuum gauges will be installed at the new SVE manifold to allow for balancing of vacuum between headers.

4.4 Air Sparging (AS) System Extension

At the new AS header, 1-inch ball valves (BV-4 and BV-5, similar to those already in-place) will be installed and electrically controlled by the Secondary Control Panel (Figure 5). Pipe runs will connect the ball valves to a manifold that will convey sparging air to the new 22 AS pipe runs. From the new manifold, each AS pipe run will have an in-line flowmeter

with flow control valve, and pressure gauges to measure the parameters of the sparging air. From the pressure gauges, the AS pipe runs will continue as 1-inch-inner-diameter (ID) Schedule (Sch) 40 galvanized steel until they transition underground, at which point the pipe material will be 1-inch-ID red rubber pneumatic air hose. The AS hose lines will be run inside 8-inch-ID Sch 80 PVC conduits. The AS pipe runs will each direct sparging air to individual AS wells.

Following installation of the clay cap and drainage blanket in the 100-foot river buffer, but before the landscaping is planted, the AS wells will be installed in 24-inch-ID Sch 80 PVC well collars with caps. The pipe material will transition to 1-inch-ID Sch 40 galvanized steel upon entering the PVC well collars (Figure 7). Inside the PVC well collars, the AS pipe runs will have the following in-line components installed: a union, an isolation valve, a check valve, and a well head tee. From the AS well head tees, each AS well will advance vertically downward until termination.

The AS wells will consist of blank casing of 1-inch-ID Sch 80 PVC followed by a 1-foot section of 1-inch-ID Sch 80 PVC 0.020 slot screen. The depth of the screened interval will be determined from in situ conditions. The screened interval will be placed above the transition from Poorly Graded Sand to Silty Sand. This transition has been observed in nearby borings at approximately 28 to 32 feet bgs. Groundwater level in the vicinity has been observed at 8 to 10 feet bgs.

The AS wells will have a filter pack of 12/20 silica sand extending to 2 feet above the screen. A bentonite seal, consisting of hydrated ⅜-inch bentonite chips, will be installed above the filter pack and extend into the PVC well collar housing the AS well.

It is assumed that each AS well will have a 10-foot radius of influence based on the pilot testing undertaken to design the initial system and the ongoing operation of the existing sparge system.

4.5 Installation

Construction activities for expansion and modification of the AS/SVE system are anticipated to require one month and are scheduled to commence during 2022. In order to avoid disturbance or damage to the landscaping to be established in the 100-foot river buffer, the construction activities will commence after all portions of the Small Warehouse other than the Equipment Room are demolished and the existing pavement and underlying soil is removed from the 100-foot river buffer. Staging and work areas will be on paved surfaces inside the Equipment Room and east of the landscaped area.

4.5.1 Aboveground Installation

The connection points to the existing AS/SVE system will be inside the Equipment Room (Figure 3) where most of the existing aboveground infrastructure is located. The connections will transition underground inside of the Equipment Room near its north wall.

Aboveground infrastructure associated with the AS/SVE system extension includes the AS electronic ball valves, AS manifold, and flow measurement devices; and the SVE extension manifold and valves. These features will be installed on the north interior wall of the Equipment Room and securely mounted to available structures and new pipe supports.

4.5.2 Belowground Installation

This section discusses the belowground installations for extension of the AS/SVE system and for modification of the system.

4.5.2.1 AS/SVE System Extension

Belowground infrastructure associated with the AS/SVE system extension includes 22 AS pipe runs, 22 AS wells, and 3 SVE pipe runs. The AS and SVE pipe runs will be installed in two trenches from the Equipment Room to where they intercept the main trench that is adjacent to the alignment of AS wells (Figure 3).

The approximately 1.5-foot-wide SVE trench will be cut before the clay cap is placed. The trench will extend to 3-feet below the elevation for the base of the clay cap. A minimum of 2 inches of pea gravel (round washed gravel sized from 3/8-inch to ¼-inch) will be placed around the screened portions of the SVE pipes. The SVE screens and adjacent pea gravel will be wrapped in a nonwoven geotextile to limit introduction of fines into the SVE screens. The geotextile will be Mirafi® 140N by Tencate Geosynthetics (Appendix B). The clay cap and drainage blanket will overlay the SVE trench. The clay cap will reduce the potential for short-circuiting of atmospheric air from the surface into the SVE trench.

After the topsoil is placed above the clay cap and drainage blanket within the 100-foot river buffer, but before the landscaping is planted, an approximately 1-foot-wide AS trench will be cut to 1-foot below the new ground surface and the material set on one side. A minimum of 2 inches of pea gravel (round washed gravel sized from 3/8-inch to ¼-inch) will be placed around the AS pipes transfer conduit. The AS transfer conduit and adjacent pea gravel will be wrapped in a nonwoven geotextile to protect the conduit. The geotextile will be Mirafi® 140N by Tencate Geosynthetics (Appendix B). The nonwoven geotextile will be overlain with the soil that had been set aside during trenching prior to landscaping. A cross section of the trenches, AS and SVE pipes placement, and backfill is provided in Figure 7.

The AS wells will be installed in PVC well collars with caps. The PVC well collars will be installed adjacent to the AS trench. A cross section of a PVC well collar is provided in Figure 7.

Excavated soil from the SVE trench will be stockpiled, reused if possible or disposed offsite at a licensed facility if not used on the 8801 property. The stockpiles will conform to requirements in Section 4.5.3. If offsite disposal is necessary, the soil is anticipated to be disposed of at a RCRA Subtitle D facility. Groundwater is not expected to be encountered in the excavation trench.

4.5.2.2 AS/SVE System Modification

The drainage blanket and associated drainpipe that will be installed in the 100-foot river buffer to support the landscaping area will intersect the belowground piping of the AS/SVE system. For this reason, the belowground piping will have to be replumbed.

Following the removal of the existing pavement on the south side of the Equipment Room, the existing AS and SVE lines will be exposed from approximately 45 feet east of the Equipment Room to their connections to the AS and SVE manifolds beneath the floor of the Equipment Room. The exposed AS and SVE pipe sections will be removed, with both ends capped and labelled.

To reconnect the AS/SVE system, an approximately 3-foot-wide trench to a depth of 3 feet below the new ground surface will be excavated. The soil will be set to one side. The trench will run from approximately 5 feet east of the 100-foot river buffer to the south side of the Equipment Room. The location of this trench is shown on Figure 3 and the trench cross-section is shown on Figure 8. Geotextile will line the bottom and sides of the trench. Two inches of pea gravel (round washed gravel sized from 3/8-inch to ¼-inch) will be placed in the bottom of the trench on top of the geotextile. The existing SVE lines will be replumbed and run along the bottom of the trench. The blank SVE lines will be sloped at least 1 inch per 100 feet towards the screens to prevent collection of condensation. Two inches of pea gravel will cover the SVE lines which are solid, not slotted, at this point.

Three 8-inch Sch 80 PVC air sparge line conduits will be plumbed on top of the SVE lines and pea gravel. The air sparge lines will be plumbed to accommodate 1 inch-ID red rubber pneumatic air hose. Up to 13 air hoses (including spares) will be run through each air sparge conduit, connecting up the AS wells with their respective AS well manifold fittings located beneath the Equipment Room. A pipe locator line will be installed on the top of each air sparge line conduit for their entire length.

Following installation and testing of the AS lines, approximately 2 inches of pea gravel will be placed on top of the air sparge line conduits and covered with geotextile. Approximately 18 inches of the set aside soil will be placed and compacted over the trench prior to landscaping.

4.5.3 Requirements for Soil Stockpiles

If excavated soil is not re-used on the 8801 property, soil stockpiles shall be constructed, if required, for the temporary storage of excavated soil while pending characterization. The soil stockpiles will be constructed to prevent or minimize releases into the environment and control cross-media transfer, as necessary to protect human health and the environment. The stockpiles will conform to the requirements in Exhibit 4-1.

Exhibit 4-1: Requirements for Construction of Soil Stockpiles

Features	Requirements
Location	The stockpiles will be placed on the 8801 property within the fenced and locked area on asphalt or concrete pavement. The stockpiles will be placed at least 100 feet from the LDW and at least 50 feet from stormwater catch basins.
Bottom Liner	Soil shall be placed on a bottom liner that is compatible with the hazardous substances in the soil and that prevents soil and groundwater beneath the liner from becoming contaminated. The bottom liner shall consist of at least 10 mil reinforced polyethylene, impermeable, and resistant to long-term (two years) ultraviolet radiation, weathering, and degradation due to contact with contamination. The bottom liner shall be free from holes, foreign matter, scathes, cracks, bubbles, undispersed raw materials, and blisters.
Top Liner	A top liner will cover the stockpiles when not in active use. The top liner will consist of at least 6mil reinforced polyethylene, impermeable, and resistant to long-term (two years) ultraviolet radiation, weathering, and degradation due to contact with contamination. The top liner shall be free from holes, foreign matter, scathes, cracks, bubbles, undispersed raw materials, and blisters. The perimeter edge of the top liner shall be lapped over the bottom liner to prevent water from running through the soil.
Containment	A retention berm around the stockpiles will be constructed with ecology blocks, straw bales, or at least 6-inch diameter polyvinyl chloride pipe. The bottom liner will overlap the berm material.
Securing Devices for Top Liner	Sandbags will be used to secure the top liner and will be placed at least every 10 feet along the perimeter. Additional sandbags will be placed in the center of the stockpile or ropes strung across the top liner to secure the liner. The top liner shall be secured whenever the stockpile is not being worked.
Signage	A sign will be installed for each stockpile to mark the contents and purpose of the stockpile. The signs will be constructed of weather-proof material and located near the stockpiles. The signs will list: the content and contamination of the soil, status (e.g., pending analysis, Hazardous Waste), owner and contractor contact info, and soil generation date.

4.6 System Startup, Operation, and Maintenance

The design pressure of the AS system is 15 pounds per square inch gauge (psig). Prior to backfilling over the installed AS lines, each new and existing AS line will be pressure tested and inspected to hold 30 psig (twice the design air pressure) for 15 minutes.

Operation of the AS/SVE system extension will be integrated into the standard operation of the entire AS/SVE system. The Operations and Maintenance (O&M) Manual will be revised to incorporate the additional infrastructure and altered operating procedure.

Two new AS system ball valves (BV-4 and BV-5) will permit the flow of pressurized air to the AS extension (AS wells 34 through 55). BV-4 and BV-5 will be open and shut using automated electronic signals from the Secondary Control Panel. The five ball valves (BV-1 through BV-5) will be placed on a cycle such that one ball valve is open at any given time. The ball valves will cycle every four hours such that the next ball valve in the sequence will be open for the following four hours, and so on. This cycle should be sufficient to aerate the groundwater plume given the groundwater velocity is estimated to be 40 feet per year, as well as promote soil/groundwater chemical concentration equilibrium prior to the next AS cycle.

Five AS compressors are installed in the existing AS system. Four compressors will operate to supply 11 AS wells (AS legs BV-1 through BV-5) with pressurized air. The compressors will supply approximately 15 cubic feet per minute (cfm) at 10 psig to each AS well. This exceeds the target flowrate of 10 cfm at 10 psig and therefore should be adequate to enhance volatilization and aerobic degradation of COCs.

Two SVE blowers are installed in the existing AS system. One SVE blower will operate at a time provide a continuous vacuum to all SVE screens.

The on/off schedule for the SVE blowers and AS compressors will be set to provide for even wear of available equipment.

4.7 Air Discharge Sampling

After completion of the AS/SVE system modifications, 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 a discharge sampling port located in the SVE exhaust system. Samples will be analyzed for volatile organic compounds, including TCE and vinyl chloride, by U.S. Environmental Protection Agency Method TO-15 using gas chromatography/mass spectrometry in full scan mode.

To evaluate compliance with PSCAA air discharge regulations, detected concentrations will be compared to PSCAA discharge limits. PSCAA provides an exemption for groundwater remediation projects if the expected total removal of chemicals in the vapor phase is less than 15 pounds per year (lb/yr) of vinyl chloride, less than 500 lb/yr of perchloroethylene,

and less than 1,000 lb/yr of toxic air contaminants (PSCAA, Regulation 1, Section 6.03(C)(94)).

Based on previous sampling of the existing AS/SVE system, it is anticipated that the PSCAA air discharge limits will not be exceeded. If the PSCAA air discharge limits are exceeded, additional measures will be implemented to reduce the mass of chemicals being discharged to within the PSCAA exemption limits. Additional measures would depend on site conditions and further analysis and could include installation of an activated carbon air scrubber or other technologies.

4.8 Remedial Action Completion Report

Once the extension and modification of the AS/SVE system is complete, a Remedial Action Completion Report and revised O&M Manual will be produced in order to document these remedial action activities.

5 COMPLIANCE MONITORING

This section discusses the compliance monitoring that will be undertaken to demonstrate compliance with the Model Toxics Control Act (MTCA). A CMP with additional detail is submitted as a separate document.

Three types of compliance monitoring are identified for remedial actions performed under MTCA (WAC 173-340-410): Protection, Performance, and Compliance Monitoring. The definition of each is presented below (WAC 173-340-410 (1)):

- Protection Monitoring – To confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of the remedial action as described in the safety and health plan. Protection monitoring for remedial actions described in this EDR will include:
  - Personal and perimeter air sampling.
  - Implementation of Best Management Practices as discussed in the existing site-specific Stormwater Pollution Prevention Plan.
  - Implementation of a temporary erosion and sedimentation control plan.
- Performance Monitoring – To confirm that the remedial action has attained cleanup standards and other performance standards. Performance monitoring for remedial actions described in this EDR will include:
  - Waste characterization for off-site treatment or disposal of soil cuttings.
  - Characterization of imported fill material.
  - Archaeological observation during subsurface work.

- Waste characterization of emissions generated during operation of the AS/SVE system.
- Monitoring of the AS/SVE system's input and output parameters to ensure the system is functioning as designed and to allow modifications to increase the system's effectiveness and monitoring system's effects on groundwater quality. Monitoring of system parameters will be fully documented in a subsequent O&M Manual. Monitored parameters will include the following:

    1. AS line flowrates will be measured via the flowmeters and pressure gauges. Flowrates will be adjusted using the 1-inch gate valves to ensure at least 10 cfm of pressurized air is injected into each well.

    2. SVE system vacuum will be measured from a vacuum gauge at the SVE header. A second SVE blower will be operated if measurements indicate that the SVE screens do not have adequate suction.

    3. Dissolved oxygen and oxidation reduction potential (ORP) will be measured in nearby groundwater monitoring wells. Injection of pressurized air into the saturated zone will be indicated by increased concentrations of dissolved oxygen in groundwater and increased ORP.

- Confirmation Monitoring – To confirm the long-term effectiveness of the remedial action once other performance standards have been attained. Confirmation monitoring for remedial actions described in this EDR will include:
    - Groundwater sampling from groundwater monitoring wells along the western boundary of the 8801 property to determine if CULs have been achieved. The locations of the proposed confirmation wells and selected analyses are provided in the CMP.

6 LIMITATIONS

Shannon & Wilson has reviewed historical records and conducted subsurface explorations of the site. We have examined and relied on documents referenced in the report and made assumptions for the design and operation of equipment. We have not conducted an independent examination of all facts contained in referenced materials and statements. We have assumed that these documents are genuine and that the information provided in these documents and statements is true and accurate. We have no knowledge or indication to the contrary unless otherwise stated in the body of the report.

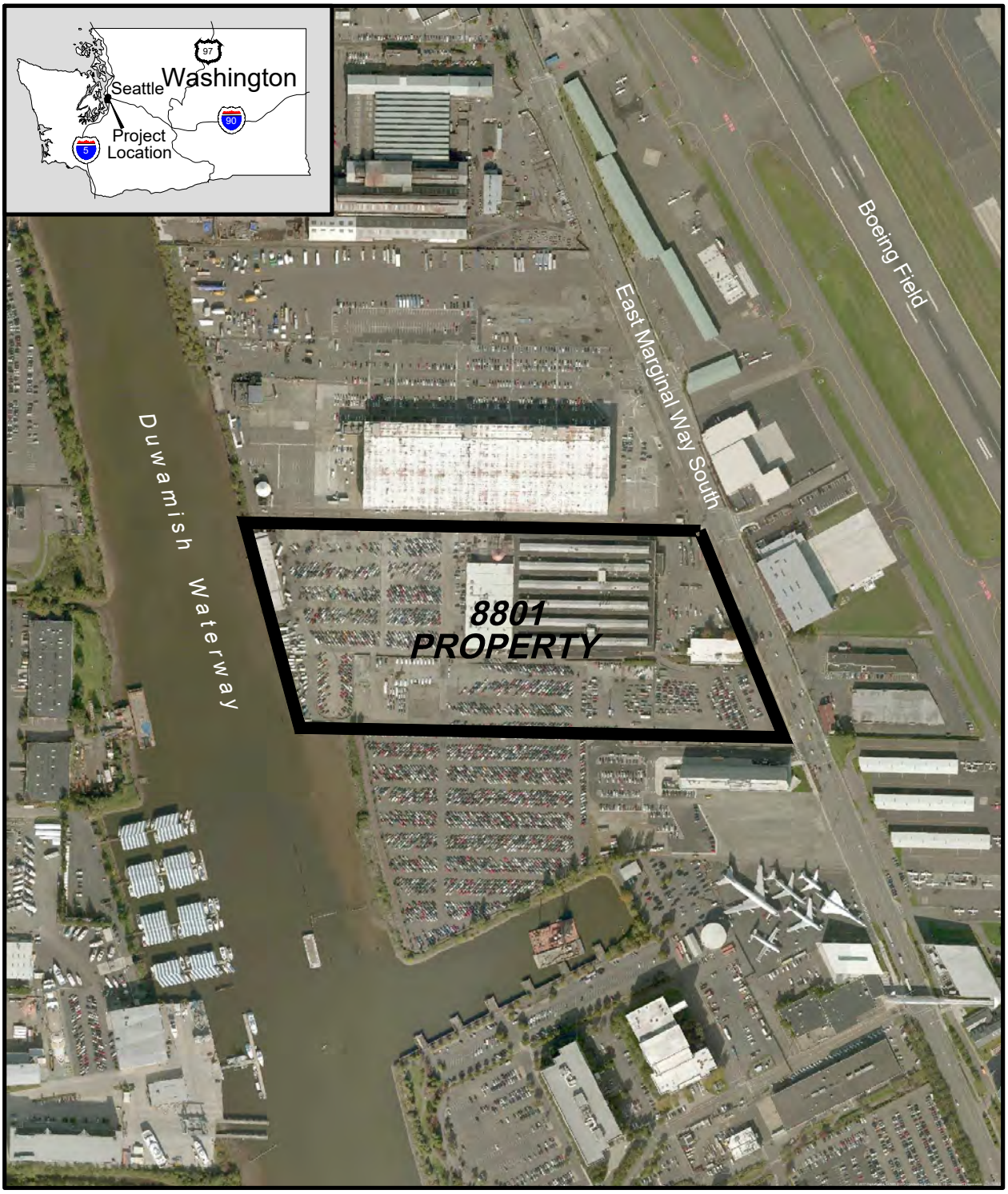
The data presented in this report are based on limited research and sampling at the site; other areas of contamination that were not identified during investigations could be present at the site. Conditions referenced in this report may change over time.

7 REFERENCES

Shannon & Wilson, 2020a, Final interim action work plan for 8801 East Marginal Way S, Tukwila, Wash.: Report prepared by Shannon & Wilson, Inc., Seattle, Wash., 21-1-12567-021, for PACCAR Inc, Bellevue, Wash., July 27.

Shannon & Wilson, Inc., 2020b, Final addendum to feasibility study and interim action work plan for 8801 East Marginal Way S, Tukwila, Wash.: Report prepared by Shannon & Wilson, Inc., 21-1-12567-023, for PACCAR Inc, December 7.

Washington State Department of Transportation (WSDOT), 2019, Standard specifications for road, bridge, and municipal construction, 2020: Olympia, Wash., Washington State Department of Transportation, Publication no. M 41-10, September 1, available: https://www.wsdot.wa.gov/publications/manuals/fulltext/M41-10/SS.pdf.



0 500 1,000

Approximate Scale in Feet

Engineering Design Report
AS/SVE System Extension
8801 East Marginal Way S.

VICINITY MAP

August 2021 21-1-12567-024

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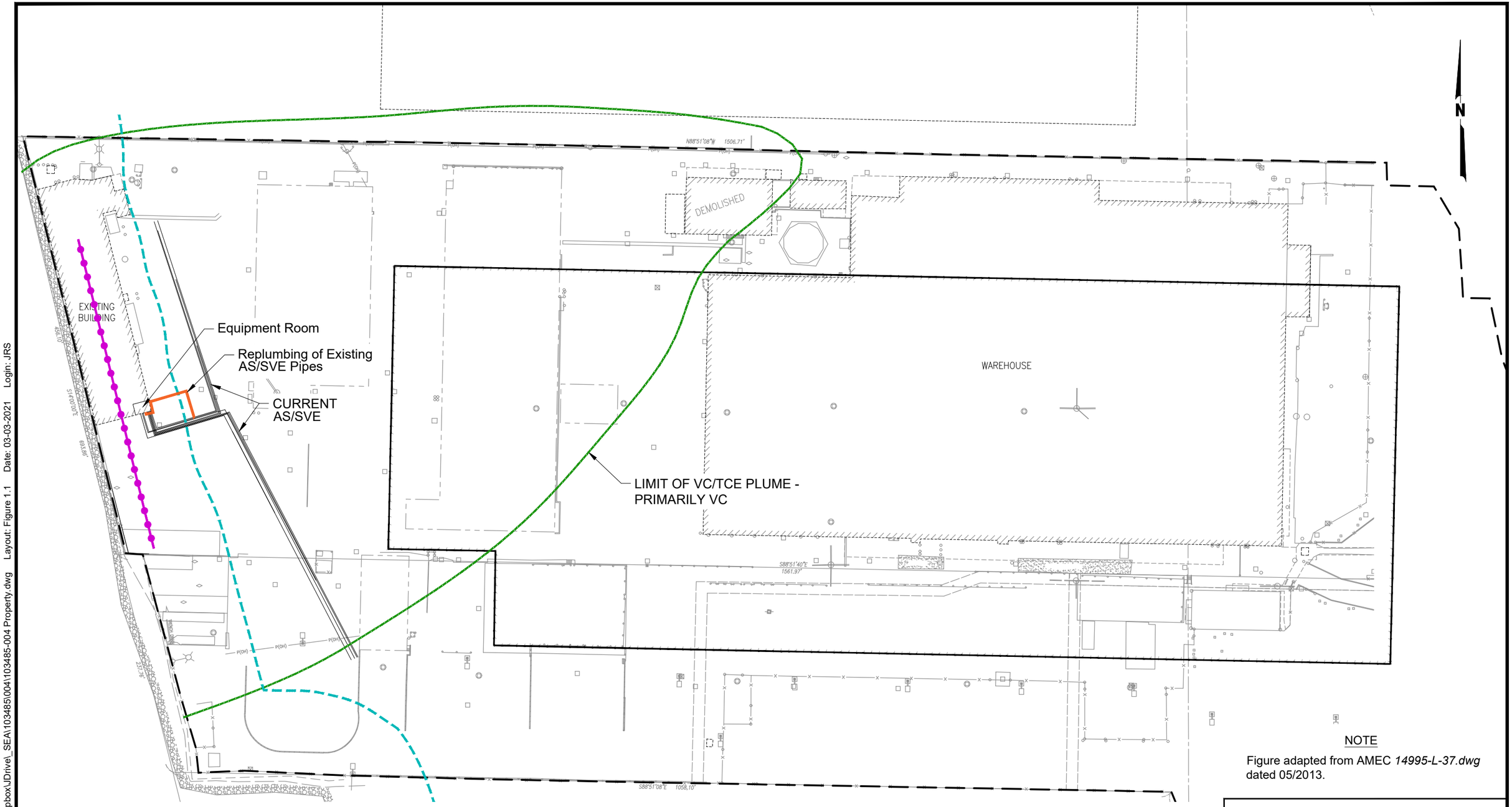
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive\211\12567\024\21-1-12567-019 Vicinity Map-AS.dwg Date: 11-17-2020 Login: JRS



LEGEND

Conceptual Building Footprint

100 Foot River Buffer

TREATMENT AREAS

AS/SVE System Extension

0 100 200

Scale in Feet

NOTE

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

AS/SVE System Extension and Modification
8801 East Marginal Way S.

DIAGRAM OF 8801 PROPERTY

August 2021 103485-004

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FIG. 2

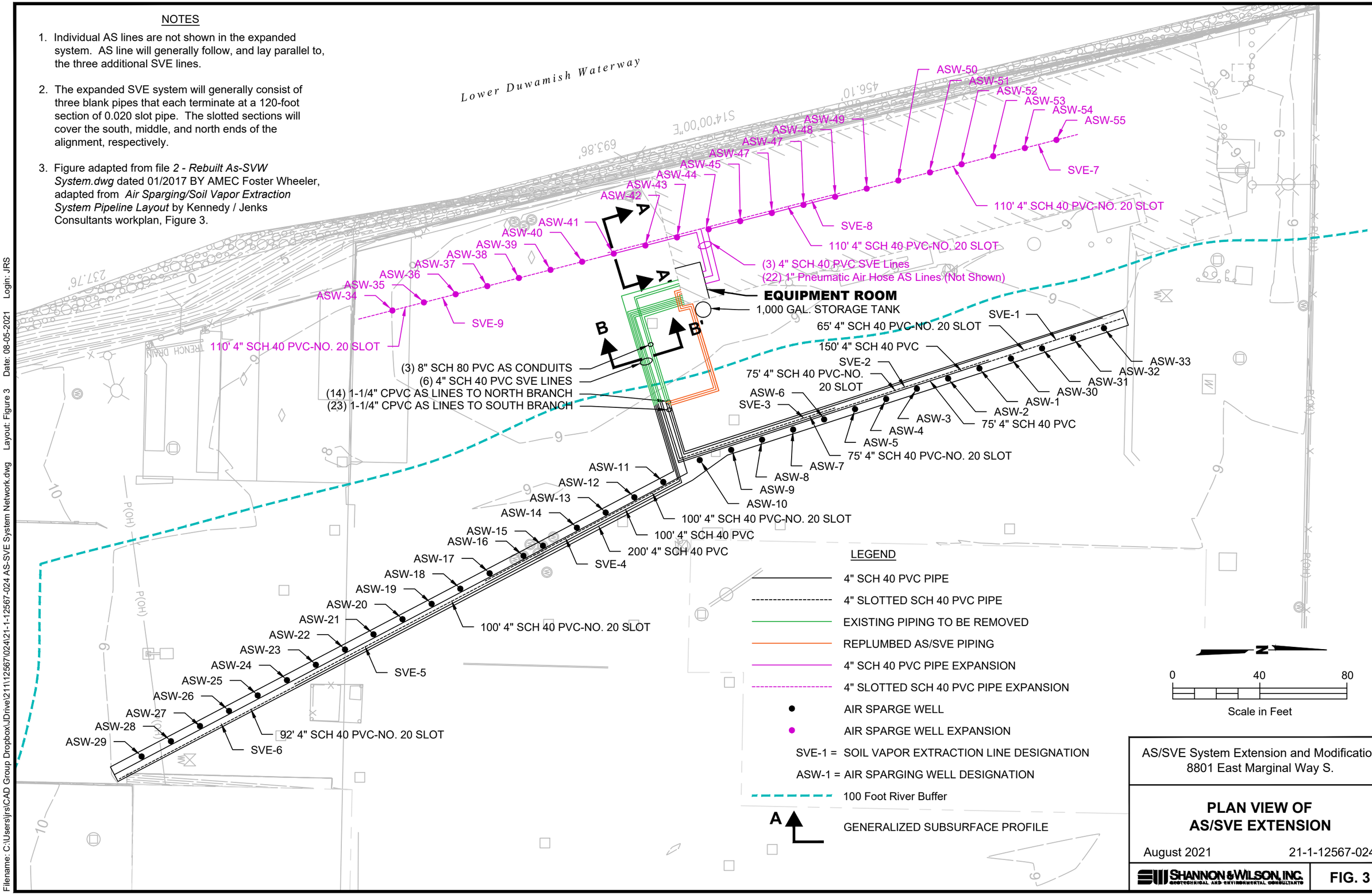
Filename: C:\Users\jrs\CAD Group Dropbox\JDrivel_SEA\103485\004\103485-004 Property.dwg Layout: Figure 1.1 Date: 03-03-2021 Login: JRS

NOTES

1. Individual AS lines are not shown in the expanded system. AS line will generally follow, and lay parallel to, the three additional SVE lines.

2. The expanded SVE system will generally consist of three blank pipes that each terminate at a 120-foot section of 0.020 slot pipe. The slotted sections will cover the south, middle, and north ends of the alignment, respectively.

3. Figure adapted from file *2 - Rebuilt As-SVW System.dwg* dated 01/2017 BY AMEC Foster Wheeler, adapted from *Air Sparging/Soil Vapor Extraction System Pipeline Layout* by Kennedy / Jenks Consultants workplan, Figure 3.



LEGEND

- 4" SCH 40 PVC PIPE
- 4" SLOTTED SCH 40 PVC PIPE
- EXISTING PIPING TO BE REMOVED
- REPLUMBED AS/SVE PIPING
- 4" SCH 40 PVC PIPE EXPANSION
- 4" SLOTTED SCH 40 PVC PIPE EXPANSION
- AIR SPARGE WELL
- AIR SPARGE WELL EXPANSION
- SVE-1 = SOIL VAPOR EXTRACTION LINE DESIGNATION
- ASW-1 = AIR SPARGING WELL DESIGNATION
- 100 Foot River Buffer
- A — GENERALIZED SUBSURFACE PROFILE

N

0 40 80

Scale in Feet

AS/SVE System Extension and Modification
8801 East Marginal Way S.

PLAN VIEW OF AS/SVE EXTENSION

August 2021 21-1-12567-024

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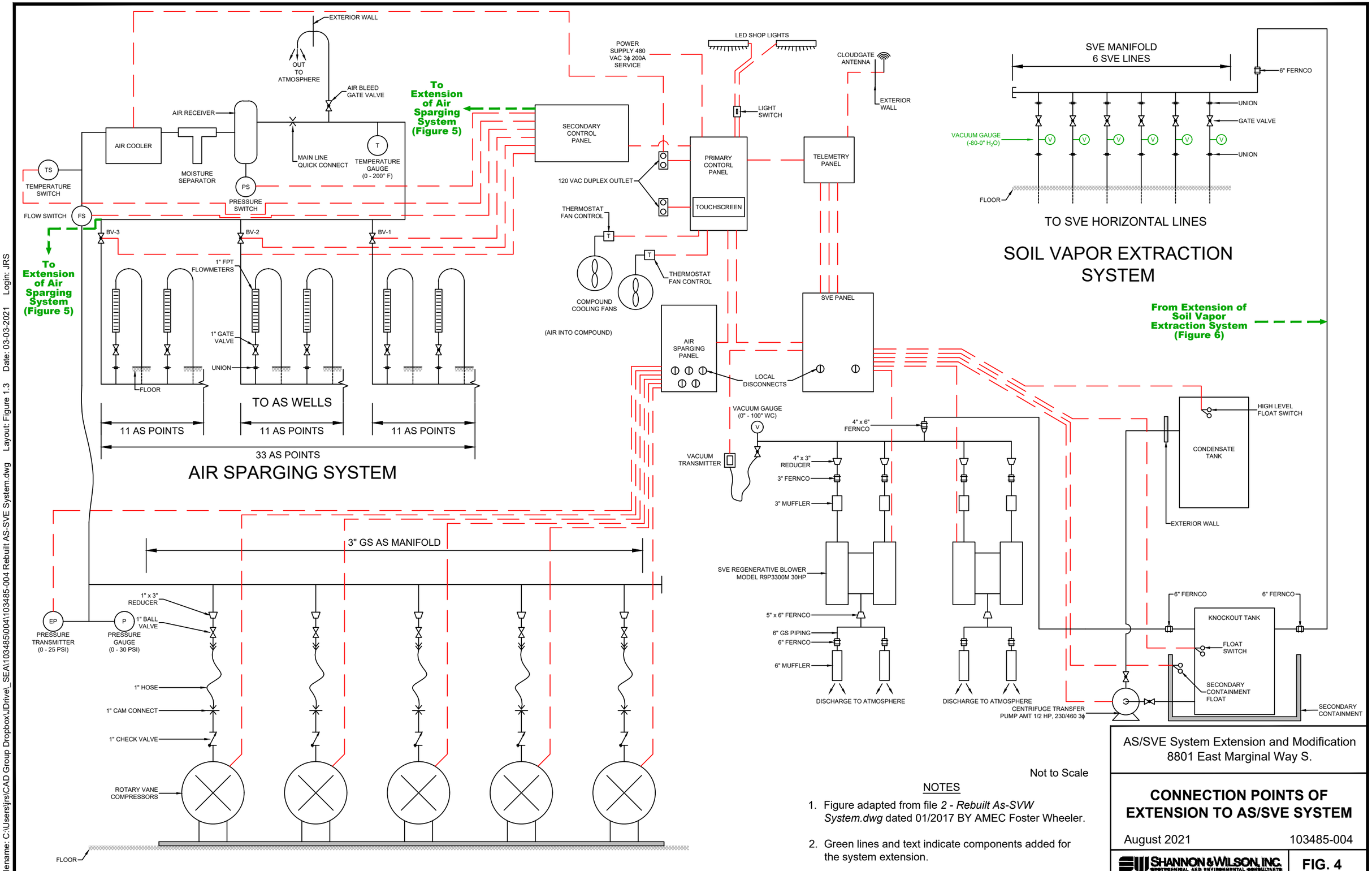
FIG. 3

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive\211\12567\024\21-1-12567-024 AS-SVE System Network.dwg Layout: Figure 3 Date: 08-05-2021 Login: JRS



Not to Scale

NOTES

1. Figure adapted from file *2 - Rebuilt As-SVW System.dwg* dated 01/2017 BY AMEC Foster Wheeler.
2. Green lines and text indicate components added for the system extension.

AS/SVE System Extension and Modification
8801 East Marginal Way S.

CONNECTION POINTS OF EXTENSION TO AS/SVE SYSTEM

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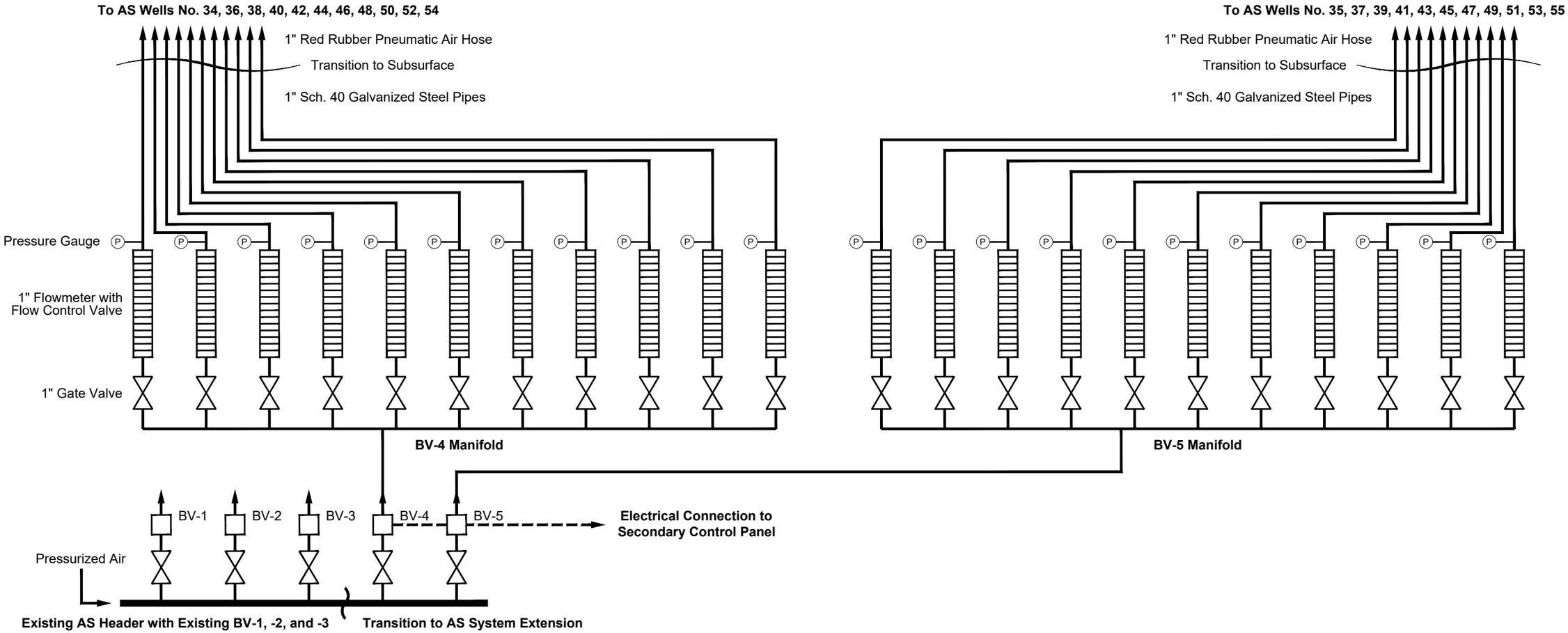
FIG. 4



AS/SVE System Extension and Modification
8801 East Marginal Way S.

LINE DIAGRAM OF AS SYSTEM EXTENSION

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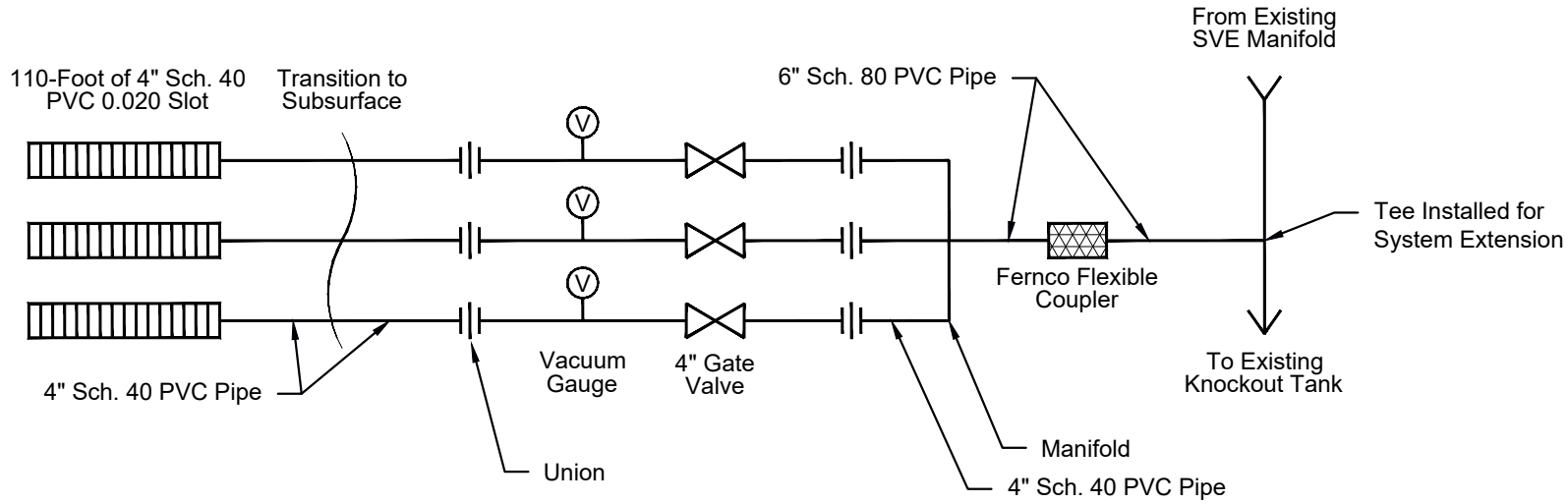
FIG. 5



AS/SVE System Extension and Modification
8801 East Marginal Way S.

LINE DIAGRAM OF SVE SYSTEM EXTENSION

August 2021 103485-004

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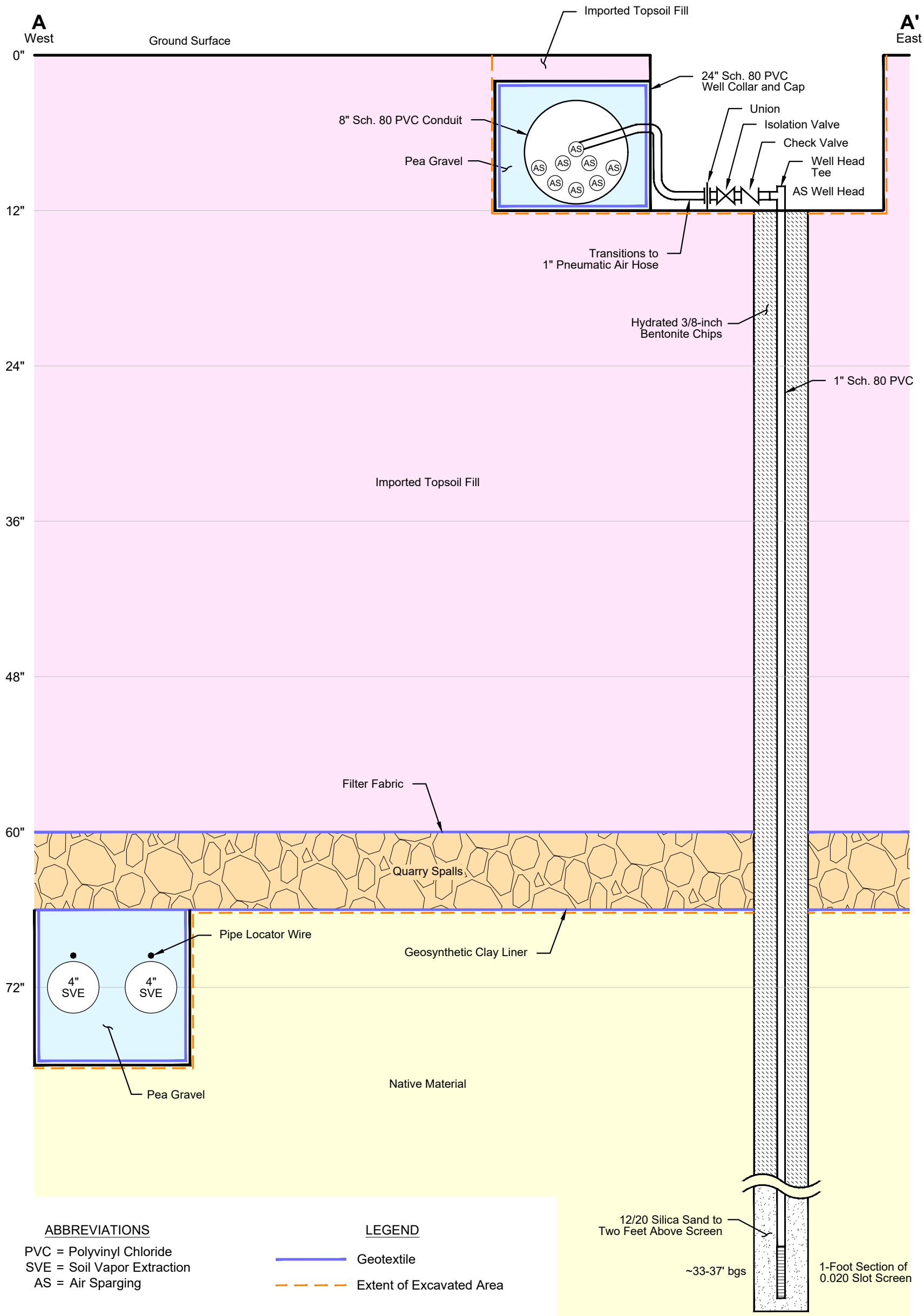
FIG. 6

FIG. 6



ABBREVIATIONS

PVC = Polyvinyl Chloride
SVE = Soil Vapor Extraction
AS = Air Sparging

LEGEND

Geotextile
Extent of Excavated Area

NOTES

1. Pea gravel will be round washed gravel sized from 3/8-inch down to 1/4-inch.
2. The backfill will be compacted consistent with requirements in the WSDOT's Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT, 2019).
3. Figure is not to scale.

AS/SVE System Extension and Modification
8801 East Marginal Way S.

CROSS SECTION OF AN AIR SPARGING WELL (A-A')

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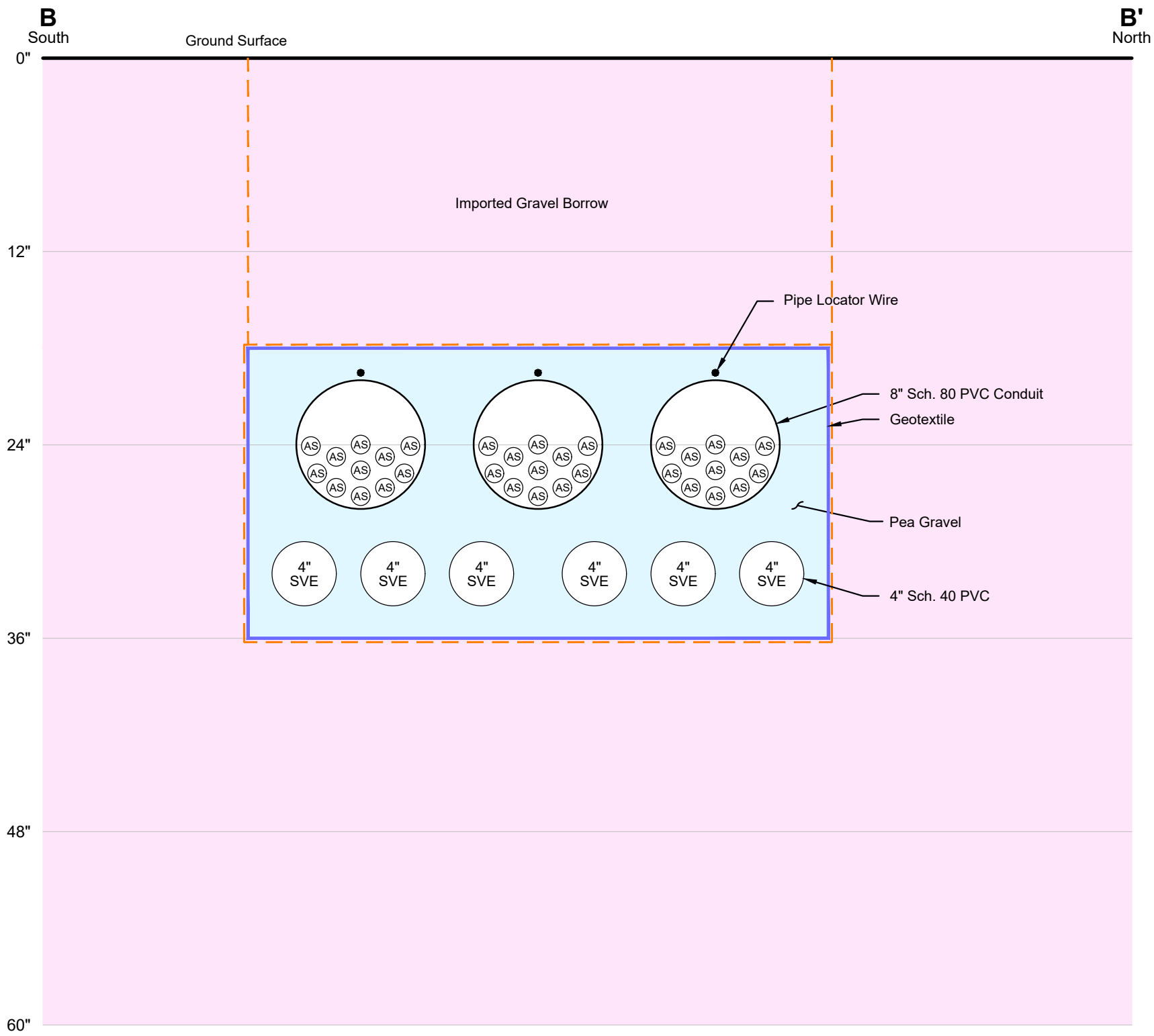
FIG. 7

FIG. 7

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive_SEA\103485\004\103485-004 Air Sparging Well.dwg Layout: Figure 1.7 Date: 03-03-2021 Login: JRS



ABBREVIATIONS

PVC = Polyvinyl Chloride
SVE = Soil Vapor Extraction
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LEGEND

Geotextile
Extent of Excavated Area

NOTES

1. Pea gravel will be round washed gravel sized from 3/8-inch down to 1/4-inch.
2. The backfill will be compacted consistent with requirements in the WSDOT's Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT, 2019).
3. Figure is not to scale.

AS/SVE System Extension and Modification
8801 East Marginal Way S.

CROSS SECTION OF EXISTING AS/SVE TRANSFER PIPING (B-B')

August 2021 103485-004

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FIG. 8

FIG. 8

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 µg/m^3
- Trichloroethene - 54 µg/m^3
- m,p-Xylene - 9.2 µg/m^3
- o-Xylene - 4.0 µg/m^3

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

- Benzene - 1.1 µg/m^3
- Ethylbenzene - 2.7 µg/m^3
- Toluene - 31 µg/m^3
- m,p-Xylene - 26 µg/m^3
- o-Xylene - 10 µg/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	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	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
- ☒ Standard
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☒ 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	2:24		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

APPENDIX B: MIRAFI® 140N PRODUCT

Appendix B

Mirafi® 140N Product Data Sheet

TENCATE Mirafi®

TENCATE GEOSYNTHETICS
Americas

Mirafi® 140N

Mirafi® 140N is a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® 140N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Mirafi® 140N meets AASHTO M288-15 Class 3 for Elongation > 50%.

TenCate Geosynthetics Americas Laboratories are accredited by Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP). NTPEP Listed

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D4632	lbs (N)	120 (534)	120 (534)
Grab Tensile Elongation	ASTM D4632	%	50	50
Trapezoid Tear Strength	ASTM D4533	lbs (N)	50 (223)	50 (223)
CBR Puncture Strength	ASTM D6241	lbs (N)	310 (1380)	
			Maximum Opening Size	
Apparent Opening Size (AOS)	ASTM D4751	U.S. Sieve (mm)	70 (0.212)	
			Minimum Roll Value	
Permittivity	ASTM D4491	sec^{-1}	1.7	
Flow Rate	ASTM D4491	$gal/min/ft^2$ ($l/min/m^2$)	135 (5500)	
			Minimum Test Value	
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	70	

Physical Properties	Unit	Roll Sizes	
Roll Dimensions (width x length)	ft (m)	12.5 x 360 (3.8 x 110)	15 x 360 (4.5 x 110)
Roll Area	yd^2 (m^2)	500 (418)	600 (502)

365 South Holland Drive
Pendergrass, GA 30567

Tel 706 693 2226
Tel 888 795 0808

Fax 706 693 4400
www.tencate.com

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FTOR77

GAI-LAP-25-97