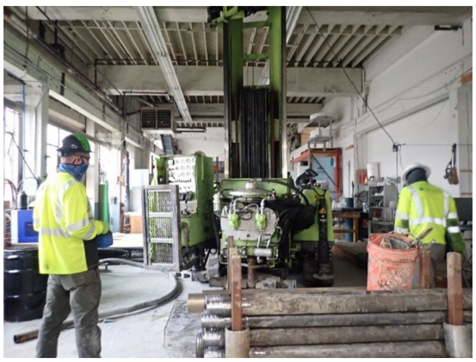
ACTIVE SUB-SLAB DEPRESSURIZATION MONITORING

WORK PLAN



Irwin Hodson Property

2808 and 2838 SE 9th Avenue
Portland, Oregon 97202

Multnomah County Parcel R251319

ODEQ ECSI File Number 6399

Prepared for:

The Irwin Hodson Company
2838 SE 9th Avenue
Portland, Oregon 97202
Attn: Heather Brown

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List of Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
bgs	below ground surface
cfm	cubic feet per minute
client	The Irwin Hodson Company, also known as Irwin Hodson
CMMP	Contaminated Media Management Plan
COCs	constituents of concern
COPCs	constituents of potential concern
CT	communication test
DQOs	data quality objectives
EAS	Environmental Analytical Services, Inc.
ECSI	Environmental Cleanup and Site Information
EDC	1,2-dichloroethane or ethylene dichloride
ENW	EVREN Northwest, Inc.
EPA	US Environmental Protection Agency
GAC	granular activated carbon
GRO	gasoline-range organics
IOW	inches of water
LUST	Leaking Underground Storage Tank
$\mu g/m^3$	micrograms per cubic meter
mg/Kg	milligrams per Kilogram
mL/min	milliliters per minute
ODEQ	Oregon Department of Environmental Quality
Pa	Pascals
PCE	tetrachloroethene
PID	photoionization detector
Qfch	Channel Facies of Missoula Flood deposits
RAO	Remedial Action Objectives
RAWP	Removal Action Work Plan
RBC	risk-based concentration
RD/RA	Remedial Design / Remedial Action
ROI	radius of influence
SF	square feet
SRA	soil removal area
SSD	sub-slab depressurization
SSV	sub-slab ventilation
TCE	trichloroethene
TSD	treatment storage and disposal
VOCs	volatile organic constituents

1.0 Introduction

This active sub-slab depressurization (SSD) monitoring work plan has been prepared by EVREN Northwest, Inc. (ENW) on behalf of The Irwin Hodson Company (Client; Irwin Hodson) for the subject site (the Irwin Hodson Property located at 2808 and 2838 SE 9th Avenue, Portland, Oregon; see Figures 1 and 2).

This work plan summarizes the previously installed passive sub-slab ventilation system (SSV), required work to activate this system such that it operates as an active SSD system and proposed monitoring following activation of this system.

2.0 Site Description and Overview of Environmental Work

2.1 Site Location and Setting

Site and Vicinity General Description. The subject property is in a commercial/industrial section of southeast Portland, Oregon, on the north side of SE Powell Boulevard (see Figure 1). The site consists of one tax lot encompassing a total of 0.85 acres, with an industrial warehouse building covering the entire building footprint. The site is bordered by a mix of commercial and industrial land uses east to SE 11th Avenue, south to SE Powell Boulevard, west to the banks of the Willamette River, and north to NE Broadway Street. Site features and nearby properties are shown in Figure 2.

Historical Land Use. Industrial land use of the site and surrounding area dates to the early 1900s. Previous occupants of the subject site included Northwest Planing Mills Company, a former coal gas facility, and the Iron Fireman Manufacturing Company. Irwin Hodson has occupied the site since the mid-1960s, operating a metal sign and printing company out of four warehouse buildings on the property. Irwin Hodson recently shared the buildings with one small, light industrial business (FORM), who subsequently terminated their lease. Irwin Hodson subsequently leased the northwest and northeast warehouse spaces to Past Lives LLC, which operates a workshop in the space in support of a community of artists, hobbyists, and beginning business owners dedicated to creating employment and mentorship opportunities for formerly incarcerated and anyone else overcoming trauma or from marginalized backgrounds. A complete account of the site's operational history is described in more detail in ENW's *Data Gap Investigation*[1] and ENW's *Sub-Slab Venting / Depressurization Installation and Focused Soil Removal Action Work Plan*, i.e., Remedial Design/Remedial Action (RD/RA) Work Plan.[2]

Soils and Geology. Soil borings completed at the site generally encountered fine sediments consisting of silt grading to sand down to a depth of approximately 18 feet below ground surface (bgs). These fine-grained sediments are underlain by dense, coarser-grained materials consisting of sands, gravels and cobbles that extended to the maximum depth drilled of 50 feet bgs. Geologic mapping of this portion of

[1] ENW, July 22, 2021. *Data Gap Investigation*, Irwin Hodson Property, 2808 and 2838 SE 9th Avenue, Portland, Oregon 97202, Multnomah County Parcel R251319, ODEQ LUST File Number 26-97-0130; prepared for The Irwin Hodson Company.

[2] ENW, July 22, 2021. *Sub-Slab Venting/Depressurization Installation and Focused Soil Removal Action Work Plan* (RAWP), Irwin Hodson Property, 2808 and 2838 SE 9th Avenue, Portland, Oregon 97202, Multnomah County Parcel R251319, ODEQ LUST File Number 26-97-0130; prepared for The Irwin Hodson Company.

Portland maps these materials as Channel Facies of Missoula Flood deposits (Qfch).[3] Boring locations and logs were presented in ENW's *Data Gap Investigation*.[1]

Ground Water. Depth to static water measured from temporary exploratory borings during subject site investigations ranged from approximately 27 to 33 feet bgs. An out-of-service industrial well (MULT 2778) was decommissioned at the subject site in June 2019. This 4-inch diameter well was deepened from 113 feet to 153 feet bgs in March 1967, at which time a static water level of 24 feet was recorded. The driller's log indicates that the well terminated in large, water-bearing gravel.

2.2 Previous Investigations

Several previous investigations were conducted at the subject site. ENW's July 2021 *Data Gap Investigation*[1] and RD/RA Work Plan[2] present a thorough summary of the results of these investigations.

2.3 Remedial Action Objectives

Remedial action objectives (RAOs) were developed in the RAWP to mitigate potential unacceptable risk from identified Constituents of Concern (COCs) at the subject site:

1. **Soil.** Prevent occupational receptors from coming into direct contact with arsenic-enriched soil concentrations greater than the background concentration of 8.8 milligrams per Kilogram [mg/Kg]).
2. **Indoor Air.** Prevent vapor intrusion of TCE (trichloroethene) at concentrations exceeding the occupational RBC (risk-based concentration) of 2.9 micrograms per cubic meter ($\mu g/m^3$) in indoor air (primary RAO).

The implemented RD/RA was designed to meet these RAOs.

2.4 Summary of Performance Monitoring Results (to date)

Based on the results of five quarters of post-remediation monitoring:

- **The RD/RA has effectively met the RAOs:**
    - Occupational receptors are prevented from coming into direct contact with possible arsenic-enriched soil under the building. A Contaminated Media Management Plan was prepared to ensure appropriate future handling and management of potentially arsenic-enriched soil during future earth works projects.
    - Intrusion of TCE at concentrations exceeding the primary RAO has been prevented.
- **Improved indoor air quality.** Implementation of the RD/RA has effectively reduced TCE concentrations in indoor air to below indoor air RAOs.
    - It should be noted that data collected during post remediation monitoring suggested a possible high bias in the reported indoor air concentrations for both PCE (tetrachloroethene) and TCE in the Radiello samples compared to the 5-day Summa canisters results averaged over five consecutive sampling events.[4]

[3] Madin, I.P., 1990, Earthquake Hazard Geology Maps of the Portland Metropolitan Area, Oregon: Oregon Department of Geology and Mineral Industries Open File Report 0-90-2.

[4] ENW, February 28, 2023 (DRAFT). *Post RD/RA Implementation, 1st Quarter 2023 Performance Monitoring and Investigation Report*, Irwin Hodson Property, 2808 and 2838 SE 9th Avenue, Portland, Oregon 97202,

- **Passive SSV appears to exert negative pressure during winter months**. Data collected during January and February 2023 between the sub-slab environment and indoor air suggest that the passive SSV system generally creates a negative pressure differential in the sub-slab environment beneath the warehouse at the site. Furthermore, differential pressure monitoring data also suggests that the passive SSV exerts a general negative pressure differential in native soils along the north margin of the soil removal area (SRA).
    - This observation is further supported when reviewing sub-slab vapor and soil gas data trends, where these trends suggest seasonal variation in concentrations of TCE beneath the building slab with first quarter 2023 data very similar to the last quarter of 2023 and the first quarter 2022 (winter months).
- *Evaluation of additional constituents of potential concern (COPCs) requested by the Oregon Department of Environmental Quality (ODEQ) has not identified any constituents exceeding the occupational RBC, confirming that these are not COCs, with the possible exceptions of benzene, ethylbenzene, 1,2-dichloroethane (EDC) and gasoline-range organics (GRO) in indoor air in the southern portion of the building. However, given the extensive use of paints, adhesives, cleaners, and lubricants in this portion of the building and the fact that these constituents were not detected in any of the sub-slab vapor samples at concentrations exceeding urban residential RBCs, it is likely that contributions of these constituents in indoor air are related to the use of these materials in this portion of the building and not from residual impacts beneath the building. Specific observations related to the storage of hazardous materials in the SE portion of the building include:*
    - *There are numerous oils, lubricants, inks, and adhesives that contain "petroleum distillates" or "VOCs" or "petroleum hydrocarbons." Several of these containers were observed to be open and are actively being used.*
    - *Several products observed primarily in the NW and SE quadrants, were noted to contain benzene, ethylbenzene, and/or naphthalene, e.g., Plasti-Dip, Deft Clear Wood Finish, Zinnser, Daly's Profin, Envirotex Spray Sealer, Gold NC-Acrylic spray paint, Mtn 94 spray paint, Rust-Oleum aerosol spray paints, Bostik GlideCote Table & Tool Surface lubricant, and Diagraph Quik Spray Marking Ink.*

3.0 Rationale for Conversion of Current Passive SSV System to Active SSD

The passive SSV system has consistently and effectively met the primary RAOs established in the RAWP. The conversion to an active SSD is being required solely by mandate of the ODEQ, which is currently undergoing an effort to revise its vapor intrusion guidance.

Multnomah County Parcel R251319, ODEQ LUST File Number 26-97-0130 and ODEQ ECSI File No. 6399: prepared for The Irwin Hodson Company.

Specifically, ODEQ is requiring a reduction of the concentration of trichloroethene (TCE) in sub-slab vapor to below its current generic Hot Spot concentration of 88,000 µg/m^3:

- During two post-remediation sampling events for SUB14 and SUB15 (Second and Third Quarters of 2022),[5,6] sub-slab vapor concentrations of trichloroethene (TCE) exceeded ODEQ's generic Hot Spot concentrations of 88,000 µg/m^3. *See Appendix A for a chart of TCE in Soil Gas and Sub-Slab Vapor vs. Time. See Figure 3 for the locations of SUB14 and SUB15.*
- ODEQ will no longer allow for the calculation of site-specific Hot Spot concentrations for soil gas in their updated guidance, even in situations where the vapor intrusion attenuation coefficient has been purposely modified though construction of barriers and seals. Therefore, Irwin Hodson is compelled to abide by generic Hot Spot concentrations regardless of the protective engineering controls in place at their facility.

The most cost-effective approach to meeting ODEQ's requirement is to convert the passive SSV system to an active SSD system.

NOTE: It is ENW's opinion that passive SSV in combination with a vapor barrier and floor sealing, such was that installed in the northeast portion of the subject site, would be expected to be associated with higher sub-slab vapor concentrations since there is not active ventilation beneath the sealed slab. However, these less expense and simpler options often can be demonstrated to show they mitigate indoor air exposure risk to building occupants, due to changes in the rates contaminates can intrude into indoor air spaces, such as at the subject property.

4.0 Previously Completed Remedial Action Measures

The following remedial action measures have been completed at the subject site.

- **Focused Soil Removal Action (northeast corner of the building).**
- **Installation of a Passive SSV (northeast corner of the building).**
- **Installation of a Vapor Barrier (northeast corner of the building).**
- **Installation of a Floor Seal.** Sealing the new and existing concrete floors throughout the subject building.

[5] ENW, May 26, 2022 (DRAFT). *Post RD/RA Implementation, April 2022 Performance Monitoring and Investigation Report*, Irwin Hodson Property, 2808 and 2838 SE 9th Avenue, Portland, Oregon 97202, Multnomah County Parcel R251319, ODEQ LUST File Number 26-97-0130 and ODEQ ECSI File No. 6399: prepared for The Irwin Hodson Company.

[6] ENW, August 30, 2022. *Post RD/RA Implementation, July-August 2022 Performance Monitoring and Investigation Report*, Irwin Hodson Property, 2808 and 2838 SE 9th Avenue, Portland, Oregon 97202, Multnomah County Parcel R251319, ODEQ LUST File Number 26-97-0130 and ODEQ ECSI File No. 6399: prepared for The Irwin Hodson Company.

- **Implementation of Institutional Controls.**
  - A DRAFT Contaminated Media Management Plan has been prepared to guide management and handling of contaminated media (soil).[7]
  - Monitoring of passive SSV. Five quarters of performance monitoring have been conducted since January of 2022 and provide to ODEQ. Each performance monitoring event has documented that the combination of the vapor barrier, floor sealing, and passive SSV have reduced the concentration of TCE in indoor air, effectively meeting the RAO for indoor air established in the RAWP.

5.0 SSV and SSD Conversion

The details of converting the existing passive SSV system to an active SSD system are described in this section. The general approach will be the addition of at least two inline fans.

5.1 Passive SSV Overview

The passive SSV designed for the Irwin Hodson property is shown on Figures 3 and the passive SSV array and active SSD conversion design are in accordance with the criteria of American Society for Testing and Materials (ASTM) Standard E2121 – 13[8] and US Environmental Protection Agency (EPA) guidance.[9] The system is comprised of the following general elements:

- Two SSV trenches containing perforated pipe bedded in pea gravel beneath the floor area in two (2) parallel west-east oriented trenches in the northeast quadrant of the building.
- Each perforated pipe leg is manifolded to a solid pipe running to a dedicated solid vertical riser pipe fitted with a sampling port (one riser for each trench).
- Riser pipes that passively vent at least three feet above the Second-Floor roof line.
- Semi-permanent points for monitoring sub-slab vacuum have been installed.

5.2 Active SSD Design Conversion

To convert the system, the following components will be added to each of the riser pipes at the First-Floor roof level:

- A manometer.
- A knock-out drum (to remove condensate).
- Two in-series 30-gallon granular activated carbon (GAC) treatment drums.
- Six-inch explosion-proof in-line fan.

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[7] ENW. April 26, 2022. *Contaminated Media Management Plan (DRAFT),* Irwin Hodson Property, 2808 and 2838 SE 9th Avenue, Portland, Oregon 97202, Multnomah County Parcel R251319, ODEQ LUST File Number 26-97-0130 and ODEQ ECSI File No. 6399: prepared for The Irwin Hodson Company.

[8] While the standard is written for radon gas, according to generally accepted professional practice the standard is considered equally suitable for volatile organic constituents (VOCs) detected in sub-slab vapor samples.

[9] EPA. June 2015. *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*. OSWER Publication 92100.2-154

5.3 Conversion Tasks and Initial Startup Monitoring

5.3.1 Active SSD Installation (Construction Details)

The following construction details are the specifications to go with the elevation view with installation notes on Figures 3 through 6.

1. The vent riser will be piped to these components:
    a. a moisture knock-out drum,
    b. two (2) 30-gallon vapor phase GAC drums in series (initially), and
    c. a suction fan installed in line with the outlet on the second GAC drum.

   Since the installation is on an exterior roof deck, a weather-tight GFI outlet on a dedicated circuit will be mounted directly adjacent to the fan to provide power.
2. Given the exterior location of the active SSD components and freezing temperatures during the winter months, the moisture knock-out drums will be wrapped with heat tape and reflective insulation. Controlled by a thermostat, current will be directed to the heat tape when the temperature drops below freezing. An indicator light on the unit will turn on when the heat tape is energized.
3. A drain valve will be installed at the base of the moisture knock-out drum to periodically drain the condensate water for proper disposal at a Treatment, Storage and Disposal (TSD) facility permitted to accept hazardous liquid wastes.
4. The size and air movement capacity of the vent pipe fan shall be sufficient to create and maintain a pressure field beneath the slab that is lower than the ambient pressure above the slab (approximately 0.02-inch water differential pressure) within the area identified on Figure 3 as the expected radius of influence. Fan sizing information is provided below.
5. Sampling ports (pre- and post-GAC treatment) will be installed in the solid portion of the vent line such that routine performance monitoring can be conducted. A manometer will be installed on the vent riser so that initial performance can be gauged and monitored visually.
6. An air-velocity port will be installed in the exhaust stack so that volumetric quantities of volatiles expelled into the atmosphere can be calculated.
7. A system description label will be placed on a primary component of system (e.g., on piping near SSD fan), on or near disconnects such as switches or the receptables providing power to plugged connections for mitigation system fans, the circuit breaker(s) protecting the mitigation system fan circuit(s), and within 12 inches (30 cm) of the electric service panel or other prominent location. The label shall state, “Sub-Slab Vapor Reduction System” or similar wording.
8. The manometer/vent will be clearly marked to indicate the initial pressure reading.

Fan Sizing. Based on EPA guidance, a sub-slab induced negative pressure of -0.016 inches of water is expected to be sufficient[10] for a successful SSD; however, the depressurization goal for active SSD will be -0.02 inches of water.

[10] USEPA, March 2009. Indoor Air Vapor Intrusion Mitigation Approaches & USEPA 2008, Brownfields Technology Primer: Vapor intrusion Considerations for Redevelopment. EPA 542-R-08-001

According to the EPA, suction field extension tests (sub-slab communication testing) are typically the only pre-mitigation diagnostic test needed prior to design and installation of SSD.[11] Pre-installation communication testing was completed on February 19, 2020. The communication testing used a suction fan rated at approximately 60 cubic feet per minute (cfm) with no resistance. Communication testing induced a vacuum of:

- 1.107 inches of water (IOW) at 5 feet from the source,
- 0.487 IOW at 10 feet from the source, and
- 0.496 IOW at 15 feet from the source.

Based on these results, ENW will install a fan capable of achieving an air flow of 70 cfm under a pressure of approximately 2 IOW, which exceeds the performance of the vacuum used in the initial communications testing and should be able to produce equal or better radius of influence (ROI). The performance information for the selected fan is shown in the following table and Appendix C.

During fan sizing, system pressure drops associated with the vapor treatment system were considered. The carbon canisters are estimated to have a pressure drop of 0.2 IOW (each) and the condensate knockout drum is considered to have a negligible pressure drop.

Table 5-1. In-line Fan Performance Characteristics

Fan	Watts	Max. Op. Pressure (IOW)	Typical CFM vs. Static Pressure (IOW)				
			0.0 IOW	0.5 IOW	1.0 IOW	1.5 IOW	2.0 IOW
RP265	95-139	2.3	375	282	204	140	70

Additionally, the EPA suggests that suction field extension testing, i.e., communication testing, may also be conducted during installation of SSD equipment to determine whether additional suction points or larger fans are required. Post-installation, SSD testing, and monitoring will be used to demonstrate a ROI of 0.02 IOW or greater that extends laterally from the SSD trench a distance (approximately 20 to 25 feet) sufficient to capture the estimated extent of TCE at concentrations exceeding its generic Hot Spot RBC for soil gas. If the specified fan is found insufficient for the task, it can easily be swapped out for a stepped-up model.

5.3.2 Active SSD Startup and Initial Communication Testing

Active SSD Objectives. Upon startup, testing of active SSD venting will be conducted to ensure:

- Approximately 0.02 IOW pressure differential between the sub-slab environment and the ambient air within the building is maintained within in the expected ROI for the SSD system.
- Concentrations of TCE in the system exhaust do not exceed modeled limits (see Air Dispersion Modeling Section 6).

Typically, the concentration of VOCs vented from a depressurization system is initially very high and then decline asymptotically over a short period time. Since the SSD exhaust will be treated using GAC, VOC concentrations will be monitored before and after the GAC filter to confirm that levels in the exhaust gas do not exceed modeled exhaust limits for TCE. To ensure effective monitoring:

[11] USEPA, 1993. Radon Reduction Techniques for Existing Detached Houses, Technical Guidance for Active Soil Depressurization Systems. EPA/625/R-93/011.

- The vent line for the depressurization system will be equipped with sampling ports. To conduct measurements required to meet air quality standards, one sampling port will be located before the first (primary) GAC filtration drum, and one port will be located after the vented air stream is treated. Additionally, an air-velocity port will be installed in the exhaust stack so that volumetric quantities of volatiles expelled into the atmosphere can be calculated.
- All monitoring equipment will be calibrated per manufacturer's recommendations prior to use.

The following schedule is a general outline we intend to use for monitoring the depressurization system. Based on site conditions, the schedule may be modified for the purposes of ensuring effective operation of the system.

System Start Up, Monitoring to Verify Sub-slab Communication and Initial Effluent Screening. To ensure the active SSD venting is meeting the above objectives, the following will be conducted:

- Upon startup:
  - At a minimum, field measurements of relative pressures in the sub-slab will be collected upon system startup following one hour of operation as well as photoionization detector (PID) measurements at each sub-slab monitoring locations (all CT and SUB locations shown on Figure 3). Differential pressure readings will be recorded using a digital micromanometer capable or readings differential pressures of below 0.5 pascals (Pa).
    - Two nested pairs of sub-slab and indoor air monitoring location will be monitored with a micromanometer. The differential pressure between both indoor and sub-slab air will be recorded daily in pascals, recorded to the nearest 0.1 Pa.
  - Initial effluent screenings will be performed with a PID on an hourly basis for the first six hours of operation to yield a semi-quantitative estimate of system emissions.
  - Within one hour of operation, pre- and post-GAC vent exhaust samples will be collected using a 30-minute flow controller to ensure a sample rate no greater than 200 milliliters per minute (mL/min).
  - Analysis of the pre- and post-GAC samples for TCE to confirm concentrations of TCE in the post-GAC sample is below the modeled limits (Section 6), and to further constrain semi-quantitative PID readings with estimate TCE concentrations (pre-GAC sample). Using SSD pre- and post-GAC vent exhaust samples, a correlation curve will be developed for PID measurements to TCE concentrations to facilitate screening of exhaust vapors as part of future monitoring.
- **Active SSD Installation and Start-up Report.** Following system startup and initial effluent screening, a technical memorandum documenting the active SSD conversion, start up, initial operation and field PID readings, and discharge sampling analytical results will be prepared and submitted to ODEQ. This will include an assessment of system performance based on pressure differential, discharge treatment, PID screening measurements, and initial air discharge volumes.

6.0 Calculation of Site-Specific TCE-Emission Limit using Air Dispersion Modeling

EPA's AERSCREEN Model[12] and model inputs derived from site-specific parameters and startup parameters from similar systems were used to estimate allowable discharge concentrations of TCE at the rooftop stack. The input parameters for the AERSCREEN model are presented in Appendix B. Modeling the input parameters yielded the following results for the elevated terrain model:

Table 6-1. Results of AERSCREEN Air Dispersion Screening Model

Impacts	COCs	Distance	Receptor Height	Bearing	Max 1-Hr Conc	Scaled 3-Hr Conc	Scaled 8-Hr Conc	Scaled 24-Hr Conc	Scaled Annual Conc
		ft	ft	Deg 0-360°	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Impact at Ambient Boundary	TCE	25	164	30 (NNE)	0.2442	0.2442	0.2197	0.1465	0.02442
Elevated Terrain	TCE	160	167	120 (ESE)	0.4659	0.4659	0.4193	0.2795	0.04659

Air dispersion screening modelling results conservatively estimate that TCE concentrations at the ambient boundary and at the elevated terrain maximum impact point are less than the ODEQ's RBC for residential air of 0.47 µg/m³, starting with a TCE concentration of 1,750 µg/m³ at the stack. **Therefore, 1,750 µg/m³ is established as the site-specific TCE emission limit at the rooftop stack.**

7.0 Post Conversion Active SSD System Monitoring

Performance monitoring of the active SSD system will be conducted approximately 30-days following completion of the conversion work and system activation, and will consist of:

- **Confirmation of Sub-Slab Differential Pressure.** Field measurements of relative pressures in the sub-slab will be collected as well as PID measurements at each sub-slab monitoring location (all CT and SUB locations shown on Figure 3). During sampling, daily readings of sub-slab/indoor air differential pressure will be recorded.
- **Indoor/Outdoor Ambient Air Sampling**. Collection of indoor air samples (in each quarter of the building, as sampled during baseline assessment) and an outdoor air reference sample (collected on the roof, up-wind of the riser location).
    - ENW will collect ambient indoor air samples in laboratory-provided Summa cannisters for a period of approximately five consecutive 5-day periods at each of the four locations using a laboratory provided flow meter. Daily readings of sub-slab/indoor air differential pressure will be recorded.
    - ENW will collect the ambient outdoor air reference sample from the building roof, for the up-wind direction.

All samples will be transported to a certified laboratory under chain-of-custody documentation and will be analyzed for TCE by EPA Method TO-15. Analytical results will be compared to ODEQ occupational RBCs for ambient air.

[12] User interface Breeze AERSCREEN® 1.9

- **SSD Exhaust Monitoring**. Collection of pre- and post-GAC vent exhaust samples using a 30-minute flow controller to ensure a sample rate no greater than 200 mL/min. Once pre-GAC TCE concentrations in the SSD exhaust are below the modeled limit, the GAC filtration units will be removed.
- **Sub-Slab Vapor Monitoring.** Collection of sub-slab vapor samples from all SUB sample locations (see Figure 3). The sub-slab vapor samples will be collected using a flow controller and analyzed for TCE using EPA Method TO-15 with data compared to ODEQ generic Hot Spot RBC for TCE for soil gas.
  - During sample collection, the cap on the vapor pin will be removed and clean 1/4-inch Teflon® tubing will then be connected to the sampling point using the barbed fitting and connected to a soil gas sample train.
  - Prior to sampling, a rag saturated with isopropyl alcohol will be placed around each sampler stem and seal on the ground surface to test for leakage.
  - After purging a minimum of two measured volumes of air using a PID or graduated syringe, sub-slab vapor will be collected in 1-liter Summa cannisters at a flow rate less than 200 milliliters (mL) per minute: the laboratory will provide certified canisters and flow meters. The samples will be transported to a certified laboratory under chain-of-custody documentation and will be analyzed for TCE and isopropyl alcohol by Method TO-15.

Assuming the data collected during the initial 30-day monitoring event does not suggest any system modifications are necessary, three additional sample events will be conducted such that all four seasons have been monitored following system modifications. These additional monitoring events will be conducted as was done during the 30-day monitoring event.

All samples will be analyzed by an ORELAP-accredited laboratory (Environmental Analytical Services, Inc.) and data quality objectives (DQOs) will be communicated to the laboratory prior to analysis.

7.1.1 Performance Monitoring Reports

One performance monitoring report will be completed for each quarter of monitoring. Each performance monitoring report will include:

- Confirmation of sub-slab differential pressure and results of co-located sub-slab and indoor air differential pressures.
- Indoor/outdoor ambient air sampling results.
- SSD exhaust monitoring results.
- Sub-slab vapor monitoring results.

7.1.2 Residual Risk Assessment

Using the data collected during the four quarters of performance monitoring, a residual risk assessment will be completed to confirm mitigation activities mitigated the risk from exposure to TCE in ambient air and the concentrations of TCE in sub-slab vapor are below ODEQ generic Hot Spot concentrations.

8.0 Anticipated Schedule

Below is the anticipated schedule required to support a probable sales transaction involving this property. The timeframe is keyed to the completion of Task 1, receipt of ODEQ approval of this Work Plan.

Table 7-1. Anticipated Schedule

Description	***Timeframe***
Obtain approval from ODEQ for SSV to SSD Work Plan	ODEQ
Convert to Active SSD System	Within 30 days of ODEQ approval
Initial Active SSD System Start up Technical Memorandum	Within 60 days of ODEQ approval
Performance Monitoring Event, 1st Quarter	*Approximately 30 days after Active SSD System Startup / Within 60 days ODEQ approval*
Performance Monitoring Event, 2nd Quarter	*Approximately 120 days of 1st Qtr. Performance Monitoring Report*
Performance Monitoring Event, 3rd Quarter	*Approximately 120 days of 2nd Qtr. Performance Monitoring Report*
Performance Monitoring Event, 4th Quarter	*Approximately 120 days of 3rd Qtr. Performance Monitoring Report*
Residual Risk Assessment	Within 30 days of 4th Qtr. Performance Monitoring Report.

9.0 Certification

This Work Plan has been prepared under the supervision of the following Oregon-registered professionals.

Lynn D. Green, C.E.G.
Principal Engineering Geologist

Paul M. Trone, R.G.
Principal Geologist

10.0 Limitations

The scope of this report is limited to observations made during on-site work; interviews with knowledgeable sources; and review of readily available published and unpublished reports and literature. As a result, these conclusions are based on information supplied by others as well as interpretations by qualified parties.

The focus of the site closure does not extend to the presence of the following conditions unless they were the express concerns of contacted personnel, report and literature authors or the work scope.

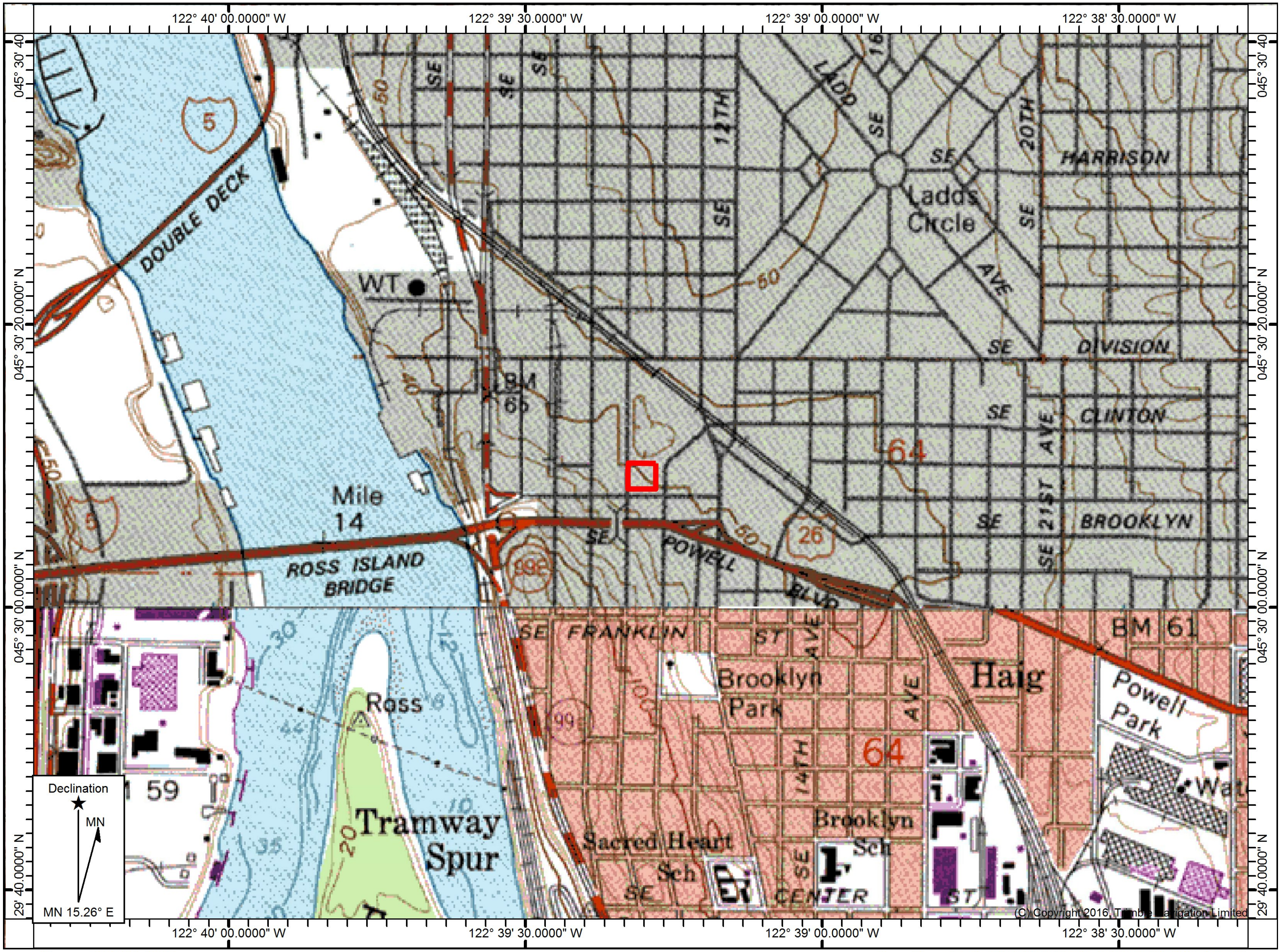
- Naturally occurring toxic or hazardous substances in the subsurface soils, geology and water,
- Toxicity of substances common in current habitable environments, such as stored chemicals, products, building materials and consumables,
- Contaminants or contaminant concentrations that are not a concern now but may be under future regulatory standards,
- Unpredictable events that may occur after ENW's site work, such as illegal dumping or accidental spillage.

There is no practice that is thorough enough to absolutely identify the presence of all hazardous substances that may be present at a given site. ENW's investigation has been focused only on the potential for contamination that was specifically identified in the Scope of Work. Therefore, if contamination other than that specifically mentioned is present and not identified as part of a limited Scope of Work, ENW's environmental investigation shall not be construed as a guaranteed absence of such materials. ENW have endeavored to collect representative analytical samples for the locations and depths indicated in this report. However, no sampling program can thoroughly identify all variations in contaminant distribution.

We have performed our services for this project in accordance with our agreement and understanding with the client. This document and the information contained herein have been prepared solely for the use of the client.

ENW performed this study under a limited scope of services per our agreement. It is possible, despite the use of reasonable care and interpretation, that ENW may have failed to identify regulation violations related to the presence of hazardous substances other than those specifically mentioned at the closure site. ENW assumes no responsibility for conditions that we did not specifically evaluate or conditions that were not generally recognized as environmentally unacceptable at the time this report was prepared.

Figures

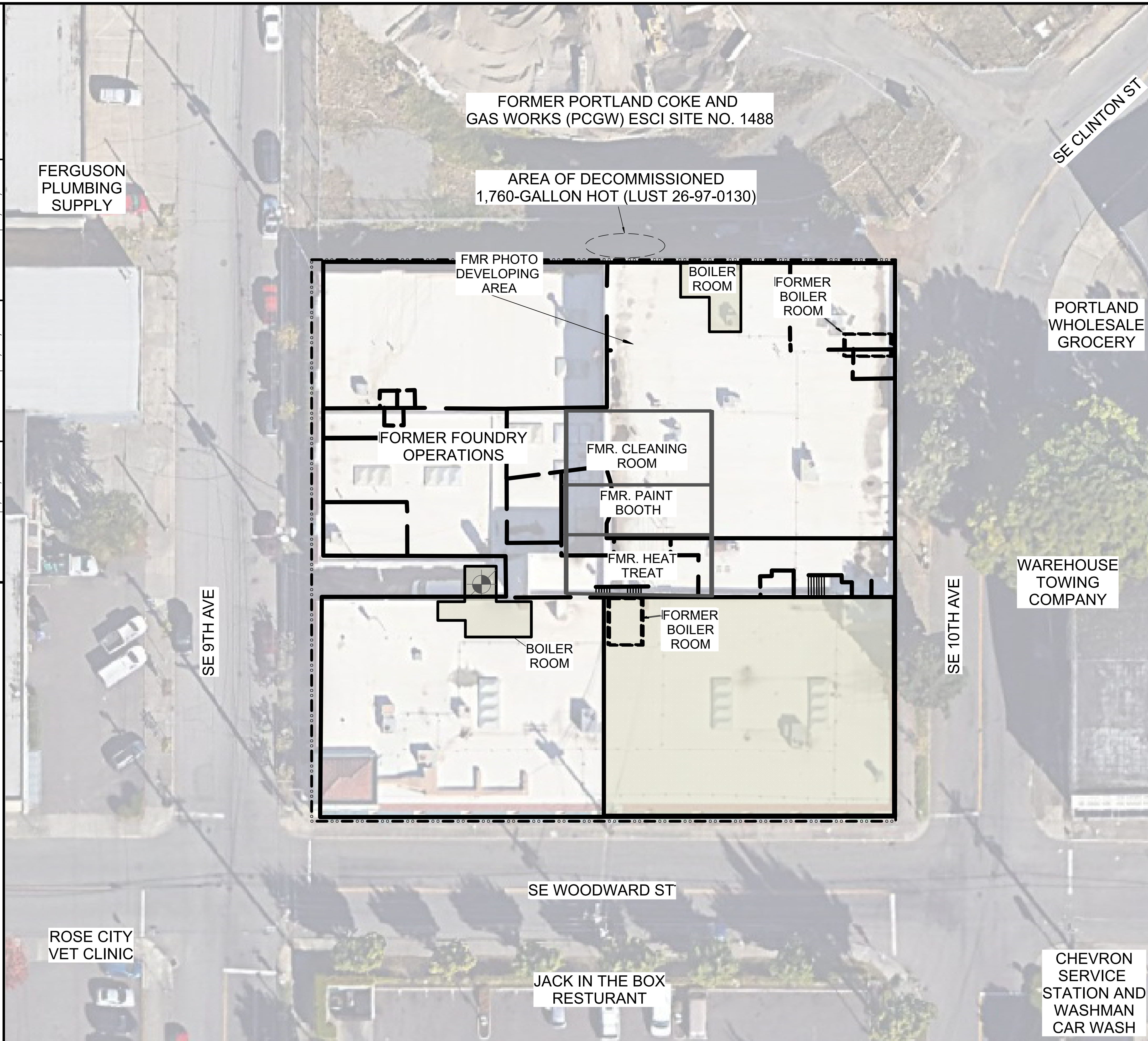


Name: PORTLAND
Date: Jan 1, 1990

0 1000 2000
Feet

Location: 045° 30' 09.2914" N, 122° 39' 18.3519" W
Contour Interval: 10 ft

EVREN NORTHWEST INC. environmental natural resource consultants	Date Drawn: 8/12/2019 CAD File Name: 186-19002-fig1sv_map(v01) Drawn By: JOB Approved By: LDG	Irwin Hodson Property 2808 and 2838 SE 9th Avenue Portland, Oregon	**Site Vicinity Map**	Project No. 186-19002 Figure No. **1**



LEGEND:

- SUBJECT PROPERTY BOUNDARIES
- SUBJECT BUILDINGS
- BASEMENT AREA
- DECOMMISSIONED WATER WELL
- HOT = HEATING OIL TANK

NOTES:

1. BASE MAP DEVELOPED FROM AN AERIAL PHOTOGRAPH MAP DATED 2018 AND ENW FIELD NOTES.
2. ALL BUILDING, STREET, AND FEATURE LOCATIONS ARE APPROXIMATE.
3. SYMBOLS REPRESENT LOCATION AND DO NOT ALWAYS REPRESENT EXACT SHAPE, SIZE, OR ORIENTATION.

APPROXIMATE SCALE

0 35 70 FEET

N

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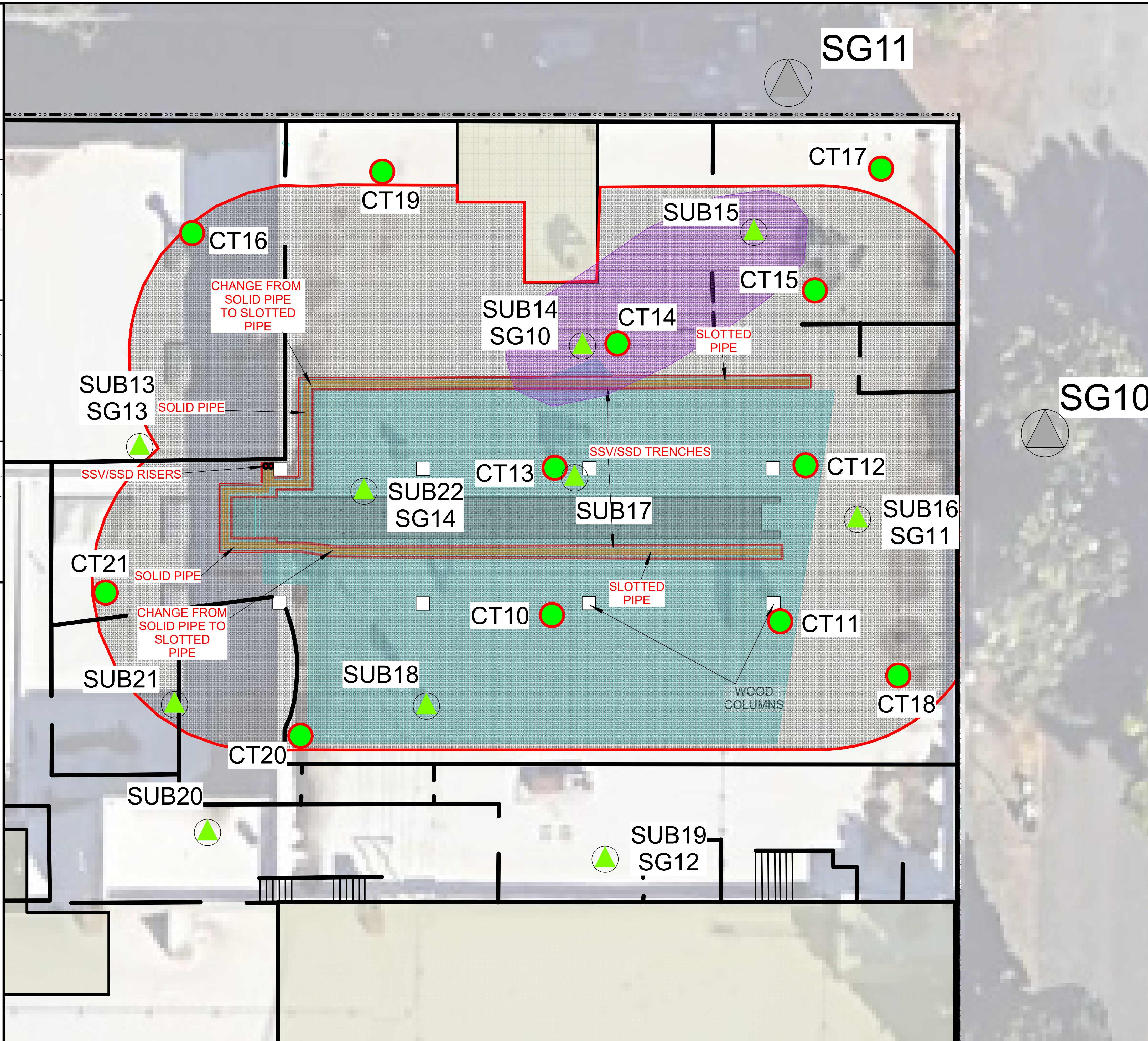
FIGURE 2

SITE PLAN

IRWIN HODSON PROPERTY
2808 AND 2838 SE 9TH AVENUE
PORTLAND, OREGON

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
C. ROSEBROOK 3/15/2022	P. TRONE 06/27/2023	L. GREEN 06/27/2023	186-19002(v01)

DRAWN BY C. ROSEBROOK 12/06/2021
CHECKED BY P. TRONE 06/27/2023
APPROVED BY L. GREEN 06/27/2023
DRAWING NUMBER 186-19002(v10)



LEGEND:

- CONCRETE EQUIPMENT PAD
- FOCUSED SOIL REMOVAL AREA AND VAPOR BARRIER INSTALLATION AREA
- SSV/SSD VAPOR COLLECTION TRENCH
- COMMUNICATION TEST LOCATIONS (CT10–21) (IF SSD SYSTEM ACTIVE)
- SUB-SLAB VAPOR SAMPLE LOCATIONS (SUB13–22) AND SOIL GAS SAMPLE LOCATIONS (SG10–14)
- ESTIMATED AREA WITH TCE SOIL GAS / SUB-SLAB VAPOR CONCENTRATIONS EXCEEDING ODEQ HOT SPOT CONCENTRATION
- SSD RADIUS OF INFLUENCE

NOTES:

1. BASE MAP DEVELOPED FROM AN AERIAL PHOTOGRAPH MAP DATED 2018 AND ENW FIELD NOTES.
2. ALL BUILDING, STREET, AND FEATURE LOCATIONS ARE APPROXIMATE.
3. SYMBOLS REPRESENT LOCATION AND DO NOT ALWAYS REPRESENT EXACT SHAPE, SIZE, OR ORIENTATION.
4. SLOTTED PIPE CONSISTS OF 4–INCH ID SCHEDULE 40 PVC PIPE WITH 0.060–INCH SLOTS (60–SLOT) INSTALLED WITH A 1/8–INCH/FOOT SLOPE TO THE EAST TO DRAIN CONDENSATE AWAY FROM THE HEADER.

APPROXIMATE SCALE
0 15 30 FEET

N

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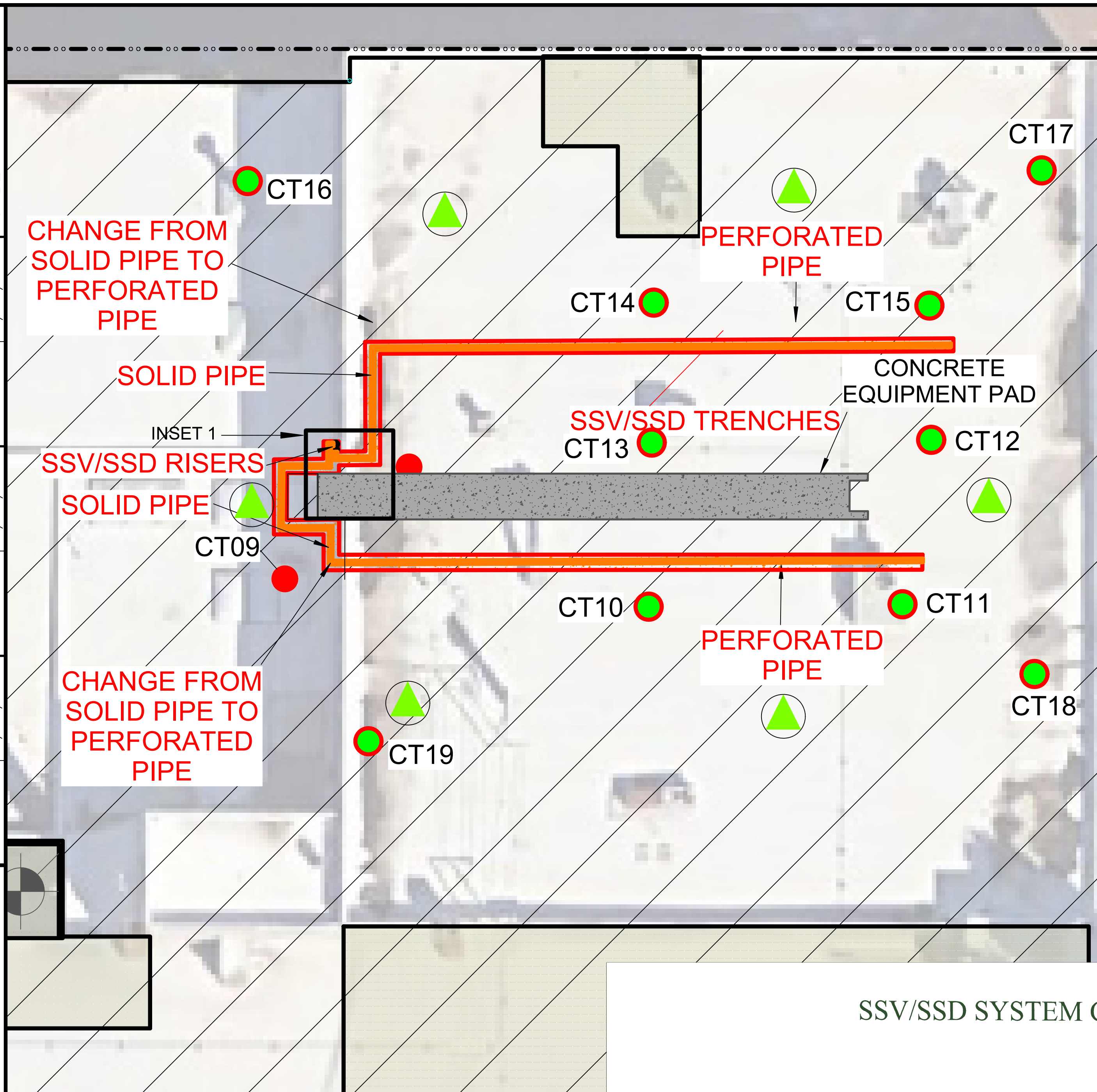
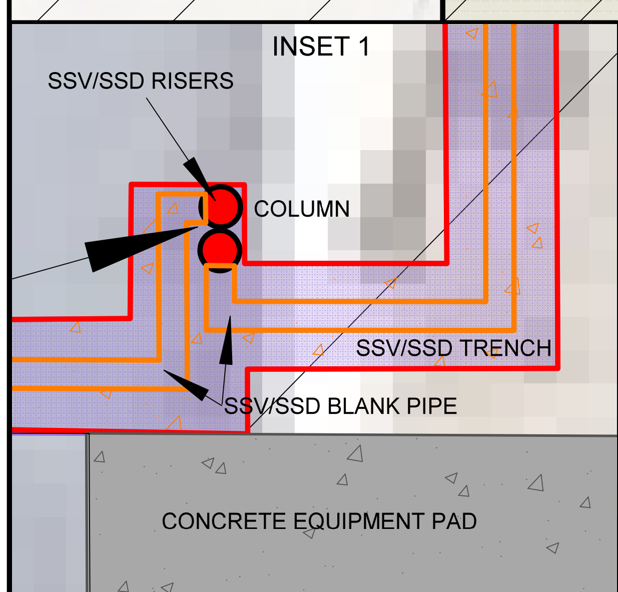
FIGURE 3

SAMPLE LOCATION DIAGRAM
SUB-SLAB VAPOR / SOIL GAS

IRWIN HODSON PROPERTY
2808 AND 2838 SE 9TH AVENUE
PORTLAND, OREGON

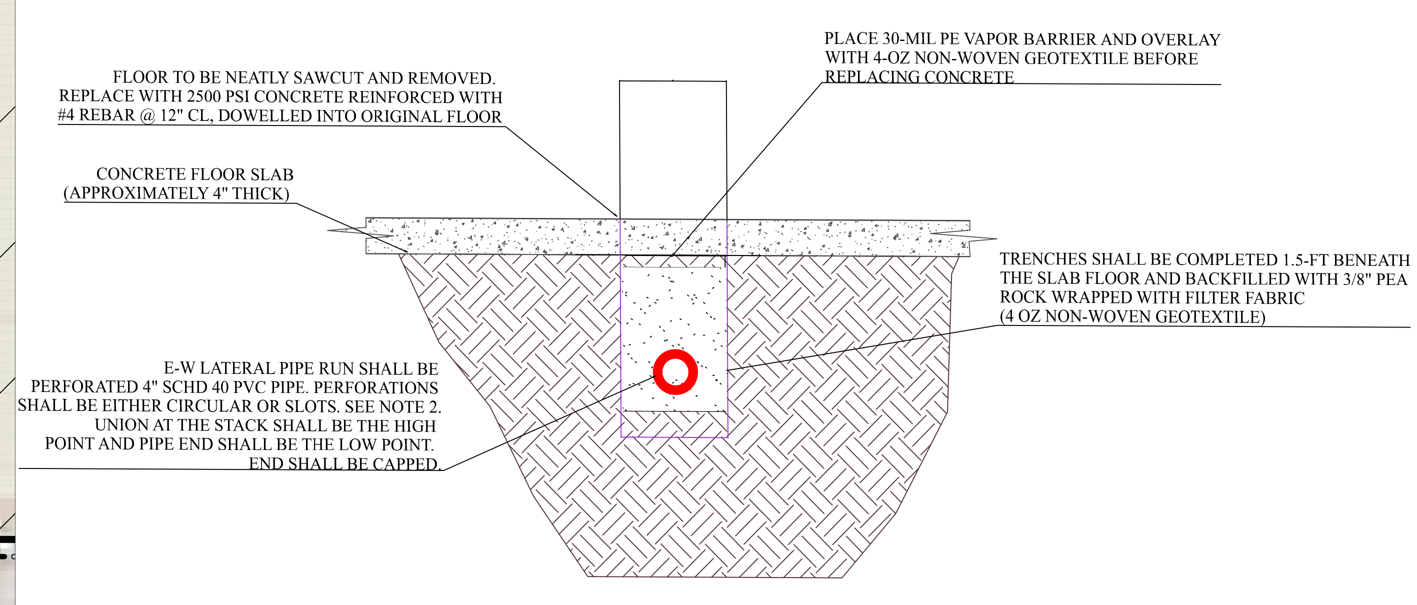




INSTALLATION NOTES:

1. Above-ground Sub-Slab Depressurization (SSD) (solid, not perforated) piping shall have a continuous downward slope towards the perforated pipe point of not less than 1/8 inch (3.2 mm) per foot (30 cm). Configurations that result in obstructed airflow by allowing water to collect within SSD piping are prohibited. This requirement is intended to allow rainwater or condensation within the pipes to drain downward into the ground beneath the slab floor.
2. Perforations shall be either circular or slots.
A. Circular perforations shall be 1/4 ± 1/16-inch diameter holes arranged in rows parallel to the axis of the pipe and evenly spaced along each row such that the center-to-center distance between perforations is not less than eight times the perforation diameter. Rows shall be arranged in two equal groups at equal distance from the bottom on each side of the vertical centerline of the pipe. The lowermost rows of perforations shall be separated by an arc of not less than 60 degrees or more than 125 degrees. The uppermost rows of perforations shall be separated by an arc not to exceed 166 degrees. The spacing of rows between these limits shall be uniform.
B. Slot perforations shall be located within the lower quadrants of the pipe with slots no wider than 1/8 inch and spaced not to exceed 11 times the perforation width. Slot perforations shall be symmetrically located in two rows, one on each side of the pipe centerline.
C. Perforations may appear at the ends of short and random lengths.
D. The minimum number of rows perforations (circular or slots) shall be two for a 4-inch ID pipe, which correlates to a minimum opening of 0.22 sq inches per lineal foot.
3. Supports for SSD plastic piping shall be installed at least every 10 feet (3m) on vertical runs and at least every 6 feet (1.8m) on horizontal runs. Support adequate to ensure structural integrity of the piping should also be provided directly below the discharge location.
4. Seal all penetrations through slab floor with polyurethane sealant.
5. Riser vent: For Diffuse Vertical Discharges: Not less than 15 feet (4.6 m) above grade nearest the point of discharge and 4 feet (120 cm) above, or not less than 15 feet (4.6 m) away from operable windows, doors or other passive ventilation openings into the occupiable portion of the structure or an adjacent structure. Install mesh critter guard at vent end.

SSV/SSD SYSTEM CROSS SECTION IN FLOOR



LEGEND:

- SUBJECT PROPERTY BOUNDARIES
- SUBJECT BUILDINGS
- BASEMENT AREA
- SSD TRENCH AND PERF PIPE
- SSD RISER
- PRE/POST COMMUNICATION TEST POINTS
- POST COMMUNICATION TEST POINTS (ACTIVE SSD ONLY)
- SEMI-PERMANENT SUB-SLAB MONITORING POINTS (ACTIVE SSD ONLY)

NOTES:

1. BASE MAP DEVELOPED FROM AN AERIAL PHOTOGRAPH MAP DATED 2018 AND ENW FIELD NOTES.
2. ALL BUILDING, STREET, AND FEATURE LOCATIONS ARE APPROXIMATE.
3. SYMBOLS REPRESENT LOCATION AND DO NOT ALWAYS REPRESENT EXACT SHAPE, SIZE, OR ORIENTATION.

APPROXIMATE SCALE
0 15 30 FEET

N

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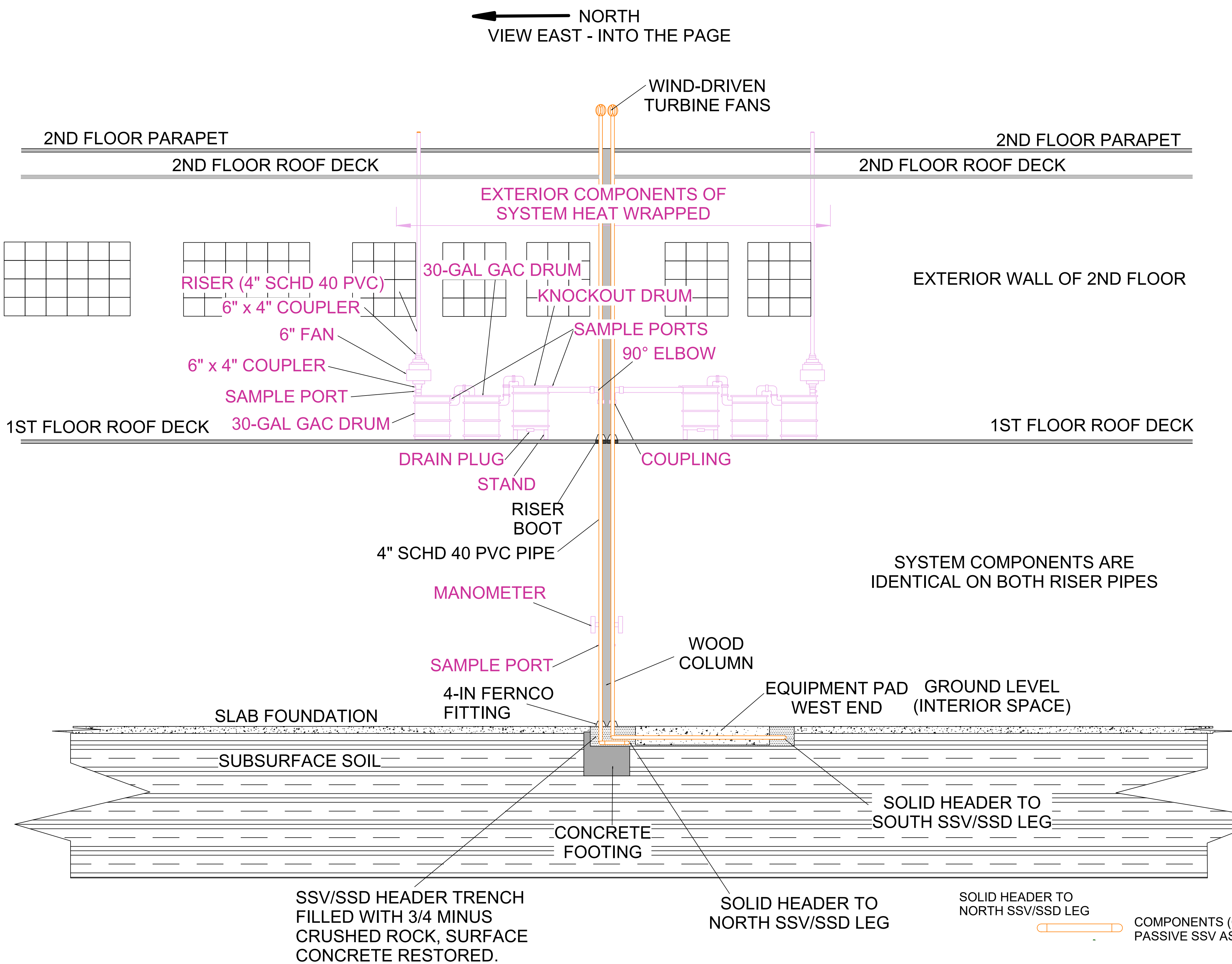
FIGURE 4
SUB-SLAB DEPRESSURIZATION SYSTEM (DETAIL)
IRWIN HODSON PROPERTY
2808 AND 2838 SE 9TH AVENUE
PORTLAND, OREGON

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
C. ROSEBROOK 01/18/2021	P. TRONE 08/03/2023	L. GREEN 08/03/2023	186-19002(v01)



SOLID HEADER TO NORTH SSV/SSD LEG

COMPONENTS (ORANGE) ARE FOR PASSIVE SSV AS INSTALLED

30-GAL GAC DRUM

COMPONENTS (PINK) ARE FOR AN ACTIVE SSD. NOT CURRENTLY INSTALLED.

NOT TO SCALE

INSTALLATION NOTES:

1. Above-ground Sub-Slab Ventilation (SSV) / Depressurization (SSD) (solid, not perforated) piping shall have a continuous downward slope towards the perforated pipe point of not less than 1/8 inch (3.2 mm) per foot (30 cm). Configurations that result in obstructed airflow by allowing water to collect within SSV/SSD piping are prohibited. This requirement is intended to allow rainwater or condensation within the pipes to drain downward into the ground beneath the slab floor.
2. All SSV/SSD duct piping, shall be rigid, non-perforated, schedule 40. PVC SSV/SSD piping shall be perforated 4" ID PVC drain pipe
3. Perforations shall be either circular or slots.
A. Circular perforations shall be 1/4 ± 1/16-inch diameter holes arranged in rows parallel to the axis of the pipe and evenly spaced along each row such that the center-to-center distance between perforations is not less than eight times the perforation diameter. Rows shall be arranged in two equal groups at equal distance from the bottom on each side of the vertical centerline of the pipe. The lowermost rows of perforations shall be separated by an arc of not less than 60 degrees or more than 125 degrees. The uppermost rows of perforations shall be separated by an arc not to exceed 166 degrees. The spacing of rows between these limits shall be uniform.
B. Slot perforations shall be located within the lower quadrants of the pipe with slots no wider than 1/8 inch and spaced not to exceed 11 times the perforation width. Slot perforations shall be symmetrically located in two rows, one on each side of the pipe centerline.
C. Perforations may appear at the ends of short and random lengths.
D. The minimum number of rows perforations (circular or slots) shall be two for a 4-inch ID pipe, which correlates to a minimum opening of 0.22 sq inches per lineal foot.
4. Supports for SSD plastic piping shall be installed at least every 10 feet (3m) on vertical runs and at least every 6 feet (1.8m) on horizontal runs. Support adequate to ensure structural integrity of the piping should also be provided directly below the discharge location and at fan location.
5. Flexible Coupling Disconnects: Where disassembly may be required in the future for maintenance purposes (fan), the disconnect shall consist of two unconnected portions of the SSD pipe joined with a flexible coupling.
6. Seal all penetrations through slab floor with polyurethane sealant.
7. Fan:
A. Since SSD, high flow, high negative pressure fan is required.
B. Fan will plug into outlet installed by Electrician located within 6 feet of fan.
C. Connect fan to solid duct piping from SSD using 90° elbows and flexible couplers on both inlet and outlet ends.
D. Extend riser vent from fan using 4-inch PVC to roof, or similar (maintaining drainage towards fan, with drains to SSV/SSD perf. piping.
8. Riser: For Diffused Horizontal Discharges (e.g.,rain caps): Not less than 15 feet (4.6 m) above grade nearest the point of discharge and 4 feet (120 cm) above, or not less than 15 feet (4.6 m) away from operable windows, doors or other passive ventilation openings into the occupiable portion of the structure or an adjacent structure.
9. Labeling:
A. Label solid piping from SSV/SSD system with "Sub-Slab Vapor Reduction" label.
B. A system description label shall be placed on a primary component of system (e.g. on duct piping near SSD fan), or within 12 inches (30 cm) of the electric service panel or other prominent location.
C. The label title shall state, "Sub-Slab Vapor Reduction System" or similar wording and include:
a. the date of installation;
b. an advisory stating that the building should be tested for sub-slab vapor at least every 2 years
c. an advisory stating that the system should be evaluated for mechanical performance quarterly
d. the installer's name, phone number and applicable certification identification;
C. Interior SSD duct piping shall be marked with not less than one label at each floor level with label titles stating "Sub-Slab Vapor Reduction System" or similar wording. For SSD systems, such labels should be affixed at intervals not greater than 10 feet (3 m) along the developed length of piping.
D. Disconnects such as switches or the receptacles providing power to plugged connections for mitigation system fans shall be marked to indicate their purpose. The label title shall identify that the disconnect is a component of a mitigation system such as with the text "Sub-Slab Vapor Fan", and can include instructions such as "Caution – Sub-Slab Vapor Fan", "Sub-Slab Vapor Fan – Leave Switch On" or "Sub-Slab Vapor Fan – Leave Plugged In."
E. The circuit breaker(s) protecting the mitigation system fan circuit(s) should also be labeled with the text "Sub-Slab Vapor" or "Sub-Slab Vapor Fan."
F. Clearly mark the manometer/vent to indicate the initial pressure reading.

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FIGURE 4

ACTIVE SSD EQUIPMENT

IRWIN HODSON PROPERTY
2808 AND 2838 SE 9TH AVENUE
PORTLAND, OREGON

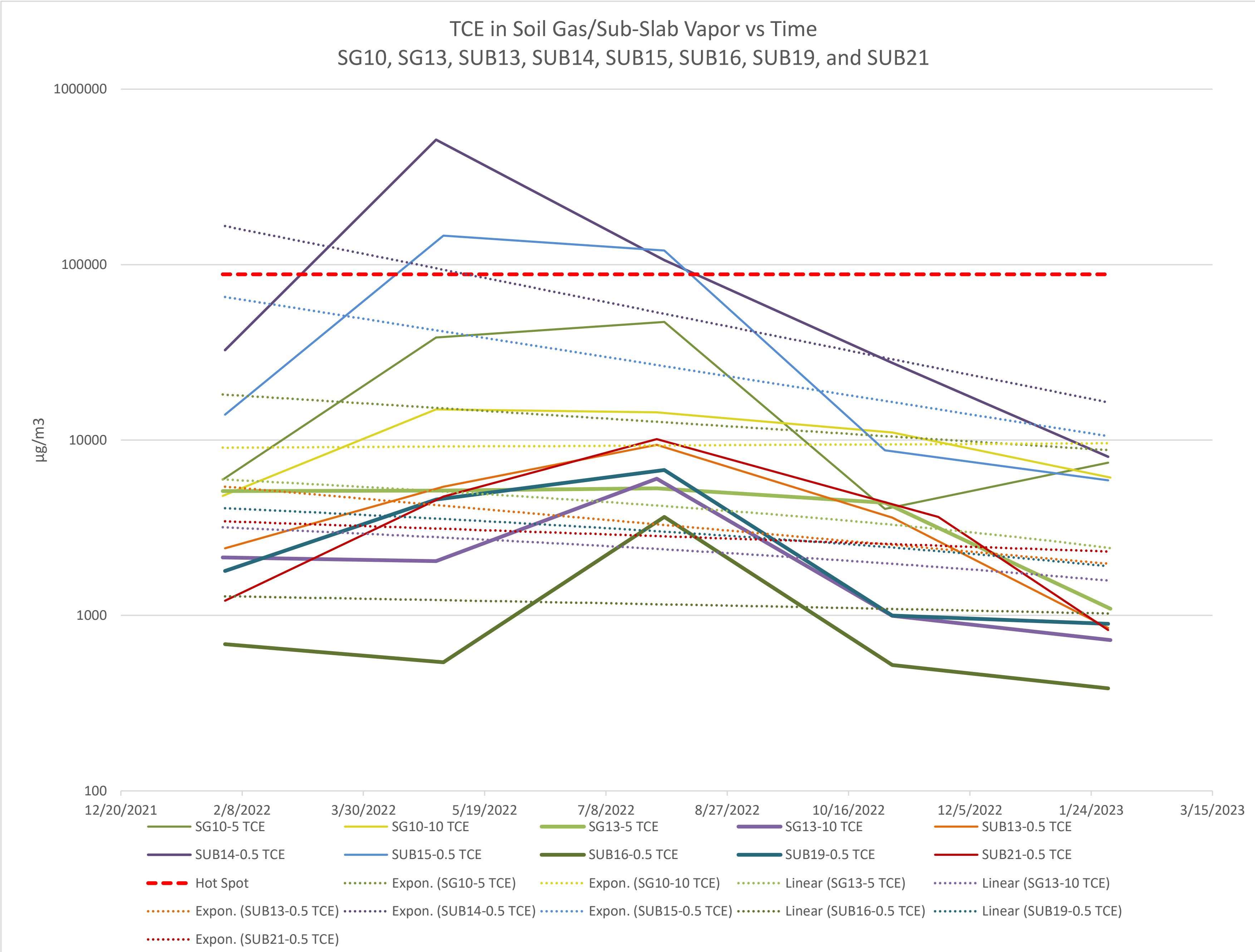
DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
C. ROSEBROOK 03/15/2021	P. TRONE 07/06/2023	L. GREEN 07/06/2023	186-19002(v01)

Appendix A

Chart – TCE in Sub-Slab Vapor and Soil Gas

(Post-Remediation Monitoring)

Chart E-3


TCE in Soil Gas/Sub-Slab Vapor vs Time
SG10, SG13, SUB13, SUB14, SUB15, SUB16, SUB19, and SUB21
µg/m3
1000000
100000
10000
1000
100
12/20/2021
2/8/2022
3/30/2022
5/19/2022
7/8/2022
8/27/2022
10/16/2022
12/5/2022
1/24/2023
3/15/2023
SG10-5 TCE
SG10-10 TCE
SG13-5 TCE
SG13-10 TCE
SUB13-0.5 TCE
SUB14-0.5 TCE
SUB15-0.5 TCE
SUB16-0.5 TCE
SUB19-0.5 TCE
SUB21-0.5 TCE
Hot Spot
Expon. (SG10-5 TCE)
Expon. (SG10-10 TCE)
Linear (SG13-5 TCE)
Linear (SG13-10 TCE)
Expon. (SUB13-0.5 TCE)
Expon. (SUB14-0.5 TCE)
Expon. (SUB15-0.5 TCE)
Linear (SUB16-0.5 TCE)
Linear (SUB19-0.5 TCE)
Expon. (SUB21-0.5 TCE)

Appendix B

AERScreen Air Dispersion Modeling Input Parameters

Appendix C
AERScreen Air Dispersion Modeling Input Parameters

Input Parameters

Control Options:

- Land Use: Urban
    - Population: 3500

Source:

- Type: Point
- Properties:
    - Emission Rate (E) = c * Q * 60 min/hr = 10.83 grains per hour (gr/hr) or 1.55E-03 pounds per hour (lb/hr)
        - TCE concentration at vent (c) = 1750 micrograms per cubic meter ($\mu g/m^3$) or 7.98E-04 grains per cubic foot (gr/ft^3) [concentrations based on iteration to determine maximum allowable concentration protective of identified receptors]
        - Flow velocity (v): 1350 feet/minute (ft/min) = 22.5 feet/sec (ft/s)[1]
        - Stack diameter (d): 4 inches
        - Stack cross-sectional area (A) = $\pi * (d/2)^2 = 0.087\ ft^2$
        - Flow Rate (Q): v * A = 118 cubic feet per minute (ft^3/min)
        - Total Flow Rate (Qt) two (2) units: 118 ft^3/min * 2 = 236 ft^3/min
    - Stack Height: 33 feet
    - Stack Temperature: use ambient
    - Exit Velocity (v): 22.5 ft/s * 2 stacks = 45 ft/s

Building:

- Building Height: 30 feet
- Maximum Horizontal Dimension: 678 ft
- Minimum Horizontal Dimension: 57 ft
- Maximum Dimension Angle to North: 90°
- Direction of S tack from Building Center: 100.8°
- Distance from Building Center to Stack: 280 ft

[1] From Radon Away RP265 velocity curves assuming 0.6 in H2O

Terrain:

- Import Elevations from: AERMAP
  - Executable: AERMAP_EPA_18081_64bit.exe
  - Datum: NAD 83
  - UTM Easting: 526851.07 m
  - UTM Northing: 5038834.66 m
  - UTM Zone: 10T
  - Override source elevation with AERMAP: yes
  - File Format: Digital Elevation Model (DEM): imported DEM file for a 0.5 square mile area around the site.

Receptors:

- Maximum Distance to Ambient Air: 25 feet to nearest roof intake
- Maximum Distance to Probe: 2200 feet
- Distances (bearings) to 10 Discrete Receptors:
  - 189 ft (72°)
  - 167 ft (110°)
  - 282 ft (143°)
  - 509 ft (162°)
  - 439 ft (183°)
  - 279 ft (194°)
  - 512 ft (204°)
  - 368 ft (227°)
  - 175 ft (285°)
  - 433 ft (7°)
- Flagpole Receptor Height: 5 feet

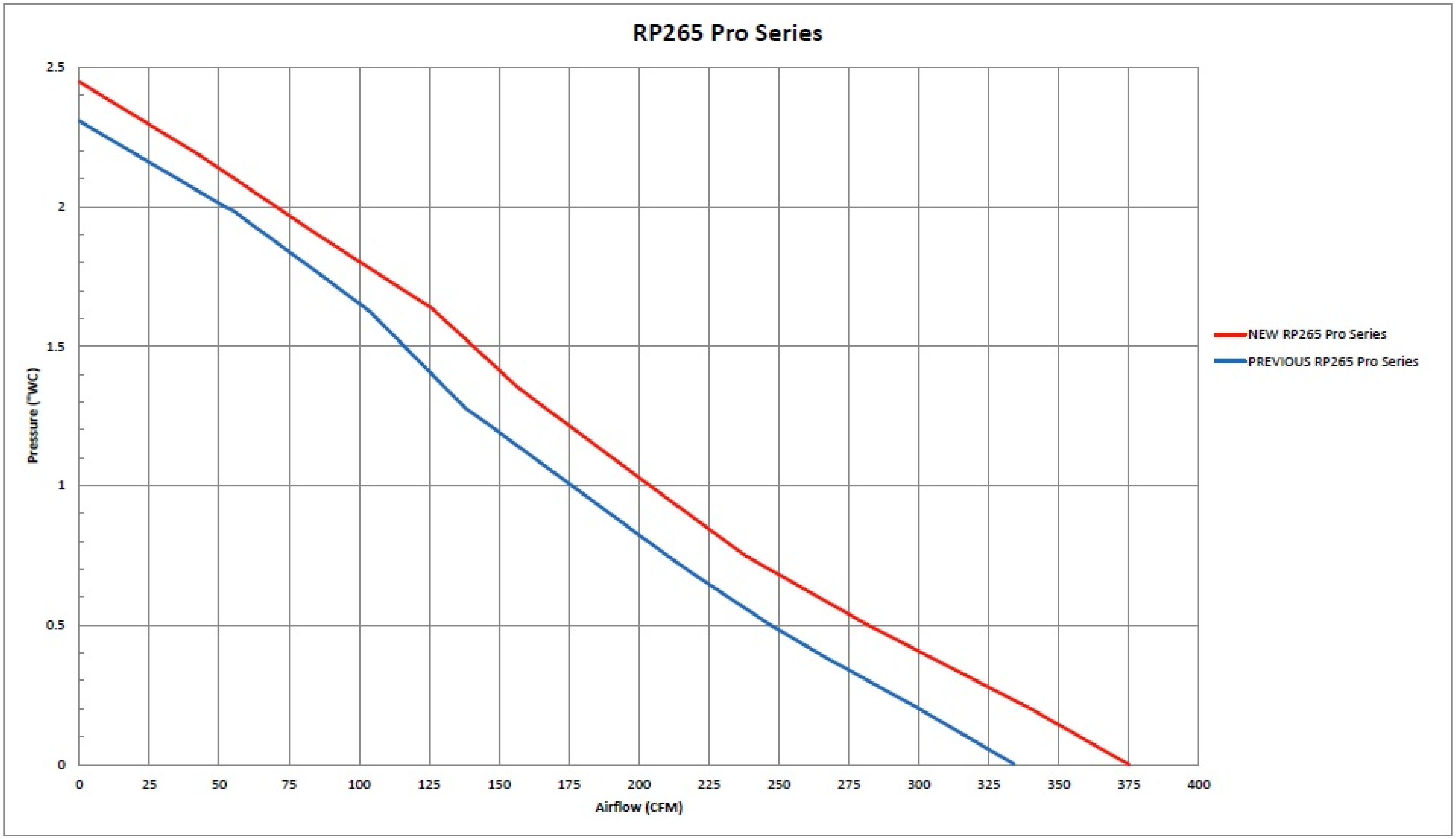
Appendix C
AERScreen Air Dispersion Modeling Input Parameters

Meteorology:

- Atmospheric Condition
    - Minimum Temperature: 32°F
    - Maximum Temperature: 105°F
    - Minimum Wind Speed: 0.5 m/s
    - Anemometer Height: 10 m
- Surface Characteristics
    - Use AERMET Seasonal Tables
        - Surface Profile: Urban
        - Climate Profile: Average
    - Adjust Surface Friction Velocity: yes

Appendix C

Radon Away RP265 Performance Information


RP265 Pro Series
Pressure ("WC)
Airflow (CFM)
0
0.5
1
1.5
2
2.5
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
NEW RP265 Pro Series
PREVIOUS RP265 Pro Series