EVERSHINE VI, L.P.

CORRECTIVE ACTION WORK PLAN

OKAIGAN DOJO
19720 STEVENS CREEK BLVD., CUPERTINO, CALIFORNIA

AUGUST 30, 2022

CORRECTIVE ACTION WORK PLAN

OKAIGAN DOJO
19720 STEVENS CREEK BLVD., CUPERTINO, CALIFORNIA

EVERSHINE VI, L.P.

PROJECT NO.: 31402714.000
DATE: AUGUST 2022

WSP
2570 NORTH FIRST STREET
SUITE 100
SAN JOSE, CA 95131

TEL.: +1 408 453-6100
FAX: +1 408 453-0496
WSP.COM

SIGNATURES

PREPARED BY

Daniel Cummings
Environmental Engineer

Xin Jiang
Assistant Consultant, Environmental Engineer

REVIEWED BY

Rick Freudenberger
Senior Director

Elena Robertson, P.G.
Senior Consultant, Geologist

PROFESSIONAL GEOLOGIST
ELENA ROBERTSON
No. 10030
EXP. 11/30/22
STATE OF CALIFORNIA

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1 INTRODUCTION

On behalf of Evershine VI, L.P. (Owner), WSP USA Inc. (WSP) has prepared this *Corrective Action Work Plan* (CAP) for 19720 Stevens Creek Boulevard, Cupertino, California (Site; Figure 1). The Site is listed as County of Santa Clara Department of Environmental Health (SCCDEH) site cleanup program case #2021-04s, GeoTracker ID #T10000016970.

This CAP addresses the area of the Site impacted by elevated concentrations of volatile organic compounds (VOCs), namely tetrachloroethene (PCE), in soil gas associated with historical dry cleaner operations. To minimize exposure of impacted soil gas for workers and occupants at the Site and other adjoining commercial spaces, the proposed engineering control will consist of the installation of a vapor intrusion mitigation system (VIMS). The VIMS will function as a sub slab depressurization (SSD) system, utilizing an energized fan to create negative pressure below the building, thereby mitigating vapor intrusion into the commercial spaces. This CAP provides a description of the technical approach and design of a SSD system, including equipment and materials specifications, the SSD extraction points/trench and monitoring points in relation to the Site, and the SSD system installation process.

1.1 SITE BACKGROUND

The Site is within a retail park and is a commercial suite that is part of a larger multi-unit complex. The retail park is bound by Stevens Creek Boulevard to the North, a gas station and retail plaza to the east, and residential homes to the south and west. Adjacent to the Site within the retail park is a pizza restaurant (Legends Pizza Co.), curtain and blind retail space, and a frozen yogurt restaurant (Yogurtland Cupertino). Dry cleaner operations were present at the Site from around 1992/1993 to 2012 (AEI Consultants [AEI], 2020). Several rounds of limited investigations conducted at the Site since 2007, as described in detail below, suggest former dry-cleaning operations have impacted shallow soil and soil vapor in the south and southwest portions of the Site.

1.2 PREVIOUS INVESTIGATIONS

Previous investigations of the Site (performed in 2007 and 2019 by AEI) have shown that shallow soil underlying the southwest portion of the Site may potentially have been impacted by historical dry-cleaning operations (AEI 2007 and 2019a). Concentrations of tetrachloroethene (PCE) were detected in some soil matrix samples, however those concentrations did not exceed the San Francisco Bay (SFB) Regional Water Quality Control Board (RWQCB) commercial/industrial environmental screening level (ESL; SFB RWQCB 2019). Previous boring and sample locations are depicted on Figure 2.

In September 2019 and January 2020, samples of soil gas, sub-slab vapor, and indoor air were collected by AEI to evaluate the potential for vapor intrusion of the VOCs detected previously in shallow soil matrix samples (AEI 2019b & 2020). Analytical results revealed PCE in sub-slab vapor samples (from 37 to 1,500 micrograms per cubic meter [$\mu g/m^3$]) and in soil gas samples (from 1.68 to 1,050 $\mu g/m^3$). Three of the four sub-slab vapor samples and nine of the twelve soil gas samples exceeded the commercial/industrial ESL for PCE of 67 $\mu g/m^3$. Furthermore, PCE (from 1.15 to 2.64 $\mu g/m^3$) was detected in indoor air samples; two of the three indoor air samples exceeded the commercial/industrial ESL for PCE of 2.0 $\mu g/m^3$.

In September 2020, WSP performed additional sub-slab vapor and indoor air sampling and analyses. The work was undertaken to confirm AEI's findings and to provide additional data for a possible design of a sub-slab depressurization (SSD) system to mitigate the potential for vapor intrusion into the building onsite, which operates as a commercial suite that is part of a larger multi-unit complex. Sub-slab vapor samples at all three sample locations contained PCE at concentrations (from 940 to 5,100 $\mu g/m^3$) that exceeded its commercial/industrial ESL of 67 $\mu g/m^3$ and trichloroethene (TCE) concentrations at one of the three locations (220 $\mu g/m^3$) that exceeded its commercial/industrial ESL of 100 $\mu g/m^3$. In addition, two of the three indoor air samples contained PCE concentrations (2.3 and 2.6 $\mu g/m^3$) that exceeded its ESL of 2 $\mu g/m^3$. In general, VOCs detected in the September 2020 samples were consistent with September 2019 and January 2020 sample results.

In February 2022, WSP conducted an additional vapor intrusion assessment which consisted of installation of six new sub-slab vapor probes (SV-006 through SV-010) installed within adjacent commercial suites to the Site, two nested soil gas probes (SGP-001 and SGP-002) installed immediately south of the Site, and indoor ambient air testing within adjacent commercial suites. PCE was detected at a concentration above the commercial/industrial ESL in only one of the six sub-slab vapor samples (SV-010 at a concentration of 1,000 µg/m^3), located in the adjacent commercial unit north of the restroom and storage closet area of the Site (Figure 3). The two nested soil gas probes also detected PCE over the ESL in all probe depths (of 5, 10, and 25 feet below ground surface (bgs)). PCE was not detected in indoor air samples collected in adjacent properties.

1.3 FUTURE SITE INVESTIGATION

Due to the detections of PCE in the nested soil gas probes installed immediately south of the Site (SGP-001 and SGP-002, Figure 3), SCCDEH concluded that the PCE soil gas plume has not been adequately defined horizontally or vertically in a directive letter dated June 3, 2022. Of particular concern is the potential for soil gas containing PCE beneath the residential properties south of the Site. WSP submitted a Site Assessment Workplan dated July 29, 2022, to further delineate both laterally and vertically, the extent of the PCE soil gas plume directly outside of the Site and to the South of the Site within the adjacent residential neighborhood and investigate whether sanitary sewer lines have acted as a migratory pathway for the PCE plume eastward or westwards. Pending SCCDEH comments and approval, this Workplan proposes installation of fifteen nested soil gas probes around the Site within the retail park and off-site in the residential neighborhood south of the property (Figure 4).

2 SSD SYSTEM DESIGN BASIS

2.1 REMEDIAL ACTION OBJECTIVE

The Response Action Objective (RAO) established for the Site that is both protective of human health and the environment and that reduces the potential for exposure to PCE in sub-slab vapor and soil gas encountered at the Site is reduce or eliminate the potential for exposure of PCE and other contaminants of potential concern at concentrations above the SFRWQCB Commercial/Industrial Ambient Air Screening Levels in Indoor Air to Site occupants (commercial/industrial receptors).

2.2 CONTAMINANTS OF POTENTIAL CONCERN

As summarized in Section 1.2, VOCs were detected above SFRWQCB screening levels in sub-slab vapor samples collected during the 2019, 2020, and 2022 investigations, with PCE, the primary contaminant of potential concern, at concentrations ranging from 37 µg/m^3 (SS-1) to 5,100 µg/m^3 (SV-002) onsite and from non-detected (SV-006, 19732 Stevens Creek Blvd.) to 1,000 µg/m^3 (SV-010; 19710 Stevens Creek Blvd.) offsite within the adjacent commercial units (Figure 3).

2.3 TECHNICAL RATIONALE

The design of the SSD system is based on concentrations and distribution of VOCs in the sub-slab exceeding screening levels, competency of the existing concrete floor as demonstrated by attenuation factors seen between co-located indoor and sub-slab vapor samples, and the anticipated air exchange rate and permeabilities of the sub-slab materials (gravel subbase and soil). Given a limited source area that is being targeted, pre-design pressure field extension testing will not be performed. Instead, the system design approach will rely on existing knowledge of Site subsurface conditions and the selection of a differential speed fan capable of achieving the desired extraction rate to effectively depressurize the subsurface floor area.

Based on historical results, the interior wall between 19710 and 19720 Stevens Creek Blvd. is assumed to be a demising wall lacking a foundation which has not inhibited the migration of VOCs in sub-slab vapor from the source area. Based on post-construction performance, an iterative approach may be taken to install additional extraction points/trenches if subsurface obstructions such as utilities are found during system activation. These obstructions may exhibit the potential for creating preferential pathways and stagnant areas outside the vacuum field.

2.4 PERMITTING

2.4.1 AIR POLLUTION CONTROL REQUIREMENTS

Before construction and operation of the SSD system can occur, the owner/operator of the emissions source will be required to submit an application for a Permit to Operate per Regulation 2 Rule 1 to the Bay Area Air Quality Management District (BAAQMD). WSP will coordinate with the BAAQMD to obtain the permit to construct/permit to operate. Review and determination are anticipated to require 4-5 months from the date of submittal. Based on long-term operation of the VIMS, the following applicable BAAQMD emissions standards will be evaluated:

- Regulation 8 Rule 47-301 Emission Control Requirement, Specific Compounds: Any air stripping and soil vapor extraction operations which emit benzene, vinyl chloride, PCE, methylene chloride and/or TCE shall be vented to a control device which reduces emissions to the atmosphere by at least 90 percent by weight.

- Regulation 8 Rule 47-302 Organic Compounds: Any air stripping and soil vapor extraction operations with a total organic compound emission greater than 15 pounds per day shall be vented to a control device which reduces the total organic compound emissions to the atmosphere by at least 90 percent by weight.
- Regulation 8 Rule 47-402 Less Than 1 Pound Per Day Petition: Any person seeking to satisfy the conditions of Section 8-47-113 shall:
- 402.1 Submit a petition to the Air Pollution Control Officer (APCO) in writing requesting review and written approval of a health risk screening analysis for the benzene, vinyl chloride, PCE, methylene chloride and/or TCE organic compound emissions that are less than 1 pound per day.

The sustainability of source area VOC volatilization will dictate VOC emissions to the atmosphere. WSP estimates that potential VOC emissions for the SSD system will be less than 0.1 pound per day (lb/day). This conservative estimate is derived from the maximum concentrations reported in the 2020 through 2022 sub-slab vapor analytical results and the fan's maximum flow rate at the highest differential speed setting. Therefore, abatement devices for emissions (per Regulation 8- Rule 47-301) are not expected, pending exemption under Regulation 8 Rule 47-113 granted, of which the system is expected to meet the requirements.

2.4.2 OTHER APPLICABLE REQUIREMENTS

Prior to beginning construction activities, building, mechanical, and electrical permits will be submitted for review and approval by the appropriate locality. The SSD system installation contractor will be responsible for obtaining all necessary construction permits.

3 SSD SYSTEM DESCRIPTION AND INSTALLATION

The VIMS will consist of an SSD extraction trench with a dedicated extraction fan and exhaust stack, designed to provide a low negative pressure in the sub-slab area and a preferential pathway of the building for discharge to the building roof. The proposed SSD system layout is shown on Sheet 3 of Appendix A. The following section provides a brief description of system components and the installation process.

All work will be conducted in accordance with a Health and Safety Plan (HASP) per 29 CFR 1910.120 and Title 8 California Code of Regulations Section 5192 to address potential hazards at the Site during the work activities related to the installation of the SSD System. The current Site-specific HASP is enclosed in Appendix B.

3.1 EXTRACTION TRENCH

Based on the location of sub-slab soil vapor exceeding screening criteria and the preference to avoid disruption to the tenant space with an extensive extraction point networks along the perimeter of the commercial suite, a centrally located extraction trench was selected. The extraction trench will be constructed within the building by neatly removing 21-foot-long and 18-inch-wide concrete and excavating an approximately 21-foot-long by 12-inch-wide by 6-inch- deep pit into the subgrade below the existing concrete floor slab. Dust suppressant will be applied, as needed, to reduce or prevent dust emissions resulting from construction activities. To promote the efficient removal of sub-slab vapor, the trench will first be filled with a 2-inch thick, highly permeable, washed gravel layer consisting of ½ to ¾-inch aggregate. The gravel layer will provide a path of least resistance for sub-slab vapor to migrate to the extraction point. A 16-foot section of 3-inch diameter, perforated, ASTM D2729 polyvinyl chloride (PVC) drainpipe will be placed below-grade inside the trench connected to an approximate four-foot section of three-inch diameter, solid schedule 40 PVC pipe. A cleanout will be installed at the end of the drainpipe to allow for future access for any maintenance needs. At a wall located adjacent to the end of the trench, three-inch diameter, Schedule 40 PVC transfer pipe will be stubbed-up vertically to the wall with applicable pipe hangers or straps. Vapor transfer piping consisting of three-inch diameter, Schedule 40 PVC pipe will be connected to the stubbed-up pipe located in the trench and routed vertically to the structural members running along the building's ceiling as shown on Sheet 3 of Appendix A.

Following the SSD extraction trench excavation, the soil spoils, concrete, and drilling fluids will be containerized, labeled, and moved to a waste storage area. The solids and liquids will be containerized separately. The soil, concrete, and liquids will be characterized and promptly disposed of in accordance with all applicable requirements.

Concrete removed for the extraction trench will be replaced to match the pre-existing conditions (grade, surface finish, and control joint spacing). Replacement concrete will also match the existing reinforcement and slab thickness and meet 4,000-pounds-per-square-inch compressive strength after 28 days of curing. If no reinforcement is observed, at a minimum, the concrete will be reinforced with welded wire fabric (4x4 - W1.4xW1.4) centered in the concrete slab. Prior to placing the concrete, deformities in the exposed concrete face will be patched to allow full bonding of new concrete with existing concrete. All concrete will be underlain by six-mil plastic sheeting. Concrete restoration details are provided on Sheet 4 of Appendix A.

3.2 SSD SYSTEM VAPOR TRANSFER PIPING

SSD transfer piping will transition horizontally along the ceiling's structural members to a roof-mounted fan and discharge point. Horizontal conveyance piping will be hung along an appropriate route as shown on Sheet 3 of Appendix A. Appropriately sized piping hangers or straps will be suspended from the ceiling's structural members to support piping at a maximum of 36 inches below the building's interior ceiling. All above-grade SSD transfer piping will be sloped

approximately 1%, towards the extraction trench riser pipe as shown on Sheet 4 of Appendix A. The actual pipe runs may be modified in the field as needed to accommodate features of the interior of the building.

3.2.1 EQUIPMENT AND INSTRUMENTATION

The horizontal pipe, transitioning to three-inch-diameter black iron pipe, will be stubbed up to penetrate through the building's roof, and will be flashed and sealed to prevent roof leaks. On the exterior side of the roof penetration, a three-inch-diameter ductile iron butterfly valve (NIBCO NLH250F or equivalent) will be installed as a temporary shut-off valve during maintenance activities. Following this valve, horizontal pipe running along the building roof will be routed to an inline fan (Obar Systems model GBR76-UD) installed to maintain a small negative pressure beneath the tenant space and to exhaust the vapors to the atmosphere (Appendix A, Sheet 4). The inline fan will be equipped with an internal condensate bypass to minimize the potential for water draining into the fan, a potential hazard that could decrease the life of the fan. The fan housing will be supported by non-penetrating rubber supports and aluminum mount framework to address wind concerns and allow for ease of replacement. Horizontal piping on the roof shall be supported at non-penetrating rubber supports with applicable pipe clamps at a maximum of every 10 feet.

A dedicated electrical connection will be installed between the existing 120-volt, single phase electrical supply (located inside the tenant space) and the fan's weather-proof enclosure as shown on Sheet 4 of Appendix A. The electrical wiring will be routed along interior walls or along the ceiling using electrical metallic tubing (EMT) conduit and vertically down to an electrical service panel inside the building using appropriate clamps or hangers. A master shut-off switch will be installed outside, at or near the fan, in-line between the electrical supply and the fan enclosure. At the electrical service panel, a locking clip will be affixed to the breaker operating the circuit the fan runs on. Electrical installation will be by a licensed contractor and will comply with electrical code.

Discharge piping from the fan's outlet will consist of three 3-inch diameter Schedule 40 black iron pipe. The discharge stack after the fan will be equipped with a three-inch U-bend. The discharge stack shall terminate a minimum of two feet above the highest point of the building roof structure and at least 10 feet horizontally from any of the building's air handling equipment intakes or windows. Warning labels as specified on Sheet 4 of Appendix A will be placed on the SSD conveyance piping and master switch. At the roof penetration, the roofing material will be restored as appropriate based on field observations.

3.2.2 POST-CONSTRUCTION TESTING AND REMOTE MONITORING

For post-construction diagnostic testing and performance monitoring of the SSD System, a sample port will be installed at the extraction point riser as shown on Sheet 4 of Appendix A. The sample port will be configured to allow for future in-line flow measurements, as needed, using an averaging pitot tube such as a Dwyer® Series DS Flow Sensor and vacuum measurements, using a differential pressure gauge.

Additionally, a differential pressure switch will be installed inline on the extraction piping to monitor the system and ensure continuous and effective operation. Conditions which have the potential for impacting the effectiveness of the system include power outages, damage and degradation of components, change in building occupancy, use, or ventilation, and alterations to the building slab. The switch will be wired to a cloud-based, cellular monitoring unit with an auto dialer function that will trigger notifications to the appropriate personnel by email or text message if an alarm condition is present (e.g., low vacuum at the switch). Similar to the fan, the remote monitoring unit and associated switch will be connected to the existing 120-volt, single phase electrical supply located inside the tenant space. For the unit, a backup battery will be used to ensure communication during the event of a power outage. A green pilot light indicator shall also be provided near the remote monitoring unit which indicates to occupants directly that the fan is in operation.

3.1 WASTE MANAGEMENT

Concrete generated during extraction trenching will be stored in drums, roll-off containers, or equivalent, prior to disposal. For excavated soils, a composite soil sample will be analyzed for VOCs using Environmental Protection Agency (EPA) method 8260B. The selected offsite disposal facility will specify additional analytical requirements, if any. A licensed waste hauler will profile the soil for disposal based on the results of the composite soil sample. The soil will be transported to a designated disposal facility under non-hazardous or uniform hazardous waste manifests.

4 SYSTEM STARTUP AND MONITORING

The objective of system startup is to ensure the SSD system is installed and operating in accordance with the specifications described in Section 3. Systems start-up includes the following components: baseline sample collection, equipment testing, system repair, system balancing, and system monitoring.

4.1 BASELINE CONDITIONS

Sub-slab vapor and soil gas data from site investigations conducted in September 2020 through September 2022 will be used for baseline conditions in assessing the performance and effectiveness of the system. In the period between the collection of this dataset and the installation of the system, no significant construction is expected which may change subsurface (e.g., utility installation; slab removal or replacement) or building characteristics (e.g., HVAC system alterations).

4.1.1 MONITORING POINT TESTING

Baseline and post-construction vacuum field propagation will be measured and evaluated using nine existing sub-slab vapor probes previously installed within the tenant spaces for 19700, 19710, 19720, and 19732 Stevens Creek Blvd (Appendix A, Sheet 2). Locations are comprised of a Vapor Pin® installed into the concrete floor slab in accordance with the manufacturer's instructions and fitted with a flush-mounted cover for protection from pedestrian traffic. Additional monitoring points may be installed within the targeted area based on the monitoring results of the proposed points. The installation of any additional sub-slab or soil vapor monitoring probes will be consistent with the existing monitoring points installed by WSP. Measurements from each Vapor Pin® shall be recorded using a digital micro-manometer with 0.001 inches of water column resolution.

4.2 EQUIPMENT STARTUP

Equipment testing is required to test the integrity and function of individual components of the SSD system and the system as a whole. The inspector will verify that each component has been installed in accordance with the manufacturer's specifications. Non-conformances will be documented, repaired, and re-tested. Testing activities will include:

- leakage testing on exposed piping connections,
- fan performance testing (flow and vacuum measurements),
- valve operation testing, and
- and alarm and remote monitoring communication testing.

In addition, after startup, a pressure field extension test will be performed following the same procedures required for gathering baseline conditions in Section 4.1. The pressure field extension testing will be used to measure the system's radius of influence or vacuum propagation beneath the slab relative to indoor air.

4.3 COMPLETION REPORT AND OPERATION AND MAINTENANCE ACTIVITIES

After completion of SSD system startup activities, a Completion Report and full-time operation and maintenance (O&M) activities will be completed as described below and submitted electronically to SCCDEH via GeoTracker

Completion Report(s) – The Completion Report(s) will include confirmation that the earthwork activities were completed according to the CAP; include descriptions and justifications for any activities that varied from the CAP; include final VIMS as-built documentation, including any other information relevant to installation of the VIMS, such as copies of permits, VIMS construction quality certification, specifications, and photo documentation of the VIMS installation; include final waste manifest(s) for disposal of soil and/or groundwater removed during construction; and include documentation of the source(s), analyses, volumes, and locations of any soil reused on site and any imported clean fill. These reports must be approved in writing by SCCDEH prior to occupancy of each building.

VIMS Operation, Maintenance, and Monitoring (OM&M) Plan(s) – The VIMS OM&M Plan(s) shall be submitted to the DEH for review and approval and will include final as-built VIMS design details and a description of verification sampling to evaluate the effectiveness of each VIMS and provide general requirements and controls to maintain the long-term integrity of each VIMS. The VIMS OM&M Plan(s) will provide general requirements and controls to maintain the long-term integrity of each VIMS. These reports must be approved in writing by SCCDEH prior to occupancy of each building.

The OM&M Plan(s) shall include a minimum of five verification sampling events for each building to evaluate the operational effectiveness of each VIMS. For each sampling event, both sub-barrier soil gas and above-barrier air samples shall be collected. The five sampling events are generally described below. Samples shall be analyzed for VOCs.

Sampling Events 1 and 2 – Sub-barrier soil gas and above-barrier air sampling shall occur following construction completion and prior to occupancy of each building over two 24-hour sampling periods to evaluate the effectiveness of each VIMS, one with the HVAC system on and one with the HVAC system off. If the SSD system is operational at the time, the system shall be temporarily shut down at least 2 weeks prior to Sampling Events 1 and 2. The results shall be included in a Pre-Occupancy Verification Monitoring Report(s), which must be approved in writing by SCCDEH prior to occupancy of each building.

Sampling Events 3 and 4 – Sub-barrier soil gas and above-barrier air sampling shall occur approximately 6- and 12-months following occupancy of each building. Results shall be included in a Long-Term Verification Monitoring Report(s) (1-Year Event).

Sampling Event 5 – Sub-barrier soil gas and above-barrier air sampling shall occur approximately 1-year following Sampling Event 4 at each building. Results shall be included in a Long-Term Verification Monitoring Report(s) (2-Year Event).

4.3.1 CONTINGENCY ACTIONS AND MONITORING ADJUSTMENTS

Based on changing site conditions and performance monitoring results, contingency actions may be performed in situations where the VIMS is not operating effectively to protect occupant health. The response time for implementing contingency actions will be consistent with the nature and magnitude of the vapor intrusion threat. Notification to the Owner and occupants will be provided when the system is inoperative for a significant period of time and significant changes are needed. Contingency actions resulting from unfavorable monitoring results may include resampling and analysis, increasing sampling frequency, or implementing short-term mitigation measures such as sealing or ventilating vapor conduits. Based on SFBRWQCB guidance, a VIMS incident report will be submitted electronically to SCCDEH via GeoTracker 30 days after completion of the contingency action.

5 SYSTEM DISCONTINUATION

The active SSD system will not be discontinued unless prior written approval is granted by the SCCDEH. If monitoring data indicates that the SSD system may no longer be required in active operation due to a reduction in risk to Site occupants, a proposal to discontinue its operation will be submitted by the remedial party to the SCCDEH and SFB RWQCB. Prior to this proposal, the remedial party will develop a shutdown monitoring plan for evaluation of the system.

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DWG Name: 314MN2714.000-005

Checked: AM 3/16/2022

Approved:

Drawn By: LS 3/16/2022

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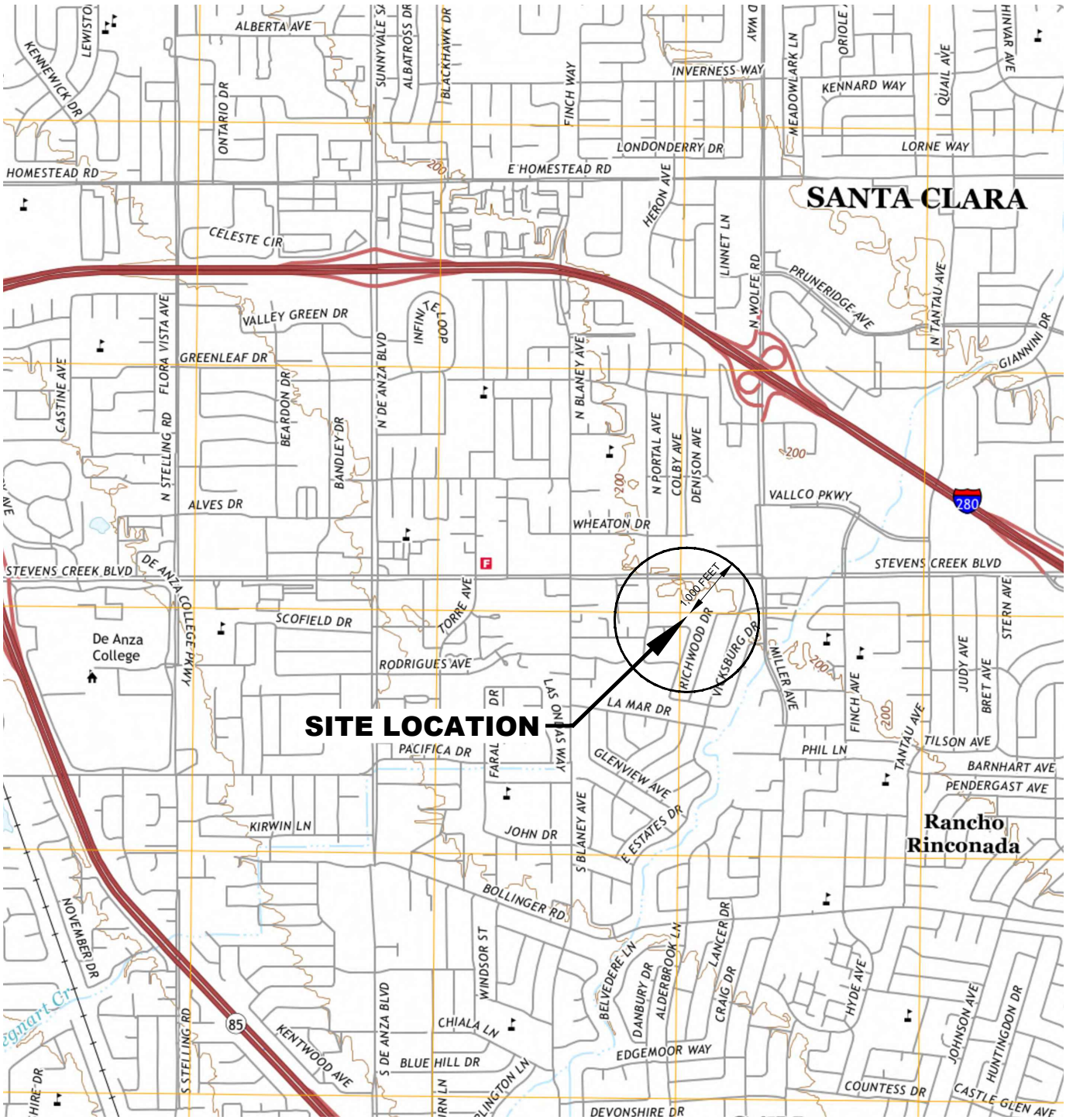


REFERENCE
7.5 MINUTE SERIES TOPOGRAPHIC QUADRANGLE
CUPERTINO, CALIFORNIA 2018

N

0 2,000 4,000
SCALE IN FEET

QUADRANGLE LOCATION

INSET OF SITE
SCALE: 1"=400'

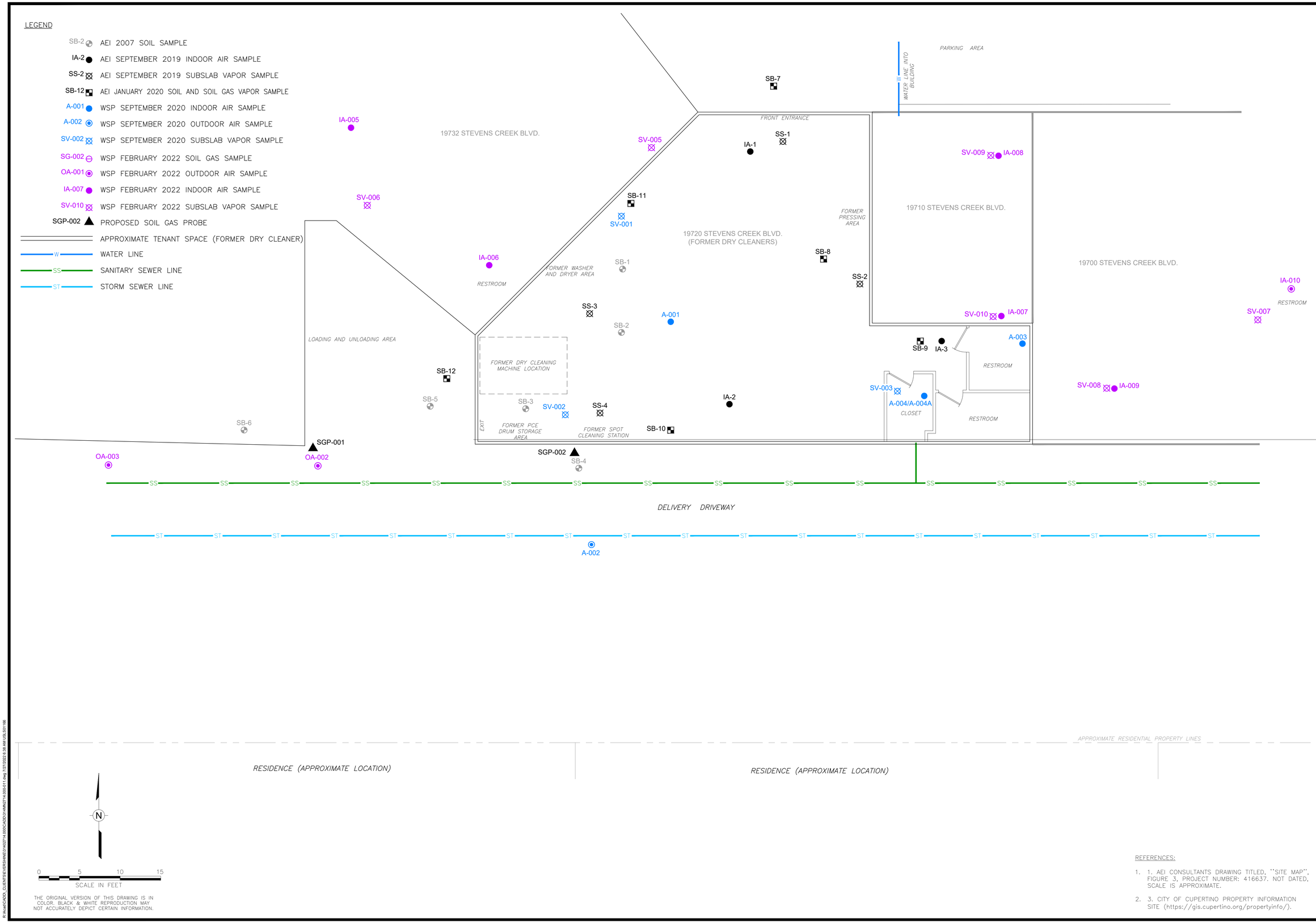
WSP USA Inc.
2025 GATEWAY PLACE
SUITE 348
SAN JOSE, CA 95110
TEL: +1 408.453.6100

Figure 1

SITE LOCATION MAP

19720 STEVENS CREEK BOULEVARD
CUPERTINO, CALIFORNIA

PREPARED FOR
EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA



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REFERENCES:

1. 1. AEI CONSULTANTS DRAWING TITLED, "SITE MAP", FIGURE 3, PROJECT NUMBER: 416637. NOT DATED, SCALE IS APPROXIMATE.
2. 3. CITY OF CUPERTINO PROPERTY INFORMATION SITE (https://gis.cupertino.org/propertyinfo/).

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Checked: ER 7/27/2022
Approved:
DWG Name: 314MN2714.000-011

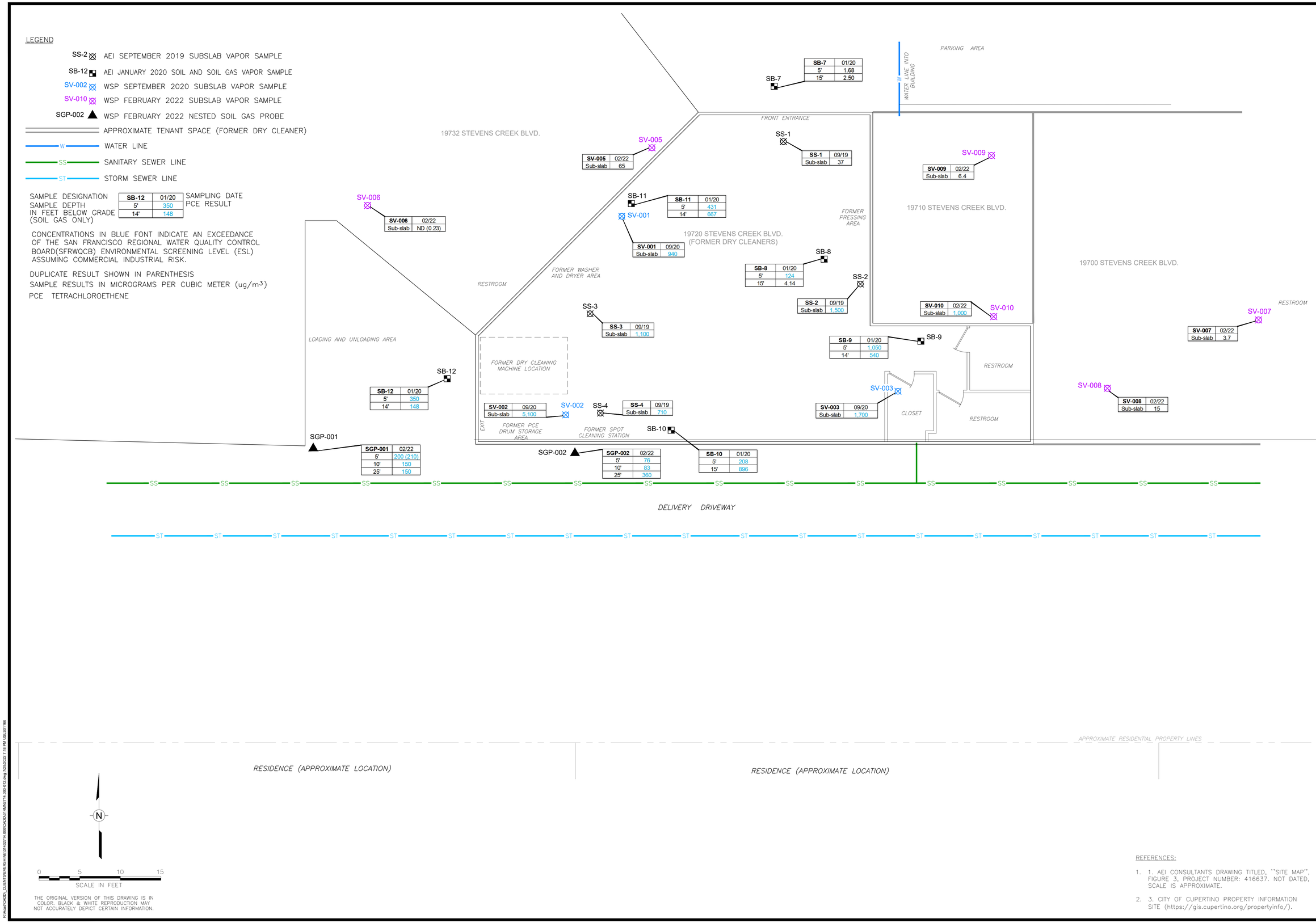
19720 STEVENS CREEK BOULEVARD
CUPERTINO, CALIFORNIA

PREPARED FOR
EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

Figure 2

SITE LAYOUT
EXISTING BORING AND SAMPLING LOCATIONS

WSP USA Inc.
2025 GATEWAY PLACE
SUITE 348
SAN JOSE, CA 95110
TEL: +1 408.453.6100



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DWG Name: 314MN2714.000-012

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CUPERTINO, CALIFORNIA

PREPARED FOR
EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

Figure 3

HISTORIC PCE CONCENTRATIONS IN SOIL GAS

WSP USA Inc.
2025 GATEWAY PLACE
SUITE 348
SAN JOSE, CA 95110
TEL: +1 408.453.6100

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APPENDIX

A SSD SYSTEM DESIGN DRAWING PACKAGE

INDEX OF DRAWINGS

DRAWING NUMBER	SHEET NUMBER	DESCRIPTION
314P2714.000-D06	1	TITLE SHEET
314P2714.000-D07	2	INDOOR AIR, SUB-SLAB VAPOR, AND SOIL GAS SAMPLING LOCATIONS AND RESULTS
314P2714.000-D08	3	SSD SYSTEM LAYOUT
314P2714.000-D09	4	SSD SYSTEM CONSTRUCTION DETAILS

TITLE SHEET

SUB-SLAB DEPRESSURIZATION SYSTEM DESIGN

19720 STEVENS CREEK BLVD.
CUPERTINO, CALIFORNIA

PREPARED FOR

EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

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TITLE SHEET

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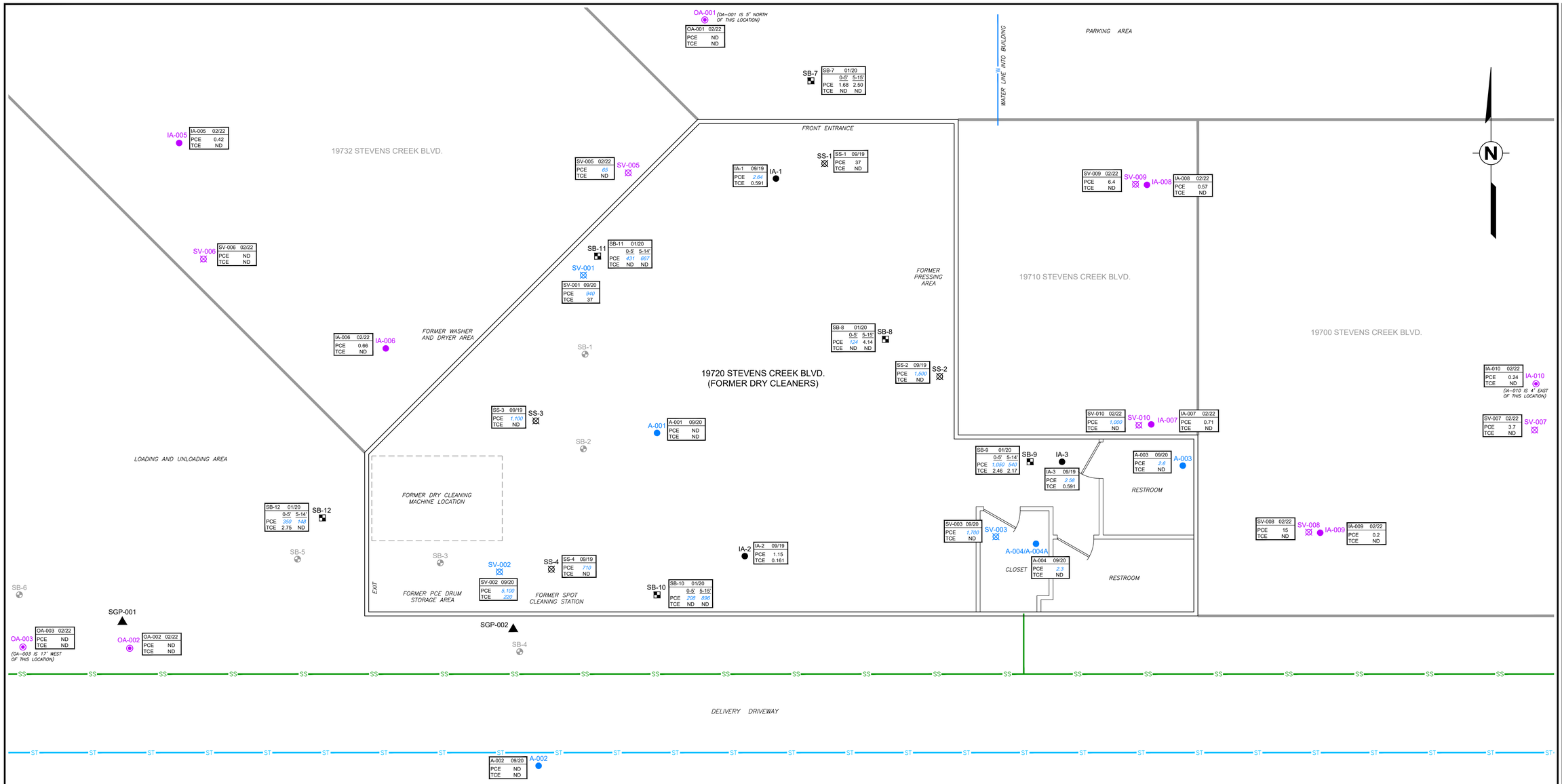
SHEET 1

Drawing Number
314P2714.000–D06



LEGEND

SB-2	AEI 2007 SOIL SAMPLE
IA-2	AEI SEPTEMBER 2019 INDOOR AIR SAMPLE
SS-2	AEI SEPTEMBER 2019 SUB–SLAB SAMPLE
SB-12	AEI JANUARY 2020 SOIL AND SOIL GAS VAPOR SAMPLE
A-002	SEPTEMBER 2020 INDOOR AND OUTDOOR AIR SAMPLE
SV-002	SEPTEMBER 2020 SUB–SLAB VAPOR SAMPLE
SV-010	WSP FEBRUARY 2022 SUB–SLAB VAPOR SAMPLE
SGP-002	WSP FEBRUARY 2022 NEST SOIL GAS PROBE
IA-007	WSP FEBRUARY 2022 INDOOR AIR SAMPLE
OA-001	WSP FEBRUARY 2022 OUTDOOR AIR SAMPLE
	APPROXIMATE TENANT SPACE (FORMER DRY CLEANER)
W	WATER LINE
SS	SANITARY SEWER LINE
ST	STORM SEWER LINE

LEGEND

SB-8 01/20 0-5' 5-15' PCE 124 4.14 TCE ND ND

- SAMPLE DESIGNATION
- SAMPLING DATE
- SAMPLE DEPTH IN FEET BELOW GROUND SURFACE (SOIL GAS ONLY)
- SAMPLE RESULTS IN MICROGRAMS PER CUBIC METER (mg/m^3) – *BLUE ITALIC* EXCEEDS ESL
- CONSTITUENTS

A or IA	INDOOR AIR
OA	OUTDOOR AIR
SB or SG	SOIL GAS
SS or SV	SUB–SLAB VAPOR
PCE	TETRACHLOROETHENE
TCE	TRICHLOROETHENE
ND	NOT DETECTED ABOVE CRITERIA

COMMERCIAL/INDUSTRIAL ENVIRONMENTAL SCREEN LEVELS (ESLs)		
	INDOOR AIR (mg/m^3)	SUB–SLAB VAPOR/ SOIL GAS (mg/m^3)
PCE	2	67
TCE	3	100

NOTES:

1. SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD ESLs FROM AUGUST 2019 (REV. 2) SUMMARY TABLES.
2. ALL SAMPLE LOCATIONS ARE APPROXIMATE.

REFERENCE:

AEI CONSULTANTS DRAWING TITLED, "SITE MAP", FIGURE 3, PROJECT NUMBER: 416637. NOT DATED, SCALE IS APPROXIMATE.

4 0 4 8
APPROXIMATE SCALE, FEET

D

RESIDENCE (APPROXIMATE LOCATION)

APPROXIMATE RESIDENTIAL PROPERTY LINES

RESIDENCE (APPROXIMATE LOCATION)

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INDOOR AIR, SUB–SLAB VAPOR, AND SOIL GAS SAMPLING LOCATIONS AND RESULTS

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CUPERTINO, CALIFORNIA

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EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

WSP USA Inc.
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SAN JOSE, CA 95110
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SHEET 2

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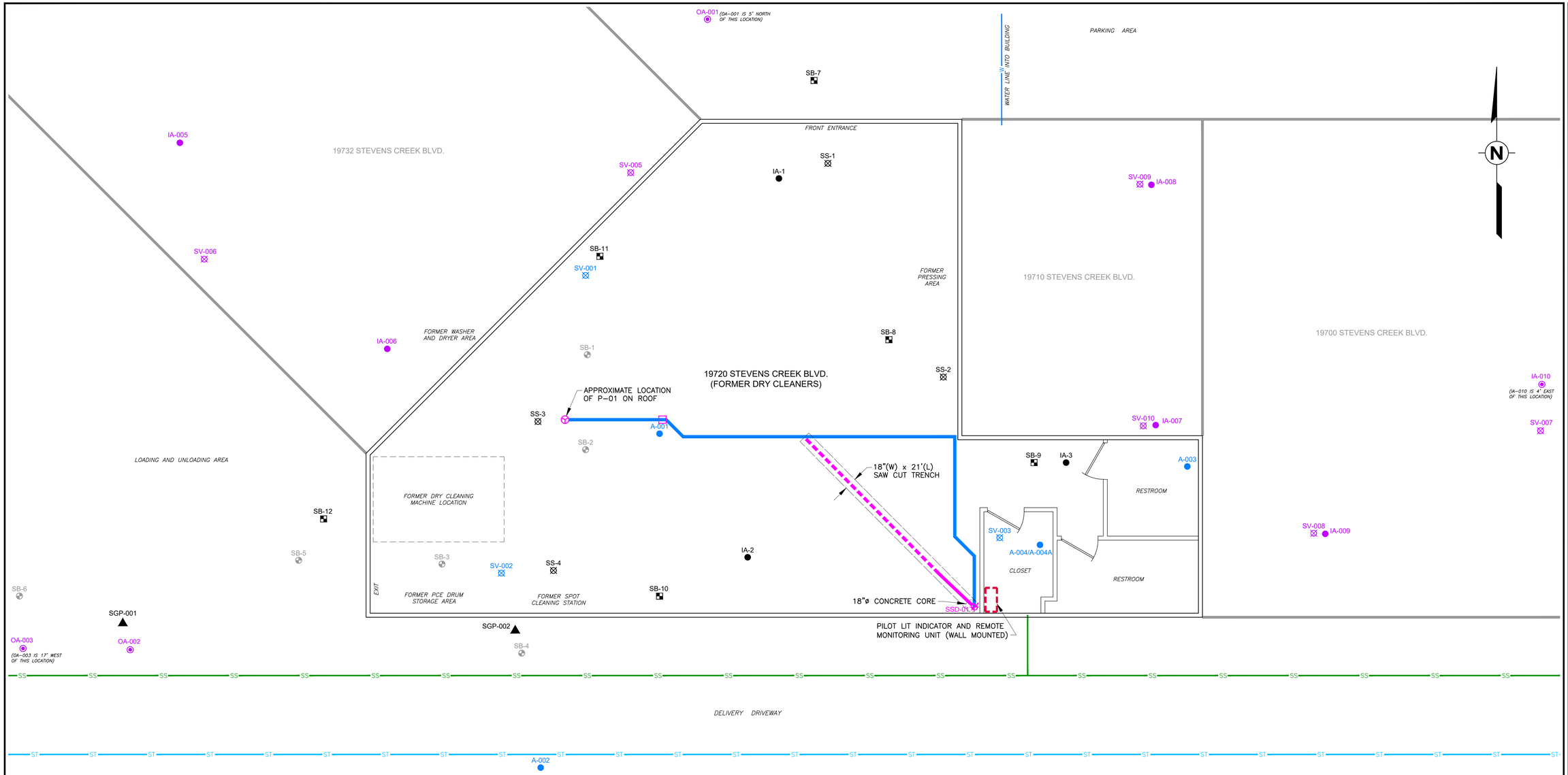

LEGEND

SB-2	AEI 2007 SOIL SAMPLE
IA-2	AEI SEPTEMBER 2019 INDOOR AIR SAMPLE
SS-2	AEI SEPTEMBER 2019 SUB-SLAB SAMPLE
SB-12	AEI JANUARY 2020 SOIL AND SOIL GAS VAPOR SAMPLE
A-002	SEPTEMBER 2020 INDOOR AIR SAMPLE
SV-002	SEPTEMBER 2020 SUB-SLAB VAPOR SAMPLE
SV-010	WSP FEBRUARY 2022 SUB-SLAB VAPOR SAMPLE
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IA-007	WSP FEBRUARY 2022 INDOOR AIR SAMPLE
OA-001	WSP FEBRUARY 2022 OUTDOOR AIR SAMPLE
	APPROXIMATE TENANT SPACE (FORMER DRY CLEANER)
W	WATER LINE
SS	SANITARY SEWER LINE
ST	STORM SEWER LINE

LEGEND

SSD-01	PROPOSED VERTICAL RISER/SSD SYSTEM EXTRACTION POINT
	PROPOSED DISCHARGE FAN (ROOF MOUNTED)
	PROPOSED ROOF PENETRATION
	PROPOSED BELOW GRADE 3"ø SCH. 40 PVC VAPOR CONVEYANCE PIPING
	PROPOSED BELOW GRADE 3"ø PERFORATED PVC SEWER AND DRAIN PIPING
	PROPOSED ABOVE GRADE 3"ø SCH. 40 PVC VAPOR CONVEYANCE PIPING

NOTE:

ALL SAMPLE LOCATIONS ARE APPROXIMATE.

REFERENCE:

AEI CONSULTANTS DRAWING TITLED, "SITE MAP", FIGURE 3, PROJECT NUMBER: 416637. NOT DATED, SCALE IS APPROXIMATE.

4 0 4 8
APPROXIMATE SCALE, FEET

D

RESIDENCE (APPROXIMATE LOCATION)

APPROXIMATE RESIDENTIAL PROPERTY LINES

RESIDENCE (APPROXIMATE LOCATION)

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SSD SYSTEM LAYOUT

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CUPERTINO, CALIFORNIA

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EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

WSP USA Inc.
2025 GATEWAY PLACE, SUITE 348
SAN JOSE, CA 95110
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SHEET 3

Drawing Number
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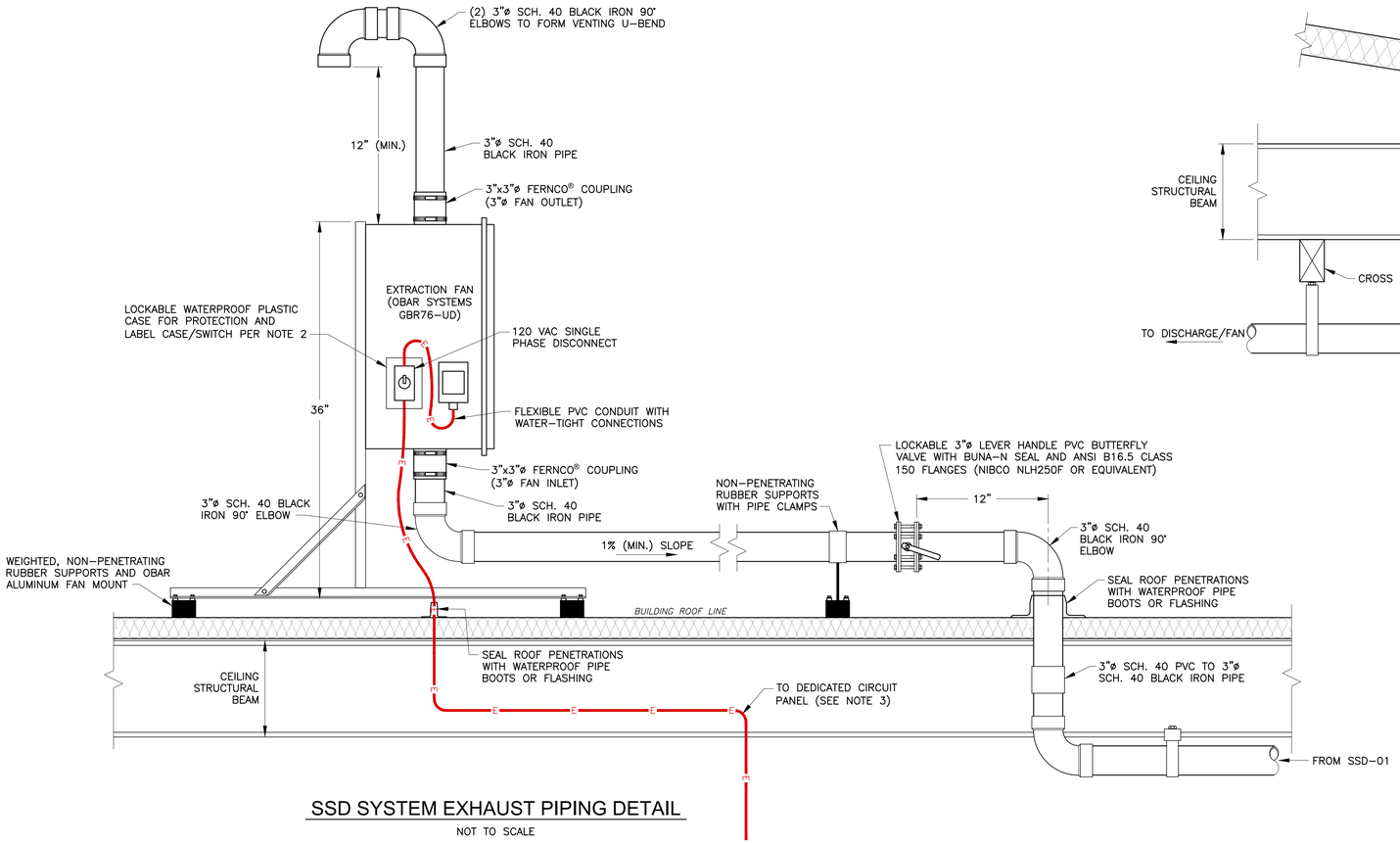
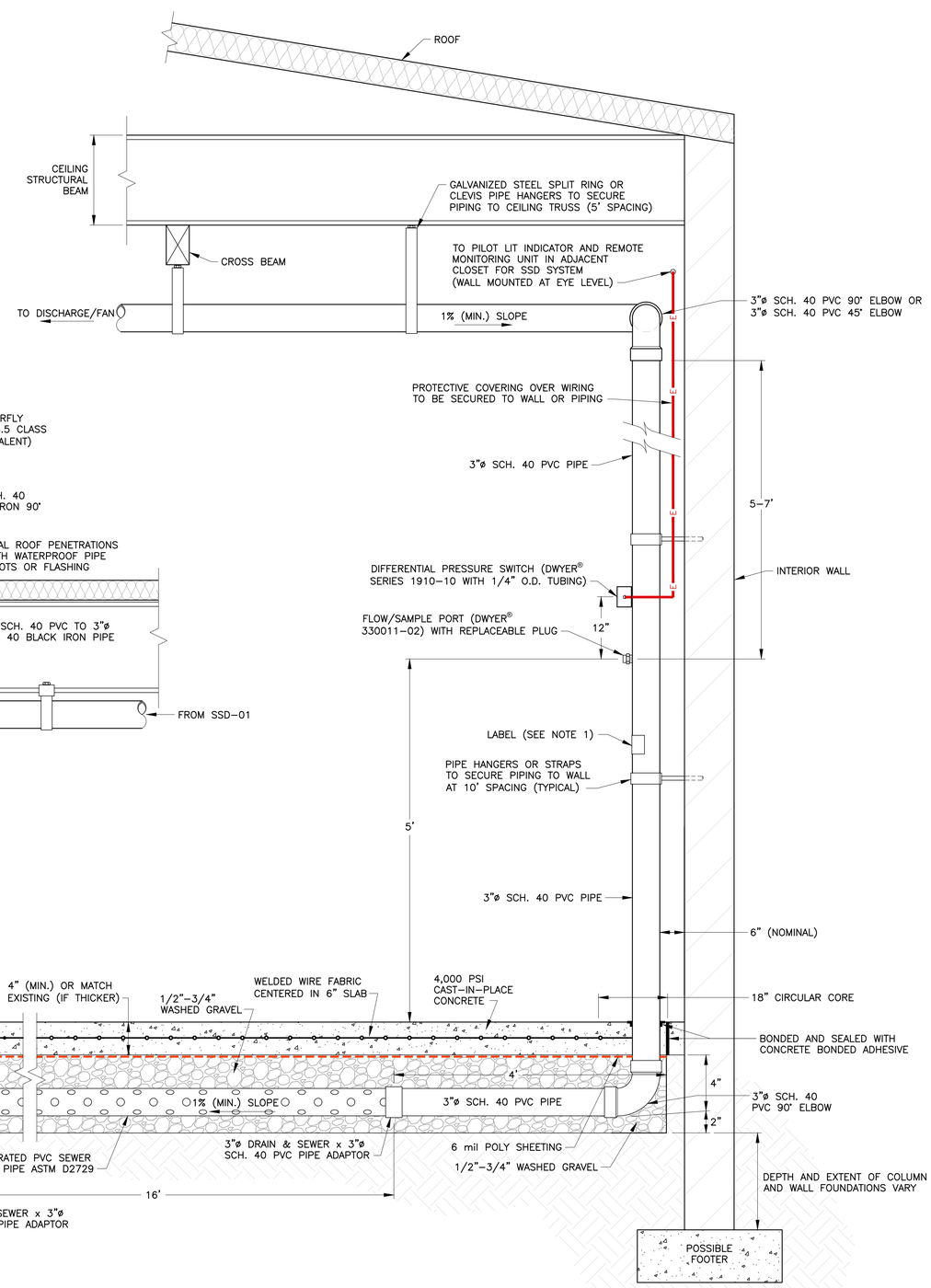


SSD SYSTEM EXHAUST PIPING DETAIL

NOT TO SCALE



EXTRACTION TRENCH AND EXHAUST RISER INSTALLATION DETAIL

NOT TO SCALE

NOTES:

1. WARNING LABELS SHALL BE AFFIXED ON EXTRACTION RISER PIPE RISER AS SHOWN IN THE DRAWING. THE LABEL WILL STATE:

SUB-SLAB DEPRESSURIZATION VENT PIPE
DO NOT CUT, DAMAGE, OR INTERFERE WITH ITS OPERATION

CONTACT BUILDING OWNER FOR ADDITIONAL INFORMATION

2. A WARNING LABEL SHALL BE AFFIXED ONTO THE MAIN SHUT-OFF SWITCH FOR THE VAPOR MITIGATION FAN. THE LABEL SHALL BE BRIGHT YELLOW WITH BLACK WRITING THAT STATES:

SHUT-OFF SWITCH - DO NOT TURN OFF.
VAPOR MITIGATION SYSTEM IN OPERATION

CONTACT BUILDING OWNER FOR ADDITIONAL INFORMATION

3. SPECIFICATION OF THE TYPE OF ELECTRICAL CONDUIT AND APPROPRIATE HANGERS SHALL BE DETERMINED BY A CALIFORNIA-LICENSED ELECTRICIAN, BASED ON THE REQUIREMENTS OF THE INLINE FAN BEING INSTALLED, AND IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL ELECTRICAL CODES.

4. REMOTE MONITORING UNIT SHALL BE A SENSAPHONE SENTINEL WITH CELLULAR MODEM AND BACKUP BATTERY PRODUCED BY MANUFACTURER. AUTODIALER SHALL BE CONFIGURED TO SEND A TEXT OR EMAIL TO APPROPRIATE PERSONNEL IN THE EVENT OF AN ALARM CONDITION.

D

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SSD CONSTRUCTION DETAILS

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CUPERTINO, CALIFORNIA

PREPARED FOR
EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

WSP USA Inc.
2025 GATEWAY PLACE, SUITE 348
SAN JOSE, CA 95110
TEL: +1 408.453.6100

SHEET 4

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APPENDIX

B SITE HEALTH AND SAFETY PLAN

19720 STEVENS CREEK BLVD

SHORT FORM HEALTH AND SAFETY PLAN

EVERSHINE VI, L.P.

VERSION I

PROJECT NO.: 31402714.000
DATE: AUGUST 2022

WSP
2570 NORTH FIRST STREET
SAN JOSE, CA 95131

TEL.: +1 408-453-6100
WSP.COM

SIGNATURES

PREPARED BY

Elena Robertson, P.G.
Senior Consultant, Geologist

REVIEWED BY

Richard Freudenberger
Senior Director

This Health and Safety Plan was prepared by WSP for the account of Evershine VI, L.P., in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

The original of the technology-based document sent herewith has been authenticated and will be retained by WSP for a minimum of ten years. Since the file transmitted is now out of WSP's control and its integrity can no longer be ensured, no

Checklist ("X" indicates task completed)	
X	Current site Operations
X	Past site Operations
X	Site contact information
X	Site address (for location of emergency room/emergency services)
X	Hazards inherent to site (regardless of contaminants, such as operations and environmental hazards
X	Site topography
X	Accessibility by road and air
X	Contaminants of concern
	Site security (do you need a security guard(s)?)
X	Obtain detailed WSP work plan
X	Review WSP SOPs, which includes:
X	Underground utility clearance and communication record (WSP SOPs)
X	Decontamination procedures (WSP SOPs)
X	Obtain NIOSH pocket guide pages for all COCs
	Be sure to include all up-to-date:
	HAZWOPER Certificates
	Respirator fit test forms
	First-aid/CPR cards
	Complete the HASP – fill in ALL form fields
	Have HASP reviewed by competent WSP staff member
	Have project manager review HASP and sign signature page
	Ensure all WSP site personnel sign signature page

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APPENDIX C ..... JOB HAZARD ANALYSIS
APPENDIX D .....WSP SOP'S

1 INTRODUCTION

Table 1.1 Site Location and Contact Information

Project No.:	31402714.000
Site Name:	Okaigan Dojo
Street Address:	19720 Stevens Creek Blvd.
City:	Cupertino
State/Country:	California
Site Contact:	Wayne Okubo
Phone Number:	--
Start Date of Work:	August 2020
End Date of Work:	On-going

1.1 ORGANIZATION STRUCTURE

Every Health and Safety Plan (HASP) we prepare is organized to ensure that information regarding changes in site conditions, potential exposure to hazards, and worker safety flows freely within the project team. Additionally, OSHA requires that a chain of command with lines of authority, responsibility, and communication is established for each project with a HASP. Therefore, we will establish a chain of command that ensures that all site operations will be conducted safely. Each project will have a project/task manager (OSHA calls this the General Supervisor) who has the responsibility and authority to direct all site operations. Generally, this person is the project director who is ultimately responsible for the overall implementation of the project. The field work that will be covered by this short form HASP will be overseen or managed by a project or task manager. This individual is responsible for the proper implementation of the comprehensive work plan that is described in Section 2.3. Each field project will have a site safety and health coordinator who has the responsibility and authority to implement the site HASP and verify compliance with the plan. Additionally, other personnel that are needed to conduct the proposed work will be assigned.

In all cases, the project director will ensure that the site work is staffed appropriately to safely and effectively implement the work plan. They will also ensure that company funds are available for the site project/task manager to provide appropriate personal protective equipment (PPE) and monitoring equipment to safely implement this HASP. The Site project/task manager will be responsible for the safe and proper implementation of the work plan. They will have the authority to expend company resources to ensure that PPE and other safety equipment are available and in good working order. They will communicate with the project director regarding implementation of the work plan. The site health and safety coordinator (SHSC) is responsible for the implementation of this HASP. The SHSC will communicate any issues with changing site conditions, upgrades in PPE, decontamination procedures and needs for monitoring equipment with the task manager. The SHSC will ensure that other workers assigned to the project are following the HASP.

It is expected that all other employees assigned to the project will follow the HASP and report any and all potential safety concerns to the SHSC.

1.2 PERSONNEL ASSIGNMENTS

Certificates documenting the training for field personnel are provided in Appendix A.

Table 1.2 Project Personnel

Responsibility	Name
Client Manager	Rick Freudenberger
Project Manager	Elena Robertson
Task Manager	Xin Jiang
SHSC	Elena Robertson
Task # Field Personnel	Lusi Tai
Task # Field Personnel	Amar Jain
Task # Field Personnel	Ciara Shirley
Task # Field Personnel	Adi Johnson

2 SITE DESCRIPTION

2.1 SITE DESCRIPTION

The Site is located within a retail park and is a commercial suite that is part of a larger multi-unit complex. The retail park is bound by Stevens Creek Boulevard to the North, a gas station and retail plaza to the east, and residential homes to the south and west. Adjacent to the Site within the retail park is a pizza restaurant (Legends Pizza Co.), curtain and blind retail space, and a frozen yogurt restaurant (Yogurtland Cupertino). The Site Location is presented in Figure 1 and the Site Layout is presented in Figure 2.

2.2 SITE HISTORY & PREVIOUS INVESTIGATIONS

Dry cleaner operations were present at the Site from around 1992/1993 to 2012 (AEI Consultants [AEI], 2020). Several rounds of limited investigations conducted at the Site since 2007 suggest former dry cleaning operations have impacted shallow soil and soil vapor in the south and southwest portions of the Site, as described in detail below.

Previous investigations of the Site (performed in 2007 and 2019 by AEI) have shown that shallow soil underlying the southwest portion of the Site may potentially have been impacted by historical dry-cleaning operations (AEI 2007 and 2019a). Concentrations of tetrachloroethene (PCE) were detected in some soil matrix samples, however those concentrations did not exceed the San Francisco Bay (SFB) Regional Water Quality Control Board (RWQCB) commercial/industrial environmental screening level (ESL; SFB RWQCB 2019). Previous boring and sample locations are depicted on Figure 2.

In September 2019 and January 2020, samples of soil gas, sub-slab vapor, and indoor air were collected by AEI to evaluate the potential for vapor intrusion of the volatile organic compounds (VOCs) detected previously in shallow soil matrix samples (AEI 2019b & 2020). Analytical results revealed PCE in sub-slab vapor samples (from 37 to 1,500 micrograms per cubic meter [µg/m3]) and in soil gas samples (from 1.68 to 1,050 µg/m3). Three of the four sub-slab vapor samples and nine of the twelve soil gas samples exceeded the commercial/industrial ESL for PCE of 67 µg/m3. Furthermore, PCE (from 1.15 to 2.64 µg/m3) was detected in indoor air samples; two of the three indoor air samples exceeded the commercial/industrial ESL for PCE of 2.0 µg/m3.

In September 2020, WSP performed additional sub-slab vapor and indoor air sampling and analyses. The work was undertaken to confirm AEI's findings and to provide additional data for a possible design of a sub-slab depressurization system (SSDS) to mitigate the potential for vapor intrusion into the building onsite, which operates as a commercial suite that is part of a larger multi-unit complex. Sub-slab vapor samples at all three sample locations contained PCE at concentrations (from 940 to 5,100 µg/m3) that exceeded its commercial/industrial ESL of 67 µg/m3 and trichloroethene (TCE) concentrations at one of the three locations (220 µg/m3) that exceeded its commercial/industrial ESL of 100 µg/m3. In addition, two of the three indoor air samples contained PCE concentrations (2.3 and 2.6 µg/m3) that exceeded its ESL of 2 µg/m3. In general, VOCs detected in the September 2020 samples were consistent with September 2019 and January 2020 sample results.

In February 2022, WSP conducted an additional vapor intrusion assessment which consisted of installation of six new sub-slab vapor probes (SV-006 through SV-010) installed within adjacent commercial suites to the Site, two nested soil gas probes (SGP-001 and SGP-002) installed immediately south of the Site, and indoor ambient air testing within adjacent commercial suites. PCE was detected at a concentration above the commercial/industrial ESL in only one of the six sub-slab vapor samples (SV-010 at a concentration of 1,000 µg/m^3) which is located in the adjacent commercial unit north of the restroom and storage closet area of the Site (Figure 3). The two nested soil gas probes also detected PCE over the ESL in all probe depths (of 5, 10, and 25 feet below ground surface (bgs)). PCE was not detected in indoor air samples collected in adjacent properties. Due to the detections of PCE in the nested soil gas probes installed immediately south of the Site (SGP-001 and SGP-002), SCCDEH concluded that the PCE soil gas plume has not been adequately defined horizontally or vertically. Of particular concern is the potential for the soil gas containing PCE beneath the residential properties south of the Site.

2.3 CHEMICALS OF CONCERN

NIOSH Pocket Guide sheet for each chemical of concern (COC) is presented in Appendix B. The COCs detected in Site media are provided in the following table.

Table 2.1 Chemicals of Concern

COC	Media	Maximum Concentration
Tetrachloroethene (PCE)	Soil Gas & Indoor Air	5,100 & 2.6 µg/m^3, respectively
Trichloroethene (TCE)	Soil Gas	220 µg/m^3

3 PROPOSED ONSITE ACTIVITIES

A job hazard analysis (JHA) was performed for each task described below and can be found in Appendix C.

3.1 TASK 1 INDOOR AIR & SUB-SLAB SAMPLING

Indoor air sampling will be performed on a semi-annual basis in the first and third quarters of each year. Indoor air sampling will involve the deployment of six indoor air sampling canisters and three ambient air sampling canisters. The indoor air sampling canisters will be deployed in the occupied units immediately surrounding the former dry cleaner space being Legend's Pizza, Blinds and Shutters, and Yogurt Land. Prior to initiating the indoor air sampling test, each tenant space will be inspected and screened with a photo-ionization detector (PID) to determine if any chemicals that may interfere with the test are present. Following the completion of the 8-hour indoor air test, WSP personnel will collect sub-slab soil gas samples from six existing sub-slab vapor pin probes. The sub-slab soil gas samples will be collected into one-liter SUMMA type canisters (or equivalent) through a helium shroud.

3.1.1 POTENTIALLY IMPACTED MEDIA

Table 3.1 Task 1 – Impacted Media

Impacted Media ("X" indicates impacted media)	
	Soil/Rock
	Sediment
	Groundwater
	Surface Water
X	Air/Vapor
	Building Materials (e.g., concrete, paint)
	Non-aqueous Phase Liquid (NAPL)
	Waste

3.2 TASK 2 SOIL GAS INVESTIGATION

An investigation to delineate the horizontal and vertical extent of PCE in soil gas on and off-site will be performed. To delineate the PCE soil gas plume, an additional fifteen nested soil gas probes will be installed to a maximum depth of 45 feet bgs. The nested soil gas probes will be installed with direct push tooling by a C-57 licensed drilling sub-contractor. Following installation of the soil gas probes, soil gas samples will be collected by either a sub-contracted mobile laboratory or by WSP personnel.

3.2.1 POTENTIALLY IMPACTED MEDIA

Table 3.2 Task 2 – Impacted Media

Impacted Media ("X" indicates impacted media)	
X	Soil/Rock
X	Sediment
	Groundwater

	Surface Water
X	Air/Vapor
	Building Materials (e.g., concrete, paint)
	Non-aqueous Phase Liquid (NAPL)
	Waste

3.3 TASK 3 SUB-SLAB DEPRESSURIZATION (SSD) SYSTEM INSTALLTION

To minimize exposure of impacted soil gas to workers and other occupants at the Site and other adjoining commercial spaces, a engineer control of the installation of a vapor intrusion mitigation system (VIMS) has been proposed. The VIMS will function as a slab depressurization (SSD) system, utilizing an energized fan to create negative pressure below the building thereby preventing vapor intrusion into the commercial spaces. Installation of the SSD system will involve creating an extensive extraction point network within the former dry cleaner space through excavation trenches. The extraction trench will be constructed within the building by neatly removing 21 foot long, and 18 inch wide concrete and excavating an approximate 21 foot long by 12-inch wide by 6-inch-deep pit into the subgrade below the existing concrete floor slab. Transfer piping will additionally be installed to route removed vapors to the building roof and into the ambient air. SSD transfer piping will transition horizontally along the ceiling's structural members to a roof-mounted fan and discharge point.

3.3.1 POTENTIALLY IMPACTED MEDIA

Table 3.1 Task 3 – Impacted Media

Impacted Media ("X" indicates impacted media)	
X	Soil/Rock
X	Sediment
	Groundwater
	Surface Water
X	Air/Vapor
X	Building Materials (e.g., concrete, paint)
	Non-aqueous Phase Liquid (NAPL)
	Waste

3.4 TASK 4 SSD SYSTEM STARTUP & MONITORING

The objective of system startup is to ensure the SSD system is installed and operating in accordance with the specifications. Systems start-up includes the following components: baseline sample collection, equipment testing, system repair, system balancing, and system monitoring.

3.4.1 POTENTIALLY IMPACTED MEDIA

Table 3.4 Task 4 – Impacted Media

Impacted Media ("X" indicates impacted media)

	Soil/Rock
	Sediment
	Groundwater
	Surface Water
X	Air/Vapor
X	Building Materials (e.g., concrete, paint)
	Non-aqueous Phase Liquid (NAPL)
	Waste

4 PERSONAL PROTECTIVE EQUIPMENT

NO CHANGES TO THE SPECIFIED LEVEL OF PROTECTION SHALL BE MADE WITHOUT THE APPROVAL OF THE SITE HEALTH AND SAFETY OFFICER AND/OR THE PROJECT GENERAL SUPERVISOR/MANAGER.

The following personal protective equipment will be available onsite for WSP personnel. Task specific equipment can be found in the JHA (Appendix C).

Table 4.1 Personal Protective Equipment

Type	PPE (list all required PPE)
Respiratory	Half/ Full-Face Air Purifying Respirator (not anticipated; to be doned only if PID readings suggest a risk)
Clothing	Weather appropriate
Gloves	Work gloves (as necessary) and nitrile gloves (when sample handling)
Boots	Steel-toed safety shoes
Hearing protection	Ear plugs or muffs (as necessary)
Other PPE	Hard hat, high visibility vest, safety glasses/ goggles, PID

5 MONITORING PROCEDURES

Site Monitoring Equipment ("X" indicates required monitoring equipment)	
X	Photoionization Detector (PID) 10.6 eV (e.g., chlorinated ethenes, benzene)
	PID 11.7 eV (e.g., chlorinated ethanes)
	Flame Ionization Detector (FID; e.g., petroleum)
	Particulate Monitor (PM; e.g., metals, polychlorinated biphenyls)
	Combustible Gas Indicator (CGI; combustibles, oxygen, carbon monoxide, hydrogen sulfide)
	Chemical Name Colorimetric Tube (or similar)

Action levels for PPE upgrades (assume all work begins in Level D): 5 ppm

Action level calculation based upon: Half the TLV of PCE (10 ppm)

The following tiered monitoring approach shall be instituted:

Work will be initiated in Level D.
The SHSO, or his designated representative, will scan the breathing zone of the workers before and during all proposed activities with a calibrated photoionization detector (PID) with a **10.6 eV** lamp to monitor levels of organic vapors.
If total VOCs **exceed 5 ppm** for 5 minutes :

- a **Stop work, exit work zone and allow area to ventilate for 15 minutes**
  - i Total VOCs **less than 5 ppm**
    - (1) **Continue work and collect periodic measurements to confirm concentration**
  - ii **Total VOCs greater than 5 ppm**
    - (1) **Stop work and exit work zone until engineering controls can be implemented to abate the build-up of organic vapors**
    - (2) In the unlikely event that organic vapors cannot be controlled, upgrade to Level C (full face air purfying respirator [APR] with organic vapor cartridge) may be necessary. **Prior to upgrage to Level C, this HASP must be ammended to include the use of respirtatiors.**
    - (3) Collect period colorimetric measurements to confirm concentration.

All breathing zone monitoring will be conducted continuously with the exception of colorimetric tubes.

Once the action level is exceeded, monitoring with colorimetric tubes will be conducted periodically.

All equipment will be calibrated per the manufacturer's recommendations. A battery and field check of each instrument will be made before it is used.

6 DECONTAMINATION PROCEDURES

Detergent and water will be used as the decontamination solution unless otherwise specified.

Decontamination procedures will include the following:

1. Scrub in non-phosphate detergent
2. Tap-water rinse
3. Tap-water rinse

Equipment Decontamination Procedures will be conducted in accordance with WSP's Standard Operating Procedures (Appendix D).

7 ONSITE CONTROL

The prevailing wind conditions are westward. No contaminant reduction zone (CRZ) or support zone will be established downwind of a work/exclusion zone.

All WSP employees are responsible for onsite control. During work activities, the following zones will be established:

1. Work/Exclusion Zone:
   - Area immediately surrounding drilling equipment and excavation equipment (within five feet).
2. CRZ:
   - Roped off (e.g. using caution tape) area around the drilling and excavation equipment or in a designated area to be named in the field.
3. Support Zone:
   - Area immediately outside of the caution taped or roped off (e.g. using high visibility cones) contamination reduction zone. If cone or tape were not used, the area is designated a minimum distance of five feet from the contamination reduction zone.

8 STANDARD OPERATING PROCEDURES

- Whenever possible, use the buddy system.
- At least one WSP employee onsite must have a first aid kit onsite that includes, at a minimum, the following:
  - 1 Absorbent compress, 32 sq. in. (81.3 sq. cm.) with no side smaller than 4 in. (10 cm)
  - 16 Adhesive bandages, 1 in. x 3 in. (2.5 cm x 7.5 cm)
  - 1 Adhesive tape, 5 yd. (457.2 cm) total
  - 10 Antiseptic, 0.5g (0.14 fl oz.) applications
  - 6 Burn treatment, 0.5 g (0.14 fl. oz.) applications
  - 4 Sterile pads, 3 in. x 3 in. (7.5 x 7.5 cm)
  - 1 Triangular bandage, 40 in. x 40 in. x 56 in. (101 cmx 101 cm x 142 cm)
- Conduct a pre-entry (i.e., tailgate) briefing before beginning site activities each day and record in field book.
- Practice good work practice controls: Never sit down or kneel in contaminated areas; never lay equipment on the ground where contaminated groundwater or soil may be present; and avoid unnecessary contact with onsite contaminated objects.
- Do not eat, drink, or use tobacco products outside the designated support zone(s).
- Whenever possible, do not use contact lenses while onsite.
- Thoroughly wash hands and face before eating, drinking, etc.
- Keep copies of the HASP available in the support zone.
- In the event PPE is ripped or torn, stop work and remove and replace PPE as soon as possible.
- In the event of direct skin contact, immediately wash the affected area with soap and water.
- If contaminated media comes in contact with eyes flush with clean water for 15 minutes.
- Ensure that all subcontractors have a site specific HASP that is maintained onsite
- Report all accidents, injuries, and environmental releases as required by the WSP USA Health and Environmental Safety Program.

8.1 LONE WORKING

Employees should not be set out to work alone in the field whenever possible. This must be considered during the proposal phase of the project. Should lone working be required, the following must be adhered to:

- Section 10.1 includes provisions for communication prior to departure, during the work, and upon completion of the task whether returning to the office or going to another location.
- Section 4 shall include specific tasks to be performed while working alone and may require the support of additional personnel should the task not be deemed acceptable as a risk for lone working.
- Project managers must consider the level of competence of the individual being sent to perform the work. Under no circumstances shall interns be sent out to work alone. By signing the HASP, the project manager acknowledges that the appropriate staff is selected for all work especially for lone working conditions.

8.2 CONFINED SPACE ENTRY

No WSP employee may conduct **ANY TYPE** of confined space entry without compliant training and the implementation of an entry program. All non-permit required confined space entries **MUST BE** approved by the Direct of Environment or their designee before any entry attempt is made. Therefore, no attempt will be made to enter any type of confined space without approval.

9 MEDICAL SURVEILLANCE

All employees, regardless of the exposure involved, are required to participate in the medical monitoring program established by WSP. OSHA regulations state that employees involved in certain activities that may expose them to hazardous materials at or above permissible exposure limits (PELs) or above the published exposure limit for greater than 30 days per year, or all employees who wear a respirator are required to participate in the monitoring program.

The purposes of the medical monitoring program are to identify any illness or condition that might be aggravated by exposure to hazardous materials or work conditions; to certify that each employee can use negative-pressure respirators as required by OSHA and withstand heat or cold stress; to ensure that employees are able to physically perform their assigned tasks and to establish and maintain a medical record to monitor for abnormalities that may be related to work exposure that could increase injury risk for the employee. WSP's medical monitoring program includes the following:

- a baseline physical examination
- annual physical examination
- a medical determination of fitness for duty, including work restrictions after any injury or illness that may affect employee safety
- a review of potential exposures to determine the need for specific biological and medical monitoring

10 COMMUNICATION PROCEDURES

All onsite personnel will practice constant communication with other WSP personnel, subcontractors, and facility personnel during active work. Generally, verbal and/or cellular telephone communication will be used while onsite.

Special Communication Procedures (e.g., two-way radios for large sites with multiple workers):

10.1 LONE WORKING

No lone working will be permitted without the completion of this section. Specific contact procedures will be agreed upon before departure:

The following persons will be contacted by the lone worker at each of the specified intervals:

Prior to departure contact (face-to-face, phone, text message or email): **Project or Client Manager**

During work contact (by phone, text message or email morning and mid-day): **Project or Client Manager**

Daily upon completion of the task (by phone, text message or email morning and mid-day): **Project or Client Manager**

When returned home (by phone, text message or email when arriving at home airport, office, or town/city): **Project or Client Manager**

10.2 EMERGENCY HAND SIGNALS

The following standard hand signals will be used in case injury or circumstance does not allow for verbal or other communication:

- Hand gripping throat = Out of air, can't breathe
- Grip partner's wrist or both hands around waist = Leave area immediately
- Hands on top of head = Need assistance
- Thumbs up = Ok, I'm all right, I understand
- Thumbs down = No, negative

11 EMERGENCY PROCEDURES

The following standard emergency procedures will be used by onsite personnel. First, WSP employees will review the emergency action plan (EAP) for any active site to be familiar with evacuation procedures established by the facility. While onsite, the site health and safety coordinator shall be notified of any onsite emergency and shall be responsible for ensuring that the appropriate procedures are followed.

11.1 EMERGENCY ACTION PLAN (ACTIVE FACILITY)

If the site is an active facility, WSP will follow established onsite evacuation procedures.

Facility evacuation procedures have been reviewed (if applicable): Not applicable; Site is not an active facility

Verification initials (by a person assigned to the project): ERR

11.2 AIR RELEASE OR FIRE/EXPLOSION

On notification of an air release or a fire/explosion, all personnel will travel at a right angle to the upwind direction. The site health and safety officer will then account for all personnel and notify the proper emergency agencies.

If the site health and safety officer is not available, the task manager or appropriate field personnel will assume these responsibilities.

11.3 INJURY

If onsite personnel require emergency medical treatment, and the buddy system is used, the following steps will be taken:

- evaluate the nature of the injury and obtain the onsite copy of this HASP
- contact local emergency service
- decontaminate to the extent possible before administration of first aid
- stay with the injured person

11.3.1 LONE WORKING

If onsite personnel are working alone, the following steps will be taken before beginning work each day:

- A cellular telephone MUST be kept with the employee at all times (before starting work, ensure that there is emergency service at a minimum).
- Inform an onsite contact (if they will be present throughout all active work activities) or senior member of WSP of your plans for the day and your expected active work schedule.

If an injury has occurred:

- Evaluate the injury and decide whether emergency services are required.
- Contact emergency services if necessary with cell phone.
- If emergency services are not necessary, attempt first aid alone or contact an onsite contact or WSP contact for assistance.

11.4 BASIC FIRST AID

- Skin Contact: Remove any contaminated clothing. Wash immediately with water for at least 15 minutes.
- Inhalation: Remove from contaminated atmosphere. Contact emergency services.
- Ingestion: Never induce vomiting on an unconscious person. Never induce vomiting when acids, alkalis, or petroleum products are suspected. Contact the poison control center.

11.5 PPE FAILURE

If any worker experiences a failure or alteration of protective equipment that affects the protection factor, that person and his or her buddy shall immediately leave the exclusion zone. Reentry shall not be permitted until the equipment has been replaced or repaired.

12 EMERGENCY CONTACT INFORMATION

Table 12.1 Emergency Contact Information

Agency	Name	Address	Phone Number(s)
Ambulance Company	Royal Ambulance	1191 N. 5th St. San Jose, CA	911 or 877-995-6161
Hospital Emergency Room	Kaiser Permanente Santa Clara Medical Center	700 Lawrence Expy. Santa Clara, CA	911 or 408-851-1000
Urgent Care	El Camino Health Urgent Care	19600 Vallco Pkwy Suite 170 Cupertino, CA	408-871-5090
Police	Sunnyvale Police Department	700 All America Way, Sunnyvale, CA	911 or 408-730-7100
Fire Department	Cupertino Fire Department	20215 Stevens Creek Blvd. Cupertino, CA	911 or 408-299-3144
Poison Control Center	California Poison Control System	3333 California St. Suite 420 San Francisco, CA	800-222-1222

The emergency contact information presented above was verified by:

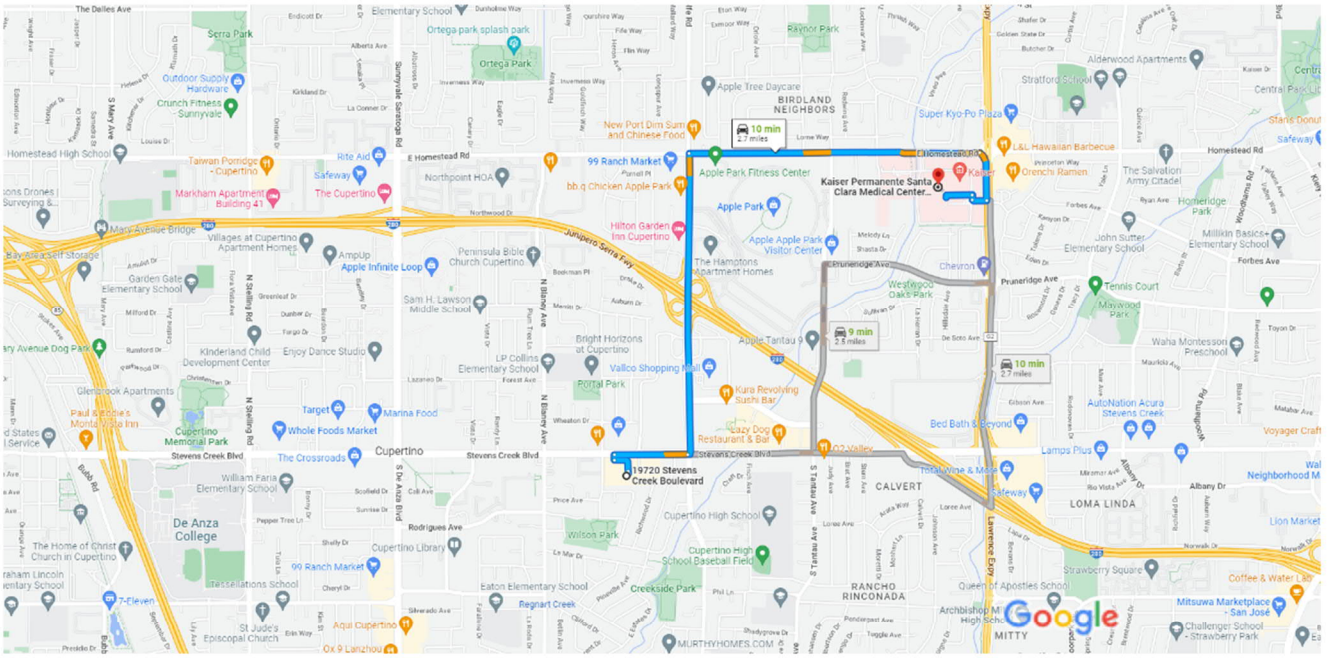
Signature

Elena Robertson
Name

Senior Consultant, Geologist
Title

8/26/22
Date

Figure 1: Directions to Hospital



Map data ©2022 Google 1000 ft

19720 Stevens Creek Blvd
Cupertino, CA 95014

Drive from N Wolfe Rd and E Homestead Rd to Santa Clara

8 min (2.4 mi)

4. Turn right onto Stevens Creek Blvd

0.3 mi

5. Use the left 2 lanes to turn left onto N Wolfe Rd

1.0 mi

6. Turn right onto E Homestead Rd

1.0 mi

7. Turn right onto Lawrence Expy

0.2 mi

13 CERTIFICATION AND SIGNATURES

All site personnel MUST sign this page to acknowledge the requirements of this HASP.

Table 13.1 HASP Certifications

Signature	Name	Title	Date

ACRONYMS

EAP	emergency action plan
PEL	permissible exposure limit
PPE	personal protective equipment
SHSC	site health and safety coordinator

REFERENCES

- AEI Consultants, 2007. Limited Phase II Subsurface Investigation Report, 19720 Stevens Creek Boulevard, Cupertino, California. July.
- AEI Consultants, 2019a. Phase I Environmental Site Assessment, 19720 Stevens Creek Boulevard, Cupertino, Santa Clara County, California. September.
- AEI Consultants, 2019b. Limited Phase II Subsurface Investigation Report, 19720 Stevens Creek Boulevard, Cupertino, Santa Clara County, California. October.
- AEI Consultants, 2020. Additional Site Investigation Report, 19720 Stevens Creek Boulevard, Cupertino, California. February 7.
- WSP. 2022. Soil Vapor and Indoor Air Investigation Report, Okaigan Dojo, 19720 Stevens Creek boulevard, Cupertino, California. March 18.

FIGURE

DWG Name: 314MN2714.000-005

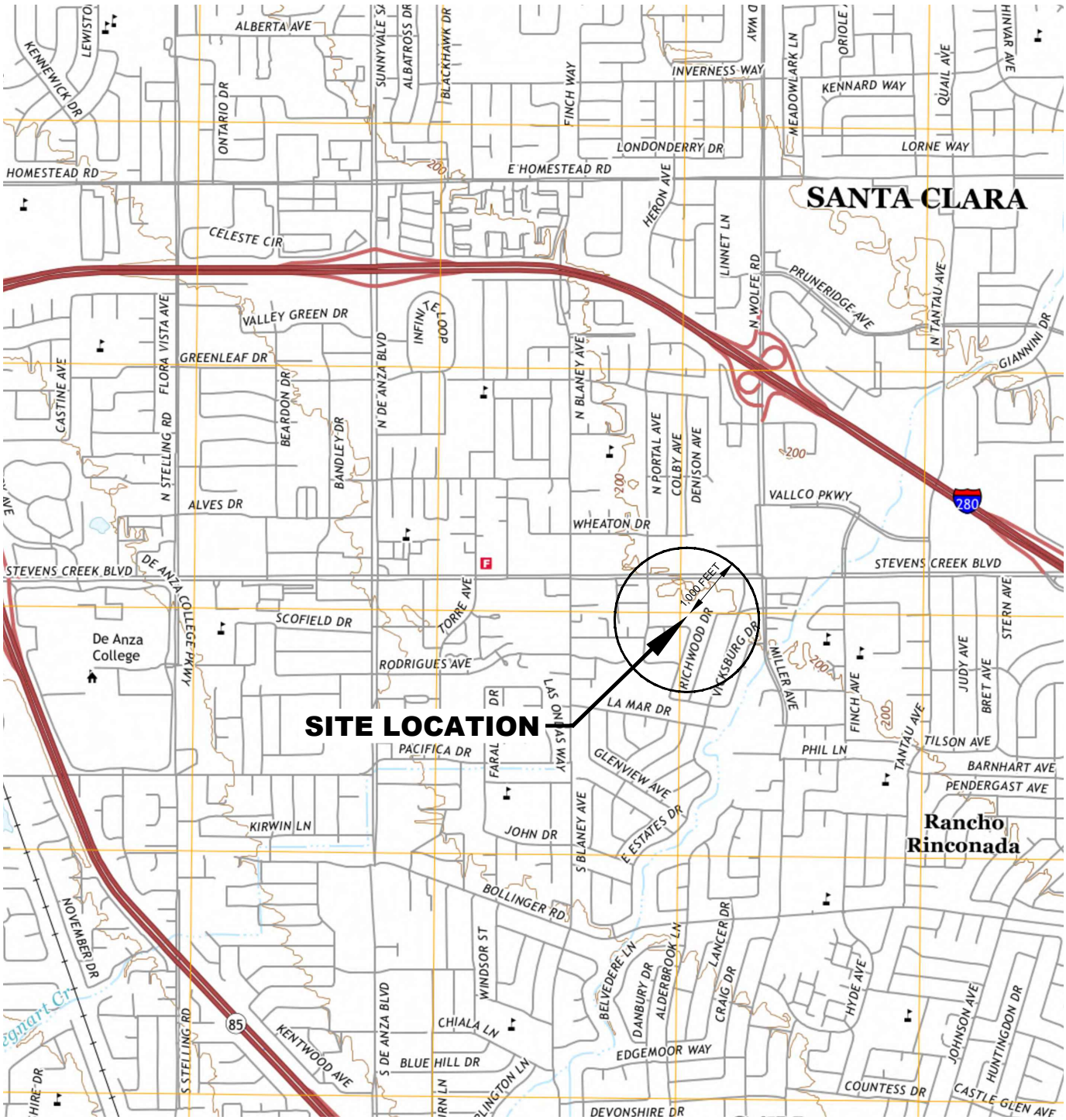
Checked: AM 3/16/2022

Approved:

Drawn By: LS 3/16/2022

A

C:\Users\usls01166\AUTOCADD FILES\EVERSHINE GROUP\31402714.000\CADD\314MN2714.000-005.dwg 3/16/2022 12:41 PM USLS01166



REFERENCE
7.5 MINUTE SERIES TOPOGRAPHIC QUADRANGLE
CUPERTINO, CALIFORNIA 2018

N

0 2,000 4,000
SCALE IN FEET

QUADRANGLE LOCATION

INSET OF SITE
SCALE: 1"=400'

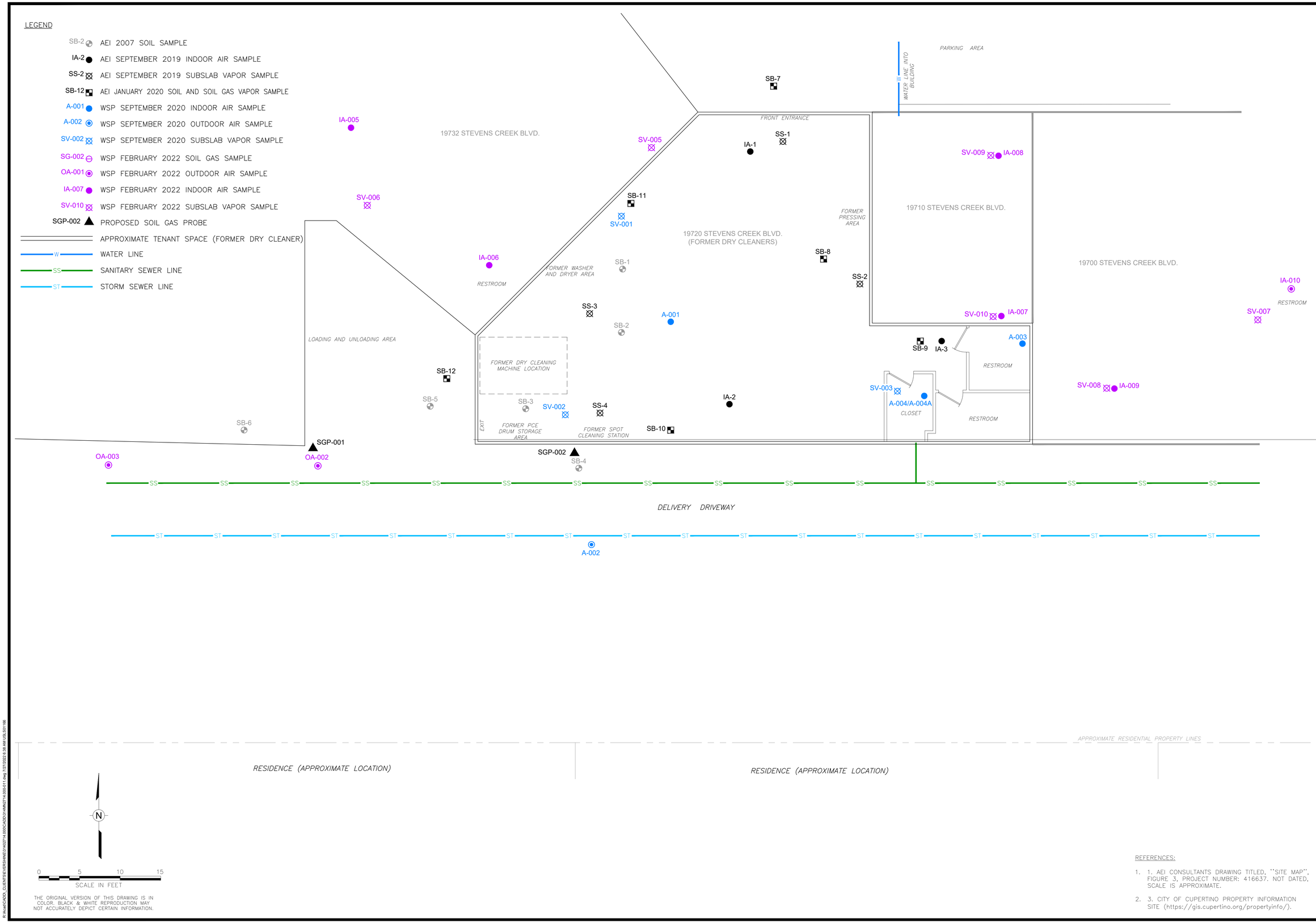
WSP USA Inc.
2025 GATEWAY PLACE
SUITE 348
SAN JOSE, CA 95110
TEL: +1 408.453.6100

Figure 1

SITE LOCATION MAP

19720 STEVENS CREEK BOULEVARD
CUPERTINO, CALIFORNIA

PREPARED FOR
EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA



THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK & WHITE REPRODUCTION MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

REFERENCES:

1. 1. AEI CONSULTANTS DRAWING TITLED, "SITE MAP", FIGURE 3, PROJECT NUMBER: 416637. NOT DATED, SCALE IS APPROXIMATE.
2. 3. CITY OF CUPERTINO PROPERTY INFORMATION SITE (https://gis.cupertino.org/propertyinfo/).

Drawn By: LS 7/27/2022
Checked: ER 7/27/2022
Approved:
DWG Name: 314MN2714.000-011

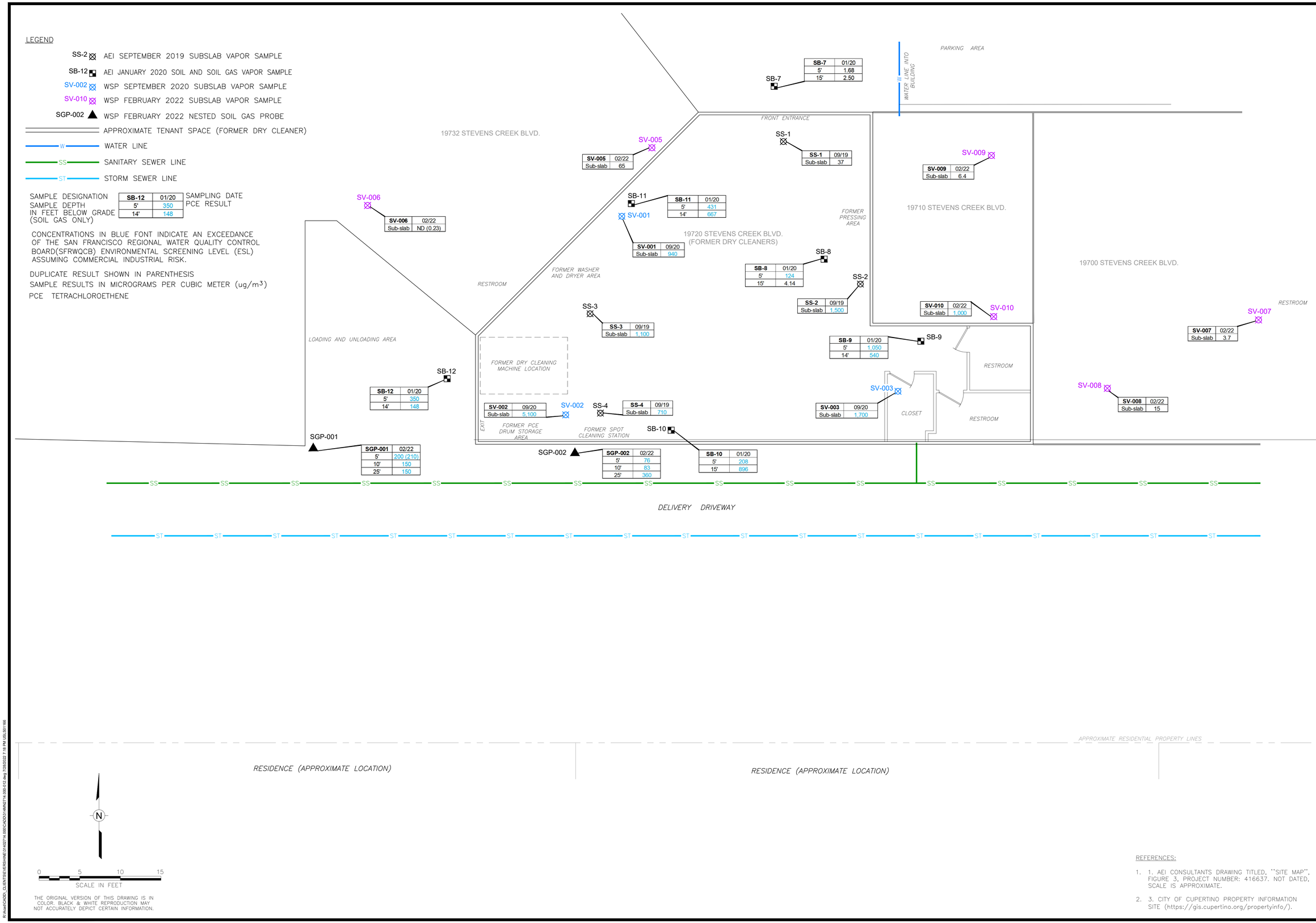
19720 STEVENS CREEK BOULEVARD
CUPERTINO, CALIFORNIA

PREPARED FOR
EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

Figure 2

SITE LAYOUT
EXISTING BORING AND SAMPLING LOCATIONS

WSP USA Inc.
2025 GATEWAY PLACE
SUITE 348
SAN JOSE, CA 95110
TEL: +1 408.453.6100



THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK & WHITE REPRODUCTION MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

REFERENCES:

1. 1. AEI CONSULTANTS DRAWING TITLED, "SITE MAP", FIGURE 3, PROJECT NUMBER: 416637. NOT DATED, SCALE IS APPROXIMATE.
2. 3. CITY OF CUPERTINO PROPERTY INFORMATION SITE (https://gis.cupertino.org/propertyinfo/).

Drawn By: LS 7/28/2022
Checked: ER 7/28/2022
Approved:
DWG Name: 314MN2714.000-012

19720 STEVENS CREEK BOULEVARD
CUPERTINO, CALIFORNIA

PREPARED FOR
EVERSHINE VI, L.P.
CUPERTINO, CALIFORNIA

Figure 3

HISTORIC PCE CONCENTRATIONS IN SOIL GAS

WSP USA Inc.
2025 GATEWAY PLACE
SUITE 348
SAN JOSE, CA 95110
TEL: +1 408.453.6100

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APPENDIX

A WSP PERSONNEL RECORDS

CLICKSAFETY®

certifies that

ELENA ROBERTSON

has successfully completed ClickSafety's web-based training course:

HAZWOPER 2021 Refresher (8-Hour)

In accordance with the requirements of 29 CFR 1910.120(e)

This course was developed and presented by ClickSafety.com, Inc.

CLICKSAFETY
www.ClickSafety.com

I confirm that I personally took the course listed above.

31499339	1/4/2021	8 HOURS	
SERIAL NUMBER	COMPLETION DATE	COURSE DURATION	STUDENT SIGNATURE

31499339

APPENDIX

B NIOSH POCKET GUIDE TO CHEMICAL HAZARDS

Carbon tetrachloride	Formula: CCl_4	CAS#: 56-23-5	RTECS#: FG4900000	IDLH: Ca [200 ppm]
Conversion: 1 ppm = 6.29 mg/m^3	DOT: 1846 151			

Synonyms/Trade Names: Carbon chloride, Carbon tet, Freon® 10, Halon® 104, Tetrachloromethane

Exposure Limits:
NIOSH REL: Ca
ST 2 ppm (12.6 mg/m^3) [60-minute]
See Appendix A
OSHA PEL†: TWA 10 ppm
C 25 ppm
200 ppm (5-minute maximum peak in any 4 hours)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless liquid with a characteristic ether-like odor.

Chemical & Physical Properties:
MW: 153.8
BP: 170°F
Sol: 0.05%
Fl.P: NA
IP: 11.47 eV
Sp.Gr: 1.59
VP: 91 mmHg
FRZ: -9°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Chemically-active metals such as sodium, potassium & magnesium; fluorine; aluminum [**Note:** Forms highly toxic phosgene gas when exposed to flames or welding arcs.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; CNS depres; nau, vomit; liver, kidney inj; drow, dizz, inco; [carc]
TO: CNS, eyes, lungs, liver, kidneys, skin [in animals: liver cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Carbonyl fluoride	Formula: COF_2	CAS#: 353-50-4	RTECS#: FG6125000	IDLH: N.D.
Conversion: 1 ppm = 2.70 mg/m^3	DOT: 2417 125			

Synonyms/Trade Names: Carbon difluoride oxide, Carbon fluoride oxide, Carbon oxyfluoride, Carbonyl difluoride, Fluoroformyl fluoride, Fluorophosgene

Exposure Limits:
NIOSH REL: TWA 2 ppm (5 mg/m^3)
ST 5 ppm (15 mg/m^3)
OSHA PEL†: none

Measurement Methods (see Table 1):
None available

Physical Description: Colorless gas with a pungent and very irritating odor. [**Note:** Shipped as a liquefied compressed gas.]

Chemical & Physical Properties:
MW: 66.0
BP: -118°F
Sol: Reacts
Fl.P: NA
IP: 13.02 eV
RGasD: 2.29
VP: 55.4 atm
FRZ: -173°F
UEL: NA
LEL: NA
Nonflammable Gas

Personal Protection/Sanitation (see Table 2):
Skin: Frostbite
Eyes: Frostbite
Wash skin: N.R.
Remove: N.R.
Change: N.R.
Provide: Frostbite wash

Respirator Recommendations (see Tables 3 and 4):
Not available.

Incompatibilities and Reactivities: Heat, moisture, hexafluoroisopropylideneamino-lithium
[**Note:** Reacts with water to form hydrogen fluoride & carbon dioxide.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Con
SY: Irrit eyes, skin, muc memb, resp sys; eye, skin burns; lac; cough, pulm edema, dysp; chronic exposure: GI pain, musc fib, skeletal fluorosis; liquid: frostbite
TO: Eyes, skin, resp sys, bone

First Aid (see Table 6):
Eye: Frostbite
Skin: Frostbite
Breath: Resp support

C

Chloroform	Formula: $CHCl_3$	CAS#: 67-66-3	RTECS#: FS9100000	IDLH: Ca [500 ppm]
Conversion: 1 ppm = 4.88 mg/m^3	**DOT:** 1888 151			

Synonyms/Trade Names: Methane trichloride, Trichloromethane

Exposure Limits:
NIOSH REL: Ca
ST 2 ppm (9.78 mg/m^3) [60-minute]
See Appendix A
OSHA PEL†: C 50 ppm (240 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003

Physical Description: Colorless liquid with a pleasant odor.

Chemical & Physical Properties:
MW: 119.4
BP: 143°F
Sol(77°F): 0.5%
Fl.P: NA
IP: 11.42 eV
Sp.Gr: 1.48
VP: 160 mmHg
FRZ: -82°F
UEL: NA
LEL: NA
Noncombustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong caustics; chemically-active metals such as aluminum or magnesium powder, sodium & potassium; strong oxidizers **[Note:** When heated to decomposition, forms phosgene gas.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; dizz, mental dullness, nau, conf; head, lass; anes; enlarged liver; [carc]
TO: Liver, kidneys, heart, eyes, skin, CNS [in animals: liver & kidney cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

bis-Chloromethyl ether	Formula: $(CH_2Cl)_2O$	CAS#: 542-88-1	RTECS#: KN1575000	IDLH: Ca [N.D.]
Conversion:	**DOT:** 2249 131			

Synonyms/Trade Names: BCME, bis-CME, Chloromethyl ether, Dichlorodimethyl ether, Dichloromethyl ether, Oxybis(chloromethane)

Exposure Limits:
NIOSH REL: Ca
See Appendix A
OSHA PEL: [1910.1008]
See Appendix B

Measurement Methods (see Table 1):
OSHA 10

Physical Description: Colorless liquid with a suffocating odor.

Chemical & Physical Properties:
MW: 115.0
BP: 223°F
Sol: Reacts
Fl.P: <66°F
IP: ?
Sp.Gr: 1.32
VP(72°F): 30 mmHg
FRZ: -43°F
UEL: ?
LEL: ?
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet (flamm)
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

See Appendix E (page 351)

Incompatibilities and Reactivities: Acids, water
[Note: Reacts with water to form hydrochloric acid & formaldehyde.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, muc memb, resp sys; pulm congestion, edema; corn damage, nec; decr pulm function, cough, dysp, wheez; blood-stained sputum, bronchial secretions; [carc]
TO: Eyes, skin, resp sys [lung cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

D

1,1-Dichloroethane

Formula:	CAS#:	RTECS#:	IDLH:
$CHCl_2CH_3$	75-34-3	KI0175000	3000 ppm

Conversion: 1 ppm = 4.05 mg/m^3

DOT: 2362 130

Synonyms/Trade Names: Asymmetrical dichloroethane; Ethylidene chloride; 1,1-Ethylidene dichloride

Exposure Limits:
NIOSH REL: TWA 100 ppm (400 mg/m^3)
See Appendix C (Chloroethanes)
OSHA PEL: TWA 100 ppm (400 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless, oily liquid with a chloroform-like odor.

Chemical & Physical Properties:
MW: 99.0
BP: 135°F
Sol: 0.6%
Fl.P: 2°F
IP: 11.06 eV
Sp.Gr: 1.18
VP: 182 mmHg
FRZ: -143°F
UEL: 11.4%
LEL: 5.4%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1000 ppm: Sa
2500 ppm: Sa:Cf
3000 ppm: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong caustics

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit skin; CNS depres; liver, kidney, lung damage
TO: Skin, liver, kidneys, lungs, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap flush prompt
Breath: Resp support
Swallow: Medical attention immed

1,2-Dichloroethylene

Formula:	CAS#:	RTECS#:	IDLH:
ClCH=CHCl	540-59-0	KV9360000	1000 ppm

Conversion: 1 ppm = 3.97 mg/m^3

DOT: 1150 130P

Synonyms/Trade Names: Acetylene dichloride, cis-Acetylene dichloride, trans-Acetylene dichloride, sym-Dichloroethylene

Exposure Limits:
NIOSH REL: TWA 200 ppm (790 mg/m^3)
OSHA PEL: TWA 200 ppm (790 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 7

Physical Description: Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.

Chemical & Physical Properties:
MW: 97.0
BP: 118-140°F
Sol: 0.4%
Fl.P: 36-39°F
IP: 9.65 eV
Sp.Gr(77°F): 1.27
VP: 180-265 mmHg
FRZ: -57 to -115°F
UEL: 12.8%
LEL: 5.6%
Class IB Flammable Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1000 ppm: Sa:Cf£/PaprOv£/CcrFOv/GmFOv/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, strong alkalis, potassium hydroxide, copper [**Note:** Usually contains inhibitors to prevent polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, resp sys; CNS depres
TO: Eyes, resp sys, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Trichloroethylene	Formula: $ClCH=CCl_2$	CAS#: 79-01-6	RTECS#: KX4550000	IDLH: Ca [1000 ppm]
Conversion: 1 ppm = 5.37 mg/m^3	**DOT:** 1710 160			
Synonyms/Trade Names: Ethylene trichloride, TCE, Trichloroethene, Trilene				

Exposure Limits:
NIOSH REL: Ca
See Appendix A
See Appendix C
OSHA PEL†: TWA 100 ppm
C 200 ppm
300 ppm (5-minute maximum peak in any 2 hours)

Measurement Methods (see Table 1):
NIOSH 1022, 3800
OSHA 1001

Physical Description: Colorless liquid (unless dyed blue) with a chloroform-like odor.

Chemical & Physical Properties:
MW: 131.4
BP: 189°F
Sol: 0.1%
Fl.P: ?
IP: 9.45 eV
Sp.Gr: 1.46
VP: 58 mmHg
FRZ: -99°F
UEL(77°F): 10.5%
LEL(77°F): 8%
Combustible Liquid, but burns with difficulty.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; head, vis dist, lass, dizz, tremor, drow, nau, vomit; derm; card arrhy, pares; liver inj; [carc]
TO: Eyes, skin, resp sys, heart, liver, kidneys, CNS [in animals: liver & kidney cancer]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Trichloronaphthalene	Formula: $C_{10}H_5Cl_3$	CAS#: 1321-65-9	RTECS#: QK4025000	IDLH: See Appendix F
Conversion:	**DOT:**			
Synonyms/Trade Names: Halowax®, Nibren wax, Seekay wax				

T

Exposure Limits:
NIOSH REL: TWA 5 mg/m^3 [skin]
OSHA PEL: TWA 5 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S128 (II-2)

Physical Description: Colorless to pale-yellow solid with an aromatic odor.

Chemical & Physical Properties:
MW: 231.5
BP: 579-669°F
Sol: Insoluble
Fl.P(oc): 392°F
IP: ?
Sp.Gr: 1.58
VP: <1 mmHg
MLT: 199°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
50 mg/m^3: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

See Appendix F

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Anor, nau; dizz; jaun, liver inj
TO: Liver

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash
Breath: Resp support
Swallow: Medical attention immed

Tetrachloroethylene	Formula: $Cl_2C=CCl_2$	CAS#: 127-18-4	RTECS#: KX3850000	IDLH: Ca [150 ppm]
Conversion: 1 ppm = 6.78 mg/m^3	DOT: 1897 160			

Synonyms/Trade Names: Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene

Exposure Limits:
NIOSH REL: Ca
Minimize workplace exposure concentrations.
See Appendix A
OSHA PEL†: TWA 100 ppm
C 200 ppm (for 5 mins. in any 3-hr. period), with a maximum peak of 300 ppm

Measurement Methods (see Table 1):
NIOSH 1003
OSHA 1001

Physical Description: Colorless liquid with a mild, chloroform-like odor.

Chemical & Physical Properties:
MW: 165.8
BP: 250°F
Sol: 0.02%
Fl.P: NA
IP: 9.32 eV
Sp.Gr: 1.62
VP: 14 mmHg
FRZ: -2°F
UEL: NA
LEL: NA
Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH
¥: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin, nose, throat, resp sys; nau; flush face, neck; dizz, inco; head, drow; skin eryt; liver damage; [carc]
TO: Eyes, skin, resp sys, liver, kidneys, CNS [in animals: liver tumors]

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash prompt
Breath: Resp support
Swallow: Medical attention immed

Tetrachloronaphthalene	Formula: $C_{10}H_4Cl_4$	CAS#: 1335-88-2	RTECS#: QK3700000	IDLH: See Appendix F
Conversion:	DOT:			

Synonyms/Trade Names: Halowax®, Nibren wax, Seekay wax

Exposure Limits:
NIOSH REL: TWA 2 mg/m^3 [skin]
OSHA PEL: TWA 2 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH S130 (II-2)

Physical Description: Colorless to pale-yellow solid with an aromatic odor.

Chemical & Physical Properties:
MW: 265.9
BP: 599-680°F
Sol: Insoluble
Fl.P(oc): 410°F
IP: ?
Sp.Gr: 1.59-1.65
VP: <1 mmHg
MLT: 360°F
UEL: ?
LEL: ?
Combustible Solid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
20 mg/m^3: ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

See Appendix F

Incompatibilities and Reactivities: Strong oxidizers

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Acne-form derm; head, lass, anor, dizz; jaun, liver inj
TO: Liver, skin, CNS

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

T

APPENDIX

C JOB HAZARD ANALYSIS

JOB HAZARD ANALYSIS
WATER & ENVIRONMENT

Prepared By:	Prepared Date:
Elena Robertson	8/26/2022
Approved By:	**Approved Date:**
Elena Robertson	8/26/2022

Project Name:	Project No:	Project Location:	Project/Task Description:	Project/Task Equipment:
Okaigan Dojo		19720 Stevens Creek Blvd. Cupertino	SSD System Instalation and Monitoring	Excavator; SSD materials; vapor sampling equipment

Chemicals of Concern:	Site-Specific Hazards:	Action Levels:
PCE	vehicle traffic	5 ppm

Level D PPE:	PPE Upgrades:	Health & Safety Equipment:
Weather appropriate clothing, steel-toed safety shoes, work gloves, nitrile gloves, safety glasses/goggles, ear plugs or muffs, hard hat, high visibility vest.	Level C PPE: Full face air purifying respirator, hooded Tyvek coveralls, chemcial-resitant gloves and boot covers.	First Aid Kit, Sunscreen,

Basic Job Step	Potential Hazards (From HASP)																										Baseline Risk Score			Hazard Controls Protection Measures	Controlled Risk Score			Persons Affected
	Explosion (Chemical Reaction)	Explosion (Over Pressurization)	Electrical (Shock/Short Circuit)	Electrical (Fire)	Electrical (Static)	Electrical (Loss of Power)	Ergonomics (Strain)	Ergonomics (Human Error)	Excavation (Collapse)	Fall (Slip, Trip)	Fire/Heat	Mechanical/Vibration (Chafing/Fatigue)	Mechanical Failure	Mechanical	Noise	Struck By (Mass Acceleration)	Struck Against	Chemical (Toxic)	Chemical (Ignitable)	Chemical (Corrosive)	Chemical (Volatile)	Radiation (Ionizing)	Radiation (Non-Ionizing)	Temperature Extreme (Heat/Cold)	Visibility	Weather Phenomena (Snow/Rain/Wind/Ice)	Biological Hazards (Venomous/Disease-Carrying Animals/Insects, Poisonous Plants)	Severity	Likelihood	Risk Score	Color Key. ▪No shading indicates acceptable risk - no action needed. ▪Green shading indicates low risk - review the operation/activity and take any steps necessary to reduce & control the risks. ▪Yellow shading indicates medium risk - inform H&S management & seek further advice before proceeding any further with the operation/activity. ▪Red shading indicates high risk - HALT the activity immediately, review and reduce the risks identified.	Severity	Likelihood	Risk Score	
Mobilize/Demobilize						X							X			X												1	3	3	Inspect vehicle for unsafe conditions; Stay alert; Be aware of other traffic; Obey traffic laws; Do not drive when tired; Reduce speed in inclement weather; Park WSP vehicle outside of work zone.	1	2	2	WSP & Subcontractor
Load/Unload equipment							X			X			X	X		X	X							X	X	X	X	X	6	2	12	Use proper lifting techniques; Stay alert; Park in designated parking/loading area; Wear work gloves and steel toe boots; Wear high visibility vest in high traffic areas; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP & Subcontractor
Tailgate meeting (daily)										X															X	X	X	X	X	3	1	3	Wear steel toe boots; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP & Subcontractor
Locate and mark drilling location							X							X				X	X	X	X				X	X	X	X	X	3	2	6	Stay alert; Wear steel toe boots; Wear high-visibility vest in high traffic areas; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP & Subcontractor
Clear drilling location for utilities							X							X				X	X	X	X				X	X	X	X	X	3	2	6	Follow SOPs; Use proper lifting techniques; Stay alert; Wear steel toe boots; Wear high-visibility vest in high traffic areas; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP & Subcontractor
Park the rig on final location		X					X	X			X	X		X	X											X	X	X		6	2	12	Stay alert; Inspect rig and work area for unsafe conditions; Guide driver to position; Wear steel toe boots; Wear high-visibility vest in high traffic areas; Use wheel chucks (as necessary)	6	1	6	WSP & Subcontractor

JOB HAZARD ANALYSIS
WATER & ENVIRONMENT

Project Name:	Project No:	Project Location:	Project/Task Description:	Project/Task Equipment:
Okaigan Dojo		19720 Stevens Creek Blvd. Cupertino	SSD System Instalation and Monitoring	Excavator; SSD materials; vapor sampling equipment

Chemicals of Concern:	Site-Specific Hazards:	Action Levels:
PCE	vehicle traffic	5 ppm

Level D PPE:	PPE Upgrades:	Health & Safety Equipment:
Weather appropriate clothing, steel-toed safety shoes, work gloves, nitrile gloves, safety glasses/goggles, ear plugs or muffs, hard hat, high visibility vest.	Level C PPE: Full face air purifying respirator, hooded Tyvek coveralls, chemcial-resitant gloves and boot covers.	First Aid Kit, Sunscreen,

Basic Job Step	Potential Hazards (From HASP)																										Baseline Risk Score			Hazard Controls Protection Measures	Controlled Risk Score			Persons Affected
	Explosion (Chemical Reaction)	Explosion (Over Pressurization)	Electrical (Shock/Short Circuit)	Electrical (Fire)	Electrical (Static)	Electrical (Loss of Power)	Ergonomics (Strain)	Ergonomics (Human Error)	Excavation (Collapse)	Fall (Slip, Trip)	Fire/Heat	Mechanical/Vibration (Chafing/Fatigue)	Mechanical Failure	Mechanical	Noise	Struck By (Mass Acceleration)	Struck Against	Chemical (Toxic)	Chemical (Ignitable)	Chemical (Corrosive)	Chemical (Volatile)	Radiation (Ionizing)	Radiation (Non-Ionizing)	Temperature Extreme (Heat/Cold)	Visibility	Weather Phenomena (Snow/Rain/Wind/Ice)	Biological Hazards (Venomous/Disease-Carrying Animals/Insects, Poisonous Plants)	Severity	Likelihood	Risk Score	Color Key: ▪No shading indicates acceptable risk - no action needed. ▪Green shading indicates low risk - review the operation/activity and take any steps necessary to reduce & control the risks. ▪Yellow shading indicates medium risk - inform H&S management & seek further advice before proceeding any further with the operation/activity. ▪Red shading indicates high risk - HALT the activity immediately, review and reduce the risks identified.	Severity	Likelihood	Risk Score	
Raise mast		X						X			X	X		X	X									X	X	X		6	2	12	Location should be cleared for overhead utilities as per SOPs; Notify driller of any unsafe or hazardous conditions observed; Stay alert; Wear steel toe boots, hard hat, and safety glasses; Wear high-visibility vest in high traffic areas; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	6	1	6	WSP & Subcontractor
Excavation		X						X			X	X		X	X									X	X	X		6	2	12	Location should be cleared for underground utilities as per SOPs; Notify driller of any unsafe or hazardous conditions observed; Stay alert; Wear steel toe boots, hard hat, hearing protection, and safety glasses; Wear high-visibility vest in high traffic areas; Perform air monitoring as per HASP; Wear full face respirator if action levels exceeded as per HASP; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	6	1	6	WSP & Subcontractor
Collect vapor samples							X							X				X	X	X	X		X	X	X	X	X	3	2	6	Follow SOPs; Inspect equipment; Stay alert; Wear nitrile gloves, steel toe boots, hard hat (when mast is raised), hearing protection (when rig is drilling), and safety glasses; Wear high-visibility vest in high traffic areas; Perform air monitoring as per HASP; Wear full face respirator if action levels exceeded as per HASP; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP
Decontamination							X			X								X		X	X							4	3	12	Stay alert; Wear nitrile gloves, steel toe boots, hard hat (if using pressure washer), hearing protection (if using pressure washer), and safety glasses or goggles (if using pressure washer); Wear high-visibility vest in high traffic areas; Perform air monitoring as per HASP; Wear full face respirator if action levels exceeded as per HASP; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	4	1	4	WSP & Subcontractor
Waste management							X			X								X		X	X							5	3	15	Use proper lifting techniques; Stay alert; Wear work or nitrile gloves and steel toe boots; Wear hard hat and safety glasses if using heavy equipment; Use hand tools properly; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	4	1	4	WSP & Subcontractor

JOB HAZARD ANALYSIS
WATER & ENVIRONMENT

Prepared By:	Prepared Date:
Elena Robertson	8/26/2022
Approved By:	**Approved Date:**
Elena Robertson	8/26/2022

Project Name:	Project No:	Project Location:	Project/Task Description:	Project/Task Equipment:
Okaigan Dojo	31400443	19720 Stevens Creek Blvd. Cupertino	Soil gas investigation	Drill rig, sampling equipment.

Chemicals of Concern:	Site-Specific Hazards:	Action Levels:
PCE	Truck traffic	5 ppm

Level D PPE:	PPE Upgrades:	Health & Safety Equipment:
Weather appropriate clothing, steel-toed safety shoes, work gloves, nitrile gloves, safety glasses/goggles, ear plugs or muffs, hard hat, high visibility vest.	Level C PPE: Full face air purifying respirator, hooded Tyvek coveralls, chemcial-resitant gloves and boot covers.	First Aid Kit, Sunscreen

Basic Job Step	Potential Hazards (From HASP)																											Baseline Risk Score			Hazard Controls Protection Measures	Controlled Risk Score			Persons Affected
	Explosion (Chemical Reaction)	Explosion (Over Pressurization)	Electrical (Shock/Short Circuit)	Electrical (Fire)	Electrical (Static)	Electrical (Loss of Power)	Ergonomics (Strain)	Ergonomics (Human Error)	Excavation (Collapse)	Fall (Slip, Trip)	Fire/Heat	Mechanical/Vibration (Chafing/Fatigue)	Mechanical Failure	Mechanical	Noise	Struck By (Mass Acceleration)	Struck Against	Chemical (Toxic)	Chemical (Ignitable)	Chemical (Corrosive)	Chemical (Volatile)	Radiation (Ionizing)	Radiation (Non-Ionizing)	Temperature Extreme (Heat/Cold)	Visibility	Weather Phenomena (Snow/Rain/Wind/Ice)	Biological Hazards (Venomous/Disease-Carrying Animals/Insects, Poisonous Plants)	Severity	Likelihood	Risk Score	Color Key: ▪No shading indicates acceptable risk - no action needed. ▪Green shading indicates low risk - review the operation/activity and take any steps necessary to reduce & control the risks. ▪Yellow shading indicates medium risk - inform H&S management & seek further advice before proceeding any further with the operation/activity. ▪Red shading indicates high risk - HALT the activity immediately, review and reduce the risks identified.	Severity	Likelihood	Risk Score	
Mobilize/Demobilize						X							X			X												6	3	18	Inspect vehicle for unsafe conditions; Stay alert; Be aware of other traffic; Obey traffic laws; Do not drive when tired; Reduce speed in inclement weather; Park WSP vehicle outside of work zone.	6	2	12	WSP
Load/Unload equipment							X			X			X	X		X	X						X	X	X	X	X	6	2	12	Use proper lifting techniques; Stay alert; Park in designated parking/loading area; Wear work gloves and steel toe boots; Wear high visibility vest in high traffic areas; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP & Subcontractor
Tailgate meeting (daily)										X														X	X	X	X	X	3	1	3	Wear steel toe boots; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP & Subcontractor
Soil Gas Well Installation							X							X				X	X	X	X			X	X	X	X	X	3	2	6	Follow SOPs; Inspect equipment; Stay alert; Wear nitrile gloves, steel toe boots and safety glasses; Wear high-visibility vest in high traffic areas;Perform air monitoring as per HASP; Wear full face respirator if action levels exceeded as per HASP; Use SPF 15 or higher sunscreen; Wear weather-appropriate clothing; Work during daylight hours; Use insect repellant containing DEET	3	1	3	WSP & Subcontractor
Soil Gas Sample Collection							X							X				X	X	X	X			X	X	X	X	X	3	2	6	Follow SOPs; Inspect equipment; Stay alert; Wear nitrile gloves, steel toe boots and safety glasses; Wear high-visibility vest in high	3	1	3	WSP & Subcontractor

APPENDIX

C-1 *OSHA'S COMMON HAZARDS AND DESCRIPTIONS*

APPENDIX

Appendix 2
Common Hazards and Descriptions

Hazards	Hazard Descriptions
Chemical (Toxic)	A chemical that exposes a person by absorption through the skin, inhalation, or through the blood stream that causes illness, disease, or death. The amount of chemical exposure is critical in determining hazardous effects. Check Material Safety Data Sheets (MSDS), and/or OSHA 1910.1000 for chemical hazard information.
Chemical (Flammable)	A chemical that, when exposed to a heat ignition source, results in combustion. Typically, the lower a chemical's flash point and boiling point, the more flammable the chemical. Check MSDS for flammability information.
Chemical (Corrosive)	A chemical that, when it comes into contact with skin, metal, or other materials, damages the materials. Acids and bases are examples of corrosives.
Explosion (Chemical Reaction)	Self explanatory.
Explosion (Over Pressurization)	Sudden and violent release of a large amount of gas/energy due to a significant pressure difference such as rupture in a boiler or compressed gas cylinder.
Electrical (Shock/ Short Circuit)	Contact with exposed conductors or a device that is incorrectly or inadvertently grounded, such as when a metal ladder comes into contact with power lines. 60Hz alternating current (common house current) is very dangerous because it can stop the heart.

APPENDIX

Hazards	Hazard Descriptions
Electrical (Fire)	Use of electrical power that results in electrical overheating or arcing to the point of combustion or ignition of flammables, or electrical component damage.
Electrical (Static/ESD)	The moving or rubbing of wool, nylon, other synthetic fibers, and even flowing liquids can generate static electricity. This creates an excess or deficiency of electrons on the surface of material that discharges (spark) to the ground resulting in the ignition of flammables or damage to electronics or the body's nervous system.
Electrical (Loss of Power)	Safety-critical equipment failure as a result of loss of power.
Ergonomics (Strain)	Damage of tissue due to overexertion (strains and sprains) or repetitive motion.
Ergonomics (Human Error)	A system design, procedure, or equipment that is error-provocative. (A switch goes up to turn something off).
Excavation (Collapse)	Soil collapse in a trench or excavation as a result of improper or inadequate shoring. Soil type is critical in determining the hazard likelihood.
Fall (Slip, Trip)	Conditions that result in falls (impacts) from height or traditional walking surfaces (such as slippery floors, poor housekeeping, uneven walking surfaces, exposed ledges, etc.)
Fire/Heat	Temperatures that can cause burns to the skin or damage to other organs. Fires require a heat source, fuel, and oxygen.
Mechanical/ Vibration (Chaffing/ Fatigue)	Vibration that can cause damage to nerve endings, or material fatigue that results in a safety-critical failure. (Examples are abraded slings and ropes, weakened hoses and belts.)

APPENDIX

Hazards	Hazard Descriptions
Mechanical Failure	Self explanatory; typically occurs when devices exceed designed capacity or are inadequately maintained.
Mechanical	Skin, muscle, or body part exposed to crushing, caught-between, cutting, tearing, shearing items or equipment.
Noise	Noise levels (>85 dBA 8 hr TWA) that result in hearing damage or inability to communicate safety-critical information.
Radiation (Ionizing)	Alpha, Beta, Gamma, neutral particles, and X-rays that cause injury (tissue damage) by ionization of cellular components.
Radiation (Non-Ionizing)	Ultraviolet, visible light, infrared, and microwaves that cause injury to tissue by thermal or photochemical means.
Struck By (Mass Acceleration)	Accelerated mass that strikes the body causing injury or death. (Examples are falling objects and projectiles.)
Struck Against	Injury to a body part as a result of coming into contact of a surface in which action was initiated by the person. (An example is when a screwdriver slips.)
Temperature Extreme (Heat/Cold)	Temperatures that result in heat stress, exhaustion, or metabolic slow down such as hypothermia.
Visibility	Lack of lighting or obstructed vision that results in an error or other hazard.
Weather Phenomena (Snow/Rain/ Wind/Ice)	Self explanatory.

APPENDIX

D

WSP SOP'S

FIELD STANDARD OPERATING PROCEDURE #2

UTILITY LOCATING PROCEDURE

The purpose of this procedure is to ensure that all required and appropriate procedures are followed to locate and mark subsurface utilities (e.g., electrical lines, natural gas lines, communication lines) before initiating any intrusive field activities (e.g., drilling, test pits, trenching, excavation). The company's preference, as indicated in our subcontractor agreement templates, is for our contractors to be responsible for both public and private utility mark-outs; this includes contacting the public authority and obtaining a subcontractor for private utility locating services, if needed. Guidance for contractors to follow to conduct a utility clearance is provided in our request for proposal (RFP) template and must be included in all RFP's for intrusive field activities.

In rare circumstances, the company may choose to accept responsibility for clearing utilities, which will require a change to the language of our subcontractor agreement. This assumption of increased liability by the company requires written rationale and approval from the cognizant District Business Leader, with written concurrence from the Chief Operating Officer. The written approvals **MUST** be obtained prior to submitting the Request for Subcontract to Contract Administration.

Compliance with this procedure for projects where the company will be responsible for clearing utilities is mandatory. **ALL** deviations from this standard operating procedure (SOP) **MUST** be approved by the project manager and a District Business Leader, with confirmation from the Chief Operating Officer **BEFORE** beginning intrusive work.

Field personnel have the authority and responsibility to postpone intrusive activities if a contractor has not completed utility clearances to the company's satisfaction; if sufficient information, as stipulated in this SOP, is not available; or, if onsite reconnaissance identifies inconsistencies in the findings of utility locators. In these instances, field personnel must notify the project manager or the health and safety officer, or their designee, before proceeding with the proposed work; approval from a District Business Leader, with confirmation from the Chief Operating Officer, is required before the work commences.

The user is advised to read the entire SOP and review the site health and safety plan (HASP) and/or project safety plan (PSP) before beginning any onsite activities.

2.1 ACRONYMS AND ABBREVIATIONS

HASP	health and safety plan
PSP	project safety plan
RFP	request for proposal
SOP	standard operating procedure

2.2 MATERIALS

- Utility Locating Form (Attachment 1)
- Field book
- Wood stakes
- Spray paint
- Flagging tape
- As-built drawings for sub-grade utilities (if available)
- Hand auger or post-hole digger

2.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel

and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company SOPs. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

WSP requires that all personnel performing specific project assignments be appropriately qualified, including having required certifications or licenses; and, are properly trained in accordance with the requirements of their assignment, the Environmental Service Line's field SOPs, and the Quality Management System.

This procedure is intended to allow the work to proceed safely and minimize the potential for damaging underground and aboveground utilities. Intrusive work includes all activities that require the company's employees or its subcontractors to penetrate the ground surface. Examples of intrusive work include, but are not limited to, hand augering, probing, drilling, injections, test pit excavations, trenching, and remedial excavations.

This SOP assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1).

2.4 PRE-FIELD MOBILIZATION PROCEDURES

Public rights-of-way and private property must be cleared of buried utilities and overhead utilities must be identified before any intrusive work can begin regardless of who is responsible for completing these activities (company or a contractor). The first step in this process is notifying the state public utility locating service of the planned work. These services provide a link between the entities performing the work and the various utility operators (e.g., the water company, the electric company, etc.). All the public utility locating service call centers in the United States have been streamlined under a single "Call Before You Dig" phone number: 811. However, the appropriate state or provincial call center (http://call811.com/811-your-state) will need to be contacted[1].

When the appropriate call center is contacted, information regarding the site (e.g., location, nearest cross street, township, etc.) and work activity (e.g., drilling, excavation) will need to be provided to the operator to aid in locating the likely utilities at the work site. The information provided on the Utility Locating Form (Attachment 1) must be recorded (by the contractor or the company) and a completed copy of this form must be maintained as part of the project file. Be aware that several states, including California, require that the proposed drilling locations be marked with white spray paint before contacting the locating services.

The following information must always accompany the field team during the field project:

- The utility clearance ticket number
- The ticket's legal dig date
- The ticket's expiration date
- Utility providers that were contacted

The ticket number serves as a point of reference for both the utility service providers and for the company or contractor should follow up (e.g., renewing the ticket) with the locating service be required. The legal dig and expiration dates reflect the times when it will be legal to perform the proposed work. Recognize that the legal dig date reflects the lead time necessary, typically between 48 and 72 hours after you call, for the utility service providers to mark the utilities in you work area. Be sure to include this delay when scheduling your work. Most utility clearance tickets expire about 2 weeks after the legal dig date. If your work is delayed beyond the expiration date, the 811 utility locating service will need to be called again and the ticket renewed. The renewed ticket will have a new legal dig date that incorporates the same lead-time (48 to 72 hours) as the original ticket.

[1] Some state or provincial laws require that the person who will be conducting the intrusive work must be the person who places the call to the public utility locating service. This means that the company cannot make this call on the contractor's behalf; the contractor must place the call in those states where required. If there is any doubt about the requirements for the state where a project is located, the relevant state authority must be contacted (http://call811.com/811-your-state).

The locating service will also provide the caller with a list of utility companies that will be notified. Compare this list with utilities generally expected at all sites (e.g., sewer, water, gas, communication, and electric). Some utilities (e.g., sewer, water, cable television) may not be included. If any expected utilities are absent from the contact list, the utilities **MUST** be contacted directly for clearance before the start of intrusive activities. All contacts should be recorded on the Utility Locating Form.

2.4.1 PRIVATE UTILITY LOCATORS AND OTHER SOURCES

Public utility service providers will generally mark their underground lines within the public right-of-way up to the private property boundary. A public utility locating service must be contacted prior to any intrusive work, regardless of whether the intrusive work is located on public or private property. However, be aware that most public utility locating services will not locate utilities on private property. If your work is to be conducted on private property, a private utility locating service **MUST** be used to clear the work area. These companies typically use a variety of methods (e.g., electromagnetic detectors, ground-penetrating radar, acoustic plastic pipe locator, trace wire) to locate utilities in the work area, including those that may be buried beneath onsite buildings. Pseudoscientific methods (e.g., dowsing, divining, witching) are not acceptable utility locating methods.

For all operating facilities and to the extent possible for closed facilities, identify a site contact familiar with the utilities on the property (e.g., plant manager, facility engineer, maintenance supervisor), and provide this individual with a site plan showing the proposed locations of all soil borings, monitoring wells, test pits, and other areas where intrusive activities will be conducted. These individuals often have knowledge of buried structures or process-specific utilities that may not be identified by the private utility locator. This is particularly important for work performed inside industrial buildings where reinforced concrete and other metallic components of the structure may interfere with the scanning devices used by the private utility locator. Ask the site contact for all drawings concerning underground utilities in the proposed work areas for future reference.

Keep in mind that no intrusive work may be done before the legal dig date provided by the state utility locating service and no digging, drilling, or other ground-breaking activities may be begin until all utilities on the list have been marked and visually verified in the work area (see below). It is **NOT ACCEPTABLE** to rely solely on as-built drawings or verbal utility clearances from the site contact (these should be used as guides only). A private locator may not be necessary in rare instances; however, nonconformity with the private locate requirement must be approved by the project manager **AND** a District Business Leader, with confirmation from the Chief Operating Officer.

2.5 SITE MOBILIZATION PROCEDURES

Upon arrival, the first step in determining if you are clear of buried and overhead utilities is to locate all the proposed drilling and trenching locations and mark them with (white) spray paint, stakes, or other appropriate markers. This will help you judge distances from marked drilling and trenching locations to underground and overhead utilities and minimizes any potential misunderstandings regarding the locations between you, the subcontractors (drillers, excavators, private utility locator), and the site contact.

Once you have the proposed work areas marked, verify that ALL utility companies listed by the state public utility locating service, and any contacted directly by the company or the contractor, have either marked the underground lines in the specified work areas or have responded (via telephone, facsimile, or e-mail) with “no conflict.” Document on the Utility Locating Form (Attachment 1) and in the field book as each utility mark is visually confirmed. When receiving verbal clearances by telephone from utility companies, or their subcontractors, it is imperative that you verify the utilities that are being cleared, particularly when dealing with subcontractors that may be marking more than one utility.

Review all available as-built utility diagrams and plans for your general work area and conduct a site walk to identify potential areas where underground lines may be present; include the site contact in these activities. It is a good idea to survey your surroundings during the walk to identify any features that may indicate the presence of underground utilities, such as linear depressions in the ground, cuts in concrete or asphalt, old road cuts, catch basins, or manholes. Keep in mind that many sewer lines can be offset from catch basins. The presence of aboveground utilities, such as parking lot lights or pad-mounted transformers, is also a good indicator of

buried electrical lines. Check these items against the Utility Locating Form checklist and discuss the locations with the private utility locating service.

2.5.1 SAFE WORKING DISTANCES AND HAND CLEARING

A minimum of 5-feet clearance must exist between utilities and proposed drilling locations, and a minimum of 6-feet between utilities and proposed trenching locations. Be aware that some clients, states and localities (e.g., New York City, Long Island) may require greater minimum working distances, depending on the utility (e.g., for high pressure gas mains). A minimum distance of 15 feet must be maintained by heavy equipment (e.g., excavator buckets, drill rig towers and rods) from overhead power lines and a safe distance of 25 feet must be maintained from high-tension overhead power lines. If work must be conducted within 25 feet of high-tension wires, the lines must be wrapped and insulated by the local utilities. Increase these minimum distances whenever possible to offer additional assurance that buried or overhead utilities will not be encountered.

If a utility conflict is identified within the minimum safe clearance distance, adjust the proposed location(s) using the criteria given above. It is recommended to have the private utility locator sweep a relatively large area (e.g., a 20-foot circle around a proposed drilling location) to provide room for adjustment should the proposed drilling or excavation area need to be moved to avoid a buried utility. Subsurface work within five feet of a confirmed or suspected utility or other subsurface structure must be done by nondestructive clearing techniques to the point where either the utility/structure is visually located and exposed, or in the case of soil borings, where the bottom depth of the structure is surpassed and drilling may begin.

Uncertainty may exist in some circumstances (e.g., inside a building) even after the area has been swept for utilities. In these cases, advance the first few feet of a soil boring (or probe the area for excavation) using a hand auger or post-hole digger. If hand digging is unable to penetrate the subsurface soils, soft dig or air knife equipment service providers may be retained to clear the location. This equipment applies high pressure air to penetrate, loosen, and extract subsurface soils in the borehole, thereby safely exposing any utilities. If using either hand digging or soft digging, the probe hole should be advanced a minimum of 5 feet below ground surface at each proposed drilling or excavation location. Complete a sufficient number of probe holes so that the area is cleared for the proposed intrusive activity (i.e., use several holes for a proposed excavation). The use of hand digging or soft digging methods **does not** replace the need for state and private utility locating services.

Protect and preserve the markings of approximate locations of facilities until the work activities are completed. If the markings of utility locations are destroyed or removed before excavation commences or is completed, stop work. Notify the utility company, utility protection service, or the utility locating service to inform them that the markings have been destroyed. Do not continue work until the utilities have been re-marked.

2.5.2 EXPANDED WORK AREAS AND TICKET RENEWAL

Many projects begin with well-defined work areas only to expand quickly as the investigation or remediation progresses. If the scope of intrusion expands or includes new onsite or offsite area(s), you will need to review the existing ticket and work performed by the private utility locator to determine whether work can progress into the new area safely. It may be necessary, depending on the scope, to contact (or for the Contractor to contact) the state locating service and request another clearance for the new area(s) of investigation and retain a private locating service. Remember, the new request will provide a new legal dig date before which NO INTRUSIVE WORK CAN BEGIN. Additionally, if a clearance ticket will expire while the work is ongoing (typically after 2 weeks), a new clearance must be requested before the first ticket expires so that work can continue uninterrupted. Refer to the Utility Locating Form (Attachment 1) for the legal dig date time frame required by the state locating service.

2.5.3 UTILITY DAMAGE

It is possible, even if you followed all the procedures outlined in this SOP, to damage an underground or overhead utility. Assuming it can be done safely, quickly turn off the drilling or excavating equipment, or move the equipment from the damaged line. Avoid contact with escaping liquids, live wires, and open flames. Abandon the equipment, evacuate the personnel from the area, and

maintain a safe perimeter if there are any concerns about safety. If a fiber optic cable is damaged, do not handle the cable or look into the end of the cable as serious eye damage may occur. Once personnel are in a secure location, immediately notify the facility operator or site contact and 811; additionally, send an immediate alert or notification via iSMS and send an email to SafetyTeam@wsp.com. You should also, as applicable, contact your immediate supervisor, human resources and sector management in accordance with company policy. If the damaged utility has the potential to cause, or is causing, dangerous conditions, immediately notify the local emergency response number listed in your HASP or PSP.

** This form is mandatory for all intrusive work, regardless of who is responsible for the public and/or private locate.

Utility Locating Form

Project Name	Project No. and Task	Work being done for (Company or Individual Name)	Project Manager

Office Address	Office Phone	Field Contact	Field Contact Phone

Project Location: Street Address	City/Township	County	State

Nearest Intersecting Street

Description of Work Area (street working on, which side of street, how far in which direction from nearest intersecting street; etc.)

Type of Work	Explosives (Y/N)	Directional Borings (Y/N)	Dig Locations Marked (Y/N)	Mark Type (e.g., stake)

Scheduled Work Start (Date & Time)	Estimated Work Stop Date	One-call Phone Number/Website Address	One-call Service Name

Call/Web Notification Made By (Name, Title and Company)	Date & Time of Call/Web Notification	Operator Name

Ticket No.	Legal Dig Date	Ticket Expiration Date	Ticket Renewal Date

Utilities Notified		Complete After Receiving Notification (e.g., e-mail, facsimile) from Utilities or Subcontractor		
		Utilities Present (Y/N)	Onsite Meeting (Y/N; if "Y" Date & Time)	Contact Name and Phone
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Form Completed By (Signature)	
	(e-mail completed page 1 to Project Manager)

** This form is mandatory for all intrusive work, regardless of who is responsible for the public and/or private locate.

Private Utility Locator Information			
Company	**Contact Name**	**Phone**	**E-mail**
Who Contracted Locator?		**Scheduled Start (Date & Time)**	**Contract Executed (Y/N/NA)**

Onsite Visual Confirmation of Utilities			
Marking Color	**Utility Type and Visual Clues**	**Cleared or Marked (Y/N)**	**No Markings - Comments**
Blue	Potable water: fire hydrant, manholes; water meter, ASTs, interior connections, hose bib, valve box		
Yellow	Gas, oil steam, petroleum: gas meter, manholes; yellow bollards, interior connections, valve box		
Red	Electric power lines, lighting cables, parking lot lights, overhead lines (telephone poles), conduits: interior connections, underground vaults, manholes, transformers/switchgear, conduit on buildings		
Green	Sewer and drain lines: underground vaults, manholes, drain grates, leach field, sand mound, no evidence of sanitary sewer (for septic system)		
Orange	Communication, alarm or signal lines, cables or conduits: red/orange bollards, telephone poles, interior connections; manholes; conduit on buildings		
Purple	Reclaimed water, irrigation, and slurry lines: sprinkler heads, hose bibs		
Pink	Survey markings		
White	Proposed locations for excavation and drilling		

Project Manager Notified of any Conflicts? (Y/N)

Notes:

Marks Verified By (Signature)	
	(scan and save to client file)

FIELD STANDARD OPERATING PROCEDURE #4

SAMPLE COLLECTION AND QUALITY ASSURANCE PROCEDURE

The purpose of this procedure is to assure that sample volumes and preservatives are sufficient for analytical services required under U.S. Environmental Protection Agency (EPA) or other agency approved protocols. This operating procedure describes sample identification procedures, sampling order for select analytes, quality control and quality assurance (QA/QC) sampling procedures, and custody documentation. The user is advised to read the entire standard operating procedure (SOP) and review the site health and safety plan (HASP) and/or project safety plan (PSP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

4.1 ACRONYMS AND ABBREVIATIONS

ºC	degrees Celsius
COC	chain-of–custody [form]
DI	laboratory-grade, analyte-free deionized water
DOT	US Department of Transportation
EDD	electronic data deliverable
EPA	US Environmental Protection Agency
HASP	health and safety plan
ID	identification [number]
MS/MSD	matrix spike and matrix spike duplicate
MSA	master services agreement
PPE	personal protective equipment
PSP	project safety plan
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SOP	standard operating procedure
VOCs	volatile organic compounds

4.2 MATERIALS

- Field book
- Indelible (waterproof) markers or pens
- PPE
- Sampling containers and labeling/shipping supplies

- Deionized (DI) water
- Cleaned or dedicated sampling equipment

4.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company's SOPs. Employees are also strongly advised to review relevant state and federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

WSP requires that all personnel performing specific project assignments be appropriately qualified, including having required certifications or licenses, and properly trained in accordance with the requirements of their assignment, the Environmental Service Line's field SOPs, and the Quality Management System.

This SOP is designed to provide the user with a general outline for collecting environmental and quality assurance samples and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), sample shipment procedures (SOP 3), investigation derived waste management procedures (SOP 5), and equipment decontamination (SOP 6). This SOP does not cover investigation planning, nor does it cover the analysis of the analytical results. These topics are more appropriately addressed in a site-specific work plan or a dedicated quality assurance project plan (QAPP). This SOP does not include an special handling requirements for specific parameters such as low-level mercury or per- and polyfluoroalkyl substances. These requirements should be included in the QAPP.

4.4 SAMPLE IDENTIFICATION PROCEDURES

All sample containers (e.g., glass bottles, plastic jars, foil bags, plungers, etc.) should be identified by an affixed sample label. Unless otherwise approved by your project manager or specified in your site-specific work plan/QAPP, information on the sample container labels must include the site/project name, project/task number, unique alpha-numeric sample identification (ID) number, sample collection date, time of collection using the military or 24-hour clock system (i.e., 0000 to 2400 hours), analytical parameters, preservative, and the initials of the sampling personnel. Employees are advised to use pre-printed waterproof mailing labels (e.g., Avery® 5xxx-series Waterproof Address Labels) for all sample identification. Electronic label templates are available.

The sample identification (ID) number must, unless otherwise approved by your project manager or specified in your site-specific work plan/QAPP, follow the company's naming protocol. This protocol was developed to aid in determining the type of sample collected (e.g., soil, groundwater, vapor, etc.), the sample location, and, where appropriate, the sample depth. This protocol was also designed to ensure consistency across the company.

Construct sample IDs in the following format:

SB-10A (4-6)

Where, in this example:

- SB = the first two or three characters will define the sample type (see list of approved prefixes below); in this case, a soil boring
- 10A = the next two or three alpha-numeric digits (separated by a dash from the sample type identifier) indicate the location of the boring on the site; in this case, boring number 10A
- (4-6) = the depth the sample was collected, with the first number (including decimals, if necessary) indicating the top of the sample interval (in feet) and the second number indicating the bottom of the sample interval (in feet); not all sample types will include depth information.

Additional label information may be added after the last character of the sample ID number (e.g., sample date, underground storage tank number, area of concern number, "Area" number, client identifier, etc.). Separate any additional information from the required portion of the sample name by dash(es).

Sample Prefix	Permitted Use
AA	Ambient outdoor air sample
CC	Concrete core/chip sample
CS	Confirmation/verification soil sample collected from an excavation
HA	Soil sample collected with a hand auger
IAB	Indoor air sample – basement
IAC	Indoor air sample – crawl space
IAF	Indoor air sample – first floor
MW	Soil sample collected from a monitoring well borehole or a groundwater sample collected from a monitoring well
PZ	Groundwater sample collected from a piezometer
SB	Soil sample collected from boreholes that will not be converted to monitoring wells
SED	Sediment sample
SG	Soil gas sample other than a sub-slab sample (e.g., sample collected from a temporary or permanent polyvinyl chloride sample point or stainless steel screen implant)
SL	Sludge sample
SS	Surface soil sample collected using hand tools (e.g., trowel, spoon, etc.) and typically at depths less than 2 feet below ground surface
SSV	Sub-slab vapor sample
SW	Surface water sample
TC	Tree core sample
TP	Soil sample collected from a test pit
WC	Waste characterization sample
WP	Wipe sample
WW	Wastewater

4.5 SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

The first step in sample collection is to verify that the correct number and type of sample containers were provided, and that each contains the appropriate preservatives for the proposed project (i.e., check against the sampling plan requirements outlined in the site-specific QAPP or, for those projects without a site-specific QAPP, the laboratory Task Order). Inspect all containers and lids for flaws (cracks, chips, etc.) before use. Do not use any container with visible defects or discoloration. Report non-receipt and any discrepancies of specific types of sample containers to the team leader or project manager immediately. Make arrangements to have missing or additional sampling containers provided on an expedited basis.

Precautions must be taken to prevent cross-contamination and contamination of the environment when collecting samples. Wear a clean pair of new, disposable gloves each time a different sample is collected and don the gloves immediately prior to collection. This limits the possibility of cross-contamination from accidental contact with gloves soiled during collection of the previous sample. The gloves must not contact the medium being sampled and must be changed any time during sample collection when their cleanliness is compromised. ***In no case should gloved hands be used as a sampling device: always use the appropriate sampler to move the sample from the sampling device to the laboratory-supplied containers.***

Sample collection must follow all appropriate SOPs, state and federal regulations, or guidance, for the collection of environmental samples; the recommended order of sample collection is:

- Geochemical measurements (e.g., temperature, pH, specific conductance)
- Volatile organic compounds (VOCs)
- Extractable organics, petroleum hydrocarbons, aggregate organics, and oil and grease
- Per- and Polyfluoroalkyl substances
- Total metals
- Dissolved metals
- Inorganic non-metallic and physical and aggregate properties
- Microbiological samples
- Radionuclides

Fill the sample bottles to the appropriate level for the parameter analyzed including eliminating head space, as appropriate. Collected samples that require thermal preservation must be immediately (within 15 minutes) placed in a cooler with wet ice and maintained at a preservation temperature of 4° Celsius (ºC).

4.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field quality assurance/quality control (QA/QC) samples may include equipment blanks, trip blanks, temperature blanks, duplicates, matrix spike and matrix spike duplicate samples, field blanks, and split samples. The project manager or QAPP must specify the type and frequency of QA/QC sample collection. The QA/QC sample identification number must, unless otherwise approved by your project manager or specified in your site-specific work plan, follow the company's naming protocol as discussed in the sections below. QA/QC samples must be clearly identified on our copy of the chain-of-custody (COC) form (described below) and in the field book. Failure to properly collect and submit required QA/QC samples can result in invalidation of an entire sampling event.

Several blanks, discussed below, require laboratory-grade analyte-free, deionized water (DI) be used. Only if all options to obtain laboratory-grade DI have been exhausted should store-grade distilled water be used to prepare blanks. If store-grade distilled water is used, be sure to record the source and lot number in the field book.

Collect, preserve, transport and document split samples using the same protocols as the related samples.

4.6.1 EQUIPMENT BLANKS

Equipment blanks, or rinsate blanks, are used to document contamination attributable to using non-dedicated equipment (i.e., equipment that must be decontaminated after each use). Collect equipment blanks in the field at a rate of one per type of sampling equipment per day, unless otherwise specified. If the site-specific work plan or QAPP indicates that an equipment blank is to be collected from dedicated sampling equipment, collect the equipment blank in the field before sampling begins. If field decontamination of sampling equipment is required, prepare the equipment blanks after the equipment has been used and field-decontaminated at least once.

Prepare equipment blanks by filling or rinsing the pre-cleaned equipment with DI and collecting the rinsate in the appropriate sample containers. Record the type of sampling equipment used to prepare the blank and how the equipment blank was generated in the field book. Decontamination of the equipment following equipment blank procurement is not required.

The samples must be labeled, preserved, and filtered (if required) in the same manner as the environmental samples. Have the equipment blanks analyzed for all the analytes for which the environmental samples are being analyzed, unless otherwise specified. Designate equipment blanks using "EB", followed by the date, and in the order of equipment blanks collected that day. For example, the first equipment blank collected on July 4, 2015, would be designated EB070415-1.

4.6.2 TRIP BLANKS

Trip blanks are used to document VOC contamination attributable to shipping and field handling procedures. Trip blanks are only required when analyzing samples for VOCs. The blanks are prepared by the analytical laboratory and shipped along with the empty sample containers. These pre-filled blanks should accompany the environmental sample containers wherever they are stored onsite (i.e., keep the trip blank sample bottles in the same shipping container used to ship and store VOC sample bottles during the sampling event). Never open the laboratory-supplied trip blank sample bottles. Only as a last resort, store-grade distilled water, can be poured into empty VOC sample bottles to generate event-specific trip blanks (or augment the laboratory-supplied ones, if they are provided in insufficient numbers).

The trip blanks, even those provided by the analytical laboratory, should be labeled in the field like other environmental samples collected during the investigation activities. Identify trip blanks using the prefix "TB", followed by the date. For example, the trip blank shipped with a cooler of samples on July 4, 2019, would be designated TB070419-1. If a second trip blank is needed on that same day, the designation would be TB070419-2. A minimum of one trip blank should accompany each shipping container of VOC samples, unless more stringent project requirements are in place. The number of trip blanks needed per shipment can be minimized by shipping all the VOC samples in the same shipping container (if possible).

4.6.3 FIELD BLANKS

The field blank is analogous to the trip blank in that it is designed to assess and document any contamination to the environmental samples that can be attributable to the (ambient) field conditions. Not all projects require the use of field blanks. Their use, if required, and the frequency of collection (often 1 blank per 10 or 20 environmental samples collected) is detailed in the QAPP and the site-specific work plan. The sample is collected by pouring DI water into empty glassware at the site during the sampling event. The intent is to expose the field blank to the same conditions in the atmosphere as those present when the environmental samples were collected.

Identify field blanks using the prefix "FB", followed by the date. For example, the field blank shipped collected on August 22, 2019, would be designated FB082219. If a second field blank is needed on that same day, the designation would be FB082219-2. At least one field blank should be collected for each analytical parameter identified in the sampling event.

4.6.4 TEMPERATURE BLANKS

Temperature blanks are used to determine if the samples are at the appropriate temperature for preservation at the time the sample container (cooler) is received by the analytical laboratory. The temperature is determined by measuring the temperature blank, which provides a proxy for the temperature of the sample container upon arrival at the laboratory. These temperature blanks are typically provided by the laboratory and should be included in each sample cooler used to ship and store the sample bottles during the sampling event. If laboratory-provided temperature blanks are not available, fill a clean, unpreserved sample bottle with potable, DI, or store-grade distilled water and identify the bottle as a temperature blank.

4.6.5 DUPLICATES

Duplicate samples, which are used for measuring the variability and documenting the precision of the sampling process, should be collected at a rate of at least 1 duplicate per 20 environmental samples collected, unless specific project requirements (as detailed in a QAPP) are in place. Be sure that the location selected for duplication has sufficient sample volume and is within the area of contamination, if known. Under no circumstances can equipment or trip blanks be used as duplicates.

Collect each duplicate sample at the same time, from the same sample aliquot, and in the same sampling order (i.e., volatile organic compounds, then semivolatile organic compounds, then inorganics, etc.) as the corresponding environmental sample. Sample bottle aqueous duplicate samples, for example, should be alternately filled with the environmental sample bottles (i.e., the actual sample bottle and the bottle to be used for the duplicate) from the same sampling device. If the sampling device does not hold enough volume to fill the sample containers, fill the first container with equal portions of the sample, and pour the remaining sample into the next

sample containers. Obtain additional sample volume and pour the first portion into the last sample container, and pour the remaining portions into the first containers. Continue with these steps until all containers have been filled.

Duplicate samples will be assigned arbitrary sample ID and a false collection time so that they are not identified as duplicates by the laboratory (i.e., submit the duplicates samples as *blind* to the lab). The blind duplicate sample "location designation" will be left up to the project manager; however, in no case will "Dup" be allowed to appear in the sample name. The duplicate samples should be analyzed for the same analytes as the original environmental sample. Be sure to record the sampling method, duplicate sample ID, the false time, and the actual time of collection in the field notebook. The duplicate should also be indicated in separate documentation, such as on our carbon copy of the chain-of-custody (i.e., the yellow copy), and not on the original chain-of-custody that accompanies the samples to the laboratory.

4.6.5 MATRIX SPIKE AND MATRIX SPIKE DUPLICATES

Matrix spike and matrix spike duplicate samples (i.e., MS/MSD samples) are used to determine the bias (accuracy) and precision of an analytical method for a specific sample matrix. Many of the company's projects require the collection of MS/MSD samples; however, laboratory generated MS/MSD samples are sufficient for some projects (as detailed in the QAPP or site-specific work plan). Collect MS/MSD samples at a rate of 1 MS and 1 MSD (i.e., 2 samples) for every 20 environmental samples, unless more stringent project requirements (as detailed in a QAPP) are in place. Clearly convey the MS/MSD identity to the laboratory by adding "MS" or "MSD" after the sample name (e.g., MW-01MS) and/or in the comments section of the chain-of-custody on the same line as the parent sample. Under no circumstances can equipment or trip blanks be used as MS/MSD samples.

4.6.6 SPLIT SAMPLES

Split samples may be collected as a means of determining compliance or as an added measure of quality control. Split samples measure the variability between laboratories and not the variability of sample collection and laboratory procedures (i.e., they are not equivalent to duplicate samples). The split samples must be subsamples of the same parent material used for the environmental sample: soil should be collected from the same in-place material (for VOCs) or, for non-discrete samples, the same mixing vessel after homogenization. Collect aqueous split samples using the same alternating bottle approach detailed in the duplicate sample description above. These procedures will ensure that the split samples are valid and are representative of the environmental sample collected as part of the investigation.

Collecting split samples of soil, sediment, waste, and sludge is not recommended because the homogenization necessary for a true split sample in these matrices is not possible and the resulting laboratory results would not be comparable.

Spilt samples should have the same sample location designation (e.g., MW-01, SB-03 (4-6), but are differentiated from each other by inserting the laboratory analyzing or the agency/consultant collecting the sample after the sample location (e.g., MW-01-WSP and MW-01-EPA).

4.7 CUSTODY DOCUMENTATION

Sample custody protocols are used to demonstrate that the samples and sample containers were handled and transferred in such a manner as to prevent tampering. Legal COC begins when the pre-cleaned sample containers are dispatched to the field from the laboratory and continues through sample analysis and eventual disposal of the sample and sample containers. Maintaining custody requires that samples must be in the actual possession or view of a person who is authorized to handle the samples (e.g., sample collector, laboratory technician, etc.), secured by the same person to prevent tampering, or stored in a designated secure area.

It is a good idea to limit, to the extent possible, the number of individuals who physically handle the samples. Samples must be placed in locked storage (e.g., locked vehicle, locked storeroom, etc.) when not in the possession or view of authorized personnel. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper indications in place (i.e., custody seals).

The COC form is used to trace sample possession from the time of collection to receipt at the analytical laboratory. It is recommended that the company's COC be used rather than the laboratory-supplied COC form to ensure that all necessary data are recorded. Submit one COC form per sample shipment, unless more stringent project requirements are in place (as detailed in the QAPP or site-specific work plan). The COC needs to have a unique COC number (pre-printed on the form), accompany all the samples, and include all appropriate project-specific information, such as:

- Project number, name, and location
- Sampler's printed name(s) and signature(s)
- Sample identification number
- Date and time (using the 24-hour clock) of collection
- Sample matrix (e.g., soil, aqueous, solid, etc.)
- Total number of containers per sample
- Parameters requested for analysis including number of containers per analyte.
- Remarks (e.g., irreducible headspace, field filtered sample, expected concentration range, specific turn-around time requested, etc.)
- Signatures of all persons involved in the chain of possession in chronological order
- Requested turn-around-time
- Name and location of analytical laboratory
- Custody seal numbers
- Shipping courier name and tracking information
- Internal temperature of shipping container upon shipment to laboratory, as needed
- Internal temperature of shipping container upon delivery to laboratory
- Employee contact information

Affix custody seals to all storage and shipping container closures when transferring or shipping sample container kits or samples to an off-property party. Place the seal so that the closure cannot be opened without breaking the seal. In the field book, record the time, date and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container. Affix new custody seals every time a seal is broken until continuation of evidentiary custody is no longer required.

FIELD STANDARD OPERATING PROCEDURE #6

DECONTAMINATION PROCEDURE

The decontamination procedures outlined in this standard operating procedure (SOP) are designed to ensure that all sampling equipment is free from the analytes that could potentially interfere with sample results. The user is advised to read the entire SOP and review the site health and safety plan (HASP) and/or project safety plan (PSP) before beginning any onsite activities. In accordance with the HASP or PSP, proper personal protective equipment (PPE) must be selected and used appropriately.

6.1 ACRONYMS AND ABBREVIATIONS

DI	deionized water
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
PPE	personal protective equipment
PSP	project safety plan
QAPP	quality assurance project plan
SOP	standard operating procedure

6.2 MATERIALS

- Field book
- PPE
- Polyethylene sheeting and/or garbage bags
- Laboratory-grade non-phosphate detergent[1] (e.g., Luminox® or Liquinox®)
- Cleaning reagents, as needed (e.g., isopropyl alcohol, methanol, hexane, nitric acid)
- Potable water
- Deionized (DI) water
- Containers (e.g., plastic buckets)
- Bristle brushes
- Aluminum foil
- Spray bottles
- Paper towels
- Pressurized steam cleaner (e.g., steam jenny), as needed
- Waste collection containers (e.g., drums), as needed
- Decontamination pad, as needed

6.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel

[1] Not all laboratory-grade detergents are phosphate free. Be sure to verify the detergent's phosphate content before use.

and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company's SOPs. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

WSP requires that all personnel performing specific project assignments be appropriately qualified, including having required certifications or licenses, and properly trained in accordance with the requirements of their assignment, the Environmental Service Line's field SOPs, and the Quality Management System.

This SOP is designed to provide the user with a general outline for decontamination and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), and investigation-derived waste management procedures (SOP 5). All decontamination references must be available for consultation in the field, including:

- Company's SOPs
- Applicable state and federal guidelines or procedures
- Manufacturer's manuals
- Project-specific work plan, PSP and/or HASP, and QAPP

6.4 GENERAL PROCEDURES

The cleaning and decontamination procedures described below are designed to ensure that the equipment used for sample collection is free of analytes that could potentially alter the analytical results. These procedures are primarily targeted at preventing the incidence of cross-contamination (i.e., compounds of interest being transferred on the sampling equipment from one sample to another) in order to produce high quality, representative sample results. As with all analytical sampling, the effectiveness of the cleaning procedures must be demonstrated with the collection of equipment blanks; equipment blank sample collection procedures and frequency are discussed in SOP 4.

6.4.1 EQUIPMENT AND REAGENT SELECTION

It is important for employees to evaluate the expected types of contamination before mobilization to a site. State programs (or the U.S. Environmental Protection Agency [EPA], depending on the site) may require more stringent decontamination procedures than those listed in this SOP, specify the types and grades of various cleaning detergents and reagents (e.g., acids and solvents), or allow the use of phosphate-containing detergents, such as Liquinox® liquid detergent (preferred[2]) or the powdered Alconox®. Decontamination equipment (e.g., spray bottles, brushes, etc.) should be constructed of non-reactive, non-leachable materials (e.g., metal, glass, Teflon®-coated, polyethylene, etc.) which are compatible with the reagents and solvents being used for decontamination.

Many of the cleaning reagents (e.g., nitric acid, hexane, methanol) are U.S. Department of Transportation (DOT) hazardous materials and must be shipped using a ground delivery service. The Safety Data Sheets (SDSs) for any hazardous cleaning reagents to be used onsite must be reviewed before the commencement of work, and the potential hazards and protective measures to be employed must be addressed in the HASP. Do not use decontamination liquids that have been improperly stored (e.g., unsealed containers).

In specific cases, it may be necessary to steam clean the field equipment before proceeding with the decontamination steps presented in Section 6.5 (e.g., hollow stem augers). Generally, the company's subcontractors are responsible for bringing or building a decontamination pad, if necessary, to contain the spray from a steam jenny. As possible, decontamination pads should be constructed on a level, paved surface in an area known or believed to be free of surface contamination, and should be of sufficient size to contain the decontamination water. Equipment that is steam cleaned should be placed on racks or saw horses and not on the floor of the

[2] Liquinox® liquid detergent, manufactured by Alconox, Inc., is phosphate-free and does not contribute to nutrient loading or algae blooms in the environment.

decontamination pad. Decontamination water should be removed from the decontamination pad frequently to minimize the potential for leaks or overflow.

Consult and involve the company's compliance professionals for storage procedures and disposal requirements of cleaning reagents, detergents, wastes, and other decontamination-related materials.

6.4.2 OTHER CONSIDERATIONS

In preparing for decontamination, you should perform the following activities (with all observations and measurements noted in the field book):

- Perform a quick reconnaissance of the site to identify a decontamination (pad) area and evaluate the accessibility to and safety of the location.
- If working in a hazardous waste exclusion area, the decontamination area should be located in the contaminant reduction zone.
- Record a description of the decontamination (pad) area.

Survey the breathing zone around the decontamination area with the appropriate air quality meter(s), as necessary (see HASP), to ensure that the level of PPE is appropriate. When decontaminating equipment, it is important to find a suitable location away from any sources of cross-contamination that could compromise the integrity of the decontamination. As possible, position the decontamination area away from fuel-powered equipment, such as drill rigs or excavators, and upwind of other site activities (e.g., purging, sampling).

6.5 DECONTAMINATION PROCEDURES

The decontamination procedures described below are a four- to nine-step process, depending on the the applicable federal or state guidelines, the project-specific work plan, or the QAPP. Sampling activities must be initiated with clean, decontaminated equipment. Decontaminate all non-dedicated equipment that contacts the sample directly (e.g., spoons, trowels, pumps), before and between each sample location and sampling interval. record decontamination procedures in the field book. Disposable, single use items, such as bailers or tubing, do not require decontamination.

The decontamination process includes the following four basic steps:

1. Physical removal of soil or debris
2. Wash with non-phosphate detergent, such as Liquinox®, and nylon brush
3. Potable water rinse
4. Laboratory-supplied deionized (DI), analyte-free water rinse (distilled water can be used as a substitute, if necessary)

The first step is to remove as much soil or other debris from the sampling device as possible near the sampling area to limit the spread of potentially-contaminated materials into clean areas of the site. Containerize all soil or debris in DOT-compliant containers in accordance with SOP 5 or the project-specific work plan. Dispose of all wastes in conformance with the project-specific work plan and applicable regulations.

Cleaning and decontamination should occur at a designated area(s) (i.e., decontamination pad) on the site. If gross contamination or an oily film or residue is observed on the equipment, use a steam jenny or wash by hand, using a brush, to remove the particulate matter or surface film. Heavy oils or grease may be initially removed with paper towels soaked with isopropyl alcohol.

The physical removal of debris process is followed by soaking (a simple dunk of the equipment is insufficient) and hand scrubbing the equipment with a solution of potable water and non-phosphate detergent (mixed to the manufacturer's instructions) followed by a potable water rinse. If not using a decontamination pad, the most common set-up uses multiple 5-gallon plastic buckets (or equivalent) for washing and rinsing. The decontamination containers should be labeled as to their contents and pertinent information from original source, such as the date opened or transferred, and the expiration date (as well as any applicable hazardous labels), placed on polyethylene sheeting (to contain drips of decontamination fluids during the decontamination process), and sealed when not in use to prevent accidental release of the fluids. If decontaminating sealed submersible pumps, pump both the non-phosphate detergent wash

fluid and the potable water rinse through the pump body itself (usually done in separate buckets) to ensure that the internal components are thoroughly cleaned. Replace the detergent solution and rinse water at least daily or when it becomes oily or silty.

Next, place the DI water for the rinse in a small spray bottle or pour over the equipment after the potable water rinse.

Typically, this level of decontamination (i.e., steps 1 through 4) is sufficient.

Following Steps 1 through 4, additional decontamination (steps 5 through 9) may be required by the applicable federal or state guidelines, the project-specific work plan, or the QAPP. Typically, these decontamination steps are performed when sampling for inorganics or oil-related substances using non-motorized equipment. These steps include:

5 10% nitric acid rinse (if metals are part of the analyses)
6 Laboratory-supplied DI water rinse
7 Pesticide-grade solvent rinse (e.g., acetone [preferred], hexane, or isopropyl alcohol)
8 Air dry (solvent must evaporate)
9 Laboratory-supplied DI water rinse

Isopropyl alcohol is the recommended solvent for organic contaminants because it is readily available and is not a DOT hazardous material; where possible, lab-grade isopropyl alcohol should be used . However, other solvents (e.g., hexane and methanol) may be more effective in removing certain contaminants, such as oils or polychlorinated biphenyls, but any waste generated using these solvents must be managed accordingly. Solvents are never used for decontamination if sampling for volatiles organic compounds.

Handle the solvents and acid with care and store unused chemicals in their original, labeled, protective containers when not in use. It is a good idea to transfer small quantities of each solution into labeled, laboratory-grade spray bottles, which offer a convenient and controllable way to rinse the equipment. The equipment can then be rinsed over a 5-gallon plastic bucket or other suitable container placed on plastic sheeting as with the first part of the cleaning process. Nitric acid rinses must be used only on non-carbon steel sampling devices. Do not spray acid or solvent into pumps.

Decontamination steps used at sites where radioactive materials are contaminants of concern are similar with a few special considerations. Radiation contamination monitoring is used to help locate contamination and guide the success of the decontamination process. The liberal use of water and fluids as a decontamination agents are minimized, where practicable, because of the expense that can be incurred with disposing of radioactively contaminated decontamination water. Containerized decontamination wastes must be evaluated for radioactive content and disposed of appropriately depending on their content.

6.6 HANDLING DECONTAMINATED EQUIPMENT

Handle any decontaminated equipment using clean gloves to prevent re-contamination. Place the equipment away (preferably upwind) from the decontamination area once the process has been completed on clean plastic sheeting to allow it to air-dry. Once the equipment is dry, protect it from re-contamination by securely wrapping and sealing with aluminum foil (shiny side out) or clean, disposable plastic bags (inorganics only). Plastic bags may be wrapped directly around wet or dry equipment except when the expected contaminants include volatile and extractable organics; under those circumstances, allow the equipment to completely dry or wrap it in aluminum foil.

All sampling equipment must be decontaminated at the end of the investigation (i.e., prior to departure from the site). Label each piece of equipment with the date of decontamination, the initials of personnel performing the decontamination, and the type of decontamination solution(s) used. Containerize all decontamination fluids, and other disposable decontamination materials in DOT-compliant containers in accordance with SOP 5 or the project-specific work plan. Dispose of all wastes, including open and unused solvents or acids, in conformance with the project-specific work plan and applicable regulations.

FIELD STANDARD OPERATING PROCEDURE #13

AIR SAMPLING PROCEDURE

The procedures outlined in this Standard Operating Procedure (SOP) are designed to ensure that air samples are representative and have not been altered or contaminated by the sampling and handling methods. Air sampling is generally conducted to assess the presence of volatile compounds (e.g., volatile organic compounds [VOCs], mercury) in ambient air as the result of site operations, materials storage, or vapor intrusion (VI). Air sampling is also conducted to assess the presence of volatile compounds in remediation system air streams. The user is advised to read the entire SOP and review the site health and safety plan (HASP) and/or project safety plan (PSP) before beginning any onsite activities. In accordance with the HASP, proper personal protective equipment (PPE) must be selected and used appropriately.

13.1 ACRONYMS AND ABBREVIATIONS

IDW	investigation derived waste
HASP	health and safety plan
PID	photoionization detector
PPE	personal protective equipment
PSP	project safety plan
QAPP	quality assurance project plan
SOP	standard operating procedure
SSV	sub-slab vapor
VI	vapor intrusion
VOCs	volatile organic compounds

13.2 MATERIALS

- Field book
- PPE
- Air quality monitoring equipment (e.g., photoionization detector [PID]) with calibration reagents and standards, as needed
- Camera
- Portable weather station , as needed
- Sampling containers and labeling/shipping supplies
- Step-ladders, shelves, stationary tables, or other objects for placement of sample canisters , as needed
- Strapping (e.g., rope, bungee cords) to secure sample canisters , as needed
- Tubing (e.g., Teflon®, Tygon®)
- Air purging pump or syringe , as needed
- Adjustable wrenches , as needed
- Air sampling pump , as needed
- Inline flow meter , as needed
- Tedlar® bags, , as needed
- Needle and syringe, with stopcock , as needed

13.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company's SOP. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

WSP requires that all personnel performing specific project assignments be appropriately qualified, including having required certifications or licenses, and properly trained in accordance with the requirements of their assignment, the Environmental Service Line's field SOPs, and the Quality Management System.

This SOP is designed to provide the user with a general outline for conducting air sampling activities and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), utility location (SOP 2), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), investigation derived waste (IDW) management procedures (SOP 5), equipment decontamination (SOP 6), and the use and calibration of air sampling and monitoring equipment (SOP 7). This SOP does not cover other vapor sampling activities, such as sub-slab vapor (SSV) sampling (SOP 14) or soil vapor sampling (SOP 15). Additionally, this SOP does not cover investigation planning, nor does it cover the analysis of the analytical results. These topics require a significant amount of planning and are more appropriately addressed in a project-specific work plan. Before implementing the air sampling, be sure to review the project-specific work plan or Quality Assurance Project Plan (QAPP) and any applicable state and federal guidelines or sampling procedures.

All sampling and monitoring references must be available for consultation in the field, including:

- Company SOPs
- Applicable state and federal guidelines or sampling procedures
- Manufacturer's manuals
- Project-specific work plan, PSP and/or HASP, and QAPP

13.4 GENERAL PROCEDURES

Consult the project-specific work plan or regulatory guidance to determine if there are any requirements on the scope, timing, and/or sequence of the sampling activities. When collected as part of a VI investigation, air sample collection is generally sequenced after a building inspection and materials survey and contemporaneously with SSV samples (See SOP 14). Performance monitoring samples collected from a vapor treatment system should be collected while the system is in operation.

Although the specific procedures used to sample air vary, most sampling can be broken down into a two-step sequence:

1. Inspection: a detailed survey of the subject building in an indoor/ambient air sampling investigation, including an evaluation of all of the materials used or stored in the structure that could potentially interfere with the sample collection; or, an operational inspection for a vapor system performance monitoring sampling event to confirm air flow and remove any condensate from the air stream to be sampled.
2. Sample Collection: collecting samples over a specified period (typically grab, 1-hour, 8-hour, or 24-hour), using a laboratory-supplied container, such as an evacuated sample canister with the appropriate regulator, a Tedlar® bag, or glass vial.

Information regarding weather conditions, including temperature, barometric pressure, wind speed and direction, and precipitation, should be noted and recorded in the field book during all steps. A portable weather station is often sufficient for documenting the weather conditions. Consult the project-specific work plan and applicable regulatory guidance to determine if fixed weather monitoring during the sample collection is required.

The project team should discuss the project-specific sampling procedures and equipment in advance of site mobilization. While the investigation is underway, the project team should avoid other environmental activities which may release volatile vapors into the investigation area, including soil sampling, excavation, and groundwater monitoring.

To ensure the integrity of the samples collected, the following common procedures shall be employed:

- The use of new, disposable or decontaminated sampling equipment
- The use, changing, and disposal of the appropriate PPE
- Selection of a suitable sampling location and staging area

Wear a clean pair of new, disposable gloves each time a different sample is collected and don the gloves immediately prior to collection. This limits the possibility of cross-contamination from accidental contact with gloves soiled during collection of the previous sample. The gloves must not contact the medium being sampled and must be changed any time during sample collection when their cleanliness is compromised.

13.5 PRE-SAMPLING CONSIDERATIONS

In preparing for sampling, you should perform the following activities (with all observations and measurements noted in the field book):

- Perform a quick reconnaissance to identify sampling locations.
- Record the approximate ambient air temperature, precipitation, wind (direction and speed), tide, and other field conditions in the field book. In addition, any site-specific conditions or situations that could potentially affect the samples at the sample locations should be recorded.
- Record sampling locations with respect to approximate distance to and direction from at least one permanent feature.
- Survey the breathing zone around the sampling location with a PID, as necessary (see HASP), to ensure that the level of PPE is appropriate.
- Establish a secure sample staging area in an uncontaminated area of the site.

13.6 BUILDING INSPECTION AND MATERIALS SURVEY

A building inspection and materials inventory is often a prerequisite activity before initiating indoor air sampling; this task is not typically performed when sampling a treatment system. The scope of this activity, including completion of an inspection questionnaire (with a building representative, if possible), shall be performed in accordance with the project-specific work plan and applicable regulatory guidance. Before embarking on the inspection, confirm that there are no access limitations for the inspection, sampling activities, or photography.

Components of a typical building walkthrough and survey include:

- Identification of potential background sources of volatile compounds, such as vapor releases from neighboring properties, or materials stored within the building, such as paint, fuels, solvents, cleaners, etc. Some states may require scanning of the potential background sources with an appropriately sensitive PID.
- Review of current and historical building operations and chemical use.
- Assessment of the building construction and condition (e.g., whether or not a basement is present, poured or block foundation, concrete slab present, air flow, etc.).
- Identifying areas of potential VI into a building (e.g., cracks in the concrete slab or walls, pipe penetrations, sumps, etc.).
- Inspection and photographic documentation, if necessary, of proposed sample locations.
- Identification of building pressure/ventilation system location and specifications.

At the conclusion of the building inspection and survey, discuss the sampling procedures with the occupants and prepare the building for the indoor air sampling in accordance with the project-specific work plan. Preparations typically include requesting that the owners close the windows, remove sources of background VOCs (e.g., paint, fuels, solvents, household cleaners, beauty items), and refrain from smoking in the investigation area during sampling activities.

13.7 TREATMENT SYSTEM INSPECTION

Perform a check on the overall treatment system, including the sample port, to ensure proper operation prior to sample collection. The system review should include:

- Check that the system is powered on and operating in accordance with the performance monitoring or appropriate work plan requirements (e.g., operations and maintenance manual, manufacturer's specifications); record any discrepancies.
- Shut the air valve to the sampling port, and inspect its integrity and cleanliness; if there is an air sample septum, inspect the septum for any tears. Clean and replace materials as necessary, but avoid using chemicals which may release volatile vapors.
- Open the applicable valves in-line with the sample location; allow sufficient time to drain any condensate buildup from the air stream.

13.8 AIR SAMPLING PROCEDURES

Air samples are collected using clean, evacuated stainless steel canisters (e.g., Entech-style or SUMMA®-equivalent) supplied by the analytical laboratory, or active equipment, such as a Tedlar® bag, hand-powered pump, or syringe with a laboratory-supplied glass sample vial. The canister sampling equipment typically includes a canister under vacuum, a flow regulator with an in-line vacuum gauge, and in-line particulate filters. The flow regulator is pre-set by the laboratory to collect a sample over the collection period specified in the project-specific work plan. Instructions for connecting the sample canister to the flow regulator are typically provided by the laboratory. Active sampling methods (Tedlar® bag or syringe and glass sample vial), that uses mechanical vapor extraction, are only appropriate for the collection of "grab" samples; syringe and glass sample vial sampling is typically used for collecting samples from high-vacuum treatment systems.

At each sampling location, record the initial conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations. Record sample locations with respect to a permanent feature and record a description of the sampling location.

If conducting performance monitoring of a vapor treatment system, ensure the air sample collection method is appropriate for the vacuum pressure measured at each sample location.

Collect quality assurance/quality control samples in accordance with SOP 4 and the project-specific work plan.

13.8.1 CANISTER SAMPLING

1. Ensure that the canister is in a stable position and will not fall or be relocated during the sampling process. As necessary, use a strapping device (e.g., bungee cords or rope) to secure the canister to a fixed object. If monitoring indoor/ambient air quality, place each air canister within the breathing zone or approximately 4 to 5 feet above the concrete slab or ground surface using a stationary object (e.g., step ladder, shelf, or table).
2. Place physical and visual barriers around the canisters, as necessary, so they are not disturbed during sample collection. The barriers should be placed in a manner so as not to compromise air flow around the canisters.
3. Open the canister's intake valve, record initial vacuum, and begin sample collection. Do not use canisters that show unacceptable initial vacuum readings as provided in the laboratory instructions or project-specific work plan.
4. Attach a label to the sample container and enter information (sample number, start date, start time, sampler's initials, analysis, initial vacuum readings, and place of collection).
5. As possible, check the canister vacuum gauge reading at least once during the sample collection period to ensure the canister's pressure is changing at the appropriate rate. If the canister's pressure is not changing at the appropriate rate, contact your project manager.
6. Once the sample collection period is completed, record the final vacuum, close the canister's intake valve, and disconnect the pre-set flow controller from the canister. Residual vacuum should be measurable after the collection period is completed; recommended residual vacuum is between -2 and -5 inches of mercury. The sample results may be subject to rejection during validation if vacuum was not maintained during the entire sample collection period. If vacuum readings are outside of the

recommended range, inform your project manager as soon as possible. Enter the remaining information on the sample label and field book (stop date, stop time, and final vacuum reading).

7 Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).

13.8.2 TEDLAR® BAG SAMPLING

1 Attach a new, appropriately-sized section of Teflon® or Teflon®-lined tubing to the air sampling pump. Note- an air sampling pump may not be necessary for treatment system sample collection if the vacuum pressure at the sample port is sufficient for sample collection.

2 Purge the tubing by operating the pump in accordance with the manufacturer's specifications, or by opening the valve at the sample port on a vapor treatment system. (This will remove the air present in the tube and pump mechanism, allowing the air to be sampled to enter the sampling assembly.)

3 Connect the pump's discharge to the Tedlar® bag sample port.

4 Open the Tedlar® bag valve.

5 Turn on the air sampling pump (or use the hand-powered pump), if necessary, and begin filling the Tedlar® bag. For active vapor treatment system samples, open the valve at the sample port and begin filling the Tedlar® bag. Ensure the air sampling pump's flow rate (or system flow rate) meets any requirements in the project-specific work plan or regulatory guidance, using a calibrated air sampling pump or inline flow meter.

6 Once the Tedlar® bag is approximately two-thirds full, close the valve on the Tedlar® bag and the treatment system valve, if necessary.

7 Discontinue pumping and disconnect the air sampling pump from the Tedlar® bag. For vapor treatment system samples, close the valve at the sample port and disconnect the sample port from the Tedlar® bag.

8 Attach a label to each bag and enter information (sample number, date, start/stop time, sampler's initials, analysis, and place of collection).

9 Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).

13.8.3 SYRINGE AND VIAL SAMPLING

1 Open all applicable valves to ensure there is air flow to the sampling location.

2 Attach a new stopcock to a new syringe, then attach a new needle on the end of the stopcock, in accordance with laboratory instructions.

3 Insert the needle into the sampling septum for the air stream to be sampled.

4 Purge the syringe using the air stream in accordance with the project-specific work plan: open the stopcock, gently/slowly pull the air stream into the syringe, then withdraw the needle perpendicular from the sampling septum and compress the plunger to evacuate the syringe.

5 Insert the needle into the sample septum again, gently/slowly pull the volume of air specified in the laboratory instructions, and hold the plunger at the specified volume for at least 30 seconds.

6 Close the stopcock and withdraw the needle perpendicular from the sampling septum.

7 Immediately insert the syringe needle through the laboratory-supplied sample vial septum. Minimize hole puncture size by keeping the syringe 'in-line' with the sample bottle.

8 Open stopcock and compress plunger to transfer sample into sample vial.

9 While keeping the plunger compressed, gently/quickly remove the vial from the needle.

10 As necessary, repeat this procedure from step 6 until the full sample volume (as specified by the analytical laboratory) has been attained.

11 Label the sample vials in accordance with laboratory instructions; note that extra labels or tape should not be added as they have the potential to damage the laboratory equipment. Record the amount of sample provided to the laboratory in the field book.

13.9 SAMPLE LABELING AND PREPARATION FOR SHIPMENT

Once sample collection is complete, prepare the air sample canisters, bags, or sample vials for offsite laboratory analysis:

1 Clean the outside of the sample container, if necessary.
2 Ensure all required information is completed on each sample label (see above).
3 Record the sample designation, date, time, and the sampler's initials in the field book and on a sample tracking form, if appropriate
4 Complete chain-of-custody forms with appropriate sampling information, including:
   - Location
   - Sample name
   - Sample collection start and end dates and times
   - Initial vacuum measurement, if applicable
   - Ending vacuum measurement, if applicable
   - Sample regulator number, if applicable
   - Sample canister number, if applicable
   - Sample volume, if applicable
   - Analytical method
5 Complete sample packing and ship in accordance with proper procedures.

Note that air samples are typically shipped under ambient temperatures.

13.10 CLOSING NOTES

Once sampling is completed, secure the sample port, if applicable, and mark all sample locations with spray paint, stakes, or other appropriate marker for future reference, as needed, or survey, including collecting Global Positioning System coordinates and photographs, in accordance with the project-specific work plan. Once sampling is completed, properly manage all PPE and IDW in conformance with SOP 6, the project-specific work plan, and applicable regulations.

FIELD STANDARD OPERATING PROCEDURE #14

SUB-SLAB VAPOR SAMPLING PROCEDURES

Sub-slab vapor sampling involves the collection of samples from the space beneath a concrete slab and above the soil column, and is typically conducted within a building footprint. The procedures outlined in this Standard Operating Procedure (SOP) are designed to ensure that sub-slab vapor (SSV) samples are representative and have not been altered or contaminated by the sampling and handling methods. Sub-slab vapor sampling is generally conducted to assess the presence of volatile organic compounds (VOCs) beneath a concrete slab, but, in special cases, may also include semivolatile organic compounds, such as naphthalene, elemental metals, such as mercury, or other organic compounds, such as polychlorinated biphenyls. The user is advised to read the entire SOP and review the site health and safety plan (HASP) and/or project safety plan (PSP) before beginning any onsite activities. In accordance with the HASP or PSP, proper personal protective equipment (PPE) must be selected and used appropriately.

14.1 ACRONYMS AND ABBREVIATIONS

IDW	investigation derived waste
HASP	health and safety plan
PID	photoionization detector
PPE	personal protective equipment
PSP	project safety plan
QAPP	quality assurance project plan
SOP	standard operating procedure
SSV	sub-slab soil vapor
VI	vapor intrusion
VOCs	volatile organic compounds

14.2 MATERIALS

- Field book
- PPE
- Air quality monitoring equipment (e.g., photoionization detector [PID]) with calibration reagents and standards, as needed
- Camera
- Portable weather station, as needed
- Sampling containers and labeling/shipping supplies
- Sample point installation materials:
  - Concrete drill or corer and appropriately sized bits (e.g., hammer drill)
  - SSV point assembly
  - Teflon®, Teflon®-lined, or stainless steel tubing
  - Tube fittings (e.g. Swagelok®, Qwik-Lok®)
  - Non-volatile sealant material (e.g., hydrated bentonite, silicone stopper, non-shrinking clay)
  - Permanent cover assembly, if necessary
  - Potable water
- Leak testing materials, as needed:
  - Tracer compound detector (e.g., helium gas detector)
  - Tracer compound gas (e.g., helium)

  - Shroud (e.g., 5-gallon bucket, stainless steel dome)
  - Shroud sealant material (e.g., bentonite pellets or modeling clay)
  - Tedlar® bags (to capture purged soil gas), as required
- Tubing (e.g., Teflon®, Tygon®)
- Air purging pump or syringe, as needed
- Adjustable wrenches, as needed
- Air sampling pump, as needed
- Inline flow meter, as needed

14.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company's SOP. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

WSP requires that all personnel performing specific project assignments be appropriately qualified, including having required certifications or licenses, and properly trained in accordance with the requirements of their assignment, the Environmental Service Line's field SOPs, and the Quality Management System.

This SOP is designed to provide the user with a general outline for conducting SSV sampling activities and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), utility location (SOP 2), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), investigation derived waste (IDW) management procedures (SOP 5), equipment decontamination (SOP 6), and the use and calibration of SSV sampling and monitoring equipment (SOP 7). This SOP does not cover other vapor sampling activities, such as air sampling (SOP 13) or soil vapor sampling (SOP 15). Additionally, this SOP does not cover investigation planning, nor does it cover the analysis of the analytical results. These topics require a significant amount of planning and are more appropriately addressed in a project-specific work plan. Before implementing the SSV sampling, be sure to review the project-specific work plan or Quality Assurance Project Plan (QAPP) and any applicable state and federal guidelines or sampling procedures.

All sampling and monitoring references must be available for consultation in the field, including:

- Company SOPs
- Applicable state and federal guidelines or sampling procedures
- Manufacturer's manuals
- Project-specific work plan, PSP and/or HASP, and QAPP

14.4 GENERAL PROCEDURES

Sub-slab vapor can be affected by temporal, structural, and meteorological factors. It is important to carefully note the use of the building and minimize the number of factors that could influence the SSV results (e.g., keeping the windows closed during the sampling). The user should also be aware that a number of regulatory agencies have specific guidelines as to timing or the sequence of the sampling activities, particularly if performed as part of a vapor intrusion (VI) investigation.

Although the specific procedures used to sample SSV vary between investigations, most sampling can be broken down into a five-step sequence:

1. Inspection (if sampling is performed within a building): a detailed survey the subject building including an evaluation of all materials used or stored in the structure that could potentially interfere with the sample collection
2. Sample Point Installation: installing the SSV point in the sub-slab material.
3. Leak Testing: testing the integrity of the SSV sample point (if required).
4. Purging: removing any non-representative vapor from the SSV sample point.
5. Sample Collection: collecting samples over a specified period (typically grab, 1-hour, 8-hour or 24-hour), using a laboratory-supplied container, such as an evacuated sample canister with the appropriate regulator, or a Tedlar® bag with an air sampling pump.

Information regarding weather conditions, including temperature, barometric pressure, wind speed and direction, and precipitation, should be noted and recorded in the field notebook during all steps. A portable weather station is often required for documenting the weather conditions. Consult the project-specific work plan and applicable regulatory guidance to determine if fixed weather monitoring during the sample collection is required.

The project team should discuss the project-specific sampling procedures and equipment in advance of site mobilization. While the investigation is underway, the project team should avoid other environmental activities which may release volatile vapors into the investigation area, including soil sampling, excavation, and groundwater monitoring.

To ensure the integrity of the samples collected, the following common procedures shall be employed:

- The use of new, disposable or decontaminated sampling equipment
- The use, changing, and disposal of the appropriate PPE
- Selection of a suitable sampling location and staging area

Wear a clean pair of new, disposable gloves each time a different sample is collected and don the gloves immediately prior to collection. This limits the possibility of cross-contamination from accidental contact with gloves soiled during collection of the previous sample. The gloves must not contact the medium being sampled and must be changed any time during sample collection when their cleanliness is compromised.

14.4.1 PRE-SAMPLING CONSIDERATIONS

In preparing for sampling, you should perform the following activities (with all observations and measurements noted in the field book):

- Perform a quick reconnaissance of the site to identify sampling locations.
- Record the approximate ambient air temperature, precipitation, wind (direction and speed), tide, and other field conditions in the field book. Any site-specific conditions or situations that could potentially affect the samples at the sample locations should also be recorded.
- Record sampling locations with respect to approximate distance to and direction from at least one permanent feature.
- Survey the breathing zone around the sampling location with a PID, as necessary (see HASP), to ensure that the level of PPE is appropriate.
- Establish a secure sample staging area in an uncontaminated area of the site.
- All construction materials must be selected in accordance with the project-specific work plan and relevant regulatory guidance.

14.5 BUILDING INSPECTION AND MATERIALS SURVEY

A building inspection and materials inventory is often a prerequisite activity before initiating SSV sampling. The scope of this activity, including completion of an inspection questionnaire (with a building representative, if possible), shall be performed in accordance with the project-specific work plan and applicable regulatory guidance. Before embarking on the inspection, confirm that there are no access limitations for the inspection, sampling activities, or photography.

Components of a typical building walkthrough and survey include:

- Identification of potential background sources of volatile compounds, such as vapor releases from neighboring properties, or materials stored within the building, such as paint, fuels, solvents, cleaners, etc. Some states may require scanning of the potential background sources with an appropriately sensitive PID.
- Review of current and historical building operations and chemical use.
- Assessment of the building construction and condition (e.g., whether or not a basement is present, poured or block foundation, concrete slab present, air flow, etc.).
- Identifying areas of potential VI into a building (e.g. cracks in the concrete slab or walls, pipe penetrations, sumps, etc.).
- Inspection and photographic documentation, if necessary, of proposed sample locations.
- Identification of building pressure/ventilation system location and specifications.

At the conclusion of the building inspection and survey, discuss the sampling procedures with building occupants and prepare the structure for the SSV sampling in accordance with the project-specific work plan. Building preparations typically include requesting that the building occupants close windows and remove sources of background VOCs (e.g., paint, fuels, solvents, household cleaners, beauty items), and that they refrain from smoking in the investigation area during sampling activities.

14.6 SAMPLE POINT INSTALLATION

Ensure each proposed SSV location is clear of potential hazards, including utilities prior to breaking the ground surface (see SOP 2). SSV points are installed through the concrete floor slab to sample the space beneath the slab and above the soil column, and are installed on ground level (slab-on-grade construction) or basement level of a structure. If the building floor is not made of concrete (e.g., earthen), you must contact the project manager to determine if soil vapor or indoor air samples are more appropriate for the conditions encountered in the field. The samples are typically collected through a small diameter (typically less than 1-inch) core hole drilled in the concrete floor to allow access to the soil and soil vapor directly beneath the slab. Before drilling, inspect the proposed location for potential hazards, including utilities (see SOP 2). In buildings with an earthen floor on the lowest level, consult the project-specific work plan and applicable regulatory guidance to determine if SSV samples collected from the available concrete area (e.g., concrete pads beneath a furnace, hot water heater, or other equipment) should be collected concurrently with either air samples (SOP 13) or soil vapor samples (SOP 15) collected from the space overlying the earthen floor.

Depending on the type of SSV sample point selected for the project, one or two concentric holes are drilled in or through the concrete slab with a hammer drill (or similar). If two holes are drilled, first the larger diameter hole (typically 1-inch), is advanced from the ground surface to a depth of approximately 1 inch to 2 inches deep. This hole will serve as an annular space to be filled with a seal (e.g., hydrated bentonite, a silicone stopper, or non-shrinking, non-volatile clay) or to house a flush-mount cover. Once the outer hole is complete, a second, smaller diameter hole (typically 3/8-inch) is drilled through the center of the outer hole, and advanced through the concrete slab and into the sub-slab material (e.g., soil, gravel); the thickness of the concrete should be recorded in the field notebook. The intent is to create a small space suitable for insertion of the sampling tubing or soil vapor sampling implant (if required) below the slab. Once the targeted depth has been reached, remove the drill from the hole and use a hand vacuum or shop vacuum to remove concrete dust from the hole and surrounding work area.

Next, based on the work plan and slab thickness, construct the SSV point; typically, the base of the point extends through the slab. SSV points can be purchased from various manufacturers, constructed of stainless steel tubing and various fitting, or constructed of simply Teflon®/Teflon®-lined tubing. If using purchased points, place the assembled point into the hole, and seal in place as per manufactures instructions. If assembling points by hand, place a small amount of clay or a silicon stopper on the point where, when inserted, the outer hole meets the inner hole (i.e., slab thickness less 1- to 2-inches). Insert assembled point into the hole snugly to create an airtight seal. The seal can be augmented, if necessary, by adding a non-shrinking, non-volatile material, such as modeling clay or grout. SSV points can be completed with protective covers (flush-mount preferred) for permanent points. Attach the appropriate fittings (e.g., a 3-way valve) and additional tubing, as necessary, and seal the point. Be sure that the tubing is clamped or otherwise closed off to avoid discharging vapor to the air.

Sampling must not be performed until the subsurface equilibrium has been re-established below the slab and, if sampling indoors as part of a VI investigation, any vapors that have escaped from the subsurface during the implant installation have had a chance to

dissipate. Equilibrium is typically re-established approximately 24 hours after the sample point installation, or as otherwise specified in the project-specific work plan or regulatory guidance.

14.7 LEAK TESTING PROCEDURES

If required, the integrity of the seal between the concrete slab and the SSV point and sample train can be verified using a tracer gas such as helium. This type of leak testing is typically performed before sampling and involves creating an enclosure above the sample point, which is then charged with the tracer gas. A meter capable of detecting the tracer is then connected to the sampling tube and monitored to ensure that the gas (an analog for indoor air) is not passing through the seal and being introduced into the sample train.

The user should verify the leak testing procedures in the project-specific work plan and/or relevant regulatory guidance.

The generic leak testing procedures are as follows:

1. Select a container to serve as the shroud (e.g., 5-gallon bucket or stainless steel dome). This The device should be of sufficient size to cover the SSV sample. Dedicated testing shrouds with fittings and sample ports are available from some laboratories or can be purchased/constructed.
2. Fit the shroud with two hose barbs or quick-lock connectors, one sized appropriately to connect to the sample tubing and the other sized appropriately for tubing from the tracer gas. These fittings allow the tracer gas to be introduced to the enclosure and the SSV sample point tubing to be connected to the detector outside of the shroud.
3. Connect the sample tubing to the appropriate connector inside the shroud and then place it over the sample point and aboveground tubing and fittings. The shroud should be sealed to the floor using modeling clay, bentonite, or other appropriate material.
4. Connect the detector to the shroud via a short length of tubing and start the detector. The detector's pump rate should not exceed a maximum of 200 milliliters per minute.
5. Charge the shroud with a tracer gas through the second hose barb or quick-lock connector. A target concentration of 10% to 20% is generally recommended for within the shroud, or as otherwise specified in the project-specific work plan and relevant regulatory guidance.
6. Measure the tracer compound concentrations by alternatingly connecting the gas detector to the first and second quick-lock connectors.
7. Monitor the SSV sample point over a period of at least 2 minutes, or as otherwise specified in the site-specific work plan or regulatory guidance. A leak is occurring if the tracer gas is detected within the sample train above background concentrations, or as otherwise specified in the project-specific work plan and relevant regulatory guidance. If a leak is detected, the seal around the SSV sample point must be repaired or augmented and the process repeated until the results indicate the seal is competent.
8. Record the leak detection procedures and observations in the field book.
9. Disassemble the shroud.

14.8 SSV POINT PURGING PROCEDURES

Before collecting the SSV sample, the sample point and sample train (tubing, connectors, valves, etc.) must be purged to remove any ambient air. Purging can be accomplished by connecting a hand-powered air pump or vapor syringe to the SSV discharge tubing. A "low-flow" purge rate (typically a maximum of 200 milliliters per minute) is required by many regulatory agencies to avoid potential short-circuiting or desorbing of volatile compounds from soil particles; a calibrated sampling pump or inline flow meter may be used to ensure the flow rate is maintained. A minimum of 3 tubing/point volumes should be purged from the SSV sampling assembly prior to sample collection. The volume is calculated as follows:

$$\textbf{Purge Volume} = (3 * \pi * r2 * h)_{point} + (3 * \pi * r2 * h)_{tubing}$$

Where:

r = the inner radius of the point and connecting tubing
h = the height of the point and the connected tubing

Purged vapor from the SSV point should be contained in Tedlar® bags to prevent the release of SSV into the indoor airspace. As required by the project-specific work plan or regulatory guidance, collect air quality readings from the purged air (e.g., PID).

14.9 SSV SAMPLE COLLECTION

SSV samples are collected using clean, evacuated stainless steel canisters (e.g., Entech-style or SUMMA®-equivalent), or active (requires a pump) equipment, such as a Tedlar® bag and hand-powered pump. The canister sampling equipment typically includes a canister under vacuum, a flow regulator with an in-line vacuum gauge, and in-line particulate filters. The flow regulator is pre-set by the laboratory to collect a sample over the collection period specified in the project-specific work plan and the laboratory task order. Instructions for connecting the sample canister to the flow regulator are typically provided by the laboratory. Tedlar® bag sampling is only appropriate for "grab" samples.

At each sampling location, record the initial conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations. Record sample locations with respect to a permanent feature and record a description of the sampling location.

Collect quality assurance/quality control samples in accordance with SOP 4 and the project-specific work plan. Duplicate samples may be collected by using a "T" fitting attached to the sample tubing.

14.9.1 CANISTER SAMPLING

1. Connect the sample canister to its dedicated[1] , pre-set flow controller with an in-line vacuum gauge. If using a SUMMA®-equivalent canister, tighten (hand-tight) the fitting with adjustable wrenches. Do not overtighten. If using an Entech-style canister, connect the canister to the flow controller by sliding back the collar on the female end of the regulator's fitting and inserting it into the male end of the canister's fitting.
2. Ensure that the canister is in a stable position and will not fall or be relocated during the sampling process. Place physical and visual barriers around the canisters, as necessary, so they are not disturbed during sample collection.
3. Open the appropriate valve port on the SSV discharge tubing to allow vapor flow from the SSV point to the sample canister.
4. Open the canister's intake valve, record initial vacuum, and begin sample collection. Do not use canisters that show unacceptable (as detailed in the laboratory instructions or project-specific work plan) initial vacuum readings.
5. Attach a label to the sample container and enter information (sample number, start date, start time, sampler's initials, analysis, initial vacuum readings, and place of collection).
6. As possible, check the canister vacuum gauge reading at least once during the sample collection period to ensure the canister's pressure is changing at the appropriate rate. If the canister's pressure is not changing at the appropriate rate, contact your project manager.
7. Once the sample collection period is completed, record the final vacuum, close the canister's intake valve, close the valve port connected to the SSV discharge tubing, disconnect the sample canister's intake port to the tubing from the SSV point, and disconnect the pre-set flow controller from the canister. Residual vacuum should be measurable after the collection period is completed; recommended residual vacuum is typically between -2 and -5 inches of mercury. The sample results may be subject to rejection during validation if vacuum was not maintained during the entire sample collection period. If vacuum readings are outside of the recommended range, inform your project manager as soon as possible. Enter the remaining information on the sample label and field book (stop date, stop time, and final vacuum reading).
8. Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).

[1] [1] Some laboratories match and pre-test specific flow controller and canister assemblies at the laboratory prior to shipment to the field for sample collection; be sure to assemble the equipment in the field using the matched components.

14.9.2 TEDLAR® BAG SAMPLING

1. Attach a new, appropriately-sized section of Teflon® or Teflon®-lined tubing to the air sampling pump.
2. Purge the tubing by operating the pump in accordance with the manufacturer's specifications (this will remove whatever air was present in the tube and pump mechanism allowing the air to be sampled to enter the sampling assembly).
3. Connect the pump's intake to the SSV discharge tubing, and the pump's discharge to the Tedlar® bag sample port.
4. Open the Tedlar® bag valve and the appropriate valve port for the SSV discharge tubing to allow air flow from the SSV point to the Tedlar® bag.
5. Turn on the air sampling pump (or use the hand-powered pump) and begin filling the Tedlar® bag. Ensure the air sampling pump's flow rate meets any requirements in the project-specific work plan or regulatory guidance, using a calibrated air sampling pump or inline flow meter.
6. Once the Tedlar® bag is approximately two-thirds full, close the valve on the Tedlar® bag and the valve on the SSV discharge tubing.
7. Discontinue pumping and disconnect the air sampling pump from the Tedlar® bag.
8. Attach a label to each bag and enter information (sample number, date, start/stop time, sampler's initials, analysis, and place of collection).
9. Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations (e.g., odor, staining, or spills).

14.10 SAMPLE LABELING AND PREPARATION FOR SHIPMENT

Once sample collection is complete, prepare the air sample canisters for offsite laboratory analysis:

1. Clean the outside of the sample container, if necessary.
2. Ensure all required information is completed on each sample label (see above).
3. Record the sample designation, date, time, and the sampler's initials in the field book and on a sample tracking form, if appropriate
4. Complete chain-of-custody forms with appropriate sampling information:
   - Location
   - Sample name
   - Sample collection start and end date and times
   - Initial vacuum measurement, if applicable
   - Ending vacuum measurement, if applicable
   - Sample regulator number, if applicable
   - Sample canister number, if applicable
   - Analytical method
5. Complete sample packing and ship in accordance with proper procedures.

Note that air samples are typically shipped under ambient temperatures.

14.11 CLOSING NOTES

Once sampling is completed, secure the sample port or abandon the location boreholes/locations in accordance with the project-specific work plan. Mark all sample locations with spray paint, stakes, or other appropriate marker for future reference, as needed, or survey, including collecting Global Positioning System coordinates and photographs, in accordance with the project-specific work plan. Decontaminate all equipment prior to departure and properly manage all PPE and IDW in conformance with SOP 6, the project-specific work plan, and applicable regulations.

FIELD STANDARD OPERATING PROCEDURE #15

SOIL VAPOR SAMPLING PROCEDURES

Soil vapor sampling involves the collection of samples from the vadose zone and may be conducted within or outside a building footprint. The procedures outlined in this Standard Operating Procedure (SOP) are designed to ensure that soil vapor samples are representative and have not been altered or contaminated by the sampling and handling methods. Soil vapor sampling is generally conducted to assess the presence of volatile organic compounds (VOCs) in the vadose zone, but, in special cases, may also include semivolatile organic compounds, such as naphthalene, elemental metals, such as mercury, or other organic compounds, such as polychlorinated biphenyls. The user is advised to read the entire SOP and review the site health and safety plan (HASP) and/or project safety plan (PSP) before beginning any onsite activities. In accordance with the HASP or PSP, proper personal protective equipment (PPE) must be selected and used appropriately.

15.1 ACRONYMS AND ABBREVIATIONS

IDW	investigation derived waste
HASP	health and safety plan
PID	photoionization detector
PPE	personal protective equipment
PSP	project safety plan
QAPP	quality assurance project plan
SOP	standard operating procedure
VI	vapor intrusion
VOCs	volatile organic compounds

15.2 MATERIALS

- Field book
- PPE
- Air quality monitoring equipment (e.g., photoionization detector [PID]) with calibration reagents and standards, as needed
- Camera
- Portable weather station, as needed
- Sampling containers and labeling/shipping supplies
- Sample point installation materials:
  - Soil vapor point assembly
  - Teflon®, Teflon®-lined, or stainless steel tubing
  - Tube fittings (e.g. Swagelok®, Qwik-Lok®)
  - Sand pack material as specified in the project-specific work plan or regulatory guidance
  - Non-volatile sealant material (e.g., hydrated bentonite chips, granular bentonite, or bentonite slurry)
  - Permanent cover assembly, if necessary
  - Potable water
- Leak testing materials, as needed:
  - Tracer compound detector (e.g., helium gas detector)
  - Tracer compound gas (e.g., helium)
  - Shroud (e.g., 5-gallon bucket or stainless steel dome)

  - Shroud sealant material (e.g., bentonite pellets or modeling clay)
  - Tedlar® bags (to capture purged soil gas), as required
- Tubing (e.g., Teflon®, Tygon®)
- Air purging pump or vapor syringe, as needed
- Adjustable wrenches, as needed
- Air sampling pump, as needed
- Inline flow meter , as needed

15.3 PRECONDITIONS AND BACKGROUND

This SOP has been prepared as part of the company's Environmental Quality Management Plan and is designed to provide detailed procedures for common field practices. Compliance with the methods presented in this document is mandatory for all field personnel and will ensure that the tasks are performed in a safe and consistent manner, are in accordance with federal and state guidance, and are technically defensible.

This SOP is written for the sole use of company employees and will be revised periodically to reflect updates to company policies, work practices, and the applicable state and/or federal guidance. Employees must verify that this document is the most recent version of the company's SOP. Employees are also strongly advised to review relevant state and/or federal guidance, which may stipulate program-specific procedures, in advance of task implementation.

WSP requires that all personnel performing specific project assignments be appropriately qualified, including having required certifications or licenses, and properly trained in accordance with the requirements of their assignment, the Environmental Service Line's field SOPs, and the Quality Management System.

This SOP is designed to provide the user with a general outline for conducting soil vapor sampling activities and assumes the user is familiar with basic field procedures, such as recording field notes (SOP 1), utility location (SOP 2), sample shipment procedures (SOP 3), sample collection and quality assurance procedures (SOP 4), investigation derived waste (IDW) management procedures (SOP 5), equipment decontamination (SOP 6), and the use and calibration of soil vapor sampling and monitoring equipment (SOP 7). This SOP does not cover other air or vapor sampling activities, such as air sampling (SOP 13) or sub-slab vapor sampling (SOP 14). Additionally, this SOP does not cover investigation planning, nor does it cover the analysis of the analytical results. These topics require a significant amount of planning and are more appropriately addressed in a project-specific work plan. Before implementing the soil vapor sampling, be sure to review the project-specific work plan or Quality Assurance Project Plan (QAPP) and any applicable state and federal guidelines or sampling procedures.

All sampling and monitoring references must be available for consultation in the field, including:

- Company SOPs
- Applicable state and federal guidelines or sampling procedures
- Manufacturer's manuals
- Project-specific work plan, PSP and/or HASP, and QAPP

15.4 GENERAL PROCEDURES

Soil vapor can be affected by temporal, structural, and meteorological factors. The user should also be aware that a number of regulatory agencies have specific guidelines as to timing or the sequence of the sampling activities, particularly if performed as part of a vapor intrusion (VI) investigation.

Although the specific procedures used to sample soil vapor vary between investigations, most sampling can be broken down into a five-step sequence:

1. Inspection (if sampling is performed within a building footprint): a detailed survey of the subject building, including an evaluation of all materials used or stored in the structure that could potentially interfere with the sample collection
2. Sample Point Installation: installing the soil vapor point in the vadose zone.

3 Leak Testing: testing the integrity of the soil vapor sample point (if required).
4 Purging: removing any non-representative vapor from the soil vapor sample point.
5 Sample Collection: collecting samples over a specified period (typically grab, 1-hour, or 8-hour), using a laboratory-supplied container, such as an evacuated sample canister with the appropriate regulator, or a Tedlar® bag with an air sampling pump.

Information regarding weather conditions, including temperature, barometric pressure, wind speed and direction, and precipitation, should be noted and recorded in the field notebook during all steps. A portable weather station is often required for documenting the weather conditions. Consult the project-specific work plan and applicable regulatory guidance to determine if fixed weather monitoring during the sample collection is required.

The project team should discuss the project-specific sampling procedures and equipment in advance of site mobilization. While the investigation is underway, the project team should avoid other environmental activities which may release volatile vapors into the investigation area, including soil sampling, excavation, and groundwater monitoring.

To ensure the integrity of the samples collected, the following common procedures shall be employed:

- The use of new, disposable or decontaminated sampling equipment
- The use, changing, and disposal of the appropriate PPE
- Selection of a suitable sampling location and staging area

Wear a clean pair of new, disposable gloves each time a different sample is collected and don the gloves immediately prior to collection. This limits the possibility of cross-contamination from accidental contact with gloves soiled during collection of the previous sample. The gloves must not contact the medium being sampled and must be changed any time during sample collection when their cleanliness is compromised.

15.4.1 PRE-SAMPLING CONSIDERATIONS

In preparing for sampling, you should perform the following activities (with all observations and measurements noted in the field book):

- Perform a quick reconnaissance of the site to identify sampling locations.
- Record the approximate ambient air temperature, precipitation, wind (direction and speed), tide, and other field conditions in the field book. Any site-specific conditions or situations that could potentially affect the samples at the sample locations should also be recorded.
- Record sampling locations with respect to approximate distance to and direction from at least one permanent feature. Survey the breathing zone around the sampling location with a PID, as necessary (see HASP), to ensure that the level of PPE is appropriate.
- Establish a secure sample staging area in an uncontaminated area of the site. All construction materials must be selected in accordance with the project-specific work plan and relevant regulatory guidance.

15.5 BUILDING INSPECTION AND MATERIALS SURVEY

If soil vapor sampling is performed within a building footprint, a building inspection and materials inventory may be required as a prerequisite activity. The scope of this activity, including completion of an inspection questionnaire (with a building representative, if possible), shall be performed in accordance with the project-specific work plan and applicable regulatory guidance. Before embarking on the inspection, confirm that there are no access limitations for the inspection, sampling activities, or photography.

Components of a typical building walkthrough and survey include:

- Identification of potential background sources of volatile compounds, such as vapor releases from neighboring properties, or materials stored within the building, such as paint, fuels, solvents, cleaners, etc. Some states may require scanning of the potential background sources with an appropriately-sensitive PID.
- Review of current and historical building operations and chemical use.
- Assessment of the building construction and condition (e.g., whether or not a basement is present, poured or block foundation, concrete slab present, air flow, etc.).
- Identifying areas of potential VI into a building (e.g., cracks in the concrete slab or walls, pipe penetrations, sumps, etc.).

- Inspection and photographic documentation, if necessary, of proposed sample locations.
- Identification of building pressure/ventilation system location and specifications.

At the conclusion of the building inspection and survey, discuss the sampling procedures with building occupants and prepare the structure for the soil vapor sampling in accordance with the project-specific work plan. Building preparations typically include requesting that the building occupants close windows, and remove sources of background VOCs (e.g., paint, fuels, solvents, household cleaners, beauty items), and that they refrain from smoking in the investigation area during sampling activities.

15.6 SOIL VAPOR POINT INSTALLATION

Ensure each proposed soil vapor boring location is clear of potential hazards, including utilities prior to breaking the ground surface (see SOP 2). Advance the soil vapor boring from the ground surface to the target depth using decontaminated drilling equipment; typically a direct-push drill rig such as a Geoprobe®, or equivalent, equipped with 1.25-inch inside diameter drilling rods and an expendable point is used to install the soil vapor boring. Record the actual depth interval in the field book once the drilling has been completed. Insert the soil vapor sampling point, which typically consists of Teflon® or Teflon®-lined tubing attached to a polyethylene or stainless steel soil gas implant, through the hollow drill string and screwed into the top of the expendable point. Retract the rods, leaving the implant with the expendable point in the bottom of the borehole and tubing leading to the surface. As detailed in the project-specific work plan, install a clean sand filter pack in the annular space around the screened interval to a minimum depth of approximately 6 inches above the top of the screen (i.e., 1-foot deep total) and place a hydrated bentonite seal (e.g., bentonite chips, granular bentonite, or bentonite slurry) to the ground surface. Attach the appropriate fittings (e.g., a 3-way valve) and additional tubing, if appropriate. Ensure that the tubing is clamped or otherwise closed off to avoid discharging vapor to the air.

Soil vapor sampling must not be performed until the subsurface equilibrium has been re-established and, if sampling indoors as part of a VI investigation, any vapors that have escaped from the subsurface during the implant installation have had a chance to dissipate. Equilibrium is typically re-established approximately 24 hours following sample point installation, or as otherwise specified in the project-specific work plan or regulatory guidance.

15.7 LEAK TESTING PROCEDURES

If required by the project-specific work plan or regulatory guidance, verify the integrity of the seal between the ground surface (or finished floor, if the sampling is within a building) and sample point assembly using a tracer gas such as helium. This type of leak testing is typically performed before sampling and involves creating an enclosure above the sample point, which is then charged with the tracer gas. A meter capable of detecting the tracer is then connected to the sampling tube and monitored to ensure that the gas (an analog for ambient air) is not passing through the seal and being introduced into the sample train.

The user should verify the leak testing procedures in the project-specific work plan and/or relevant regulatory guidance.

Typical leak testing procedures are:

1. Select a container to serve as the shroud (e.g., 5-gallon bucket or stainless steel dome). This device should be of sufficient size to cover the soil vapor sample point. Dedicated testing shrouds with fittings and sample ports are available from some laboratories or can be purchased/constructed.
2. Fit the shroud with two hose barbs or quick-lock connectors, one sized appropriately to connect to the sample tubing and the other sized appropriately for tubing from the tracer gas. These fittings allow the tracer gas to be introduced to the enclosure and the soil vapor sample point tubing to be connected to the detector outside of the shroud.
3. Connect the sample tubing to the appropriate connector inside the shroud and then place it over the sample point and aboveground tubing and fittings. The shroud should be sealed to the ground surface or floor using modeling clay, bentonite, or other appropriate material.
4. Connect the detector to the shroud via a short length of tubing and start the detector. The detector's pump rate should be adjusted to not exceed a maximum of 200 milliliters per minute.

5. Charge the shroud with a tracer gas through the second hose barb or quick-lock connector. A target concentration of 10% to 20% is generally recommended for within the shroud, or as otherwise specified in the project-specific work plan and relevant regulatory guidance.
6. Monitor the tracer compound concentrations by alternatingly connecting the gas detector to the first and second quick-lock connectors.
7. Monitor the soil vapor sample point over a period of at least 2 minutes, or as otherwise specified in the site-specific work plan and/or regulatory guidance. A leak is occurring if the tracer gas is detected within the sample train above background concentrations, or as otherwise specified in the project-specific work plan and relevant regulatory guidance. If a leak is detected, the seal around the soil vapor sample point must be repaired or augmented and the process repeated until the results indicate the seal is competent.
8. Record the leak detection procedures and observations in the field book.
9. Disassemble the shroud

15.8 SOIL VAPOR POINT PURGING PROCEDURES

Before collecting a soil vapor sample, the sample point and sample train (tubing, connectors, valves, etc.) must be purged to remove ambient air. Purging can be accomplished by connecting a hand-powered air pump or vapor syringe to the soil vapor discharge tubing. A "low-flow" purge rate (typically a maximum of 200 milliliters per minute) is required by many regulatory agencies to avoid potential short-circuiting or desorbing of volatile compounds from soil particles; a calibrated sampling pump or inline flow meter may be used to ensure the flow rate is maintained. Purge a minimum of 3 tubing/point volumes from the soil vapor sampling assembly prior to sample collection. The volume is calculated as follows:

$$\textbf{Purge Volume} = (3 * \pi * r2 * h)_{point} + (3 * \pi * r2 * h)_{tubing}$$

Where:

r = the inner radius of the point and connecting tubing
h = the height of the point and the connected tubing

Purged vapor from the soil vapor point should be contained in Tedlar® bags to prevent the release of soil vapor into the air (if the sampling is being conducted inside a building as part of a VI investigation). As required by the project-specific work plan or regulatory guidance, collect air quality readings from the purged air (e.g., PID).

15.9 SOIL VAPOR SAMPLE COLLECTION

Soil vapor samples are collected using clean, evacuated stainless steel canisters (e.g., Entech-style or SUMMA®-equivalent), or active (requires a pump) equipment, such as a Tedlar® bag and hand-powered pump. The canister sampling equipment typically includes a canister under vacuum, a flow regulator with an in-line vacuum gauge, and in-line particulate filters. The flow regulator is pre-set by the laboratory to collect a sample over the collection period specified in the project-specific work plan and the laboratory task order. Instructions for connecting the sample canister to the flow regulator are typically provided by the laboratory. Tedlar® bag sampling is only appropriate for "grab" samples.

At each sampling location, record the initial conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and indoor and outdoor temperature), PID readings, and any observations. Record sample locations with respect to a permanent feature and record a description of the sampling location.

Collect quality assurance/quality control samples in accordance with SOP 4 and the project-specific work plan. Duplicate samples may be collected by using a "T" fitting attached to the sample tubing.

15.9.1 CANISTER SAMPLING

1. Connect the sample canister to its dedicated[1], pre-set flow controller with an inline vacuum gauge. If using a SUMMA®-equivalent canister, tighten (hand-tight) the fitting with adjustable wrenches. Do not over tighten. If using an Entech-style canister, connect the canister to the flow controller by sliding back the collar on the female end of the regulator's fitting and inserting it into the male end of the canister's fitting.
2. Ensure that the canister is in a stable position and will not fall or be relocated during the sampling process. Place physical and visual barriers around the canisters, as necessary, so they are not disturbed during sample collection.
3. Open the appropriate valve port on the soil vapor discharge tubing to allow vapor flow from the soil vapor point to the sample canister.
4. Open the canister's intake valve, record initial vacuum, and begin sample collection. Do not use canisters that show unacceptable (as detailed in the laboratory instructions or project-specific work plan) initial vacuum readings.
5. Attach a label to the sample container and enter information (sample number, start date, start time, sampler's initials, analysis, initial vacuum readings, and place of collection).
6. Check the canister vacuum gauge reading at least once during the sample collection period to ensure the canister's pressure is changing at the appropriate rate. If the canister's pressure is not changing at the appropriate rate, contact your project manager.
7. Once the sample collection period is completed, record the final vacuum, close the canister's intake valve, close the valve port connected to the soil vapor discharge tubing, disconnect the sample canister's intake port to the tubing from the soil vapor point, and disconnect the pre-set flow controller from the canister. Residual vacuum should be measurable after the collection period is completed; recommended residual vacuum is typically between -2 and -5 inches of mercury. The sample results may be subject to rejection during validation if vacuum was not maintained during the entire sample collection period. If vacuum readings are outside of the recommended range, inform your project manager as soon as possible. Enter the remaining information on the sample label and field book (stop date, stop time, and final vacuum reading).
8. Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and air temperature), PID readings, and any observations (e.g., odor, staining, or spills).

15.9.2 TEDLAR® BAG SAMPLING

1. Attach a new, appropriately-sized section of Teflon® or Teflon®-lined tubing to the air sampling pump.
2. Purge the tubing by operating the pump in accordance with the manufacturer's specifications (this will remove whatever air was present in the tube and pump mechanism allowing the air to be sampled to enter the sampling assembly).
3. Connect the pump's intake to the soil vapor discharge tubing, and the pump's discharge to the Tedlar® bag sample port.
4. Open Tedlar® bag valve and the appropriate valve port for the soil vapor discharge tubing to allow air flow from the soil vapor point to the Tedlar® bag.
5. Turn on the air sampling pump (or use the hand-powered pump) and begin filling the Tedlar® bag. Ensure the air sampling pump's flow rate meets any requirements in the project-specific work plan or regulatory guidance, using a calibrated air sampling pump or inline flow meter.
6. Once the Tedlar® bag is approximately two-thirds full, close the valve on the Tedlar® bag and the valve on the soil vapor discharge tubing.
7. Discontinue the pump operation and disconnect the air sampling pump from the Tedlar® bag.
8. Attach a label to each bag and enter information (sample number, date, start/stop time, sampler's initials, analysis, and place of collection).

[1] [1] Some laboratories match and pre-test specific flow controller and canister assemblies at the laboratory prior to shipment to the field for sample collection; be sure to assemble the equipment in the field using the matched components.

9 Record the final conditions at the sample location in accordance with the project-specific work plan or regulatory guidance, often including the weather conditions (e.g., precipitation, barometric pressure, and air temperature), PID readings, and any observations (e.g., odor, staining, or spills).

15.10 SAMPLE LABELING AND PREPARATION FOR SHIPMENT

Once sample collection is complete, prepare the sample canisters for offsite laboratory analysis:

1 Clean the outside of the sample container, if necessary.
2 Ensure all required information is completed on each sample label (see above).
3 Record sample designation, date, time, and the sampler's initials in the field book.
4 Complete chain-of-custody forms with appropriate sampling information, including:
- Location
- Sample name
- Sample collection start and end date and times
- Initial vacuum measurement, if applicable
- Ending vacuum measurement, if applicable
- Sample regulator number, if applicable
- Sample canister number, if applicable
- Analytical method

5 Complete sample packing and ship in accordance with proper procedures.

Note that air samples are typically shipped under ambient temperatures.

15.11 CLOSING NOTES

Once sampling is completed, secure the sample port or abandon the location boreholes/locations in accordance with the project-specific project work plan. Mark all sample locations with spray paint, stakes, or other appropriate marker for future reference, as needed, or survey, including collecting Global Positioning System coordinates and photographs, in accordance with the project-specific work plan. Decontaminate all equipment prior to departure and properly manage all PPE and IDW in conformance with SOP 6, the project-specific work plan, and applicable regulations.