CITY OF Fremont

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March 24, 2016

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Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502
Attention: Mr. Mark Detterman, PG, CEG

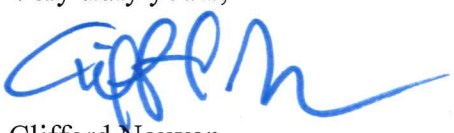
Transmittal
Vapor Mitigation System, Basis of Design Report
39155 and 39183 State Street, Fremont, CA

Dear Mr. Detterman:

Submitted herewith for your review is the *Vapor Mitigation System, Basis of Design Report, 39155 and 39183 State Street, Fremont, CA* prepared by PES Environmental, Inc.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document are true and correct to the best of my knowledge.

Very truly yours,



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PES Environmental, Inc.
Engineering & Environmental Services

A Report Prepared for:

Fremont State Street Center, LLC
Attention: Ms. Denise Cunningham
3000 Executive Parkway, Suite 450
San Ramon, California 94583

VAPOR MITIGATION SYSTEM
BASIS OF DESIGN REPORT
STATE STREET CENTER
FREMONT, CALIFORNIA

MARCH 24, 2016

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220.003.03.002

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

PES Environmental, Inc. (PES) has prepared this Vapor Mitigation System Basis of Design Report (Design Report) on behalf of Fremont State Street Center, LLC (FSSC) for construction of the vapor mitigation system (VMS) during redevelopment of the property located at 39155 and 39183 State Street in Fremont, California (the subject property or site; see Plate 1). Redevelopment plans for the site, known as the State Street Center, include grading and soil excavation for utilities and construction of a mixed use residential and retail project with 157 residential dwelling units and approximately 21,000 square feet of retail area. Approximately 50 percent of the residences will be on-grade townhomes, the rest are podium townhomes and flats (Plate 2). Soil will be excavated from the northwestern portion of the site to construct subgrade parking lots beneath the commercial retail/residential buildings[1]. The surrounding area will contain roadways with associated landscaping.

The purpose of this Design Report is to describe and document the proposed design of the VMS to be installed at the future commercial retail/residential buildings with subsurface parking along the northwestern portion of the site, and the slab-on-grade residential buildings to the southeast. The VMS will consist of an impermeable membrane installed beneath the residential spaces and retail area elevator pits to mitigate the potential for subsurface vapors from entering the buildings. The membrane will consist of a sprayed-in-place continuous barrier system (Geo-Seal membrane by Land Science Technologies). Additionally, a passive subslab venting system (Vapor-Vent by Land Science Technologies) will be installed at the slab-on-grade townhomes to passively vent accumulated vapors beneath the impermeable membrane to outdoor air.

The Alameda County Environmental Health (ACEH) is the regulatory agency for this project. The ACEH has the authority to review, provide comments on, and approve all VMS design documents submitted by (or on behalf of) the Owner, including this design report, the construction plans, and the construction completion report.

2.0 BACKGROUND

2.1 Site Location and Description

The site has the street addresses of 39155 and 39183 State Street in Fremont, California. A majority of the subject property is currently developed as a vacant lot. The site consists of approximately 5.3 acres. The southern corner of the site consists of a building located at 39180 Fremont Boulevard (Nation's Giant Hamburgers) with associated parking and landscaping areas (Plate 2). The site is bounded to the northeast by State Street, to the northwest by Capital Avenue and farther northwest by the Fremont Plaza Shopping Center,

[1] KTGY Group, Inc. (KTGY), 2015. *100% Design Development Drawings, State Street Center On-Grade, Fremont, California*. November 30.

to the southwest by commercial properties including restaurants and banks, and to the southeast by the Fremont Professional Park office complex.

2.2 Site History

PES previously authored a Phase I Environmental Site Assessment (ESA) report for the subject property, dated July 15, 2014 (PES, 2014)[2]. Historical documents indicate that the site was originally developed as cultivated farmland from at least 1939 through 1966. The subject property was redeveloped in 1966 with a 62,000 square foot building and asphalt-paved parking lot throughout the remainder of the property. The building was utilized as a Payless Drug Store and, later, a Nob Hill General Store. The building was reportedly demolished in 2001.

Another building, approximately 12,000 square feet in area, was built in front of the subject property directly northeast of the larger building in 1989, and Fremont Bank was reportedly the only tenant. Available records indicate that the subject property buildings had been demolished and that the site remained mostly vacant from the early 2000s until the present. The approximate location of the former buildings are shown on Plate 2. Limited use of the site, after demolition of site buildings has included a training yard for the Fremont Fire Department, a traveling carnival, and as a storage yard for a construction company. The storage yard was located on the northeastern portion of the site, and the traveling carnival were located on the northwestern portion of the site (Plate 2). The location of the former training yard for the fire department is unknown.

39180 Fremont Boulevard (Nation's Giant Hamburgers) which forms the southwestern corner of the current site area was not included as part of the property at the time of the Phase I ESA. As a result, no information regarding date of construction or previous uses of this property are known to PES.

2.3 Geology and Hydrogeology

Based on the results of the geotechnical investigation performed at the subject property in 1965, subsurface materials are comprised of a heterogeneous mixture of predominately fine-grained deposits of silty clays and clayey silts with some sand, from the surface to approximately 18 feet below ground surface (bgs)[3]. The fine-grained deposits are underlain by a fine- to coarse-grained sand layer with some silts and gravels to a depth of at least 28 feet bgs.

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[2] PES, 2014. *Phase I Environmental Assessment, 39155 and 39183 State Street, Fremont, California*. July 15.

[3] Gribaldo, Jacobs, Jones and Associates (Gribaldo and Associates), 1965. *Soils and Foundations Investigation*. December 27.

In the 1965 investigation, the soils below 10 feet bgs were very moist, but no evidence of a stable groundwater table was observed. According to groundwater monitoring reports available on GeoTracker for the Leaking Underground Storage Tank (LUST) cases located nearby at 4004 and 4190 Mowry Avenue, groundwater flow in the shallow aquifer fluctuates seasonally, but generally flows to the northeast (GeoTracker, 2014). The depth to water measured in monitoring wells installed at the 4190 Mowry Avenue LUST case averaged approximately 32 feet below ground surface in March 2013[4].

2.4 Summary of Previous Investigations

Previous subsurface investigation activities have been conducted at the site in October 2014, December 2014, January 2015, September 2015, and February 2016 under Alameda County Water District (ACWD) and Alameda County Department of Environmental Health (ACEH; the lead agency for the subject property) oversight (PES, 2015a, 2015b, 2016b). The investigations included completing 60 borings (B1 through B60) for soil and/or soil vapor sample collection. Subsurface lithologies were generally similar to the materials encountered during the 1965 geotechnical investigation.

Observations made during drilling on the southern portion of the site, in the vicinity of boring B4, identified dark brown silty gravel to the total depth explored of 5 feet below grade. This layer is underlain by concrete debris that prohibited deeper observations. Brick debris was identified in a single boring (B47) at a depth of 4 feet bgs. In addition, brown silt was observed in boring B50 adjacent to the Nation's Giant Hamburgers building to the total depth explored of 10 feet bgs.

During the February 2016 investigation, soil vapor borings B51 through B56 were each advanced approximately three feet northwest of a prior boring location and four borings B57 through B60 were collected in the western portion of the subject property within the footprint of planned elevators. The soil vapor samples at boring B57 through B60 were collected at a depth of 25 feet below grade (i.e., 5 feet below the proposed future elevator sump bottom elevation). The approximate locations of the borings are shown on Plate 2.

Soil vapor sample analytical results are summarized in Table 1. As indicated on Table 1, several volatile organic compounds (VOCs) were identified during the soil vapor investigations. However, only tetrachloroethylene (PCE), chloroform, and benzene were detected above the newly published Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) Tier 1 environmental screening levels (ESLs) for soil gas in a residential land use setting[5]. To further evaluate the data, a site-specific vapor intrusion screening level (e.g., Tier 2 screening levels) for PCE (1,260 $\mu g/m^3$), chloroform (220 $\mu g/m^3$), and benzene (160 $\mu g/m^3$) were calculated for the residential land use scenario based on the observed

[4] Arcadis, 2013. Site *Conceptual Model and Closure Request Report, Former BP Station No. 11100, 4190 Mowry Avenue, Fremont, California. ACWD Case No. 0235.* July 29.

[5] RWQCB, 2016. Tier 1 ESLs. February. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml.

subsurface soil conditions (clay soils) and using the Department of Toxic Substances Control (DTSC) vapor intrusion model.[6] As requested by ACEH, a column has been added to the table that lists the approximate sample depth relative to the future building foundation elevation, where applicable.

Soil sample analytical results are summarized on Table 2 and Table 3. No VOCs in soil were detected above their respective laboratory reporting limits during the 2014 and 2015 investigations, with the exception of acetone. Acetone, a common laboratory contaminant, was detected at a several locations up to a maximum concentration of 130 micrograms per kilogram (μg/kg). This concentration is below the residential ESL.

2.4.1 PCE and Chloroform in Soil Vapor

The PCE in soil vapor appears to be the result of discharges of PCE into the sanitary sewer and/or storm drain by a prior dry cleaning establishment, Norge Cleaners, formerly located to the northwest at 39067 State Street within the adjacent Fremont Plaza Shopping Center (Plate 2). In a memorandum dated April 17, 2015, PES discussed the source of the PCE release[7]. The memorandum identified that Norge Cleaners operated a nearby dry cleaning business beginning in 1969 and ending in 1996 (27 years) and used and stored PCE during operations. Previously, it was common practice to dispose of PCE-containing waste to the sewer. Consequently, it is possible that the PCE release occurred throughout the timeframe of Norge Cleaner's operations; however, no specific dates of release have been established at this time.

The sewer lateral at the former Norge Cleaners drains to State Street. Based on a video survey of the sewer line within State Street, it was established that there are tree roots in the pipe joints, and there is an apparent sag at the location were elevated PCE concentrations were identified in soil vapor samples collected within State Street. These defects represent a preferential pathway for PCE laden wastewaters to have migrated from the sewer pipe at some point in the past into the sewer backfill and surrounding native soils. Disposal of PCE wastewater at Norge Cleaners and leakage from the sewer represents the best explanation for the presence of elevated PCE concentrations in soil vapor samples collected within State Street and on the subject property. As documented in the letter from the Alameda County Water District (ACWD) to the current property owner, the City of Fremont, the site is not considered by the ACWD to be the source of the contamination[8].

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[6] DTSC, 2014. Department of Toxic Substance Control, Vapor Intrusion Screening Model - Soil Gas. December. The default soil type was adjusted to reflect the site-specific soil type (clay) that is present within the top 5 feet of the site.

[7] PES, 2015. *Source of VOCs in Soil Vapor, 39155 and 39183 State Street, Fremont, California*. April 14.

[8] Alameda County Water District (ACWD), 2015. *Contamination Detected at 39144 and 39183 State Street, Fremont (ACWD Site #690)*. May 13.

All of the soil vapor samples collected within State Street (adjacent to the sewer) and in the sidewalk contained PCE and all detections exceeded the residential ESL (240 μg/m^3), with the exception of the sample collected at boring B40 with PCE at 220 μg/m^3. The maximum off-site concentration of PCE was 23,000 μg/m^3 in boring B38 (collected in January 2015). During the February 2016 investigation, the maximum off-site concentration of PCE was 15,000 μg/m^3 in boring B52 (adjacent to boring B38). Chloroform was not detected in any of the off-site samples.

Three on-site samples (all located adjacent to State Street within the footprint of the future residential building located closest to State Street) exceeded the site-specific vapor intrusion screening level for PCE of 1,260 μg/m^3: borings B21 (8,500 μg/m^3), B30 (1,700 μg/m^3), and B56 (1,300 μg/m^3). Borings B21 and B56 were collected adjacent to each other in December 2014 and February 2016, respectively. Based on the results of the most recent investigation conducted in February 2016, the concentration of PCE in soil vapor in the vicinity of the sewer line that runs down the center of State Street and along the northeastern property boundary are either approximately the same or less than prior sample results from 2014 and 2015. These results establish a baseline condition prior to redevelopment and indicate that concentrations of PCE remain approximately the same or have decreased over time.

Two soil vapor samples collected from borings B16 and B27 within Capital Avenue (adjacent to future Buildings A and B) contained PCE detections that exceeded the residential ESL (240 μg/m^3). PCE was detected at concentrations of 550 μg/m^3 in boring B16 (collected in October 2014) and 430 μg/m^3 in boring B27 (collected in December 2014). As shown on Table 1, PCE and chloroform were detected in the two samples collected from borings B59 and B60 within the footprint of planned elevators at future Building A. PCE and chloroform were not detected in the two samples collected from borings B57 and B58 within the footprint of planned elevators at future Building B. The maximum concentrations of PCE and chloroform detected at a depth of 25 feet bgs was 570 μg/m^3 and 190 μg/m^3, respectively. These concentrations are below their respective site-specific vapor intrusion screening levels.

2.4.2 Benzene in Soil Vapor

Benzene has been detected in soil vapor samples collected from four borings (B4, B45, B46 and B47) in a localized area in the southern portion of the site at concentrations that exceed the RWQCB Tier 1 ESL for soil gas in a residential land use setting of 48 μg/m^3. Benzene was detected at concentration of: 510 μg/m^3 in boring B4; 88 μg/m^3 in boring B45; 91 μg/m^3 in boring B46; and 710 μg/m^3 in boring B47. These detections of benzene in soil vapor appear to be associated with the presence of concrete debris in the subsurface. The drilling rig encountered refusal due to a layer of concrete debris at a depth of 5 feet below ground surface (bgs) in borings B4, B44, B45, B46, and B47. As noted above, elevated benzene concentrations were observed in each of these borings, with the exception of boring B44.

This localized area of benzene in soil vapor is currently planned for excavation. A work plan for soil excavation of an area that includes borings B4, B44, B45, B46 and B47 has been submitted to the ACEH for approval (PES, 2016a)[9]. This area planned for excavation also includes the area where elevated chloroform was detected. It is expected that the remedial excavation and subsequent confirmation sampling of this area will document that the soil and soil vapor conditions are below the respective residential ESLs.

3.0 VAPOR MITIGATION SYSTEM OBJECTIVE

The objective of the VMS is to protect future site occupants by mitigating the potential vapor intrusion risk from PCE (and PCE degradation products) in soil vapor into indoor air. Specifically, the VMS will be installed to mitigate the PCE that has been detected in soil vapor samples collected on the site at locations adjacent to and within State Street and at locations within Capitol Avenue. The VMS will not be installed to mitigate the benzene (and chloroform) that has been detected in soil vapor in the southern portion of the site as excavation and removal of the potentially contaminated material in the vicinity of the benzene and concrete debris occurrences is planned for this area. Cross sections that depict residual PCE, chloroform and benzene contamination, if any, proposed to remain at the site following the benzene excavation and after redevelopment activities are provided in Appendix A.

The VMS will be installed at the future residential on-grade townhomes to mitigate the potential vapor intrusion risk from subsurface vapors entering the buildings through entry points (such as cracks, openings, or penetrations) in the building foundation and on-grade floor slab. The proposed commercial retail/residential buildings are planned to be podium-style buildings with ventilated below grade parking; therefore, the VMS will be installed at the elevator pits in the commercial retail/residential buildings to mitigate the potential vapor intrusion risk from subsurface vapors entering the building through entry points (such as cracks and openings) in the below grade elevator pits and migrating to upper floors via the elevator shafts. Plate 3 shows the proposed locations where the VMS will be installed, which includes the buildings located on the northern portion of the site (Buildings 7, 8, 9, 10, 11 and 12) and the elevator pits at the commercial retail/residential building located near State Street (Building A).

The mitigation objective is to maintain concentrations of PCE (and PCE degradation products) present in soil gas, at concentrations below their respective indoor air ESLs in the future site buildings. The following indoor air treatment objectives for the future site buildings are based on the recent 2016 RWQCB Tier 1 ESLs for indoor air in a residential land use setting:

- PCE = 0.48 $\mu g/m^3$;
- trichloroethene (TCE) = 0.68 $\mu g/m^3$;

[9] PES, 2016a. *Work Plan for Soil Excavation and Well Destruction, 39155 and 39183 State Street, Fremont, California*. January 29.

- cis-1,2-dichloroethene (cis-1,2-DCE) = 8.3 $\mu g/m^3$;
- trans-1,2-dichloroethene (trans-1,2-DCE) = 63 $\mu g/m^3$; and
- vinyl chloride (VC) = 0.036 $\mu g/m^3$.

4.0 VAPOR MITIGATION SYSTEM DESIGN

The VMS will consist of a vapor barrier membrane and passive subslab venting system that will be installed during construction of the new building foundations. The vapor barrier membrane is installed beneath the building slab and provides a physical barrier that has extremely low permeability to soil vapor to reduce the potential for subsurface vapors from entering the building. As an added mitigation measure, the subslab venting system will consist of a connected array of perforated piping installed in a high permeability gravel layer beneath the building slab to provide a low resistance pathway for any accumulated subsurface vapors beneath the barrier to escape to the outdoor air. The combined installation of these two systems will provide a continuous vapor intrusion barrier beneath the building, provide a low resistance mechanism to vent soil gas from beneath the building, and offer increased flexibility should additional mitigation measures become necessary in the future (e.g., active sub-slab depressurization or active venting).

The proposed VMS including the vapor barrier membrane and subslab collection piping layout are shown on the Draft VMS Design Drawings included in Appendix B.

4.1 Key Design Parameters

The following key design parameters were used in the design of the VMS:

- The current extent of the PCE soil vapor concentrations greater than the 2016 RWQCB Tier 1 ESLs for soil gas in a residential land use setting;
- The anticipated remedial excavation of the localized area in the southern portion of the site wherein benzene soil vapor concentrations exceed the 2016 RWQCB Tier 1 ESLs for soil gas in a residential land use setting (includes the area where elevated chloroform was detected). It is expected that the remedial excavation and subsequent confirmation sampling of this area will document that the soil conditions are below the respective residential ESLs;
- Commercially available VMS components (vapor barrier membranes and/or venting systems) and their expected performance;
- The proposed building foundation design and building footprint; and

- Regulatory advisories; the VMS will be installed in accordance with the recommendations outlined in the *Methane Mitigation Standard* published by the City of Los Angeles Department of Building and Safety (CLADBS, 2004) and the *Vapor Intrusion Mitigation Advisory* published by the California Department of Toxic Substances Control (DTSC, 2011b).

4.2 Extent of Vapor Mitigation System

Two primary criteria are considered in the DTSC Vapor Intrusion Guidance (DTSC, 2011a)[10] to evaluate whether or not a site is a candidate for vapor intrusion: (1) the nature of the subsurface contaminants, and (2) the proximity of existing or future buildings to subsurface contaminants. Therefore, the lateral extent of the VMS membrane installation was determined based on the proximity of the proposed building footprints or elevator pit location to the locations of PCE soil vapor concentrations exceeding the 2016 RWQCB Tier 1 ESLs for soil gas. Per the DTSC Vapor Intrusion Guidance, for future buildings at sites where unacceptable contaminant levels are left in the subsurface, engineering controls would be needed unless buildings are at least 100 feet from contamination.

The VMS will be installed at the future residential on-grade townhomes to mitigate the potential vapor intrusion risk from subsurface vapors entering the buildings through entry points (such as cracks, openings, or penetrations) in the building foundation and on-grade floor slab. The proposed commercial retail/residential buildings are planned to be podium-style buildings with ventilated below grade parking; therefore, the VMS will be installed at the elevator pits in the commercial retail/residential buildings to mitigate the potential vapor intrusion risk from subsurface vapors entering the building through entry points (such as cracks and openings) in the below grade elevator pits and migrating to upper floors via the elevator shafts.

Plate 3 shows the proposed locations where the VMS will be installed, which includes the residential on-grade townhomes located on the northern portion of the site closest to State Street (Buildings 7, 8, 9, 10, 11 and 12) and the elevator pits at the commercial retail/residential building located near State Street (Building A).

The VMS membrane will not be installed below the on-grade townhomes located on the southern portion of the site, the elevator pits at the commercial retail/residential building located near Capitol Avenue (Building B), the "podium" commercial retail/residential structures (with the exception of the elevator pits), open space areas (parking or landscaping), or parking garage structures.

[10] DTSC, 2011a. *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance)*. October 2011.

4.3 Vapor Barrier Membrane (Geo-Seal)

Geo-Seal membrane manufactured by Land Science Technologies was selected as the vapor barrier membrane for this project to serve as a physical barrier to soil vapor due to its extremely low permeability. Geo-Seal is a composite system that creates the ideal blend between constructability and chemical resistance by using both high density polyethylene (HDPE) and spray applied asphalt latex. The Geo-Seal membrane will be applied to a nominal dry thickness of 60 mils, which is the typical installation thickness for vapor intrusion applications and provides damage (i.e. puncture) resistance during installation and subsequent foundation installation.

4.4 Subslab Ventilation System

The passive subslab vent system will be installed at the on-grade townhomes. The purpose of subslab venting is to provide a low resistance pathway for any accumulated subsurface vapors beneath the barrier to escape to the outdoor air. This system will require minimal operations and maintenance activities due to its passive nature. The subslab venting system consists of a connected array of perforated low profile vent piping installed in a permeable gravel layer directly below the VMS membrane with vent risers attached to the low profile vent piping that run to the roof of the building (located away from building rooftop HVAC fresh air intakes).

4.4.1 Gravel Layer

The low profile vent pipe will be installed in a permeable gravel layer directly below the VMS membrane. The permeable gravel layer is intended to provide a continuous, highly permeable zone beneath the VMS membrane that allows soil vapor to flow to the collection piping system. This permeable layer will consist of a 4-inch minimum thickness, continuous layer of 3/8-inch pea gravel placed beneath each foundation slab. The permeable base layer must also meet all requirements set forth by the project's geotechnical engineer for the site redevelopment. If the gravel layer is modified from 3/8-inch pea gravel to a different type of gravel or crushed rock, then an additional gravel protection layer may be required to protect the vapor barrier membrane from damage.

4.4.2 Low Profile Vapor Collection Piping

Vapor-Vent, manufactured by Land Science Technologies was selected as the low profile vapor collection vent piping. Vapor-Vent piping consists of perforated, fabric-wrapped, low-profile HDPE piping. Vapor-Vent is ideal for use in conjunction with Geo-Seal membrane, as these products have been specifically designed for integrated VMS use by the manufacturer (Land Science Technologies). Material and construction quality assurance and quality control are improved by the use of these integrated products, due to the nature of having a single manufacturer and single certified installer. Vapor-Vent's low profile, 1-inch thickness also allows for easy installation within the 4-inch permeable base layer with adequate material cover above and below the pipe.

The sub-slab collection piping layout for this project has been designed to meet the maximum manufacturer recommended and CLADBS Methane Mitigation Standard required spacing between piping of less than 100 feet. The sub-slab collection piping layout was designed based on planned locations of the building foundation elements.

4.4.3 VMS Vent Risers

The low profile vapor collection vent piping will be connected to 4-inch diameter cast iron vertical vent risers that run to the roof of the building which will channel the collected vapor to outdoor air. The vent risers will be connected to the low profile vent piping using manufacturer produced conversion fittings. The use of cast iron for the main vertical stack follows material specifications as set forth in Section 5 of the CLADBS Methane Mitigation Standard (CLADBS, 2004). Vent riser locations were chosen to correspond with vertical building columns and walls for the planned buildings. Vent risers will extend above the roofline, terminating approximately 1 foot above the roofline elevation. The vents will be located and terminated with minimum clearances specified in Section 906.2 of the 2013 California Plumbing Code.

A single 4-inch vent is capable of servicing a vapor mitigation membrane area ranging from 4,000 square feet (ft^2) (NAVFAC, 2011, and Hatton, 2010) to 10,000 ft^2 (CLADBS, 2004). Using the conservative 4,000 ft^2 recommended service area for 4-inch diameter pipes, the number of vents per area with a VMS membrane was determined as follows:

Building Number	Approximate Area (ft^2)	Selected Vent Size	Service Area for Selected Vent (ft^2)	Calculated Number of Vents Required	Selected Number of Vents
Building 7 Building 12	9,100	4-inch	4,000	3	4
Building 8 Building 10	2,500	4-inch	4,000	1	2
Building 9 Building 11	3,000	4-inch	4,000	1	2

This number of vent risers meets the CLADBS Methane Mitigation Standard requirements for the maximum treatment area for each vent riser. The proposed vent riser locations are shown on the VMS Design Drawings which are presented in Appendix B. The final locations of the vent risers may be modified during installation due to as-built conditions of footings, columns, or walls, and to maintain the minimum clearances and setback distances required by the 2013 California Plumbing Code for the heating and ventilation equipment installed on the roof.

Vacu-Stack caps will be installed at the top of each of the vent riser pipes. Each vent riser will also be equipped with a Vacu-Stack® cap, requiring no power to operate. The selected cap is a 6-inch (flue diameter), stainless steel, Vacu-Stack Model #VSS-6-S5, manufactured by Improved Consumer Products, Inc. These caps are designed to prevent wind-related chimney down draft problems and protect against the inflow of rain water.

4.5 Maximum Allowable Design Flow Rate

Passive soil vapor extraction operations with operations with total emissions of less than 1 pound per day of benzene, vinyl chloride, PCE, methylene chloride, and/or TCE are exempt from requiring a treatment system to reduce emissions to the atmosphere[11]. The following methodology was used to estimate the maximum allowable flow rate for this VMS system, which would meet the exemption requirements.

The BAAQMD 8-47-113 exempt maximum allowable flow rate for the VMS was determined based on historical PCE in soil vapor concentrations from samples collected within the footprints and in the immediate vicinity of the planned buildings. The other compounds which are limited by BAAQMD 8-47-113 were not detected in any of these samples. The following soil vapor samples (PES, 2015a and PES, 2015b) and their average detected PCE concentrations were used to calculate the VMS maximum allowable flow rate:

VMS Area	Soil Vapor Sample Locations	Average PCE Concentration ($\mu g/m^3$)
Building 12	B21, B22, B30, B31, B39	2,770
Buildings 8, 9, 10 and 11	B1, B5, B19, B33	208
Building 7	B2, B20	100

Supporting calculations are shown in Appendix C.

Based on these soil vapor concentrations, the VMS maximum allowable flow rate for each vent was calculated to be approximately 226 cubic feet per minute (ft^3/min) to remain under the 1 pound per day emission limit per BAAQMD. The maximum allowable vent flow rate calculation is presented in Appendix C.

The VMS maximum allowable flow rate (per each vent riser) of 226 ft^3/min is approximately equivalent to an air speed of 29.4 miles per hour through the planned 4-inch diameter vent risers before a BAAQMD exceedance could possibly occur. Based on the passive (i.e. non-powered) nature of the VMS, reaching sustained flow rates that would exceed the BAAQMD 1 pound per day emission limit is not feasible. The performance of the VMS will also be tested following its installation to ensure the system is functioning at a discharge rate below the BAAQMD limit.

[11] Per Section 8-47-113 of the Bay Area Air Quality Management District (BAAQMD) 2005. *Regulation 8, Organic Compounds, Rule 47, Air Stripping and Soil Vapor Extraction Operations (Adopted December 20, 1989)*. June 15.

5.0 IMPLEMENTATION

The VMS will be installed during construction of the State Street Center buildings and coordinated with other trades as necessary. The installation schedule of the VMS will be coordinated with the site Construction Manager and will be subject to regulatory and permit approvals. To allow for sequential occupancy of the future residential on-grade townhome buildings, the results of performance monitoring for each building (see Section 7.0) will be provided to ACEH as the buildings are constructed.

5.1 VMS Contractor and Subcontractor Requirements

The Geo-Seal membrane and Vapor-Vent piping must be installed by an LST certified installer, in compliance with the Construction Drawings and LST-recommended installation and quality control procedures. The VMS installation contractor and all subcontractors must be licensed by the California Contractors State License Board (CA CSLB).

5.2 Regulatory Permitting and Approval

The following permits and approvals are required for the installation of the VMS:

- ACEH approval of this Design Report;
- City of Fremont grading and building permits issued for the sitewide redevelopment; and
- BAAQMD Authority to Construct and subsequent Permit to Operate for the VMS.

Site grading and construction activities not related to the VMS may take place prior to the VMS approval by ACEH and/or BAAQMD.

The planned VMS system is limited to the extents of the proposed building footprints. Based on this design feature, it is not anticipated that the VMS system implementation will affect any public infrastructure which might require additional permitting or approval measures.

5.3 VMS Installation

Installation of the VMS permeable layer, sub-slab piping, and membrane will take place after final site grading activities and structural foundation work have been completed, and completed prior to building slab installation.

5.3.1 Mobilization and Site Preparation

The Geo-Seal and Vapor-Vent certified installer will mobilize to the site upon the completion of grading activities and construction of building foundation elements by others. Site preparation will include identification of the final layout of the horizontal piping and locations

for the vent risers, based on the as-built conditions of other subslab utilities and foundation elements. The final location of the vent risers will correspond with the location of building columns and walls and will be determined in coordination with the project architect, structural engineer, and other relevant project disciplines as necessary.

5.3.2 Permeable Base Layer Installation

Installation of the permeable base layer will commence once grading activities have been completed and the foundation extents have been established. The permeable base will consist of a 4-inch minimum thickness layer of gravel or crushed rock that will be placed beneath the slab areas designated for membrane installation. The permeable material will be placed within the footprint of the future foundation, but will not extend beneath any building edge foundation or footing.

5.3.3 Subslab Piping Installation

Shallow trenches will be hand dug within the permeable gravel layer along the final Vapor-Vent horizontal piping layout. The horizontal low profile vapor collection vent piping will then be installed within the permeable gravel layer and covered with base material removed from the trenches. Vapor-Vent piping lengths and spacing shall match the VMS design drawings in all locations except those requiring adjustments based on foundation and utility as-built conditions. Any variations from the VMS design drawings will be recorded for inclusion in the VMS as-built drawings. The Vapor-Vent piping will be connected to 4-inch diameter vent risers using manufacturer produced conversion fittings. The stub out will be terminated at a minimum elevation of 12 inches above the top of foundation slab and will be capped until vertical pipe installation can take place.

5.3.4 Membrane Installation

The Geo-Seal membrane will be installed following successful installation of permeable base layer and Vapor-Vent piping. The membrane installation will be performed prior to foundation slab construction and will consist of separate base, core, and bond layers.

The membrane base layer will be installed per manufacturer recommendations (i.e. minimum overlap between adjacent sheets, seam sealing of sheets, etc.). Penetrations through the base layer will be cut as necessary to for utilities, foundation reinforcement, etc. Tears and/or punctures in the base layer will be repaired prior to application of the core layer.

The core layer will be spray-applied on top of the base layer using manufacturer recommended equipment and installation techniques. The core layer will be applied to a minimum dry thickness of 60 mils. The layer will be applied with smooth and consistent motion and with the layers sprayed such that they are overlapping. The core layer will require a curing period of 24 to 48 hours prior to quality control testing.

Installation of the bond layer will not occur until all quality control testing and repairs to the core layer have been completed. The bond layer will be installed per manufacturer recommendations. The bond layer seam seals will be allowed to cure for a period of 24 to 48 hours prior to the beginning of pouring of the building slabs.

Any damage that penetrates the core layer prior to the pouring of the building slabs will require repair by a LST-certified installer.

5.3.5 Vent Riser Installation

Installation of the vent risers will take place during vertical construction of the buildings and will be completed in a manner similar to other plumbing piping installations for the buildings. Vent risers may be located along outside building walls, or within building walls or furred pilasters. Vent risers shall not be installed within firewalls. Vent risers shall be protected from physical damage.

The vent risers shall terminate a minimum of 3-feet above the roof surface and 12-inches above adjacent parapet. Vent risers shall terminate at least 10 feet from any window, door, roof hatch, opening or air intake into the building, and 5 feet from any electrical device. Horizontal vent riser piping shall be set at an incline, with a slope on no less than 2%.

5.3.6 Waste Management

Waste material generated during the installation of the VMS system will be disposed as nonhazardous waste or recycled with other general construction debris.

5.3.7 Demobilization and Project Closeout

The VMS contractor and any subcontractors will demobilize from the site following approval by the Owner and Project Engineer of the installed work. The vent riser piping contractor will demobilize from the site upon completion of the vertical vent risers, which is expected to closely coincide with the completion of the vertical development of the buildings. The contractor and/or subcontractors may be required to return to the site to address repairs to the VMS, or deficiencies identified at the time of startup/commissioning of the VMS.

Project closeout procedures will include Owner and Project Engineer inspections and approvals of the installations. Closeout documents will include as-built markups of design drawings, documentation of installed materials and equipment, available operation and maintenance manuals, and written warranties (as applicable) for work and installed products.

5.3.8 As-Built Drawings

As-built alignments of installed Vapor-Vent horizontal piping and locations of the vent riser slab penetrations shall be clearly marked on the design drawings upon completion of their installation and prior to building foundation construction.

5.4 Contingencies

The vapor barrier and subslab venting system, once installed and covered by the concrete floor slab, cannot be accessed or directly inspected. The following contingency plans are provided in the event of a planned penetration of the floor slab or suspected failure of the vapor barrier.

5.4.1 Intentional Penetrations of the Floor Slab

It is possible that penetrations of the floor slab may be required (e.g., for utility repairs, tenant improvements that involve sub-slab work, etc.). Sheet 4.0 of the design drawings included in Appendix B presents generalized procedures for protecting and repairing the vapor barrier in the event that vapor barrier penetrations are required. It is imperative that the floor slab removal be conducted in such a way that adequate flaps of the vapor barrier remain around the entire perimeter of the area that is penetrated. This will permit the vapor barrier patches to be adhered to the existing vapor barrier in order to maintain a continuous vapor barrier across the building footprint. As with the initial vapor barrier installation activities, the vapor barrier repairs must be performed by a certified applicator, in order to maintain the product warranty.

If a planned penetration of the slab is to occur, it is recommended that the Owner retain a qualified environmental professional to prepare an action plan specific to the proposed penetrations and verify it is properly implemented. The action plan will include: provisions to collect data to verify that the work will not result in a health risk to building occupants; steps to protect the vapor barrier system, or (if it is to be breached) procedures to repair the barrier to its original condition in accordance with the design specifications; and, quality control procedures to verify the adequacy of any barrier repairs.

5.4.2 Suspected Vapor Barrier Failures

If information becomes available that indicates a possible failure of the vapor barrier, the building Owner shall take the following actions. A qualified environmental professional should be retained to evaluate the information indicating a suspected vapor intrusion mitigation system failure. The environmental professional should be asked to prepare, and the Owner should implement, an assessment plan to determine whether there is an actual failure of a mitigation system and whether there is an associated health risk concern. As recommended by the environmental professional in the assessment plan, additional information may be collected to ascertain the condition and functionality of the mitigation systems. Based on its evaluation of

the data, the environmental professional should be asked to prepare, and the Owner should implement, a corrections plan to remedy identified vapor intrusion problems.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Specific quality assurance and quality control (QA/QC) measures for the installation of the VMS are included in the VMS-specific Construction Quality Assurance (CQA) Plan presented in Appendix D. The VMS Contractor will be required to submit a Construction Quality Control (CQC) Plan outlining their planned actions to meet the quality control requirements of the project, as required by the CQA Plan and the project specifications. The CQA and CQC Plans make up the construction quality management program for the project.

6.1 VMS Quality Assurance

Definitions of the roles and responsibilities for the team, materials, and procedures to be used during construction are provided in the CQA Plan. The CQA Plan assures the applicable regulatory agencies that construction materials will be tested, installed and monitored as specified by the construction plans and specifications, accepted civil engineering practices, and applicable CQA requirements. A designated CQA Manager will oversee the tasks detailed in the CQA Plan. An organizational chart depicting the various quality assurance roles is included as part of the CQA Plan.

CQA coordination will include a pre-installation meeting between the Owner, Project Engineer, Construction Quality Control (CQC) Manager, and any contractors/subcontractors involved in the installation of the VMS. This preconstruction meeting will serve to introduce all parties and establish the chain of command and lines of communications for the project. During the construction of the VMS, additional meetings will be held as needed to assess construction progress, address deviations from the design, and discuss any identified QA/QC issues and resolutions.

6.2 VMS Quality Control

6.2.1 VMS Materials Quality Control

The selected contractor will provide material data specifications to the Owner and Project Engineer for approval prior to delivery to the site. All materials will be inspected initially upon arrival at the site and prior to installation. Any materials found to be deviating from the approved specifications will be replaced and damaged materials will be repaired or replaced as necessary. The Geo-Seal and Vapor-Vent materials will be sourced solely from the manufacturer, LST.

6.2.2 VMS Construction Quality Control

Construction of the subsurface Vapor-Vent piping and Geo-Seal membrane will be a certified LST installer. The installer shall provide current certification document(s) issued by LST indicating that the installer meets and complies with the manufacturer's QA requirements for the installation of its products. In addition, the contractor shall possess a current contractor license issued by the CA CSLB.

Construction quality control for the Geo-Seal membrane will include, at a minimum, the following measures:

- Smoke testing will be performed to test the seal created around penetrations and terminations and to demonstrate integrity of the applied membrane; and
- Selected coupon sampling and testing will be performed on the installed membrane to verify applied minimum thickness of 60 mils.

Appropriate smoke and coupon testing protocol will be described in detail in the Project Submittal provided by the manufacturer, LST.

The CQC Manager will perform regularly scheduled inspections of the VMS construction activities to verify conformance with the construction plans and specifications. The locations of foundation penetrations will be coordinated with the architect and structural engineer. Prior to completion of the vent risers at roof level, the vent setback and clearance will be verified for conformance with the California Plumbing Code requirements for roof vents.

7.0 PERFORMANCE MONITORING, OPERATIONS, AND MAINTENANCE

The VMS is intended to act as a long-term, passive approach to mitigating risks to indoor air. Long-term routine operations, maintenance, and monitoring (OMM) activities are not expected to be required.

An initial performance monitoring event will be conducted following the completion of the VMS installation to verify that the system is functioning as intended. To allow for sequential occupancy of the future residential on-grade townhome buildings, the results of performance monitoring for each building will be provided to ACEH as the buildings are constructed. The need for any additional or continual system monitoring will be determined based on the results of the initial performance monitoring event, ACEH approval, and BAAQMD approval.

A VMS specific Operations and Maintenance (O&M) Plan will be issued following the successful installation of the VMS. This O&M plan will include the requirements and inspection protocol for any future building foundation modifications or other activities that might affect the integrity of the vapor membrane. The names and contact information of the owner-assigned O&M personnel will be kept updated within the O&M Plan to ensure that they are easily reachable when needed.

VMS initial performance monitoring will include vent riser sampling. The performance monitoring will be conducted to test the vent riser emission rates and to evaluate the soil vapor concentration in the subsurface beneath the buildings.

Initial performance monitoring of the vent risers will consist of collection of flow rate data and representative samples of vented soil vapor from each installed riser. The flow rate data and vapor samples will be collected from pre-installed ports at roof level in each vent riser and concentrations may also be screened for total VOCs using a PID. The collected vented soil vapor samples will be sent for laboratory analysis for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE and VC. Flow rate and vented soil vapor concentrations will be used to calculate the emissions from each vent riser. The total VMS emissions will then be calculated in order to verify that the combined emissions (aggregate of all vents) is less than 1 pound per day as required by BAAQMD regulations for unabated sources (BAAQMD, 2005). Adjustments to the vent riser flow rates and/or additional sampling may be performed as necessary, if the total VMS emissions are determined to be above this amount.

8.0 SCHEDULE AND REPORTING

8.1 Documentation and Reporting

Following installation of the VMS, PES will prepare and submit a construction completion report to ACEH for review and approval. The completion report will summarize the observations and findings made during construction. The completion report will also include a CQA Manager and Design Engineer certification that the completed VMS conforms to the construction plans and specifications, the CQA Plan, and the CQC plan.

VMS initial performance monitoring activities will commence following completion and certification of the project. Upon completion of the performance monitoring, a summary letter report of the findings will be provided to the ACEH and BAAQMD by PES. The summary report will document the sample procedures, analytical results, and provide recommendations and/or corrective actions as needed. Copies of the field sampling forms and laboratory reports will be attached to the report.

8.2 Schedule

The construction schedule for the activities described in this Design Report is still to be determined. The initial performance monitoring activities for the VMS will commence once the building envelope has been constructed. A schedule for these activities will be provided to ACEH prior to implementation.

9.0 REFERENCES

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TABLES

Table 1
Summary of Soil Vapor Analytical Results
State Street Center
Fremont, California

Sample Location	Date Sampled	Sample Number	Sample Depth (feet bgs)	Sample Depth (feet below future building foundation elevation)	Purge Volume	PCE (µg/m³)	Benzene (µg/m³)	Toluene (µg/m³)	Ethyl-benzene (µg/m³)	m,p-Xylene (µg/m³)	o-Xylene (µg/m³)	Freon 11 (µg/m³)	Freon 12 (µg/m³)	Chloroform (µg/m³)	1,1-DFA (µg/m³)	Percent Oxygen
On-Site																
B1	10/28/2014	B1-SV	5.0	4.6	3	< 100	< 80	< 200	< 100	< 200	< 100	< 100	< 100	< 100	< 10,000	--
B2	10/28/2014	B2-SV	5.0	4.4	3	< 100	< 80	< 200	< 100	< 200	< 100	**120**	**1,900**	< 100	< 10,000	--
B4	10/27/2014	B4-SV	5.0	3.3 e	1	< 100	**320**	**1800**	< 100	**360**	**140**	< 100	**1,700**	**160**	< 10,000	--
				3.3 e	3	< 100	**480**	**1500**	**160**	**520**	**190**	< 100	**2,300**	**160**	< 10,000	--
				3.3 e	5	< 100	**510**	**780**	**230**	**690**	**260**	< 100	**2,100**	< 100	< 10,000	--
B5	10/27/2014	B5-SV	5.0	4.7	3	**300**	< 80	< 200	< 100	< 200	< 100	< 100	**1,000**	< 100	< 10,000	--
B6	10/28/2014	B6-SV	5.0	5.7	3	< 100	**97**	< 200	< 100	< 200	< 100	< 100	**240**	< 100	< 10,000	--
B8	10/27/2014	B8-SV	5.0	3.6	3	< 100	< 80	< 200	< 100	< 200	< 100	**1,600**	**6,400**	< 100	< 10,000	--
B9	10/28/2014	B9-SV	5.0	-7.0 f	3	< 100	< 80	< 200	< 100	< 200	< 100	**110**	< 100	< 100	< 10,000	--
B10	10/28/2014	B10-SV	5.0	-6.8 f	3	< 100	< 80	< 200	< 100	< 200	< 100	**370**	**1,400**	< 100	< 10,000	--
B11	10/28/2014	B11-SV	5.0	-6.4 f	3	< 100	< 80	< 200	< 100	< 200	< 100	< 100	**410**	< 100	< 10,000	--
B12	10/28/2014	B12-SV	5.0	-7.0 f	3	< 100	< 80	< 200	< 100	< 200	< 100	**1,100**	**4,100**	< 100	< 10,000	--
B14	10/28/2014	B14-SV	5.0	NA	3	< 100	< 80	< 200	< 100	< 200	< 100	< 100	**390**	< 100	< 10,000	--
B15	10/28/2014	B15-SV	5.0	NA	3	< 100	< 80	< 200	< 100	**420**	**150**	< 100	**1,800**	< 100	< 10,000	--
B16	10/28/2014	B16-SV	5.0	NA	3	**550**	< 80	< 200	< 100	< 200	< 100	**160**	**2,300**	< 100	< 10,000	--
B17	10/28/2014	B17-SV	5.0	NA	3	< 100	< 80	< 200	**220**	**1100**	**350**	**460**	**1,900**	< 100	< 10,000	--
B18	10/28/2014	B18-SV	5.0	NA	3	< 100	< 80	< 200	< 100	< 200	< 100	< 100	**210**	< 100	< 10,000	--
B19	12/10/2014	B19-SV	10.0	9.7	3	**330**	< 80	< 200	< 100	< 200	< 100	< 100	**1,500**	< 100	< 10,000	--
B20	12/10/2014	B20-SV	5.0	4.8	3	< 100	< 80	< 200	< 100	< 200	< 100	**320**	**3,200**	< 100	< 10,000	--
B21	12/10/2014	B21-SV	5.0	5.3	3	**8,500**	< 80	< 200	< 100	< 200	< 100	**150**	**2,000**	< 100	< 10,000	--
B22	12/10/2014	B22-SV	5.0	5.6	3	**110**	< 80	**210**	< 100	< 200	< 100	< 100	**400**	< 100	< 10,000	--
B23	12/10/2014	B23-SV	10.0	9.1 e	3	< 100	< 80	< 200	< 100	< 200	< 100	**590**	**2,400**	< 100	< 10,000	--
B24	12/10/2014	B24-SV	5.0	NA	3	< 100	< 80	< 200	< 100	< 200	< 100	**730**	**1,600**	< 100	< 10,000	--
B25	12/10/2014	B25-SV	5.0	5.4	3	< 100	< 80	< 200	< 100	< 200	< 100	**480**	**2,900**	< 100	< 10,000	--
B26	12/10/2014	B26-SV	5.0	3.2	3	< 100	< 80	< 200	< 100	< 200	< 100	**2,300**	**4,800**	< 100	< 10,000	--
B27	12/10/2014	B27-SV	10.0	NA	3	**430**	< 80	< 200	< 100	< 200	< 100	**230**	**3,900**	< 100	< 10,000	--
B28	12/10/2014	B28-SV	5.0	-6.9 f	3	< 100	< 80	< 200	< 100	< 200	< 100	**220**	**4,800**	< 100	< 10,000	--
B29	12/10/2014	B29-SV	5.0	-6.8 f	3	< 100	< 80	< 200	< 100	< 200	< 100	**290**	**2,300**	< 100	< 10,000	--
B30	1/30/2015	B30-SV	5.0	5.3	3	**1,700**	< 80	< 200	< 100	< 200	< 100	< 100	**1,400**	< 100	< 10,000	--
B31	1/30/2015	B31-SV	5.0	NA	3	**640**	< 80	< 200	< 100	< 200	< 100	< 100	**1,200**	< 100	< 10,000	--
B32	1/30/2015	B32-SV	5.0	-6.7 f	3	< 100	< 80	< 200	< 100	< 200	< 100	< 100	**410**	< 100	< 10,000	--
B33	1/30/2015	B33-SV	5.0	5.0	3	< 100	< 80	< 200	< 100	< 200	< 100	< 100	< 100	< 100	< 10,000	--
B41	9/21/2015	B41-SV	5.0	NA	3	< 100	< 80	< 200	**280**	**1200**	**340**	< 100	< 100	< 100	< 10,000	--
B42	9/21/2015	B42-SV	5.0	4.5	3	< 100	< 80	< 200	**110**	**410**	< 100	< 100	< 100	< 100	< 10,000	--
B43	9/21/2015	B43-SV	5.0	3.6	3	< 100	< 80	< 200	**120**	**420**	**100**	< 100	< 100	< 100	< 10,000	--
B44	9/21/2015	B44-SV	5.0	3.3 e	3	< 100	< 80	< 200	< 100	< 200	< 100	< 100	< 100	< 100	< 10,000	**21**
B45	9/21/2015	B45-SV	5.0	3.2 e	3	< 100	**88**	< 200	**130**	**270**	**140**	**240**	**2,700**	< 100	< 10,000	**21**
B46	9/21/2015	B46-SV	5.0	3.2 e	3	< 100	**91**	< 200	< 100	< 200	< 100	**1,400**	**1,000**	< 100	< 10,000	**14**
B47	9/21/2015	B47-SV	5.0	3.4	3	< 100	**710**	**400**	< 100	**260**	**100**	**200**	**330**	< 100	< 10,000	**15**
B48	9/21/2015	B48-SV	13.0	1.4 f	3	**150**	< 80	< 200	< 100	< 200	< 100	< 100	**1,000**	< 100	< 10,000	--
B48-dup	9/21/2015	B48-SV	13.0	1.4 f	3	**200**	< 80	< 200	< 100	< 200	< 100	**130**	**1,200**	< 100	< 10,000	--
B49	9/21/2015	B49-SV	13.0	NA	3	< 100	< 80	< 200	< 100	< 200	< 100	**460**	**3,200**	< 100	< 10,000	--
B50	9/21/2015	B50-SV	10.0	8.8 e	3	< 100	< 80	< 200	< 100	< 200	< 100	**690**	**420**	< 100	< 10,000	**21**
B55	2/2/2016	B55-SV	5.0	5.3	3	**1,100**	< 80	< 200	< 100	< 200	< 100	< 100	**200**	< 100	< 10,000	**19**
B56	2/2/2016	B56-SV	5.0	5.3	3	**1,300**	< 80	< 200	< 100	< 200	< 100	< 100	**120**	< 100	< 10,000	**20**
B57	2/2/2016	B57-SV	25.0	5.0 p	3	< 100	< 80	< 200	< 100	< 200	< 100	**110**	**240**	< 100	< 10,000	**9.2**
B58	2/2/2016	B58-SV	25.0	5.0 p	3	< 100	< 80	< 200	< 100	< 200	< 100	**830**	**3,000**	< 100	< 10,000	**11**
B59	2/3/2016	B59-SV	25.0	5.0 p	3	**140**	< 80	< 200	< 100	< 200	< 100	**120**	**1,700**	**190**	< 10,000	**10**
B59-dup	2/4/2016	B59-SV	25.0	5.0 p	3	**140**	< 80	< 200	< 100	< 200	< 100	**120**	**1,700**	**180**	< 10,000	**11**
B60	2/3/2016	B60-SV	25.0	5.0 p	3	**570**	< 80	< 200	< 100	< 200	< 100	< 100	**970**	**160**	< 10,000	**9.4**
Off-Site																
B34	1/30/2015	B34-SV	9.0	NA	3	**680**	< 80	< 200	< 100	< 200	< 100	< 100	< 100	< 100	< 10,000	--
B35	1/30/2015	B35-SV	9.0	NA	3	**350**	< 80	< 200	< 100	< 200	< 100	< 100	< 100	< 100	< 10,000	--
B36	1/30/2015	B36-SV	9.0	NA	3	**700**	< 80	< 200	< 100	< 200	< 100	< 100	**130**	< 100	< 10,000	--
B37	1/30/2015	B37-SV	9.0	NA	3	**5,000**	< 80	< 200	< 100	< 200	< 100	< 100	**470**	< 100	< 10,000	--
B38	1/30/2015	B38-SV	9.0	NA	3	**23,000**	< 80	< 200	< 100	< 200	< 100	< 100	**170**	< 100	< 10,000	--
B39	1/30/2015	B39-SV	6.0	NA	3	**2,900**	< 80	< 200	< 100	< 200	< 100	< 100	**100**	< 100	< 10,000	--
B40	1/30/2015	B40-SV	8.75	NA	3	**220**	< 80	< 200	< 100	< 200	< 100	< 100	**230**	< 100	< 10,000	--
B51	2/2/2016	B51-SV	6.0	NA	3	**3,400**	< 80	< 200	< 100	< 200	< 100	< 100	**130**	< 100	< 10,000	**14**
B51-dup	2/3/2016	B51-SV	6.0	NA	3	**2,900**	< 80	< 200	< 100	< 200	< 100	< 100	**120**	< 100	< 10,000	**13**
B52	2/2/2016	B52-SV	9.0	NA	3	**15,000**	< 80	< 200	< 100	< 200	< 100	< 100	**110**	< 100	< 10,000	**18**
B53	2/2/2016	B53-SV	9.0	NA	3	**4,600**	< 80	< 200	< 100	< 200	< 100	< 100	**290**	< 100	< 10,000	**17**
B54	2/2/2016	B54-SV	9.0	NA	3	**670**	< 80	< 200	< 100	< 200	< 100	< 100	< 100	< 100	< 10,000	**17**
Site-Specific Vapor Intrusion Screening Level for Residential Land Use (DTSC, 2014) [1]						1,260	160	NC	NC	NC	NC	NC	NC	220	NC	NE
Residential land use ESL [2]						240	48	160,000	560	52,000	52,000	NE	NE	61	NE	NE
Commercial/Industrial land use ESL [2]						2,100	420	1,300,000	4,900	440,000	440,000	NE	NE	530	NE	NE

Notes:
Detections are shown in bold.
Results equal to or exceeding site-specific vapor intrusion screening level for residential land use (benzene, chloroform, and PCE only) or residential ESL (all other compounds and off-site samples) are shaded. For samples collected at and in the vicinity of B4 (including B44, B45, B46 and B47), the standard residential ESL was used for comparison because the soils in this area are not clay rich and use of the site-specific screening level is not appropriate.
feet bgs: feet below ground surface.
µg/m³: micrograms per cubic meter.
PCE: Tetrachloroethene; Freon 11: Trichlorofluoromethane; Freon 12: Dichlorodifluoromethane; 1,1-DFA: 1,1-Difluoroethane (Leak Check Compound).
e: Sample boring lies outside of a planned building footprint, depth is estimated based on proposed depth of foundation for future adjacent building.
f: Proposed building foundation elevation is unknown, sample depth is relative to proposed finished floor elevation.
p: Sample depth relative to proposed elevator sump bottom elevation
A negative sample depth indicates that the sample was collected above the future building foundation elevation, and will be excavated during construction.
< 100: not detected at or above the indicated laboratory reporting limit.
1. DTSC, 2014. Department of Toxic Substance Control, Vapor Intrusion Screening Model - Soil Gas. December. Default soil type adjusted to reflect site-specific soil type (clay) in top 5 feet at site.
2. ESL = February 2016 Regional Water Quality Control Board, San Francisco Bay Region (SFRWQCB) Environmental Screening Levels (ESLs), Tier 1 Vapor Summary, Subslab/Soil Gas Vapor Intrusion: Human Health Risk Screening Levels (Table SG-1), Residential and Commercial/Industrial Exposure.
--: Not Analyzed
NA: Not Applicable
NE: Not established.
NC: Not calculated

Table 2
Summary of Analytical Results for Soil - Metals & Pesticides
State Street Center
Fremont, California

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Depth (feet below building foundation elevation)	Date Collected	Metals		Pesticides						
					Arsenic (mg/Kg)	Lead (mg/Kg)	Endrin (µg/Kg)	DDD (µg/Kg)	DDE (µg/Kg)	DDT (µg/Kg)	Dieldrin (µg/Kg)	Heptachlor epoxide (µg/Kg)	alpha-Chlordane (µg/Kg)
B1	B1-1.0-2.0	1.0-2.0	0.6	10/27/2014	**5.3**	**5.1**	< 3.3	< 3.3	< 3.3	< 3.3	< 1.7	< 1.7	< 1.7
	B1-3.0-4.0	3.0-4.0	2.6	10/27/2014	NA	NA	NA	NA	NA	NA	NA	NA	NA
B3	B3-1.0-2.0	1.0-2.0	0.7	10/27/2014	**5.8**	**8.9**	**24 C**	**94 #**	**650**	**22**	< 1.7	< 1.7	**7.0**
	B3-3.0-4.0	3.0-4.0	2.7	10/27/2014	NA	NA	< 3.3	< 3.3	**28 #**	**18 #**	< 1.7	**1.8**	< 1.7
B5	B5-1.0-2.0	1.0-2.0	0.7	10/27/2014	**5.3**	**5.3**	< 3.3	< 3.3	< 3.3	< 3.3	< 1.7	< 1.7	< 1.7
	B5-3.0-4.0	3.0-4.0	2.7	10/27/2014	NA	NA	NA	NA	NA	NA	NA	NA	NA
B6	B6-1.0-2.0	1.0-2.0	1.7	10/28/2014	**8.2**	**13**	**48**	**86 #**	**430**	**89**	**2.1 C #**	< 1.8	**4.9**
	B6-3.0-4.0	3.0-4.0	3.7	10/28/2014	NA	NA	< 3.3	< 3.3	< 3.3	< 3.3	< 1.7	< 1.7	< 1.7
B7	B7-1.0-2.0	1.0-2.0	0.8	10/28/2014	**7.3**	**9.7**	**24 C**	**61 #**	**320**	**75**	< 1.7	< 1.7	< 1.7
	B7-3.0-4.0	3.0-4.0	2.8	10/28/2014	NA	NA	< 3.3	< 3.3	< 3.3	< 3.3	< 1.7	< 1.7	< 1.7
B8	B8-1.0-2.0	1.0-2.0	-0.4	10/28/2014	**7.8**	**10**	**37**	**87 #**	**850 C**	**27**	**3.5 C #**	< 1.7	**9.6**
	B8-3.0-4.0	3.0-4.0	1.6	10/28/2014	NA	NA	< 8.5	< 8.5	**260 #**	**19 #**	**9.3 #**	< 17	< 17
B11	B11-1.0-2.0	1.0-2.0	-8.5 f	10/29/2014	**4.3**	**5.3**	**27 C**	**6.1 C #**	**670 C**	**130**	< 1.7	< 1.7	**5.4**
	B11-3.0-4.0	3.0-4.0	-10.5 f	10/29/2014	NA	NA	< 3.3	< 3.3	< 3.3	< 3.3	< 1.7	< 1.7	< 1.7
B12	B12-1.0-2.0	1.0-2.0	-9.0 f	10/29/2014	**4.3**	**7.7**	< 33	< 33	**460**	**100**	< 17	< 17	< 17
	B12-3.0-4.0	3.0-4.0	-11.0 f	10/29/2014	NA	NA	< 3.3	< 3.3	< 3.3	< 3.3	< 1.7	< 1.7	< 1.7
B13	B13-1.0-2.0	1.0-2.0	NA	10/29/2014	**5.6**	**11**	< 17	< 17	**54**	< 17	< 17	< 17	< 8.5
	B13-3.0-4.0	3.0-4.0	NA	10/29/2014	NA	NA	NA	NA	NA	NA	NA	NA	NA
B16	B16-1.0-2.0	1.0-2.0	NA	10/29/2014	**4.7**	**5.3**	< 3.3	< 3.3	**21**	**7.7**	< 1.7	< 1.7	< 1.7
	B16-3.0-4.0	3.0-4.0	NA	10/29/2014	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil Tier 1 ESL [1]					0.067	80	0.65	2,700	1,900	1,900	0.17	0.42	480
Residential shallow soil ESL [2]					0.067	80	21,000	2,700	1,900	1,900	38	67	480
Commercial/Industrial shallow soil ESL [2]					0.31	320	290,000	12,000	8,500	8,500	170	300	2,200
Background Concentration [3]					11 [5]	11.43 [6]	NE	NE	NE	NE	NE	NE	NE
TTLC values [4]					500	1,000	200	1,000	1,000	1,000	8,000	4.7	2,500

Notes:

Detections are shown in bold.

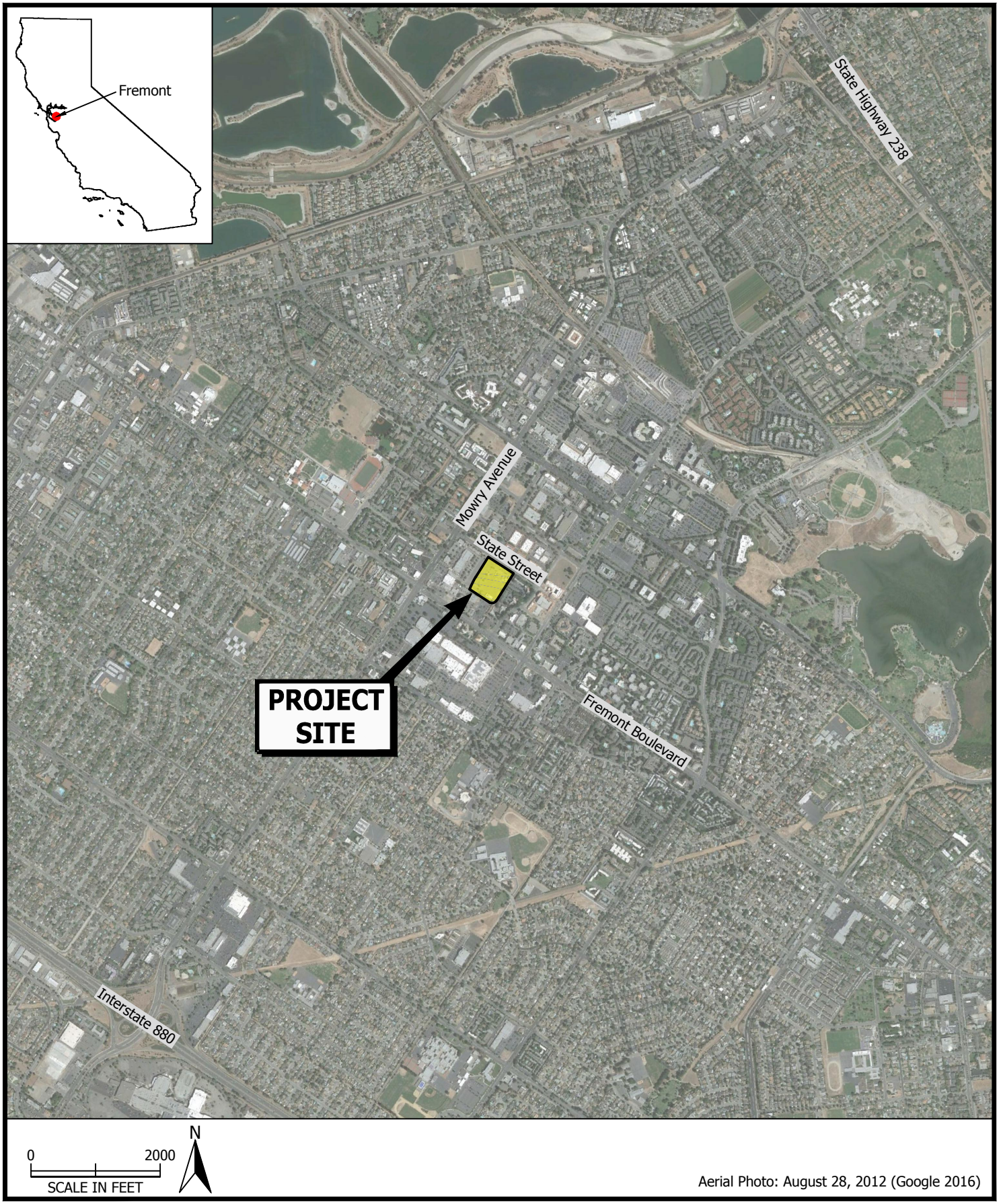
Results equal to or exceeding residential ESL and/or background concentrations are shaded.
Total Metals by U.S. EPA Test Methods 6010B and 7471A.
Pesticides by U.S. EPA Test Methods 8081A.
Feet bgs: Feet below ground surface.
DDD: dichlorodiphenyldichloroethane
DDE: dichlorodiphenyldichloroethylene
DDT: dichlorodiphenyltrichloroethane
mg/Kg: Milligrams per Kilogram.
µg/Kg: Micrograms per Kilogram.
e: Sample boring lies outside of a planned building footprint, depth is estimated based on proposed depth of foundation for future adjacent building.
f: Proposed building foundation elevation is unknown, sample depth is relative to proposed finished floor elevation.
A negative sample depth indicates that the sample was collected above the future building foundation elevation, and will be excavated during construction.
< 3.3 : Not detected at or above the specified laboratory reporting limit.
Only metals and pesticides detected in one or more soil sample are presented on this table.
NA: Not Analyzed.
C: Presence confirmed, but RPD between columns exceeds 40%.
#: CCV drift outside limits; average CCV drifts within limits per method requirements.
1. Soil Tier 1 ESL = February 2016 Regional Water Quality Control Board, San Francisco Bay Region (SFRWQCB) Environmental Screening Levels (ESLs).
2. ESL = February 2016 Regional Water Quality Control Board, San Francisco Bay Region (SFRWQCB) Environmental Screening Levels (ESLs), Shallow Soil Exposure Scenario (Lowest of Tables S-1 and S-4), Residential and Commercial/Industrial Exposure.
3. Dylan Durengé, 2011. Establishing Background Arsenic in Soil of the Urbanized San Francisco Bay Region. December.
4. Christina Scott, 1991. Background Metal Concentrations in Soils in Northern Santa Clara County, California. December.
TTLC: Total Threshold Limit Concentration
NA: Not Applicable

Table 3
Summary of Analytical Results for Soil - VOCs & TPH
State Street Center
Fremont, California

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Depth (feet below building foundation elevation)	Date Collected	VOCs	Total Petroleum Hydrocarbons			
					Acetone (µg/Kg)	TPH-d (mg/Kg)	TPH-d* (mg/Kg)	TPH-mo (mg/Kg)	TPH-mo* (mg/Kg)
B1	B1-1.0-2.0	1.0-2.0	0.6	10/27/2014	< 16	NA	NA	NA	NA
	B1-3.0-4.0	3.0-4.0	2.6	10/27/2014	NA	NA	NA	NA	NA
B3	B3-1.0-2.0	1.0-2.0	0.7	10/27/2014	**14**	NA	NA	NA	NA
	B3-3.0-4.0	3.0-4.0	2.7	10/27/2014	NA	NA	NA	NA	NA
B5	B5-1.0-2.0	1.0-2.0	0.7	10/27/2014	< 14	NA	NA	NA	NA
	B5-3.0-4.0	3.0-4.0	2.7	10/27/2014	< 18	NA	NA	NA	NA
B6	B6-1.0-2.0	1.0-2.0	1.7	10/28/2014	< 16	NA	NA	NA	NA
	B6-3.0-4.0	3.0-4.0	3.7	10/28/2014	< 13	NA	NA	NA	NA
B7	B7-1.0-2.0	1.0-2.0	0.8	10/28/2014	< 13	NA	NA	NA	NA
	B7-3.0-4.0	3.0-4.0	2.8	10/28/2014	NA	NA	NA	NA	NA
B8	B8-1.0-2.0	1.0-2.0	-0.4	10/28/2014	< 15	NA	NA	NA	NA
	B8-3.0-4.0	3.0-4.0	1.6	10/28/2014	NA	NA	NA	NA	NA
B11	B11-1.0-2.0	1.0-2.0	-8.5 f	10/29/2014	< 14	NA	NA	NA	NA
	B11-3.0-4.0	3.0-4.0	-10.5 f	10/29/2014	NA	NA	NA	NA	NA
B12	B12-1.0-2.0	1.0-2.0	-9.0 f	10/29/2014	< 14	NA	NA	NA	NA
	B12-3.0-4.0	3.0-4.0	-11.0 f	10/29/2014	NA	NA	NA	NA	NA
B13	B13-1.0-2.0	1.0-2.0	NA	10/29/2014	< 18	NA	NA	NA	NA
	B13-3.0-4.0	3.0-4.0	NA	10/29/2014	NA	NA	NA	NA	NA
B16	B16-1.0-2.0	1.0-2.0	NA	10/29/2014	< 15	NA	NA	NA	NA
	B16-3.0-4.0	3.0-4.0	NA	10/29/2014	< 16	NA	NA	NA	NA
B44	B44S-1.0-2.0	1.0-2.0	-0.7 e	9/21/2015	**130**	**190**	**140**	**1,200**	**850**
	B44S-3.0-4.0	3.0-4.0	-1.3 e	9/21/2015	< 46	**49**	**42**	**140**	**130**
B45	B45S-1.0-2.0	1.0-2.0	0.8 e	9/21/2015	< 35	**25**	**18**	**130**	**100**
	B45S-3.0-4.0	3.0-4.0	1.2 e	9/21/2015	< 45	**30**	**23**	**94**	**72**
B46	B46S-1.0-2.0	1.0-2.0	0.8 e	9/21/2015	< 46	**48**	**41**	**190**	**170**
	B46S-3.0-4.0	3.0-4.0	1.2 e	9/21/2015	< 39	**59**	**47**	**180**	**150**
B47	B47S-1.5-2.5	1.5-2.5	0.6	9/21/2015	< 44	**170**	**130**	**1,400**	**840**
	B47S-3.5-4.5	3.5-4.5	1.4	9/21/2015	< 38	**43**	**31**	**140**	**110**
B50	B50S-9.0-10.0	9.0-10.0	7.8	9/21/2015	< 40	**1.5**	< 0.99	< 49	< 49
				Soil Tier 1 ESL (1)	500	240	240	100	100
				Residential shallow soil ESL (2)	500,000	240	240	100	100
				Commercial/Industrial shallow soil ESL (2)	1,000,000	1,000	1,000	500	500

Notes:
Detections are shown in bold.
Results equal to or exceeding residential ESL are shaded.
VOCs: Volatile organic compounds by U.S. EPA Test Method 8260B.
TPH-d: Total petroleum hydrocarbons quantified as diesel.
TPH-mo: Total petroleum hydrocarbons quantified as motor oil.
Feet bgs: Feet below ground surface.
*** =** Analysis performed with silica gel cleanup
µg/Kg: Micrograms per Kilogram.
e: Sample boring lies outside of a planned building footprint, depth is estimated based on proposed depth of foundation for future adjacent building.
f: Proposed building foundation elevation is unknown, sample depth is relative to proposed finished floor elevation.
A negative sample depth indicates that the sample was collected above the future building foundation elevation, and will be excavated during construction.
< 16 : Not detected at or above the specified laboratory reporting limit.
NA : Not Analyzed.
Only VOCs detected in one or more soil sample are presented on this table. Total petroleum hydrocarbons quantified as gasoline were not detected above the laboratory reporting limit.
1. Soil Tier 1 ESL = February 2016 Regional Water Quality Control Board, San Francisco Bay Region (SFRWQCB) Environmental Screening Levels (ESLs).

ILLUSTRATIONS



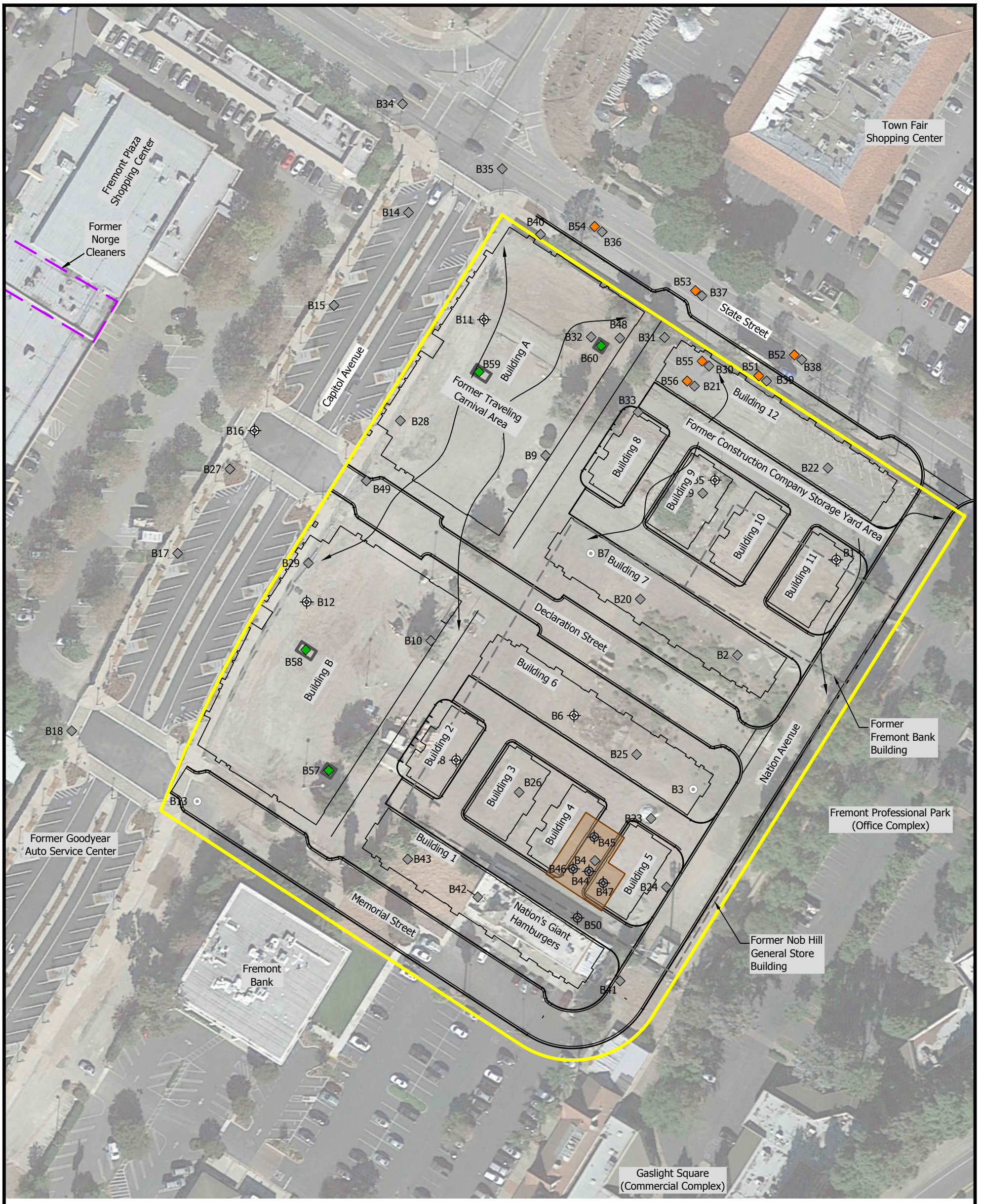
Aerial Photo: August 28, 2012 (Google 2016)

PES Environmental, Inc.
Engineering & Environmental Services

Site Location and Vicinity
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
1

220.003.03.002	22000303002_VMS_1	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Approximate Property Boundary
- Proposed Development Plan
- Approximate Former Building Location
- B17 — Soil Vapor Sampling Location (PES, 2014-2015)
- B6 — Soil Vapor and Soil Sampling Location (PES, 2014-2015)
- B13 — Soil Sampling Location (PES, 2014-2015)
- B53 — Soil Vapor Sample Location (PES, 2016)
- B57 — Soil Vapor Sample Location within planned elevator pit (PES, 2016)
- Planned Area of Excavation

0 80
SCALE IN FEET

N

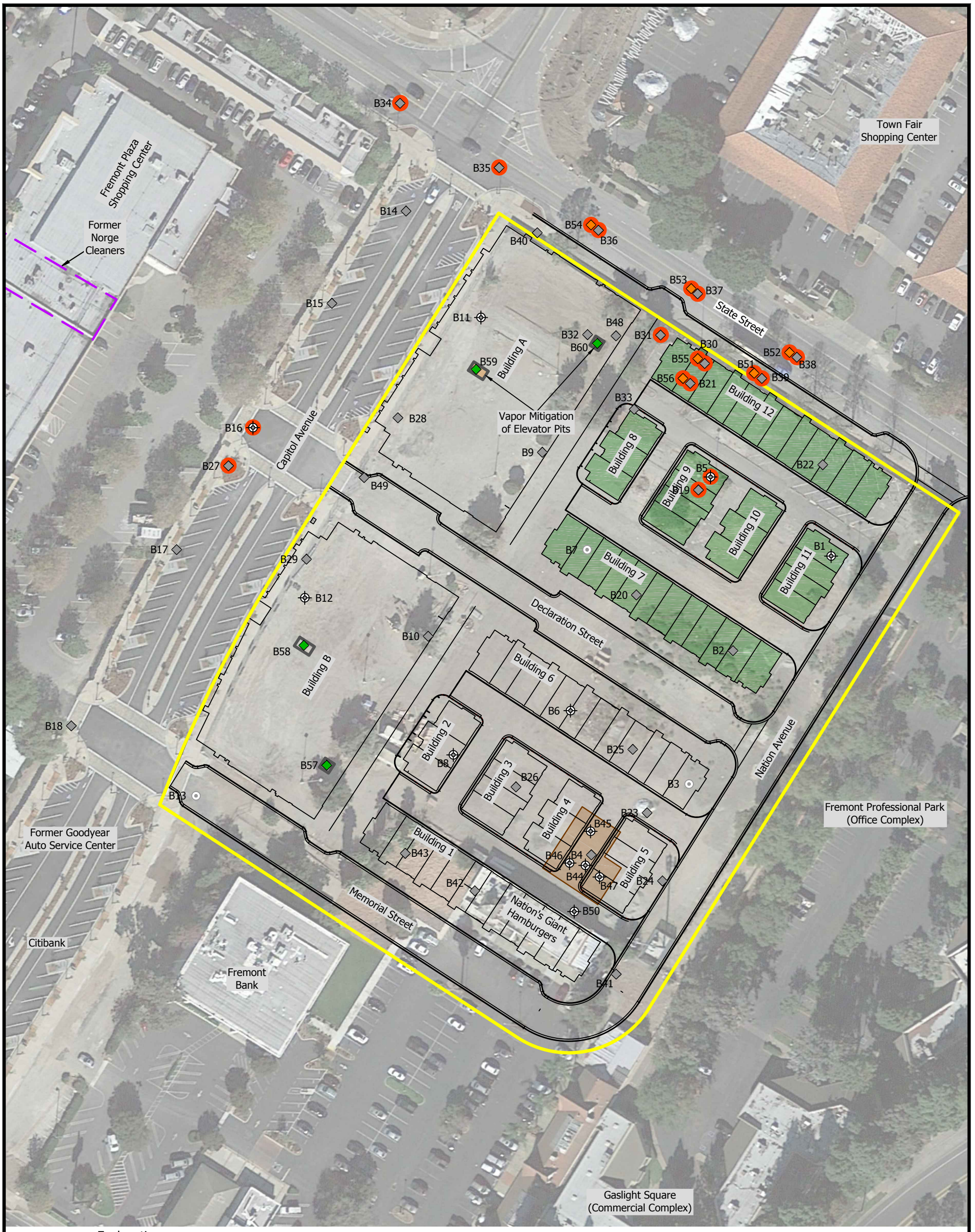
Aerial Photo: October 30, 2015 (Google 2016)

PES Environmental, Inc.
Engineering & Environmental Services

Site Plan and Sample Locations
Vapor Mitigation System Design Report
Sate Street Center
Fremont, California

PLATE
2

220.003.03.002	22000303002_VMS_2	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Approximate Property Boundary
- B17 — Soil Vapor Sampling Location (PES)
- B6 — Soil Vapor and Soil Sampling Location (PES)
- B13 — Soil Sampling Location (PES)
- B53 — Soil Vapor Sample Location
- B57 — Soil Vapor Sample Location beneath planned elevator pit
- Planned Area of Excavation
- Vapor Mitigation Areas for Slab-On-Grade Townhomes
- Vapor Mitigation Areas for Below Grade Parking Elevator Pits
- Concentration is greater than 2016 RWQCB Tier 1 ESL for PCE in Soil Gas (240 micrograms per cubic meter)

0 80
SCALE IN FEET

N

Aerial Photo: October 30, 2015 (Google 2016)

PES Environmental, Inc.
Engineering & Environmental Services

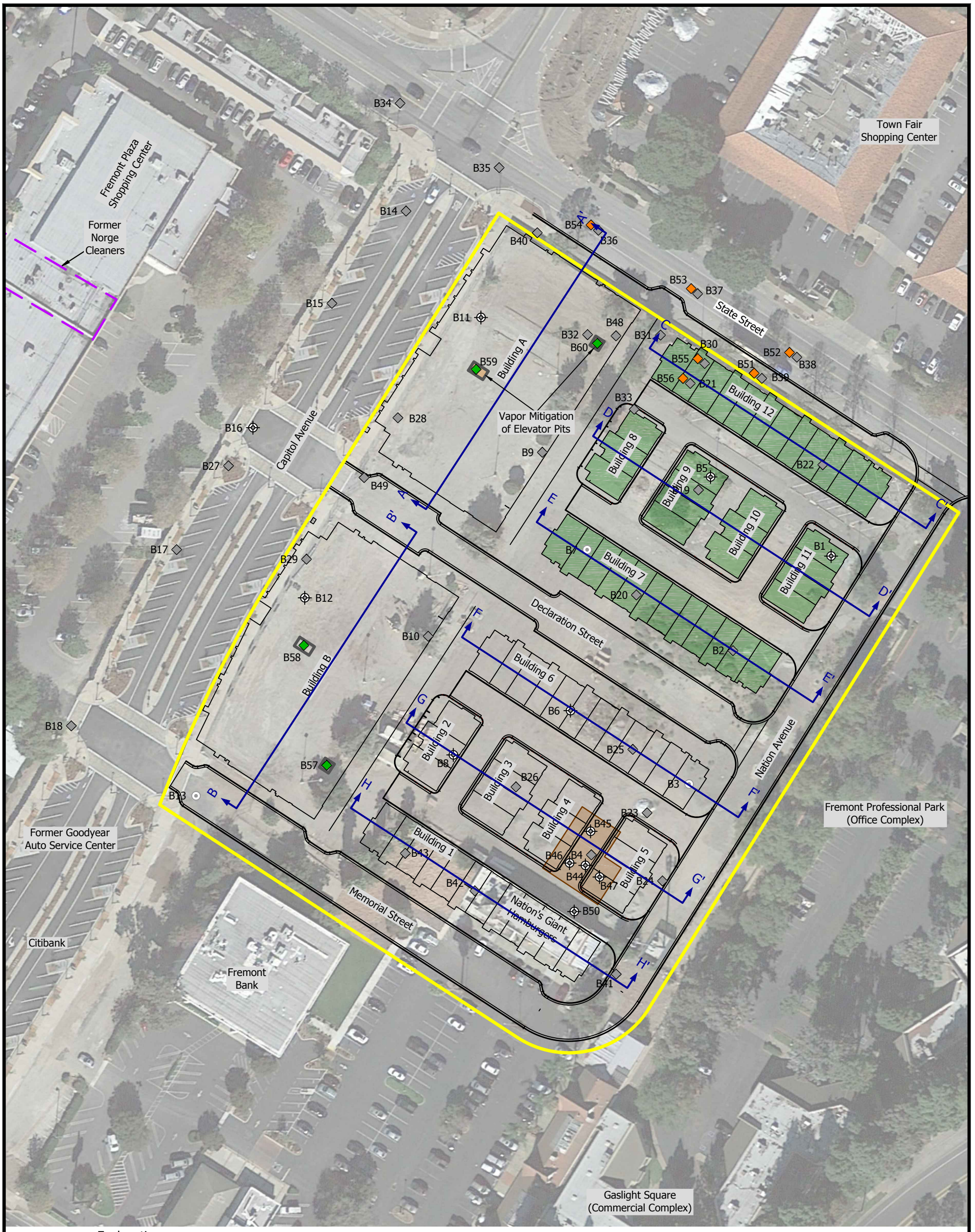
Proposed Vapor Mitigation and Soil Removal Areas
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
3

220.003.03.002	22000303002_VMS_3	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

APPENDIX A

CROSS SECTIONS



Explanation

- Approximate Property Boundary
- B17 — Soil Vapor Sampling Location (PES)
- B6 — Soil Vapor and Soil Sampling Location (PES)
- B13 — Soil Sampling Location (PES)
- B53 — Soil Vapor Sample Location
- B57 — Soil Vapor Sample Location within planned elevator pit
- A A' — Cross-Section Location (Arrows show direction of view)
- Planned Area of Excavation
- Vapor Mitigation Areas for at-grade Townhomes
- Vapor Mitigation Areas for Below Grade Parking Elevator Pits

0 80
SCALE IN FEET

N

Aerial Photo: October 30, 2015 (Google 2016)

PES Environmental, Inc.
Engineering & Environmental Services

Site Plan and Cross Section Locations
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A1

220.003.03.002	22000303002_A1	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

A
Southwest

A'
Northeast

B28 (63-feet Northwest)
B9 (56-feet Southeast)
B59 (29-feet Northwest)
B11 (50-feet Northwest)
B60 (45-feet Southeast)
B32 (34-feet Southeast)
B48 (55-feet Southeast)
B40 (49-feet Northwest)
Approximate Property Boundary
B54 (15-feet Northwest)
= B36 (6-feet Northwest)

State Street

Future Garage

Building A Finished Floor
(42.16-ft)

Building A Elevator Pad
(33.66-ft)
(20-ft Northwest)

Building A Elevator Pad
(33.66-ft)
(40-ft Southeast)

Elevation (feet, NAVD 88)

60
55
50
45
40
35
30

B36	
PCE	**700**
Benzene	< 80
Chloroform	< 100

B54	
PCE	**670**
Benzene	< 80
Chloroform	< 100

B40	
PCE	**220**
Benzene	< 80
Chloroform	< 100

B48	
PCE	**150**
Benzene	< 80
Chloroform	< 100

B48-dup	
PCE	**200**
Benzene	< 80
Chloroform	< 100

B59	
PCE	**140**
Benzene	< 80
Chloroform	**190**

B59-dup	
PCE	**140**
Benzene	< 80
Chloroform	**180**

B60	
PCE	**570**
Benzene	< 80
Chloroform	**160**

Explanation

Proposed Building

Approximate Current Ground Surface Elevation

Proposed Vapor Barrier for Elevator Pit

Soil Sample Location

Soil Vapor Sample Location

Notes:

Detections are shown in bold

VOCs: Volatile Organic Compounds by U.S. EPA Test Method 8260B

PCE: Tetrachloroethene

NA: Not Analyzed

ND: Not Detected

< 80: Not Detected at or above the indicated laboratory reporting limit

Analytical data only shown for samples that represent soil or soil vapor concentrations that will remain at the site after redevelopment.

Only soil gas values for Chloroform, Benzene, and PCE are shown. No other chemicals in soil vapor were detected above their respective residential Environmental Screening Level (ESL).

Chloroform, Benzene, and PCE values above their respective site-specific screening level level are shaded. Note that site-specific screening levels do not apply for samples collected within State Street; Residential ESLs are used for shading in this area.

5
0
Vertical Scale in Feet

0
20
Horizontal Scale in Feet

Vertical Exaggeration 4:1

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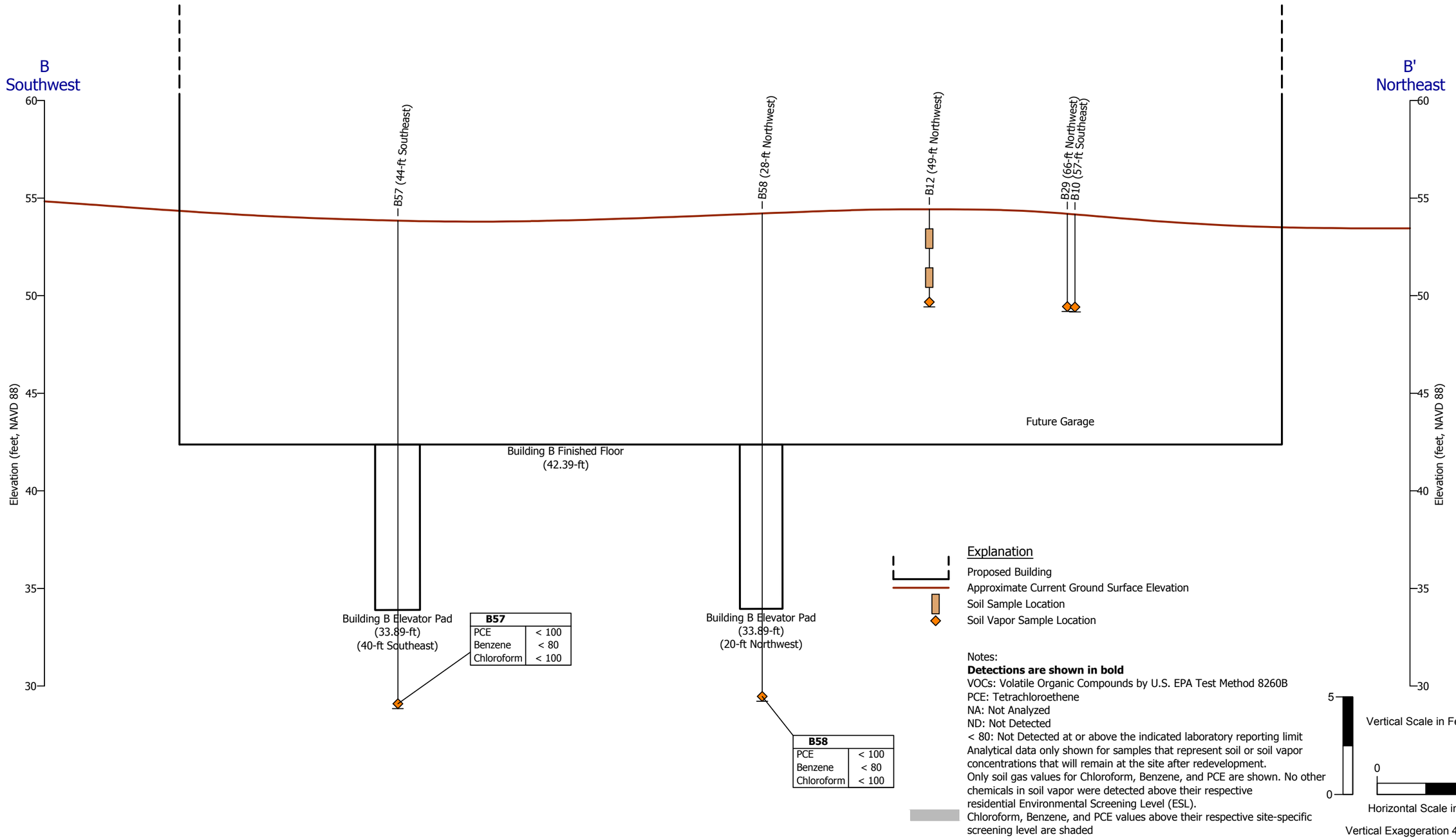
Cross Section A-A'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A2

220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



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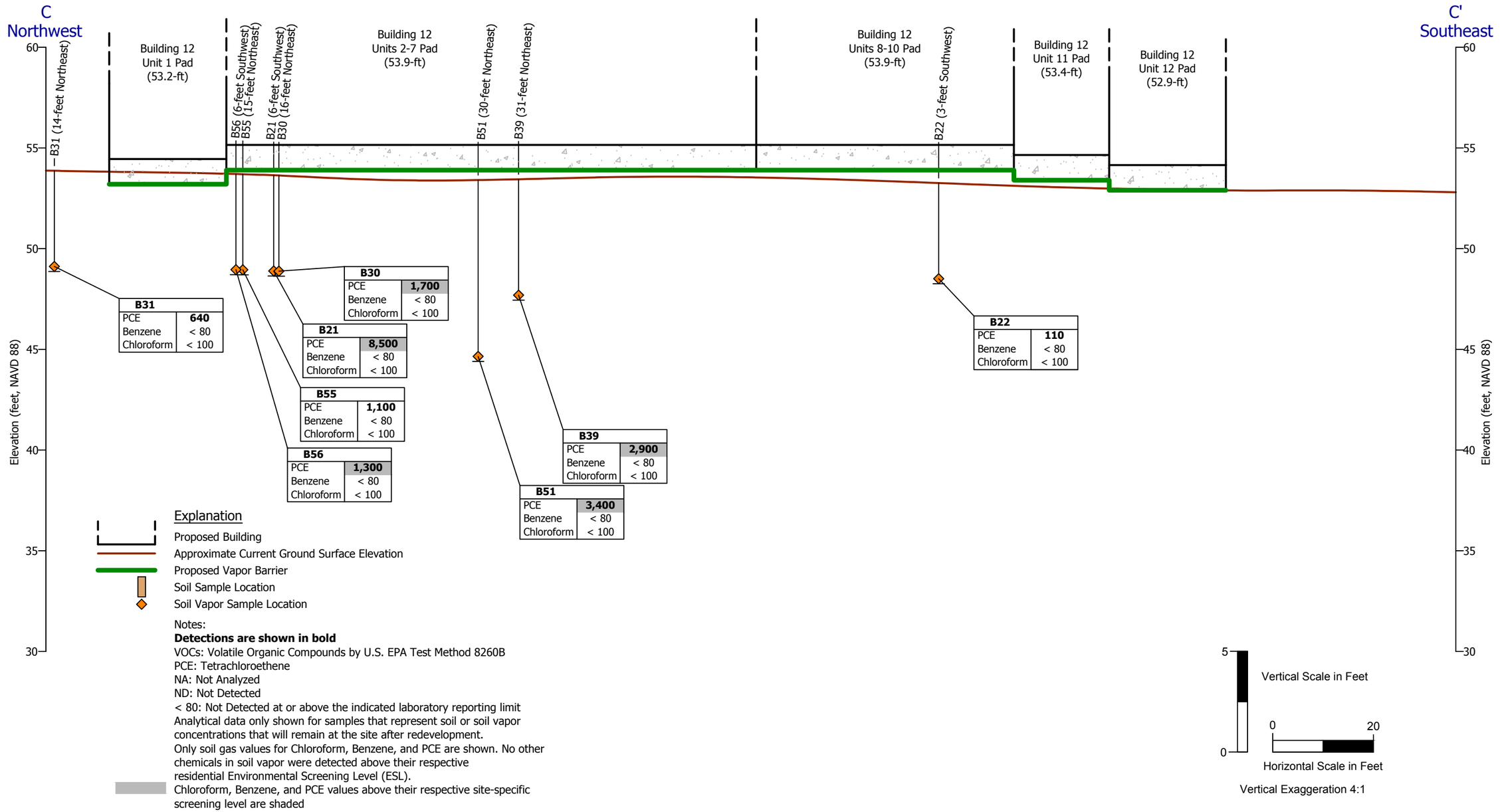
Cross Section B-B'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A3

220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Notes:
Detections are shown in bold
VOCs: Volatile Organic Compounds by U.S. EPA Test Method 8260B
PCE: Tetrachloroethene
NA: Not Analyzed
ND: Not Detected
< 80: Not Detected at or above the indicated laboratory reporting limit
Analytical data only shown for samples that represent soil or soil vapor concentrations that will remain at the site after redevelopment.
Only soil gas values for Chloroform, Benzene, and PCE are shown. No other chemicals in soil vapor were detected above their respective residential Environmental Screening Level (ESL).
Chloroform, Benzene, and PCE values above their respective site-specific screening level are shaded

PES Environmental, Inc.
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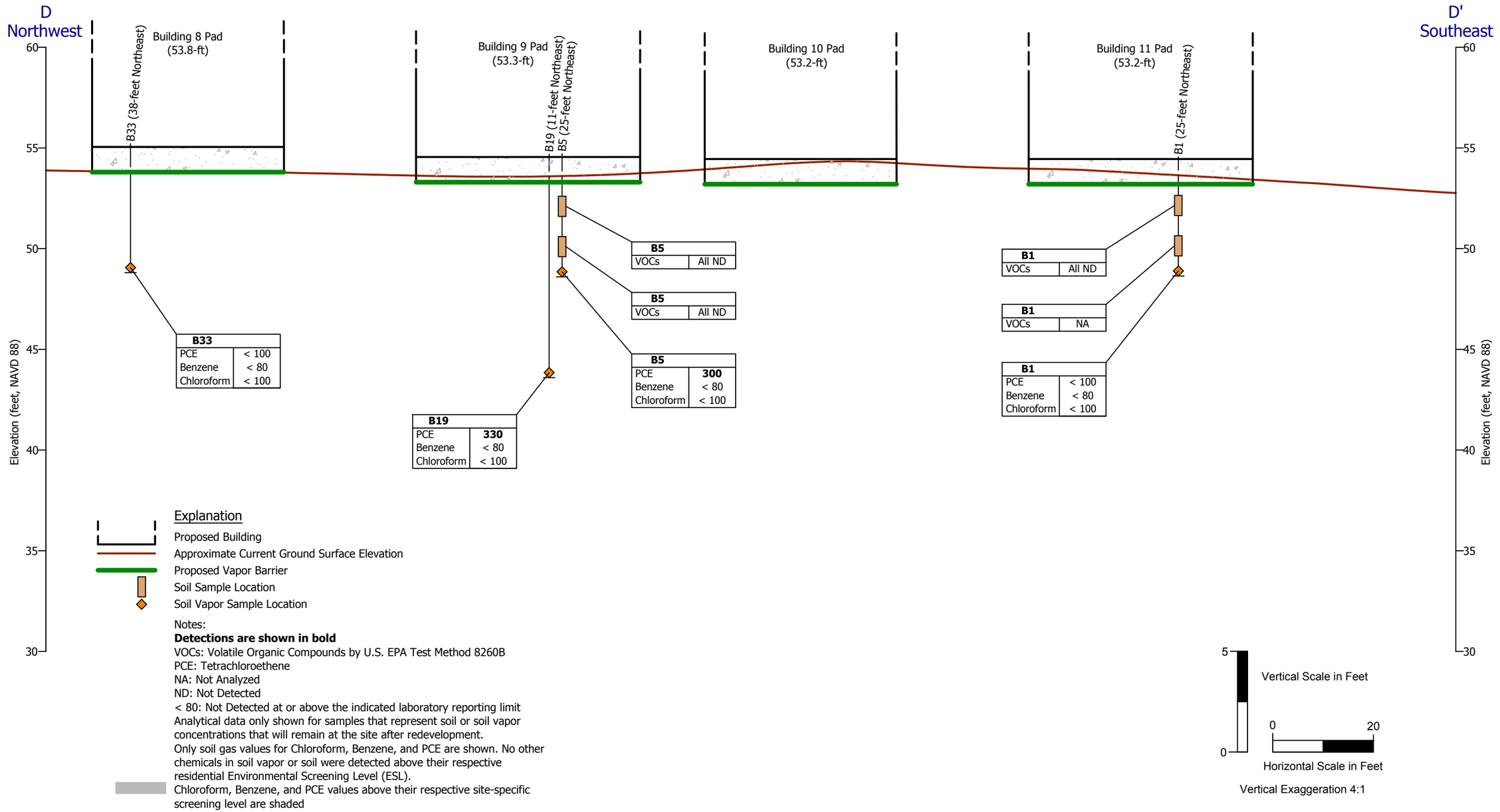
Cross Section C-C'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A4

220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

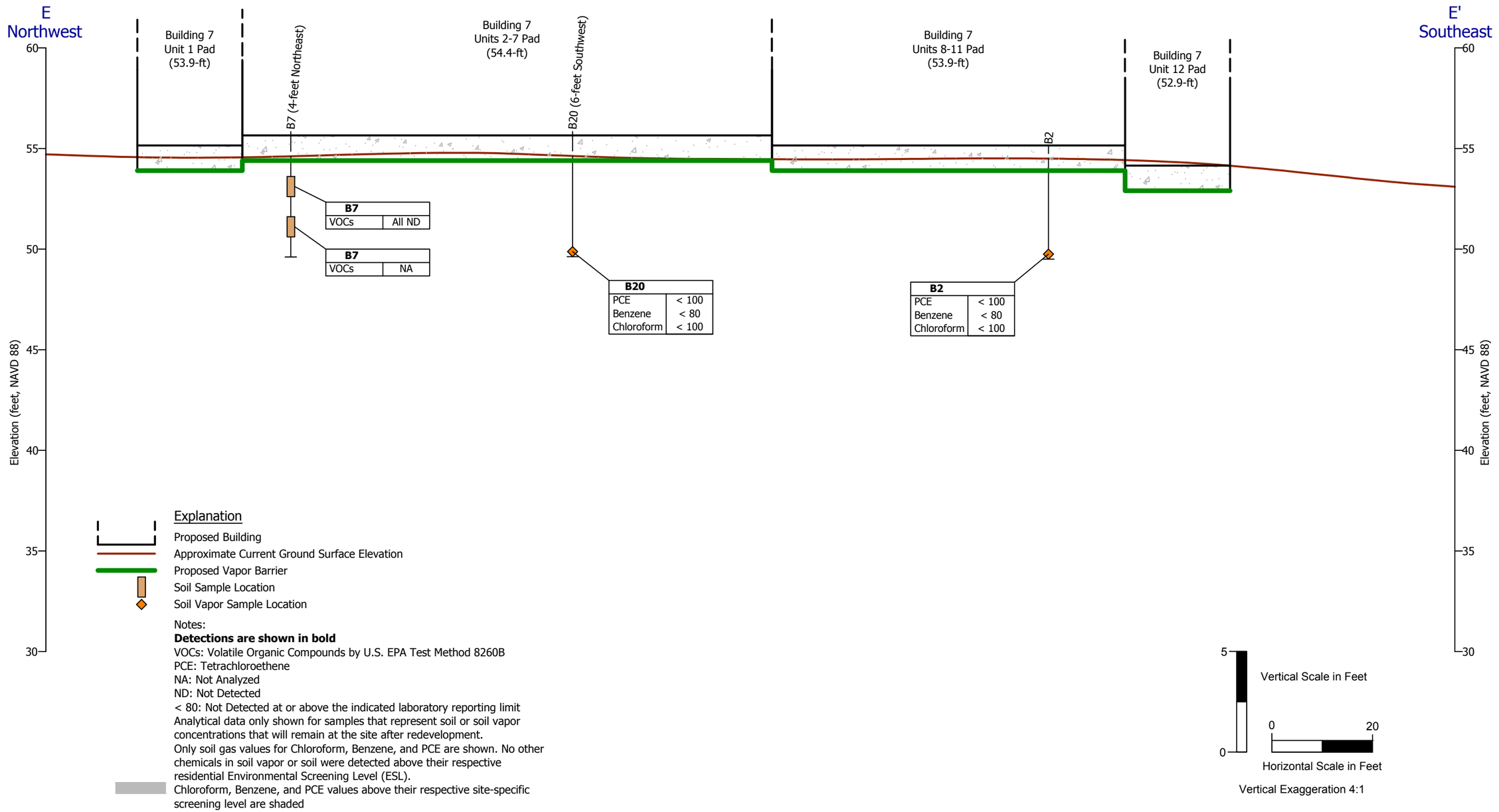


PES Environmental, Inc.
Engineering & Environmental Services

Cross Section D-D'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A5

220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

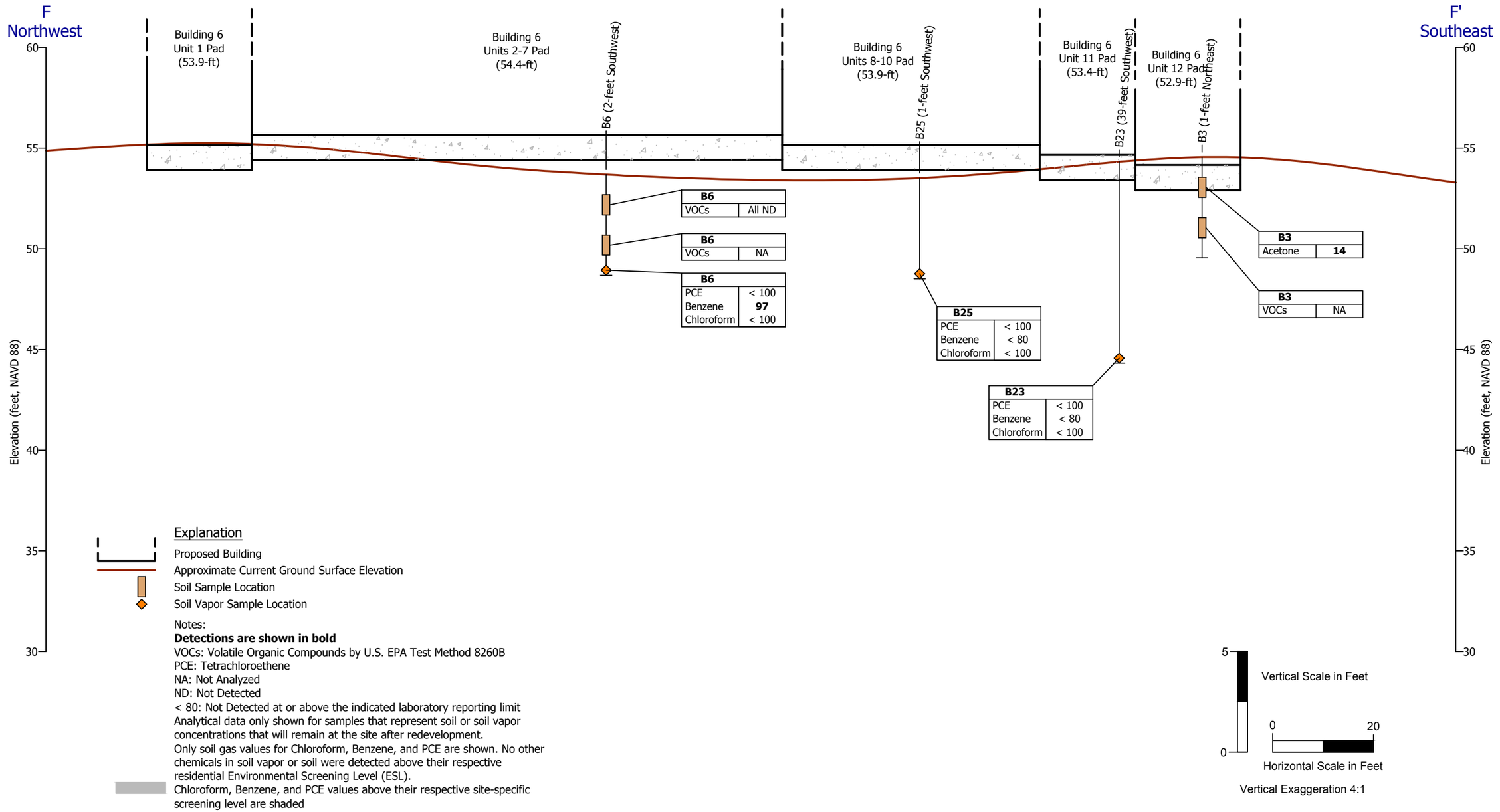


PES Environmental, Inc.
Engineering & Environmental Services

Cross Section E-E'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A6

220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



PES Environmental, Inc.
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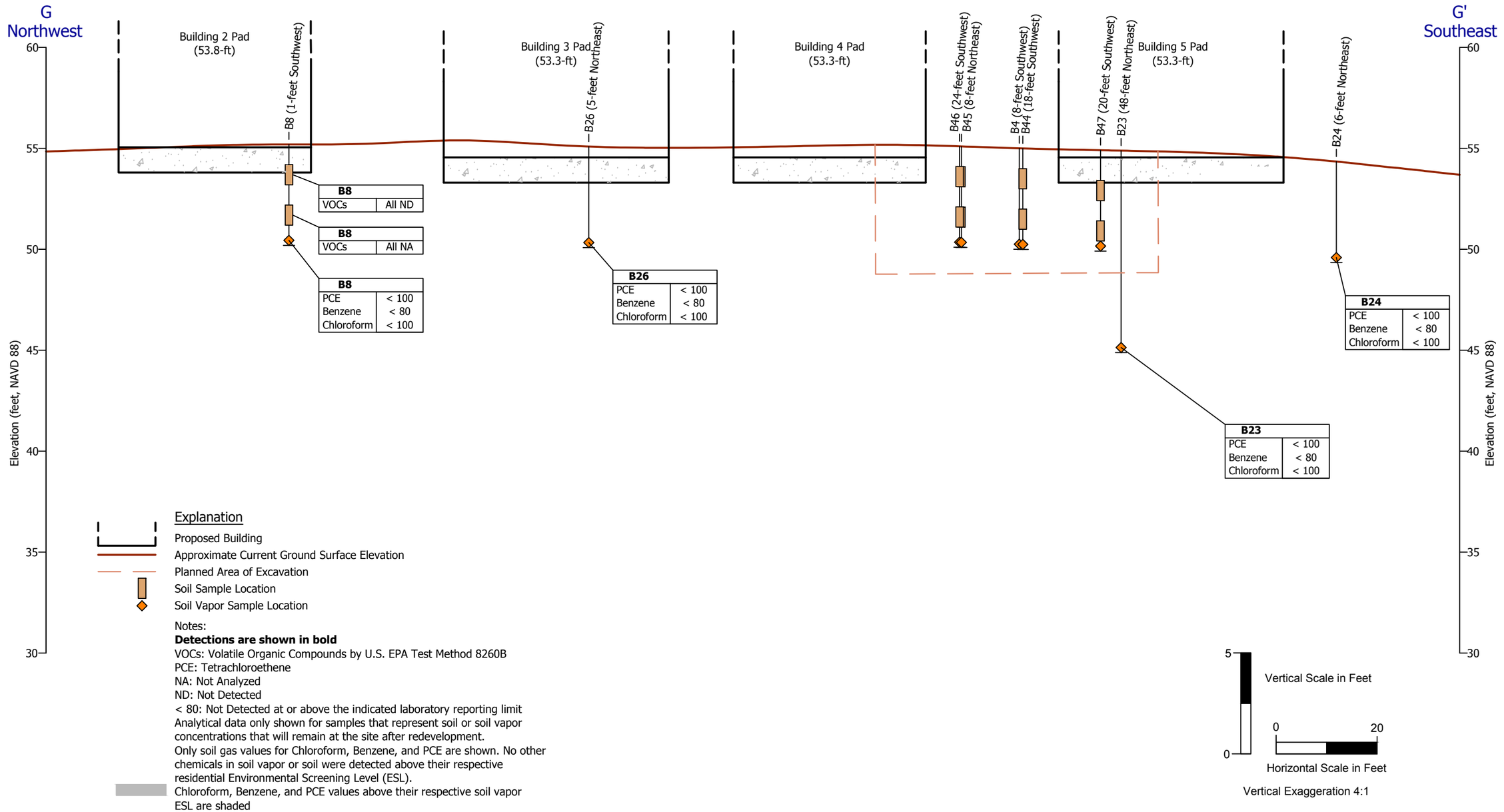
Cross Section F-F'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A7

220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



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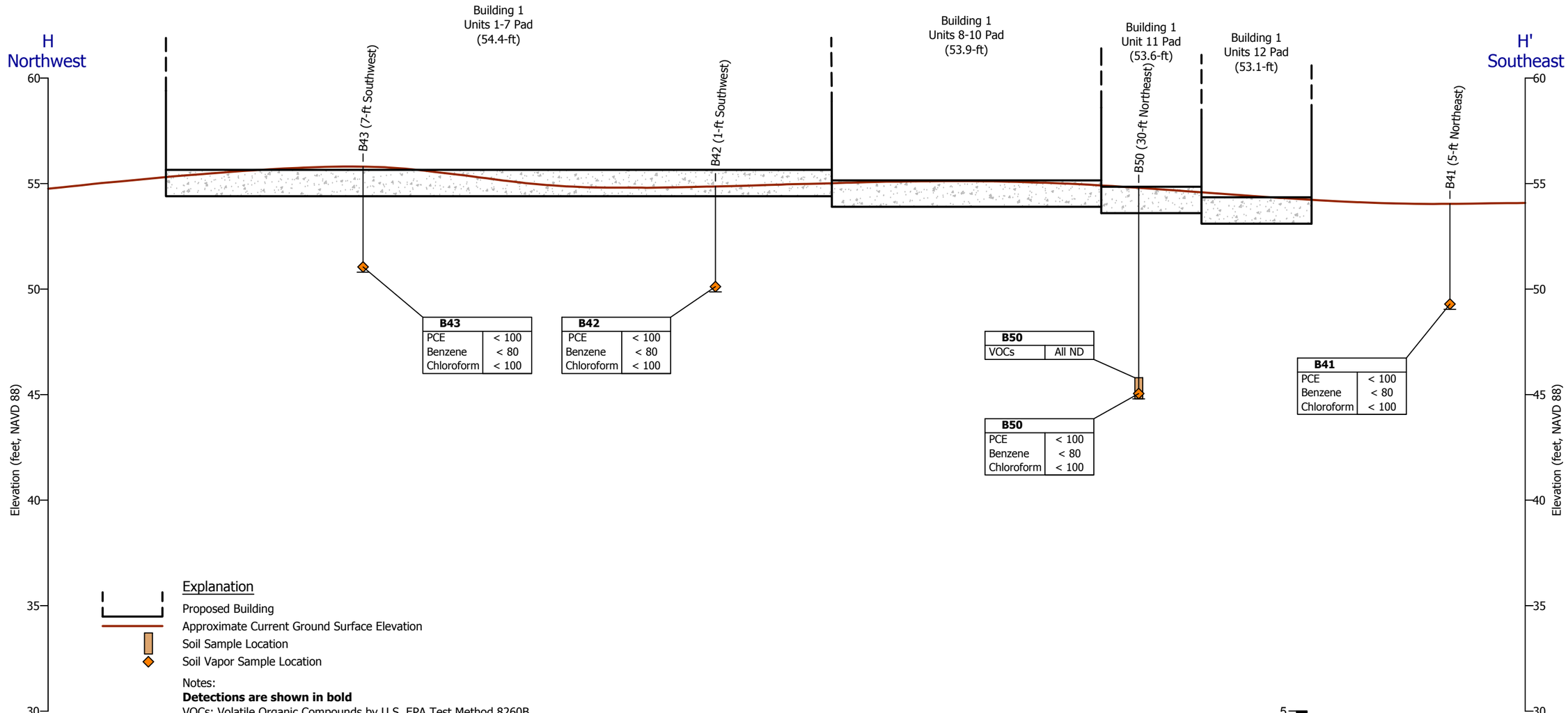
Cross Section G-G'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A8

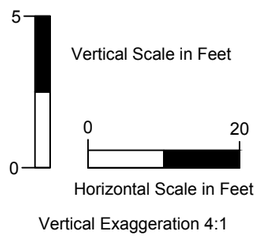
220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Proposed Building
- Approximate Current Ground Surface Elevation
- Soil Sample Location
- Soil Vapor Sample Location

Notes:
Detections are shown in bold
VOCs: Volatile Organic Compounds by U.S. EPA Test Method 8260B
PCE: Tetrachloroethene
NA: Not Analyzed
ND: Not Detected
< 80: Not Detected at or above the indicated laboratory reporting limit
Analytical data only shown for samples that represent soil or soil vapor concentrations that will remain at the site after redevelopment.
Only soil gas values for Chloroform, Benzene, and PCE are shown. No other chemicals in soil vapor or soil were detected above their respective residential Environmental Screening Level (ESL).
Chloroform, Benzene, and PCE values above their respective site-specific screening level are shaded



Vertical Exaggeration 4:1

PES Environmental, Inc.
Engineering & Environmental Services

Cross Section H-H'
Vapor Mitigation System Design Report
State Street Center
Fremont, California

PLATE
A9

220.003.03.003	22000303002_A2-9	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

APPENDIX B

VAPOR MITIGATION SYSTEM DESIGN DRAWINGS AND SPECIFICATIONS

No.	Date	Revisions	By
–	1/15/16	Issued for Review	

Scale: AS NOTED
Designed by: JA 1/15/16
Drawn by: BP 1/15/16
Checked by: –
Date: 1/15/16
Approved by: –
Date: 1/15/16

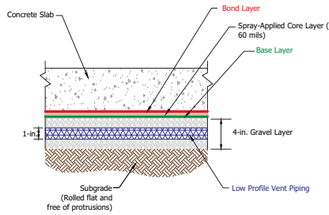
System Configuration
State Street Center
Fremont, California

prepared for:
Fremont State Street Center, LLC
prepared by:
PES Environmental, Inc.
Engineering & Environmental Services

Sheet No. **2.0**

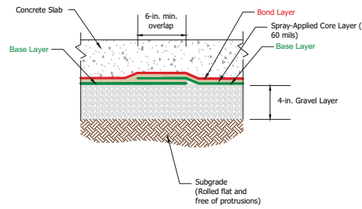
JOB NUMBER	DRAWING NUMBER	DATE
220.003.03.002	22000303002_VB_1-4	1/16

SM



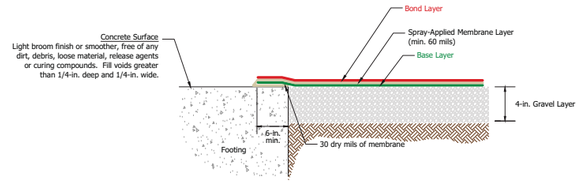
A - **Detail A - Typical Membrane and Vent Piping Configuration**

(Not to Scale)



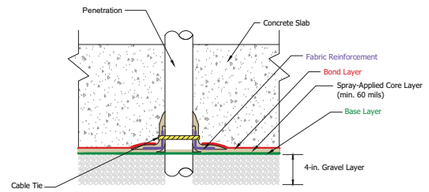
B - **Detail B - Typical Membrane Lap Joint**

(Not to Scale)



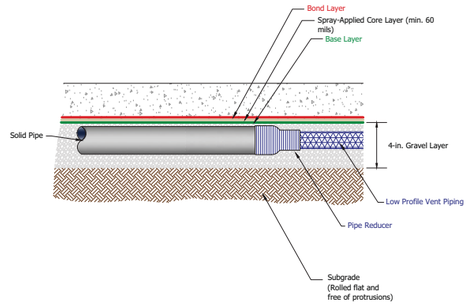
C - **Detail C - Typical Membrane Termination Configuration**

(Not to Scale)



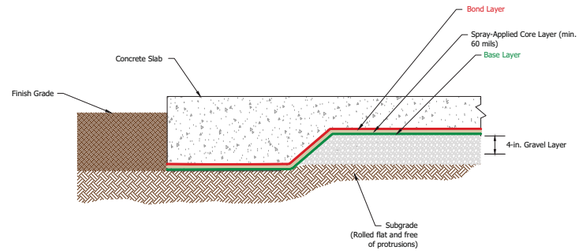
D - **Detail D - Vertical Penetration Detail**

(Not to Scale)



E - **Detail E - Vent Pipe To PVC Transition**

(Not to Scale)



F - **Detail F - Typical Edge of Slab Condition Detail**

(Not to Scale)

Explanation

- Bond Layer = Geo-Seal BOND
- Spray-Applied Core Layer = Geo-Seal CORE
- Base Layer = Geo-Seal BASE
- Low Profile Vent Piping = Vapor-Vent
- Gravel Layer = 3/8-in Pea Gravel

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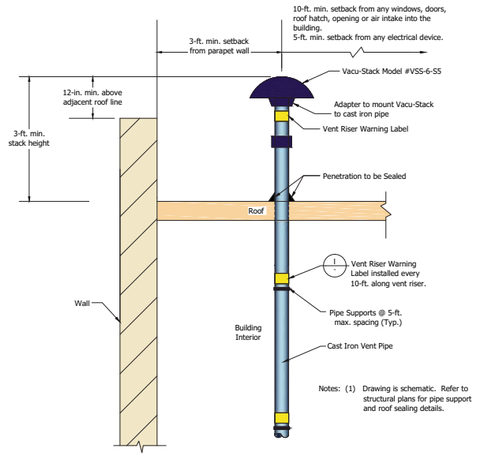
Approved by: -- Date: 1/15/16

Project Details
State Street Center
Fremont, California

prepared for:
Fremont State Street Center, LLC
prepared by:
PES Environmental, Inc.
Engineering & Environmental Services

Sheet No. **3.0**

JOB NUMBER	DRAWING NUMBER	DRAWING NUMBER	DATE
220.003.03.002	22000303002_VB_1-4	DRAFT	1/16



H - Detail H - Vent Riser Termination at Roof

(Not to Scale)

CAUTION

SUBSLAB VENT PIPE

IMMEDIATELY NOTIFY BUILDING OWNER IF DAMAGED

3-in. x 4-in. wide

All labels with adhesive backing

Large letters: 1/2-in. (min.) height

Small letters: 1/4-in. (min.) height

Red letter on white or yellow background

3 min. required per vent riser

These labels are to be placed near each vent piping inlet and outlet and every 10-ft. (min.) along the vent riser piping

I - Detail I - Vent Riser Warning Label

WARNING

THIS BUILDING IS PROTECTED WITH A SUBSLAB VAPOR CONTROL BARRIER.
ANY PROPOSED PENETRATION OR ALTERATION OF FLOOR SLAB REQUIRES NOTIFICATION OF THE BUILDING OFFICIAL AND INSPECTION BY A QUALIFIED ENGINEER

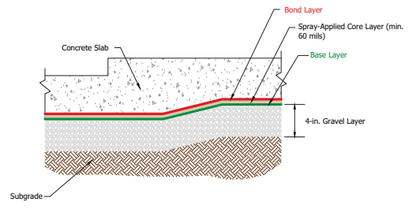
This notification is to be permanently stamped in the surface of the slab at the time it is poured or a plate with this notification is to be affixed to the slab or electrical room wall after construction.

All letters 1/2-in. min. in height

At least 2 Warning Placards shall be permanently fixed to the slab or wall in an electrical or utility room.

J - Detail J - Warning Placard

(Not to Scale)



K - Detail K - Membrane at Small Slab Step (less than 12-inches)

(Not to Scale)

Explanation

- Bond Layer = Geo-Seal BOND
- Spray-Applied Core Layer = Geo-Seal CORE
- Base Layer = Geo-Seal BASE
- Low Profile Vent Piping = Vapor-Vent
- Gravel Layer = 3/8-in Pea Gravel

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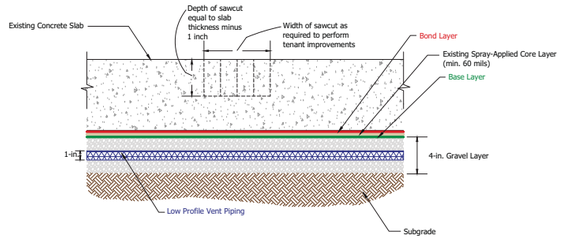
Checked by: --
Date: 1/15/16
Approved by: --
Date: 1/15/16

Project Details
State Street Center
Fremont, California

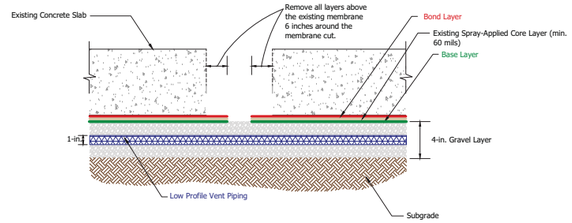
prepared for:
Fremont State Street Center, LLC
prepared by:
PES Environmental, Inc.
Engineering & Environmental Services

Sheet No. **3.1**

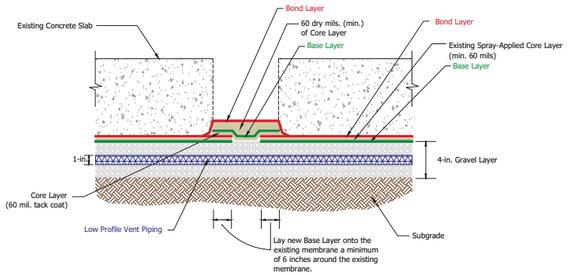
JOB NUMBER	DRAWING NUMBER	DRAWING NUMBER	DATE
220.003.03.002	22000303002_VB_1-4	DRAFT	1/16



Step 1 - Perform a shallow sawcut to facilitate removal of concrete.

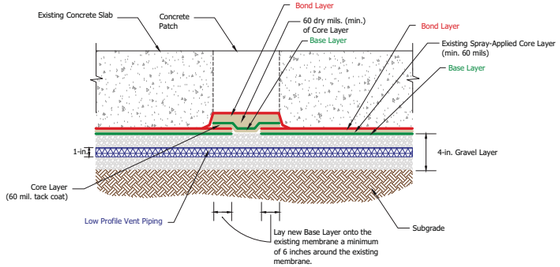


Step 2 - Gently break out concrete along edges of sawcut. Cut vapor barrier in center of sawcut area and pull back to expose gravel layer or subgrade. Remove all layers above the existing vapor barrier membrane, 6 inches around the membrane cut. Check gravel layer for presence of vent piping. Leave vent piping in place if present. Perform subgrade work.



Step 3 - Contract original approved vapor barrier installer to repair vapor barrier. Repair to include:

1. **Restoration of gravel layer.**
2. **Clean the exposed membrane area with water and a soft brush.**
3. **Wipe the exposed membrane with a mild non-chlorinated solvent and allow the solvent to evaporate completely before proceeding to the next step.**
4. **Apply a thin (60-mil) tack coat to the exposed membrane and allow to tack.**
5. **Lay new base layer onto the existing membrane referenced above a minimum 6 inches around the existing membrane cut.**
6. **Patch over base layer with vapor barrier membrane to the specified thickness and extending a minimum 6 inches onto the existing membrane.**
7. **After membrane has cured and been checked for proper thickness and flaws, install protection layer pursuant to manufacturer's instructions.**



Step 4 - Backfill sawcut area with concrete and finish to match existing concrete.

Procedures for Preserving and Repairing Vapor Barrier if Future Penetrations Required

(Not to Scale)

Notes on Repair

1. Steps 1 and 2 to be performed by others prior to vapor barrier installer arrival.
2. It is the General Contractor's responsibility to observe and supervise preparations for repair, and to ensure sufficient vapor barrier flaps remain around entire perimeter of sawcut area. If not, the vapor barrier installer may require additional shallow sawcutting and removal of concrete from the perimeter, in order to expose sufficient vapor barrier flaps for adherence of the patch.
3. All due care must be used to ensure hand-chipping of concrete from perimeter of sawcut does not penetrate or damage in-place liner.
4. Step 3 to be performed by vapor barrier installer.
5. Pouring and finishing of concrete patch to be performed by others.

Explanation

- Bond Layer = Geo-Seal BOND
- Spray-Applied Core Layer = Geo-Seal CORE
- Base Layer = Geo-Seal BASE
- Low Profile Vent Piping = Vapor-Vent
- Gravel Layer = 3/8-in Pea Gravel

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Checked by: --
Date: 1/15/16
Approved by: --
Date: 1/15/16

Procedures for Vapor Barrier Penetrations and Repairs
State Street Center
Fremont, California

prepared for:
Fremont State Street Center, LLC
prepared by:
PES Environmental, Inc.
Engineering & Environmental Services

Sheet No. **4.0**

JOB NUMBER	DRAWING NUMBER	DRAWING NUMBER	DATE
220.003.03.002	22000303002_VB_1-4	DRAFT	1/16

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Product Data Sheet

Geo-Seal® CORE

Geo-Seal® CORE is an elastic water-based co-polymer modified asphaltic membrane spray applied to a minimum dry thickness of 60 mils. The CORE material has exceptional bonding to a wide variety of substrates and will build up to the specified thickness in a single application. Since the CORE material is water-based, there is little or no odor during or after product application, making it safe for use in sensitive areas. This material can also be applied to green concrete as it exhibits exceptional bonding capability that will not delaminate from the intended substrate. The seamless application of the CORE material makes for easy installation around penetrations, uneven surfaces and oddly shaped areas.

COVERAGES	TEST METHOD	UNITS
Application to BASE Layer		60 mils (17 ft^2/gal)
Typical Uncured Properties		
Specific Gravity	ASTM D 244	1.00
Viscosity	ASTM D 1200	>25 centipoise
PH		12.3
Flammability	ASTM D 3143	500^0 F
Color		Brown to Black
Non-Toxic		No Solvents
Shelf Life		6 months
Typical Cured Properties		
Tensile Strength	ASTM 412	32 psi
Elongation	ASTM 412	4140%
Resistance to Decay	ASTM E 125 Section 13	4% Perm Loss
Accelerated Aging	ASTM G 23	No Effect
Moisture Vapor Transmission	ASTM E 96	0.026 g / ft^2 per hour
Hydraulic Water Pressure	ASTM D 751	26 psi
Perm Rating	ASTM E 96 (US Perms)	0.21
Methane Transmission Rate	ASTM D 1434	Passed
Adhesion to Concrete & Masonry	ASTM C 836 & ASTM C 704	11 lbf / inch
Hardness	ASTM C 836	80
Crack Bridging	ASTM C 836	No Cracking
Low Temp Flexibility	ASTM C 836-00	No Cracking at -20^0 C
Resistance to Acids		
Acetic		30%
Sulfuric and Hydrochloric		13%
Temperature Effect:		
Stable		248^0 F
Flexible		13^0 F
Packaging: 330 gal. totes or 55 gal. drums		

Approvals: City of Los Angeles RR# 25478, NSF

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Ph. 949-366-8000 / F. 949- 366-8090

Land Science™ Technologies
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Product Data Sheet

Geo-Seal® CORE DETAIL

Geo-Seal® CORE DETAIL is ideally used to perform detailing and repairs to the Geo-Seal system. It is also ideal for those areas where the necessary clearance is not available for the application of the Geo-Seal spray. This proprietary and unique material can be used all at once or over a period of a few days without breaking down or hardening. Geo-Seal CORE DETAIL is water-based and can be applied to green concrete with exceptional bonding capability that will not delaminate from the intended substrate. Geo-Seal CORE DETAIL's viscosity allows high build applications to be done easily due to its ability to set quickly and get jobs done fast.

PROPERTIES	TEST METHOD	UNITS
TYPICAL UNCURED PROPERTIES		
Specific Gravity		1.034
Viscosity		9m-13m centipoise
PH		11.5
Flammability		270^0 F
Color		Brown to Black
Non-Toxic		No Solvents
Shelf Life		6 months
TYPICAL CURED PROPERTIES		
Initial Cure		30 minutes
Final Cure		24-24 hours
Tensile Strength	ASTM 412	32 psi
Elongation	ASTM 412	3860%
Resistance to Decay	ASTM E 125 Section 13	9% Perm Loss
Accelerated Aging	ASTM G 23	No Effect
Moisture Vapor Transmission	ASTM E 96	0.026 gal/ft^2 per hour
Hydrostatic Water Pressure	ASTM D 751	28 psi
Perm Rating (US Perms)	ASTM E 96	0.17
Methane Transmission Rate	ASTM D 1434	0
Adhesion to Concrete & Masonry	ASTM C 836	7 lbf/inch
Hardness	ASTM C 836	85
Crack Bridging	ASTM C 836	No Cracking
Low Temp Flexibility	ASTM C 836-00	No Cracking at -20^0 C
Resistance to Acids		
Acetic		30%
Sulfuric and Hydrochloric		13%
COVERAGES		
60-mils (dry)		19 ft^2/gal
Packaging: Available in 1 or 5 gal. buckets		

Approvals: City of Los Angeles RR# 25478 (for methane and waterproofing), NSF Standard 61 for potable water containment

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Product Data Sheet

Geo-Seal™ BASE Layer

The Geo-Seal™ BASE layer is comprised of a high strength laminated HDPE membrane that is thermally bonded to a polypropylene geotextile giving the BASE layer a high puncture resistance (Class A Rating) as well as high chemical resistance. The BASE layer is installed over the substrate with the HDPE side facing up and provides the ideal surface for the application of the Geo-Seal CORE component.

PROPERTIES	TEST METHOD	Geo-Seal BASE
Film Thickness		5 mil
Composite Thickness		18 mil
Tensile @ ULT	ASTM D 882 MD	37.3 lbs / in
	ASTM D 882 TD	32.0 lbs / in
Elongation @ ULT	ASTM D 882 MD	51.00%
	ASTM D 882 TD	55.30%
Dart Impact	ASTM D 1709	
	Method A	>1070 gms
	Method B	594 gms
Modulus	ASTM D 882 MD	295.5 lbs / in
	ASTM D 882 TD	270.6 lbs / in
Elmendorf Tear	ASTM D 1922 MD	5,260 gms
	ASTM D 1922 TD	5,140 gms
Puncture Prop. Tear	ASTM B 2582 MD	11,290 gms
	ASTM B 2582 TD	13,150 gms
Beach Puncture Tear	ASTM D 751 MD	160 lb / in
	ASTM D 751 TD	165 lb / in
Permeability (water vapor)	ASTM E96	0.214
Chemical Resistance		Excellent
Packaging: 15'x150' = 100 lbs		

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Product Data Sheet

Geo-Seal™ BOND Layer

The Geo-Seal™ BOND layer is comprised of a high strength laminated HDPE membrane that is thermally bonded to a polypropylene geotextile giving the BASE layer a high puncture resistance (Class A Rating) as well as high chemical resistance. The BOND layer is installed as a protection course over the BASE and CORE layers with the geotextile side facing up. The BOND layer also provides an excellent substrate and friction surface for concrete to adhere to.

PROPERTIES	TEST METHOD	Geo-Seal BOND
Film Thickness		5 mil
Composite Thickness		18 mil
Tensile @ ULT	ASTM D 882 MD	37.3 lbs / in
	ASTM D 882 TD	32.0 lbs / in
Elongation @ ULT	ASTM D 882 MD	51.00%
	ASTM D 882 TD	55.30%
Dart Impact	ASTM D 1709	
	Method A	>1070 gms
	Method B	594 gms
Modulus	ASTM D 882 MD	295.5 lbs / in
	ASTM D 882 TD	270.6 lbs / in
Elmendorf Tear	ASTM D 1922 MD	5,260 gms
	ASTM D 1922 TD	5,140 gms
Puncture Prop. Tear	ASTM B 2582 MD	11,290 gms
	ASTM B 2582 TD	13,150 gms
Beach Puncture Tear	ASTM D 751 MD	160 lb / in
	ASTM D 751 TD	165 lb / in
Permeability (water vapor)	ASTM E96	0.214
Chemical Resistance		Excellent
Packaging: 15'x150' = 100 lbs		

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Product Data Sheet

Geo-Seal™ Reinforcement Fabric

The Geo-Seal™ Reinforcement Fabric is a textile material composed of staple fibers hydraulically entangled, which is composed of 100% polyester. The basic use of the Geo-Seal Reinforcement Fabric is designed to act as reinforcement when used in conjunction with Geo-Seal CORE spray applied membrane.

CHEMICAL	EXPOSURE (at room temperature)	% STRENGTHENED RETAINED
Dimethyl Formamide	1000 hours	100%
Ethylene Glycol	1000 hours	100%
1% Sodium Hydroxide	6 hours	100%
60% Sulfuric Acid	150 hours	54%
Perchlorethylene	1000 hours	100%
Acetone	1000 hours	100%
Distilled Water	1000 hours	100%
PHYSICAL PROPERTY DATA		
Weight/Square (lbs.)	ASTM D 3776	1.1
Oz./Sq./Yd. (oz.)	ASTM D 3776	1.6
Bulk (mills)		22
Dry Tensile-MD (lbs.)	ASTM D1777	25
Dry Tensile-CD (lbs.)	ASTM D 1777	18
Elongation-MD (per/cent)	ASTM D 1682	45
Elongation-CD (per/cent)	ASTM D 1682	100
Mullen Burst (P. S. I.)	ASTM D 3786	35
Packaging: 6” x 360’, 12” x 360’		

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Land Science™ Technologies
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Product Data Sheet

Vapor-Vent™

Vapor-Vent™ is a low profile, trenchless, flexible, sub slab vapor collection system used in lieu of perforated piping. Installation of Vapor-Vent increases construction productivity as it eliminates time consuming trench digging and costly gravel importation. Vapor-Vent is offered with two different core materials, Vapor-Vent POLY is recommended for sites with inert methane gas and Vapor-Vent is recommended for sites with aggressive chlorinated volatile organic or petroleum vapors.

VENT PROPERTIES	**TEST METHOD**	**Vapor-Vent POLY**	**Vapor-Vent**
Material		Polystyrene	HDPE
Comprehensive Strength	ASTM D-1621	9,500 lbs / ft^2	11,400 psf
Flow Rate (Hydraulic gradient = .1)	ASTM D-4716	30 gpm/ft width	30 gpm/ft width
Chemical Resistance		N/A	Excellent
FABRIC PROPERTIES	**TEST METHOD**	**Vapor-Vent POLY**	**Vapor-Vent**
Grab Tensile Strength	ASTM D-4632	100 lbs.	110 lbs.
Puncture Strength	ASTM D-4833	65 lbs.	30 lbs.
Mullen Burst Strength	ASTM D-3786	N/A	90 PSI
AOS	ASTM D-4751	70 U.S. Sieve	50 U.S. Sieve
Flow Rate	ASTM D-4491	140 gpm / ft2	95 gpm / ft2
UV Stability (500 hours)	ASTM D-4355	N/A	70% Retained
DIMENSIONAL DATA		**Vapor-Vent POLY**	**Vapor-Vent**
Thickness		1”	1”
Standard Widths		12”	12”
Roll Length		165 ft	165 ft
Roll Weight		65 lbs	68 lbs

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Geo-Seal® Vapor Intrusion Barrier
02 56 19.13
Fluid-Applied Gas Barrier
Version 1.30

Note: If membrane will be subjected to hydrostatic pressure, please contact Land Science Technologies™ for proper recommendations.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 specification sections, apply to this section.

1.2 SUMMARY

A. This section includes the following:

1. Substrate preparation:
2. Vapor intrusion barrier components:
3. Seam sealer and accessories.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 2 Section “Earthwork”, “Pipe Materials”, “Sub-drainage Systems”, “Gas Collection Systems”:
2. Division 3 Section “Cast-in-Place Concrete” for concrete placement, curing, and finishing:
3. Division 5 Section “Expansion Joint Cover Assemblies”, for expansion-joint covers assemblies and installation.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide a vapor intrusion barrier system that prevents the passage of methane gas and/or volatile organic compound vapors and complies with physical requirements as demonstrated by testing performed by an independent testing agency of manufacturer’s current vapor intrusion barrier formulations and system design.

1.4 SUBMITTALS

A. Submit product data for each type of vapor intrusion barrier, including manufacturer’s printed instructions for evaluating and preparing the substrate, technical data, and tested physical and performance properties.

B. Project Data - Submit shop drawings showing extent of vapor intrusion barrier, including details for overlaps, flashing, penetrations, and other termination conditions.

C. Samples – Submit representative samples of the following for approval:

1. Vapor intrusion barrier components.

D. Certified Installer Certificates – Submit certificates signed by manufacturer certifying that installers comply with requirements under the “Quality Assurance” article.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has been trained and certified in writing by the membrane manufacturer, Land Science Technologies™ for the installation of the Geo-Seal® System.

B. Manufacturer Qualification: Obtain vapor intrusion barrier materials and system components from a single manufacturer source Land Science Technologies.

C. Field Sample: Apply vapor intrusion barrier system field sample to 100 ft^2 (9.3 m^2) of field area demonstrate application, detailing, thickness, texture, and standard of workmanship.

1. Notify engineer or special inspector one week in advance of the dates and times when field sample will be prepared.

2. If engineer or special inspector determines that field sample, does not meet requirements, reapply field sample until field sample is approved.

3. Retain and maintain approved field sample during construction in an undisturbed condition as a standard for judging the completed methane and vapor intrusion barrier. An undamaged field sample may become part of the completed work.

D. Pre-installation Conference: A pre-installation conference shall be held prior to application of the vapor intrusion barrier system to assure proper site and installation conditions, to include contractor, applicator, architect/engineer, other trades influenced by vapor intrusion barrier installation and special inspector (if any).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site as specified by manufacturer labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.

B. Store materials as specified by the manufacturer in a clean, dry, protected location and within the temperature range required by manufacturer. Protect stored materials from direct sunlight. If freezing temperatures are expected, necessary steps should be taken to prevent the freezing of the Geo-Seal CORE and Geo-Seal CORE Detail components.

C. Remove and replace material that cannot be applied within its stated shelf life.

1.7 PROJECT CONDITIONS

A. Protect all adjacent areas not to be installed on. Where necessary, apply masking to prevent staining of surfaces to remain exposed wherever membrane abuts to other finish surfaces.

B. Perform work only when existing and forecasted weather conditions are within manufacturer's recommendations for the material and application method used.

C. Minimum clearance of 24 inches is required for application of product. For areas with less than 24-inch clearance, the membrane may be applied by hand using Geo-Seal CORE Detail.

D. Ambient temperature shall be within manufacturer's specifications. (Greater than +45ºF/+7ºC.) Consult manufacturer for the proper requirements when desiring to apply Geo-Seal CORE below 45ºF/7ºC.

E. All plumbing, electrical, mechanical and structural items to be under or passing through the vapor intrusion barrier system shall be positively secured in their proper positions and appropriately protected prior to membrane application.

F. Vapor intrusion barrier shall be installed before placement of fill material and reinforcing steel. When not possible, all exposed reinforcing steel shall be masked by general contractor prior to membrane application.

G. Stakes used to secure the concrete forms **shall not penetrate** the vapor intrusion barrier system after it has been installed. If stakes need to puncture the vapor intrusion barrier system after it has been installed, the necessary repairs need to be made by a certified Geo-Seal applicator. To confirm the staking procedure is in agreement with the manufactures recommendation, contact Land Science Technologies.

1.8 WARRANTY

A. General Warranty: The special warranty specified in this article shall not deprive the owner of other rights the owner may have under other provisions of the contract documents, and shall be in addition to, and run concurrent with, other warranties made by the contractor under requirements of the contract documents.

B. Special Warranty: Submit a written warranty signed by vapor intrusion barrier manufacturer agreeing to repair or replace vapor intrusion barrier that does not meet requirements or that does not remain methane gas and/or volatile organic compound vapor tight within the specified warranty period. Warranty does not include failure of vapor intrusion barrier due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in the attached to structures that exceed 1/16 inch (1.58 mm) in width.

1. Warranty Period: 1 year after date of substantial completion. Longer warranty periods are available upon request to the manufacturer.

C. Labor and material warranties are available upon request to the manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Geo-Seal; Land Science Technologies™, San Clemente, CA. (949) 481-8118

1. Geo-Seal BASE sheet layer
2. Geo-Seal CORE spray layer and Geo-Seal CORE Detail
3. Geo-Seal BOND protection layer

2.2 VAPOR INTRUSION BARRIER SPRAY MATERIALS

A. Fluid applied vapor intrusion barrier system – Geo-Seal CORE; a single course, high build, polymer modified, asphalt emulsion. Waterborne and spray applied at ambient temperatures. A nominal thickness of 60 dry mils, unless specified otherwise. Non-toxic and odorless. Geo-Seal CORE Detail has similar properties with greater viscosity and is roller or brush applied. Manufactured by Land Science Technologies.

B. Fluid applied vapor intrusion barrier physical properties.

Geo-Seal CORE – TYPICAL CURED PROPERTIES

Properties	Test Method	Results
Tensile Strength - CORE only	ASTM 412	32 psi
Tensile Strength - Geo-Seal System	ASTM 412	662 psi
Elongation	ASTM 412	4140%
Resistance to Decay	ASTM E 154 Section 13	4% Perm Loss
Accelerated Aging	ASTM G 23	No Effect
Moisture Vapor Transmission	ASTM E 96	.026 g/ft^2/hr
Hydrostatic Water Pressure	ASTM D 751	26 psi
Perm rating	ASTM E 96 (US Perms)	0.21
Methane transmission rate	ASTM D 1434	Passed
Adhesion to Concrete & Masonry	ASTM C 836 & ASTM C 704	11 lbf./inch
Hardness	ASTM C 836	80
Crack Bridging	ASTM C 836	No Cracking
Heat Aging	ASTM D 4068	Passed
Environmental Stress Cracking	ASTM D 1693	Passed
Oil Resistance	ASTM D543	Passed
Soil Burial	ASTM D 4068	Passed
Low Temp. Flexibility	ASTM C 836-00	No Cracking at –20°C
Resistance to Acids:		
Acetic		30%
Sulfuric and Hydrochloric		13%
Temperature Effect:		
Stable		248°F
Flexible		13°F

Geo-Seal CORE Detail – TYPICAL CURED PROPERTIES

Properties	Test Method	Results
Tensile Strength	ASTM 412	32 psi
Elongation	ASTM 412	3860%
Resistance to Decay	ASTM E 154 Section 13	9% Perm Loss
Accelerated Aging	ASTM G 23	No Effect
Moisture Vapor Transmission	ASTM E 96	.026 g/ft^2/hr
Hydrostatic Water Pressure	ASTM D 751	28 psi
Perm rating (US Perms)	ASTM E 96	0.17
Methane transmission rate	ASTM D 1434	Passed
Adhesion to Concrete & Masonry	ASTM C 836	7 lbf./inch
Hardness	ASTM C 836	85
Crack Bridging	ASTM C 836	No Cracking
Low Temp. Flexibility	ASTM C 836-00	No Cracking at –20ºC
Resistance to Acids:		
Acetic		30%
Sulfuric and Hydrochloric		13%
Temperature Effect:		
Stable		248°F
Flexible		13°F

2.3 VAPOR INTRUSION BARRIER SHEET MATERIALS

A. The Geo-Seal BASE layer and Geo-Seal BOND layer are chemically resistant sheets comprised of a 5 mil high density polyethylene sheet thermally bonded to a 3 ounce non woven geotextile.

B. Sheet Course Usage

1. As foundation base layer, use Geo-Seal BASE course and/or other base sheet as required or approved by the manufacturer.

2. As top protective layer, use Geo-Seal BOND layer and/or other protection as required or approved by the manufacturer.

C. Geo-Seal BOND and Geo-Seal BASE physical properties.

Properties	Test Method	Results
Film Thickness		5 mil
Composite Thickness		18 mil
Water Vapor Permeability	ASTM E 96	0.214
Adhesion to Concrete	ASTM D 1970	9.2 lbs/inch^2
Dart Impact	ASTM D 1790	>1070 gms, method A
		594 gms, method B
Puncture Properties Tear	ASTM B 2582 MD	11,290 gms
	ASTM B 2582 TD	13,150 gms

2.4 AXILLARY MATERIALS

A. Sheet Flashing: 60-mil reinforced modified asphalt sheet good with double-sided adhesive.

B. Reinforcing Strip: Manufacturer's recommended polypropylene and polyester fabric.

C. Gas Venting Materials: Geo-Seal Vapor-Vent HD or Geo-Seal Vapor-Vent Poly, and associated fittings.

D. Seam Detailing Sealant Mastic: Geo-Seal CORE Detail, a high or medium viscosity polymer modified water based asphalt material.

1. Back Rod: Closed-cell polyethylene foam.

PART 3 – EXECUTION

3.1 AUXILIARY MATERIALS

A. Examine substrates, areas, and conditions under which vapor intrusion barrier will be applied, with installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 SUBGRADE SURFACE PREPARATION

A. Verify substrate is prepared according to manufacturer's recommendations. On a horizontal surface, the substrate should be free from material that can potentially puncture the vapor intrusion barrier. Additional protection or cushion layers might be required if the earth or gravel substrate contains too many jagged points and edges that could puncture one or more of the system components. Contact manufacturer to confirm substrate is within manufactures recommendations.

B. Geo-Seal can accommodate a wide range of substrates, including but not limited to compacted earth, sand, aggregate, and mudslabs.

1. Compacted Earth: Remove pieces of debris, gravel and/or any other material that can potentially puncture the Geo-Seal BASE. Remove any debris from substrate that can potentially puncture the Geo-Seal system prior to application.

2. Sand: A sand subgrade requires no additional preparation, provided any material that can potentially puncture the Geo-Seal BASE layer is not present.

3. Aggregate: Contact the manufacturer to ensure the aggregate layer will not be detrimental to the membrane. **The gravel layer must be compacted and rolled flat.** Ideally a ¾" minus gravel layer with rounded edges should be specified; however the Geo-Seal system can accommodate a wide variety of different substrates. Contact Land Science Technologies if there are questions regarding the compatibility of Geo-Seal and the utilized substrate. Exercise caution when specifying pea gravel under the membrane, if not compacted properly, pea gravel can become an unstable substrate.

4. Mudslabs: The use of a mubslab under the Geo-Seal system is acceptable, contact Land Science Technologies for job specific requirements.

C. Mask off adjoining surface not receiving the vapor intrusion barrier system to prevent the spillage or over spray affecting other construction.

D. Earth, sand or gravel subgrades should be prepared and compacted to local building code requirements.

3.3 CONCRETE SURFACE PREPARATION

A. Clean and prepare concrete surface to manufacturer's recommendations. In general, only apply the Geo-Seal CORE material to dry, clean and uniform substrates. Concrete surfaces must be a light trowel, light broom or equivalent finish. Remove fins, ridges and other projections and fill honeycomb, aggregate pockets, grout joints and tie holes, and other voids with hydraulic

cement or rapid-set grout. It is the applicator's responsibility to point out unacceptable substrate conditions to the general contractor and ensure the proper repairs are made.

B. When applying the Geo-Seal CORE or Geo-Seal CORE Detail material to concrete it is important to not apply the product over standing water. Applying over standing water will result in the membrane not setting up properly on the substrate

C. Surfaces may need to be wiped down or cleaned prior to application. This includes, but is not limited to, the removal of forming oils, concrete curing agents, dirt accumulation, and other debris. Contact form release agent manufacturer or concrete curing agent manufacturer for VOC content and proper methods for removing the respective agent.

D. Applying the Geo-Seal CORE to "green" concrete is acceptable and can be advantageous in creating a superior bond to the concrete surface. To help reduce blistering, apply a primer coat of only the asphalt component of the Geo-Seal CORE system. Some blistering of the membrane will occur and may be more severe on walls exposed to direct sunlight. Blistering is normal and will subside over time. Using a needle nose depth gauge confirm that the specified mil thickness has been applied.

3.4 PREPARATIONS AND TREATMENT OF TERMINATIONS

A. Prepare the substrate surface in accordance with Section 3.3 of this document. Concrete surfaces that are not a light trowel, light broom or equivalent finish, will need to be repaired.

B. Terminations on horizontal and vertical surfaces should extend 6" onto the termination surface. Job specific conditions may prevent a 6" termination. In these conditions, contact manufacturer for recommendations.

C. Apply 30 mils of Geo-Seal CORE to the terminating surface and then embed the Geo-Seal BASE layer by pressing it firmly into the Geo-Seal CORE layer. Next, apply 60 mils of Geo-Seal CORE to the BASE layer. When complete, apply the Geo-Seal BOND layer. After the placement of the Geo-Seal BOND layer is complete, apply a final 30 mil seal of the Geo-Seal CORE layer over the edge of the termination. For further clarification, refer to the termination detail provided by manufacturer.

D. The stated termination process is appropriate for terminating the membrane onto exterior footings, pile caps, interior footings and grade beams. When terminating the membrane to stem walls or vertical surfaces the same process should be used.

3.5 PREPARATIONS AND TREATMENT OF PENETRATIONS

A. All pipe penetrations should be securely in place prior to the installation of the Geo-Seal system. Any loose penetrations should be secured prior to Geo-Seal application, as loose penetrations could potentially exert pressure on the membrane and damage the membrane after installation.

B. To properly seal around penetrations, cut a piece of the Geo-Seal BASE layer that will extend 6" beyond the outside perimeter of the penetration. Cut a hole in the Geo-Seal BASE layer just big enough to slide over the penetration, ensuring the Geo-Seal BASE layer fits snug against the penetration, this can be done by cutting an "X" no larger than the inside diameter of the penetration. There should not be a gap larger than a 1/8" between the Geo-Seal BASE layer and the penetration. Other methods can also be utilized, provided, there is not a gap larger than 1/8" between the Geo-Seal BASE layer and the penetration.

C. Seal the Geo-Seal BASE layer using Geo-Seal CORE or Geo-Seal CORE Detail to the underlying Geo-Seal BASE layer.

D. Apply one coat of Geo-Seal CORE Detail or Geo-Seal CORE spray to the Geo-Seal BASE layer and around the penetration at a thickness of 30 mils. Penetrations should be treated in a 6-inch radius around penetration and 3 inches onto penetrating object.

E. Embed a fabric reinforcing strip after the first application of the Geo-Seal CORE spray or Geo-Seal CORE Detail material and then apply a second 30 mil coat over the embedded joint reinforcing strip ensuring its complete saturation of the embedded strip and tight seal around the penetration.

F. After the placement of the Geo-Seal BOND layer, a cable tie should then be placed around the finished penetration. The cable tie should be snug, but not overly tight so as to slice into the finished seal.

OPTION: A final application of Geo-Seal CORE may be used to provide a finishing seal after the Geo-Seal BOND layer has been installed.

NOTE: Metal or other slick penetration surfaces may require treatment in order to achieve proper adhesion. For plastic pipes, sand paper may be used to achieve a profile, an emery cloth is more appropriate for metal surfaces. An emery cloth should also be used to remove any rust on metal surfaces.

3.6 GEO-SEAL BASE LAYER INSTALLATION

A. Install the Geo-Seal BASE layer over substrate material in one direction with six-inch overlaps and the geotextile (fabric side) facing down.

B. Secure the Geo-Seal BASE seams by applying 60 mils of Geo-Seal CORE between the 6" overlapped sheets with the geotextile side down.

C. Visually verify there are no gaps/fish-mouths in seams.

D. For best results, install an equal amount of Geo-Seal BASE and Geo-Seal CORE in one day. Leaving unsprayed Geo-Seal BASE overnight might allow excess moisture to collect on the Geo-Seal BASE. If excess moisture collects, it needs to be removed.

NOTE: In windy conditions it might be necessary to encapsulate the seam by spraying the Geo-Seal CORE layer over the completed Geo-Seal BASE seam.

3.7 GEO-SEAL CORE APPLICATION

A. Set up spray equipment according to manufacturer's instructions.

B. Mix and prepare materials according to manufacturer's instructions.

C. The two catalyst nozzles (8001) should be adjusted to cross at about 18" from the end of the wand. This apex of catalyst and emulsion spray should then be less than 24" but greater than 12" from the desired surface when spraying. When properly sprayed the fan pattern of the catalyst should range between 65° and 80°.

D. Adjust the amount of catalyst used based on the ambient air temperature and surface temperature of the substrate receiving the membrane. In hot weather use less catalyst as hot conditions will quickly "break" the emulsion and facilitate the curing of the membrane. In cold conditions and on vertical surfaces use more catalyst to "break" the emulsion quicker to expedite curing and set up time in cold conditions.

E. To spray the Geo-Seal CORE layer, pull the trigger on the gun. A 42° fan pattern should form when properly sprayed. Apply one spray coat of Geo-Seal CORE to obtain a seamless membrane free from pinholes or shadows, with an average dry film thickness of 60 mils (1.52 mm).

F. Apply the Geo-Seal CORE layer in a spray pattern that is perpendicular to the application surface. The concern when spraying at an angle is that an area might be missed. Using a perpendicular spray pattern will limit voids and thin spots, and will also create a uniform and consistent membrane.

G. Verify film thickness of vapor intrusion barrier every 500 ft^2. (46.45 m^2), for information regarding Geo-Seal quality control measures, refer to the quality control procedures in Section 3.9 of this specification.

H. The membrane will generally cure in 24 to 48 hours. As a rule, when temperature decreases or humidity increases, the curing of the membrane will be prolonged. The membrane does not need to be fully cured prior the placement of the Geo-Seal BOND layer, provided mil thickness has been verified and a smoke test will be conducted.

I. **Do not penetrate** membrane after it has been installed. If membrane is penetrated after the membrane is installed, it is the responsibility of the general contractor to notify the certified installer to make repairs.

J. If applying to a vertical concrete wall, apply Geo-Seal CORE directly to concrete surface and use manufacturer's recommended protection material based on site specific conditions. If applying Geo-Seal against shoring, contact manufacturer for site specific installation instructions.

NOTE: Care should be taken to not trap moisture between the layers of the membrane. Trapping moisture may occur from applying a second coat prior to the membrane curing. Repairs and detailing may be done over the Geo-Seal CORE layer when not fully cured.

3.8 GEO-SEAL BOND PROTECTION COURSE INSTALLATION

A. Install Geo-Seal BOND protection course perpendicular to the direction of the Geo-Seal BASE course with overlapped seams over nominally cured membrane no later than recommended by manufacturer and before starting subsequent construction operations.

B. Sweep off any water that has collected on the surface of the Geo-Seal CORE layer, prior to the placement of the Geo-Seal BOND layer.

C. Overlap and seam the Geo-Seal BOND layer in the same manner as the Geo-Seal BASE layer.

D. To expedite the construction process, the Geo-Seal BOND layer can be placed over the Geo-Seal CORE immediately after the spray application is complete, provided the Geo-Seal CORE mil thickness has been verified.

3.9 QUALITY ASSURANCE

A. The Geo-Seal system must be installed by a trained and certified installer approved by Land Science Technologies.

B. For projects that will require a material or labor material warranty, Land Science Technologies will require a manufacturer's representative or certified 3rd party inspector to inspect and verify that the membrane has been installed per the manufacturer's recommendations.

The certified installer is responsible for contacting the inspector for inspection. Prior to application of the membrane, a notice period for inspection should be agreed upon between the applicator and inspector.

C. The measurement tools listed below will help verity the thickness of the Geo-Seal CORE layer. As measurement verification experience is gained, these tools will help confirm thickness measurements that can be obtained by pressing one's fingers into the Geo-Seal CORE membrane.

To verify the mil thickness of the Geo-Seal CORE, the following measurement devices are required.

1. Mil reading caliper: Calipers are used to measure the thickness of coupon samples. To measure coupon samples correctly, the thickness of the Geo-Seal sheet layers (18 mils each) must be taken into account. Mark sample area for repair.

2. Wet mil thickness gauge: A wet mil thickness gauge may be used to quickly measure the mil thickness of the Geo-Seal CORE layer. The thickness of the Geo-Seal sheet layers do not factor into the mil thickness reading.

   NOTE: When first using a wet mil thickness gauge on a project, collect coupon samples to verify the wet mil gauge thickness readings.

3. Needle nose digital depth gauge: A needle nose depth gauge should be used when measuring the Geo-Seal CORE thickness on vertical walls or in field measurements. Mark measurement area for repair.

To obtain a proper wet mil thickness reading, take into account the 5 to 10 percent shrinkage that will occur as the membrane fully cures. Not taking into account the thickness of the sheet layers, a freshly sprayed membrane should have a minimum wet thickness of 63 (5%) to 66 (10%) mils.

Methods on how to properly conduct Geo-Seal CORE thickness sampling can be obtained by reviewing literature prepared by Land Science Technologies.

D. It should be noted that taking too many destructive samples can be detrimental to the membrane. Areas where coupon samples have been removed need to be marked for repair.

E. Smoke Testing is highly recommended and is the ideal way to test the seal created around penetrations and terminations. Smoke Testing is conducted by pumping non-toxic smoke underneath the Geo-Seal vapor intrusion barrier and then repairing the areas where smoke appears. Refer to smoke testing protocol provided by Land Science Technologies. For projects that will require a material or labor material warranty, Land Science Technologies will require a smoke test.

F. Visual inspections prior to placement of concrete, but after the installation of concrete reinforcing, is recommended to identify any punctures that may have occurred during the installation of rebar, post tension cables, etc. Punctures in the Geo-Seal system should be easy to indentify due to the color contrasting layers of the system.

Vapor-Vent™
SOIL GAS COLLECTION SYSTEM
Version 1.5

SECTION 02 56 19 – GAS CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Substrate preparation.
2. Vapor-Vent™ installation.
3. Vapor-Vent accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 2 Section “Earthwork”, “Pipe Materials”, “Sub-drainage systems”, ”Gas Control System”, “Fluid-Applied gas barrier”.
2. Division 3 Section “Cast-in-Place Concrete” for concrete placement, curing, and finishing.
3. Division 5 Section “Expansion Joint Cover Assemblies”, for expansion-joint covers assemblies and installation.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide a gas venting material that collects gas vapors and directs them to discharge or to collection points as specified in the gas vapor collection system drawings and complies with the physical requirements set forth by the manufacturer.

1.4 SUBMITTALS

A. Submit Product Data for each type of gas venting system specified, including manufacturer’s specifications.

B. Sample – Submit representative samples of the following for approval:

1. Gas venting, Vapor-Vent.
2. Vapor-Vent accessories.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who is certified in writing and approved by vapor intrusion barrier manufacturer Land Science Technologies for the installation of the Geo-Seal® vapor intrusion barrier system.

B. Manufacturer Qualification: Obtain gas venting, vapor intrusion barrier and system components from a single manufacturer Land Science Technologies

C. Pre-installation Conference: A pre-installation conference shall be held prior to installation of the venting system, vapor intrusion barrier and waterproofing system to assure proper site and installation conditions, to include contractor, applicator, architect/engineer and special inspector (if any).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site as specified by manufacturer labeled with manufacturer’s name, product brand name and type, date of manufacture, shelf life, and directions for handling.

B. Store materials as specified by the manufacturer in a clean, dry, protected location and within the temperature range required by manufacturer. Protect stored materials from direct sunlight.

C. Remove and replace material that is damaged.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Land Science Technologies, San Clemente, CA. (949) 481-8118

1. Vapor-Vent™

2.2 GAS VENT MATERIALS

A. Vapor-Vent – Vapor-Vent is a low profile, trenchless, flexible, sub slab vapor collection system used in lieu or in conjunction with perforated piping. Vapor-Vent is offered with two different core materials, Vapor-Vent POLY is recommended for sites with inert methane gas and Vapor-Vent is recommended for sites with aggressive chlorinated volatile organic or petroleum vapors. Manufactured by Land Science Technologies

B. Vapor-Vent physical properties

VENT PROPERTIES	**TEST METHOD**	**VAPOR-VENT POLY**	**VAPOR-VENT**
Material		Polystyrene	HDPE
Comprehensive Strength	ASTM D-1621	9,000 lbs / ft^2	11,400 lbs / ft^2
In-plane flow (Hydraulic gradient-0.1)	ASTM D-4716	30 gpm / ft of width	30 gpm / ft of width
Chemical Resistance		N/A	Excellent
FABRIC PROPERTIES	**TEST METHOD**	**VAPOR-VENT POLY**	**VAPOR-VENT**
Grab Tensile Strength	ASTM D-4632	100 lbs.	110 lbs.
Puncture Strength	ASTM D-4833	65 lbs.	30 lbs.
Mullen Burst Strength	ASTM D-3786	N/A	90 PSI
AOS	ASTM D-4751	70 U.S. Sieve	50 U.S. Sieve
Flow Rate	ASTM D-4491	140 gpm / ft^2	95 gpm / ft^2
UV Stability (500 hours)	ASTM D-4355	N/A	70% Retained
DIMENSIONAL DATA			
Thickness		1”	1”
Standard Widths		12”	12”
Roll Length		165 ft	165 ft
Roll Weight		65 lbs	68 lbs

2.3 AUXILIARY MATERIALS

A. Vapor-Vent End Out

B. Reinforced Tape.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which gas vent system will be installed, with installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 SUBSTRATE PREPARATION

A. Verify substrate is prepared according to project requirements.

3.3 PREPARATION FOR STRIP COMPOSITE

A. Mark the layout of strip geocomposite per layout design developed by engineer.

3.4 STRIP GEOCOMPOSITE INSTALLATION

A. Install Vapor-Vent over substrate material where designated on drawings with the flat base of the core placed down and shall be overlapped in accordance with manufacturer's recommendations.

B. At areas where Vapor-Vent strips intersect cut and fold back fabric to expose the dimpled core. Arrange the strips so that the top strip interconnects into the bottom strip. Unfold fabric to cover the core and use reinforcing tape, as approved by the manufacturer, to seal the connection to prevent sand or gravel from entering the core.

C. When crossing Vapor-Vent over footings or grade beams, **consult with the specifying environmental engineer and structural engineer for appropriate use and placement of solid pipe materials**. Place solid pipe over or through concrete surface and attach a Vapor-Vent End Out at both ends of the pipe before connecting the Vapor-Vent to the pipe reducer. Seal the Vapor-Vent to the Vapor-Vent End Out using fabric reinforcement tape. Refer to Vapor-Vent detail provided by Land Science Technologies.

D. Place vent risers per specifying engineer's project specifications. Connect Vapor-Vent to Vapor-Vent End Out and seal with fabric reinforced tape. Use Vapor-Vent End Out with the specified diameter piping as shown on system drawings.

3.5 PLACEMENT OF OVERLYING AND ADJACENT MATERIALS

A. All overlying and adjacent material shall be placed or installed using approved procedures and guidelines to prevent damage to the strip geocomposite.

B. Equipment shall not be directly driven over and stakes or any other materials may not be driven through the strip geocomposite.

Geo-Seal Quality Control

Certified Applicator

Authorized installation of Geo-Seal can only be accomplished by one of Land Science Technologies Certified Applicators.

Membrane Inspections

For projects that will require a material or system (workmanship and material) warranty, Land Science Technologies will require a manufacturer's representative or certified 3rd party inspector to inspect and verify that the membrane has been installed per the manufacturer's recommendations.

The applicator is responsible for contacting the inspector for inspection. Prior to application of the membrane, a notice period for inspection should be agreed upon between the applicator and inspector.

Material Yield

Material yield is one of the first indicators in determining if the Geo-Seal CORE layer has been installed correctly. A baseline standard for yield is as follows:

Material Container	60 dry mils	80 dry mils	100 dry mils
55 Gallon Drum	935 ft^2	660 ft^2	550 ft^2
275 Gallon Tote	4,675 ft^2	3,300 ft^2	2,750 ft^2
330 Gallon Tote	5,610 ft^2	3,960 ft^2	3,300 ft^2

The estimated yield is 17 ft^2 per gallon for a 60 dry mil application using the recommended thickness, unless otherwise noted by a specified engineer or regulatory agency.

Yields can decrease based on the complexity of the foundation. Projects containing many penetrations and areas where a lot of detailing is required might reduce the material yield to 16 ft^2 or 15 ft^2 per gallon for a 60 mil membrane.

Millage Verification

The measurement tools listed below will help verify the thickness of the Geo-Seal CORE layer. As measurement verification experience is gained, these tools will help confirm thickness measurements that can be obtained by pressing one's fingers into the Geo-Seal CORE membrane.

To verify the mil thickness of the Geo-Seal CORE, the following measurement devices are required:

Mil reading caliper: Calipers are used to measure the thickness of coupon samples. To measure coupon samples correctly, the thickness of the Geo-Seal sheet layers must be taken into account (This is best done by obtaining a sample of the Geo-Seal BASE layer and then zeroing out the caliper to the Geo-Seal BASE layer). Mark sample area for repair.

Wet mil thickness gauge: A wet mil thickness gauge may be used to quickly measure the mil thickness of the Geo-Seal CORE layer. The thickness of the Geo-Seal sheet layers do not factor into the mil thickness reading, but the softness of the subgrade might result in inaccurate readings.

NOTE: When first using a wet mil thickness gauge on a project, collect coupon samples to verify the wet mil gauge thickness readings.

Needle nose digital depth gauge: A needle nose depth gauge can be used when measuring the Geo-Seal CORE thickness on vertical walls or in field measurements. Mark measurement area for repair.

To obtain a proper wet mil thickness reading, take into account the 5 to 10 percent shrinkage that will occur as the membrane fully cures. Not taking into account the thickness of the sheet layers, a freshly sprayed membrane should have a minimum wet thickness of 63 (5%) to 66 (10%) mils.

Visual Inspections

The guidelines outlined in this section provide ways to quantify and observe the proper installation of the Geo-Seal system. However, a visual inspection should also be done to ensure any visual imperfections are not present, i.e. fish-mouths, punctures, voids, etc. During a visual inspection, punctures in the Geo-Seal system should be easy to indentify due to the color contrasting layers of the system.

Membrane Testing Log

To aid in the inspection process and properly document the Geo-Seal membrane inspection, create a membrane testing log. We recommend creating the log by using the foundation plan (plan view) of the structure and then creating a 500 square foot grid over the foundation. If this is not able to be done, enclosed is a membrane testing log template that can also be used. (Appendix E)

Wet Mil Thickness Readings

A wet mil thickness gauge is one method to verify the mil thickness of the Geo-Seal CORE layer. An advantage to this method is the ability to verify the Geo-Seal CORE thickness by minimizing destructive coupon sampling.

1. Create a membrane testing log by obtaining a copy of the foundation plan and then draw a 500 square foot grid over the foundation plan. Make two copies of the membrane testing log; one should be used when collecting coupon samples and the other should be used when conducting the smoke test.

2. Note time, date, project name, inspector name, temperature and weather conditions on testing log.

3. Number each quadrant and inspect sequentially.

4. When arriving at each quadrant quickly assess if there are any conditions that might present any challenges in establishing a proper seal. Note areas and discuss with applicator.

5. Conduct a visual inspection of the membrane. Look for areas where a proper seal was not created, i.e. a fish-mouth at the termination and areas where the membrane might be sprayed thin. Mark areas needed for repair in the field with florescent paint or with chalk. Also make a note on the testing log.

6. Conduct a thickness sample in the area that is suspected to be sprayed thin and take three readings within 3" of one another. **When beginning a project, verify the wet mil gauge thickness reading by cutting a coupon sample and measuring the thickness with a caliper.** Once wet mil thickness readings have been confirmed and established, confirm wet mil thickness periodically by taking a coupon sample and caliper measurement.

7. After sampling 5 quadrants it is at the discretion of the inspector to continue collecting samples every 500 ft^2 or 1,000 ft^2.

8. This method will verify the thickness of the Geo-Seal CORE layer prior to it fully curing. Observed shrinkage of the Geo-Seal CORE layer during the curing process ranges from 5% to 10%. When taking uncured samples assume a minimum of 10% loss for horizontal surfaces and 5% for vertical surfaces. Assuming a 10% loss, the gauge should read a mil thickness between 65 and 70 mils (≥66 mils).

9. If using a wet mil gauge to verify a fully cured membrane the gauge should read 60 mils.

10. When testing is complete, send a copy of the membrane testing log to Land Science Technologies. Keep the coupon samples for the file, or send them to Land Science Technologies.

Coupon Sampling

Coupon sampling is the most accurate way to verify the Geo-Seal CORE thickness. However, please note that taking too many coupon samples, or destructive samples, can be counter-productive. To collect a coupon sample the following steps should be followed:

1. Create a membrane testing log by obtaining a copy of the foundation plan and then draw a 500 square foot grid over the foundation plan. Make two copies of the membrane testing log, one should be used when collecting coupon samples and the other should be used when conducting the smoke test.

2. Note time, date, project name, inspector name, temperature and weather conditions on testing log.

3. Number each quadrant and inspect sequentially.

4. When arriving at each quadrant quickly assess if there are any conditions that might present any challenges in establishing a proper seal. Note areas and discuss with applicator.

5. Conduct a visual inspection of the membrane. Look for areas where a proper seal was not created, i.e. a fish-mouth at the termination and areas where the membrane might be sprayed thin. Mark areas needed for repair in the field with florescent paint or with chalk. Also make a note on the testing log.

6. Calibrate mil reading caliper to account for the thickness of the Geo-Seal BASE layer. This is best done by obtaining a sample of the Geo-Seal BASE layer and then zeroing out the caliper to the Geo-Seal BASE layer.

7. Collect a coupon sample in the area that is suspected to be sprayed thin. Use a box cutter to cut a 3 square inch sample from the membrane. Measure each side to confirm the specified minimum thickness has been obtained. Number each sample and save in the job file. Mark the area for repair in the field and on the site plan.

8. After sampling 5 quadrants it is at the discretion of the inspector to continue collecting samples every 500 ft^2 or 1,000 ft^2.

9. Samples may be collected prior to the Geo-Seal CORE layer fully curing. Observed shrinkage of the Geo-Seal CORE layer during the curing process for horizontal surfaces is 10%. Assuming a 10% loss, a minimum of 66 mills thickness should be measured for a cured measurement of 60 mils.

10. When testing is complete, send a copy of the membrane testing log to Land Science Technologies. Keep the coupon samples for the file, or send them to Land Science Technologies.

Smoke Testing

This test is intended to visually verify and confirm the proper installation of the Geo-Seal system. Land Science Technologies requires a smoke test on all projects in order to obtain a warranty. The smoke test will be performed by the applicator.

Smoke testing should occur after the Geo-Seal CORE layer has been installed and mil thickness verified. Smoke testing may occur after the Geo-Seal BOND layer is installed, if preferred by the applicator. Upon completion of the original smoke test, additional smoke tests can be conducted per the membrane manufacturer's, specifying engineer or regulatory agency's request. To conduct a smoke test follow these steps:

1. One smoke test can cover between 2000-3000 square feet per test. However, coverage will greatly depend on the sub grade under the membrane. On sites where multiple smoke tests will be needed, use the first two smoke tests to estimate the coverage area per test.

2. Visual verification of soundness of seams, terminations and penetrations should be performed. Identify/correct any apparent deficiencies and/or installation problems.

3. Note time, date, project name, inspector name, temperature and weather conditions on testing log. In addition, record humidity, barometric pressure, and wind speed/direction. Confirm wind speed is below 15 mph. Visual identification of leaks becomes more difficult with increasing wind speed.

4. Cap other vent outlet(s) not being used. If the installation has no sub-slab vent system or the membrane is isolated from the vent system, connect the smoke testing system directly to the membrane using a temporary boot collar or other method. Insert the smoke test hose into coupon sampling locations, creating a seal around the smoke test hose with a rag.

5. Activate the smoke generator/blower system and connect to sub-slab vent riser or directly to the membrane.

6. To confirm the adequate flow of smoke under the membrane cut a 2" vent in the membrane to facilitate the purging of air pockets under it. If working properly, smoke will consistently flow though the 2" vent. If a low rate of smoke flow is observed it is an indication of poor smoke flow under the membrane. If low flow does occur, insert the smoke testing hose into the 2" membrane vent.

7. Mark sampling locations with fluorescent paint or chalk. Repair sampling locations per Land Science Technologies recommendations

8. Maintain operation of smoke generator/blower system for at least 15 minutes following purging of membrane. Thoroughly inspect entire membrane surface. Use fluorescent paint or chalk to mark/label any leak locations. Mark/label leak locations on testing log. NOTE: The duration of the smoke test will vary depending on the size of the area being tested. To help determine the duration, monitor the pressure building up under the membrane. If excessive lifting of the membrane occurs, decrease the duration or pressure of the smoke test.

9. Prepare membrane inspection log. Identify the type of leak found, i.e. poor seal around penetration, fish-mouth, puncture, etc.

10. Repair leak locations marked in step 7 and step 8 per procedures outlined in "Geo-Seal Repair Procedures" section using Geo-Seal CORE or Geo-Seal DETAIL.

11. Repeat steps 4 through 10 as necessary to confirm the integrity of the membrane.

12. Complete the smoke testing inspection form indicating the successful completion of the smoke test.

Post Installation Inspection

After a manufacturer's representative or 3rd party inspector signs off on the membrane installation and the steel workers begin to install the rebar, it is recommended to conduct a visual inspection prior to the pouring of concrete. Damages are most likely to occur during this time and it is imperative that punctures are indentified prior to the placement of the slab. The system configuration of Geo-Seal, the top white Geo-Seal BOND layer with a middle black layer, will make rebar punctures easy to identify when conducting a visual inspection.

09/08

GEOSEAL CORE MATERIAL SAFETY DATA SHEET

LAND SCIENCE TECHNOLOGIES Phone: 949-366-8000
1011 Calle Sombra, Ste., 110
San Clemente, CA 92673

1. PRODUCT IDENTIFICATION

Trade Names: Geo-Seal CORE, Geo-Seal CORE Detail
Chemical Name: Asphalt Emulsion
Synonyms: N/A
Hazardous Ingredients/OSHA: CHEMICAL FAMILIES:

A. Bitumen/Asphalt
B. Synthetic rubber
C. Fatty acids
D. Polymers

Hazard: No evidence of serious health hazards exists.
Carcinogenic ingredients/OSHA/NTP: Bitumen IARC: None

Ingredient	Percentage	C. A. S. #
Asphalt	50-60%	8052-42-4
Water	20-40%	7732-18-5
Latex:		9003-55-8
Styrene Latex	0-15%	100-42-5
Butadiene Latex	0-15%	106-99-0
Sodium Hydroxide	.1-1%	1310-73-2
Amino Ethanol	.01-.1%	34375-28-5

2. WARNING STATEMENTS

Avoid prolonged or frequent skin contact, as the presence of emulsifying and de-emulsifying agents during application may irritate the skin.

3. PHYSICAL AND CHEMICAL DATA

Appearance: Brown to black
Specific Gravity: (H_2O = 1): 1.028 (S) 1.034 (R) 1.13 (T)
Solubility in Water: Insoluble
Percent Volatiles: None
Boiling Point: N/A
Vapor Pressure (mm Hg): N/A
Vapor Density (Air = 1): N/A
Evaporation Rate: N\A

4. FIRE PROTECTION

Bitumen emulsions are water based products and as such will not burn. In cases of fire in the vicinity of drums, cool with water.

5. REACTIVITY DATA

Contact with strong oxidizing agents may create geling and water condensation.

6. HEALTH HAZARD DATA

Exposure Limits: Avoid prolonged or frequent skin contact.

7. PHYSIOLOGICAL EFFECTS SUMMARY

Acute: Skin irritation and rash
Chronic: Dermatitis

8. PRECAUTIONS FOR SAFE HANDLING

Avoid contact with eyes.
Avoid inhalation.
Avoid prolonged or frequent skin contact.
Avoid ingestion.

9. PROTECTION AND CONTROL MEASURES

Protective Equipment: Use of clothing, gloves, and/or barrier cream is recommended for skin protection.
Respiratory Protection: Inhalation should be avoided, but is not considered to be hazardous.
Ventilation: Use local exhaust ventilation when applying in an enclosed area.

10. EMERGENCY AND FIRST AID PROCEDURES

For ingestion: DO NOT induce vomiting. Keep at rest and get prompt medical attention.
For eye contamination: Irrigate eyes with water.
For skin contact: Wash affected areas of the body with proprietary hand cleaner, then wash with soap and water.

Contact physician as needed for any of the above occurrences.

11. SPILL AND DISPOSAL PROCEDURES

Contain spillages with sand or earth and remove by normal methods. Dispose of according to State and Local regulations. If the Bitumen enters a water course or sewer, advise respective water authority. The non-cured and cured material is non-toxic and non-flammable and can be disposed of in land fill sites.

Other Precautions: For Additional Information Contact:

Land Science Technologies
1011 Calle Sombra, Ste., 110
San Clemente, CA 92673
(949) 366-8000

8/03

Geo-Seal BASE and BOND: Material Safety Data Sheet

Land Science Technologies
1011 Calle Sombra
San Clemente, CA 92673
PHONE: 949-366-8000

1. PRODUCT IDENTIFICATION

Trade Name: Geo-Seal BASE, Geo-Seal BOND
Chemical Name: POLYMERIC COMPONENTS, GEOTEXTILE FABRIC
Synonyms: N/A
Hazardous Ingredients/OSHA: NO HAZARDOUS INGREDIENTS

THIS PRODUCT IS SUPPLIED IN COMPLIANCE WITH THE TSCA REPORTING REUQIREMENTS.

Carcinogenic Ingredients/OSHA/NTP: NONE
IARC: NONE
Transportation information: CONTAINS NO HAZARDOUS INGREDIENTS
Transportation emergency: Land Science Technologies, 949-366-8000

2. PHYSICAL AND CHEMICAL DATA

Appearance and Odor: White Solid Sheet, Odorless
Specific Gravity (Water = 1): 0.90
Vapor Pressure (mm Hg): Not Determined
Vapor Density (Air = 1): Not Determined
Evaporation Rate: (Butyl Acetate - 1): N/A
Auto Ignition Temperature: Not Determined
Solubility in Water: Negligible, below 0.1%
Percent Volatiles: None
Boiling Point: Degrees: Not Determined
Melting Point: 320° F

3. FIRE AND EXPLOSION DATA

Flash Point: N/A
Flammable limits %: Lower N/A Upper N/A
Extinguishing Media: Agents approved for Class A hazards (e.g. foam, steam) or water fog.
Special Fire Fighting Procedures: Firefighters should wear full bunker gear, including a positive pressure self-contained breathing apparatus.
Unusual Fire and Explosion Hazards: None identified.

4. REACTIVITY DATA

Stability: Stable Conditions to avoid: Keep away from ignition sources (e.g. heat, sparks and open flames).
Incompatibility (materials to avoid): None Identified
Hazardous Decomposition or Byproducts: Incomplete burning can produce carbon monoxide and/or carbon dioxide and other harmful products.
Hazardous Polymerization: Will not occur

5. HEALTH HAZARD DATA

Route(s) of Entry: Inhalation: No Skin: No Ingestion: No
Health Hazards (Acute & Coronic): Will not present any health hazards under normal processing conditions.
Eye & Skin Contact: None Identified.
Skin Absorption: Non-toxic.
Inhalation: No significant irritation expected.
Ingestion: No significant health hazards identified.
Carcinogenicity: Unrelated NTP: No IARC: No OSHA Regulated: No

6. PROTECTION AND CONTROL MEASURES

Precautions to be taken in handling and storing: Store away from heat, ignition sources and open flame in accordance with applicable regulations.
Respiratory Protection: Not required under normal process conditions.
Ventilation: Local Exhaust

Protective Gloves: Not required.
Eye Protection: Not required.
Other Protective clothing or equipment: Not required.
Work/Hygienic Practices: Wash hands after handling and before eating.

7. EMERGENCY AND FIRST AID PROCEDURES

In Case of Combustion (550°)" Eye Contamination: Flush with large amounts of water for 20 minutes lifting upper and lower lids occasionally. Get medical attention.
Skin contact: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse.
Inhalation: If overexposure occurs, remove individual to fresh air. If breathing stops, administer artificial respiration. Get medical attention.
Ingestion: If a large amount of material is swallowed **DO NOT INDUCE VOMITING**. If vomiting begins lower victim's head in an effort to prevent vomit from entering lungs and get medical attention.

8. SPILL AND DISPOSAL PROCEDURES

Spill is not applicable. Material is normally in solid form.

Land Science Technologies 949-366-8000
1011 Calle Sombra
San Clemente, CA 92673

APPENDIX C

VMS DESIGN CALCULATIONS

Appendix C
VMS Design Calculations
State Street Center
Fremont, California

VMS Average PCE Concentration Calculation					
VMS Area	**Soil Vapor Sample Location**	**Detected PCE Concentration[1,2] ($\mu g/m^3$)**	**Average PCE Concentration ($\mu g/m^3$)**	**Average PCE Concentration (lb/ft^3)**	**Combined Average PCE Concentration (lb/ft^3)**
Building #12 [Type C.3]	B21	8,500	2770	0.000000173	0.000000192
	B22	110			
	B30	1,700			
	B31	640			
	B39	2,900			
Buildings #8, 10 [Type E] and Buildings #9, 11 [Type D]	B1	100	208	0.000000013	
	B5	300			
	B19	330			
	B33	100			
Building #7 [Type C.1]	B2	100	100	0.000000006	
	B20	100			

Maximum Allowable Vent Flow Rate				
Combined Average PCE Concentration (lb/ft^3)	**BAAQMD Exempt Maximum Allowable Flowrate (lb/day)**	**Calculated Maximum Allowable Flow Rate for VMS (ft^3/day)**	**Calculated Maximum Allowable Flow Rate for VMS (ft^3/min)**	**Calculated Maximum Allowable Flow Rate From Each Vent Riser[3] (ft^3/min)**
0.000000192	0.999	5199873	3611	**226**

Notes:

1.Concentrations recorded during the 2014 and 2015 site investigations performed by PES Environmental, Inc.

2. Average concentrations calculated using laboratory reporting limits for samples with PCE not detected at or above the reporting

3. Calculations are based off of a total of 16 vent risers

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

lb/ft^3 = pounds per cubic foot

lb/day = pounds per day

ft^3/day = cubic feet per day

ft^3/minute = cubic feet per minute

PCE = tetrachloroethene

VMS = Vapor Mitigation System

APPENDIX D

VMS CONSTRUCTION QUALITY ASSURANCE PLAN

PES Environmental, Inc.
Engineering & Environmental Services

Prepared for:

Fremont State Street Center, LLC
Attention: Ms. Denise Cunningham
3000 Executive Parkway, Suite 450
San Ramon, California 94583

CONSTRUCTION QUALITY ASSURANCE PLAN
VAPOR MITIGATION SYSTEM
STATE STREET CENTER
FREMONT, CALIFORNIA

MARCH 24, 2016

By:

John T. Alexander, P.E.
Senior Engineer

Scott M. Morrison, P.E.
Associate Engineer

220.003.03.002

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

PES Environmental, Inc. (PES) has prepared this Construction Quality Assurance (CQA) Plan on behalf Fremont State Street Center, LLC (FSSC) for construction of the vapor mitigation system (VMS) at the property located at 39155 and 39183 State Street in Fremont, California (the site or subject property; see Plate 1). This CQA Plan describes quality assurance activities to be performed prior to and during the VMS construction in order to meet the quality requirements presented in the VMS construction plans.

2.0 SITE LOCATION AND DESCRIPTION

The site has the street addresses of 39155 and 39183 State Street in Fremont, California. A majority of the subject property is currently developed as a vacant lot. The site consists of approximately 5.3 acres. The southern corner of the site consists of a building located at 39180 Fremont Boulevard (Nation's Giant Hamburgers) with associated parking and landscaping areas. The site is bounded to the northeast by State Street, to the northwest by Capital Avenue and farther northwest by the Fremont Plaza Shopping Center, to the southwest by commercial properties including restaurants and banks, and to the southeast by the Fremont Professional Park office complex.

3.0 BACKGROUND

Summary of Site History

PES previously authored a Phase I Environmental Site Assessment (ESA) report for the subject property, dated July 15, 2014.[1] Historical documents indicate that the site was originally developed as cultivated farmland from at least 1939 through 1966. The subject property was redeveloped in 1966 with a 62,000 square foot building and asphalt-paved parking lot throughout the remainder of the property. The building was utilized as a Payless Drug Store and, later, a Nob Hill General Store. The building was reportedly demolished in 2001.

Another building, approximately 12,000 square feet in area, was built in front of the subject property directly northeast of the larger building in 1989, and Fremont Bank was reportedly the only tenant. Available records indicate that the subject property buildings had been demolished and that the site remained mostly vacant from the early 2000s until the present. Limited use of the site, after demolition of site buildings has included a training yard for the Fremont Fire Department, a traveling carnival, and as a storage yard for a construction company. The storage yard was located on the northeastern portion of the site, and the traveling carnival were located on the northwestern portion of the site. The location of the former training yard for the fire department is unknown.

[1] PES, 2014. *Phase I Environmental Assessment, 39155 and 39183 State Street, Fremont, California*. July 15.

39180 Fremont Boulevard (Nation's Giant Hamburgers) which forms the southwestern corner of the current site area was not included as part of the property at the time of the Phase I ESA. As a result, no information regarding construction dates or previous uses of this property are known to PES.

Planned Site Redevelopment

Redevelopment plans for the site, known as the State Street Center, include grading and soil excavation for utilities and construction of a mixed use residential and retail project with 157 residential dwelling units and approximately 21,000 square feet of retail area. Approximately 50 percent of the residences will be on-grade townhomes, the rest are podium townhomes and flats (Plate 2). Soil will be excavated from the northwestern portion of the site to construct subgrade parking lots beneath the commercial retail/residential buildings[2]. The surrounding area will contain roadways with associated landscaping.

The VMS will be installed at portions of the the future commercial retail/residential buildings with subsurface parking along the northwestern portion of the site, and the slab-on-grade residential buildings to the southeast. The VMS will consist of an impermeable membrane installed beneath the residential spaces and retail area elevator pits to mitigate the potential for subsurface vapors from entering the buildings. The membrane will consist of a sprayed-in-place continuous barrier system (Geo-Seal membrane by Land Science Technologies). Additionally, a passive subslab venting system (Vapor-Vent by Land Science Technologies) will be installed at the slab-on-grade townhomes to passively vent accumulated vapors beneath the impermeable membrane to outdoor air.

4.0 OBJECTIVE

The objective in developing and implementing this CQA Plan for the VMS is to define the management system that will control and document the following:

- The quality assurance activities that will be performed by the CQA Manager;
- The quality assurance procedures to be used during project construction to assure that the techniques, materials, and equipment meet design specifications;
- The integration of quality assurance inspections and corrective measures into the project documentation; and
- The framework for communicating the quality assurance procedures and requirements to the construction project personnel.

[2] KTGY Group, Inc. (KTGY), 2015. *100% Design Development Drawings, State Street Center On-Grade, Fremont, California*. November 30.

These CQA Plan activities will be performed in order to meet the quality assurance requirements set forth in the VMS construction plans. Although the design and construction of the VMS are part of the site-wide commercial/residential development project, the scope of this CQA Plan only addresses requirements specific to the VMS.

5.0 POSITION RESPONSIBILITIES

The Construction Contractor will be responsible for the quality of construction in the finished product and for compliance with the construction documents, drawings, and specifications. The Project Engineer will have ultimate responsibility for the oversight of construction of the VMS and for conformance with the construction drawings, specifications, and quality assurance requirements. The construction, design, and CQA team organization is presented on Plate 3.

The Construction Quality Control (CQC) team members will be employed by the construction contractor. Therefore, specific positions, and their associated descriptions and responsibilities, will be set forth by the Construction Contractor.

5.1 Construction Quality Assurance Team

The CQA team will solely participate in the quality assurance function for installation of the VMS and will not be involved in any other aspect of the construction effort. This team will, however, possess all of the credentials, capabilities, and experience of an independent design/construction oversight team. The duties and responsibilities of each position are described below. One individual or entity may perform multiple CQA responsibilities.

Project Engineer

The Project Engineer is responsible for overall implementation and management of the CQA Plan. The duties and responsibilities of the Project Engineer include the following:

- Provide support to the CQA Manager in interpreting the meaning and intent of the construction plans and specifications and in the performance and supervision of the CQA testing program;
- Identify, as appropriate and in coordination with the CQA Manager, discrepancies or deficiencies in project work;
- Prepare the final completed VMS construction documents;
- Make recommendations to the Construction Manager regarding the approval of construction subcontractors and material vendors;

- Consult with the Owner and Construction Manager during construction to address any unforeseen conditions and approve any design modifications that may be required as a result;

- Review and evaluate change orders proposed by the Construction Contractor, Owner, or CQA team. All change orders will require a signature indicating approval from all above-referenced parties;

- Assist the Owner in the preparation of Regulatory Agency required documentation; and

- Provide other technical support as required.

CQA Manager

The CQA Manager will report directly to the Project Engineer. The duties and responsibilities of the CQA Manager include the following:

- Implementation of the CQA Plan;

- Perform and/or oversee all CQA testing activities;

- Coordinate CQA activities with the Construction Manager and the Project Engineer;

- Review and approve the CQC Plan;

- Review CQA and CQC Plan reporting, testing results, and certifications; and

- Provide CQA documentation to the Regulatory Agency.

The general purpose of the CQA Manager is to ensure that the Construction Contractor provides a full, complete, and properly constructed product in accordance with all plans and specifications. The primary duties of the CQA Manager are to verify that all quality assurance and quality control (QA/QC) tests required under the construction contract are performed, and assure that all installed equipment and materials have passed the required tests. The CQA Manager will complete material and equipment tests and maintain reports of testing results, any failures, and any corrective actions employed to obtain acceptable test results. The CQA Manager shall be permitted to suspend construction activities under conditions such as inclement weather, where they believe the integrity of the VMS or any of its components will be compromised.

Field CQA Inspectors

Field CQA Inspectors will report directly to the CQA Manager and will be present during all major VMS construction activities. The duties and responsibilities of this position include the following:

- Visually inspect VMS materials imported to the site for conformance with contract specifications;
- Observe field sampling and testing performed by the Construction Contractor's CQC staff, and review test results;
- Observe and record observations regarding the storage and handling of equipment and materials; and
- Prepare daily reports documenting all contractor activities.

5.2 Construction Quality Control Team

Key positions in the Construction Contractor's CQC team will be delineated in the construction contract; e.g., Contractor Superintendent, Contractor CQC Manager, etc. Other CQC positions and responsibilities will be assigned at the discretion of the contractor. Team members may be employed directly by the contractor, or as subcontracted firms or individuals. One individual or entity may perform multiple CQC responsibilities. The CQC team will consist of the following positions, or equivalent:

Contractor Superintendent

The Construction Contractor Superintendent will have overall responsibility for implementing the CQC program, including appointment of a CQC Manager, and providing daily construction reports documenting testing and construction activities.

CQC Manager

The CQC Manager will be responsible for overseeing all quality control testing performed by the contractor and providing contractor certification reports to the CQA Manager. Other related duties will include coordinating drawing submittals, providing required samples, and coordinating work and testing with the CQA Manager. The CQC Manager will provide daily construction reports which document all testing and describe construction activities performed at the site. The CQC Manager will report directly to the Construction Contractor Superintendent.

Field CQC Inspectors

Field CQC Inspectors will report directly to the CQC Manager and will be present during all major construction activities. The duties and responsibilities of this position include the following:

- Visually inspect materials imported to the site for conformance with contract specifications and for variations from tests completed prior to the materials being delivered to the site;

- Observe and record observations regarding the storage and handling of equipment and materials; and

- Prepare daily reports documenting all contractor activities.

5.3 Owner

The Owner is in control of the project and selects all associated parties (with the exception of the Regulatory Agency) to assist in the execution of the project work. The Owner of this project is of Fremont State Street Center, LLC (FSSC). Specific responsibilities and authorities of the Owner include the following:

- Selecting the Construction Contractor and the Project Engineer;

- Stopping the Contractor's work if it is found to be defective or out of compliance with the construction plans;

- Approving changes to the construction plans including all Addenda, Change in Work Directives/Field Orders, and Change Orders;

- Providing final documentation to the Regulatory Agency to support construction completion reporting requirements; and

- Communicating with the Regulatory Agency, the Project Engineer, and Construction Contractor throughout the design, construction, and completion reporting process.

5.4 Construction Manager

The Construction Manager oversees all construction activities and serves as a representative of the Owner. The Construction Manager for this project will be determined prior to commencement of construction. Specific responsibilities and authorities of the Construction Manager include the following:

- Managing and representing the interests of the Owner during construction;

- Retaining the VMS Construction Contractor under contract;

- Communicating with the Owner, Construction Contractor, and any subcontractor regularly throughout construction;

- Stopping the Construction Contractor's work if it is found to be defective or out of compliance with the VMS construction plans;

- Performing daily construction administration and management;

- Reviewing and approving the Construction Contractor's submittals, requests, invoices, and completed work;
- Maintaining all project documentation that is required by the Regulatory Agency;
- Observing and documenting that the work of the Construction Contractor meets the technical specifications in the construction plans;
- Managing, scheduling, and coordinating the required CQA activities with the CQA Manager;
- Reviewing manufacturer quality control (MQC) and CQC test results, data, and installed work to verify compliance with the construction plan requirements; and
- Preparing CQA documentation in coordination with CQA Manager for submittal to the Regulatory Agency.

5.5 Regulatory Agency

The Alameda County Department of Environmental Health (ACEH) is the Regulatory Agency for this project. The Regulatory Agency has the following specific responsibilities and authorities: reviewing, providing comments on, and approving the design documents submitted by (or on behalf of) the Owner, including the Design Report, the construction plans, and the construction completion report.

6.0 VMS SPECIFIC QUALITY ASSURANCE MEASURES

The following report section summarizes CQA Plan activities which are specific to the VMS construction process.

6.1 Construction Contractor Requirements

The Construction Contractor shall provide proof of licensure and the appropriate health and safety certifications as required by local, state, and federal agencies for both the Construction Contractor and the subcontractor as appropriate.

The Construction Contractor shall provide documentation demonstrating that they or their subcontractor meets the qualification requirements specified in the construction plans for the successful installation of Geo-Seal membrane and Vapor-Vent systems. The Construction Contractor shall also provide documentation that they or their subcontractor are a manufacturer certified installer.

6.2 Subgrade Preparation

Prior to placement of the Vapor-Vent system vent lines and the Geo-Seal membrane material, the subgrade surface must be prepared in accordance with the construction plans. The Construction Contractor must provide documentation (i.e. laboratory testing results, permeable material certifications) to the Construction Manager, Project Engineer, and CQA Manager confirming that the properties of the subgrade material meets the requirements of the construction plans. The Construction Manager along with the CQA Manager and/or Field CQA Inspector must inspect and approve the final prepared subgrade surface prior to the Vapor-Vent system installation. Upon completion of the Vapor-Vent system installation, the Construction Manager along with the CQA Manager and/or Field CQA Inspector will inspect and approve the Vapor-Vent system before Geo-Seal membrane installation begins.

6.3 VMS Component Installation

The installation of the Vapor-Vent system and Geo-Seal membrane will be performed in accordance with the construction plans, the manufacturer's recommendations, and industry-accepted standards.

Vapor-Vent and Geo-Seal installation must be completed by a manufacturer-certified installer. The Construction Contractor may subcontract a certified installer to perform the installation and associated QC testing of the system components, if necessary. Subcontractor management and quality of work is considered the responsibility of the Construction Contractor.

6.3.1 Manufacturer Quality Control

The Vapor-Vent system and Geo-Seal membrane manufacturer (Land Science Technologies) shall provide MQC product certification and testing data indicating the materials meet or exceed the performance requirements specified in the construction plans. The product certifications and testing data shall be supplied to the Construction Manager, Project Engineer and CQA Manager for review and approval prior to delivery of the material to the site. The required MQC product certifications and testing data for each material are further described in the technical specifications included in the construction plans.

6.3.2 Handling and Storage

The Construction Contractor shall inspect the Vapor-Vent and Geo-Seal materials and related equipment at the time of delivery to the site and confirm they are in accordance with the construction plan specifications. Damaged materials or those not meeting the specifications shall be segregated and labeled for repair or replacement.

The Construction Contractor is responsible for the storage and handling of the Vapor-Vent and Geo-Seal materials. The materials must be stored in a clean, dry, and protected location and within the temperature range required by the manufacturer. Vapor-Vent and Geo-Seal material

delivery and inspection records must be provided by the Construction Contractor to the Construction Manager and CQA Manager.

6.3.3 Vent System CQC Measures

The Construction Contractor shall inspect the Vapor-Vent and associated vent risers at the time of installation to ensure the system is in accordance with construction plans. Points of inspection include the following:

- Thickness of the subgrade material prior to the placement of Vapor-Vent lines;
- Location and dimensions of the installed Vapor-Vent lines;
- Location of slab penetrations in accordance with the construction plans;
- Condition of the Vapor-Vent line connection points;
- Condition of the vent riser at each floor elevation;
- Condition of the vent riser at each roof penetration; and
- Measuring setbacks and clearances for roof vents.

The Construction Contractor shall also complete an as-built location map of the Vapor-Vent system, including Vapor-Vent line horizontal locations, dimensions, and slab penetration locations.

Inspections shall be documented by the Construction Contractor and submitted to the Construction Manager and CQA Manager for review and approval.

6.3.4 Geo-Seal CQC Measures

The Construction Contractor shall perform the manufacturer-required QC inspection and testing procedures for the installed Geo-Seal membrane. The manufacturer's QC procedures are presented in the Geo-Seal specifications. The Geo-Seal specifications identify each classification of testing, testing frequency, and summarize the specific testing requirements.

Inspection of the installed Geo-Seal membrane by the Construction Contractor must be performed in order to identify any areas that require repair and/or replacement. Any material not meeting the manufacturer requirements or construction plan specifications shall be repaired or removed and retested by the Construction Contractor, as needed. Field QC testing will also be observed by the CQA Manager and/or the Field CQA Inspector. The Construction Contractor shall document all of the Geo-Seal field QC test results, verifications, and inspections for submittal to the CQA Manager.

6.4 VMS Installation Review and Acceptance

The Project Engineer shall review the VMS as-built drawings, field QC test results, and inspection documentation at time of the VMS installation completion. Upon review, the Project Engineer will confirm and accept the Vapor-Vent system and Geo-Seal membrane installations were completed in accordance with the construction plans and the CQA and CQC Plans.

7.0 NON-CONFORMANCE ACTION PLAN

Non-conforming materials or work are defined as material provided or work completed that does not comply with the requirements/specifications of the construction plans.

7.1 Non-Conformance Identification and Reporting

When either of the following two conditions exist, a Non-Conformance Action Plan should be initiated:

- Repeated attempts to construct a component of the work yields a non-conforming product as documented by CQC testing and/or inspection and documentation by the CQC Team; and

- CQA monitoring, inspection, or testing verifies that materials or completed work do not meet the minimum requirements specified for the Project.

7.2 Non-Conformance Action Plan

In general, the Non-Conformance Action Plan consists of the following:

- Define the problem;

- Verify that the testing or observations which identify the problem are accurate;

- Define the extent of the non-conformance using the available test information or by completing additional tests; and

- Resolve the problem through additional work, re-work, or material replacement to the limits of the non-conforming area.

The first step identifies a potential problem found by inspection, and then testing further defines the problem. The second step is to verify that the original result is representative of the construction materials or in-place conditions. Test results that are not in compliance with the construction plans could be caused by a problem with sampling, instrument calibration, or laboratory testing errors. For in-place field testing, two additional tests will be taken within a

few feet of the failed test location to verify that the test result is correct. When verification testing shows that the initial result seems to be in error, the initial result can be considered an outlier, and documented as such. If the original test result is verified, then additional testing may be conducted to define the limits of the area that is in non-conformance. Repairs or replacement will then be made to the area that is in non-conformance. Results of all testing (non-conformance, verification, and final acceptance) will be reported to the CQA Manager.

7.3 Corrective Action Acceptance

A corrective action that is implemented must be confirmed successful through supporting verification testing and/or inspection/measurement. Reported non-conformances must be remedied by accepted corrective actions reviewed and approved by the CQA Manager.

8.0 DOCUMENTATION

Upon completion of all VMS construction activities, CQA activities, and approval from the Owner that the project is considered complete, a Construction Completion Report will be authored by the Project Engineer. The project will not be considered complete until this Construction Completion Report has been approved by the Regulatory Agency.

8.1 Final Completion

A final inspection of the site is required to confirm Final Completion of the contractual requirements between the Construction Contractor and the Owner. Upon notice from the Construction Contractor that the project is complete, the Owner, Construction Contractor, Project Engineer, and Construction Manager will meet to inspect the completed VMS. A punch list of incomplete work items, if any, will be developed for the Construction Contractor to complete prior to Owner granting Final Completion.

8.2 Construction Completion Report

After Final Completion status has been granted to the Construction Contractor, the Construction Contractor will submit all record documents for the VMS to the Owner and Project Engineer. The Project Engineer will prepare the Construction Completion Report for review and approval by the Owner and final submission to the ACEH. The report will include the following:

- Description of the VMS installation work performed;
- A summary of VMS inspection and testing results;
- Photographic documentation, showing significant stages of construction;

- VMS documentation including: material test reports, material specifications, change orders, As-Built Drawings, and other documents necessary to accurately define the actual constructed work; and

- A statement, bearing the seal and signature of the CQA Manager and Project Engineer, certifying that the completed project conforms to the construction plans including this CQA Plan.

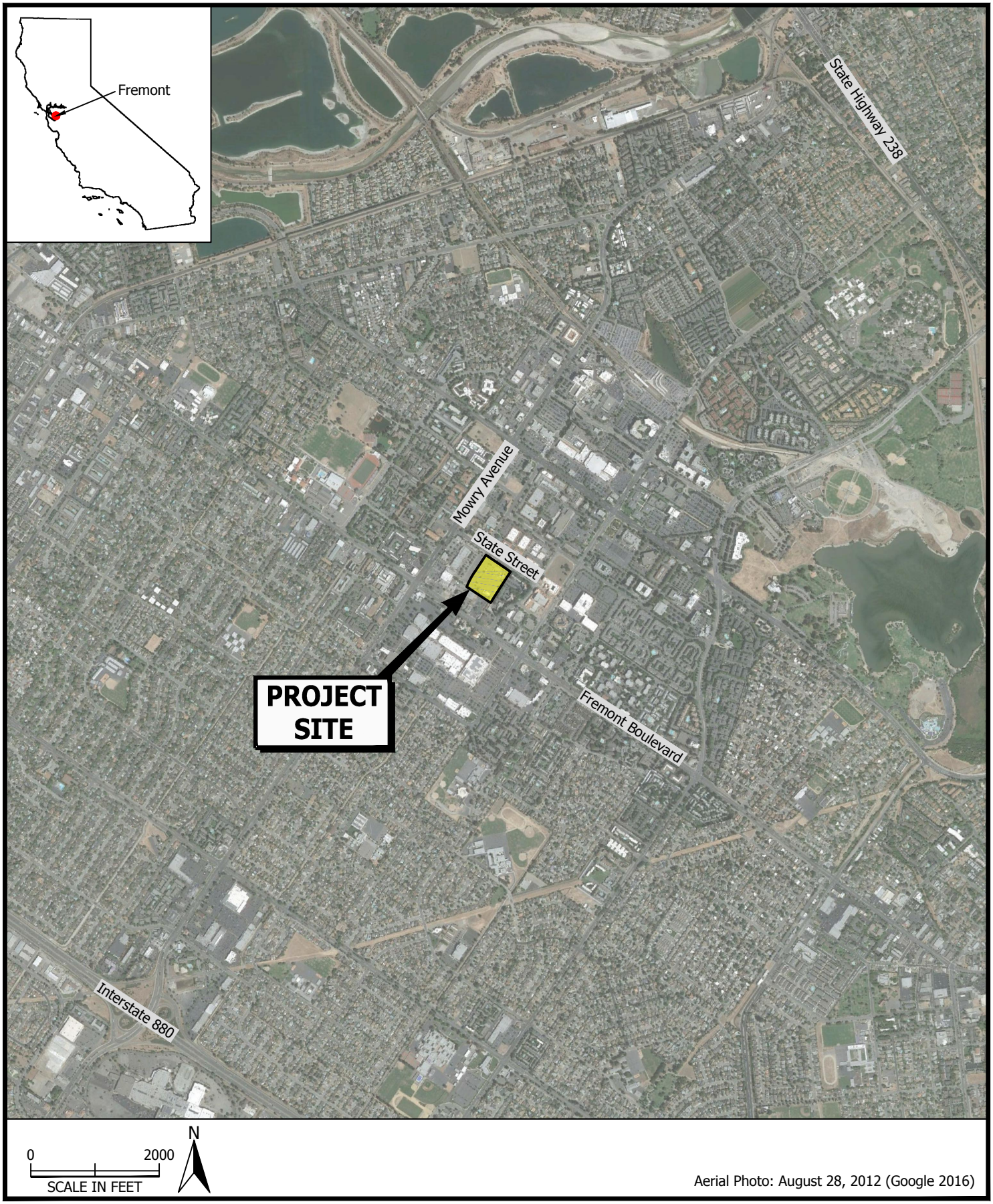
Copies of the Construction Completion Report and all associated VMS record documents will be maintained by the Owner and Project Engineer in accordance with the required legal statutes.

9.0 REFERENCES

PES Environmental, Inc. (PES), 2014. *Phase I Environmental Assessment, 39155 and 39183 State Street, Fremont, California*. July 15.

KTGY Group, Inc. (KTGY), 2015. *100% Design Development Drawings, State Street Center On-Grade, Fremont, California*. November 30.

ILLUSTRATIONS



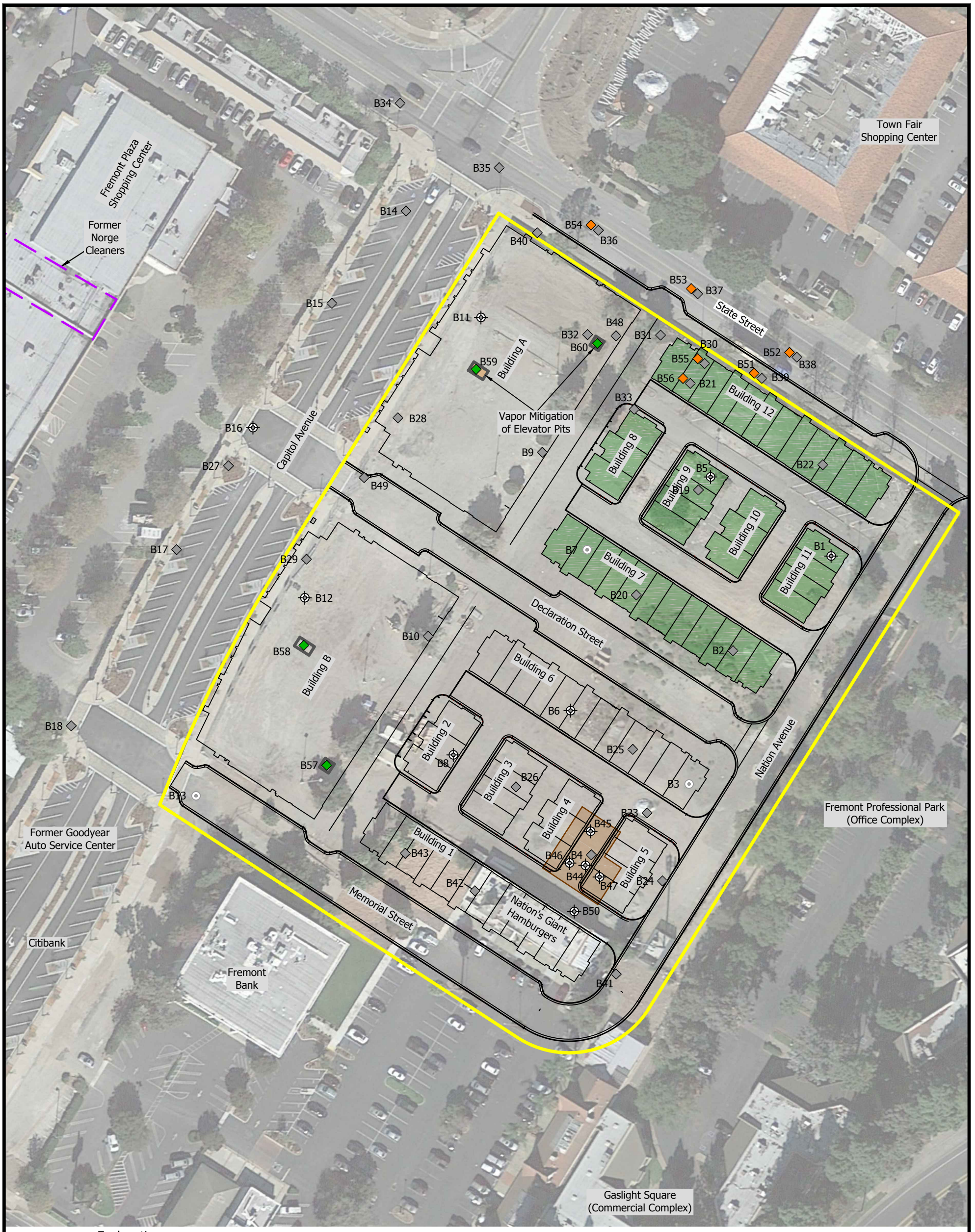
Aerial Photo: August 28, 2012 (Google 2016)

PES Environmental, Inc.
Engineering & Environmental Services

Site Location and Vicinity
CQA Plan
State Street Center
Fremont, California

PLATE
1

220.003.03.002	22000303002_CQA_1	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Explanation

- Approximate Property Boundary
- B17 — Soil Vapor Sampling Location (PES)
- B6 — Soil Vapor and Soil Sampling Location (PES)
- B13 — Soil Sampling Location (PES)
- B53 — Soil Vapor Sample Location
- B57 — Soil Vapor Sample Location beneath planned elevator pit
- Planned Area of Excavation
- Vapor Mitigation Areas for Slab-On-Grade Townhomes
- Vapor Mitigation Areas for Below Grade Parking Elevator Pits

0 80
SCALE IN FEET

N

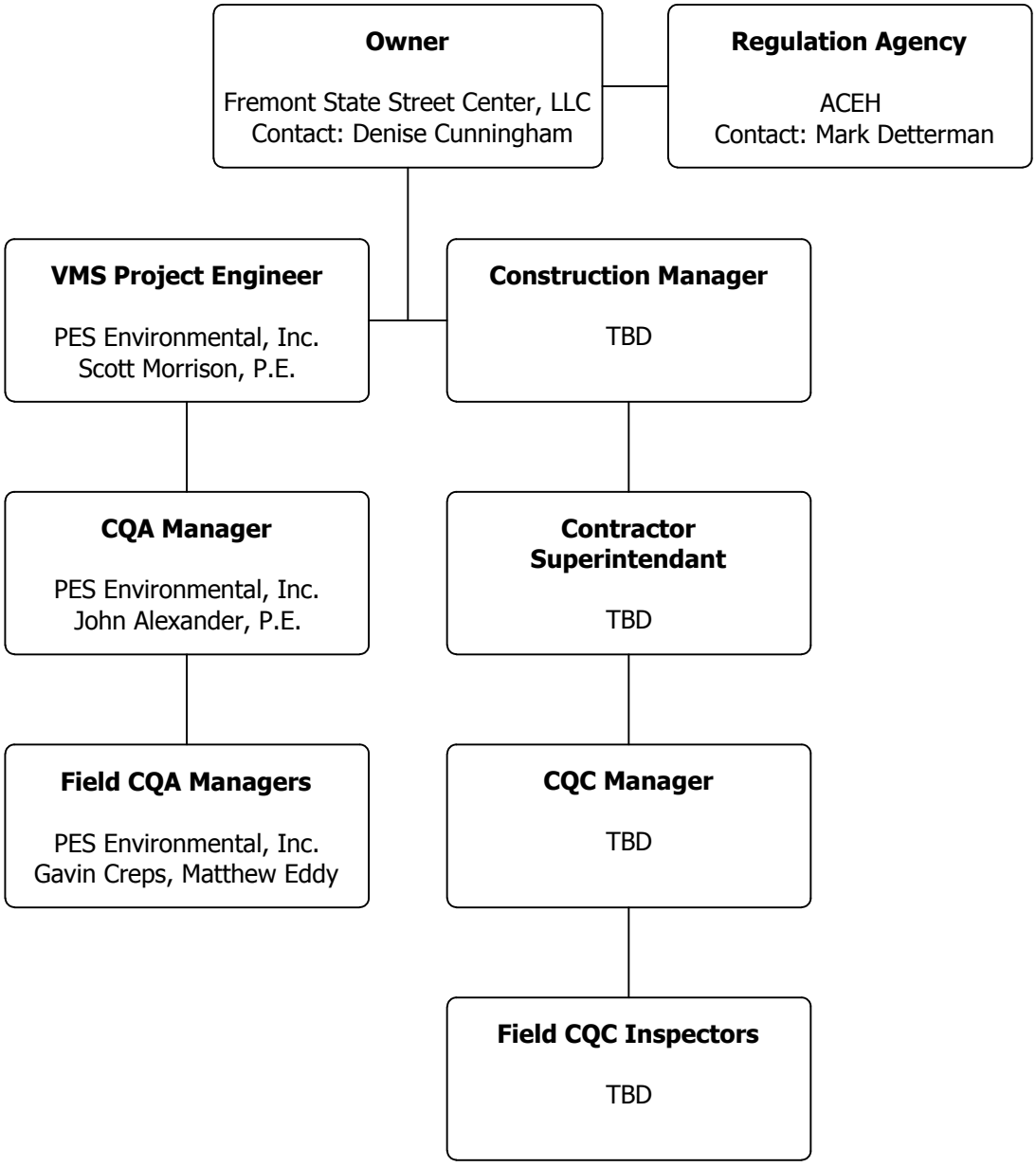
Aerial Photo: October 30, 2015 (Google 2016)

PES Environmental, Inc.
Engineering & Environmental Services

Proposed Redevelopment Plan
CQA Plan
State Street Center
Fremont, California

PLATE
2

220.003.03.002	22000303002_CQA_2	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Abbreviations
ACEH = Alameda County Department of Environmental Health
CQA = Construction Quality Assurance
CQC = Construction Quality Control
VMS = Vapor Mitigation System
TBD = To Be Determined

PES Environmental, Inc.
Engineering & Environmental Services

Quality Program Organizational Chart
CQA Plan
State Street Center
Fremont, California

PLATE
3

220.003.03.002	22000303002_CQA_3	SM	3/16
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

DISTRIBUTION

VAPOR MITIGATION SYSTEM
BASIS OF DESIGN REPORT
STATE STREET CENTER
FREMONT, CALIFORNIA

MARCH 24, 2016

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