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Peter Solar
Managing Director

Mr. Gabe Stivala, P.G.
ATC Group Services LLC
915 Highland Point Drive, Suite 250
Roseville, CA 95678

Subject: **Revised Soil and Groundwater Management Plan Addendum and
Corrective Implementation Action Plan**
2820 and 2855 Broadway, Oakland, CA
Alameda County LOP No. RO 3198

Dear Mr. Stivala:

I have read and acknowledge the content, recommendations and/or conclusions contained in the attached document or report submitted on my behalf to ACDEH's FTP server and the SWRCB's GeoTracker website.

Sincerely,

A handwritten signature in blue ink that reads "PS" with a stylized flourish.

Peter Solar
Managing Director
Alliance Residential Company
477 Pacific Ave, Suite One
San Francisco, California 94133



**ENVIRONMENTAL • GEOTECHNICAL
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**REVISED SOIL AND GROUNDWATER MANAGEMENT PLAN ADDENDUM AND
CORRECTIVE ACTION IMPLEMENTATION PLAN**

**Proposed Broadway Valdez Development Site
2820 and 2855 Broadway
Oakland, California
Alameda County LOP No. RO 3198**

**City Of Oakland
Building Department Permit Numbers
B1604083 and B1604077**

Submitted to:

Ms. Dilan Roe, P.E.
Alameda County
Environmental Health Services
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Submitted by:

ATC Group Services, LLC
915 Highland Pointe Drive, Suite 250
Roseville, California 95678

On Behalf of:

Mr. Peter Solar
Broadstone on Broadway, LLC
477 Pacific Ave, Suite One
San Francisco, California 94133

ATC Project No. 118EM01075

June 13, 2017

CERTIFICATION*

Information, conclusions, and recommendations contained in this *Revised Soil and Groundwater Management Plan Addendum and Corrective Action Implementation Plan* were prepared under the supervision of an ATC California Professional Geologist.

Prepared by:
ATC Group Services, LLC



Gabe Stivala, P.G.
Senior Geologist



Andrew Stuart
National Program Director

* A professional geologist's certification of conditions comprises a declaration of his or her professional judgment. It does not constitute a warranty or guarantee, expressed or implied, nor does it relieve any other party of its responsibility to abide by contract documents, applicable codes, standards, regulations, and ordinances.

cc: Mr. Peter Solar, Broadstone on Broadway, LLC
Ms. Elizabeth Mack, Locke Lord LLP

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1.0 Introduction

On behalf of Broadstone on Broadway, LLC (Broadstone on Broadway), ATC Group Services, LLC (ATC) has prepared this *Revised Soil and Groundwater Management Plan Addendum and Corrective Action Implementation Plan* (Revised SGMP Addendum and CAIP) for the Proposed Broadway Valdez redevelopment located at 2820 and 2855 Broadway (Site) in Oakland, California (**Figure 1 and Figure 2**). The Revised SGMP Addendum portion of this document revises details of the proposed vapor mitigation system proposed in ATC's *Revised Soil and Groundwater Management Plan*, dated April 28, 2017. The revisions address additional vapor intrusion concerns for the 2820 Broadway property expressed by the Alameda County Environmental Health (ACEH) in a May 23, 2017 meeting between the ACEH, Broadstone on Broadway LLC, and ATC and subsequent telephone conversations related to that meeting in late May and early June 2017. The CAIP portion of this document proposes corrective actions to further address petroleum related impacts in soil and groundwater in the vicinity trench basin at the 2820 Broadway property, also discussed in the May 23, 2017 meeting.

The City of Oakland Planning Department plan number for this project is PLN16110. The Building Department permit numbers are B1604083 for the 2820 Broadway property and B1604077 for the 2855 Broadway property. The Site consists of two properties located on opposing sides of Broadway between 28th and 29th Streets in Oakland, California. APN 9-685-69-1 at 2820 Broadway is located on the eastern side of Broadway and extends east to the terminus of Valdez Street. APN 9-686-3 at 2855 Broadway is located on the western side of Broadway and bound to the west by Webster Street.

2.0 Mitigation Measures for Future Use

Due to the presence of the volatile organic compounds (VOCs) in groundwater, mitigation measures to protect future occupants have been added to the redevelopment/construction design for both the 2820 Broadway and 2855 Broadway properties. Based on the site assessment, the only potential exposure pathway under the future site development condition relates to vapor intrusion to indoor air. Revisions to the measures to mitigate potential vapor intrusion risks at each property are described in the following sections.

2.1 Vapor Mitigation at 2820 Broadway (APN 9-685-69-1) - REVISED

At 2820 Broadway, benzene, ethylbenzene, trichloroethene (TCE), and carbon tetrachloride have been detected in groundwater samples at concentrations in excess or equal to environmental screening levels (ESLs) for vapor intrusion risk from shallow groundwater. Note that the concentrations of benzene, ethylbenzene, and TCE in groundwater in excess of the Shallow Groundwater Vapor Intrusion ESLs are limited to the eastern half of the 2820 Broadway property, while a carbon tetrachloride concentration equal to the Shallow Groundwater Vapor Intrusion ESL, was detected at one location in the western portion of the property. The eastern portion of the property will be developed as a two-level, podium-style parking garage. The two level parking garage extends into the western portion of the site, with the western most section consisting of commercial tenant units on the first level and residential amenity space on the second floor. Floors above the second level consist of residential tenant units.

To address the potential for vapor intrusion through the entire building slab, including elevator pits and stairwells into occupied portions of the building, vapor intrusion mitigation measures will be implemented across the entire footprint of the proposed building at the 2820 Broadway property, including parking garage areas. The measures will include a vapor barrier and utility trench dams. Although not intended for continuous human occupancy the parking garage will be mechanically ventilated in accordance with local code providing additional mitigation for potential vapors in this area.

2.1.1 Vapor Barrier

The revised mitigation for this property consists of the application of a Geo-Seal vapor barrier across the entire future structure footprint; installed beneath the entire first level slab and elevator pits. The original vapor barriers proposed for the 2820 Broadway property in the *Revised Soil and Groundwater Management Plan*, dated April 28, 2017, will no longer be applied; the original barriers included a limited application of a Coreflex 60 vapor barrier manufactured by CETGO to elevator pits and Stego wrap beneath the western commercial space.

Geo-Seal® is a sub-slab vapor intrusion barrier system and was selected to address vapor intrusion concerns for the 2820 Broadway property. Geo-Seal is an effective vapor barrier for the subsurface contaminants at the site including chlorinated and petroleum-related VOCs (i.e. TCE, carbon tetrachloride, and benzene). The barrier will be installed between the slab of the building and the ground surface to eliminate vapor intrusion pathways and prevent contaminant vapors from intruding through the slab to the proposed overlying structure. The product consists of a base layer of a high density polyethylene (HDPE) sheet membrane (Geo-Seal Film 11) with a thickness of 11 millimeters (mm), an interior spray-applied asphalt latex (Geo-Seal Core 30) layer with a thickness of 30 mm, and a protective top layer of HDPE sheet membrane (Geo-Seal Film 11) with a thickness of 11mm.

Details of the Geo-Seal application specifications, QA/QC protocols, site-specific product certification letter from the manufacturer, and product brochure are included in **Appendix A**. **Figure 3** depicts the location of the proposed barriers.

2.1.2 Revised Utility Trench Dam Configuration (2820 Broadway)

Three utility trench dams will be installed within proposed sanitary sewer and storm sewer utility trenches at the 2820 Broadway property to prevent lateral VOC migration through these trenches. The *Revised Soil and Groundwater Management Plan*, dated April 28, 2017, originally proposed two trench dams. The revised configuration includes a third utility trench dam that will be installed at the western most edge of the property within the proposed sanitary sewer trench. The trench dams will prevent VOC migration along utility trenches 1) from the eastern portion of the property to the western portion of the property where ground level commercial units will be located; 2) from the residual VOC impacts in the eastern portion of property offsite to the eastern offsite property; and 3) from an unknown offsite carbon tetrachloride source(s) onto the 2820 Broadway property from the west. **Figure 3** depicts the locations of the proposed utility trench dams.

Each trench dam will have a horizontal thickness of at least three feet, in the direction of the trench. The bottom and sides of the trench will extend at least one foot into surrounding fill on the bottom and sides to prevent potential vapors from migrating around the sides and bottom of the dam. The top of the dam will be at an elevation that is flush with bottom of the proposed building's first floor slab.

A specification sheet from the building plans and application specification for the utility trench dam are included in **Appendix D** of the *Revised Soil and Groundwater Management Plan*, dated April 28, 2017. .

2.2 Vapor Mitigation at 2855 Broadway (APN 9-686-3)

This document does not propose changes to the vapor mitigation originally proposed for the 2855 Broadway property in the *Revised Soil and Groundwater Management Plan*, dated April 28, 2017.

2.3 Vapor Mitigation System Construction Quality Assurance

ATC will observe vapor barrier installation at both 2820 and 2855 Broadway and utility trench dam installation at 2820 Broadway as the Construction Quality Assurance engineer in accordance with protocols described in section 6.12.4 of the *Revised Soil and Groundwater Management Plan*, dated April 28, 2017.

Additional detail regarding the barrier installation process and QA/QC protocols specific to Geo-Seal are detailed in the construction specification included in **Appendix A** of this document.

2.4 Maintenance of Vapor Barriers and Utility Trench Dam

At both 2820 and 2855 Broadway, if subsurface work is planned that may disturb barriers, the Owner will ensure that appropriate measures are taken to protect barriers and the utility trench dams. Similarly, if subsurface work requires penetration or disturbance of barriers or the dam, measures will be taken to restore these items upon completion of work.

3.0 Corrective Action Implementation Plan (2820 Broadway)

Corrective action will be performed in the eastern portion of the 2820 Broadway property to further address potential vapor intrusion risks related benzene impacts in soil and groundwater in the vicinity of the existing trench basin. The corrective action will consist of over-excavating soil the area with highest benzene impacts in soil followed by application of oxygen releasing compound (i.e. ORC Advanced® Pellets).

3.1 Remedial Excavation of Hydrocarbon-Impacted Soil

Vadose zone and saturated zone soil containing concentrations of TPHd and VOCs in excess of Groundwater Leaching ESLs was encountered in soil borings B21 and B29 advanced in the vicinity of the trench basin. Petroleum hydrocarbons and VOCs in vadose zone and saturated soil at concentrations in excess of Groundwater Leaching ESLs will be excavated to a depth of 15 feet bgs (**Figure 4**). The excavation will be performed following the removal of the trench basin and will be performed as part of the general construction grading activities. The excavation will be performed in the area of the trench basin and will extend laterally northward to boring B-21. Estimated excavation limits are shown in **Figures 5 and 6**.

Petroleum hydrocarbon and VOC impacted soil in the vadose zone in this area will be removed to prevent potential future impacts to groundwater and/or vapor intrusion risks. The corrective action goals for the lateral extent of the excavation will consist of petroleum hydrocarbon ESLs from Table S-2 for Leaching to Groundwater Levels for Drinking Water, and include the following:

- TPHg - 770 mg/kg;
- TPHd - 570 mg/kg;
- Benzene - 0.044 mg/kg;
- Toluene - 2.9 mg/kg;
- Ethylbenzene - 1.4 mg/kg;
- Total xylenes -2.3 mg/kg; and
- Naphthalene - 0.033 mg/kg.

Verification samples collected from excavation sidewalls will be compared to the ESLs above and the excavation will be extended laterally if the ESLs are exceeded.

We will excavate to a total depth of 15 feet bgs into the saturated zone. Benzene is the driver for the excavation due to its potential to pose vapor intrusion risks. The areal extent of the excavation into the saturated zone is based on previously collected soil and groundwater data indicating this area is a historic source of benzene to groundwater in the vicinity of the trench basin. Previously collected data indicates detections of benzene in vadose and saturated soil (B-21 and B-29) and concentrations of benzene in groundwater (borings B-21, B-27, and monitoring well MW-1/B-29).

To mitigate residual petroleum impacts that may remain in the saturated zone following excavation, oxygen releasing compound (ORC) will be incorporated into backfill material from 11 feet bgs to the bottom of the excavation at 15 feet bgs. ORC application is discussed in Section 3.2.

The previously estimated volume of potentially impacted soil to be excavated from the eastern portion of the 2820 Broadway property was 1,475 cubic yards. The additional corrective action excavation described above increased the estimated total by approximately 525 cubic yards for a revised total estimate of 2,000 yards.

This corrective action excavation will be performed concurrently and in accordance with the construction related excavation for utilities, elevator pits and footings previously described in Section 6.0 of the *Revised Soil and Groundwater Management Plan*, dated April 28, 2017.

3.1.1 Verification sampling

Verification sampling will be performed in accordance with protocols described in Section 6.7.3 of the *Revised Soil and Groundwater Management Plan*, dated April 28, 2017

3.1.2 Dewatering

Dewatering during excavation into the saturated zone will be performed using containment methods as needed by pumping water into a holding tank on-site (e.g. Baker Tank). The water in the tank will be allowed to settle for at least 24 hours, then a representative profile sample will be collected to determine proper disposal. The contained water will be disposed of at an appropriate California permitted waste disposal facility.

3.1.3 Soil Disposal

Excavated soil will be disposed of in accordance with protocols described in Section 6.7.4 of the *Revised Soil and Groundwater Management Plan*, dated April 28, 2017.

3.2 Application of Oxygen Releasing Compound

To mitigate residual petroleum hydrocarbons remaining in soil and groundwater in the saturated zone in the vicinity of the trench basin, ORC Advanced® Pellets, manufactured by Regenesis, will be applied to the base of the excavation. This product accelerates biodegradation of petroleum hydrocarbons and is designed specifically for use in excavations. Application of the solid form of ORC allows for controlled-release oxygen for up to 12 months. The product also contains micro-nutrients nitrogen, phosphorous and potassium (N,P,K) which may benefit aerobic microorganisms and enhance biodegradation.

Based on the anticipated extent of the excavation and the petroleum hydrocarbon concentrations that will remain in place, Regenesis recommends 0.1% amount of product be mixed into the bottom 4 feet of backfill following excavation, which amounts to approximately 720 pounds of ORC Advanced® Pellets. The product will be applied to the backfill by placing it into the excavator bucket and then mixed into the bottom four feet of backfill from 11 feet bgs to 15 feet bgs. Three feet of applied product will be within the saturated

zone. The proposed lateral and vertical application extents of the product are shown in **Figures 5 and 6**, respectively. Product application instructions and specifications are included in **Appendix B**.

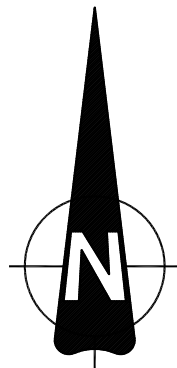
4.0 Limitations

This document was prepared on behalf of Broadstone on Broadway, LLC and is specific to the 2820 and 2855 Broadway Site. It was prepared in accordance with generally accepted professional engineering and environmental consulting practices existing at the time this report was prepared and applicable to the location of the site. The opinions and conclusions are based on the data and are specific to the site.

FIGURES



SOURCE: GOOGLE MAPS. RETRIEVED 12/10/15. NOT TO SCALE

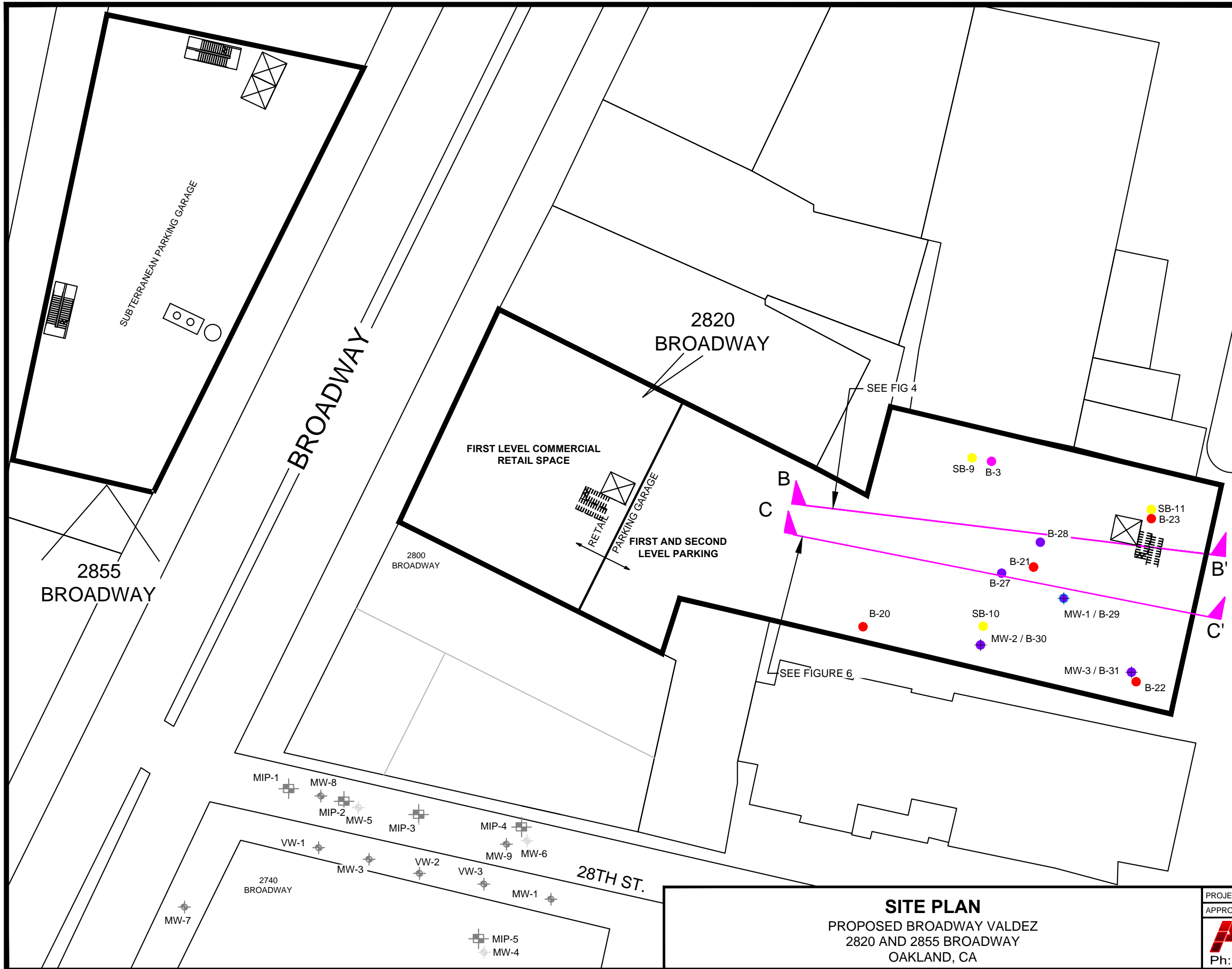


SITE VICINITY MAP















ALLIANCE REALTY
 2800, 2820, 2855 BROADWAY
 OAKLAND CALIFORNIA

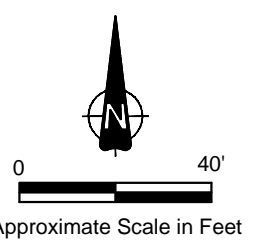
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APPROVED BY: GS	DRAWN BY: OHR	1

ATC 915 Highland Pointe Drive Suite 250
 Roseville, California 95678
 Ph: (916) 724-5201 *** Fax: (916) 223-5201




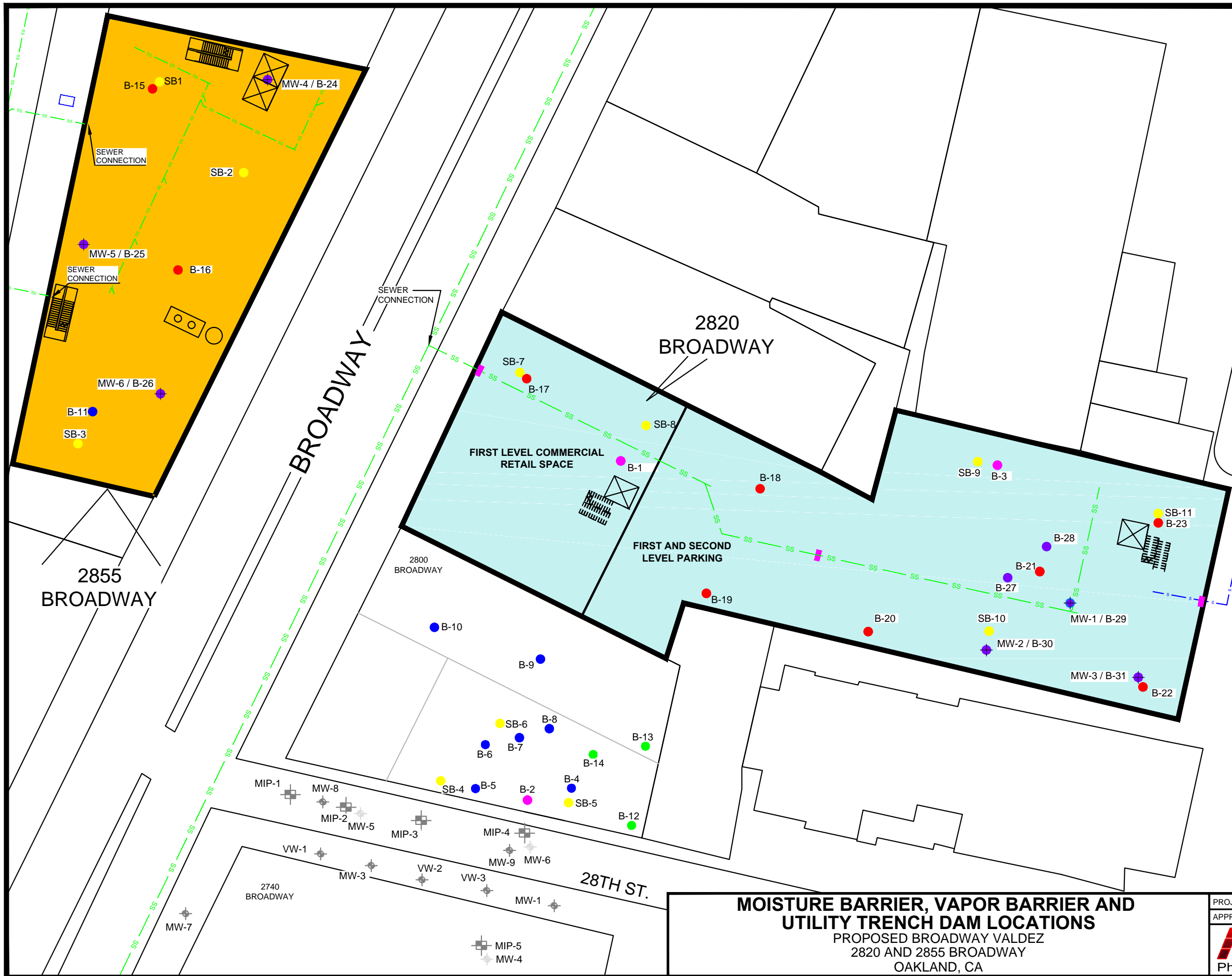
LEGEND

-  EXISTING WATER UTILITY LINE
-  EXISTING SEWER UTILITY LINE
-  PROPOSED ELEVATOR LOCATION
-  PROPOSED STAIRWELL LOCATION
-  SB-1 SOIL BORING - APRIL 8, 2015 (AEI)
-  B-1 SOIL BORING - SEPTEMBER 19, 2015
-  B-4 SOIL BORING - OCTOBER 3, 2015
-  B-12 SOIL BORING - OCTOBER 10, 2015
-  B-15 SOIL BORING - NOVEMBER 5 & 6, 2015
-  B-27 SOIL BORING - JULY 7 & 8, 2016
-  MW-1 / B-26 MONITORING WELL / SOIL BORING - JULY 7 & 8, 2016
-  MW-9 HISTORICAL MONITORING WELL (ARCADIS)
-  MIP-3 HISTORICAL MIP BORINGS, APRIL 2013 (ARCADIS)
-  CROSS SECTION TRANSECT LINE



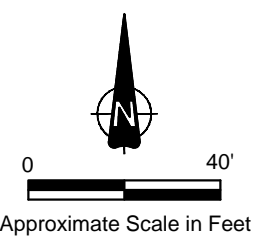
SITE PLAN
 PROPOSED BROADWAY VALDEZ
 2820 AND 2855 BROADWAY
 OAKLAND, CA

PROJECT NUMBER: 118EM01075	DATE: 6/12/17	FIGURE
APPROVED BY: GS	DRAWN BY: CC	2
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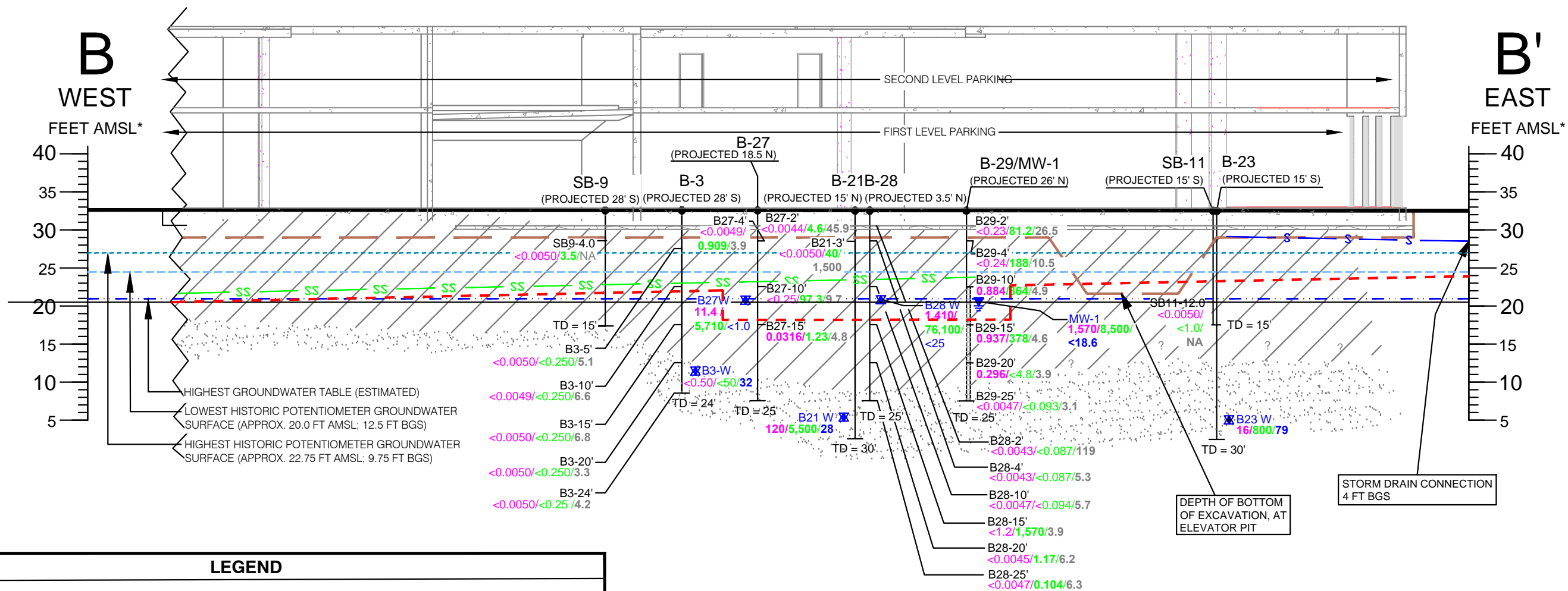
LEGEND

- s — PROPOSED STORM SEWER LOCATION
- ss — PROPOSED SANITARY SEWER LOCATION
- PROPOSED ELEVATOR LOCATION
- PROPOSED STAIRWELL LOCATION
- SB-1 ● SOIL BORING - APRIL 8, 2015 (AEI)
- B-1 ● SOIL BORING - SEPTEMBER 19, 2015
- B-4 ● SOIL BORING - OCTOBER 3, 2015
- B-12 ● SOIL BORING - OCTOBER 10, 2015
- B-15 ● SOIL BORING - NOVEMBER 5 & 6, 2015
- B-27 ● SOIL BORING - JULY 7 & 8, 2016
- MW-1 / B-26 ● MONITORING WELL / SOIL BORING - JULY 7 & 8, 2016
- MW-9 HISTORICAL MONITORING WELL (ARCADIS)
- MIP-3 HISTORICAL MIP BORINGS, APRIL 2013 (ARCADIS)
- VAPOR BARRIER (GEO-SEAL)
- VAPOR BARRIER (CETCO)
- █ UTILITY TRENCH DAM



**MOISTURE BARRIER, VAPOR BARRIER AND
UTILITY TRENCH DAM LOCATIONS**
PROPOSED BROADWAY VALDEZ
2820 AND 2855 BROADWAY
OAKLAND, CA

PROJECT NUMBER: 118EM01075	DATE: 6/12/17	FIGURE
APPROVED BY: GS	DRAWN BY: CC	3
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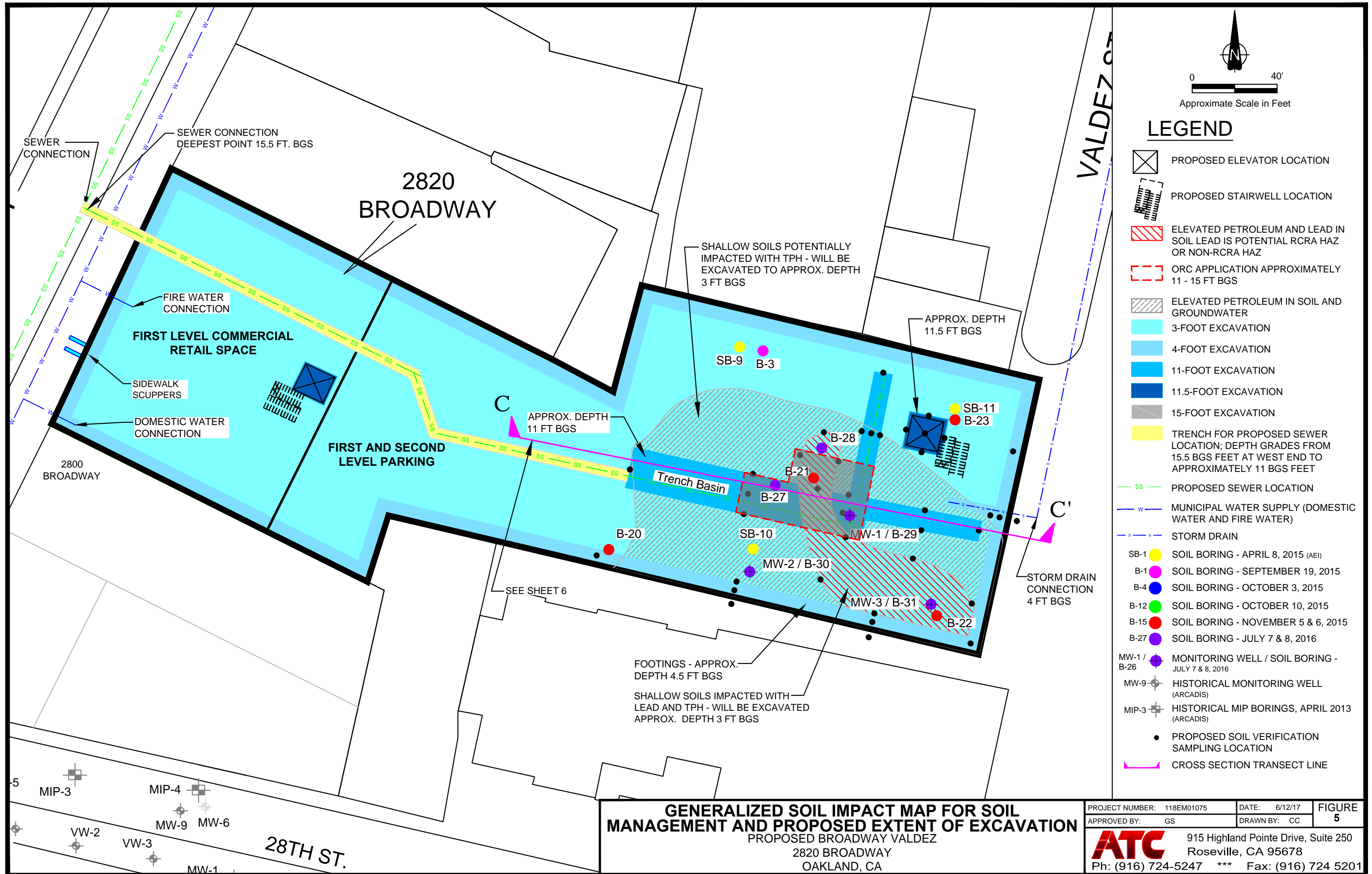
LEGEND

- TOP OF BORING
- SOIL SAMPLE ID AND LOCATION
- SCREENED INTERVALS
- <0.0050/<0.230/4.8 Benzene / TPHg / LEAD - SOIL SAMPLE RESULTS (mg/kg).
- <0.50/<50/<0.50 Benzene / TPHg / TCE - GROUNDWATER SAMPLE RESULTS (ug/L).
- SAND WITH CLAY (SP-SC), SILTY SAND (SM), CLAYEY SAND (SC) COARSE GRAINED SOILS: SAND (SP/SW).
- FINE GRAINED SOILS: SILT (ML), CLAY (CL)
- APPROXIMATE EXTENT OF EXCAVATION FOR LAND DEVELOPMENT
- APPROXIMATE DEEPEST EXTENT OF EXCAVATION FOR SEWER INSTALLATION TRENCH
- PROPOSED SEWER LOCATION
- APPROXIMATE GROUNDWATER TABLE
- APPROXIMATE LOWEST HISTORIC POTENTIOMETER GROUNDWATER SURFACE
- APPROXIMATE HIGHEST HISTORIC POTENTIOMETER GROUNDWATER SURFACE
- APPROXIMATE CURRENT GRADE/GROUND SURFACE
- GROUNDWATER SAMPLE LOCATION
- ND= NOT DETECTED ABOVE LABORATORY REPORTING LIMIT
- TD= TOTAL DEPTH BELOW CURRENT GRADE/GROUND SURFACE EXPLORED AT EACH BORING LOCATION
- (mg/kg) = MILLIGRAMS PER KILOGRAMS
- (ug/L) = MICROGRAMS PER LITER
- * = ELEVATIONS ARE RELATIVE TO CITY OF OAKLAND DATUM WHICH IS APPROXIMATELY +3.0 FEET HIGHER THAN STANDARD MSL




























Cross-Section B-B' - Benzene, TPHg, Lead and TCE in Soil
Groundwater with Projected Stratigraphy and Proposed Development Plans
 PROPOSED BROADWAY VALDEZ
 2820 BROADWAY
 OAKLAND, CALIFORNIA

PROJECT NUMBER: 118EM01075	DATE: 6/12/17	FIGURE
APPROVED BY: GS	DRAWN BY: CC	4
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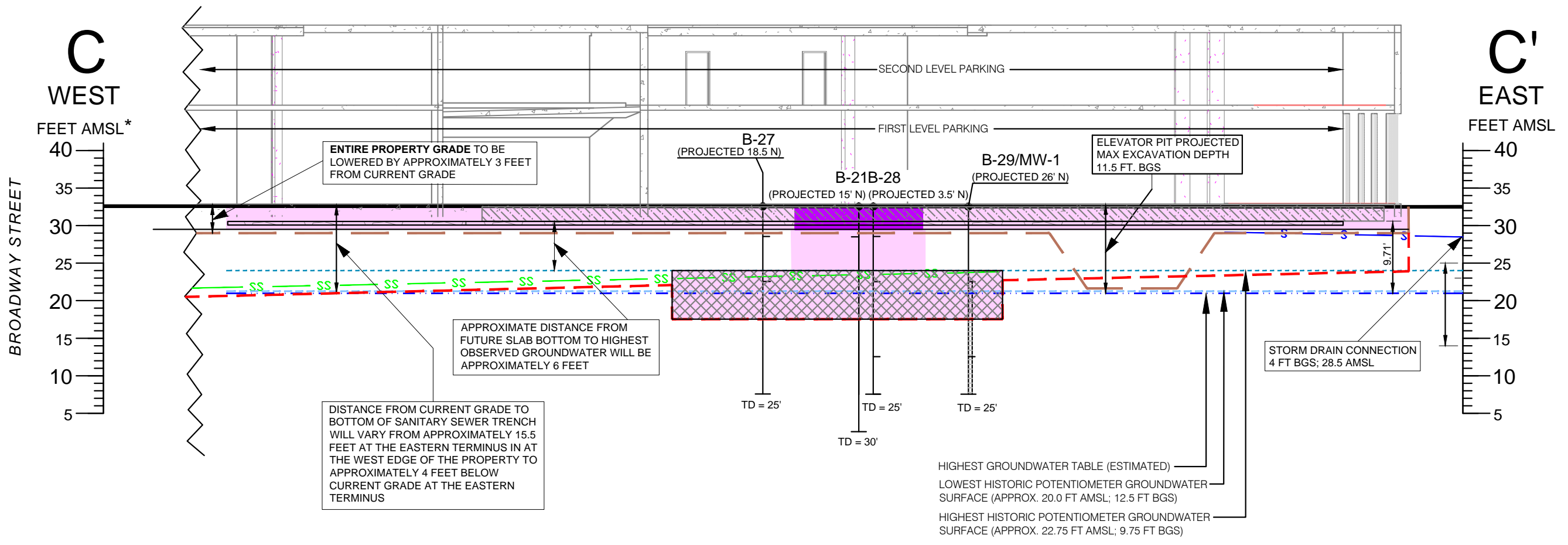
LEGEND

-  PROPOSED ELEVATOR LOCATION
-  PROPOSED STAIRWELL LOCATION
-  ELEVATED PETROLEUM AND LEAD IN SOIL LEAD IS POTENTIAL RCRA HAZ OR NON-RCRA HAZ
-  ORC APPLICATION APPROXIMATELY 11 - 15 FT BGS
-  ELEVATED PETROLEUM IN SOIL AND GROUNDWATER
-  3-FOOT EXCAVATION
-  4-FOOT EXCAVATION
-  11-FOOT EXCAVATION
-  11.5-FOOT EXCAVATION
-  15-FOOT EXCAVATION
-  TRENCH FOR PROPOSED SEWER LOCATION; DEPTH GRADES FROM 15.5 BGS FEET AT WEST END TO APPROXIMATELY 11 BGS FEET
-  PROPOSED SEWER LOCATION
-  MUNICIPAL WATER SUPPLY (DOMESTIC WATER AND FIRE WATER)
-  STORM DRAIN
-  SB-1 SOIL BORING - APRIL 8, 2015 (AEI)
-  B-1 SOIL BORING - SEPTEMBER 19, 2015
-  B-4 SOIL BORING - OCTOBER 3, 2015
-  B-12 SOIL BORING - OCTOBER 10, 2015
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-  MW-9 HISTORICAL MONITORING WELL (ARCADIS)
-  MIP-3 HISTORICAL MIP BORINGS, APRIL 2013 (ARCADIS)
-  PROPOSED SOIL VERIFICATION SAMPLING LOCATION
-  CROSS SECTION TRANSECT LINE

GENERALIZED SOIL IMPACT MAP FOR SOIL MANAGEMENT AND PROPOSED EXTENT OF EXCAVATION
 PROPOSED BROADWAY VALDEZ
 2820 BROADWAY
 OAKLAND, CA

PROJECT NUMBER: 118EM01075	DATE: 6/12/17	FIGURE 5
APPROVED BY: GS	DRAWN BY: CC	

ATC 915 Highland Pointe Drive, Suite 250
 Roseville, CA 95678
 Ph: (916) 724-5247 *** Fax: (916) 724 5201



LEGEND	
	APPROXIMATE EXTENT OF EXCAVATION FOR LAND DEVELOPMENT
	DEEPEST APPROXIMATE EXTENT OF EXCAVATION FOR SEWER AND STORM DRAIN INSTALLATION TRENCH
	PROPOSED SEWER LOCATION
	PROPOSED STORM DRAIN LOCATION
	APPROXIMATE GROUNDWATER TABLE
	APPROXIMATE LOWEST HISTORIC POTENTIOMETER GROUNDWATER SURFACE
	APPROXIMATE HIGHEST HISTORIC POTENTIOMETER GROUNDWATER SURFACE
	APPROXIMATE EXISTING GRADE
	TRENCH BASIN
	ELEVATED PETROLEUM AND LEAD IN SOIL LEAD IS POTENTIAL RCRA HAZARDOUS OR NON-RCRA HAZARDOUS WASTE TO BE EXCAVATED
	POTENTIALLY ELEVATED PETROLEUM IMPACTS IN VADOSE ZONE SOIL (NON-HAZARDOUS WASTE) TO BE EXCAVATED
	ORC APPLICATION THICKNESS APPROXIMATELY 11 - 15 FEET BGS
*	ELEVATIONS CORRESPOND TO THE CITY OF OAKLAND DATUM

CROSS-SECTION C-C' (EAST 2820)
GENERALIZED SOIL IMPACTS FOR SOIL MANAGEMENT
 PROPOSED BROADWAY VALDEZ
 2820 BROADWAY
 OAKLAND, CALIFORNIA

PROJECT NUMBER: 118EM01075	DATE: 6/12/17	FIGURE
APPROVED BY: GS	DRAWN BY: CC	6
915 Highland Pointe Drive Suite 250 Roseville, California 95678 Ph: (916) 724-5201 *** Fax: (916) 223-5201		

APPENDIX A

Geo-Seal Specifications, Certification, and Brochure



Film 11 Modified

Geo-Seal® Vapor Intrusion Barrier System

**Geo-Seal® M11 Vapor Intrusion
Barrier 02 56 19.13
Fluid-Applied Gas Barrier
Version 1.5M**

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 ft² (9.3 m²) 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 +45°F/+7°C.) Consult manufacturer for the proper requirements when desiring to apply Geo-Seal CORE below 45°F/7°C.
- 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. 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 FILM 11 base layer
 - 2. Geo-Seal CORE 30 mil spray layer and Geo-Seal CORE Detail
 - 3. Geo-Seal FILM 5 protective 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 30 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.

2.3 VAPOR INTRUSION BARRIER SHEET MATERIALS

- A. The Geo-Seal FILM 11 layer is a chemically resistant, high strength, cross laminated sheet comprised of an 11 mil high density polyethylene.
- B. The Geo-Seal FILM 5 layer is a chemically resistant, high strength, cross laminated sheet comprised of a 5 mil high density polyethylene.
- C. Sheet Course Usage
 - 1. As foundation base layer, made to receive the Geo-Seal CORE layer.
 - 2. As a top sheet for the Geo-Seal CORE layer.
- D. Geo-Seal FILM 11 physical properties.

Properties	Test Method	Results
Film Thickness		11 mil
Classification	ASTM E 1745-09	Exceed Class A,B and C
Tensile	ASTM E 154-93	50 lbs./in
Puncture Resistance	ASTM D 1709	2400 grams
Water Vapor Permeance	ASTM E 96	0.020 Perms
Life Expectancy	ASTM E 154-93	Indefinite
Chemical Resistance	ASTM E 154-93	Excellent

- E. Geo-Seal FILM 5 physical properties.

Properties	Test Method	Results
Film Thickness		5 mil
Classification	ASTM E 1745-09	Exceed Class C
Tensile	ASTM E 154-93	21 lbs./in
Puncture Resistance	ASTM D 1709	500 grams
Water Vapor Permeance	ASTM E 96	0.110 Perms
Life Expectancy	ASTM E 154-93	Indefinite
Chemical Resistance	ASTM E 154-93	Excellent

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 FILM 11 base layer. 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 FILM 11 base layer is not present.
 3. Aggregate: **Contact the manufacturer to ensure the aggregate layer will not be detrimental to the FILM 11 base layer. The gravel layer must be compacted and rolled flat.** Ideally a $\frac{3}{4}$ " 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. NOTE: Angular substrates will likely require the use of a 4 oz. geotextile cushion layer, contact Land Science Technologies for additional information.
 4. Mudslabs: The use of a mudslab 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 60 mils of Geo-Seal CORE to the terminating surface and then embed the Geo-Seal FILM 11 base layer by pressing it firmly into the Geo-Seal CORE layer. Next, apply 30 mils of Geo-Seal CORE to the FILM 11 base layer. When complete, apply the Geo-Seal FILM 5 bond layer. After the placement of the Geo-Seal FILM 5 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 FILM 11 base layer that will extend 6" beyond the outside perimeter of the penetration. Cut a hole in the Geo-Seal FILM 11 base layer just big enough to slide over the penetration, ensuring the Geo-Seal FILM 11 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 FILM 11 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 FILM 11 base layer and the penetration.

- C. Seal the Geo-Seal FILM 11 base layer using Geo-Seal CORE or Geo-Seal CORE Detail to the underlying cut piece of Geo-Seal FILM 11 base layer.
- D. Apply one coat of Geo-Seal CORE Detail or Geo-Seal CORE spray to the Geo-Seal FILM 11 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 FILM 5 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 FILM 5 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 FILM 11 BASE LAYER INSTALLATION

- A. Install the Geo-Seal FILM 11 base layer over substrate material in one direction with six-inch overlaps.
- B. Secure the Geo-Seal FILM 11 base seams by applying 60 mils of Geo-Seal CORE between the 6" overlapped sheets.
- C. Visually verify there are no gaps/fish-mouths in seams.
- D. For best results, install an equal amount of Geo-Seal FILM 11 base and Geo-Seal CORE in one day. Leaving the Geo-Seal FILM 11 layer unsprayed overnight might allow excess moisture to collect on the Geo-Seal FILM 11 base layer. 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 FILM 11 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 30 mils (0.75 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 ft². (46.45 m²), 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 FILM 5 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 FILM 5 BOND PROTECTION COURSE INSTALLATION

- A. Install Geo-Seal FILM 5 protective bond course perpendicular to the direction of the Geo-Seal FILM 11 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 FILM 5 bond layer.
- C. Overlap and seam the Geo-Seal FILM 5 bond layer in the same manner as the Geo-Seal FILM 11 base layer.
- D. To expedite the construction process, the Geo-Seal FILM 5 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 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.

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 FILM-11 sheet layers (11 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 32 (5%) to 34 (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 identify due to the color contrasting layers of the system.

Vapor-Vent™
SOIL GAS COLLECTION SYSTEM
Version 1.6

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 up 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.



June 8, 2017

ATC Group Services LLC
915 Highland Pointe Drive, Suite 250
Roseville, CA 95678

Attn: Gabe Stivala
Cc: Andrew Stuart, Zach Gilmer, Tom Szocinski, Joe Gergen

RE: Oakland Project – Broadway Valdez at 2820 & 2855 Broadway, Oakland, CA

Dear Gabe,

Land Science reviewed the attached Soil and Groundwater Analytical Data.pdf provided by your office. Land Science confirms the identified contaminants levels reported on this site will not have any adverse effect to the modified Geo-Seal vapor barrier system (Film 11, 30 mil Core, Film 11).

Please feel free to contact me with any questions.

Thank you,

A handwritten signature in black ink, appearing to read "Hieu Nguyen".

Hieu Nguyen
Senior Research Engineer
Land Science
hnguyen@landsciencetech.com
949-892-8856

 **Geo-Seal**[®]
Vapor Intrusion Barrier

Vapor Management Technology



Introduction

Geo-Seal® is a sub-slab vapor intrusion barrier system designed to eliminate vapor intrusion for brownfields or any type of environmentally-impaired site. Geo-Seal is a chemically-resistant material placed between the foundation of the building and the soil pad to eliminate vapor intrusion pathways and stop contaminant vapors from permeating through the slab. By deploying Geo-Seal, developers can ensure a healthy indoor environment while reducing the cost of site remediation and expediting site construction.

- 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.
- Geo-Seal has been tested and proven to be highly effective against VOCs like chlorinated solvents and petroleum contaminants, and, methane.
- Geo-Seal is the 1st patented vapor intrusion barrier system in the US
- Geo-Seal has gained wide approval among various regulatory agencies across the country.





Geo-Seal BASE

The BASE layer is rolled out geotextile facing down, which allows Geo-Seal CORE to be applied directly to the high density polyethylene. The BASE layer provides the ultimate substrate and enables the spray layer to be free of shadowing and pinholes.

Geo-Seal CORE

The CORE is sprayed to the base layer, seals around penetrations and seals the seams of the BASE layer.

Geo-Seal BOND

A proprietary protection layer is placed over the CORE layer to enhance the curing of the membrane and increase puncture resistance.

Geo-Seal Triple-Layer System (2 Chemical Resistant Layers + 1 Spray Applied Core Layer)

Dual Chemical Resistant Layers

The BASE layer (bottom) and the BOND layer (top) are composed of a high-density polyethylene material bonded to a geo-textile on the out-facing side. High density polyethylene is known for chemical resistance, high tensile strength, excellent stress-crack resistance and for highly reliable subsurface containment. The geo-textile which is physically bonded to the chemical resistant layer accomplishes two goals; it allows the BOND layer to adhere to the slab, and provides a friction course between the BASE layer and the soil.

Spray Applied CORE Layer

The CORE layer is composed of a unique, elastic co-polymer modified asphaltic membrane which also provides additional protection against vapor transmission. This layer creates a highly-effective seal around slab penetrations and eliminates the need for mechanical fastening at termination points.

Chemical Resistance

The dual chemical resistant layers combined with the spray CORE form a barrier resistant to the most concentrated chemical pollutant vapors.

Enhanced Curing

Geo-Seal is “construction friendly” as the reduced curing time of the Geo-Seal CORE layer and the ability to apply it in cooler temperatures ensures quick installation and minimizes the impact on construction schedules.

Puncture Resistance

Geo-Seal forms a highly puncture resistant barrier that greatly reduces the chance of damage occurring after installation and prior to the placement of concrete.

EXPERTS IN VAPOR INTRUSION MITIGATION

Land Science® develops vapor intrusion mitigation solutions that protect people and invigorate renewal of contaminated properties.

We leverage our industry expertise to assist clients in developing site specific solutions that are technically sound and cost-effective.



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APPENDIX B

**OXYGEN RELEASING COMPOUND
APPLICATION INSTRUCTIONS AND SPECIFICATIONS**

REGENESIS ORC ADVANCED® PELLETS

Dust Minimizing Formulation for Excavations, Tank Pits and Trenches

PRODUCT APPLICATION INSTRUCTIONS

Introduction

The features and benefits of controlled-release, ORC Advanced are posted in other areas (product brochure, www.regenesis.com, and MSDS). From the field application standpoint, the benefits of ORC Advanced® Pellets (ORC-A Pellets) are in ease of handling and Health & Safety. Pelletized ORC Advanced is much easier to use because it eliminates the need for water and equipment associated with spray application and Health & Safety are dramatically improved by elimination of ORC Advanced dust and associated respiration issues. The later feature makes the material much easier to handle in open-air application approaches such as excavations and trenches.

Design Considerations

The new configuration of this material does not change the quantity estimated in the design process. The materials' available oxygen is up to 17% by weight and its physical attributes are designed to be easier to handle through the use of a pelletized version of the product and the elimination of the dust associated with dry application of ORC Advanced powder.

Application Methods

The pelletized form allows the user to simply and easily apply the ORC Advanced in a dry format using existing on-site operations or by manual methods. Some typical methods include:

- Application via the excavator bucket:
 - Simply insert a pre-determined quantity (unit - bucket) of ORC-A Pellets into an excavator bucket and use the excavator to mix and distribute the ORC-A Pellets into previously backfilled soil
- Application via manual or mechanical broadcasting/spreaders:
 - Manually or mechanically broadcast/spread pelletized ORC-A Pellets into the excavation at a pre-determined rate per unit of backfill material or per soil lift (as the soil is being backfilled)
 - Follow the manual broadcast step with mechanically mixing the ORC-A Pellets directly into the backfill using the excavator equipment

Example Estimates:

Using an example unit weight of ORC-A Pellets (55.1 lb. plastic container)

For a 0.1% weight of ORC-Advanced to backfill:

- Each 100,000 lbs. of soil
- Apply 100 lbs. ORC-A Pellets



REGENESIS ORC ADVANCED® PELLETS

Dust Minimizing Formulation for Excavations, Tank Pits and Trenches

PRODUCT APPLICATION INSTRUCTIONS

For a 0.2% weight of ORC-Advanced to backfill:

- Each 100,000 lbs. of soil
- Apply 200 lbs. ORC-A Pellets

Example Estimates (SI Units):

Using an example unit weight of ORC-A Pellets (25 kg plastic container)

For a 0.1% weight of ORC-A Pellets to backfill:

- Each 45 metric tons of soil
- Apply 45 kg ORC-A Pellets

For a 0.2% weight of ORC-A Pellets to backfill:

- Each 90 metric tons of soil
- Apply 90 kg ORC-A Pellets

ORC Advanced® Pellets Technical Specification

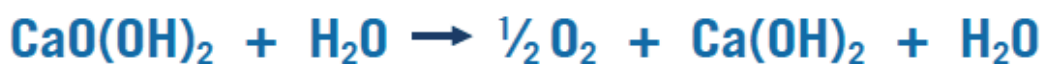
ORC Advanced Pellets are a dust-minimizing, dry application, pelletized form of the widely-used ORC Advanced controlled-release oxygen compound.

They are designed specifically for the treatment of dissolved-phase petroleum hydrocarbons through direct application into excavations, petroleum storage tank pits, trenches and backfill.

Oxygen is released from ORC Advanced for a period of 9 to 12 months *in situ*.



Example of ORC Advanced Pellets



ORC Advanced is a formulation of calcium oxyhydroxide which, upon hydration, releases oxygen and forms simple calcium hydroxide and water.

For a list of treatable contaminants with the use of ORC Advanced, view the [Range of Treatable Contaminants Guide](#).

Chemical Composition

- Calcium Oxyhydroxide
- Calcium Hydroxide
- Monopotassium Phosphate
- Ammonium Phosphate Dibasic

Properties

- Pellet size: 3-10 mm
- Contains micro-nutrients such as nitrogen, phosphorous, and potassium (N,P,K) which can be beneficial to aerobic biodegradation processes

ORC Advanced® Pellets Technical Specification

Storage and Handling Guidelines

Storage

Store in a cool, dry place out of direct sunlight

Store in original tightly closed container

Store in a well-ventilated place

Do not store near combustible materials

Store away from incompatible materials

Provide appropriate exhaust ventilation in places where dust is formed

Handling

Minimize dust generation and accumulation

Keep away from heat

Routine housekeeping should be instituted to ensure that dust does not accumulate on surfaces

Observe good industrial hygiene practices

Take precaution to avoid mixing with combustibles

Keep away from clothing and other combustible materials

Avoid contact with water and moisture

Avoid contact with eyes, skin, and clothing

Avoid prolonged exposure

Wear appropriate personal protective equipment

Applications

- *In situ* or *ex situ* out of the bag
- Direct application into open excavations, petroleum storage tank pits and trenches
- Direct application to contaminated backfill or contaminated soils
- *Ex situ* biopile applications (requires a source of hydration)

Health and Safety

Wash thoroughly after handling. Wear protective gloves, eye protection, and face protection.

Please review the Material Safety Data Sheet for additional storage, usage, and handling requirements here: [ORC Advanced SDS](#).

