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Alameda County
Environmental Health

**FEASIBILITY STUDY /
CORRECTIVE ACTION PLAN**

6211 San Pablo Avenue
Oakland, California

AEI Project No. 280346

Prepared For

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1.0 INTRODUCTION

AEI has prepared this Feasibility Study / Corrective Action Plan (FS/CAP) for the property located at 6211 San Pablo Avenue, Oakland, California (Figure 1: Site Location Map). AEI has been retained by Mr. Pritpaul Sappal (client) to provide environmental engineering and consulting services relating to the release of petroleum hydrocarbons from the use of underground storage tanks (USTs) at the property. The FS/CAP was requested in a letter from the Alameda County Health Care Services Agency (ACHCSA), dated January 27, 2009. The purpose of the FS/CAP is as follows:

- Present a summary of the historic and current site conditions.
- Propose site cleanup levels and goals for soil and groundwater at the site.
- To evaluate potential cleanup alternatives and determine the best course of action based on expected effectiveness, technical feasibility, and cost for the remedial option to reach the proposed goals.
- To select the best suited remedial option for the site.
- To proposed a feasibility study to conduct pilot testing activities on the selected remedial alternative to evaluate the effectiveness of the remedial option to complete cleanup activities and move the site towards closure.

2.0 SITE DESCRIPTION AND HISTORY

The subject property is located at 6211 San Pablo Avenue, northwest of the intersection of San Pablo Avenue and 62nd Street in a mixed residential and light commercial area of Oakland, California (Figure 1 and 2). The site currently consists of a retail gasoline station with three underground storage tanks (USTs) dispensing gasoline fuel through six dual-sided fuel dispensing islands. Site features are included in Figure 3.

In April 1999, three borings B-1 through B-3 were advanced at the site by Herschy Environmental Inc. (Herschy). Significant concentrations of hydrocarbons were present in the soil and groundwater samples collected during the investigation. Subsequently, in June 1999, five additional soil borings were advanced (B-4 through B-8) at the site. Based on the data collected during the investigation, it was determined that additional assessment was necessary as the lateral extent of the contamination had not been determined. Therefore, in October 1999 monitoring wells MW-1 through MW-3 were installed and a groundwater monitoring program was initiated.

In November 2001, monitoring wells MW-4 through MW-6 were installed and borings B-9 through B-14 were advanced on the property. Based on the data obtained, it was determined that additional wells were necessary offsite and interim remedial action was required, therefore a

workplan was prepared for the implementation of both. The offsite monitoring wells were not installed by Herschy due to difficulty obtaining an encroachment permit with the City of Oakland.

In an effort to remediate hydrocarbons at the site, five air sparge wells (AS-1 through AS-5), thirteen vapor extraction wells (VE-1 through VE-13), and one groundwater extraction well (EX-1) were installed in January 2004. In addition, well MW-1R was installed to replace well MW-1. In February 2004, three 10,000 gallon USTs and associated product piping were removed and replaced (with the current UST system) at the site. During construction activities, approximately 1,100 tons of soil and 40,000 to 60,000 gallons of groundwater was removed from the site and properly disposed of.

A soil vapor extraction system was installed and was operational from August 31, 2006 through November 19, 2007. Initially the system operated utilizing a thermal oxidizer; however, due to low influent concentrations, the system was modified to run in catalytic mode only during January and February 2007. Shortly thereafter, it was determined that the system was reaching asymptotic levels; therefore, on May 7, 2007, a dual phase extraction (DPE) pilot test was attempted in order to determine if SVE coupled with DPE would produce better results. The test was halted after 4 hours due to high temperatures (outside the catalytic oxidizer operating range) and increasing influent concentrations. Subsequently, after acquiring the proper equipment, on February 5 and 6, 2008, the DPE test was performed for approximately 13 hours. Following the test, Herschy concluded that the limited data suggested that DPE may be a viable option. The system is currently not operating at the site as the equipment was removed by Herschy in August and September 2008.

In August 2007 borings DP-1 and DP-3 were installed at and in the vicinity of the site. Several offsite borings were expected to be completed, however, they were not performed for a variety of reasons. In September 2008, consulting responsibilities were transferred to AEI Consultants. Subsequently, AEI submitted the requested revised Site Conceptual Model (SCM) dated October 8, 2008 which updated a proposed scope of work to complete additional offsite characterization for the site. Approval for the completion of the work was issued in a letter from the ACHCSA dated October 16, 2008.

On November 24 through November 26, 2008 AEI advanced ten shallow soil borings (DP-4, SB-5, SB-7 to SB-14) in the vicinity of the subject property and four deep soil borings (DDP-1 to DDP-4) at the subject property. In addition, three nested soil vapor probes (SG-1 through SG-3) were installed at the site. Data obtained during the investigation further validated the known need for offsite monitoring wells in the vicinity of the site.

The location of all former and current site features, including previous boring locations, are included on Figures 2 and 3.

3.0 GEOLOGY AND HYDROGEOLOGY

Sediments encountered during the most recent investigation were generally classified as fine grained sediments (a combination of silt and clay) just below the asphalt surface to depths ranging from approximately 5 to 11 feet below ground surface (bgs). Grain size distribution analysis of samples encountered from this zone indicated approximately 7% to 21% sand, approximately 40% silt, and approximately 37% to 53% clay. The fine grained silty clay was underlain by a sandy, gravelly silt/clay with varying amounts of fine to coarse grained sand and minor gravel to depths ranging from approximately 11 feet bgs to 17 feet bgs (the terminus of several of the shallow borings). Grain size distribution analysis of select sediments encountered from this zone indicated approximately 4% to 26% gravel, 44% to 58% sand, and 29% to 36% fine grained silt and clay. Deep borings advanced at the site indicated interbedded layers of silt and well graded sand and gravel to the maximum depth explored, 40 feet bgs.

Shallow groundwater was encountered at varying depths ranging generally from 11 to 14 feet bgs, and stabilizing from 5 feet to 10 feet bgs. In deep borings DDP-2 through DDP-4, deep groundwater (past 20 feet bgs) was not collected. Several potential water producing zones were identified during drilling, however the zones may be described as slow producing and upon setting screens in these borings at varying depths from 25 to 40 feet bgs, measurable groundwater was not present after approximately 1 hour. In boring DDP-1, a hydropunch screen was open from 32 to 40 feet bgs, however was initially dry. After approximately 3 hours, groundwater was measured at 28 feet bgs.

Groundwater during the 2nd Quarter 2009 quarterly monitoring episode ranged from 4.16 to 7.79 feet below the top of casing or 28.62 to 29.58 feet above mean sea level (amsl). The direction of the groundwater flow during the May 15, 2009 sampling event was towards the west/southwest with an estimated overall hydraulic gradient of 0.01 feet/foot, relatively consistent with historical data. Laboratory reported physical properties of soil conditions are included on Table 5.

4.0 SITE CONCEPTUAL MODEL UPDATE

On May 27, 2008, Herschy submitted a SCM to the ACHCSA followed by an Addendum to the SCM (well survey) dated June 18, 2008, and on October 8, 2009, AEI submitted the requested revised SCM. Please refer to these three documents for site specific details. Below is a brief summary of release information which incorporates data from the recent (November 2008) investigation and subsequent soil vapor sampling and updates the SCM.

4.1 Extent of Soil Impacts

The lateral extent of significant adsorbed hydrocarbon concentrations appears primarily limited to within the site property. Historical soil data (prior to 2008) reported soil concentrations prior to SVE system operation. Therefore, soil samples collected by AEI during the November 2008 investigation, although limited in number, are representative of post-SVE activities. Soil samples from DDP-1 through DDP-3 each contained elevated concentrations of hydrocarbons (particularly MTBE) in the capillary fringe or above (7.5 feet bgs or less). The elevated concentrations of

hydrocarbons indicates that a significant source remains in soil beneath the site. Soil samples collected from the capillary fringe and above in the offsite borings during the November 2008 investigation did not contain the elevated concentrations observed in the onsite borings. The low concentrations that were detected in the offsite borings were typically around 6 feet bgs to 7.5 feet bgs and are likely due to high water levels.

The vertical extent of the soil contamination was investigated by soil borings DDP-1 through DDP-4. Based on the results obtained, it appears that the majority of the hydrocarbon contaminated soil is present between 5 and 10 feet bgs. By 20 feet bgs, TPHg and benzene concentrations drop to below laboratory detection limits. MTBE decreases with depth in the soil borings and is below the respective Environmental Screening Level (ESL) by 10 feet bgs in DDP-4 and 26 feet bgs in DDP-3. In DDP-2, MTBE is present at a concentration of 0.039 mg/kg at 35.5 feet bgs which is slightly above the ESL of 0.023 mg/kg, however MTBE exhibited a decreasing trend with depth in this boring beginning at 10 feet bgs. Based on the results of the soil samples, it appears that hydrocarbons decrease with depth in the borings. Soil analytical data from the November 2008 investigation is included on Figure 5 and Table 1.

4.2 Extent of Groundwater Impacts

The groundwater plume beneath the site has been monitored and studied for several years; however the extent of the offsite plume is undefined and until recently, relatively unknown. Following the November 2008 investigation, groundwater contamination was confirmed to the southwest of the site. The extent of the contamination to the west, southwest, and south of the site has not been fully determined. Monitoring wells are needed in the area of the completed soil borings and beyond to further assess the extent, concentrations, and stability of this plume. These wells have been approved and will be installed in the future; a modified well installation and sampling program is presented below. Groundwater analytical data is included on Tables 2 and 3.

4.3 Soil Gas Impact

Three nested soil vapor probes (SG-1 to SG-3) are present at the site. Each probe contains a monitoring point at 3 feet bgs and 6 feet bgs. Two rounds of soil vapor sampling have indicated that while relatively high concentrations (significantly exceeding ESL levels) are present in the probes at 6 feet bgs, the vapor concentrations significantly attenuate by the 3 foot probes. TPHg in the 3 foot probes has been detected above the ESL in each of the sampling events, however at significantly lower concentrations than the 6 foot probes. Refer to Table 4 for the soil vapor concentrations at the site.

4.4 Site Cleanup Considerations

AEI understands that groundwater in the vicinity of the site has not been fully delineated. However, this FS/CAP has been prepared as a two fold approach: 1) to continue additional characterization activities and 2) to evaluate what remedial option may best cut off continued migration of hydrocarbon contaminants from the property and cleanup the onsite remaining source.

5.0 REMEDIATION OBJECTIVES & CLEANUP GOALS

The tentative target soil, soil gas, and groundwater cleanup goals for contaminants known to have been release onsite were evaluated and selected based on current land use and zoning of the property, to be adequately protective of human health and groundwater resources, and to be reasonable, cost-effective, and technically feasible to achieve within a reasonable period of time. The proposed cleanup goals have been based on a commercial / industrial land use scenario using the Environmental Screening Levels (ESLs) presented in the San Francisco Bay RWQCB's document "Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater Interim-Final", dated November 2007, revised May 2008.

5.1 Groundwater Cleanup Goals

The groundwater in the area of the site has been designated in the RWQCB Basin Plan as of beneficial use or potential beneficial use. Although the lack of production wells identified in close proximity to the site (well survey was performed in Herschy's SCM and SCM Addendum), indicates the groundwater is not currently used for drinking water, based on the RWQCB Basin Plan, the potential is there. Therefore, ESLs for drinking water resource have been adopted for the final cleanup goals. This is expected to be adequately protective of shallow water quality of the area.

Contaminant	Proposed Groundwater Goals (µg/L)	Pathway Basis for Goal
	Shallow Groundwater	
TPH-g	100	Ceiling Value
MTBE	5.0	Ceiling Value
Benzene	1.0	Drinking Water Toxicity
Toluene	40	Ceiling Value
Ethylbenzene	30	Ceiling Value
Xylenes	20	Ceiling Value

Source: May 2008 ESLs

5.2 Soil Cleanup Goals

Due to the relatively shallow groundwater present at the site, proposed cleanup goals for soil are presented for shallow soil (<10 feet bgs) only and are based on leaching potential above groundwater for the commercial / industrial land use exposure scenarios.

Contaminant	Proposed Soil Goals (mg/kg)		Pathway Basis for Goal
	Shallow Soil (<10 feet bgs)		
TPH-g	83		Groundwater Protection
MTBE	0.023		Groundwater Protection
Benzene	0.044		Groundwater Protection
Toluene	2.9		Groundwater Protection
Ethylbenzene	3.3		Groundwater Protection
Xylenes	2.3		Groundwater Protection

Source: May 2008 ESLs

5.3 Soil Vapor Cleanup Goals

Although the subject site is a commercial property, residential properties are located to the north and west of the site. Therefore, two sets of soil vapor cleanup goals are proposed: residential for borings near the residences property line and commercial for onsite borings away from the residential property.

Contaminant	Proposed Soil Vapor Goals ($\mu\text{g}/\text{m}^3$)		Pathway Basis for Goal
	Shallow Soil Vapor (<5 feet bgs)		
	Residential	Commercial	
TPH-g	10,000	29,000	Vapor Intrusion
MTBE	9,400	31,000	Vapor Intrusion
Benzene	84	280	Vapor Intrusion
Toluene	63,000	180,000	Vapor Intrusion
Ethylbenzene	980	3,300	Vapor Intrusion
Xylenes	21,000	58,000	Vapor Intrusion

Source: May 2008 ESLs

6.0 SITE CLEANUP TECHNOLOGIES

Remediation of groundwater and soils impacted with petroleum hydrocarbons are broadly categorized into *in situ* and *ex situ* approaches and mass removal and diffusion-controlled technologies. In situ or onsite treatment involves either the removal of contaminants without excavation or extraction of the soil and groundwater or by destroying the hydrocarbon in place either biologically or chemically. Ex situ or offsite treatment involves the physical removal of the soil or groundwater for either above ground treatment or offsite disposal. Mass removal technologies remove source materials and may include: soil excavation, soil vapor extraction, and free product recovery. Diffusion-controlled technologies are limited by mass transfer and degradation mechanisms and may include: passive bioremediation, air sparging / biosparging, bioventing, oxygen diffusion, and in situ chemical oxidation (ISCO). The methods discussed

below are not intended to be exhaustive but rather provide an overview of generally accepted methods for soil and groundwater remediation at sites impacted by petroleum hydrocarbons.

6.1 Soil Excavation

Soil excavation consists of the physical removal or excavation of impacted soil to the water table, but can often extend below the water table for removal of the smear zone. Generally, this is the most effective method of removing the source of petroleum contamination. Once above ground, soils can either be treated in aerated biopiles, among other methods, and put back in place or transported offsite to an appropriate disposal facility.

A significant amount of soil beneath the site appears to be impacted by the petroleum hydrocarbons. A reasonable approach would be to remove the top 10 feet of soil west of the USTs and dispenser islands (downgradient direction). A quick estimate yields that approximately 1,700 cubic yards of soil would have to be removed from the subsurface. It is expected that the excavation would be successful in removing a large portion of the source area at the site. However, the following negative impacts are associated with this approach:

- The site is an active retail gasoline station. In order to perform the soil excavation, the station would have to be shut down for an extended period of time.
- Soil contaminate mass that could be under the building is not accessible.
- The site contains an extensive network of SVE wells, air sparging wells, and monitoring wells. Prior to the excavation, each of these wells would have to be decommissioned and re-installed as necessary.
- The costs associated with the major excavation project of approximately 1,700 cubic yards (roughly estimated at \$220,000), not including restoration cost, may not be the most cost effective method.

For the reasons stated above, AEI does not plan to pursue soil excavation activities at this time. If additional testing demonstrates that alternative remediation options would not be successful, then the soil excavation option will be revisited.

6.2 Passive Bioremediation / Monitored Natural Attenuation

Passive bioremediation or natural attenuation involves monitoring of the natural processes that degrade contaminants in the subsurface. Natural attenuation of petroleum hydrocarbon is a well-documented beneficial process occurring at most fuel sites. Based on the elevated concentrations of hydrocarbons as well as the extent of hydrocarbon distribution, a more aggressive approach than monitored natural attenuation appears necessary at the site. MNA may be used for the offsite plume once offsite groundwater monitoring begins.

6.3 Soil Vapor Extraction

Soil vapor extraction (SVE) is a proven and cost-effective technology for the removal of volatile contaminants. SVE is the process of applying a vacuum to the subsurface to increase the recovery of volatile and sometime semi-volatile contaminants, such as gasoline, trapped as vapor in the soil pore space, adsorbed to the soil, dissolved in pore water, or occluded between soil

particles as free product. A 2 to 4-inch diameter extraction well, screened across the vadose zone, or sometimes an existing monitoring well if the construction is known and appropriate, is connected to a regenerative blower, rotary lobe blower, or sometimes a liquid ring pump to remove hydrocarbons from the subsurface. The extracted vapors are treated above ground by a variety of means, including: direct-fired thermal incineration or catalytic oxidation, flameless catalytic oxidation, granular activated carbon adsorption, reinjection or recirculation, or above-ground biofiltration, depending upon the influent concentrations and system flow rate. Lighter gasoline-range hydrocarbons, such as BTEX and MTBE, are amenable to SVE due to their relatively high vapor pressure. Heavier diesel-range petroleum hydrocarbons and longer chained hydrocarbons such as fuel oils are not volatile and can not be effectively removed by SVE. However, diesel and fuel oil can be removed by aerating the soil to stimulate aerobic biodegradation in a process known as bioventing. SVE systems are designed to maximum volatilization with a secondary benefit of increasing aerobic biodegradation of petroleum hydrocarbons in the vadose zone. The effectiveness of SVE is dependent upon the soil type, vapor pressure of the contaminants, soil gas permeability, and soil structure (i.e., homogeneous or heterogeneous).

The extraction well network and conveyance piping for SVE are currently present at the site. However, the extraction system has been removed by the previous consultant. As described earlier in this report, an SVE system operated at the site from August 2006 through November 2007. Due to high groundwater at the site, the permeable capillary fringe zone was not accessible and vapor concentrations reached asymptotic levels relatively quickly. Past SVE activities at the site have proven that SVE alone is not a practical or cost-effective remedial option, therefore SVE will not be considered as a viable remedial option.

6.4 Groundwater Extraction & Treatment

Commonly called groundwater pump and treat (P&T), groundwater extraction and treatment above ground can successfully reduce the concentrations of dissolved contaminants in the groundwater. However, only a small percentage (1 to 2% in most cases) of total hydrocarbon mass exists in the dissolved phase. The effectiveness of groundwater P&T is reduced exponentially when a continuing source of free-phase or adsorbed contaminants are present. P&T is most useful for hydraulic containment. Groundwater is removed from existing monitoring wells or specially designed extraction wells using submersible electric or pneumatic bladders pumps. Above ground treatment can be accomplished by spray-aeration or air stripping for volatiles, oil-water separation for non-volatiles, granular activated carbon adsorption, biofiltration, or ozone and ultraviolet advanced oxidation processes. Federal, state, and local discharge permit requirements must be met prior to water discharge to surface drains or sanitary sewers, which often require treatment to very low to non-detectable concentrations for most contaminants. In addition to direct removal of contaminants from impacted groundwater, pumping may limit the spread of contaminants by altering the hydraulic gradient near the pumping well(s).

The dissolved phase plume is assumed to be relatively large at the site (based on concentrations in boring SB-14). A groundwater P&T system would have to be on a very large scale in order to

effect groundwater near SB-14. Groundwater treatment through P&T on this plume would be extremely costly and not feasible. Therefore, groundwater extraction and treatment is not considered a cost effective remedial option at this time.

6.5 Dual Phase Extraction

DPE is a combination of SVE and P&T activities (as described above) resulting in the removal of both liquid phase and vapor phase hydrocarbons. Given ideal site conditions, DPE can lower the groundwater table, therefore exposing more of the source area in the soil (which is often more permeable and amenable to SVE) which can effectively remove soil vapor using the SVE portion of the remediation.

A short term (13 hours) dual phase extraction pilot test was performed in February 2008. Based on the limited pilot testing data, it was determined by Herschy that the site appears to be amenable to DPE. While Herschy concluded that DPE may work at the site, this technology does not appear to be “ideal” but rather a “best attempt” to utilize the SVE system which was already in place and was not successful. After further review, AEI does not believe that DPE is the best option for the site for the following reasons:

- All extraction and sparge wells at the site have been paved over. In order to properly run a DPE system, each well would need to be uncovered in order for well head modifications to be made (installation of a drop tube or “stinger”).
- All former system components (with the exception of the onsite air compressor) have been removed from the site; therefore new equipment must be purchased. DPE seemed a logical solution based on the low cost alternative when all the equipment was at the site. However, in lieu of the system modifications and purchases necessary, other remedial options seem to be a better fit at this site.
- The onsite DPE system may effectively treat onsite contamination, however, would do little to mitigate the larger offsite groundwater plume.

6.6 In Situ Chemical Oxidation

In situ chemical oxidation (ISCO) involves the use of an oxidant such as permanganate, ozone, hydrogen peroxide, or the hydroxyl radical (Fenton’s reagent) to chemically destroy the hydrocarbons. The selected oxidant must be injected into the soils and come in direct contact with the contaminant. The effectiveness of chemical oxidation is highly dependent on the nature of the contaminants, soil type, permeability, organic carbon and mineral content, heterogeneity or homogeneity of the soil matrix, distribution of contaminants, and the presence of free product.

In situ ozone oxidation, also known as ozone sparging, has recently become a widely used technology for groundwater treatment. Ozone (O_3) with an electrochemical potential of 2.07V is one of the most powerful oxidants available for in situ chemical oxidation. Ozone sparging combines traditional air sparging with the power in situ chemical oxidation to directly oxidize and convert hydrocarbons in the soil and groundwater to innocuous carbon dioxide and water. In situ ozone oxidation involves the injection of highly concentrated ozone (up to 6% by weight) blended with air below the water table using sparge points (micro-porous diffusers) or short 2 to 3-foot

sections of stainless steel slotted well screen. Ozone sparging into the saturated zone shares many similarities with air sparging by increasing volatilization, supplying oxygen for aerobic biodegradation, and promoting some degree of groundwater mixing.

The contaminants of concern at the subject site (TPH_g, BTEX, and MTBE) are very favorable to ozone sparging. Ozone sparging is a proven technology at remediating groundwater plumes, and would be a reasonable approach as both a groundwater remediation treatment barrier and for mitigation of the downgradient plume and onsite source. Physical soil characteristics analyzed by the laboratory during November 2008 testing (Table 5) revealed that the saturated zone consist of a large portion of coarse grained sediments (gravel and sands). Coarse grained sediments are also ideal for ozone sparging at the radius of influence can greatly increase.

Based in this information, it appears that ozone sparging may be the best option to mitigate the large offsite groundwater plume. The exiting sparge wells could be used to perform a pilot test at the site to evaluate the radius of influence which may be achieved at the site. The work plan for this option is included in Section 7.0 of this report.

6.7 Bioventing

Bioventing is the process of venting or aerating subsurface soils to stimulate aerobic biodegradation of contaminants in the vadose zone and capillary fringe by indigenous microorganisms. Bioventing can be successfully used to treat any aerobically biodegradable contaminant, but has been most widely applied in the remediation of petroleum hydrocarbon releases such as gasoline, diesel, jet fuel, and fuel oil. A small regenerative blower or rotary lobe blower is typically used to inject or extract air (often times at lower flow rates than for SVE) into 2 to 4-inch wells screened across the vadose zone. Sometimes existing monitoring wells are used when the construction details are known and appropriate for the application of bioventing. The practical design goal is to supply at least 5% oxygen to the entire contaminated soil volume during operation, although research suggests that as little as 2 to 3% is sufficient to support bioremediation. Bioventing system are operated and optimized to maximize aerobic biodegradation and to minimize volatilization and the potential for vapor migration. At most gasoline sites with significant concentration of volatile hydrocarbons, bioventing systems are first operated in extraction mode followed by a period of air injection. This reduces the potential for uncontrolled vapor migration during the initial stages of remediation. The effectiveness of bioventing is dependent upon the same subsurface conditions as SVE, except bioventing has been proven to be effective even in marginally permeable to low permeability soils, such as clays.

Site conditions appear favorable to Bioventing; therefore, AEI recommends a pilot test for Bioventing be performed for the following reasons:

- As observed by previous investigations at the site and failed SVE mitigation, the shallow subsurface consist of relatively fine grained sediments. Within these sediments much of the contaminate source is located. Bioventing has been proven effective in low permeable soils such as present at the site.
- Bioventing is most effective following a period of SVE, which has been performed at the site.

- The existing SVE wells could be used, as installed, for the Bioventing activities (and potentially the onsite air compressor).
- If necessary, a small rotary blower system which is relatively inexpensive (typically around \$12,000) is all that would be needed to complete a Bioventing system, along with the necessary manifold and electricity.
- Bioventing may be effective at lowering the water table, often called “pressure dewatering” (same effect as with DPE), thereby exposing the more permeable source area.

Details of the proposed Bioventing Pilot Test are contained in Section 7.0

7.0 FEASIBILITY STUDY / PILOT TEST

The subject site is unique in that although the mechanical portion of the SVE system has been removed from the site, an extensive network of SVE/AS wells and piping, along with an air compressor, are present at the site. While SVE/AS was not effective in the past, AEI proposes to complete a feasibility study for Bioventing and ozone sparging at the subject site using existing wells, where possible. The proposed feasibility study is expected to give a better understanding of site conditions and potential for success of the selected remedial options. As a cost savings measure, wherever possible, AEI will use the in place SVE/AS well/piping system, to the extent possible, to perform the feasibility study. The below feasibility study has been proposed with general objectives and guidelines; however specifics may change as deemed necessary by AEI staff based on actual site conditions/results during the testing.

7.1 Bioventing Pilot Testing

Bioventing pilot testing will be performed utilizing the current SVE well network at the site. AEI will utilize the onsite air compressor (if functional and practical) or a mobile remediation unit consisting of a regenerative blower, variable frequency drive, flow instrumentation, indicator lights, hour meter, a vacuum relief valve, cooling fans, and circuitry which is housed in a 3 by 2 foot metal locking storage box. The compressor or blower will be connected to the piping manifold for the SVE wells and air will be circulated to one, all, or any combination of the wells (to be determined in the field based on readings).

In order to determine radius of influence of the Bioventing system, AEI will install soil vapor monitoring probes to collect pressure readings. The soil vapor probes will be installed at distances of approximately 5, 10, 15, and 20 feet from select injection wells to monitoring radius of influence data. Pressure readings will be collected from the probes and based on the results an effective radius of influence for the Bioventing activities will be calculated. See Section 7.3.2 for details of the vapor probe installation.

In order to determine current biodegradation rates (thereby verifying the necessity of Bioventing), AEI will conduct a respiration test and vapor monitoring from each of the vapor points. Vapor will be collected using a RKI Instruments Eagle multi-gas detector which can provide rapid and reliable information on the soil gas chemistry for bioventing applications and eliminates need for and significant costs associated with fixed laboratory analyses. The Eagle measures the concentrations of total volatile hydrocarbons (TVH) in parts per million by volume (ppmv) or percent lower

explosive limit (%LEL) and methane (CH₄), oxygen (O₂), and carbon dioxide (CO₂) in percent (%) by volume.

The respiration test is conducted by injecting ambient air into the subsurface until the test locations are fully oxygenated or near ambient levels (20.9% O₂ and 0.1% CO₂). Air is injected into the soil gas probes for 24 hours at flow rates ranging from 1.0 to 1.7 cfm. Air injection is stopped and the variation of O₂ and CO₂ concentrations are measured over the next 24 to 72 hours. Initial readings are taken every 1 to 2 hours and progressively over 4 to 8 hour intervals or as determined by the rate of oxygen uptake. Data obtained regarding oxygen, carbon dioxide, and TPH can be used to evaluate the system effectiveness at distributing oxygen throughout the subsurface as well as biodegradation of TPH. Details of the respiration test will allow for a mass TPH removal estimate.

7.2 Ozone Chemical Oxidation Injection Testing

Ozone chemical oxidation injection testing will be performed by utilizing the onsite air sparge wells. The chemical oxidation process between ozone and hydrocarbons is a well documented process, therefore the goal of the injection pilot testing is not to determine the effectiveness of ozone at destroying hydrocarbons, but rather to determine the effective radius of influence for ozone sparging through the groundwater in the subsurface. Due to the size of the offsite hydrocarbon plume, it is essential to understand the site specific radius of influence expected for the proposed ozone injection remediation technology. If the radius of influence is found to be minimal at the site, then an ozone sparging system to remediate the extensive offsite hydrocarbon plume may not be feasible.

To determine the radius of influence in the sparge wells, a standard design approach involving several tests will be implemented. The proposed tests can be categorized as follows:

- Soil Gas Sampling (O₂ Monitoring)
- Helium Tracer Test
- Dissolved Oxygen Measurements
- Injection Pressure Versus Flow Rate Test
- Transient Pressure Transducer Response Test

A general overview of the planned testing is included as follows, for specific details regarding the test, please refer to Leeson, A, et al, 2002 *Air Sparging Design Paradigm*, dated August 12, 2002. The helium tracer gas test, will involve combining helium gas with the injected oxygen in one or more of the existing air sparge wells. A helium detector will then be used to obtain helium readings from the nearby monitoring wells. A detection of helium in the well will indicate positive communication between wells (as helium is not naturally present in the subsurface) and will be utilized to determine the effective radius of influence for the injection.

The transient pressure response test, involves placing pressure transducers in several of the monitoring wells. As helium is injected into the sparge wells, the pressure transducers will collect pressure readings to indicate breakthrough (positive communication) between the sparge well and

monitoring well. Several injection wells and monitoring points will be used for the testing activities, however the exact number and location will be determined in the field based on field observations.

7.3 Additional Monitoring Point Installation

7.3.1 Groundwater Monitoring Wells

Eight offsite monitoring wells have been approved by the ACHCSA, however have yet to be installed. AEI plans to install a portion of these wells (a total of 4) during pilot study activities in order to obtain additional data needed to help with long term remediation plans. The wells will be installed as proposed in AEI's *Subsurface Investigation Report* dated January 9, 2009, and approved by the ACHCSA in a letter dated January 27, 2009. The wells to be installed are displayed on Figure 6.

7.3.2 Soil Vapor Monitoring Probes

The probes will be installed using a hand auger or rotary hammer drill to a depth of approximately 3 to 5 feet bgs. The soil vapor probes will be constructed with 1/4-inch outside diameter by 1/8-inch inside diameter stainless steel tubing and 6-inch long soil gas implants with a 0.0057-inch stainless wire mesh screen. Approximately 6-inches of No. 30 Monterey sand will be placed in the bottom of the borehole. Then, the 6-inch long stainless steel soil gas implant with 1/4-inch Kynar[®] tubing attached will be lowered to the terminus of the boring. A No. 30 Monterey sand will then be placed around the implant to approximately 6-inches above the top of the implant. Hydrated bentonite is placed above the sand pack to seal the probe interval from overlying soils. A gas-tight Swagelok[®] valve will be used to cap the sampling tube. Each probe will be finished with a flush mounted, traffic rated well box. The location of the probes will be determined in the field, however it is expected that one more probes will be included beneath or beneath the existing site building to assess conditions in its vicinity. The schematic for the proposed vapor borings is shown on Figure 4.

8.0 SCHEDULE AND REPORTING

Implementation of the proposed feasibility study is expected to begin immediately upon approval from the ACHCSA and client. It is anticipated that field work would be completed approximately 1 to 2 months following ACHCSA approval. A report documenting the results of the feasibility study including long term recommendations will be prepared within 1 to 2 months after receiving all necessary data. The data will be consolidated and presented in a report to the ACHCSA complete with recommendations for the remedial course of action, if supported by the data.

9.0 REPORT LIMITATION


This report has been prepared by AEI Consultants relating to the environmental release at the property located at 6211 San Pablo Avenue, in the City of Oakland, Alameda County, California. Material samples have been collected and analyzed, and where appropriate conclusions drawn and recommendations made based on these analyses and other observations. This report may not reflect subsurface variations that may exist between sampling points. These variations cannot be fully anticipated, nor could they be entirely accounted for, in spite of exhaustive additional testing. This document should not be regarded as a guarantee that no further contamination, beyond that which could have been detected within the scope of past investigations is present beneath the property or that all contamination present at the site will be identified, treated, or removed. Undocumented, unauthorized releases of hazardous material(s) and petroleum products, the remains of which are not readily identifiable by visual inspection and/or are of different chemical constituents, are difficult and often impossible to detect within the scope of a chemical specific investigation and may or may not become apparent at a later time. All specified work has been performed in accordance with generally accepted practices in environmental engineering, geology, and hydrogeology and performed under the direction of appropriate California registered professionals.

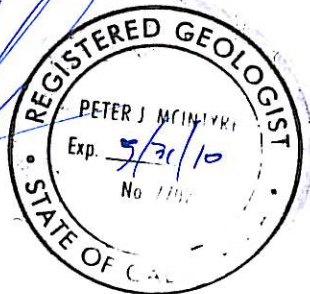
If you have any questions regarding our investigation, please do not hesitate to contact the undersigned at (925) 746-6000.

Sincerely,
AEI Consultants


Jeremy Smith
Senior Project Manager


Peter J. McIntyre, P.G.
Senior Project Geologist

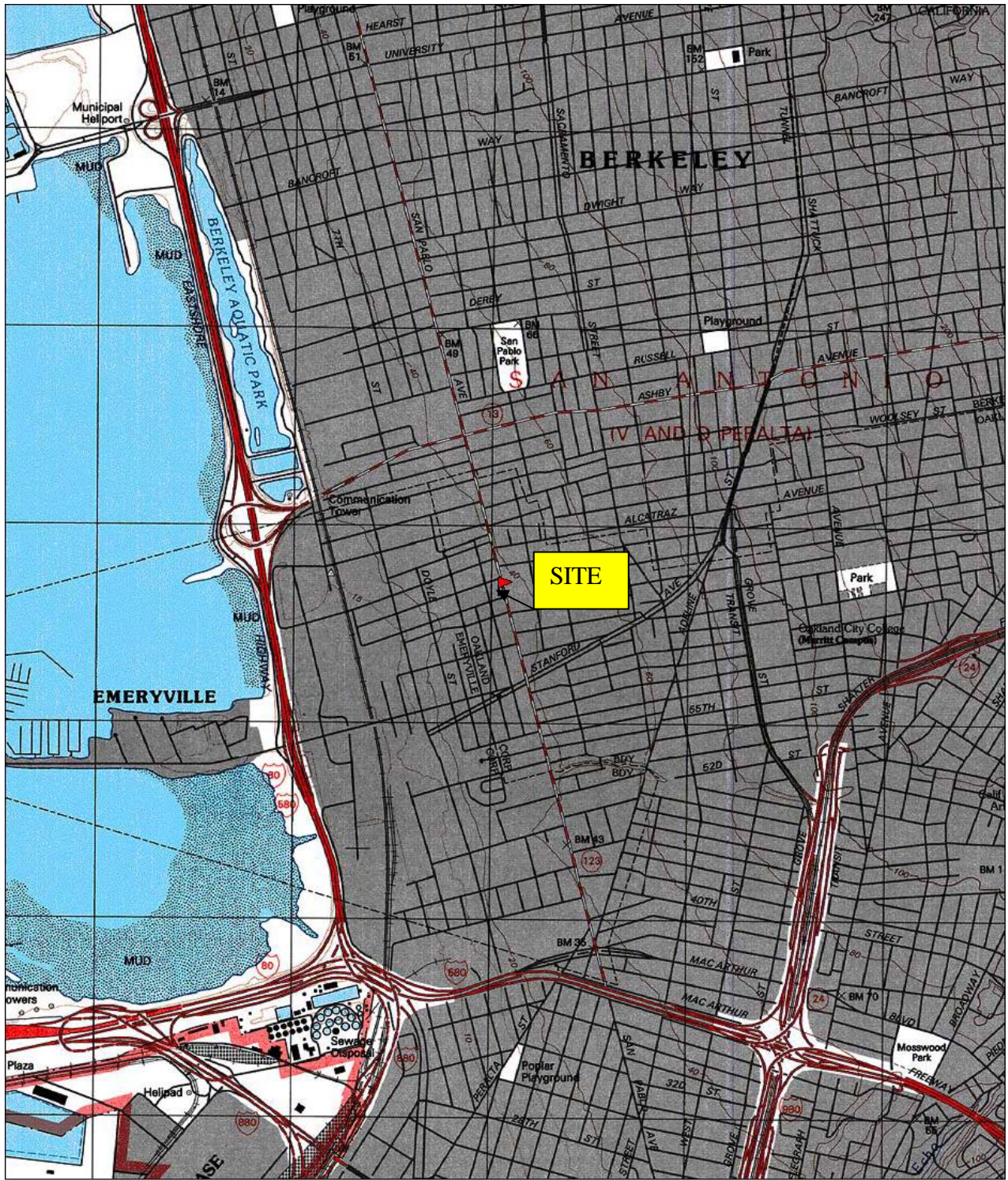

Richard J. Bradford
Project Engineer



Report Distribution:

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Mr. Leroy Griffin, Oakland Fire Department, 250 Frank H. Ogawa Plaza, Ste. 3341, Oakland, CA 94612

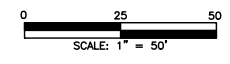
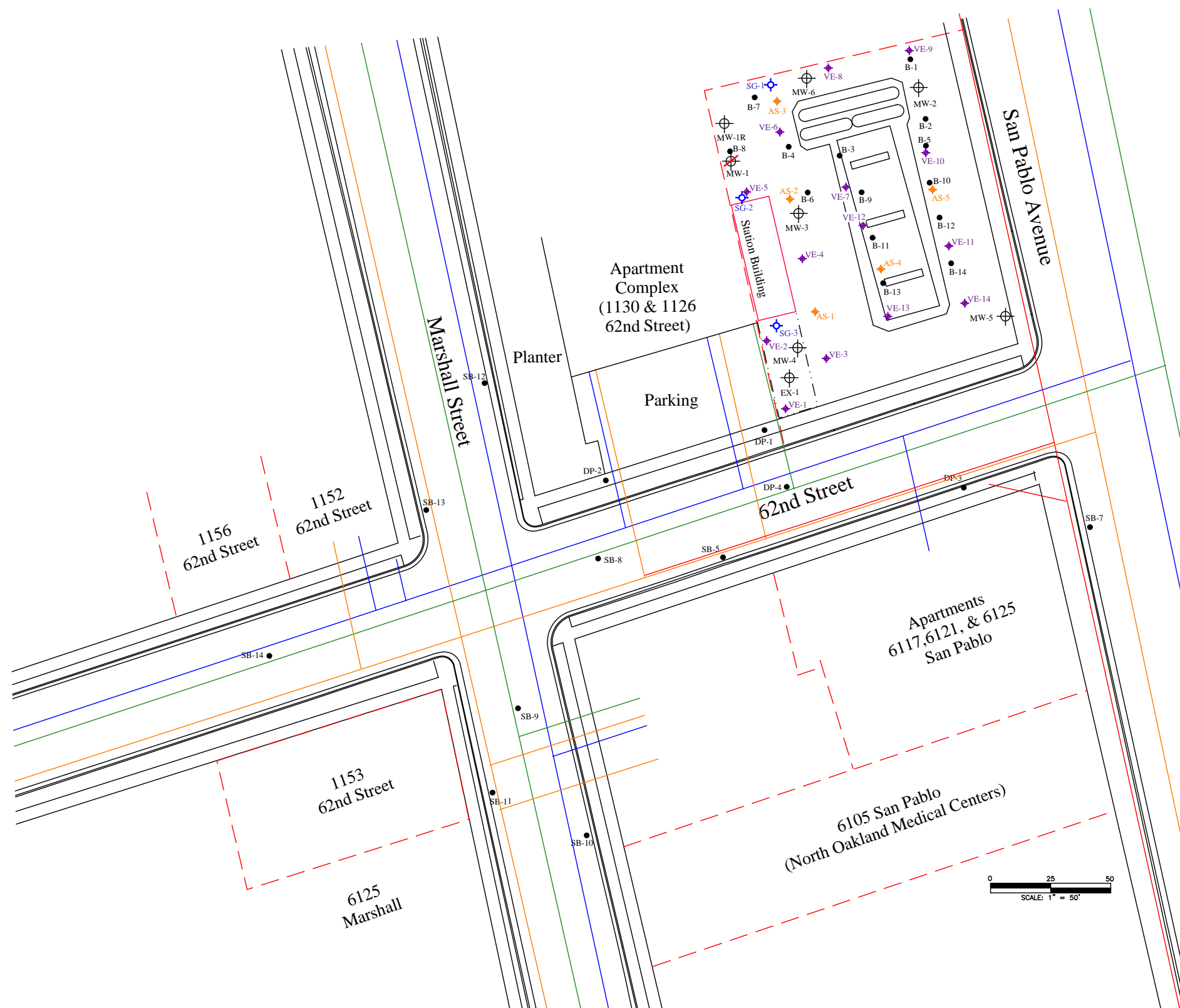
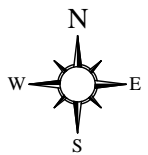
FIGURES



TN \nearrow MN
15°

0 5 1 MILE
0 1000 FEET 0 500 1000 METERS
Map created with TOPO! © 2003 National Geographic (www.nationalgeographic.com/topo)

AEI CONSULTANTS	
SITE LOCATION PLAN	
6211 SAN PABLO AVENUE OAKLAND, CALIFORNIA	FIGURE 1 PROJECT NO. 280346



LEGEND

- MONITORING WELL
- SOIL BORING
- ⊗ ABANDONED WELL
- ⊕ NESTED VAPOR PROBE
- ⊕ VAPOR EXTRACTION WELL
- ⊕ AIR SPARGE WELL
- APPROXIMATE PROPERTY BOUNDARY
- WATER LINE
- NATURAL GAS LINE
- ELECTRIC LINE
- SEWER LINE

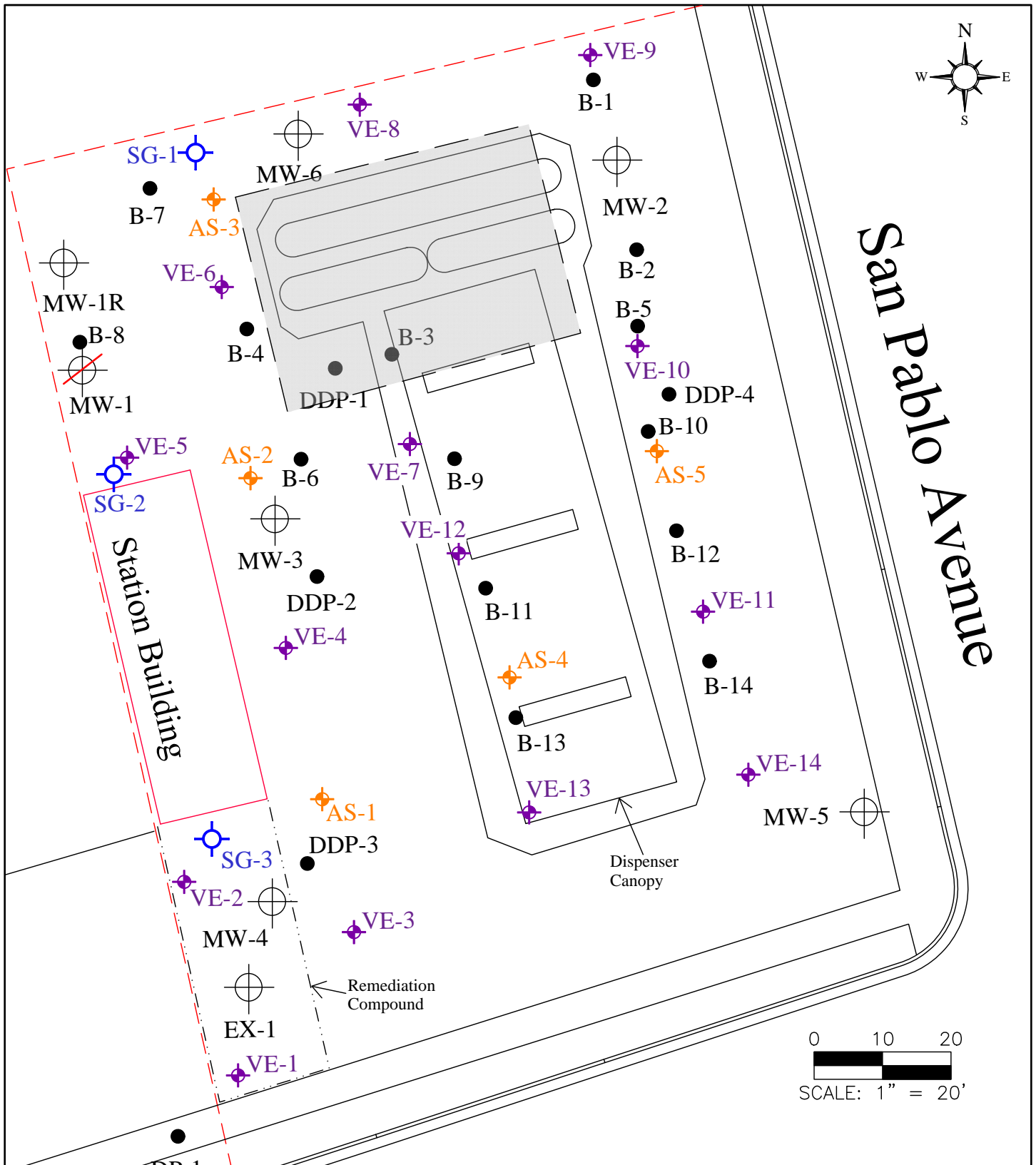
DRAFTED BY JAS 9/10/08
REVISED BY JAS 9/26/08

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2500 CAMINO DIABLO, SUITE 200, WALNUT CREEK

EXTENDED SITE PLAN

6211 SAN PABLO AVENUE
OAKLAND, CALIFORNIA

FIGURE 2
PROJECT NO. 280346



LEGEND

- | | | | |
|--|--------------------|--|--------------------------|
| | MONITORING WELL | | VAPOR EXTRACTION WELL |
| | SOIL BORING | | AIR SPARGE WELL |
| | ABANDONED WELL | | UNDERGROUND STORAGE TANK |
| | NESTED VAPOR PROBE | | DISPENSER ISLAND |
| | | | FORMER UST EXCAVATION |

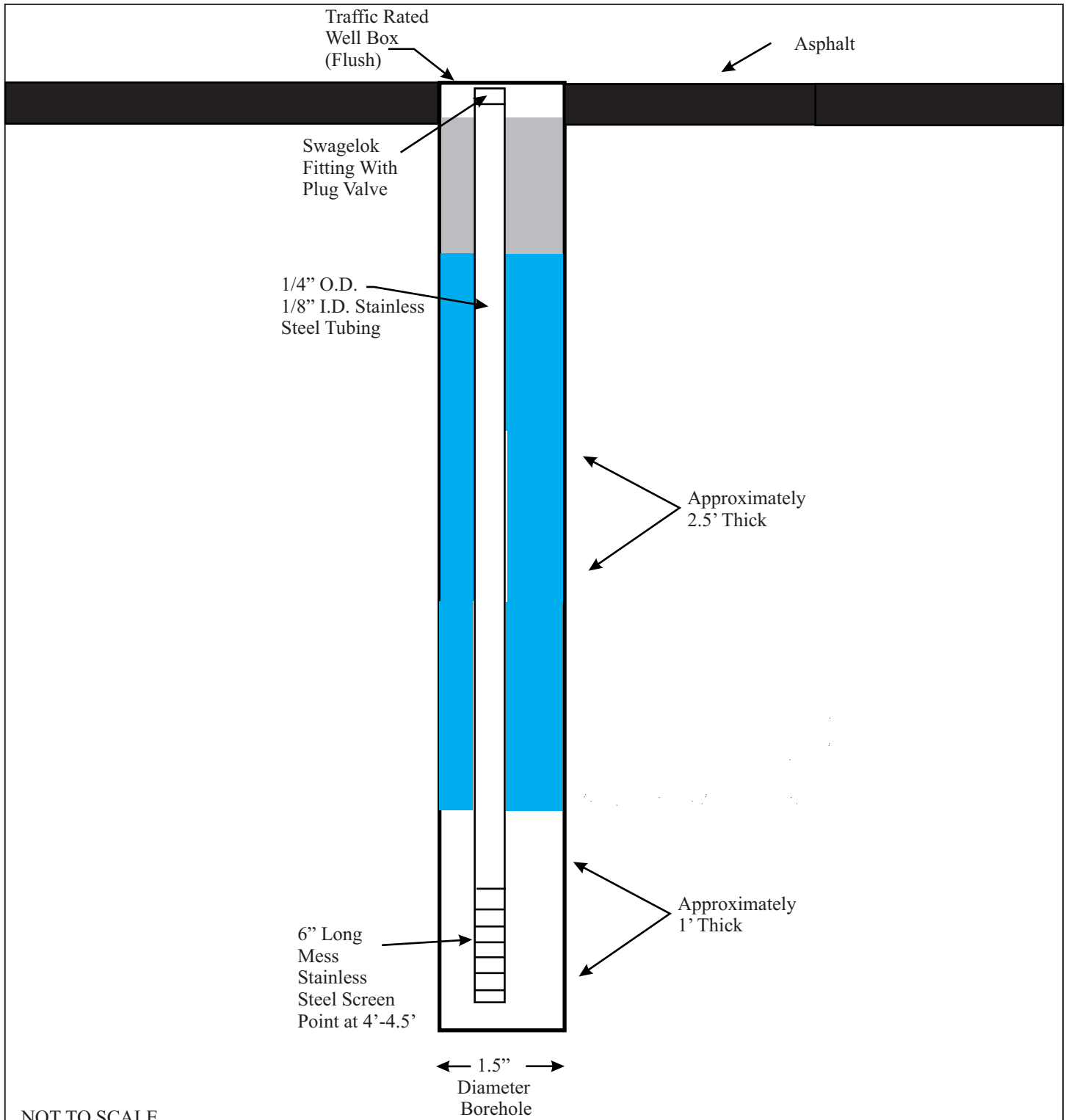
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 2500 CAMINO DIABLO, WALNUT CREEK

SITE PLAN





6211 SAN PABLO AVENUE
 OAKLAND, CALIFORNIA

FIGURE 3
 PROJECT NO. 280346



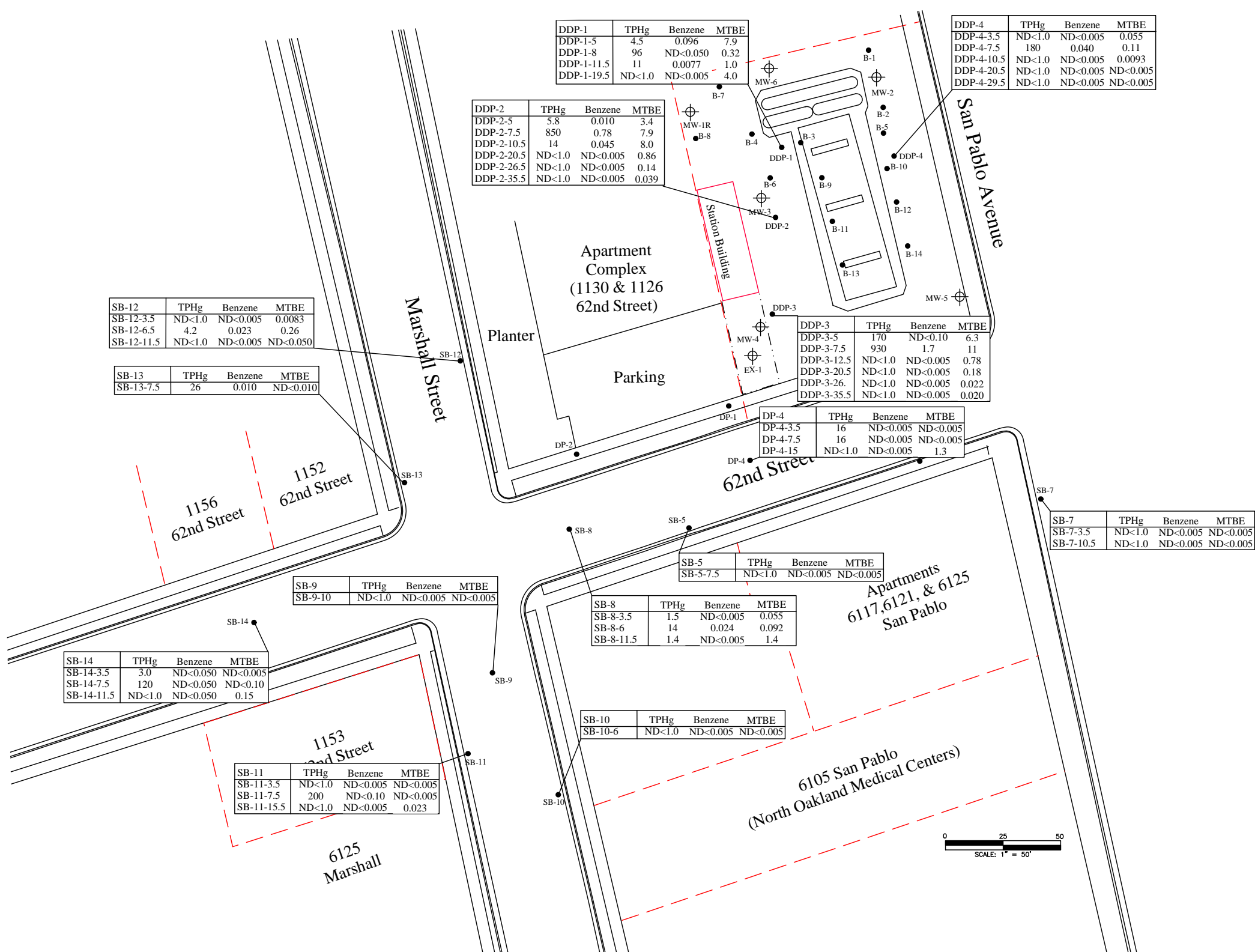
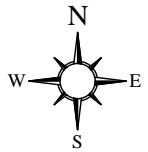
NOT TO SCALE

LEGEND

-  Neat Cement Grout Seal
-  Bentonite Seal
-  Sand Filter Pack
-  Monitoring Point

AEI CONSULTANTS
 2500 CAMINO DIABLO, WALNUT CREEK, CA

**FIGURE 4:
 SOIL VAPOR PROBE SCHEMATIC**



LEGEND

○ MONITORING WELL

● SOIL BORING

All results in milligrams per kilogram (mg/kg)
 TPHg = Total Petroleum Hydrocarbons as gasoline
 MTBE = methyl tert butyl ether
 Refer to Table 1 for complete analytical data.

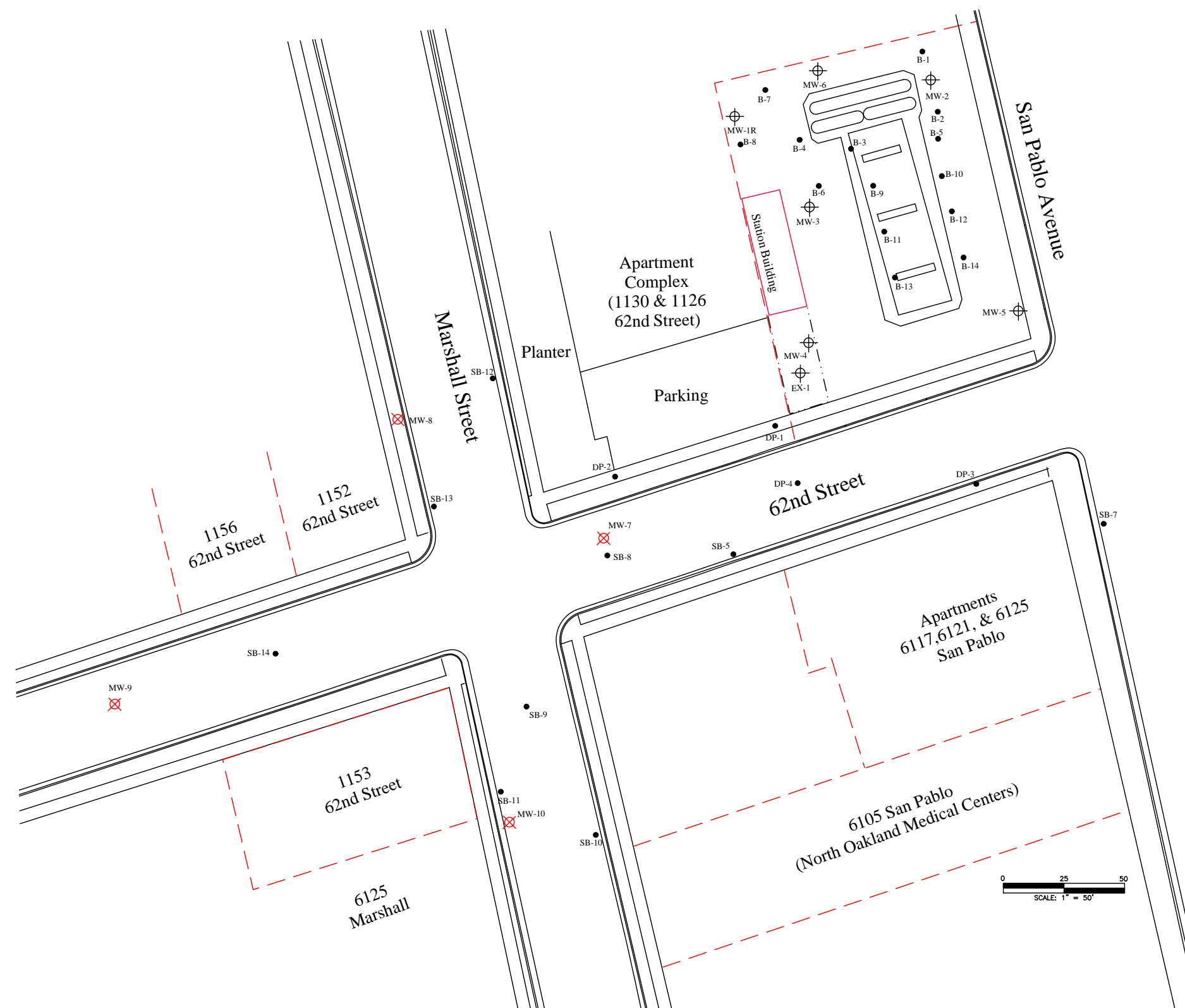
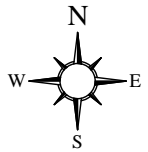
DRAFTED BY JAS 9/10/08
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SOIL ANALYTICAL MAP

6211 SAN PABLO AVENUE
 OAKLAND, CALIFORNIA

FIGURE 5
 PROJECT NO. 280346



LEGEND

- MONITORING WELL
- SOIL BORING
- ⊗ PROPOSED MONITORING WELL (revised from earlier work plan)

DRAFTED BY JAS 9/10/08
REVISED BY JAS 9/26/08

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**PROPOSED MONITORING
WELL LOCATIONS**

6211 SAN PABLO AVENUE
OAKLAND, CALIFORNIA

FIGURE 6
PROJECT NO. 280346

TABLES

Table 1, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Soil Analytical Data

Sample ID	Date	Depth (feet bgs)	TPHg mg/kg	Benzene mg/kg	Toluene mg/kg	Ethylbenzene mg/kg	Xylenes mg/kg	MTBE mg/kg	DIPE mg/kg	ETBE mg/kg	TAME mg/kg	TBA mg/kg	1,2-DCA mg/kg	EDB mg/kg
DP-4														
DP-4-3.5	11/24/2008	3.5	16	ND<0.005	0.037	ND<0.005	0.041	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.15	ND<0.004	ND<0.004
DP-4-7.5	11/24/2008	7.5	16	ND<0.005	0.12	0.016	0.032	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DP-4-15	11/24/2008	15	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	1.3	ND<0.10	ND<0.10	0.12	ND<1.0	ND<0.080	ND<0.080
SB-5														
SB-5-7.5	11/25/2008	7.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-7														
SB-7-3.5	11/25/2008	3.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-7-10.5	11/25/2008	10.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-8														
SB-8-3.5	11/24/2008	3.5	1.5	ND<0.005	0.024	ND<0.005	ND<0.005	0.055	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-8-6	11/24/2008	6	14	0.024	0.12	0.45	0.087	0.092	ND<0.005	ND<0.005	ND<0.005	0.090	ND<0.004	ND<0.004
SB-8-11.5	11/24/2008	11.5	1.4	ND<0.005	ND<0.005	0.034	0.049	1.4	ND<0.050	ND<0.050	0.061	2.7	ND<0.040	ND<0.040
SB-9														
SB-9-10	11/24/2008	10	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-10														
SB-10-6	11/24/2008	6	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-11														
SB-11-3.5	11/24/2008	3.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-11-7.5	11/24/2008	7.5	200	ND<0.10	0.96	1.4	3.9	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-11-15.5	11/24/2008	15.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.023	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-12														
SB-12-3.5	11/25/2008	3.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.0083	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-12-6.5	11/25/2008	6.5	4.2	0.023	0.034	0.036	0.0088	0.26	ND<0.010	ND<0.010	ND<0.010	0.17	ND<0.0080	ND<0.0080
SB-12-11.5	11/25/2008	11.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.050	ND<0.050	ND<0.050	ND<0.050	2.1	ND<0.040	ND<0.040
SB-13														
SB-13-7.5	11/25/2008	7.5	26	0.010	0.20	0.18	0.64	ND<0.010	ND<0.010	ND<0.010	ND<0.010	0.12	ND<0.0080	ND<0.0080
SB-14														
SB-14-3.5	11/24/2008	3.5	3.0	ND<0.050	0.014	ND<0.050	ND<0.050	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
SB-14-7.5	11/24/2008	7.5	120	ND<0.050	0.75	2.3	6.2	ND<0.10	ND<0.10	ND<0.10	ND<0.10	ND<1.0	ND<0.080	ND<0.080
SB-14-11.5	11/24/2008	11.5	ND<1.0	ND<0.050	ND<0.050	ND<0.050	ND<0.050	0.15	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004

Table 1, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Soil Analytical Data

Sample ID	Date	Depth (feet bgs)	TPHg mg/kg	Benzene mg/kg	Toluene mg/kg	Ethylbenzene mg/kg	Xylenes mg/kg	MTBE mg/kg	DIPE mg/kg	ETBE mg/kg	TAME mg/kg	TBA mg/kg	1,2-DCA mg/kg	EDB mg/kg
DDP-1														
DDP-1-5	11/25/2008	5	4.5	0.096	0.044	0.017	0.021	7.9	ND<0.25	ND<0.25	0.28	12	ND<0.20	ND<0.20
DDP-1-8	11/25/2008	8	96	ND<0.050	0.93	0.19	0.13	0.32	ND<0.020	ND<0.020	ND<0.020	1.3	ND<0.016	ND<0.016
DDP-1-11.5	11/25/2008	11.5	11	0.0077	0.099	0.016	0.057	1.0	ND<0.033	ND<0.033	0.17	4.4	ND<0.027	ND<0.027
DDP-1-19.5	11/25/2008	19.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	4.0	ND<0.20	ND<0.20	0.26	7.1	ND<0.16	ND<0.16
DDP-2														
DDP-2-5	11/26/2008	5	5.8	0.010	0.054	0.0063	0.057	3.4	ND<0.10	ND<0.10	0.23	2.3	ND<0.080	ND<0.080
DDP-2-7.5	11/26/2008	7.5	850	0.78	4.0	6.8	63	7.9	ND<0.20	ND<0.20	0.58	3.4	ND<0.16	ND<0.16
DDP-2-10.5	11/26/2008	10.5	14	0.045	0.13	0.040	0.14	8.0	ND<0.50	ND<0.50	ND<0.50	12	ND<0.40	ND<0.40
DDP-2-20.5	11/26/2008	20.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.86	ND<0.050	ND<0.050	ND<0.050	ND<0.50	ND<0.040	ND<0.040
DDP-2-26.5	11/26/2008	26.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.14	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DDP-2-35.5	11/26/2008	35.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.039	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DDP-3														
DDP-3-5	11/26/2008	5	170	ND<0.10	1.6	0.81	20	6.3	ND<0.25	ND<0.25	0.38	6.6	ND<0.20	ND<0.20
DDP-3-7.5	11/26/2008	7.5	930	1.7	23	11	73	11	ND<0.50	ND<0.50	1.1	ND<5.0	ND<0.40	ND<0.40
DDP-3-12.5	11/26/2008	12.5	ND<1.0	ND<0.005	0.0075	ND<0.005	0.013	0.78	ND<0.10	ND<0.10	ND<0.10	12	ND<0.080	ND<0.080
DDP-3-20.5	11/26/2008	20.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.18	ND<0.010	ND<0.010	ND<0.010	ND<0.10	ND<0.0080	ND<0.0080
DDP-3-26	11/26/2008	26	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.022	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DDP-3-35.5	11/26/2008	35.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.020	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DDP-4														
DDP-4-3.5	11/26/2008	3.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.055	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DDP-4-7.5	11/26/2008	7.5	180	0.040	0.84	0.26	2.5	0.11	ND<0.020	ND<0.020	ND<0.020	ND<0.20	ND<0.016	ND<0.016
DDP-4-10.5	11/26/2008	10.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	0.0093	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DDP-4-20.5	11/26/2008	20.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004
DDP-4-29.5	11/26/2008	29.5	ND<1.0	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.05	ND<0.004	ND<0.004

Notes:

TPHg = total petroleum hydrocarbons as gasoline using EPA Method 8015

Benzene, toluene, ethylbenzene, and xylenes using EPA Method 8021B

MTBE = methyl-tertiary butyl ether using EPA Method 8260B

TBA = tert-butyl alcohol using EPA Method 8260B

TAME = tert-amyl methyl ether using EPA Method 8260B

DIPE = diisopropyl ether using EPA Method 8260B

ETBE = ethyl tert-butyl ether using EPA Method 8260B

1,2-DCA = 1,2-dichloroethane using EPA Method 8260B

EDB = Ethylene dibromide using EPA Method 8260B

mg/kg = milligrams per kilogram

ND = non detect at respective reporting limit

Table 2, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Groundwater Analytical Data - Soil Borings

Sample ID	Date	TPHg ug/L	Benzene ug/L	Toluene ug/L	Ethylbenzene ug/L	Xylenes ug/L	MTBE ug/L	DIPE ug/L	ETBE ug/L	TAME ug/L	TBA ug/L	1,2-DCA ug/L	EDB ug/L
DP-4	11/24/2008	1,700	17	5.6	22	5.3	9,700	ND<250	ND<250	800	10,000	ND<250	ND<250
SB-5	11/25/2008	430	ND<1.7	ND<1.7	ND<1.7	ND<1.7	4,600	ND<100	ND<100	460	ND<400	ND<100	ND<100
SB-7	11/25/2008	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<2.0	ND<0.5	ND<0.5
SB-8	11/24/2008	47,000	530	200	3,100	4,100	1,900	ND<170	ND<170	ND<170	30,000	ND<170	ND<170
SB-9	11/24/2008	1,300	8.6	3.9	55	200	180	ND<5.0	ND<5.0	12	25	ND<5.0	ND<5.0
SB-10	11/24/2008	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	18	ND<0.5	ND<0.5	ND<0.5	2.5	ND<0.5	ND<0.5
SB-11	11/24/2008	1,200	5.6	0.59	38	220	160	ND<5.0	ND<5.0	5.4	37	ND<5.0	ND<5.0
SB-12	11/25/2008	390	1.3	0.93	18	56	3,900	ND<120	ND<120	ND<120	29,000	ND<120	ND<120
SB-13	11/25/2008	1,100	ND<5.0	ND<5.0	ND<5.0	14	18,000	ND<250	ND<250	720	5,400	ND<250	ND<250
SB-14	11/24/2008	1,300	20	6.9	61	170	1,900	ND<50	ND<50	52	350	ND<50	ND<50
DDP-1	11/25/2008	ND<50	ND<0.5	ND<0.5	ND<0.5	ND<0.5	47	ND<1.0	ND<1.0	2.8	100	ND<1.0	ND<1.0
DDP-1D	11/25/2008	130	5.7	6.6	5.4	21	21	ND<2.5	ND<2.5	2.7	500	ND<2.5	ND<2.5

Notes:

TPHg = total petroleum hydrocarbons as gasoline using EPA Method 8015

Benzene, toluene, ethylbenzene, and xylenes using EPA Method 8021B

MTBE = methyl-tertiary butyl ether using EPA Method 8260B

TBA = tert-butyl alcohol using EPA Method 8260B

TAME = tert-amyl methyl ether using EPA Method 8260B

DIPE = diisopropyl ether using EPA Method 8260B

ETBE = ethyl tert-butyl ether using EPA Method 8260B

1,2-DCA = 1,2-dichloroethane using EPA Method 8260B

EDB = Ethylene dibromide using EPA Method 8260B

µg/L= micrograms per liter

ND = non detect at respective reporting limit

Table 3, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Groundwater Analytical Data

Sample ID	Date	TPHg µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes µg/L	MTBE µg/L	DIPE µg/L	ETBE µg/L	TAME µg/L	TBA µg/L	1,2-DCA µg/L	EDB µg/L
MW-1	11/7/1999	5,700	170	59	22	85	20,000	NA	NA	NA	NA	NA	NA
	3/8/2001	17,000	480	150	52	170	38,000	NA	NA	NA	NA	NA	NA
	11/17/2001	10,000	230	210	60	250	22,000	NA	NA	NA	NA	NA	NA
	3/31/2002	12,000	61	ND	ND	29	35,000	NA	NA	NA	NA	NA	NA
	11/9/2003	19,000	ND	ND	ND	ND	50,000	NA	NA	NA	NA	NA	NA
	12/9/2003	22,000	150	ND	ND	ND	66,000	NA	NA	NA	NA	NA	NA
MW-1R	11/17/2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	3/31/2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	9/9/2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	12/9/2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2/19/2004	1,800	95	130	44	200	220	NA	NA	NA	NA	NA	NA
	5/24/2004	210	12	10	5.4	23	79	ND	ND	2.1	37	ND	ND
	9/3/2004	300	1.5	7.1	9.4	42	81	ND	ND	1.6	ND	ND	ND
	11/2/2004	290	14	30	9.5	45	45	ND	ND	1.1	ND	NA	NA
	2/17/2005	530	3.4	ND	ND	2.6	1,000	ND	ND	100	ND	NA	NA
	5/24/2005	NA	NA	NA	NA	NA	NA	ND	ND	610	ND	ND	ND
	8/15/2005	2,500	64	240	61	210	2,300	ND	ND	210	ND	ND	ND
	11/17/2005	2,500	66	290	75	290	1,300	ND	ND	110	1,600	ND	ND
	2/8/2006	3,300	100	310	86	470	1,400	ND	ND	130	1,400	ND	ND
	5/5/2006	3,400	170	350	97	550	1,100	ND	ND	100	2,400	ND	ND
	8/18/2006	5,800	190	1,000	230	1,000	490	ND	ND	36	2,900	ND	ND
	12/1/2006	410	1.7	6.3	1.2	47	100	ND	ND	4.7	100	ND	ND
	2/23/2007	ND	ND	0.51	ND	1.4	3	ND	ND	ND	ND	ND	ND
	5/10/2007	ND	ND	ND	ND	2.0	5.9	ND	ND	ND	ND	ND	ND
	8/16/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/8/2007	1,300	11	82	54	270	1.4	ND	ND	ND	ND	ND	ND
2/14/2008	800	7.6	31	23	150	1.7	ND	ND	ND	ND	ND	ND	
5/15/2008	3,200	20	200	110	550	4.2	ND<0.50	ND<0.50	1.0	ND<20	ND<0.50	ND<0.50	
9/10/2008	1,000	6.5	22	19	120	2.3	ND<0.50	ND<0.50	ND<0.50	4.0	ND<0.50	ND<0.50	
11/18/2008	430	4.1	18	12	100	1.8	ND<0.50	ND<0.50	ND<0.50	ND<2.0	ND<0.50	ND<0.50	
2/17/2009	220	3.6	6.1	2.0	41	1.3	ND<0.50	ND<0.50	ND<0.50	ND<2.0	ND<0.50	ND<0.50	
5/15/2009	890	6.0	17	27	110	1.8	ND<0.50	ND<0.50	ND<0.50	3.9	ND<0.50	ND<0.50	
MW-2	11/7/1999	6,000	1,300	92	50	400	6,800	NA	NA	NA	NA	NA	NA
	3/8/2001	41,000	8,100	870	2,000	4,100	26,000	NA	NA	NA	NA	NA	NA
	11/17/2001	18,000	3,700	180	610	640	16,000	NA	NA	NA	NA	NA	NA
	3/31/2002	32,000	6,500	270	1,700	2,700	19,000	NA	NA	NA	NA	NA	NA
	9/9/2003	24,000	4,600	ND	1,200	440	19,000	NA	NA	NA	NA	NA	NA
	12/9/2003	31,000	6,200	170	1,600	2,700	19,000	NA	NA	NA	NA	NA	NA
	2/19/2004	21,000	4,600	120	970	2,000	15,000	NA	NA	NA	NA	NA	NA
	5/24/2004	1,200	120	3	63	67	1,900	ND	ND	ND	ND	ND	ND
	9/3/2004	2,300	120	ND	51	70	1,700	ND	ND	26	ND	ND	ND
	11/2/2004	530	35	ND	17	30	520	ND	ND	28	100	NA	NA

Table 3, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Groundwater Analytical Data

Sample ID	Date	TPHg µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes µg/L	MTBE µg/L	DIPE µg/L	ETBE µg/L	TAME µg/L	TBA µg/L	1,2-DCA µg/L	EDB µg/L
MW-2 (cont.)	2/17/2005	18,000	2,100	31	800	680	20,000	ND	ND	1,000	ND	NA	NA
	5/24/2005	22,000	3,200	52	1,400	1,700	16,000	ND	ND	NS	NS	ND	ND
	8/15/2005	2,000	66	ND	46	47	2,400	ND	ND	95	880	ND	ND
	11/17/2005	760	19	0.64	15	13	1,000	ND	ND	26	810	ND	ND
	2/8/2006	10,000	1,500	8	660	380	4,300	ND	ND	120	2,800	ND	ND
	5/5/2006	15,000	1,800	ND	1,200	1,200	5,800	ND	ND	150	4,300	ND	ND
	8/18/2006	360	11	ND	13	9.7	160	ND	ND	4.6	600	ND	ND
	12/1/2006	11,000	1,000	ND	990	910	2,100	ND	ND	87	2,000	ND	ND
	2/23/2007	3,200	210	ND	270	85	900	ND	ND	33	1,400	ND	ND
	5/10/2007	590	31	ND	39	22	200	ND	ND	5.9	250	ND	ND
	8/16/2007	650	49	ND	71	49	100	ND	ND	3.5	82	ND	ND
	11/8/2007	110	1.6	ND	1.9	1.6	23	ND	ND	0.64	48	ND	ND
	2/14/2008	350	24	ND	12	5.9	190	ND	ND	7.7	320	ND	ND
	5/15/2008	81	0.59	ND<0.50	0.71	0.66	38	ND<0.50	ND<0.50	1.4	54	ND<0.50	ND<0.50
	9/10/2008	150	6.4	ND<0.50	8.4	5.1	14	ND<0.50	ND<0.50	0.55	38	ND<0.50	ND<0.50
	11/18/2008	420	25	0.70	46	47	29	ND<0.50	ND<0.50	1.3	60	ND<0.50	ND<0.50
	2/17/2009	460	23	0.96	51	37	26	ND<0.50	ND<0.50	1.4	61	ND<0.50	ND<0.50
5/15/2009	220	13	0.93	26	13	21	ND<0.50	ND<0.50	0.87	60	ND<0.50	ND<0.50	
MW-3	11/7/1999	43,000	860	70	ND	65	120,000	NA	NA	NA	NA	NA	NA
	3/8/2001	90,000	1,800	ND	ND	ND	210,000	NA	NA	NA	NA	NA	NA
	11/17/2001	110,000	1,600	ND	ND	ND	300,000	NA	NA	NA	NA	NA	NA
	3/31/2002	130,000	2,400	670	300	390	300,000	NA	NA	NA	NA	NA	NA
	9/9/2003	190,000	1,600	ND	ND	ND	420,000	NA	NA	NA	NA	NA	NA
	12/9/2003	170,000	2,000	ND	ND	ND	4,500,000	NA	NA	NA	NA	NA	NA
	2/19/2004	86,000	1,800	630	ND	ND	160,000	NA	NA	NA	NA	NA	NA
	5/24/2004	120,000	2,200	ND	180	220	400,000	ND	ND	15,000	ND	ND	ND
	9/3/2004	180,000	2,000	ND	ND	ND	510,000	ND	ND	14,000	ND	ND	ND
	11/2/2004	150,000	1,700	ND	ND	ND	350,000	ND	ND	31,000	140,000	NA	NA
	2/17/2005	130,000	2,100	420	210	730	290,000	ND	ND	11,000	ND	NA	NA
	5/24/2005	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	8/15/2005	110,000	1,500	ND	ND	ND	260,000	ND	ND	21,000	25,000	ND	ND
	11/17/2005	200,000	2,400	ND	ND	ND	580,000	ND	ND	24,000	49,000	ND	ND
	2/8/2006	470,000	3,800	660	ND	790	490,000	ND	ND	26,000	49,000	ND	ND
	5/5/2006	400,000	3,300	ND	ND	ND	590,000	ND	ND	21,000	86,000	ND	ND
	8/18/2006	310,000	1,800	ND	ND	ND	440,000	ND	ND	23,000	79,000	ND	ND
	12/1/2006	270,000	ND	ND	ND	ND	290,000	ND	ND	11,000	90,000	ND	ND
	2/23/2007	220,000	ND	ND	ND	ND	260,000	ND	ND	15,000	33,000	ND	ND
	5/10/2007	140,000	ND	ND	ND	ND	180,000	ND	ND	7,100	80,000	ND	ND
8/16/2007	69,000	ND	ND	ND	ND	85,000	ND	ND	3,400	180,000	ND	ND	
11/8/2007	34,000	ND	ND	ND	ND	38,000	ND	ND	1,400	140,000	ND	ND	
2/14/2008	41,000	ND	ND	ND	ND	44,000	ND	ND	1,900	110,000	ND	ND	
5/15/2008	43,000	ND<100	ND<100	ND<100	ND<100	62,000	ND<100	ND<100	1,100	200,000	ND<100	ND<100	
9/10/2008	1,600	14	8.6	7.7	23	21,000	ND<1,000	ND<1,000	ND<1,000	290,000	ND<1,000	ND<1,000	
11/18/2008	4,500	86	150	100	590	29,000	ND<1,000	ND<1,000	ND<1,000	290,000	ND<1,000	ND<1,000	
2/17/2009	2,500	45	53	35	160	16,000	ND<1,000	ND<1,000	ND<1,000	190,000	ND<1,000	ND<1,000	
5/15/2009	2,000	15	21	13	35	13,000	ND<1,000	ND<1,000	ND<1,000	260,000	ND<1,000	ND<1,000	

Table 3, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Groundwater Analytical Data

Sample ID	Date	TPHg µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes µg/L	MTBE µg/L	DIPE µg/L	ETBE µg/L	TAME µg/L	TBA µg/L	1,2-DCA µg/L	EDB µg/L
MW-4	11/17/2001	64,000	960	1,400	360	1,600	140,000	NA	NA	NA	NA	NA	NA
	3/31/2002	78,000	4,400	4,700	690	2,700	150,000	NA	NA	NA	NA	NA	NA
	9/6/2007	49,000	710	840	ND	10,000	3,600	ND	ND	510	32,000	ND	ND
	11/8/2007	64,000	1,300	2,600	1,000	8,500	1,500	ND	ND	360	14,000	ND	ND
	2/14/2008	60,000	390	460	230	2,000	52,000	ND	ND	2,000	58,000	ND	ND
	5/15/2008	22,000	670	130	740	2,700	3,300	ND<5.0	ND<5.0	340	35,000	ND<5.0	ND<5.0
	9/10/2008	16,000	500	150	730	2,500	2,000	ND<250	ND<250	ND<250	65,000	ND<250	ND<250
	11/18/2008	24,000	820	190	1,200	5,000	1,400	ND<50	ND<50	260	9,300	ND<50	ND<50
	2/17/2009	17,000	350	170	620	2,600	360	ND<10	ND<10	82	2,100	ND<10	ND<10
	5/15/2009	32,000	300	190	880	3,200	470	ND<10	ND<10	95	380	ND<10	ND<10
	MW-5	11/17/2001	210	15	12	11	23	4.8	NA	NA	NA	NA	NA
3/31/2002		120	11	7.4	6.1	16	4.2	NA	NA	NA	NA	NA	NA
9/9/2003		ND	1.5	ND	ND	ND	1.7	NA	NA	NA	NA	NA	NA
12/9/2003		130	32	ND	2.6	0.57	5	NA	NA	NA	NA	NA	NA
2/19/2004		ND	ND	ND	ND	ND	1.5	NA	NA	NA	NA	NA	NA
5/24/2004		ND	ND	ND	ND	ND	0.55	ND	ND	ND	ND	ND	ND
9/3/2004		100	6.4	ND	ND	0.79	4.2	ND	ND	ND	ND	ND	ND
11/2/2004		ND	2.6	ND	1.7	0.87	1	ND	ND	ND	ND	ND	ND
2/17/2005		51	0.74	ND	0.94	ND	1.5	ND	ND	ND	ND	ND	ND
5/24/2005		ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND
8/15/2005		ND	ND	ND	ND	ND	0.88	ND	ND	ND	ND	ND	ND
11/17/2005		71	0.81	ND	1.1	ND	1.4	ND	ND	ND	ND	ND	ND
2/8/2006		50	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND
5/5/2006		ND	ND	ND	ND	ND	0.93	ND	ND	ND	ND	ND	ND
8/18/2006		ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND
12/1/2006		ND	0.69	ND	ND	0.52	0.97	ND	ND	ND	ND	ND	ND
2/23/2007		73	ND	ND	ND	ND	1.7	ND	ND	ND	ND	ND	ND
5/10/2007		ND	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
8/16/2007		ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND
11/8/2007		ND	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND
2/14/2008	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND	
5/15/2008	ND<50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	1.7	ND<0.50	ND<0.50	ND<0.50	ND<20	ND<0.50	ND<0.50	
9/10/2008	480	17	1.8	2.7	0.59	12	ND<0.50	ND<0.50	ND<0.50	4.4	ND<0.50	ND<0.50	
11/18/2008	130	2.3	1.6	ND<0.50	ND<0.50	7.3	ND<0.50	ND<0.50	ND<0.50	ND<2.0	ND<0.50	ND<0.50	
2/17/2009	170	ND<0.50	2.7	ND<0.50	ND<0.50	4.2	ND<0.50	ND<0.50	ND<0.50	ND<2.0	ND<0.50	ND<0.50	
5/15/2009	ND<50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	7.6	ND<0.50	ND<0.50	ND<0.50	ND<2.0	ND<0.50	ND<0.50	
MW-6	11/17/2001	3,500	160	260	95	420	1,500	NA	NA	NA	NA	NA	NA
	3/31/2002	3,200	410	170	82	280	3,000	NA	NA	NA	NA	NA	NA
	9/9/2003	800	49	ND	7.4	ND	1,700	NA	NA	NA	NA	NA	NA
	12/9/2003	970	150	9.9	31	83	1,200	NA	NA	NA	NA	NA	NA
	2/19/2004	1,900	280	58	17	160	2,700	NA	NA	NA	NA	NA	NA
	9/3/2004	1,100	27	ND	14	27	2,200	ND	ND	85	ND	ND	ND
	11/2/2004	1,800	32	ND	5	11	4,100	ND	ND	170	270	ND	ND
	2/17/2005	5,600	190	34	41	110	10,000	ND	ND	780	2,000	ND	ND
	8/15/2005	1,800	27	ND	6	23	3,800	ND	ND	300	3,500	ND	ND
	11/17/2005	1,100	30	ND	4	9	2,400	ND	ND	190	9,500	ND	ND
2/8/2006	3,600	220	43	66	160	2,700	ND	ND	180	7,800	ND	ND	

Table 3, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Groundwater Analytical Data

Sample ID	Date	TPHg µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes µg/L	MTBE µg/L	DIPE µg/L	ETBE µg/L	TAME µg/L	TBA µg/L	1,2-DCA µg/L	EDB µg/L	
MW-6 (cont.)	5/5/2006	1,600	130	21	37	65	1,400	ND	ND	53	3,100	ND	ND	
	8/18/2006	270	27	ND	3	4	240	ND	ND	11	2,400	ND	ND	
	12/1/2006	1,700	ND	ND	ND	ND	1,700	ND	ND	92	800	ND	ND	
	2/23/2007	ND	ND	ND	ND	ND	15	ND	ND	ND	ND	ND	ND	
	5/10/2007	ND	3.0	ND	ND	1.9	26	ND	ND	2	48	ND	ND	
	8/16/2007	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	
	11/8/2007	ND	ND	ND	ND	ND	5.3	ND	ND	ND	ND	ND	ND	
	2/14/2008	ND	ND	ND	ND	ND	11	ND	ND	0.94	220	ND	ND	
	5/15/2008	ND<50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	13	ND<0.50	ND<0.50	1.0	130	ND<0.50	ND<0.50	
	9/10/2008	78	1.4	0.60	0.94	1.3	71	ND<1.0	ND<1.0	6.2	160	ND<1.0	ND<1.0	
	11/18/2008	ND<50	2.4	ND<0.50	ND<0.50	0.70	72	ND<1.2	ND<1.2	7.2	180	ND<1.2	ND<1.2	
	2/17/2009	ND<50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	ND<0.50	ND<2.0	ND<0.50	ND<0.50	
	5/15/2009	53	3.2	ND<0.50	ND<0.50	1.7	44	ND<1.0	ND<1.0	4.3	89	ND<1.0	ND<1.0	
	EX-1	2/19/2004	120,000	9,500	4,300	840	3,900	150,000	NA	NA	NA	NA	NA	NA
		2/14/2008	84,000	2,300	4,900	1,800	14,000	3,900	ND	ND	610	10,000	ND	ND
5/15/2008		24,000	2,100	750	640	2,100	1,800	ND<0.50	ND<0.50	380	11,000	ND<0.50	ND<0.50	
9/10/2008		9,200	1,000	160	300	1,000	780	ND<100	ND<100	180	22,000	ND<100	ND<100	
11/18/2008		8,900	1,400	290	360	1,300	840	ND<100	ND<100	230	20,000	ND<100	ND<100	
2/17/2009		70,000	2,700	3,600	1,900	13,000	1,400	ND<25	ND<25	480	1,500	ND<25	ND<25	
5/15/2009		18,000	1,400	250	530	1,700	640	ND<25	ND<25	200	5,500	ND<25	ND<25	

Notes:

- TPHg = total petroleum hydrocarbons as gasoline using EPA Method 8015
- Benzene, toluene, ethylbenzene, and xylenes using EPA Method 8021B
- MTBE = methyl-tertiary butyl ether using EPA Method 8021B; EPA Method 8260B Beginning in May 2008
- TBA = tert-butyl alcohol using EPA Method 8260B
- TAME = tert-amyl methyl ether using EPA Method 8260B
- DIPE = diisopropyl ether using EPA Method 8260B
- ETBE = ethyl tert-butyl ether using EPA Method 8260B
- 1,2-DCA = 1,2-dichloroethane using EPA Method 8260B
- EDB = Ethylene dibromide using EPA Method 8260B
- µg/L= micrograms per liter
- ND = non detect at respective reporting limit
- NA = not analyzed

Table 4, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346

Soil Vapor Analytical Data

Sample ID	Date	TPHg ug/m ³	Benzene ug/m ³	Toluene ug/m ³	Ethylbenzene ug/m ³	Xylenes ug/m ³	MTBE ug/m ³
<i>Shallow Probes</i>							
SG-1-3	12/3/2008	20,000	ND<6.5	25	10	39	ND<7.3
	5/15/2009	150,000	ND<26	ND<31	ND<35	ND<110	ND<29
SG-2-3	12/3/2008	18,000	ND<26	ND<31	ND<35	ND<110	470
	5/15/2009	NS	NS	NS	NS	NS	NS
SG-3-3	12/3/2008*	470,000	ND<140	10,000	ND<120	750	ND<1,200
	5/15/2009	78,000	ND<6.5	ND<7.7	ND<8.8	ND<27	ND<7.3
<i>Deep Probes</i>							
SG-1-6	12/3/2008*	43,000,000	12,000	480,000	ND<7,600	21,000	ND<110,000
	5/15/2009	860,000	3,200*	ND<500*	ND<500*	ND<500*	ND<500*
SG-2-6	12/3/2008*	38,000,000	41,000	370,000	ND<5,400	ND<8,000	ND<290,000
	5/15/2009	860,000	12,000*	ND<500*	ND<500*	ND<500*	ND<500*
SG-3-6	12/3/2008*	1,200,000	890	26,000	ND<1.5	2,300	ND<15,000
	5/15/2009	860,000	2,300*	ND<500*	ND<500*	ND<500*	ND<500*
<i>Duplicates</i>							
SG-3-6-DUP	12/3/2008*	440,000	570	8,800	ND<390	1,100	ND<17,000
SG-3-3	5/15/2009	10,000	ND<6.5	ND<7.7	ND<8.8	ND<27	ND<7.3
ESL - Residential		10,000	84	63,000	980	21,000	9,400
ESL - Commercial		29,000	280	180,000	3,300	58,000	31,000

Notes:

TPHg = total petroleum hydrocarbons as gasoline using TO3 or EPA Method 8015*

Benzene, toluene, ethylbenzene, and xylenes using Method TO15 or EPA Method 8021B*

MTBE = methyl-tertiary butyl ether using Method TO15 or EPA Method 8021B*

µg/m³ = micrograms per cubic meter

ND = non detect at respective reporting limit

NS = not sampled

ESL = Environmental Screening Level for shallow soil vapor as determined by the Regional Water Quality Control Board - San Francisco Bay Region.

**Table 5, 6211 San Pablo Avenue, Oakland, CA - AEI Project # 280346
Additional Soil Analytical Data**

Sample ID	Date	Depth (feet bgs)	*Moisture Content (wet wt %)	Wet Bulk Density (g/cm ³)	Dry Bulk Density (g/cm ³)	Wet Bulk Density (pcf)	Dry Bulk Density (pcf)	Porosity (Est.) n	TIC (mg/kg)	TOC (mg/kg)	TC (mg/kg)	Grain Size Distribution as %				Soil Description
												Gravel	Sand	Silt	Clay	
SB-12 SB-12-11.5	11/25/08	11.5	17.4%	2.0	1.7	124.7	106.3	0.36	390	660	1,050	4.4	58.5	26.9	10.2	Gray Clayey SAND
DDP-1 DDP-1-6	11/25/08	6	19.6%	1.9	1.6	118.5	99.1	0.40	1,200	5,200	6,400	0	7.3	39.6	53.1	Gray CLAY
DDP-1-10	11/25/08	10	13.3%	2.1	1.9	131.0	115.6	0.30	ND<200	1,000	1,100	18.5	45.6	21.1	14.8	Olive Gray Clayey SAND w/ Gravel
DDP-3 DDP-3-5.5	11/26/08	5.5	13.1%	1.9	1.7	118.5	104.8	0.37	6,700	10,000	16,700	0	21.1	41.5	37.4	Gray CLAY w/ Sand & Calcium Carbonate
DDP-3-10	11/26/08	10	14.8%	1.9	1.7	118.5	103.2	0.38	ND<200	900	1,000	26.3	44.9	21.8	7.0	Mottled Olive Clayey SAND w/ Gravel

Notes:

feet bgs = feet below ground surface
g/cm³ = grams per cubic centimeter
pcf = pounds per cubic foot
wet wt = wet weight
TIC = Total Inorganic Carbon
TOC = Total Organic Carbon
TC = TIC + TOC = Total Carbon

Bulk Density by SSSA #5
Moisture Content by ASTM D2216
TIC by SM5310B
TOC by SM5310B
Grain size / particle distribution by ASTM D422

Porosity = 1 - (Dry Bulk Density / Soil Specific Gravity)
Soil Specific Gravity = 2.65 (estimated value for sand)
1 pound = 454 grams
1 ft³ = 28,317 cm³
g/cm³ * 62.37 = pcf

*A 2% by weight was the lowest soil moisture content measured at a successful U.S. Air Force Bioventing Initiative site in San Bernardino County, California (Hinchee & Leeson, 1997)