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CORRECTIVE ACTION
PILOT TEST WORKPLAN

325 Martin Luther King Jr. Way
Oakland, California

Project No. 270308
ACEHS Toxics Case # RO0002930

Prepared On Behalf Of

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1.0 INTRODUCTION

AEI Consultants (AEI) has prepared this Corrective Action Pilot Test Work Plan on behalf of Mr. and Mrs. Allen for the property located at 325 Martin Luther King Jr. Way, located in the City of Oakland, California (Figure 1). This plan was prepared to present a summary of site conditions, a comparative evaluation of potentially appropriate remedial alternatives, and propose an approach for remediation of the release of petroleum hydrocarbons. This plan has been requested by the Alameda County Health Care Services Agency (ACHCSA) in a letter dated October 10, 2007.

Sample analytical results confirm that the dissolved-phase plume in groundwater consists of gasoline-range fuel hydrocarbons. Analytical data and their distributions suggest that the release of hydrocarbons is limited in extent, confined to the immediate area adjacent to the abandoned UST. This plan includes a scope of work for the requested soil gas investigation and remedial action pilot testing. AEI is proposing to perform a pilot test scale treatment via direct push injections of a chemical oxidant, RegenOx™, which has been selected as a potentially cost effective and timely remedial alternative for the fuel release.

2.0 SITE DESCRIPTION AND HISTORY

The subject property is located on the western corner of the intersection of Martin Luther King Jr. Way and 4th Street in a mixed commercial and industrial area of Oakland. The property measures approximately 100 feet along Martin Luther King and approximately 150 feet along 4th Street with the property building covering approximately 100% of the land area. The northwestern portion of the building along 4th Street has also been historically addressed as 671 4th Street. The property building is currently vacant, but was previously occupied by Pucci Enterprises as warehouse space and cold storage freezers.

Touchstone Developments completed a Phase I Environmental Site Assessment (ESA) of the property dated November 1, 1993 and identified a 10,000-gallon former fuel UST that currently exists below the north side of the building. The fuel UST was used to provide fuel for the Pucci Enterprises truck fleet. Marvin Busby Company, Inc. decommissioned the tank on October 20, 1993 by steam cleaning the tank, pumping remaining sludge out of the tank, and filling the tank with concrete slurry. At the time of the UST closure, the eastern section of the building had not yet been built. The tank could not be removed because of its proximity to the footing of the 671 4th Street building. After tank closure, the eastern portion of the building (325 Martin Luther King) was constructed. Although records show that the UST was abandoned in accordance with proper procedures applicable at that time, no documentation of sampling around the tank prior to abandonment was available.

A number of site investigations have been performed by several environmental consultants since May 2005. A summary of each project is presented below. Approximate soil boring locations are presented on Figure 2 and analytical data available to AEI is presented in Tables 1 and 2.

Phase II Investigation – AEI, May 2005

AEI performed a Phase II Subsurface Investigation in May 2005 as part of environmental due diligence for a potential real estate transaction. A total of two borings (SB-2 and SB-4) were drilled with soil and groundwater samples collected (SB-1 and SB-3 encountered refusal at four feet below ground surface (bgs), possibly the top of the concrete filled UST). A release was discovered during the investigation, which indicated an impact to groundwater. Total petroleum hydrocarbon (TPH) as gasoline (TPH-g), TPH as diesel (TPH-d), and benzene were detected in groundwater at concentrations up to 780 micrograms per liter (µg/l), 420 µg/l, and 53 µg/l, respectively. AEI recommended further investigation, and due to the discovery of a release, that the report be forwarded to the ACHCSA.

Environmental Investigation – Terra Firma, September 2005

In September 2005, an additional investigation was performed, presumably relating to another potential real estate transaction. Groundwater samples were reportedly collected from four (4) soil borings (labeled 50901-1 to 50901-4). Details on the methods, field observations (including soil conditions), or analytical reports were not made available to AEI. Based on the information provided, groundwater sample analyses revealed the highest concentrations of TPH-g, TPH-d, and benzene at 20,000 µg/l, 3600 µg/l, and 990 µg/l, respectively from two borings to the south of the UST. The two borings southwest of the UST were found to contain lower, but still detectable, concentrations of fuel contaminants.

Soil and Groundwater Investigation – Ceres Associates, June 2006

In June 2006, Ceres Associates performed another subsurface investigation, apparently for another possible transaction. The project included the analyses of soil and groundwater from an additional five soil borings (labeled SB-5 to SB-9). Significant concentrations of fuel contaminants were detected in both soil and groundwater, particularly in SB-7 (located southeast of the UST). Logs of the borings were not made available to AEI.

Supplemental Investigation Workplan – LRM Consulting, August 2006

A fourth consultant, LRM Consulting, prepared release notification documentation and a workplan for the ACHCSA in August 2006. The workplan included additional research into possible additional source locations (dispenser, piping, offsite releases, etc) and the installation of three (3) monitoring wells. The wells were proposed as 2" PVC wells with a screen interval of approximately 5 to 20 feet bgs.

Site Characterization Workplan – AEI Consultants, March 2007

The ACHCSA had several comments relating to the previous assessments, following which AEI was retained to prepare a comprehensive workplan. The workplan detailed soil boring investigation and well installation activities to effectively characterize the release.

Site Characterization Investigation – AEI Consultants, May and August 2007

In May of 2007, AEI advanced an additional twelve (12) soil borings at the property. The soil boring locations were chosen to help determine the magnitude and extent of the petroleum release. Low to moderate concentrations of petroleum hydrocarbons were detected in the soil adjacent to the abandoned UST and in groundwater. Contaminant distributions in groundwater suggested that the release of hydrocarbons is limited in extent and confined to the 325 Martin Luther King Jr. Way unit.

3.0 GEOLOGY AND HYDROLOGY

The site is located in a highly urbanized, primarily light industrial and commercial, area of Oakland. The sits is situated at an elevation of approximately 12 feet above mean sea level (msl). Based on a review of the United States Geological Survey (USGS) Oakland West, California Quadrangle topographic map the topography of the site is generally flat; however, the area slopes very gently to the southwest toward the Oakland Inner Harbor. The nearest surface water body is the harbor located approximately ¼ mile (1,300 feet) to the southwest.

The site is located on the San Francisco Bay margin. According to the map Quaternary Geology of Alameda County and Surrounding Areas, California derived from OFR 97-97 (Helley, et al, 1997), the site is underlain by the Holocene and Pleistocene Merritt Sand deposits. The unconsolidated deposits of the area are generally characterized by sequences of alluvial fan and bay margin organic rich clay deposits with interfingered lake, river channel, swamp, and flood plain deposits, and the aeolian Merritt Sands. Depths to the bedrock basement in the vicinity of the site are mapped at approximately 700 feet (Norfleet, 1998).

AEI has drilled and logged a total of fourteen (14) soil borings at the site. Borings have been continuously cored to total depths ranging from 16 feet bgs to 20 feet bgs. Copies of these logs are included in Appendix B. Soils encountered below the concrete generally consisted of a clayey sand grading down to medium-grained sand at a depth of approximately 13 feet bgs. Saturated sediments were encountered in the borings by a depth of 13 feet bgs, within the coarser grained sand. Hydropunch™ discrete sampling was performed for one of the borings (SB-20) to a depth of 30 feet bgs to determine whether a second, deeper water-bearing zone existed beneath the shallow aquifer. The Hydropunch screen was initially set to an interval of 26 feet bgs to 30 feet bgs and as well as 22 feet bgs to 26 feet bgs; a second water-bearing zone was not encountered.

Based on water table elevation data for three quarterly events, groundwater has been calculated to flow towards the south. The hydraulic gradient was calculated to be on the order of 10^{-3}. Depth to water was has been measured in the wells during these three quarterly events at a depth of approximately 8 feet bgs. Fence diagrams are presented in Figures 7 and 8. Groundwater elevation data is presented in Table 5.

4.0 SITE CONCEPTUAL MODEL

4.1 Release Occurrence

Subsurface investigation work has identified a release of petroleum hydrocarbons from the abandoned UST. Soil and groundwater samples have been collected from numerous soil borings in a relatively localized area around the abandoned UST. Soil sample analyses, from borings SB-7 and MW-3 in particular, suggest that the source area is the abandoned

UST. The primary contaminants detected in soil and groundwater consist of gasoline, diesel, BTEX, and the fuel additives EDB and 1,2-DCA.

MTBE was detected for the first time during the May 2007 investigation in boring SB-18 and has been detected in well MW-1 during subsequent groundwater monitoring events at a comparatively low concentration. The presence of high concentrations of benzene detected near the UST, not typically a component of diesel fuel, suggests that the UST was historically utilized for gasoline.

A geophysical survey was performed by Cruz Brothers Locators, Inc. on January 8, 2008, in an attempt to confirm the location of the abandoned UST and to locate associated product piping. Ground-penetrating radar and a magnetometer were employed during the geophysical survey. The results of the survey were inconclusive. Radar signatures that are representative of an in-place UST and product piping were not apparent.

4.2 Release Extent

The hydrocarbon plume has effectively been delineated in each direction by the May 2007 investigation. Soil and groundwater sample analytical data and their distributions suggest that the release of free phase hydrocarbons is limited in extent; confined to the 325 Martin Luther King Jr. Way unit, immediately adjacent to the abandoned UST. Analytical data from the three installed monitoring wells confirm that the release is limited. Diesel was detected at a low concentration in one of the borings advanced in the 301 Martin Luther King Jr. Way unit.

4.3 Migration Pathways and Receptors

A conduit study was performed and documented in AEI's *Soil and Groundwater Investigation Report,* dated September 21, 2007. Based on the results of the conduit study, the possibility exists that the sewer line running underneath the 671 4th Street unit could act as a preferential pathway for contaminants. However, based on depth to groundwater data and analytical data from soil and groundwater samples collected from boring SB-12, which is adjacent to the sewer line, the release does not appear to run along this sewer line as a migratory path. An illustration of the results of this study is presented in Figure 3.

A receptor study using records from both the California Department of Water Resources and the Alameda County Public Works Agency (ACPWA) was presented in the same report referenced above. Based on the well survey and the magnitude of the site fuel release, none of the identified wells appear to risk acting as preferential vertical conduits for migration of site contaminants nor does there appear to be active use of groundwater in the area that would be threatened by the release.

5.0 SOIL VAPOR PROBE INSTALLATION

As requested by the ACHCSA, to evaluate potential soil vapor intrusion to within the building, soil gas sampling is proposed. Soil vapor sampling probes will be installed so that a soil vapor monitoring program can be implemented if needed. AEI is proposing four (4) permanent soil vapor probes to a depth of 5 feet bgs. Data on the presence of vapor phase contaminants will be used to assess the potential for vapor intrusion and changes to subsurface air composition can be utilized to monitor subsurface changes caused by remedial activities. The locations of the proposed soil vapor probe locations are presented on Figure 6.

5.1 Soil Vapor Probe Construction

AEI proposes installing four (4) permanent vapor probes (VS-1 through VS-4) using direct push or soil recovery auger equipment. The soil vapor probes will be constructed with a 6-inch long stainless steel implant attached to a section of 1/4-inch outside diameter by 1/8-inch inside diameter Kynar® (PVDF), Teflon® (PTFE), or equivalent tubing. Each soil vapor implant will be driven to a depth of 5 feet bgs, and centered in a minimum of 18-inches of #2/16 Monterey sand with 6-inches of sand extending above and below each implant. The reminder of the borehole above the sandpack will be sealed to approximately 12-inches bgs with hydrated bentonite chips. The tubes will be capped with a 1/4-inch Swagelok ball valve to prevent the infiltration of water and ambient air. The ball valves will be labeled with the corresponding probe location and depth using the following convention: [SG]-[Location]-[Depth]. The wellhead will be completed to grade with an 8-inch traffic-rated well box.

5.2 Equipment Decontamination, Waste Storage, and Disposal

All rods and down-hole equipment will be scrubbed and cleaned with an Alconox® or equivalent detergent and rinsed with clean water between borings. Soil cuttings and other investigation-derived wastes (IDW) will be temporarily stored in 5-gallon buckets (sealed and labeled) pending the results of the sample analyses and arrangements for off-site disposal. IDWs will be handled and disposed in accordance with all applicable local, state, and federal regulations.

6.0 SOIL VAPOR PROBE SAMPLING FOR VAPOR INTRUSION EVALUATION

Soil vapor sampling for vapor intrusion, including purging, leak testing, sampling, and analyses will be performed in accordance with the "*Advisory – Active Soil Gas Investigations*" (ASGI), dated January 28, 2003.

6.1 Sample Collection

The first soil gas sampling event will be scheduled to occur just before (within several days) of the pilot test to serve as a baseline (see section 10.1). Depending on the findings of the initial soil gas sampling event and the pilot test, a soil gas monitoring program could be established using the probes, if required.

Three (3) volumes of dead air will be purged from the sample tubing using a 30 to 60 milliliter (mL) plastic syringe before collecting a soil vapor sample. This will ensure that a sufficient volume of ambient air will be removed from the sampling point and that samples collected will be representative of subsurface conditions.

After the probe is purged, samples will be collected into 1 or 6-liter evacuated Summa™ canisters pending transportation to the laboratory. If no-flow to low-flow conditions are encountered (flow rates are ≤10 mL/min or down-hole vacuum ≥10 inches of mercury or 136 inches of water) due to fine grained soil, clay, or otherwise saturated soils, soil vapor sampling may not be possible, but will still be attempted. Soil vapor sampling will immediately cease if moisture or other foreign material is detected in the sample tubing.

All soil vapor probes will be leak tested during the first soil vapor sampling event. A leak test dome will be placed over the sampling probe at the surface. A rag moistened with isopropyl alcohol (i.e., 2-propanol) will be place under the dome as a leak test tracer substance. This tracer compound is not suspected to be present in gasoline. If the tracer compound is detected in the sample, the cause will be evaluated and corrected and the soil gas probe will be retested before subsequent sampling. Appropriate methods will be used to analyze for isopropyl alcohol tracer gas with a detection limit of ≤10 micrograms per liter of air (ug/L).

A soil gas sampling manifold will be provided by the laboratory. The sampling manifold will be equipped with a critical orifice flow regulator and down-hole pressure (i.e., vacuum) gage. The critical orifice device will maintain a sampling flow rate of between 100 to 200 milliliters per minute (mL/min) depending upon the down-hole vacuum. The soil gas sampling manifold will be place inline between the soil gas probe and Summa™ canister and used for both purging and sample collection.

6.2 Sample Analyses

Soil vapor samples collected in Summa™ canister will be delivered McCampbell Analytical, Inc. of Pittsburg, California (DHS No. 1644) under proper chain of custody protocol on the day of collection. The soil vapor samples will be analyzed for TPH-g by EPA Method TO-3 and for MBTEX and leak check compound by EPA Method TO-15 with appropriate detection limits for evaluating vapor intrusion potential. The detection limit for 2-propanol will be at least 10 μg/L. Laboratory procedures will include appropriate quality assurance and quality control protocols, including method blanks and use of surrogates during sample analyses.

7.0 SITE CLEANUP GOALS

As required by the ACHCSA, target cleanup goals have been selected to be protective of human health and groundwater resources. Proposed site cleanup goals are based on the Environmental Screening Levels (ESLs) in the San Francisco Bay RWQCB's document *Screening for Environmental Concerns at Site with Contaminated Soil and Groundwater* (Interim Final, Nov.

2007). Based on the commercial land use of the site and area, the ESL values for a commercial / industrial land use exposure scenario have been selected. Although no current use of groundwater was identified in vicinity of the site, groundwater in the area is considered of potential beneficial use. Therefore the proposed groundwater cleanup goals will be the drinking water ESLs. Proposed cleanup goals are presented below:

Contaminant	Proposed Groundwater Goals	
	Soil (mg/kg)	**Groundwater (μg/L)**
TPH-g	83	100
TPH-d	83	100
Benzene	0.044	1.0
Toluene	2.9	40
Ethylbenzene	3.3	30
Xylenes	2.3	20
MTBE	0.023	5.0
EDB	0.0003	0.05
1,2-DCA	0.0045	0.5

8.0 REMEDIAL OPTION EVALUATION

Soil and groundwater treatment can be broadly grouped into ex-situ or in-situ treatment. Primary factors for consideration include aquifer properties, groundwater chemistry, biology, and permitting issues. Below is a discussion of commonly employed soil and groundwater treatment approaches.

8.1 Mechanical Excavation

Soil excavation generally consists of the removal of impacted soil to the water table. Generally, this is the most aggressive and effective method of removing contamination. Excavation would involve removing the existing soil to an offsite, approved landfill or treated above ground prior to placement back in place. Confirmation soil samples are collected prior to backfilling the excavation in order to determine the effectiveness of the excavation activities. Above ground treatment may include enhanced biodegradation, thermal desorption, or aeration, when feasible. Excavation of contaminated soil and groundwater and the dismantling of the abandoned UST has been considered at the site, however; based on the UST's apparent proximity to the northwestern wall of the 325 Martin Luther King Jr. Way building, excavation has been eliminated as a mitigation choice based on structural integrity concerns associated with undermining the wall during excavation activities.

8.2 Enhanced Bioremediation

Enhanced bioremediation, also called bio-augmentation or biosparging, involves adding oxygen and other amendments to groundwater to affect pH, oxygen, nutrient content, and /or bacterial communities in the subsurface. Oxygen availability is commonly the limiting factor for biodegradation. Increasing oxygen levels results in an increase in the biomass, which results in an increased rate of degradation of the hydrocarbons. Bio-sparging is similar to air sparging, however, in air sparging, hydrocarbons are removed through volatilization while biosparging is performed with much lower air flow rates to simply increase oxygen content. A variety of other methods have been developed to deliver oxygen to the subsurface including the use of proprietary chemicals, molecular diffusion, and as a secondary advantage of chemical oxidation (discussed below).

In addition to increasing oxygen content, other amendments can be added to adjust pH, increase necessary nutrient for aerobic degradation (nitrogen, phosphorous, potassium, etc.), or provide cultured bacteria directly into the subsurface. In general, extensive bio-chemical and geochemical analyses of soil and groundwater are necessary as are bench scale testing to appropriately design an injection system and program.

8.3 In-situ Chemical Oxidation (ISCO)

A number of methods of directly degrading contaminants in the subsurface have been developed and implemented in recent years. Hydrocarbons can be directly oxidized by the injection of reactants such as Fenton's Reagent, persulfate, hydrogen peroxide, or sparging of ozone. Such methods have a significant advantage over pump and treat in that removal of groundwater is not required. These methods can also be employed in the vadose zone. Injectants are delivered to the subsurface through either temporary soil borings or permanent injection wells. The spacing and volume of injectants is determined by chemical analyses, stoichiometric evaluation, and soil conditions. Effectiveness is highly dependant on geochemistry and permeability of sediments. Chemical oxidation, depending on the method, can have the added advantage of oxygenating the subsurface.

8.4 Natural Attenuation (No Action)

As with soil treatment by this approach, natural attenuation relies on naturally occurring processes to degrade and reduce contaminants present in the aquifer. These include biodegradation, which is generally considered to be the primary natural attenuation mechanism, along with sorption and dispersion. Controlling factors include those discussed above and sufficient evidence must be identified to show that timely attenuation will occur. With larger releases, these processes can be slow or not effective at reaching site goals. Monitoring is generally required as part of this method to ensure protection of human health and groundwater resources and to ensure that reduction is occurring.

9.0 CLEANUP METHODOLOGY SELECTION AND DISCUSSION

Although the above discussion was not intended to be inclusive of all options or combinations thereof, chemical oxidation via injections has been selected as suitable for further evaluation and pilot testing. Mechanical excavation is not considered a safe and cost-effective treatment method based on structural integrity concerns resulting from the proximity of the abandoned UST to a building wall. Even if soil was safely excavated from around the UST, it is likely that sorbed contaminated remaining below the UST would continue to migrate and impact groundwater. Natural Attenuation is also not considered likely a cost-effective method, as relying on natural biodegradation to break down elevated concentrations of diesel onsite may require monitoring for a lengthy period of time. Injections into sandy soils, which appears to be prevalent onsite, is likely more effective than more costly or passive remediation methods.

RegenOx™, a chemical oxidant, has been selected to treat contaminants in the saturated and vadose zones via direct push injections. RegenOx™ uses a solid alkaline oxidant that employs a sodium percarbonate complex with a multi-part catalytic formula. The product is delivered as two parts that are combined and injected into the subsurface using common drilling or direct-push equipment. Once in the subsurface, the combined product produces an oxidation reaction comparable to that of Fenton's Reagent without a dangerous exothermic reaction. With the addition of ORC Advanced™ (slow-release oxygen-releasing compounds), the mixture also allows for a transition to enhanced bioremediation. RegenOx™ has been shown to destroy contaminants for periods of up to one month. RegenOx™ as an 8% solution has the viscosity of water.

There are several concerns when using chemical oxidants to oxidize contaminants in groundwater. A low pH and oxidation can cause dissolved metal concentrations to increase in the groundwater, although this increase has been demonstrated in the past to be relatively brief. There is also the potential for gas generation/volatilization of contaminants; this will be monitored using the soil gas probes. Although, it has been shown that for RegenOx™ concentrations at 3%, heat production is minimal.

A pilot test is outlined below to gather additional information for evaluation of this method. If successful, the pilot test report will include recommendations for larger scale injections. If unsuccessful, an alternative approach will be considered for use at the site.

10.0 PROPOSED PILOT TEST

The goal of the pilot test is to document feasibility of source area treatment using RegenOx™ injections followed up with ORC Advanced™ as a polisher. If successful, the goal of full-scale injections would be to sufficiently reduce source area contaminants, thereby limiting the spread of the plume and promoting natural aerobic bioremediation.

Prior to injection activities, appropriate soil boring permits will be obtained from the ACPWA. Five (5) injection locations are proposed (IP-1 through IP-5). The locations of the injection points will be up and cross-gradient of source area well MW-3. In each of the five injection locations, illustrated in Figure 6, a temporary injection rod will be installed 10 feet below the water table. During injections, the temporary rods will also be raised slowly to eventually target smear zone contamination, at a depth of approximately 7 feet bgs. Based on the apparent sandy sediments onsite, a ROI varying from approximately 5 to 15 feet may be expected. The parameter to be evaluated during this pilot test will be to determine whether a minimum ROI of 5 feet can be achieved by the injections. This will be evaluated by the reduction in contaminant concentrations and groundwater chemistry changes. An ROI smaller than 5 feet will suggest that direct push injections as a means of delivering a chemical oxidant may not be a cost-effective remediation technique to treat the entire plume. The data collected before and following the small scale pilot study will also evaluate the potential for unintended metals mobilization as well as possible changes to shallow soil gas conditions.

10.1 Baseline Sampling

Prior to injection activities, a groundwater monitoring event will be performed on all wells (MW-1 through MW-3). If within on month of a regulatory scheduled quarterly monitoring event, the baseline data will be considered the quarterly data. Water quality parameters [pH, temperature, specific conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP)] will be measured and samples collected for analysis for site COCs. This data, particularly pH, DO, ORP, and COC concentrations, will be used as a baseline for short-term evaluation of effectiveness of COC destruction and oxidant travel distance. In addition, to determine whether specific metals are being mobilized, analyses for arsenic, barium, cadmium, chromium (total and Hexavalent), copper, iron (total), lead, and selenium will be performed, as these metals are more mobile in an oxidized state.

For the baseline analyses, groundwater samples will be collected from the three wells and analyzed for:

- TPH-gas, BTEX and diesel by EPA Method 8021/8015 and;
- Dissolved Arsenic, Barium, Cadmium, Total and Hexavalent Chromium (E218.6), Copper, Iron (total), Lead, and Selenium by EPA Method E200.8 and;
- MTBE, EDB, and 1,2-DCA by EPA Method 8260

In addition, a soil vapor sampling event for vapor probes will be performed prior to pilot test injections. The data obtained from this sampling event will be used to primarily evaluate vapor intrusion potential and monitor the in-situ changes in soil gas composition caused by injection activities. Upon completion of the pilot test, a proposed monitoring schedule for groundwater and soil vapor will be presented.

10.2 Health and Safety Meeting

Prior to any injection events, a site safety meeting will be held at a designated command post near the working area to review the Health and Safety Plan (HASP). Working hazards and emergency procedures will be discussed at this meeting, including an explanation of the hazards of the known or suspected chemicals of interest as well as the location and route to the nearest hospital. All site personnel will be in modified Level D personal protection equipment. A work area or "exclusion zone" will be established with orange cones and/or barricades and warning tape to delineate the zone where hard hats and steel-toed shoes must be worn and where unauthorized personnel will not be allowed. A site safety plan conforming to Part 1910.120 (i) (2) of 29 CFR will be available on site at all times during the project.

10.3 Chemical Reagent Mixing and Handling

As stated in Section 9.0, there are two parts to the RegenOx™ mixture, Part A being the RegenOx™ oxidant powder and Part B being the RegenOx™ activator liquid. The composition of Part A is a mixture of sodium percarbonate, sodium carbonate, sodium silicate, and silica gel. The composition of Part B is a mixture of sodium silicate solution, silica gel, and ferrous sulfate. RegenOx™ is typically injected as a 3% weight/weight solution. Thus, for example, 30 lbs of the oxidant and activator are added to 116 gallons of water. Following the injections of RegenOx™, or mixed with the RegenOx™, ORC will be added to the aquifer to polish the injections.

Using injection points IP-1 through IP-5, 480 lbs of RegenOx™ at a concentration of 3 – 5% will be injected into the aquifer at a rate of approximately 3 gallons per minute (gpm), although this will be dependant on how much liquid the aquifer will accept. Injection rates may be adjusted accordingly. In addition, 300 lbs of ORC Advanced™ at a concentration of 30% will be injected following RegenOx™ injections. MSDS information regarding the oxidant and activator are presented in Appendix C.

A staging area to store equipment and supplies will be located onsite in a secure location. The staging area will be used as a mixing zone for chemical products. Products mixed or diluted on site will be either injected during the remediation program or removed from the site at the completion of the project.

It is expected that the pilot test will take a day to complete. A typical injection day will consist of moving the products at the staging area, mobilizing to the designated injection locations, and injecting the reagents into the direct push points. Once the prepared products are injected and therefore expended, the injection team will return to the staging area, and mobilize to the next injection location. Oxidant application equipment includes pneumatic double-diaphragm pumps, ¾-inch diameter high pressure injection hose, valves, and cam-lock connectors.

Investigation-derived waste (IDW) generated from the investigation, including drill cuttings liquid waste, will be characterized by laboratory results received for samples taken from waste containers, the waste containers being U.S. DOT-approved 55-gallon drums or roll-off bins stated at the site. Following waste profiling, the drums or bins will be removed from the site by a waste disposal contractor and transported to an appropriate waste facility.

10.4 Direct Push Drilling and Pilot Test Monitoring

A direct push drill rig will be used to install injection rods and screens to predetermined depths at five (5) injection locations across the site by a qualified C-57 licensed driller with experience with in-situ chemical oxidation and RegenOx use. The direct push injection borehole locations are presented in Figure 6. The direct push injection system is designed to allow for pressure injection and introduction of oxidants directly into the aquifer. A 1.5-inch injection tool will be driven into the subsurface via the drill rig. Solid sections of 5-foot long casing will be added behind the initial injection tool and advanced until the desired injection depth is reached at which time the injection tool will be extracted one foot to expose the injection screen (1 foot to 5 foot in length). Then the expendable tip can be dropped from the drive rods. After connecting the delivery hose to the pump outlet and the delivery sub-assembly, the RegenOx™ will be pumped through the delivery system to displace the water/fluid in the rods. Standard Operating Procedures for direct-push injections are presented in Appendix B.

Groundwater sampling events to be conducted to monitor the performance of the pilot-scale treatment performance are listed below.

- Baseline event (quarterly sampling event prior to injection, see Section 10.1 and 6.3) – All wells and soil vapor probes
- One (1) day following injections event – MW-3
- Weeks 1, 2, and 4 following injections event – MW-3

In addition, water quality parameters pH, temperature, specific conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be measured. If a subsequent performance monitoring event occurs during the time-frame of a regularly scheduled quarterly groundwater monitoring event, the events will be combined.

10.5 Borehole Abandonment and Equipment Decontamination

Upon completion of the oxidant injection, direct push boreholes will be sealed with neat cement grout or hydrated Bentonite granules in accordance with permit conditions. The drill locations will be resurfaced to existing grade.

Field equipment that may have been contaminated during field activities will be decontaminated. Decontamination is performed as a quality assurance measure and a safety precaution, preventing cross-contamination among samples and helping to maintain a clean working environment.

Small, reusable equipment will be decontaminated by rinsing with liquids that include soap or detergent solutions (e.g., Alconox), potable water, and distilled water. Gross contamination consisting of solid particles will be removed from the equipment by brushing and rinsing with potable water. Equipment will then be washed with a detergent solution and a brush, followed by a thorough rinse with potable water. A final triple rinse using distilled water will also be performed.

Drilling equipment including rigs, drill rods, auger, bits, casing, down-hole logging equipment, and other large pieces of field equipment will be high-pressure steam cleaned before and after use. Cleaning will be performed at an appropriate designated decontamination area specified in the field. The decontamination area will be capable of containing decontamination fluids and solids.

11.0 PILOT TEST REPORTING

Upon completion of pilot test injections and the 1 month sample analyses, a pilot test report will be prepared. The report will include site plans, logs of boring and wells, injection concentrations and rates, data obtained, and contaminant concentrations trends. Any alterations made to scope of work will be documented. Assuming adequate contaminant concentration reductions, scale-up of the injection program will be recommended.

12.0 REFERENCES

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Touchstone Developments, *Phase I Investigation*, November 1, 1993

13.0 CLOSING STATEMENT AND SIGNATURES

This plan has been prepared by AEI on behalf of Mr. and Mrs. Allen to address the release of petroleum hydrocarbons from the abandoned UST system on the property located at 325 Martin Luther King Jr. Way in the City of Oakland, California. This document outlines potentially appropriate options for mitigating the release and recommends a scope of work. The recommendations rendered in this report were based on previous field investigations and laboratory testing of soil and groundwater samples. This document does not reflect subsurface variations that may exist between sampling points. These variations cannot be anticipated, nor could they be entirely accounted for, in spite of exhaustive additional testing. This plan 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 said property or that all contamination present at the site will be treated or removed. Undocumented, unauthorized releases of hazardous materials, the remains of which are not readily identifiable by visual inspection and are of different chemical constituents, are difficult and often impossible to detect within the scope of a chemical specific investigation that may or may not become apparent at a later time. All specified work would be performed in accordance with generally accepted practices in geotechnical and environmental engineering, engineering geology, and hydrogeology and will be performed under the direction of appropriate registered professional(s).

We look forward to comment on the scope of work outlined herein. Should you have any questions or need additional information, please contact us at 800/801-3224.

Sincerely,
AEI Consultants

Adrian M. Angel
Project Geologist

Harmony TomSun
Staff Geologist

Peter J. McIntyre, PG, REA
Senior Project Manager

REGISTERED GEOLOGIST
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2 Lone Tree Way
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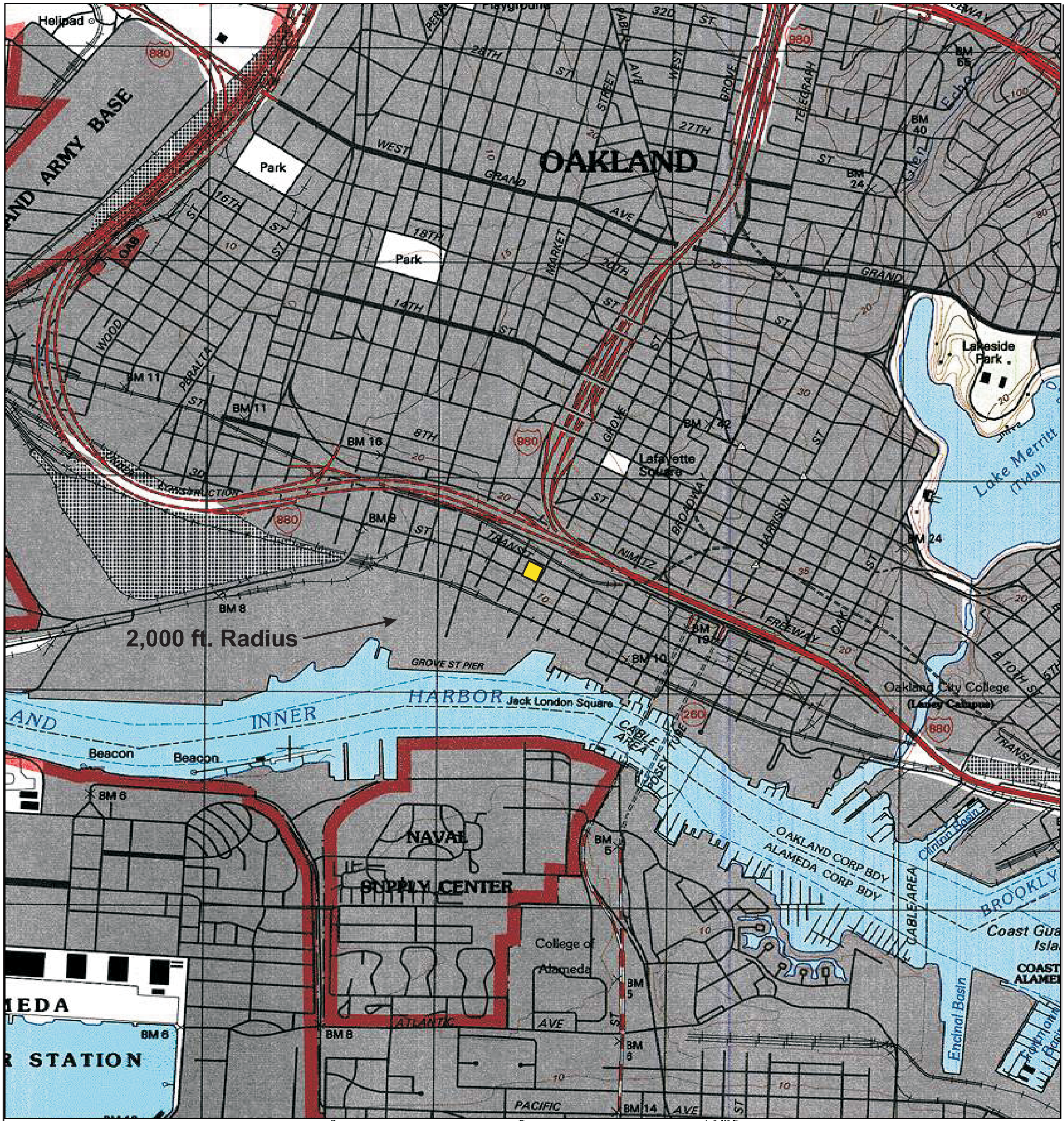
Alameda County Environmental Health Services (ACEHS) (electronic)
Attn: Mr. Jerry Wickham
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

GeoTracker (electronic)

FIGURES



TN / MN 15°

0 .5 1 MILE

0 1000 FEET 0 500 1000 METERS

Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

LEGEND

N

SITE LOCATION

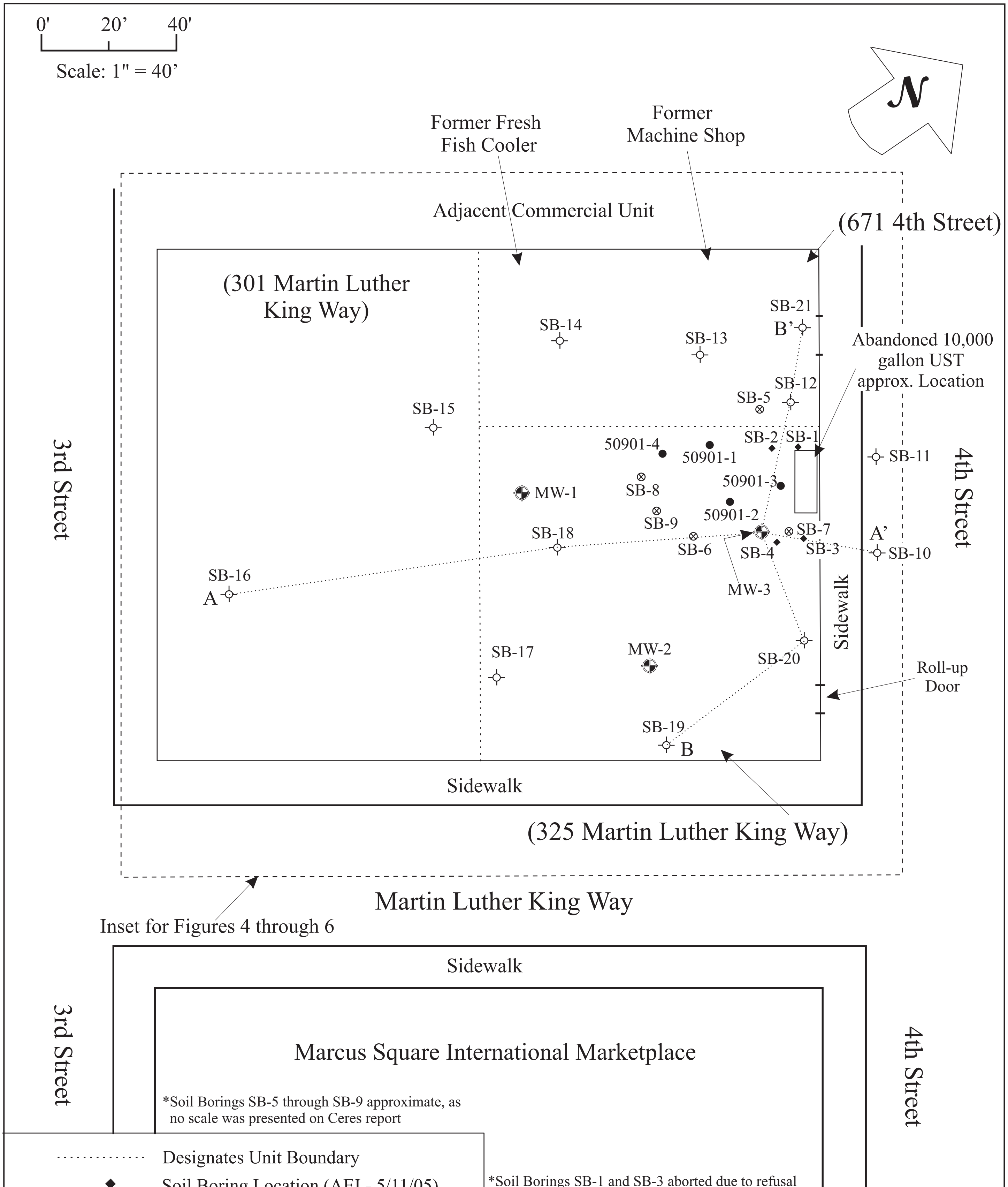
AEI Consultants

2500 Camino Diablo, Suite 200, Walnut Creek, CA 94597

Well Survey

325 Martin Luther King Jr. Way
Oakland, CA 94607

FIGURE 1
Job No: 270308

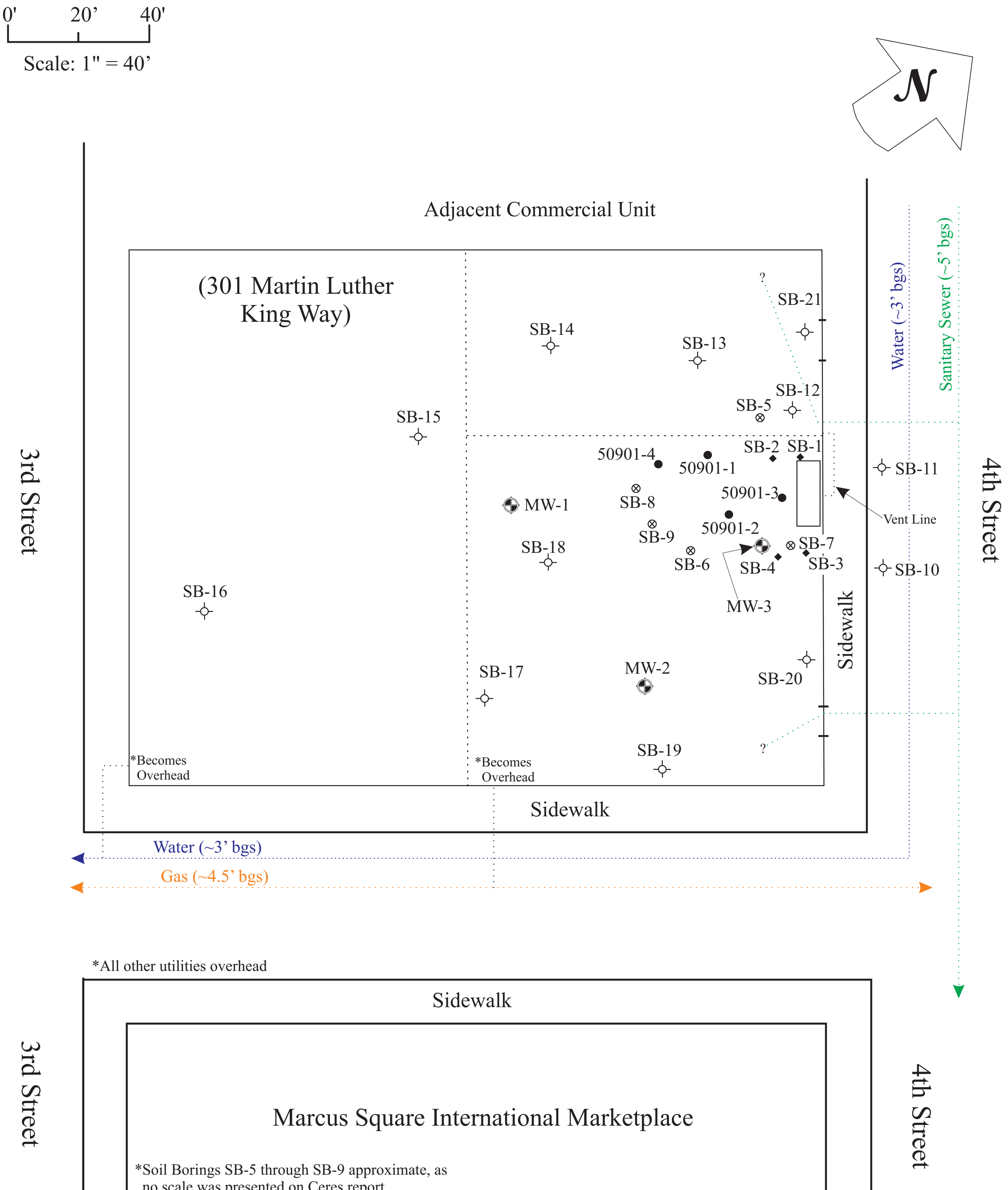


AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200 WALNUT CREEK, CA

Site Plan

325 Martin Luther King Jr. Way
Oakland, California

FIGURE 2
PROJECT No . 270308



- .... Designates Unit Boundary
- ◆ Soil Boring Location (AEI - 5/11/05)
- ● Soil Boring Location (TFC - 9/8/05)
- ⊗ Soil Boring Location (Ceres - 6/6/06)
- ⌖ Soil Boring Location (AEI - 5/29-30/07)
- Monitoring Well Location

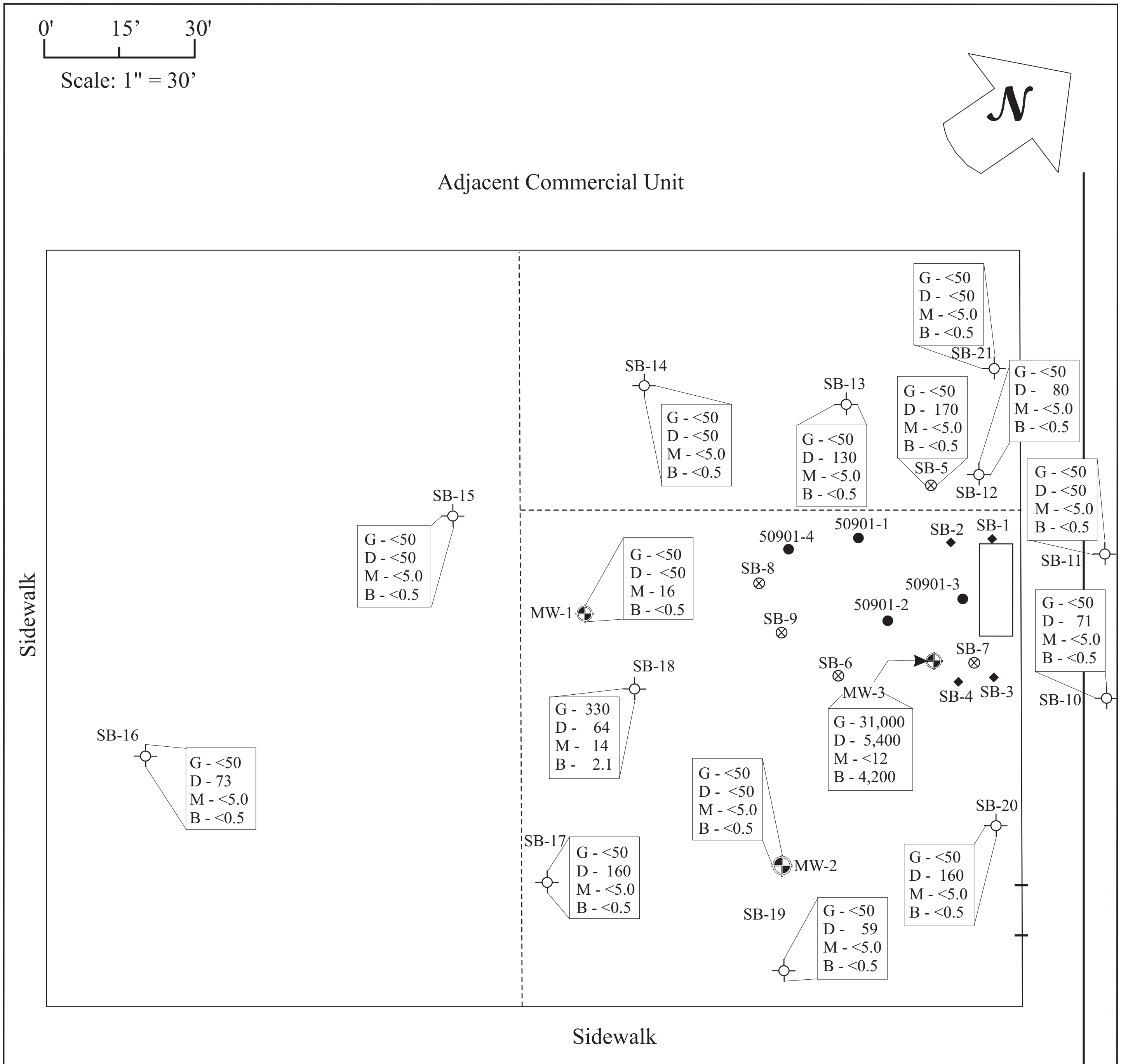
AEI CONSULTANTS

2500 CAMINO DIABLO, SUITE 200 WALNUT CREEK, CA

Utility Plan

325 Martin Luther King Jr. Way
Oakland, California

FIGURE 3
PROJECT No . 270308



Hydrocarbon concentrations expressed in ug/L
(Refer to Tables 2, 3 and 6 for details)

G = total petroleum hydrocarbons as gasoline
D = total petroleum hydrocarbons as diesel
B = benzene
M = methyl tertiary butyl ether (MTBE)

- - - - - - - - - - Designates Unit Boundary
◆ Soil Boring Location (AEI - 5/11/05)
● Soil Boring Location (TFC - 9/8/05)
⊗ Soil Boring Location (Ceres - 6/6/06)
⌖ Soil Boring Location (AEI - 5/29-30/07)
Monitoring Well Location

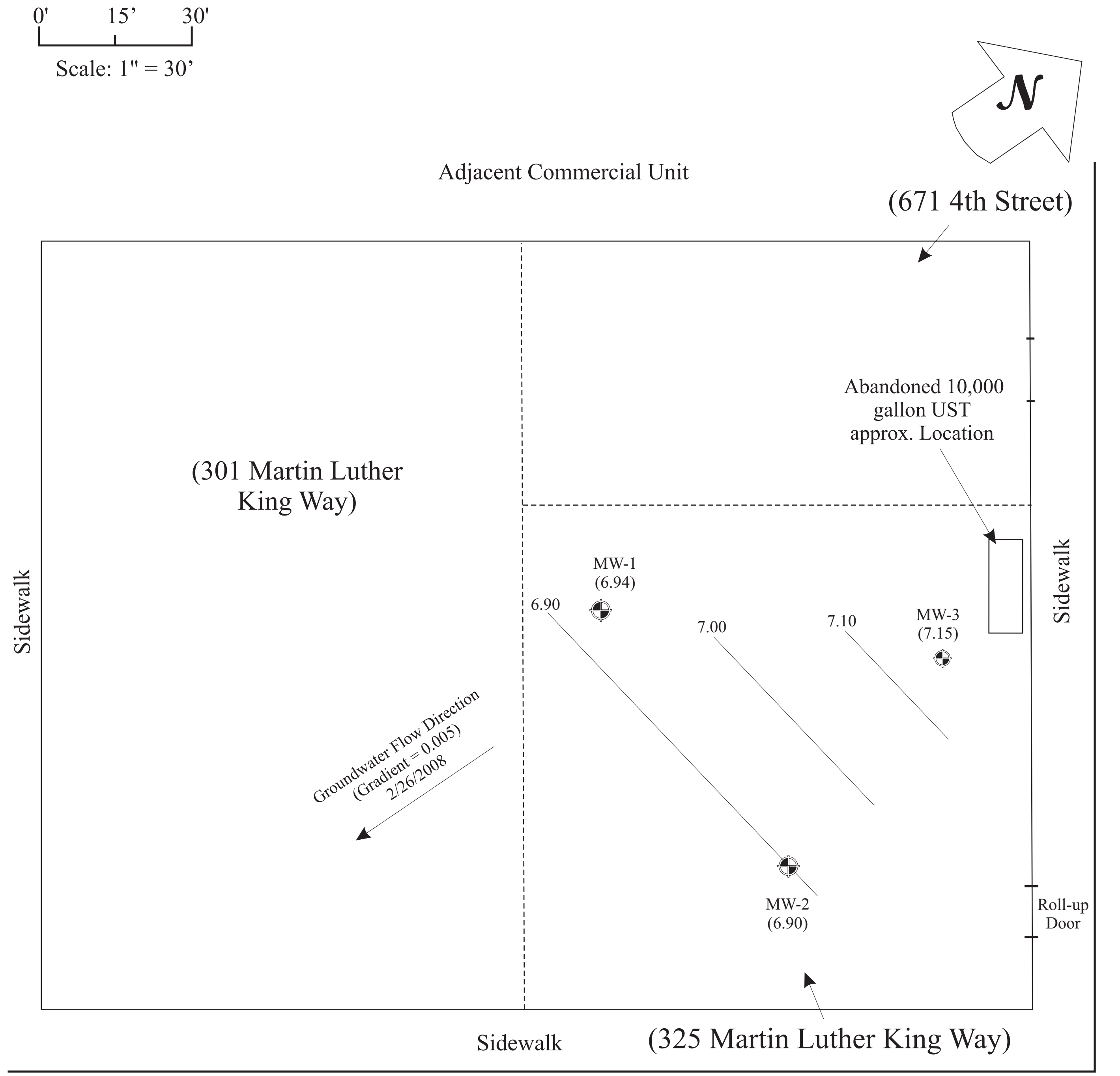
*Data for wells MW-1 through MW-3 collected on 2/26/08

AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200 WALNUT CREEK, CA

Groundwater Sample Data

325 Martin Luther King Jr. Way
Oakland, California

FIGURE 4
PROJECT No . 270308



Monitoring Well Locations

MW-2 (6.49) Water table elevations shown in parentheses in feet ams (above mean sea level)

Contour Interval = 0.1 feet

AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200 WALNUT CREEK, CA

Water Table Elevations (2/26/08)

325 Martin Luther King Jr. Way
Oakland, California

FIGURE 5
PROJECT No . 270308

- - - - - - - - - Designates Unit Boundary

◆ Soil Boring Location (AEI - 5/11/05)

● Soil Boring Location (TFC - 9/8/05)

⊗ Soil Boring Location (Ceres - 6/6/06)

Soil Boring Location (AEI - 5/29-30/07)

Monitoring Well Location

Proposed Soil Vapor Location

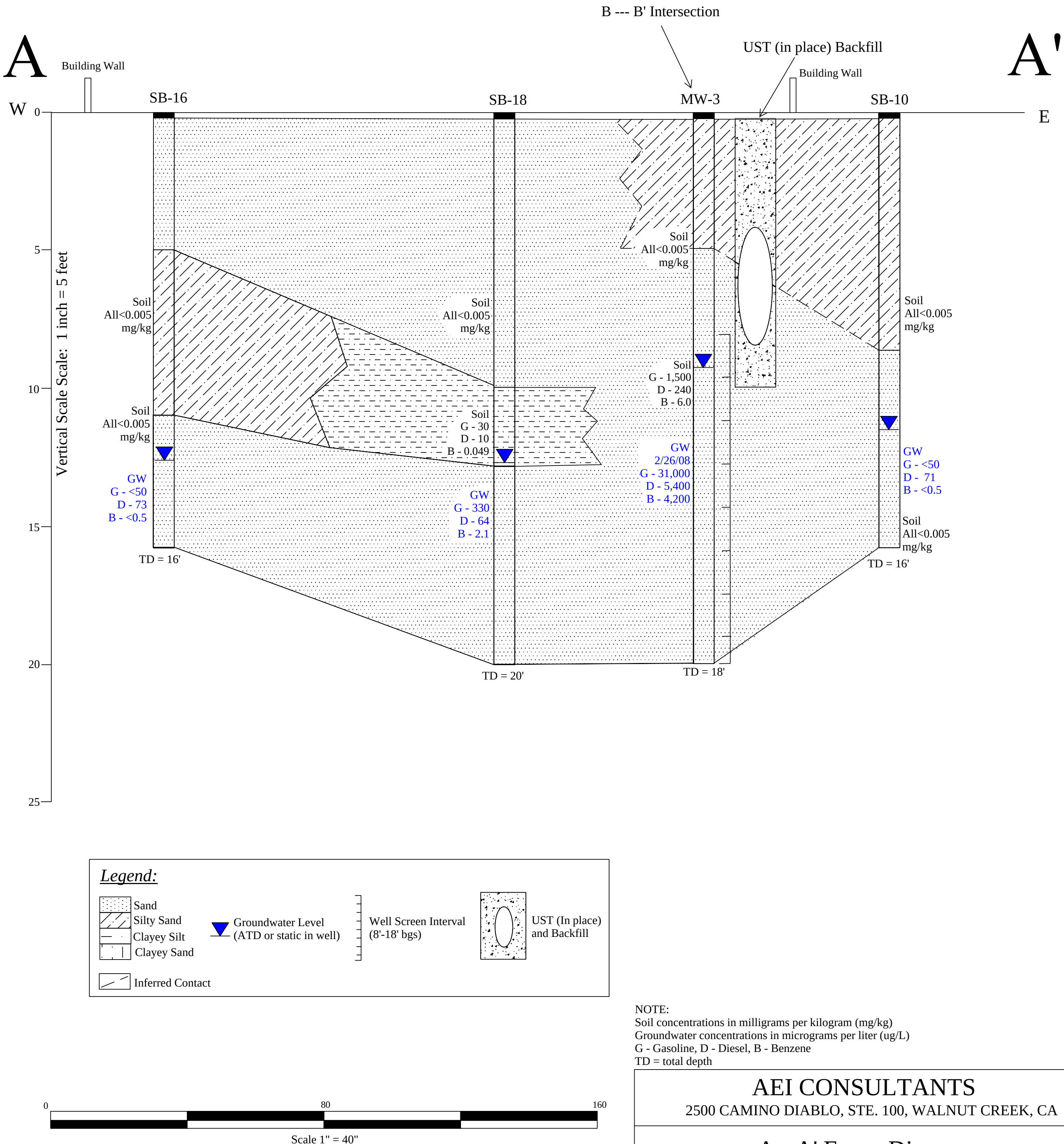
\+ Proposed Injection Location

AEI CONSULTANTS
2500 CAMINO DIABLO, SUITE 200 WALNUT CREEK, CA

Proposed Soil Vapor and Injection Locations

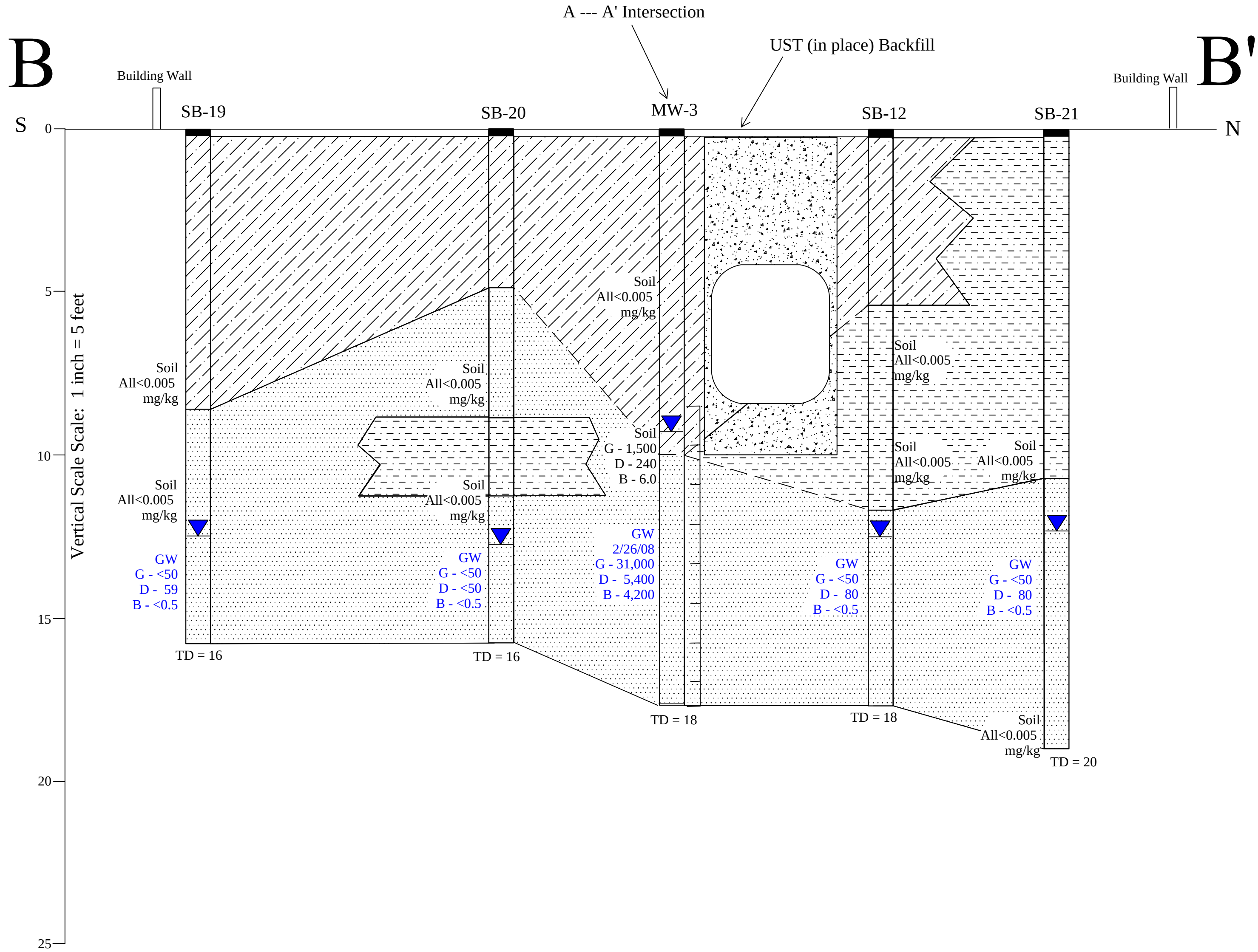
325 Martin Luther King Jr. Way
Oakland, California

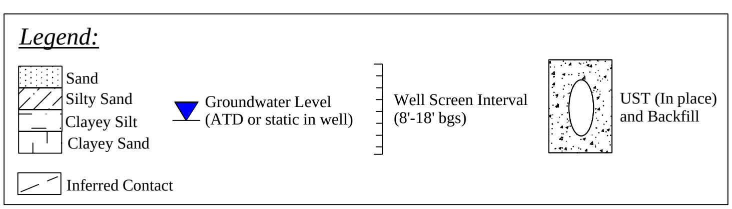
FIGURE 6
PROJECT No . 270308



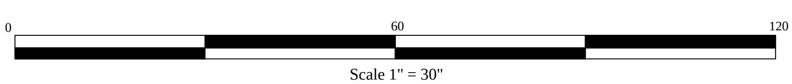
NOTE:
Soil concentrations in milligrams per kilogram (mg/kg)
Groundwater concentrations in micrograms per liter (ug/L)
G - Gasoline, D - Diesel, B - Benzene
TD = total depth

AEI CONSULTANTS 2500 CAMINO DIABLO, STE. 100, WALNUT CREEK, CA	
A - A' Fence Diagram	
325 Martin Luther King Jr Way Oakland, CA	**Figure 7** PROJECT NO. 270308





NOTE:
Soil concentrations in milligrams per kilogram (mg/kg)
Groundwater concentrations in micrograms per liter (ug/L)
G - Gasoline, D - Diesel, B - Benzene
TD - total depth



AEI CONSULTANTS
2500 CAMINO DIABLO, STE. 100, WALNUT CREEK, CA

B - B' Fence Diagram

325 Martin Luther King Jr Way
Oakland, CA

Figure 8
PROJECT NO. 270308

TABLES

Table 1 - AEI Project # 270308
Soil Sample Analytical Data

Sample ID	Consultant	Date Collected	TPH-g mg/Kg	TPH-d mg/Kg	MTBE mg/Kg	Benzene mg/Kg	Toluene mg/Kg	Ethylbenzene mg/Kg	Xylenes mg/Kg
						EPA Method SW8021B/8015Cm			
SB-2 12'	AEI	5/11/2005	10	5.6	<0.05	0.25	0.071	0.33	1.6
SB-4 12'	AEI	5/11/2005	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-5-10	Ceres	6/6/2006	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-6-10	Ceres	6/6/2006	5.0	3.1	<0.05	0.023	0.025	0.027	0.64
SB-7-10	Ceres	6/6/2006	20,000	3,300	<45	200	980	320	1,400
SB-7-17	Ceres	6/6/2006	9.2	3.4	<0.1	0.74	0.64	0.16	0.70
SB-8-10	Ceres	6/6/2006	4.7	3.0	<0.05	0.058	0.030	0.083	0.48
SB-9-10	Ceres	6/6/2006	7.5	4.2	<0.05	0.068	0.22	0.21	1.1
SB-10-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-10-16'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-11-11'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-11-16'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-12-7'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-12-12'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-13-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-13-14'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-14-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-14-12'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-15-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-15-12'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-16-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-16-12'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-17-9'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-17-12'	AEI	5/29-30/07	<1.0	2.7	<0.05	<0.005	<0.005	<0.005	<0.005
SB-18-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-18-12'	AEI	5/29-30/07	30	10	<0.17	0.049	0.22	0.36	1.8
SB-19-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-19-12'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-20-8'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-20-12'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-21-12'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
SB-21-17'	AEI	5/29-30/07	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
MW-3-5'	AEI	8/10/2007	<1.0	<1.0	<0.05	<0.005	<0.005	<0.005	<0.005
MW-3-10'	AEI	8/10/2007	1,500	240	<10	6.0	42	12	120
RL	-	-	1.0	1.0	0.05	0.005	0.005	0.005	0.005

Notes:
mg/Kg - milligrams per kilogram
TPH - g - Total Petroleum Hydrocarbons as gasoline
TPH - d - Total Petroleum Hydrocarbons as diesel
RL - Reporting Limit
AEI - AEI Consultants
Ceres - Ceres Associates
No known soil data for Terra Firma Consulting report

Table 2 - AEI Project # 270308
Groundwater Sample Analytical Data

Sample ID	Consultant	Date Collected	TPH-g ug/L	TPH-d ug/L	MTBE ug/L	Benzene ug/L	Toluene ug/L	Ethylbenzene ug/L	Xylenes ug/L
					EPA Method SW8021B/8015Cm				
SB-2W	AEI	5/11/2005	780	420	<5.0	53	9.0	35	100
SB-4W	AEI	5/11/2005	<50	<50	<5.0	<0.5	<0.005	<0.005	0.76
50901-1	TFC	9/8/2005	860	740	-	6.0	7.5	22	100
50901-2	TFC	9/8/2005	13,000	3,600	-	410	1,200	390	1,700
50901-3	TFC	9/8/2005	20,000	2,000	-	990	3,100	590	2,300
50901-4	TFC	9/8/2005	550	230	-	20	17	19	56
SB5-GW	Ceres	6/6/2006	<50	170	<5.0	<0.5	<0.5	<0.5	1.8
SB6-GW	Ceres	6/6/2006	380	290	<5.0	3.4	1.8	3.8	51
SB7-GW	Ceres	6/6/2006	100,000	110,000	<100	3,300	11,000	2,100	20,000
SB8-GW	Ceres	6/6/2006	580	550	<5.0	8.4	3.6	18	47
SB9-GW	Ceres	6/6/2006	610	360	<5.0	10	15	21	70
SB-10-W	AEI	5/29-30/07	<50	71	<5.0	<0.5	<0.5	<0.5	<0.5
SB-11-W	AEI	5/29-30/07	<50	<50	<5.0	<0.5	<0.5	<0.5	<0.5
SB-12-W	AEI	5/29-30/07	<50	80	<5.0	<0.5	<0.5	<0.5	<0.5
SB-13-W	AEI	5/29-30/07	<50	130	<5.0	<0.5	<0.5	<0.5	<0.5
SB-14-W	AEI	5/29-30/07	<50	<50	<5.0	<0.5	<0.5	<0.5	<0.5
SB-15-W	AEI	5/29-30/07	<50	<50	<5.0	<0.5	<0.5	<0.5	<0.5
SB-16-W	AEI	5/29-30/07	<50	73	<5.0	<0.5	<0.5	<0.5	<0.5
SB-17-W	AEI	5/29-30/07	<50	160	<5.0	<0.5	<0.5	<0.5	<0.5
SB-18-W	AEI	5/29-30/07	330	64	14	2.1	5.4	8.9	31
SB-19-W	AEI	5/29-30/07	<50	59	<5.0	<0.5	<0.5	<0.5	<0.5
SB-20-W	AEI	5/29-30/07	<50	<50	<5.0	<0.5	<0.5	<0.5	<0.5
SB-21-W	AEI	5/29-30/07	<50	<50	<5.0	<0.5	<0.5	<0.5	<0.5
RL	-	-	50	50	5.0	0.5	0.5	0.5	0.5

Notes:
ug/L - microgram per liter
TPH-g - Total Petroleum Hydrocarbons as gasoline
TPH-d - Total Petroleum Hydrocarbons as diesel
MTBE = methyl tertiary butyl ether
RL - reporting limit
AEI - AEI Consultants
TFC - Terra Firma Consulting
Ceres - Ceres Associates

Table 3 - AEI Project # 270308
Soil and Groundwater Sample Analytical Data - Fuel Additives

Sample ID	Date Collected	MTBE ug/L	TAME ug/L	TBA ug/L	DIPE ug/L *EPA 8260B*	ETBE ug/L	Ethanol ug/L	Methanol ug/L	EDB ug/L	1,2-DCA ug/L
Soil		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SB-12-12'	5/29-30/2007	<0.005	<0.005	<0.05	<0.005	<0.005	<0.25	<2.5	<0.005	<0.005
SB-17-12'	5/29-30/2007	<0.005	<0.005	<0.05	<0.005	<0.005	<0.25	<2.5	<0.005	<0.005
SB-18-12'	5/29-30/2007	<0.010	<0.010	<0.10	<0.010	<0.010	<0.5	<5.0	<0.010	<0.010
Groundwater		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SB-10-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
SB-11-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
SB-12-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
SB-13-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
SB-14-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
SB-15-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	4.5
SB-16-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	2.7
SB-17-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	0.52
SB-18-W	5/29-30/2007	19	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	1.2
SB-19-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
SB-20-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
SB-21-W	5/29-30/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
RL	-	0.5	0.5	5	0.5	0.5	50	500	0.5	0.5

Notes:
mg/kg - milligrams per kilogram
µg/L - micrograms per liter
RL - Reporting Limit (before any dilution)
MTBE - methyl tertiary butyl ether
TAME - tert-amyl methyl ether
TBA - tert-butyl alcohol
DIPE - diisopropyl ether
ETBE - ethyl tert-butyl ether
1,2-DCA - 1,2 - dichloroethane
EDB - 1,2 - dibromoethane

Table 4 - AEI Project # 270308
Monitoring Well Construction Details

Well ID	Date Installed	Top of Casing Elevation (ft amsl)	Well Depth (ft)	Slotted Casing (ft)	Slot Size (in)	Sand Interval (ft)	Sand Size	Bentonite Interval (ft)	Grout Interval (ft)
MW-1	08/10/07	14.92	18.0	8 - 18	0.010	7 - 18	# 2/12	7 - 8	0.75 - 7
MW-2	08/10/07	15.27	17.0	7 - 17	0.010	6 - 17	# 2/12	6 - 7	0.75 - 6
MW-3	08/10/07	15.26	18.0	8 - 18	0.010	7 - 18	# 2/12	7 - 8	0.75 - 7

Notes:
ft amsl = feet above mean sea level

Table 5 - AEI Project # 270308

Groundwater Elevation Data

Well ID (Screen Interval)	Date Collected	Well Elevation *(ft amsl)*	Depth to Water *(ft)*	Groundwater Elevation *(ft amsl)*
MW-1	8/21/2007	14.92	8.38	6.54
(8 - 18)	11/21/2007	14.92	8.37	6.55
	2/26/2008	14.92	7.98	6.94
MW-2	8/21/2007	15.27	8.78	6.49
(7 - 17)	11/21/2007	15.27	8.72	6.55
	2/26/2008	15.27	8.37	6.90
MW-3	8/21/2007	15.26	8.59	6.67
(8 - 18)	11/21/2007	15.26	8.55	6.71
	2/26/2008	15.26	8.11	7.15

Event #	Date	Average Water Table Elevation (ft amsl)	Change from Previous Episode (ft)	Flow Direction (gradient) (ft/ft)
1	8/21/2007	6.57	NA	S (0.003)
2	11/21/2007	6.60	0.04	S (0.005)
3	2/26/2008	7.00	0.39	S (0.005)

ft amsl = feet above mean sea level
All water level depths are measured from the top of casing

Table 6 - AEI Project # 270308

Groundwater Monitoring Sample Analytical Data

Sample ID	Date	TPHg µg/L	TPHd µg/L	MTBE µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes µg/L	Lead µg/L
MW-1	8/21/2007	<50	<50	15	<0.5	<0.5	<0.5	<0.5	<0.5
	11/21/2007	<50	<50	12	<0.5	<0.5	<0.5	<0.5	-
	2/26/2008	<50	<50	-	<0.5	<0.5	<0.5	<0.5	-
MW-2	8/21/2007	<50	<50	<5.0	<0.5	<0.5	<0.5	<0.5	<0.5
	11/21/2007	<50	<50	<5.0	<0.5	<0.5	<0.5	<0.5	-
	2/26/2008	<50	<50	-	<0.5	<0.5	<0.5	<0.5	-
MW-3	8/21/2007	24,000	2,100	<180	2,600	3,500	450	2,400	8.6
	11/21/2007	36,000	3,800	<500	4,900	1,200	230	2,700	-
	2/26/2008	31,000	5,400	-	4,200	1,900	590	2,200	-

Notes:
TPHd = total petroleum hydrocarbons as diesel (C10-C23) using EPA Method 8015
TPHg = total petroleum hydrocarbons as gasoline (C6-C12) using EPA Method 8015
Benzene, toluene, ethylbenzene, and xylenes using EPA Method 8021B
MTBE = methyl-tertiary butyl ether using EPA Method 8021B
Lead using EPA Method E200.8
µg/L= micrograms per liter
ND<50 = non detect at respective reporting limit

Table 7 - AEI Project # 270308

Groundwater Monitoring Sample Analytical Data

Fuel Additives

Sample ID	Date	MTBE µg/L	TAME µg/L	TBA µg/L	DIPE µg/L	ETBE µg/L	Ethanol µg/L	Methanol µg/L	EDB µg/L	1,2-DCA µg/L
MW-1	8/21/2007	18	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	5.2
	11/21/2007	-	-	-	-	-	-	-	-	-
	2/26/2008	16	-	-	-	-	-	-	<0.5	6.9
MW-2	8/21/2007	<0.5	<0.5	<5.0	<0.5	<0.5	<50	<500	<0.5	<0.5
	11/21/2007	-	-	-	-	-	-	-	-	-
	2/26/2008	<0.5	-	-	-	-	-	-	<0.5	<0.5
MW-3	8/21/2007	<5.0	<5.0	<50	<5.0	<5.0	<500	<5000	34	140
	11/21/2007	-	-	-	-	-	-	-	-	-
	2/26/2008	<12	-	-	-	-	-	-	31	220

Notes:
µg/L= micrograms per liter
ND<50 = non detect at respective reporting limit
MTBE - methyl tertiary butyl ether
TAME - tert-amyl methyl ether
TBA - tert-butyl alcohol
DIPE - diisopropyl ether
ETBE - ethyl tert-butyl ether
1,2-DCA - 1,2 - dichloroethane
EDB - 1,2 - dibromoethane
Fuel additives analysed by EPA Method 8260

APPENDIX A

Boring/Well Logs

Project: Allen Project Location: 325 Martin Luther King Jr Way, Oakland, CA Project Number: 270308	# Log of Boring SB-10 Sheet 1 of 1

Date(s) Drilled **May 29, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **12 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Silty Sand, dark to reddish brown, slightly loose, poorly graded, dry		
	5							
		X	SB-10-8'	SP		Sand, tannish brown, poorly graded, slightly loose, moist	<1	
	10					becoming very moist		
				SP		(ATD) ▽ Sand, tannish brown, medium grained sand, poorly graded, SATURATED		
		X	SB-10-13'				<1	
	15							
		X	SB-10-16'				<1	
						Bottom of Boring at 16 feet bgs		
	20							

Figure

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Project: Allen **Project Location: 325 Martin Luther King Jr Way, Oakland, CA** **Project Number: 270308**	# Log of Boring SB-11 Sheet 1 of 1

Date(s) Drilled **May 29, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **14 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Clayey Sand, dark to reddish brown, slightly loose, poorly graded, dry		
	5							
		X	SB-11-7'	SP		Silty Sand, tannish brown, poorly graded, slightly loose, slightly moist, increasing in moisture with depth	<1	
	10					becoming very moist		
		X	SB-11-14'	SP		Sand, tannish brown, medium grained sand, poorly graded, SATURATED (ATD)	<1	
	15	X	SB-11-16'				<1	
						Bottom of Boring at 16 feet bgs		
	20							

Figure

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Project: Allen Project Location: 325 Martin Luther King Jr Way, Oakland, CA Project Number: 270308	**Log of Boring SB-12** Sheet 1 of 1

Date(s) Drilled **May 29, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **18 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **~13 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Clayey Sand, dark to reddish brown, slightly loose, poorly graded, dry		
	5							
		Tube	SB-12-7'				<1	
						Clay content decreasing		
	10					becoming very moist		
		Tube	SB-12-12'				<1	
				SP		Sand, tannish brown, medium grained sand, poorly graded, SATURATED, slight petroleum hydrocarbon odor in groundwater sample		
	15							
						Bottom of Boring at 18 feet bgs		
	20							

Figure

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Project: Allen Project Location: 325 Martin Luther King Jr Way, Oakland, CA Project Number: 270308	**Log of Boring SB-13** Sheet 1 of 1

Date(s) Drilled **May 29, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **20 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **15 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Clayey Sand, dark to reddish brown, loose, fine grained sand, poorly graded, dry		
		X	SB-13-5'				<1	
	5			SP		Silty Sand, tannish brown, poorly graded, fine grained sand, slightly loose, moist		
		X	SB-13-8'				<1	
						becoming very moist		
	10							
		X	SB-13-14'				<1	
	15			SP		Sand, tannish brown, medium grained sand, poorly graded, SATURATED (ATD)		
		X	SB-13-19'				<1	Insufficient groundwater recharge, drilled to 20 feet bgs
	20					Bottom of Boring at 20 feet bgs		

Figure

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Project: Allen **Project Location: 325 Martin Luther King Jr Way, Oakland, CA** **Project Number: 270308**	# Log of Boring SB-14 Sheet 1 of 1

Date(s) Drilled **May 29, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **13 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Clayey Sand, dark to reddish brown, slightly loose, fine grained sand, poorly graded, dry		
	5	X	SB-14-5'				<1	
				SP		Silty Sand, tannish brown, poorly graded, fine grained sand, slightly loose, locally mottled (light grey), moist		
		X	SB-14-8'				<1	
						becoming very moist		
	10							
				SP		Sand, tannish brown, medium grained sand, poorly graded, SATURATED (ATD) ▽		
		X	SB-14-12'				<1	
	15							
		X	SB-14-16'				<1	
						Bottom of Boring at 16 feet bgs		
	20							

Figure

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Project: Allen Project Location: 325 Martin Luther King Jr Way, Oakland, CA Project Number: 270308	**Log of Boring SB-15** Sheet 1 of 1

Date(s) Drilled **May 29, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **13 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Clayey Sand, dark brown, slightly loose, fine grained sand, poorly graded, dry		
	5	X	SB-15-5'				<1	
				SP		Silty Sand, tannish brown, poorly graded, fine grained sand, slightly loose, locally mottled (light grey), moist		
		X	SB-15-8'				<1	
						becoming very moist		
	10							
				SP		Sand, tannish brown, medium grained sand, poorly graded, SATURATED (ATD)		
		X	SB-15-12'				<1	
	15	X	SB-15-16'				<1	
						Bottom of Boring at 16 feet bgs		
	20							

Figure

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Project: Allen
Project Location: 325 Martin Luther King Jr Way, Oakland, CA
Project Number: 270308

Log of Boring SB-16

Date(s) Drilled **May 30, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **13 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Sand, dark brown, slightly loose, fine grained sand, locally clayey, poorly graded, dry		
		X	SB-16-5'				<1	
	5			SP		Silty Sand, tannish brown, poorly graded, fine grained sand, oxidized streaks, slightly loose, locally mottled (light grey), moist		
		X	SB-16-8'			becoming very moist	<1	
	10							
				SP		(ATD) ▽ Sand, tannish brown, medium grained sand, poorly graded, SATURATED		
		X	SB-16-12'				<1	
	15							
		X	SB-16-16'				<1	
						Bottom of Boring at 16 feet bgs		
	20							

Figure

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Project: Allen
Project Location: 325 Martin Luther King Jr Way, Oakland, CA
Project Number: 270308

Log of Boring SB-17

Sheet 1 of 1

Date(s) Drilled **May 30, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **20 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **14 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Sand, dark to reddish brown, slightly loose, fine grained sand, locally clayey, poorly graded, dry, increasing in moisture with depth		
	5	X	SB-17-5'				<1	
						staining observed, changing color of soil to olive brown, petroleum hydrocarbon odors noted (smear zone contamination?)		
		X	SB-17-9'				2.8	
	10			SP		Clayey Sand, olive brown, poorly graded, moderate petroleum hydrocarbon odors		
		X	SB-17-12'				4.5	
				SP		(ATD) ▽ Sand, olive brown, medium grained sand, poorly graded, SATURATED, moderate petroleum hydrocarbon odors		
	15							
		X	SB-17-16'				2.1	
								Not enough groundwater to sample, drilled to 20 feet bgs
	20	X	SB-17-20'				1.4	
						Bottom of Boring at 20 feet bgs		

Figure

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Project: Allen Project Location: 325 Martin Luther King Jr Way, Oakland, CA Project Number: 270308	**Log of Boring SB-18** Sheet 1 of 1

Date(s) Drilled **May 30, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **20 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **13 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Sand, dark to reddish brown, slightly loose, fine grained sand, locally clayey, poorly graded, dry, increasing in moisture with depth		
	5	X	SB-18-5'				<1	
						staining observed, changing color of soil to olive brown, petroleum hydrocarbon odors noted (smear zone contamination?)		
	10			ML		Clayey Silt, olive brown, poorly graded, moderate petroleum hydrocarbon odors		
		X	SB-18-12'				2.6	
				SP		(ATD) ▽ Sand, olive brown, medium grained sand, poorly graded, SATURATED, moderate petroleum hydrocarbon odors		
	15	X	SB-18-16'				2.1	
								Not enough groundwater to sample, drilled to 20 feet bgs
	20	X	SB-18-20'				<1	
						Bottom of Boring at 20 feet bgs		

Figure

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Project: Allen **Project Location: 325 Martin Luther King Jr Way, Oakland, CA** **Project Number: 270308**	# Log of Boring SB-19 Sheet 1 of 1

Date(s) Drilled **May 30, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **13 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Silty Sand, dark to reddish brown, minor clay, slightly loose, fine grained sand, poorly graded, dry, increasing in moisture with depth		
	5							
						clay content decreasing		
			SB-19-8'	SP		Sand, tannish brown, medium grained sand, poorly graded, SATURATED	<1	
	10							
			SB-19-12'				<1	
						(ATD)		
	15							
						Bottom of Boring at 16 feet bgs		
	20							

Figure

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Project: Allen **Project Location: 325 Martin Luther King Jr Way, Oakland, CA** **Project Number: 270308**	# Log of Boring SB-20 Sheet 1 of 1

Date(s) Drilled **May 30, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **16 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **13.5 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Silty Sand, dark to reddish brown, minor clay, slightly loose, fine grained sand, poorly graded, dry		
	5					becoming moist		
		X	SB-20-8'				<1	
				ML		Clayey Silt, reddish to dark brown, poorly graded, fine sand grains, organic streaks, moist		
	10							
		X	SB-20-12'	SP		Sand, tannish brown, medium grained sand, poorly graded, wet	<1	
						becoming SATURATED (ATD) ▽		
	15							
						Bottom of Boring at 16 feet bgs		Hydropunched to depth of approx. 30 feet bgs, no groundwater encountered beneath shallow aquifer
	20							

Figure

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Project: Allen Project Location: 325 Martin Luther King Jr Way, Oakland, CA Project Number: 270308	**Log of Boring SB-21** Sheet 1 of 1

Date(s) Drilled **May 30, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Direct Push**	Drill Bit Size/Type **2.8 inch**	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Geoprobe 5410**	Drilling Contractor **ECA**	Approximate Surface Elevation
Groundwater Level and Date Measured **13 feet ATD**	Sampling Method(s) **Tube**	Well Permit.
Borehole Backfill **Tremied; Portland Cement & Grout**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	REMARKS AND OTHER TESTS
	0			Concrete		Concrete		
				SP		Clayey Sand, dark to reddish brown, slightly loose, poorly graded, dry		
	5					decreasing clay content		
						becoming very moist		
	10							
		X	SB-21-12'				<1	
				SP		(ATD) ▽ Sand, tannish brown, medium grained sand, poorly graded, SATURATED		
	15							
		X	SB-21-17'				<1	
						Bottom of Boring at 17 feet bgs		
	20							

Figure

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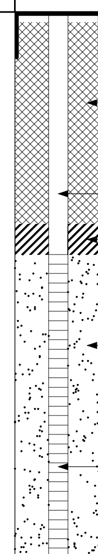
Project: Allen **Project Location: 325 Martin Luther King Jr Way, Oakland, CA** **Project Number: 270308**	# Log of Boring MW-1 Sheet 1 of 1

Date(s) Drilled **August 10, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **8.2 inch**	Total Depth of Borehole **18 feet bgs**
Drill Rig Type **Limited-access**	Drilling Contractor **Gregg**	Approximate Surface Elevation **0 feet MSL**
Groundwater Level and Date Measured **Not Measured**	Sampling Method(s) **Tube**	Hammer Data
Borehole Backfill **See Below**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	Well Log	REMARKS AND OTHER TESTS
	0				Concrete			
					Silty Sand, medium brown, poorly graded, moist			Neat cement grout
	5		MW-1		Silty Sand, medium brown, minor clay, poorly graded, slightly loose, moist	<1		Blank 2" schedule 40 PVC casing
								Bentonite chips
	10		MW-1-10'		Silty Sand, tannish to medium brown, poorly graded, slightly loose, moist	<1		# 2/12 Monterey sand
	15		MW-1-15'		Silty Sand, tannish brown, poorly graded, saturated	<1		0.010 slotted, 2" schedule 40 PVC casing
					Bottom of Boring at 18 feet bgs			
	20							
	25							
	30							
	35							



Figure

Project: Allen
Project Location: 325 Martin Luther King Jr Way, Oakland, CA
Project Number: 270308

Log of Boring MW-2

Sheet 1 of 1

Date(s) Drilled **August 10, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **8.2 inch**	Total Depth of Borehole **17 feet bgs**
Drill Rig Type **Limited-access**	Drilling Contractor **Gregg**	Approximate Surface Elevation **0 feet MSL**
Groundwater Level and Date Measured **Not Measured**	Sampling Method(s) **Tube**	Hammer Data
Borehole Backfill **See Below**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	Well Log	REMARKS AND OTHER TESTS
	0				Concrete			
					Clayey Sand, medium brown, poorly graded, moist			Neat cement grout
	5		MW-2-5'		Silty Sand, medium brown, minor clay, poorly graded, slightly loose, moist	<1		Blank 2" schedule 40 PVC casing; Bentonite chips
	10		MW-2-10'		Silty Sand, tannish to medium brown, poorly graded, slightly loose, moist, moderate petroleum hydrocarbon odors in sample tubes	<1		# 2/12 Monterey sand
	15		MW-2-15'		Silty Sand, tannish brown, poorly graded, saturated, slight petroleum odor	<1		0.010 slotted, 2" schedule 40 PVC casing
	17				Bottom of Boring at 17 feet bgs			
	20							
	25							
	30							
	35							

Figure

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Project: Allen **Project Location: 325 Martin Luther King Jr Way, Oakland, CA** **Project Number: 270308**	# Log of Boring MW-3 Sheet 1 of 1

Date(s) Drilled **August 10, 2007**	Logged By **Adrian Angel**	Checked By **Peter McIntyre**
Drilling Method **Hollow Stem Auger**	Drill Bit Size/Type **8.2 inch**	Total Depth of Borehole **18 feet bgs**
Drill Rig Type **Limited-access**	Drilling Contractor **Gregg**	Approximate Surface Elevation **0 feet MSL**
Groundwater Level and Date Measured **Not Measured**	Sampling Method(s) **Tube**	Hammer Data
Borehole Backfill **See Below**	Location	

Elevation, feet	Depth, feet	Sample Type	Sample Number	Graphic Log	MATERIAL DESCRIPTION	PID Reading, ppm	Well Log	REMARKS AND OTHER TESTS
	0				Concrete			
					Silty Sand, medium brown, poorly graded, moist			Neat cement grout
	5		MW-3-5'		Silty Sand, medium brown, minor clay, poorly graded, slightly loose, moist	<1		Blank 2" schedule 40 PVC casing Bentonite chips
	10		MW-3-10'		Silty Sand, tannish to medium brown, minor clay, poorly graded, loose, moist to very moist, moderate petroleum hydrocarbon odors	224		# 2/12 Monterey sand
	15		MW-3-15'		Silty Sand, tannish brown, poorly graded, saturated, strong petroleum hydrocarbon odors in sampling tubes	12.5		0.010 slotted, 2" schedule 40 PVC casing
					Bottom of Boring at 18 feet bgs			
	20							
	25							
	30							
	35							

Figure

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APPENDIX B

Direct Push Injection
Standard Operating Procedures (SOP)

REGENESIS

RegenOx™ CHEMICAL OXIDATION REDEFINED

RegenOx™ *In Situ* Chemical Oxidation Application Instructions

Using Direct-Push Injection (Step-by-Step Procedures)

RegenOx™ is the new generation of chemical oxidation. RegenOx™ is a proprietary (patent-applied-for) *in situ* chemical oxidation process using a solid oxidant complex (sodium percarbonate/catalytic formulation) and an activator complex (a composition of ferrous salt embedded in a micro-scale catalyst gel). RegenOx™ with its catalytic system has very high activity, capable of treating a very broad range of soil and groundwater contaminants including both petroleum hydrocarbons and chlorinated solvents.

Instructions

1) Prior to the installation of RegenOx™, any surface or overhead impediments should be identified as well as the location of all underground structures. Underground structures include but are not limited to utility lines; tanks; distribution piping; sewers; drains; and landscape irrigation systems. The planned installation locations should be adjusted to account for all impediments and obstacles. These considerations should be part of the SSHP or HASP.

2) Pre-mark the installation locations, noting any points that may have different vertical application requirements or total depth.

3) Set up the direct push unit over each point and follow the manufacturer standard operating procedures (SOP) for the direct push equipment. Care should be taken to assure that probe holes remain in the vertical.

4) For most applications, Regenesis suggests using 1.5-inch O.D./0.625-inch I.D drive rods. However, some applications may require the use of 2.125-inch O.D./1.5-inch I.D. or larger drive rods.

5) Advance drive rods through the surface pavement, as necessary, following SOP.

6) Push the drive rod assembly with an expendable tip to the desired maximum depth. Regenesis suggests pre-counting the number of drive rods needed to reach depth prior to starting injection activities.

7) After the drive rods have been pushed to the desired depth, the rod assembly should be withdrawn three to six inches. Then the expendable tip can be dropped from the drive rods, following SOP. If an injection tool was used instead of an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.

8) In some cases, introduction of a large column of air prior to RegenOx™ application may be problematic because the air can block water flow to the treatment area. This is particularly the case in deep injections (>50 ft) with large diameter rods (>1.5-inch O.D.). To prevent the injection of air into the aquifer during RegenOx™ application, as well as to prevent problems associated with heaving sands, fill the drive rods with water, or the RegenOx™ mixture prior dropping the expendable tip or exposing the injection tool.

9) The RegenOx™ percent of the oxidizer in solution should range between 3% to 5%. Although solutions up to 8% may be used, this will likely increase the difficulty of injection due to reactivity. Solutions with greater than 8% oxidizer in solution will result in excess reaction and flocculation prior to injection and are not typically recommended

Measure the appropriate quantity of RegenOx™ Oxidizer for one to four vertical foot of injection into a 55 gallon drum or mixing tank. The volume of water per injection location can be calculated from the following formula:

$$\frac{\text{RegenOx Oxidizer lbs/foot}}{(8.34\text{ lbs/gal water})(\%\ \mathrm{R}egenOx\_Oxidizer\text{ solids})}\left[1-(\%\ \mathrm{R}egenOx\_Oxidizer\text{ solids})\right]$$

Tighter formations (clays and silts), and even some fine sand formations will likely require higher oxidant percentages since less volume can be injected per location. The following are guides to various RegenOx™ mixing ratios based on the above equation.

- to make a roughly 3% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 38 gallons of water.
- to make a roughly 4% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 28 gallons of water.
- to make a roughly 5% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 22 gallons of water.

10) Pour the pre-measured quantity of RegenOx™ Oxidizer into the pre-measured volume of water to make the desired target % oxidant in solution. NOTE: always pour the Oxidizer into water, do not pour water into the Oxidizer. Mix the water and oxidant with a power drill and paint stirrer or other mechanical mixing device to ensure that the Oxidizer has dissolved in the water.

11) Pour the applicable quantity of the pre-mixed RegenOx™ Activator into the oxidant:water solution. Mix the Oxidant and Activator using a power drill paint stirrer or other mechanical mixing device for at least 5 minutes until a homogenous mixture is formed. After mixing the RegenOx™ mixture should be injected into the subsurface as soon as possible.

12) Do not mix more RegenOx™ material than will be used over roughly 1 to 4 feet of injection so as to minimize potential above ground reaction/flocculation prior to injection.

Transfer the contents of the mixing tank to the pump using gravity feed or appropriate transfer pump. (See Section 9.2: Pump Selection) For some types of pumps, it may be desirable to perform a volume check prior to injecting RegenOx™

13) Connect the delivery hose to the pump outlet and the delivery sub-assembly. Circulate RegenOx™ though the hose and the delivery sub-assembly to displace air in the hose. NOTE: an appropriately sized pressure gauge should be placed between the pump outlet and the delivery sub-assembly in order to monitor application pump pressure and detect changes in aquifer backpressures during application.

14) Connect the sub-assembly to the drive rod. After confirming that all of the connections are secure, pump the RegenOx™ through the delivery system to displace the water/fluid in the rods.

15) Slowly withdraw the drive rods. Commonly RegenOx™ injection progress at 1-foot intervals. However, continuous injection while slowly withdrawing single lengths of drive rod (3 or 4 feet) is an acceptable option. The pre-determined volume of RegenOx™ should be pumped into the aquifer across the desired treatment interval.

16) Remove one section of the drive rod. The drive rod may contain some residual RegenOx™. Place the RegenOx™-filled rod in a clean, empty bucket and allow the RegenOx to drain. Eventually, the RegenOx™ should be returned to the RegenOx™ pump hopper for reuse.

17) Monitor for any indications of aquifer refusal. This is typically indicated by a spike in pressure as indicated or (in the case of shallow applications) RegenOx™ "surfacing" around the injection rods or previously installed injection points. At times backpressure caused by reaction off-gassing will impede the pumps delivery volume. This can be corrected by bleeding the pressure off using a pressure relief/bypass valve (placed inline between the pump discharge and the delivery sub-assembly) and then resume pumping. If aquifer acceptance appears to be low, as indicated by high back pressure, allow sufficient time for the aquifer to equilibrate prior to removing the drive rod.

18) Repeat steps 13 through 23 until treatment of the entire contaminated vertical zone has been achieved. It is recommended that the procedure extend to the top of the capillary fringe/smear zone, or to the top of the targeted treatment interval.

19) Install an appropriate seal, such as bentonite, above the RegenOx™ material through the entire vadose zone. Prior to emplacing the borehole seal, we recommend placing clean sand in the hole to the top of the RegenOx™ treatment zone (especially important in holes that stay open). Bentonite chips or granular bentonite should be placed immediately above the treatment zone, followed by a cement/bentonite grout to roughly 0.5 feet below ground surface. Quick-set concrete should then be used as a surface seal.

20) Remove and clean the drive rods as necessary.

21) Finish the borehole at the surface as appropriate (concrete or asphalt cap, as needed). We recommend a quick set concrete to provide a good surface seal with minimal set up time.

22) A proper borehole and surface seal assures that the RegenOx™ remains properly placed and prevents contaminant migration from the subsurface. Each borehole should be sealed immediately following RegenOx™ application to minimize RegenOx™ surfacing during the injection process. If RegenOx™ continues to "surface" up the direct push borehole, an appropriately sized (oversized) disposable drive tip or wood plug/stake can be used to plug the hole until the aquifer pressures equilibrates and the RegenOx™ stops surfacing. If wells are used for RegenOx™ injection the RegenOx™ injection wells and all nearby groundwater monitoring wells should be tightly capped to reduce potential for surfacing through nearby wells.

23) Periodically compare the pre- and post-injection volumes of RegenOx™ in the holding tank or pump hopper using the pre-marked volume levels. Volume level may not be present on all tanks or pump hoppers. In this case, volume level markings can be temporarily added using known amounts of water and a carpenter's grease pencil (Kiel crayon).

24) Move to the next probe point, repeating steps 8 through 29. We recommend that the next RegenOx™ injection point be as far a distance as possible within the treatment zone from the previous RegenOx™ injection point. This will further minimize RegenOx™ surfacing and short circuiting up an adjacent borehole. When possible, due to the high volumes of liquid being injected, working from the outside of the injection area towards the center will limit expansion of the plume.

Pump Selection

Regenesis has evaluated a number of pumps and many are capable of delivering RegenOx™ to the subsurface at a sufficient pressure and volumetric rate. However, even though a number of the evaluated pumps may be capable of delivering the RegenOx™ to the subsurface based on adequate pressures and delivery rates, each pump has its own set of practical issues that may make it more or less difficult to manage in a field setting.

In general, Regenesis strongly recommends using a pump with a pressure rating of 200 pounds per square inch (psi) in sandy soil settings, and 800 psi in silt, clay or weathered bedrock settings. Any pump under consideration should have a minimum delivery rate of 5 gallons per minute (gpm). A lower gpm rated pump may be used; however, they are not recommended due to the amount of time required to inject the volume of liquids typically associated with a RegenOx™ injection (i.e. 1,000 lbs of RegenOx™ [500 lbs Oxidant/500 lbs Activator] require roughly 1,100 gallons of water to make a 5% Oxidant solution).

Quite often diaphragm pumps are used for the delivery of chemical oxidants. Generally, these pumps operate pressures from 50-150 psi. Some of these pumps do not have the pressure head necessary to overcome the back pressure encountered in silt and clay lenses. In these cases the chemical oxidant thus ends up being delivered to the surrounding sands (the path of least resistance) and is not delivered to soil with residual adsorbed contamination. The use of a positive displacement pump such as a piston pump or a progressing cavity pump is may be superior because these pumps have the pressure necessary to overcome the resistance of low permeability soils. NOTE: be aware that application at pressures that are too high may over-consolidate the soil and minimize the direct contact of the oxidant. The key is to inject at a rate and pressure that maximizes the radius of influence without causing preferential flow. This can be achieved by injecting at the minimum pressure necessary to overcome the particular pressures associated with your site soil conditions.

Whether direct injection or wells are used, it is best to start by injecting RegenOx™ outside the contaminated area and spiral laterally inwards toward the source. Similarly, RegenOx™ should be applied starting vertically at the bottom elevation of contamination, through the layer of contamination, and a couple of feet above the layer of contamination. The reagents can be pushed out from the well bore with some water.

Pump Cleaning

For best results, flush all moving parts and hoses with clean water at the end of the day; flush the injection system with a mixture of water and biodegradable cleaner such as Simple Green.

For more information or technical assistance please call Regenesis at 949-366-8000

APPENDIX C

Safety and Handling Information

Regen OX – Part A (Oxidizer Complex)

Material Safety Data Sheet (MSDS)

Last Revised: November 7, 2005

Section 1 – Supplier Information and Material Identification

Supplier:

REGENESIS
1011 Calle Sombra
San Clemente, CA 92673
Telephone: 949.366.8000
Fax: 949.366.8090
E-mail: info@regenesis.com

Chemical Description:	A mixture of sodium percarbonate [$2Na_2CO_3 \cdot 3H_2O_2$], sodium carbonate [Na_2CO_3], sodium silicate and silica gel.
Chemical Family:	Inorganic Chemicals
Trade Name:	Regen Ox – Part A (Oxidizer Complex)
Product Use:	Used to remediate contaminated soil and groundwater (environmental applications)

Section 2 – Chemical Information/Other Designations

CAS No.	Chemical
15630-89-4	Sodium Percarbonate
5968-11-6	Sodium Carbonate Monohydrate
1344-09-8	Silicic Acid, Sodium Salt, Sodium Silicate
63231-67-4	Silica Gel

Section 3 – Physical Data

Form:	Powder
Color:	White
Odor:	Odorless
Melting Point:	NA
Boiling Point:	NA

Section 3 – Physical Data (cont)

Flammability/Flash Point:	NA
Vapor Pressure:	NA
Bulk Density:	0.9 – 1.2 g/cm^3
Solubility:	Min 14.5g/100g water @ 20 ºC
Viscosity:	NA
pH (3% solution):	˜ 10.5
Decomposition Temperature:	Self-accelerating decomposition with oxygen release starts at 50 ºC.

Section 4 – Reactivity Data

Stability:	Stable under normal conditions
Conditions to Avoid/Incompatibility:	Acids, bases, salts of heavy metals, reducing agents, and flammable substances
Hazardous Decomposition Products:	Oxygen. Contamination with many substances will cause decomposition. The rate of decomposition increases with increasing temperature and may be very vigorous with rapid generation of oxygen and steam.

Section 5 – Regulations

TSCA Inventory Listed: Yes

CERCLA Hazardous Substance (40 CFR Part 302)

Listed Substance: *No*

Unlisted Substance: *Yes*

SARA, Title III, Sections 313 (40 CFR Part 372) – Toxic Chemical Release Reporting: Community Right-To-Know

Extremely Hazardous Substance:	No
WHMIS Classification:	C, D2B
Canadian Domestic Substance List:	Appears

Section 6 – Protective Measures, Storage and Handling

Technical Protective Measures

Storage: Oxidizer. Store in a cool, well ventilated area away from all sources of ignition and out of the direct sunlight. Store in a dry location away from heat and in temperatures less than 40 ?C.

Keep away from incompatible materials and keep lids tightly closed. Do not store in improperly labeled containers.

Protect from moisture. Do not store near combustible materials. Keep containers well sealed.

Store separately from reducing materials. Avoid contamination which may lead to decomposition.

Handling: Avoid contact with eyes, skin and clothing. Use with adequate ventilation.

Do not swallow. Avoid breathing vapors, mists or dust. Do not eat, drink or smoke in the work area.

Label containers and keep them tightly closed when not in use.

Wash hands thoroughly after handling.

Personal Protective Equipment (PPE)

Engineering Controls: General room ventilation is required if used indoors. Local exhaust ventilation, process enclosures or other engineering controls may be needed to maintain airborne levels below recommended exposure limits. Avoid creating dust or mists. Maintain adequate ventilation at all times. Do not use in confined areas. Keep levels below recommended exposure limits. To determine actual exposure limits, monitoring should be performed on a routine basis.

Respiratory Protection: For many conditions, no respiratory protection is necessary; however, in dusty or unknown conditions or when exposures exceed limit values a NIOSH approved respirator should be used.

Hand Protection: Wear chemical resistant gloves (neoprene, rubber, or PVC).

Section 6 – Protective Measures, Storage and Handling (cont)

Eye Protection:	Wear chemical safety goggles. A full face shield may be worn in lieu of safety goggles.
Skin Protection:	Try to avoid skin contact with this product. Chemical resistant gloves (neoprene, PVC or rubber) and protective clothing should be worn during use.
Other:	Eye wash station.
Protection Against Fire & Explosion:	Product is non-explosive. In case of fire, evacuate all non-essential personnel, wear protective clothing and a self-contained breathing apparatus, stay upwind of fire, and use water to spray cool fire-exposed containers.

Section 7 – Hazards Identification

Potential Health Effects	
Inhalation:	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath, and irritations to mucous membranes, nose and throat.
Eye Contact:	Causes irritation, redness and pain.
Skin Contact:	Causes slight irritation.
Ingestion:	May be harmful if swallowed (vomiting and diarrhea).

Section 8 – Measures in Case of Accidents and Fire

After Spillage/Leakage:	Eliminate all ignition sources. Evacuate unprotected personnel and never exceed any occupational exposure limit. Shovel or sweep spilt material into plastic bags or vented containers for disposal. Do not return spilled or contaminated material to the inventory.
Extinguishing Media:	Water
First Aid	
Eye Contact:	Flush eyes with running water for at least 15 minutes with eyelids held open. Seek a specialist.
Inhalation:	Remove affected person to fresh air. Seek medical attention if the effects persist.
Ingestion:	If the individual is conscious and not convulsing, give two-four cups of water to dilute the chemical and seek medical attention immediately. **Do Not** induce vomiting.

Section 8 – Measures in Case of Accidents and Fire (cont)

Skin Contact:	Wash affected areas with soap and a mild detergent and large amounts of water.

Section 9 – Accidental Release Measures

Precautions:	
Cleanup Methods:	Shovel or sweep spilt material into plastic bags or vented containers for disposal. Do not return spilled or contaminated material to the inventory.

Section 10 – Information on Toxicology

Toxicity Data	
LD50 Oral (rat):	2,400 mg/kg
LD50 Dermal (rabbit):	Min 2,000 mg/kg
LD50 Inhalation (rat):	Min 4,580 mg/kg

Section 11 – Information on Ecology

Ecology Data	
Ecotoxicological Information:	NA

Section 12 – Disposal Considerations

Waste Disposal Method	
Waste Treatment:	Dispose of in an approved waste facility operated by an authorized contactor in compliance with local regulations.
Package (Pail) Treatment:	The empty and clean containers are to be recycled or disposed of in conformity with local regulations.

Section 13 – Shipping/Transport Information

D.O.T. Shipping Name:	Oxidizing Solid, N.O.S. [A mixture of sodium percarbonate [$2Na_2CO_3 \cdot 3H2O_2$], sodium carbonate [Na_2CO_3], sodium silicate and silica gel.]
UN Number:	1479
Hazard Class:	5.1
Labels:	5.1 (Oxidizer)
Packaging Group:	III

Section 14 – Other Information

HMIS® Rating	Health – 1 (slight)	Reactivity – 1 (slight)
	Flammability – 0 (none)	Lab PPE – goggles, gloves, and lab coat

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Section 15 – Further Information

The information contained in this document is the best available to the supplier at the time of writing, but is provided without warranty of any kind. Some possible hazards have been determined by analogy to similar classes of material. The items in this document are subject to change and clarification as more information become available. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must exercise their independent judgment in determining its appropriateness for a particular purpose.