July 31, 2001

CORRECTIVE ACTION PLAN

1075 40TH Street
Oakland, California

Project No. 4436

Prepared For
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Prepared By

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July 31, 2001

Mr. Don Hwang
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Subject: **Corrective Action Plan**
1075 40th Street
Oakland, California
AEI Project No. 4436

Dear Mr. Hwang:

On behalf of Mr. Monte Upshaw, AEI Consultants (AEI) is responding to a request from your office to develop a Corrective Action Plan (CAP) for the above referenced site. AEI has been retained by Mr. Upshaw to provide environmental engineering and consulting services for this site.

1.0 INTRODUCTION

A CAP results from a process of review of site characterization data and available remedial technologies that could be used to clean up the site. The feasibility of each method is evaluated, and an appropriate method is selected. A feasibility test is designed to determine (1) whether the method will work at the site and (2) site specific parameters for implementation of the technology. In addition to the method to be employed at the subject site, the plan specifies expectations for cleanup levels to be attained that are appropriate for the soil and groundwater uses on site and in the surrounding area.

1.1 Site Description and Contacts

The site is located in a mixed residential and commercial area of Oakland at 1075 40th Street, and currently supports the operation of Fidelity Roof Company. Figure 1.1-1 shows the general location of the site and Figure 1.1-2 is a well location map showing the distribution of existing groundwater monitoring wells including proposed monitoring and remediation wells. Table 1.1-1 gives important contact information.

Table 1.1-1. Contact Information Relevant to Investigation

Site Owner	Oversight Agency	Environmental Consultant
Fidelity Roof Company 1075 40th Street Oakland, CA 94608-3691 **Contact: Monty Upshaw** (510) 547-6330	Alameda County Health Care Services 1131 Harbor Bay Parkway Suite 250 Alameda, CA 94502-6577 **Contact: Don Hwang** (510) 567-6746	AEI Consultants (AEI) 3210 Old Tunnel Road, Suite B, Lafayette, CA 94549-4157 **Contact: Peter McIntyre** (800) 401-8500

1.2 Objective of Proposed Work

Soil and groundwater beneath the site are impacted with hydrocarbon fuel constituents. The purpose of this Corrective Action Plan (CAP) is to prescribe a method for preventing the spread of hydrocarbon contamination by removing hydrocarbons from the soil and groundwater. This CAP presents an evaluation of the potential methods of soil and groundwater remediation; selects the most cost effective treatment methods, and gives specific design details for the recommended remediation method.

2.0 SITE HISTORY AND CHARACTERISTICS

On December 19, 1995, Tank Protect Engineering removed one (1) 1,000 gallon diesel underground storage tank (UST) and one (1) 500 gallon gasoline UST from the southeast corner of the property. The removal of the tanks produced a single excavation. The excavated soil was stockpiled north of the excavation. Three discrete soil samples were collected from beneath the USTs. Analysis of the samples indicated that soil beneath the 1,000 gallon UST was impacted by minor concentrations of gasoline petroleum hydrocarbons (TPH-g), diesel petroleum hydrocarbons (TPH-d), benzene, toluene, ethylbenzene and total xylenes (BTEX), and methyl tertiary butyl ether (MTBE). A single soil sample collected from beneath the 500 gallon UST indicated that 100 mg/kg of TPH-g and 96 mg/kg of TPH-d were present.

On September 12, 1996, AEI advanced four soil borings in the vicinity of the former UST excavation (Ref. 1). Soil samples were collected from all of the borings and groundwater samples were collected from two of the borings. Analytical results from the subsurface investigation revealed significant levels of gasoline and diesel present in soil to the south and to the west of the open excavation. The contamination was thought to extend beneath the existing pump island. Groundwater analysis indicated maximum concentrations of 5,500 ug/L of TPH-g, 340 ug/L of benzene, and 2,100 ug/L of TPH-d. Due to the high concentrations of petroleum hydrocarbons within the groundwater, the ACHCSA required further investigation of the extent and magnitude of the groundwater contaminant plume.

During the Phase II subsurface Investigation, AEI collected four soil samples from the stockpile where soil had been stored from the original UST excavation. The samples were combined into one composite sample for analysis in the laboratory. Analysis of the samples indicated concentrations of 3.8 mg/kg of TPH-g, 29 mg/kg of TPH-d, and minor concentrations of BTEX. Ms. Hugo of the ACHCSA granted approval to reuse the stockpiled soil as backfill material.

On October 25, 1996, AEI extended the excavation laterally 7 feet to the south and 12 feet to the west (Ref. 2). Soil was removed to a depth of 9 feet below ground surface (bgs). The contaminated soil was stockpiled on-site and profiled for disposal into a Class III Landfill. The dispenser island and associated piping were also removed. Groundwater was not encountered during the excavation activities. Four confirmation soil samples were collected from the excavation sidewalls, indicating that up to 150 mg/kg of TPH-g, 16 mg/kg of benzene, and 200 mg/kg of TPH-d remains within the western sidewall of the excavation.

The excavated soil was profiled and accepted for disposal at the BFI Vasco Road Sanitary Landfill, in Livermore, California. In November 1996, approximately 235 tons of contaminated soil were loaded and transported to the landfill for disposal, under non-hazardous waste manifest.

On March 6, 1997, AEI installed three groundwater-monitoring wells (Ref. 3). The wells were subsequently sampled in March 1997, June 1997, October 1997 and January 1998. The analytical data from January 1998 indicated that 29,000 ug/L of TPH-g, 5,600 ug/L of benzene and 7,300 ug/L of TPH-d were present in the groundwater.

At the request of the ACHCSA, six additional soil borings were drilled south and west of existing well locations on November 4, 1998 (Ref. 4). The locations of these borings were chosen to assess the lateral extent of impacted groundwater at the site. TPH-d was detected at 2,400 ug/L in the groundwater to the south of the former excavation. No significant concentrations of petroleum hydrocarbons were detected from the other borings.

Based on the results of these six soil borings, the ACHCSA requested the installation of a fourth groundwater monitoring well at the site, located south of the former tank locations along Yerba Buena. Avenue. Monitoring well MW-4 was installed on July 15, 1999, and two soil samples at 10 and 14 feet bgs were analyzed from the boring (Ref. 5). No detectable concentrations of petroleum hydrocarbons were found in the soil samples.

The last groundwater-sampling episode took place on April 18, 2001. Strong hydrocarbon odors were present while sampling MW-1, MW-2, and MW-4. Groundwater levels ranged from 35.22 to 36.72 feet above Mean Sea Level (MSL). The direction of groundwater flow was toward the west with a hydraulic gradient of approximately 0.02 foot per foot.

Concentrations of TPH-g increased in wells MW-1, MW-3, and MW-4 since the last sampling episode. Concentrations of TPH-d increased in wells MW-1 and MW-4, and MTBE concentrations increased in wells MW-2 and MW-4. Wells MW-3 and MW-4 contained higher concentrations of benzene with respect to the previous sampling episode. The change in concentrations may be due to the shift in direction of groundwater flow and/or varying depths of groundwater. Monitoring well MW-3 continues to yield the highest levels of TPH-g, TPH-d and benzene. TPH-g and TPH-d were detected up to 75,000 ug/L and 13,000 ug/L, respectively. Concentrations of BTEX were detected up to 9,200 ug/L, 1,200 ug/L, 2,500 ug/L and 12,000 ug/L, respectively. MTBE was detected up to 2,800 ug/L in well MW-2.

Figure 2.0-1 is a plot of benzene concentrations in groundwater from MW-3 during the four-year period March 1997 through March 2001. Figure 2.0-2 is a similar plot of concentrations of TPH-g in groundwater from MW-3. The time-series data show that concentrations show an increasing trend within the previous two years.

Figure 2.0-3 is a plot of MTBE concentration in groundwater from MW-2 over the four-year period. Concentrations of MTBE have been increasing exponentially over the past three years.

2.1 Site Geology

Borehole logs for groundwater monitoring wells are included in Appendix A. In general, the sediments in the upper 21 feet of the site are poorly sorted, consisting of sandy clay with variable gravel content. Color variations from dark greenish gray to yellowish brown indicate that the water table undergoes significant vertical fluctuation. Vertical fluctuation of the water table can act as a pump to admit oxygen to the subsurface.

2.2 Site Hydrogeology

Figure 2.2-1 is a map of water table contours obtained from water level measurements in the four groundwater-monitoring wells taken on April 18, 2001. The direction of groundwater flow is to the northwest with a hydraulic gradient of 0.02 foot per foot.

One additional groundwater monitoring well at the western area of the site is proposed (see Figure 1.1-2). The purpose of the well is to provide additional control for definition of the water table gradient and flow direction, and for monitoring of contaminant levels of groundwater leaving the subject site.

3.0 CHARACTERISTICS OF REPORTED CONTAMINANTS

Gasoline range hydrocarbons, present in the soils and groundwater beneath the site, are targeted for remediation. Gasoline fuels are composed of varying percentages of numerous chemical constituents. However, aromatic compounds such as benzene, toluene, ethyl benzene and xylenes (BTEX) are used as marker compounds because these components are the most water soluble of the gasoline range compounds (Bruce, 1993). The presence of methyl tertiary butyl ether (MTBE), a fuel oxygenate, has been demonstrated at the site.

Gasoline constituents partition in the subsurface environment as the free phase (mobile liquid hydrocarbon), the vapor phase, the residual phase (adsorbed and trapped on or between the soil grains) and the dissolved phase. The percentage of hydrocarbons within each phase is dependent on the properties of each chemical component. The relative partitioning of benzene, toluene, ethyl benzene and ortho-xylene is shown below in Table 3.0-1.

Table 3.0-1. Relative Environmental Partitioning of Petroleum Constituents

Petroleum Compound	Adsorption Onto Soil Molecules (%)	Volatilization (%)	Soluble Portion In Groundwater and Soil Moisture (%)
Benzene	3	62	35
Toluene	3	77	20
Ethyl benzene	21	59	20
(O) Xylene	15	54	31

Modified from Kostecki and Calabrese, 1989, Petroleum Contaminated Soils

Vapor pressure, Henry's Law constant and boiling point are diagnostic indicators of the volatility of specific chemicals. Generally, contaminants with vapor pressures greater than 0.5 mm Hg, Henry's Law constants greater than 100 atm, and boiling points less than 250 to 300 deg C are considered amenable to removal by soil vapor extraction (U.S. EPA, 1994). These properties for BTEX and several other petroleum fuels are listed below in Table 3.0-2.

Table 3.0-2. Properties of Several Common Petroleum Constituents and Petroleum Products

Chemical Constituent	Vapor Pressure (mm Hg @ 20 deg C)	Henry's Law Constant (atm)	Water Solubility (mg/L @20 deg C)	Boiling Point (deg C)
Benzene	76	230	1780	80
Toluene	22	217	515	111
Ethyl benzene	7	359	152	136
Xylenes	6	266	185	138-144
Tetraethyl Lead	0.2	4700	0.0025	100
Gasoline	NA	NA	NA	40-225
MTBE	240	NA	48,000	55.2

NA = Not available
* = U.S. EPA, 1994, How To Evaluate Alternate Cleanup Technologies For Underground Storage Tank Sites
** = U.S. Department of Health and Human Services, 1985, NIOSH Pocket Guide to Chemical Hazards

The data listed in Tables 3.0-1 and 3.0-2 indicate that gasoline range hydrocarbons tend to partition into the vapor phase. Based on the nature of the contaminant (gasoline), in situ remediation technologies utilizing volatilization will generally be more effective than Bioremediation processes.

4.0 DESCRIPTION OF REMEDIAL TECHNOLOGIES (SOIL)

Various technologies have been developed to remediate soils impacted by petroleum hydrocarbons. These technologies involve interactions between complex physical, chemical and biological processes, some of which are not yet completely understood. In addition, many of the available technologies have not been subjected to adequate testing and research to prove their effectiveness under all field conditions. Because of the limited amount of information available, this process overview is not intended to be exhaustive, but will provide a discussion of several of the potentially effective technologies that may be employed to remediate hydrocarbons beneath this site. In general, highly volatile fuels such as gasoline are more effectively remediated through volatilization rather than by bioremediation processes.

Soil remediation processes are divided into two categories: (1) the in place treatment (in-situ) of hydrocarbon contamination and (2) the excavation and surface treatment of the hydrocarbons adsorbed onto the soil (ex-situ). In situ processes are soil vapor extraction, bioventing and natural attenuation (passive bioremediation or no planned remedial action). Once the soil is removed from the ground, ex situ processes such as land farming or recycling may be used to treat the soils. Several of these processes can be combined to more effectively remediate the hydrocarbons and accelerate the cleanup. The costs presented here are from The Alternate Cleanup Technologies for Underground Storage Tank Sites (U.S. EPA, 1994).

4.1 Soil Vapor Extraction (SVE)

Soil vapor extraction, also known as soil venting, is a widely used, proven, cost-effective technology to remediate volatile hydrocarbon constituents such as gasoline. The process involves removing volatile hydrocarbon vapors from the subsurface soil matrix utilizing extraction wells and vacuum pumps. The extracted well vapors are generally treated at the surface through carbon adsorption or by thermal or catalytic oxidation. Soil vapor extraction is easily combined with other remediation technologies and results in minimal disruption of site activities. This technology is also cost competitive at $20 to $50 per ton. The effectiveness of the technology is less certain on stratified soils or soil with low permeability.

4.2 Bioventing

Bioventing involves injecting and/or extracting air (oxygen) and possibly nutrients into the subsurface to enhance the naturally occurring microorganisms that biodegrade the hydrocarbons. The process is similar to soil vapor extraction, however, in soil vapor extraction, hydrocarbons are removed through volatilization while bioremediation promotes degradation of the hydrocarbons through lower air injection and extraction rates. Bioventing is easily combined with other remediation technologies and creates minimal disturbance of site activities. This technology is also cost competitive at $45 to $140 per ton. However, bioventing does not affect hydrocarbons within the capillary fringe and the saturated zone and is not effective in remediation of soils with high clay content. High constituent concentrations may also be initially toxic to the microorganisms. Hydrocarbons of the C_{10}-C_{22} range are generally considered to be least toxic to biota and most biodegradable (Grubbs, 1986).

4.3 Natural Attenuation/Passive Bioremediation (No Action)

Natural attenuation is a passive remediation approach that depends on naturally occurring processes such as aerobic or anaerobic biodegradation, dispersion, volatilization, and adsorption to degrade or disperse hydrocarbons. Bioremediation is generally considered to be the primary natural attenuation mechanism. This mechanism is dependent on factors such as soil microbe population density, soil pH, soil moisture, temperature, soil nutrients, and hydrocarbon content, and is extremely dependent on subsurface oxygen levels. Generally, one or more of these conditions are limited, resulting in relatively slow attenuation rates. Hydrocarbons present in subsurface soils can potentially migrate or leach into the groundwater resulting in additional damage to the natural aquifer system.

The potential for hydrocarbons present in the sub-surface soil matrix to leach into the groundwater is demonstrated by the detection of free-phase product and elevated levels of hydrocarbons during the initial and subsequent groundwater sampling events conducted at the site. Although natural attenuation process will continue to slowly degrade the hydrocarbons, these contaminants, which are present in the soil, remain a potential source of continuing groundwater contamination. Regulations established under Titles 22, 23, and 26 of the Code of Federal Regulations and the Porter-Cologne Water Quality Control Act (Div.7, Section 13000) require the cleanup or abatement of unauthorized releases such as petroleum fuels.

4.4 Land Farming (Soil Aeration)

Land farming is a remediation technology in which excavated contaminated soils are remediated by aeration (volatilization into the atmosphere) and biodegradation. The soils are generally spread in a uniform layer (2 to 6 inches deep) and mixed with nutrients, minerals and moisture to stimulate microbial activity. In addition, the soils are generally tilled or plowed periodically to further enhance the aeration and bioremediation processes. Because of health exposure risks and Air Pollution requirements, land farming is generally not permitted near occupied businesses or residences. Additional costs may be involved transporting the excavated soils to an acceptable remediation location. The associated costs related to this technology are $30 to $60 per ton. Land farming is one of the quicker technologies, needing only 3 to 6 months to complete the aeration/degradation process.

4.5 Recycling

Recycling generally involves manifesting and transporting excavated soils to an approved permitted recycling facility where the soils are treated and/or recycled. Several of these facilities incinerate the contaminants and incorporate the treated soils in aggregate mixes used as covers in landfills or incorporated in asphalt mixes used in road construction. The costs of permitting, transporting and disposing the soils using this process range from $70 to $120 per ton, relatively high compared with other technologies.

5.0 DESCRIPTION OF REMEDIAL TECHNOLOGIES (GROUNDWATER)

The methods used to remediate groundwater impacted with petroleum constituents are primarily dependent on subsurface hydrogeologic processes, groundwater chemistry, temperature and contaminant characteristics. Groundwater remediation feasibility testing (slug and pump tests, air sparge tests or microbial plate counts) is needed for efficient system design. Included below are process descriptions for groundwater pump and treatment, air sparging and biosparging.

5.1 Pump and Surface Treatment or "Pump and Treat"

Pump and treat processes involve pumping the contaminated groundwater from the sub-surface and removing the contaminants from the resultant groundwater stream prior to re-injecting the water back into the aquifer or discharging the water to a storm drain or sewer system. Treatment is accomplished by passing the groundwater through granular activated carbon or volatilizing the contaminants from the water and treating the off-gas in a method similar to soil vapor extraction.

Although pump and treat can be used to control the migration of hydrocarbon plumes, this may not be a cost effective method of aquifer remediation. This determination is based on the relatively long time needed to pump large volumes of groundwater to effectively remove the dissolved, residual and free phase hydrocarbons and slow groundwater movement through impermeable clay soils. Furthermore, the treatment and disposal of large quantities of water is costly. An additional concern at the subject site is that the site is operational and limited space exists for groundwater treatment units and surface holding tanks.

5.2 Air Sparging

Air sparging is an in-situ process by which air is injected into water saturated zones (aquifers) resulting in the volatilization and enhanced biodegradation of the organic contaminants that are either adsorbed onto the soil particles or dissolved into the groundwater. Air sparging is generally combined with soil vapor extraction to remove the contaminants that have volatilized into the injected air. Because air sparging does not involve the removal of groundwater, relative costs are generally small when combined with soil vapor extraction. Air sparging can be used to remediate soils in the capillary fringe which are not effectively remediated by vapor extraction or bioventing processes. Air sparging is most effective in remediation of soils with high permeability (sand and silty sand) contaminated with gasoline range hydrocarbons. However, remediation of stratified or low permeability soils with air sparging may be ineffective. Insufficient system design or lack of sufficient data may result in the off-site migration of the petroleum constituents. Air sparging, at $30 to $60 per ton of saturated soils, is less costly than above ground treatment.

6.0 EVALUATION OF REMEDIATION TECHNOLOGIES FOR SUBJECT SITE

6.1 No Further Action

Alameda County Health Care Services (ACHCS) favors remediation at the site due to the potential for degradation of regional groundwater quality. Natural attenuation is therefore a factor for eliminating any residual petroleum concentrations after remediation, but is not viable for remediation. The estimated expense for remediation by natural attenuation is approximately $10,000-20,000 per year that mainly supports the cost of monitoring activities. The scope of work includes preparation of a Risk-Based Corrective Action report, and groundwater monitoring for an undetermined time period. Since groundwater has been impacted at this site, and the regulatory agency favors remedial action at the site, State regulations generally preclude and prevent the "no further action" remedial option.

6.2 Soil Vapor Extraction

Soil vapor extraction can be applied to unsaturated soil matrices of clays, silts, sands, gravels and fractured bedrock over a wide hydraulic conductivity range from 10^{-6} to 10^{-1} cm/sec. Sediments at the subject site consist of sandy clay with variable gravel content. This type of sediment has a high probability of adequate permeability to air for performance of soil vapor extraction. The high volatility of the petroleum hydrocarbon contaminants is also dealt with effectively by this technology. Unique characteristics of the method that make it applicable to the subject site are that it minimizes site disturbances. This is important because the site is an operating roofing business. Soil vapor extraction can be performed under existing buildings and structures on the site if necessary. The method performs rapid cleanup for property sale or development. The method can be implemented quickly for quick response.

6.3 Air Sparging

Air sparging is an attractive option for remediation of groundwater beneath the subject site because most of the piping can be installed below grade and the blower for vapor extraction, compressor for air sparging, and carbon canisters for vapor treatment can be housed in a relatively small footprint area. Such systems are also relatively quiet, a consideration because of the active roofing business on the site.

6.4 Excavation and Removal of Affected Soils

Petroleum hydrocarbon constituents are present in the sub-surface from 1 to 10 feet below grade. Evidence of hydrocarbon contamination of the water table aquifer at a depth of 10 to 21 ft was found in MW-2 and MW-3. The "hot spot" is at or near MW-3. Considering that the shape of the affected area can be approximated by a rectangular solid with width 10 ft, length 20 ft, and depth 10 feet, an estimated 2000 cubic feet or 74 cubic yards of contaminated soil would need to be removed and backfilled in order to completely eliminate the remaining source of hydrocarbons in the 1 – 10 foot zone west of the former UST location.

An estimated cost of $15,000 to $20,000 would be required for excavation and removal of the remaining soil. Excavation and removal of contaminated soil would not result in an immediate improvement in groundwater contaminant concentrations. Such improvement would likely occur over an extended period of time as a result of dilution by clean groundwater flowing onto the site. Monitoring would still be necessary for an indefinite period of time.

7.0 RECOMMENDED REMEDIATION TECHNOLOGIES AND FEASIBILITY TESTING

Petroleum hydrocarbons in groundwater are relatively high in concentration and show recently increasing trends. Groundwater quality down gradient could be affected. For these reasons, no further action must be ruled out.

As pointed out in the previous paragraph, excavation and removal of contaminated soil would not mitigate the groundwater problem, and therefore must be ruled out as well.

AEI recommends soil vapor extraction and air sparging for remediation of soil and groundwater at the subject site. This is a practical and proven technology that will effect removal of volatile organic compounds from soil and groundwater. The following sections provide specific guidance for feasibility testing and implementation of a vapor extraction/air sparge system at the subject site.

7.1 Feasibility Testing

Feasibility testing is necessary in order to determine if the selected method will operate effectively under site-specific conditions and to obtain site-specific parameters. For soil vacuum extraction and air sparging, the most important field parameters to be evaluated are the suitability of existing wells for vapor extraction, the radius of influence of each well, and the pumping rate.

7.1.1 Groundwater Testing

Slug tests are conducted to assess whether sufficient permeability exists in the saturated zone to support air sparging. Generally, the range of permeability that is suitable for air sparging is from 10^{-6} to 10^{-1} cm/sec. For this site, existing wells are 2-inch ID with water columns that range in length from 10 – 13 feet. It is not possible to conduct **valid slug tests** in these wells because the slug would be too small in volume to stress the aquifer to a significant degree.

AEI proposes to conduct a slug test in the new groundwater-monitoring well shown on Figure 1.1-2. This well will be constructed with 4 inch ID casing and will be screened from 6 to 26 feet. The slug test will be conducted prior to design and installation of the air sparge well.

7.1.2 Proposed Vapor Extraction Testing

Four 2-inch ID groundwater-monitoring wells on site, MW-1 through MW-4, can be used for vapor extraction feasibility testing. These wells were completed to a total depth of 20 – 21 feet below ground surface (bgs) with 15 feet of screen. The water levels in these wells range in depth from 7.3 to 9.5 feet bgs. This configuration indicates that anywhere between 2.7 and 4.5 feet of screen is open to the unsaturated zone.

Vapor extraction testing will be carried out by pumping in one of the monitoring wells while monitoring suction in the remaining three. The distances between the wells range from 30 to 40 feet. This spacing is adequate to resolve the radius of influence of a vapor extraction well operating in silty clays since previous experience has shown that approximately a 50-foot radius of influence can be expected. do not agree.

The soil vent test includes procedures to determine the flow rate and vacuum characteristics of the individual wells, the intrinsic soil permeability, the radius of influence (ROI), the darcian vapor velocity, and the initial and final hydrocarbon and atmospheric gas concentrations with respect to time during the test.

The test of vapor extraction wells will entail an initial step test, followed by a longer-duration, constant rate-pumping test at maximum practical vacuum. The system will be calibrated a second time while operating the air sparge well.

The equipment used to conduct the vent test included a 7.5 horsepower (hp) positive displacement blower capable of generating flow rates up to 125 cubic feet per minute (cfm) at a maximum wellhead vacuum (WHV) of 10 inches of mercury. The vapor control device will utilize two carbon canisters installed in series. Suction and flow rates will be monitored using magnahelic vacuum gauges and Pitot gauges attached to wells. Samples of vapor will be collected for chemical analysis at the end of constant rate pumping periods. Samples will be collected in Tedlar® bags and analyzed for petroleum hydrocarbons according to USEPA Method 8015M and for benzene, toluene, ethylbenzene, and xylenes (BTEX) according to USEPA Method 8020.

The results of vapor extraction testing will include estimates of the radius of influence of vapor extraction wells and air sparging, in addition to the wellhead vacuums that permit consistent long term pumping.

An estimate will be made of the time required to remove contaminants from the soil and groundwater. The volume of and average concentration of contaminants in soil and groundwater plumes are approximated. The average concentration of contaminant in the extracted vapor in a constant rate-pumping interval during the pilot test is determined. The mass of contaminant pumped per unit time is divided into the total mass to yield the time required to remediate the site.

8.0 SCOPE OF PROPOSED REMEDIATION

Based upon the results of the last quarterly monitoring episode (4/18/01), ACHCS recommended that a CAP be prepared to discuss and pursue remedial action.

Should results of the vapor extraction/air sparging pilot test prove favorable, AEI will recommend soil vapor extraction in the vadose zone and capillary fringe, coupled with air sparging for the water table aquifer as the most effective and expedient measures for reduction of groundwater hydrocarbon levels. The system will consist of the existing four groundwater monitoring wells which permit extraction of soil vapors from the top of the well screen, in addition to three new wells. The first new well will be an air sparge well, screened below the water table. A second well will be a soil vapor extraction well, screened in the gravel backfill in the former tank vault. The purpose of the additional soil vapor extraction well in the tank vault will be to take advantage of the high permeability material in the tank vault which will enable much higher vapor flow rates. The third well will be an additional down gradient groundwater monitoring well at the southwestern corner of the site. The purpose of the additional groundwater-monitoring well will be to determine if remediation is effective in either containing the contamination or decreasing the concentrations of groundwater contaminants leaving the site.

Hydrocarbons will be removed from extracted air by sorption on activated carbon. Due to the low levels of TPH in the groundwater that rule out the occurrence of free product, neither free product recovery nor thermal oxidation of gasoline vapors will be necessary.

8.1 Remediation Overview

The proposed system will extract and stimulate (as a result of subsurface oxygenation) the degradation of volatile organic compounds (VOCs) from the subsurface soil and groundwater at the water table. AEI's remediation approach for this site will use vapor extraction to remove hydrocarbons from the vadose zone, and air sparging to remove dissolved hydrocarbons from the groundwater by injection of air below the water table.

It is intended that the remediation system be operated continuously unless experience proves otherwise. Operation and maintenance of the system and monitoring of remediation progress will be provided by AEI.

Existing groundwater monitoring wells may be used as vapor extraction or suction monitoring wells. Additional wells will include the air sparge well, a soil vapor extraction well, and a fifth groundwater monitoring well down gradient from the treatment area.

8.2 Groundwater Remediation Program

Groundwater remediation will be effected by the installation of a single air sparge well. Hydrocarbons in the dissolved phase will be displaced into the vapor phase for capture by the vapor extraction system. The vapor extraction system will be comprised of existing groundwater monitoring wells and an additional vapor extraction well completed in the former tank vault area. The extracted vapors will be absorbed on granular activated carbon.

8.3 Remediation System Construction

The air sparge well, AS-1, will consist of a one inch ID schedule 80 PVC well screened from 15 to 20 feet bgs. The air sparge well will be installed between MW-2 and MW-3 as indicated on Figure 1.1-2.

A 4-inch ID PVC soil vapor extraction well will be installed in the former tank vault area with a screen open from 3 to 8 feet bgs. It is likely that the region from 3 to 8 feet bgs will be unsaturated. Given the high effective porosity of the coarse grained sediments in the former tank vault area, a high flow rate is anticipated. The high flow rate can impact volatiles in the most contaminated soils adjacent to the former tank vault.

How were cleanup levels for BTEX in GW determine.

cleanup should be for a residential scenario using
Oakland's RBCA. Table 7 for Sandy Silts
Use RWQCB's RBSL's for cleanup of TPH

It is anticipated that the blower, carbon canisters, and compressor for air sparging can be placed adjacent to the inside wall facing Yerba Buena Avenue.

All piping will be installed in 12-inch deep trenches.

8.4 Proposed Target Soil and Groundwater Cleanup Levels

Proposed target clean levels for soil are based upon USEPA Region 9 guidance for preliminary remediation goals (PRGs) for industrial soil non-carcinogenic hazard quotient HQ=1: benzene- 24 ppm, toluene- 2,000 ppm, ethylbenzene-6,000 ppm, and xylenes- 4,500 ppm. The proposed target levels for groundwater are: Benzene- 11 ppb, toluene- 720 ppb, ethylbenzene- 1,300 ppb, and xylenes- 1,400 ppb. Benzene is a carcinogen and the USEPA considers that concentrations of benzene at 0.65 ppm in soil and 0.35 ppb in water translate to a 10^{-6} cancer risk.

Given the non-beneficial use nature of the local aquifer and the industrial development of the area, the non-carcinogenic hazard quotient HQ=1 PRG for benzene in soil of 24 ppm and in groundwater of 11 ppb do not pose significant risks to human health. The exposure pathways of dermal contact with soil is incomplete because soil is covered by concrete or asphalt cover, and groundwater is not potable. Furthermore, residual hydrocarbons below the target cleanup level present in soil would be further remediated to background levels by natural attenuation processes, and would not represent further migration potential from the site.

Table 8.4-1 summarizes the proposed soil and groundwater cleanup levels for BTEX compounds.

Table 8.4-1. Summary of Proposed Soil and Groundwater Cleanup Levels

Medium (conc.)	Benzene	Toluene	Ethylbenzene	Xylenes
Soil (mg/kg)	24	2000	6000	4500
Groundwater (ug/L)	11	720	1300	1400

8.5 Groundwater Monitoring and MTBE Analysis

The four existing groundwater wells, MW-1, MW-2, MW-3, MW-4 and the new monitoring well MW-5 will be purged, monitored, and sampled on a quarterly basis prior to and during soil and groundwater remediation. In order to accomplish this, the vacuum extraction system will be shut down during the monitoring event in order to gain access to groundwater. Monitoring data will provide information on groundwater depth, gradient magnitude and flow direction, and petroleum constituent concentration, and to monitor the progress of groundwater remediation. Reports summarizing the groundwater monitoring will be prepared by AEI and submitted to ACHCS. Groundwater samples will be analyzed for Total Petroleum Hydrocarbons as Gasoline (TPH-g) using EPA method 8015M, and, benzene, toluene, ethylbenzene, and xylenes (BTEX) and methyl tertiary butyl ether (MTBE) using EPA method 8020. The presence of MTBE will be confirmed using EPA Method 8260, if detected by method 8020. Table 8.5-1, below, summarizes groundwater sample test methods and detection limits.

Table 8.5-1. Test Methods and Detection Limits for Laboratory Analyses

DESCRIPTION	NUMBER OF SAMPLES	MINIMUM REPORTING LEVEL
Water Samples (includes trip blanks)		
TPH-g - (EPA 8015NI)		
BTEX - (EPA 8020)	4	50 ug/l
MTBE - (EPA Method 8020A	4	0.5 ug/l
or 8021B)	4	0.5 ug/l
Optional MTBE Confirmation (EPA 8260)	1	5 ug/l

EPA = Environmental Protection Agency.
TPH-g = Total petroleum hydrocarbons, gasoline-range constituents.
BTEX Benzene, toluene, ethylbenzene, and xylenes.
MTBE Methyl tertiary butyl ether.
mg/kg = Milligrams per kilogram.
ug/l = Micrograms per liter.

Groundwater monitoring will be performed prior to remedial system operation to set the baseline for assessment of progress toward cleanup goals. Groundwater monitoring data will be also be used to refine the groundwater remediation system design.

8.6 Air Emissions and Treated Groundwater Effluent Discharge Permit Requirements

Permits are required to operate soil and groundwater treatment systems to ensure that effluent from these systems does not continue to adversely affect air, soil and groundwater. The Bay Area Air Quality Management District has jurisdiction over air quality at this site. The contractor that supplies the blower motor for vacuum extraction testing will obtain a permit prior to conduct of the vapor extraction test. AEI will obtain a permit for the vapor extraction system prior to startup of the remediation system. No water discharge from the site is planned.

The remediation system will be monitored for the basic field parameters daily for the first week of operation, twice a week during the second week, and weekly thereafter.

8.7 Confirmation Sampling and Site Closure

After the soil and groundwater treatment system influent concentrations have reached constant low levels, and after discussion with the ACHCS, AEI will propose in a written workplan to drill and sample approximately three borings located within the former area of petroleum impacted soils, The borings will be drilled adjacent to former boreholes. Soil samples will be collected from the confirmation borings at the same depths as were sampled in the original boreholes. The results of the confirmation borings investigation will be submitted to the ACHCS in a written report. Based on the results of the confirmation borings investigation, AEI will propose site closure. Continued groundwater monitoring may be required by the ACHCS for an additional time period prior to site closure.

9.0 CLOSING STATEMENT

This Corrective Action Plan has been prepared for Mr. Monte Upshaw as it pertains to the property known as 1075 40th Street, Oakland, CA. The recommendations rendered in this report are based on previous field investigation and laboratory testing of soil and groundwater samples. This report 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. Nor should this report be regarded as a guarantee that no further contamination, beyond that which could have been detected within the scope of this investigation is present beneath the said property. Undocumented, unauthorized releases of hazardous material, 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. All work will he performed in accordance with generally accepted practices in geotechnical environmental engineering, engineering geology, and hydrogeology. No other warranty, either expressed or implied, is made.

10.0 REFERENCES

10.1 Published Reports

Bruce, Lyle G., 1993, Refined Gasoline in the Sub-surface, American Association of Petroleum Geologists Bulletin, v. 77, no. 2, pp. 212-224.

Grubbs, 1986, Enhanced Biodegradation of Aliphatic and Aromatic through
Bio-augmentation, Presented at the Fourth Annual Hazardous Materials Management Conference, Atlantic City, New Jersey.

Johnson, P. C., Kemblowski, M. W. and Colthart, 1. D., 1990, Quantitative Analysis for the Cleanup of Hydrocarbon-Contaminated Soils by In-Situ Soil Venting, Groundwater, May-June 1990, pp.413-429.

Kostecki, P. T. and Calabrese, E. J., 1989, Petroleum Contaminated Soils, Lewis Publishers, Boca Raton, Florida.

Norris, R. M., and R. W. Webb, 1976. Geology of California, John Wiley and Son, Inc., Santa Barbara, California.

U.S. Environmental Protection Agency, 1994, How to Evaluate Alternate Cleanup Technologies for Underground Storage Tank Sites, EPA 510-B-94-003.

10.2 AEI Reports

1. Phase II Soil and Groundwater Investigation Report, October 7, 1996, prepared by AEI.
2. Excavation and Disposal of Contaminated Soil Report, January 7, 1997, prepared by AEI.
3. Phase II Subsurface Investigation Report, May 30, 1997, prepared by AEI.
4. Phase II Subsurface Investigation Report, December 9, 1998, prepared by AEI.
5. Groundwater Monitoring Well and Sampling report, September 3, 1999, prepared by AEI.
6. Quarterly Groundwater Monitoring and Sampling Report, March 21, 2000, prepared by AEI
7. Quarterly Groundwater Monitoring and Sampling Report, July 28, 2000, prepared by AEI.
8. Quarterly Groundwater Monitoring and Sampling Report, November 6, 2000, prepared by AEI.
9. Quarterly Groundwater Monitoring and Sampling Report, January 29, 2001, prepared by AEI.

SIGNATURES OF ENVIRONMENTAL PROFESSIONALS

AEI Consultants has prepared a Corrective Action Plan for the site located at 1075 40th Street in the City of Oakland, California. If you have any questions regarding this plan, please do not hesitate to contact us at (800) 801-3224.

Sincerely,

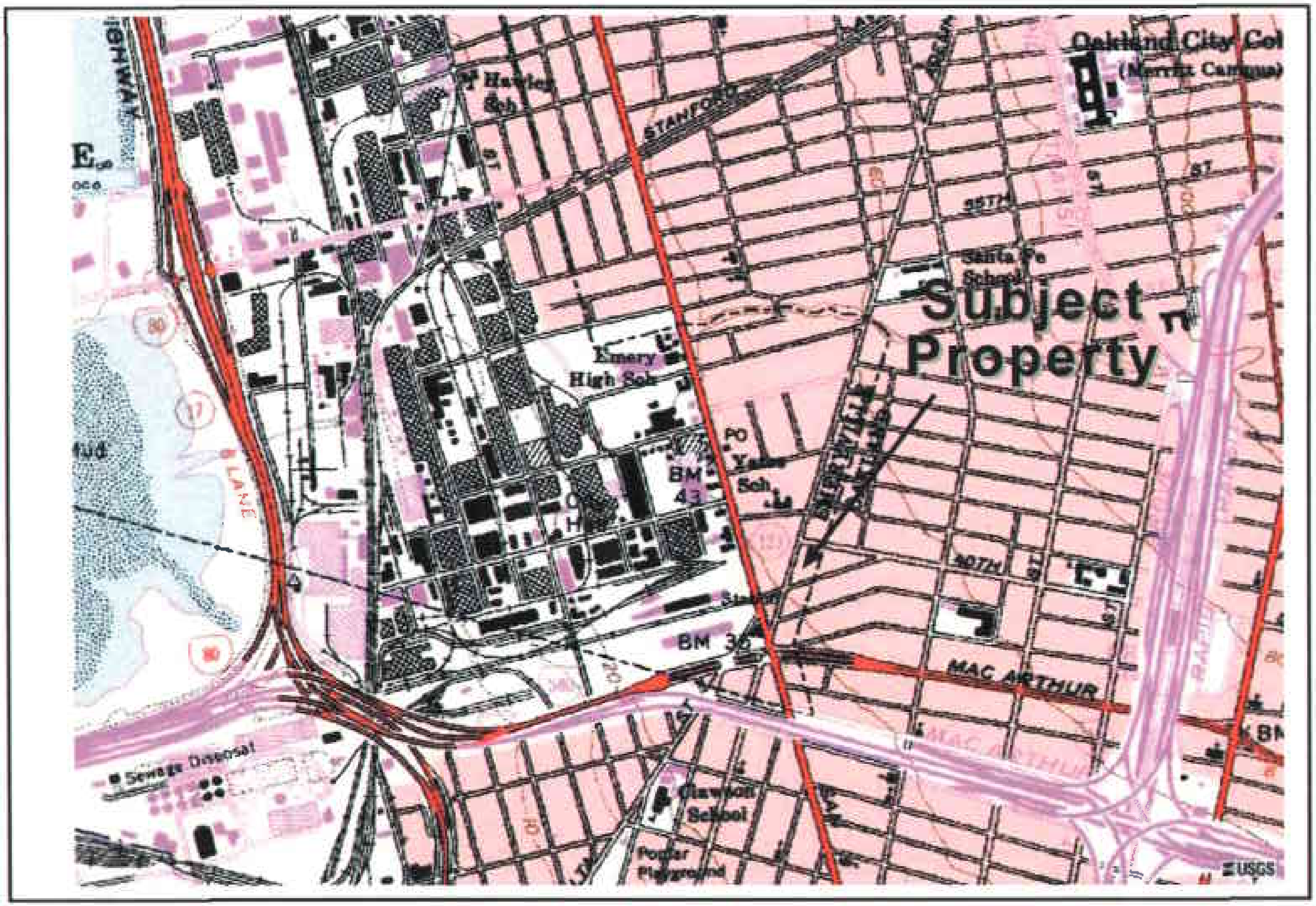
Edward I. Wallick, Ph.D.
Senior Hydrogeologist

Joseph P. Derhake, P.E., C.A.C.
Principal

REGISTERED PROFESSIONAL ENGINEER
JOSEPH P. DERHAKE
C055476
Exp. 12/31/04
CIVIL
STATE OF CALIFORNIA

FIGURES

APPENDIX A: Borehole Logs



N

USGS TOPOGRAPHIC MAP
Oakland, California, United States
Created 1996

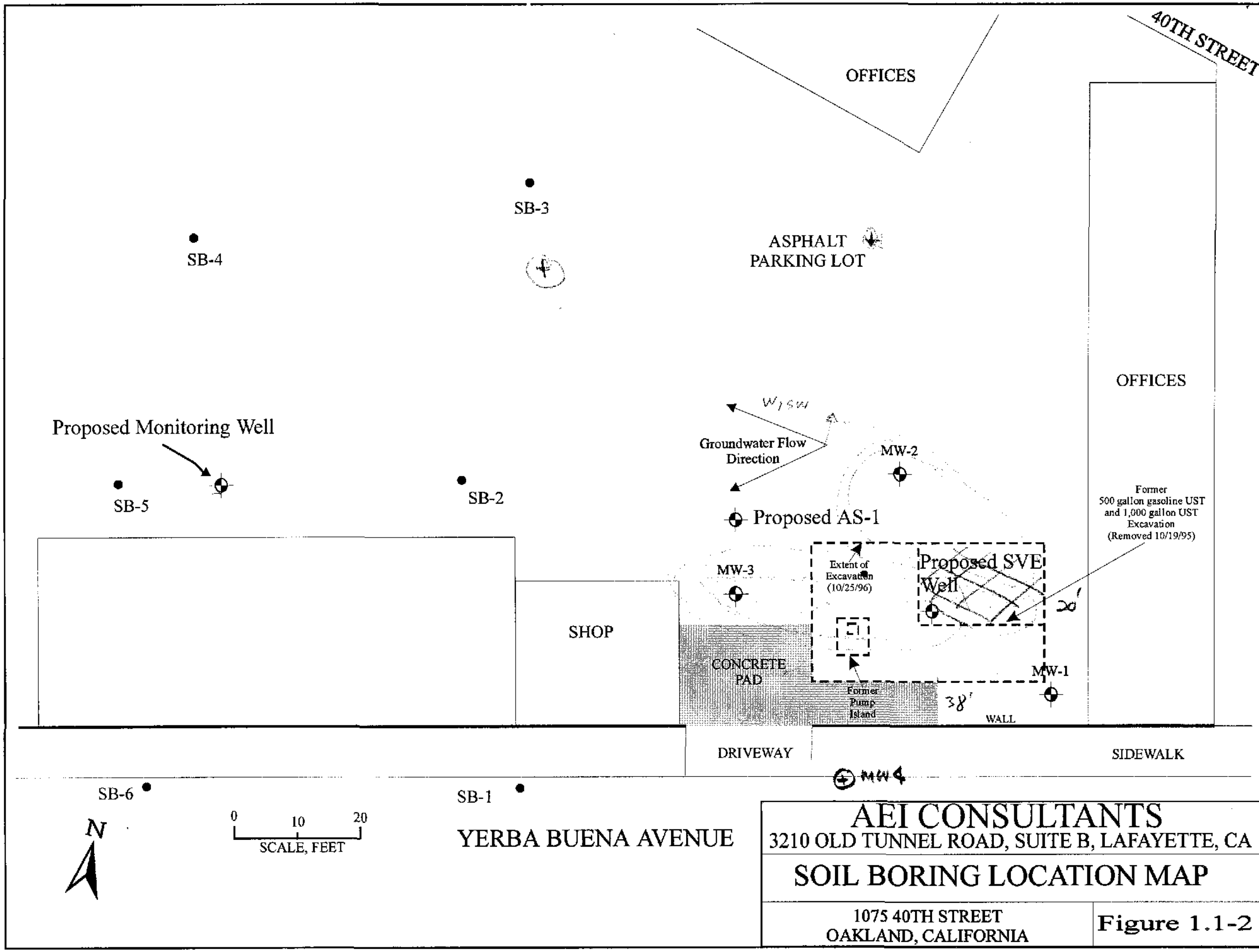
AEI CONSULTANTS

3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA

Figure 1.1-1 General Location Map

1075 40th Street
Oakland, California

JN 4436

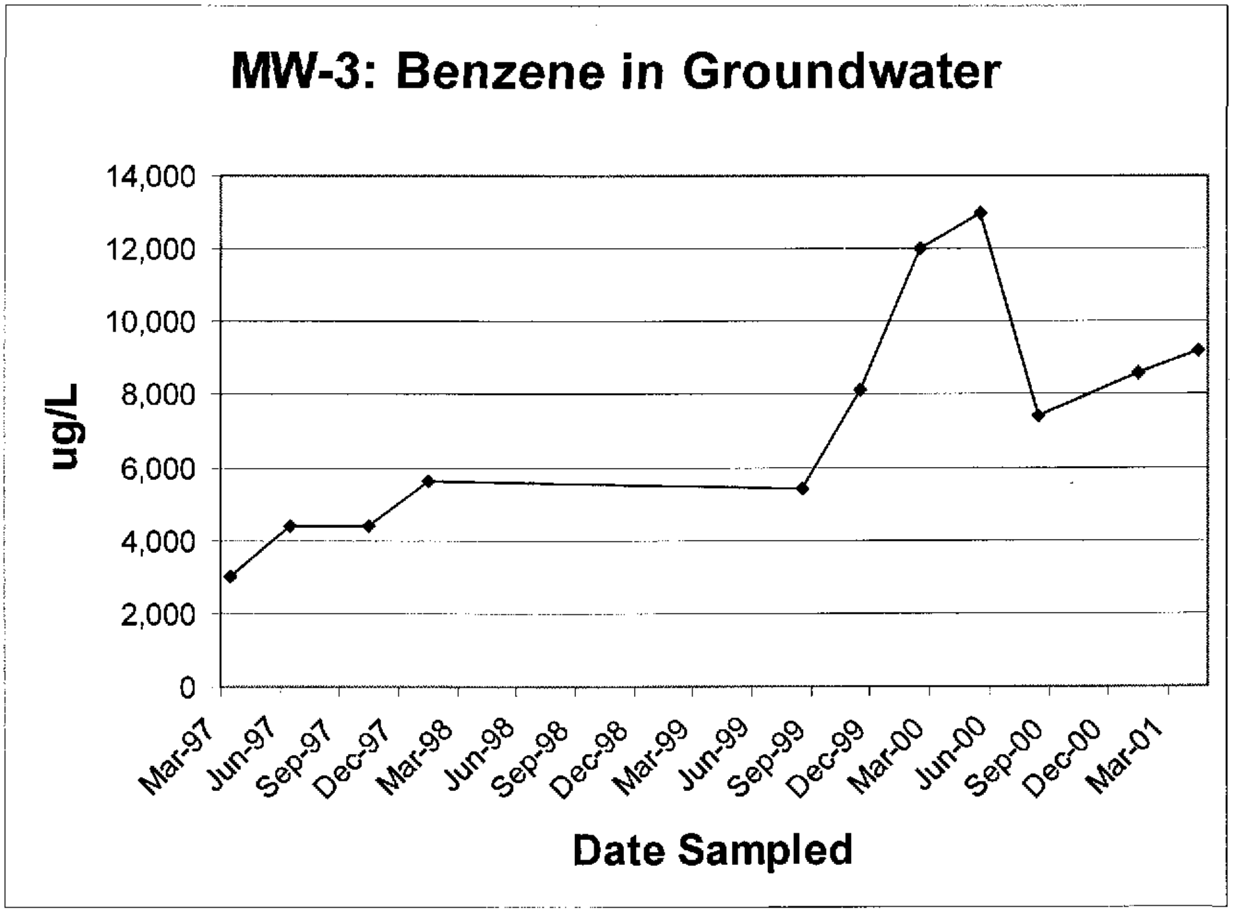


AEI CONSULTANTS
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA

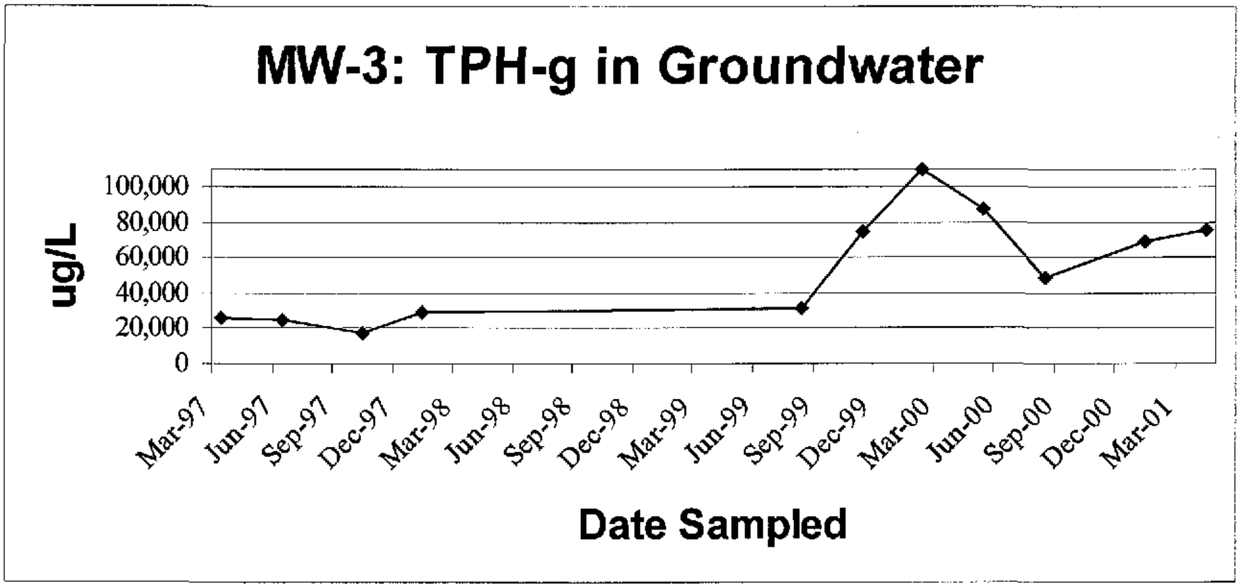
SOIL BORING LOCATION MAP

1075 40TH STREET
OAKLAND, CALIFORNIA

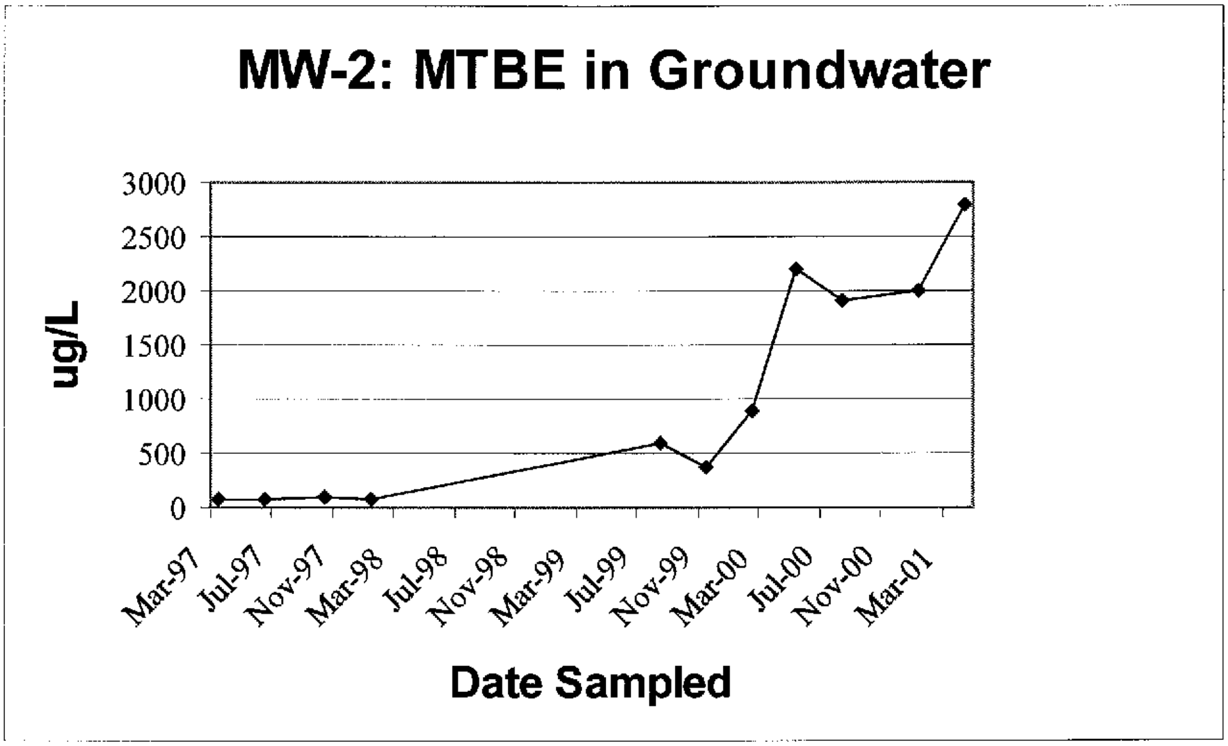
Figure 1.1-2



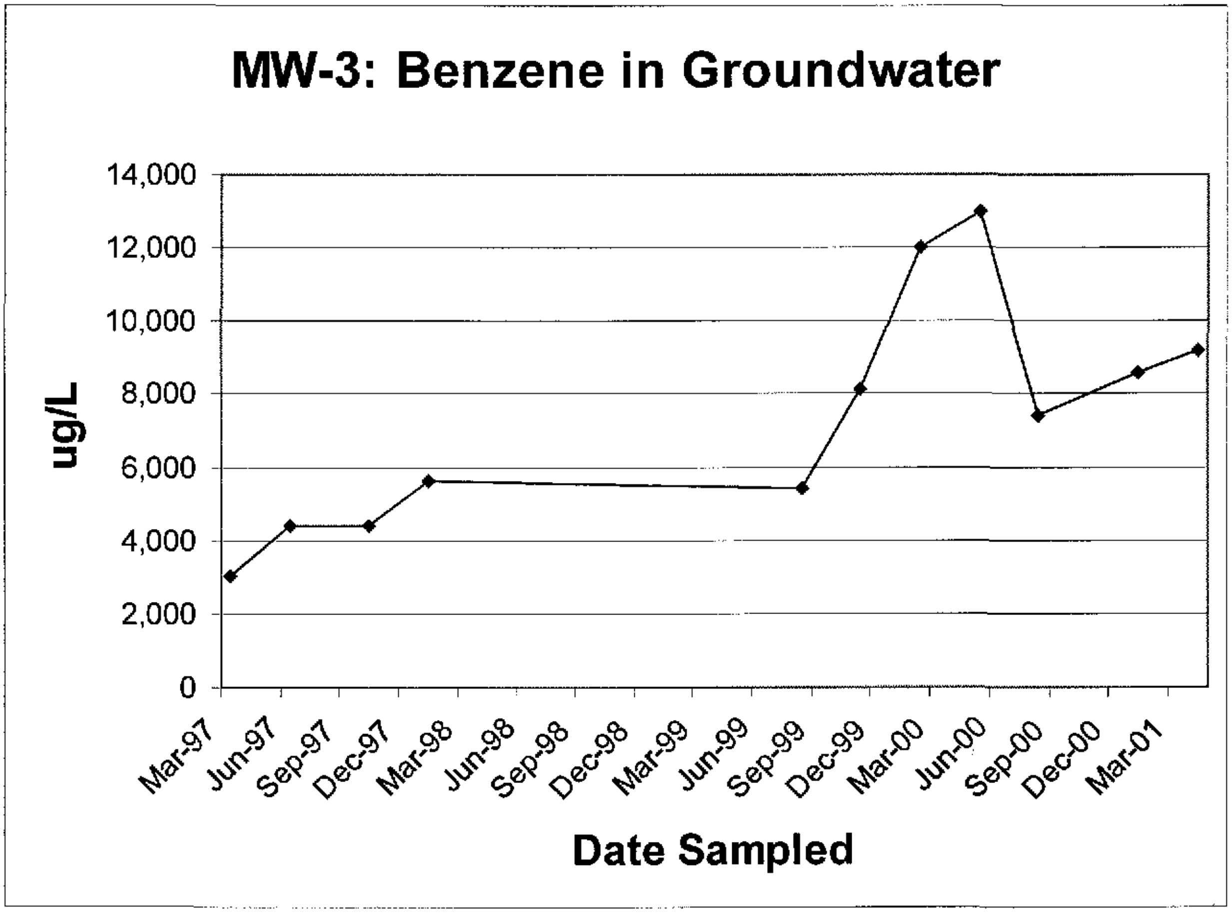
AEI CONSULTANTS	
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA	
1075 40TH STREET OAKLAND, CALIFORNIA	Figure 2.0-1. Benzene Concentrations in Groundwater from MW-3



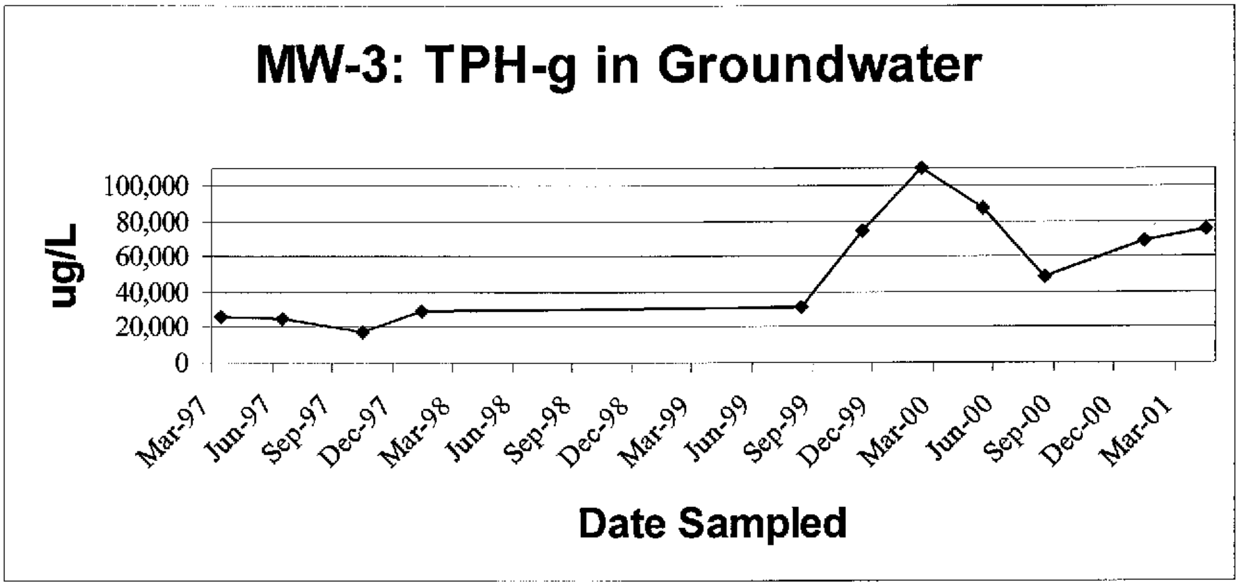
AEI CONSULTANTS	
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA	
1075 40TH STREET OAKLAND, CALIFORNIA	Figure 2.0-2. TPH-g in Groundwater from MW-3



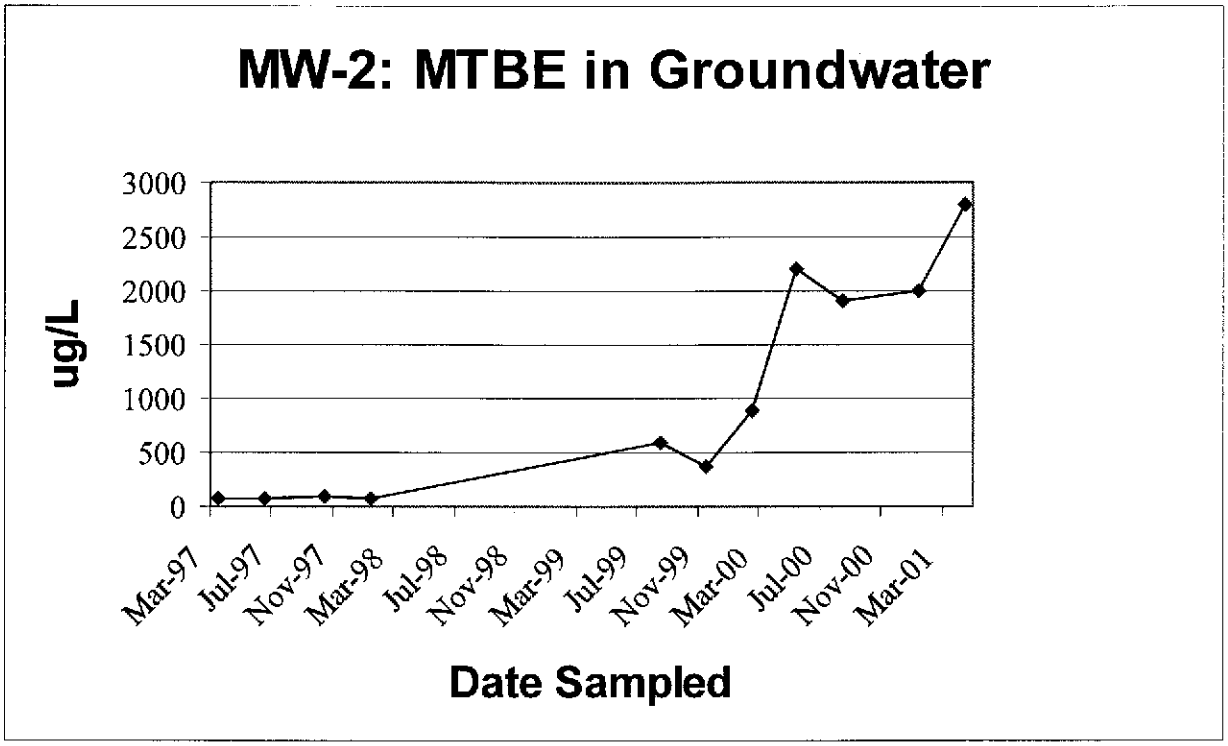
AEI CONSULTANTS	
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA	
1075 40TH STREET OAKLAND, CALIFORNIA	Figure 2.0-3. MTBE in Groundwater from MW-2



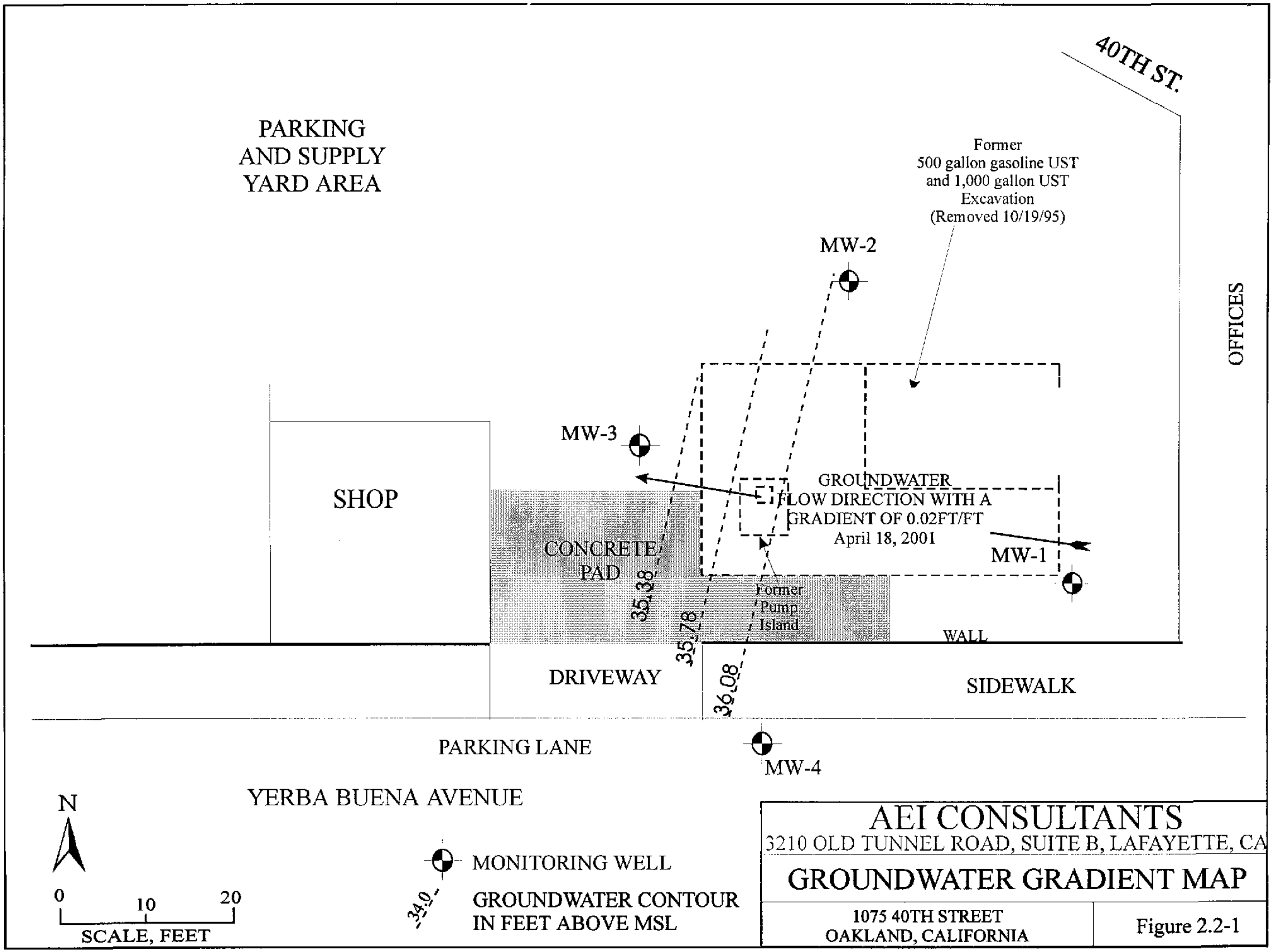
AEI CONSULTANTS	
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA	
1075 40TH STREET OAKLAND, CALIFORNIA	Figure 2.0-1. Benzene Concentrations in Groundwater from MW-3



AEI CONSULTANTS	
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA	
1075 40TH STREET OAKLAND, CALIFORNIA	Figure 2.0-2. TPH-g in Groundwater from MW-3



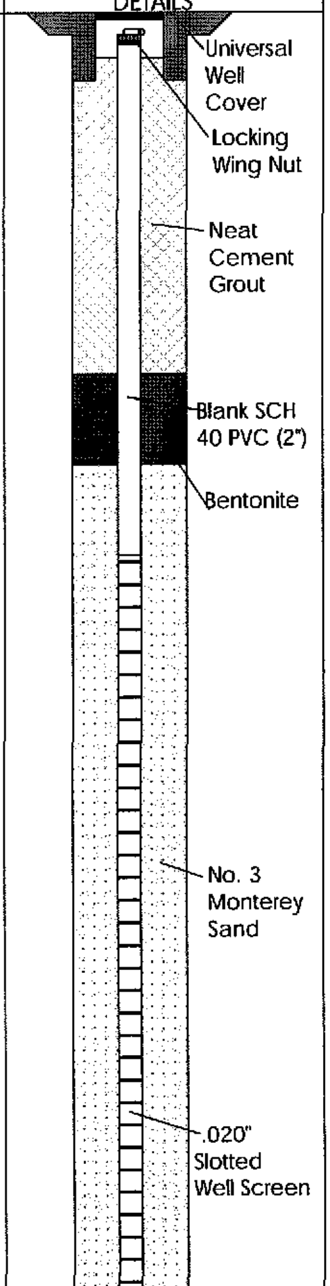
AEI CONSULTANTS	
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA	
1075 40TH STREET OAKLAND, CALIFORNIA	Figure 2.0-3. MTBE in Groundwater from MW-2


40TH ST.
PARKING
AND SUPPLY
YARD AREA
Former
500 gallon gasoline UST
and 1,000 gallon UST
Excavation
(Removed 10/19/95)
MW-2
OFFICES
MW-3
SHOP
GROUNDWATER
FLOW DIRECTION WITH A
GRADIENT OF 0.02FT/FT
April 18, 2001
MW-1
CONCRETE
PAD
35.38
35.78
36.08
Former
Pump
Island
WALL
DRIVEWAY
SIDEWALK
PARKING LANE
MW-4
YERBA BUENA AVENUE
N
0
10
20
SCALE, FEET
MONITORING WELL
34.0
GROUNDWATER CONTOUR
IN FEET ABOVE MSL
AEI CONSULTANTS
3210 OLD TUNNEL ROAD, SUITE B, LAFAYETTE, CA
GROUNDWATER GRADIENT MAP
1075 40TH STREET
OAKLAND, CALIFORNIA
Figure 2.2-1

PROJECT: Fidelity Roof Co. # 1540		LOG OF WELL NUMBER: MW-1	
BORING LOC.: REFER TO SITE PLAN		ELEVATION, TOC: 45.41'	
DRILLING CONTRACTOR: GREGG DRILLING		START DATE: 3/6/97	END DATE: 3/6/97
DRILLING METHOD: HOLLOW STEM AUGER		TOTAL DEPTH: 21'	SCREEN INT: 6'-21'
DRILLING EQUIPMENT: MOBILE B-53		DEPTH TO WATER: 9'	CASING: 2" PVC
SAMPLING METHOD: 2" DRIVE SAMPLER		LOGGED BY: BC	
HAMMER WEIGHT and FALL: 140 lb, 30"		RESPONSIBLE PROFESSIONAL: JPD	

DEPTH (feet)	SOIL SYMBOLS	DESCRIPTION	SAMPLES: SAMPLE NO.	INTERVAL	BLOW COUNTS
0	AB	0.0 - 0.6; Asphalt, 3" Aggregate Base.			
4				X	6
					12
5	CL	0.6 - 21.0: Sandy Gravelly Clay; dark greenish gray with low plasticity; gravel up to 1/8"; slight hydrocarbon odor; 30 ppm.	5'	X	18
9		▼		X	7
					14
10	CL	0.6 - 21.0: Sandy Clay (cont.): moderate yellowish brown with high plasticity; grayish olive mottling; strong hydrocarbon odor; 700 ppm.	10'	X	14
14				X	5

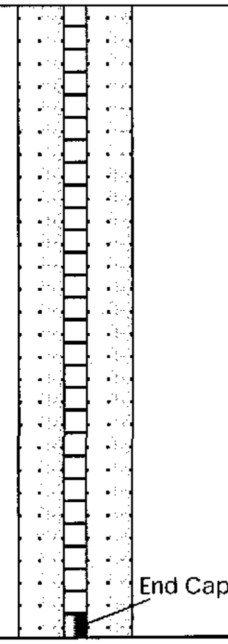
WELL CONSTRUCTION DETAILS



PROJECT: Fidelity Roof Co. #1540	LOG OF BOREHOLE: MW-1

DEPTH (feet)	SOIL SYMBOLS	DESCRIPTION	SAMPLE NO.	INTERVAL	BLOW COUNTS
					7
15	CL	0.6 - 21.0: Sandy Clay (cont.): moderate yellowish brown with low plasticity; grayish olive mottling; slight hydrocarbon odor; 30 ppm.	15'		8
16					
17					
18					
					20
19					25
20	CL	0.6 - 21.0: Sandy Gravelly Clay (cont.): moderate yellowish brown with high plasticity; grayish olive mottling; slight hydrocarbon odor; 0 ppm.	20'		40
21		Terminated at 21.0'			
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					

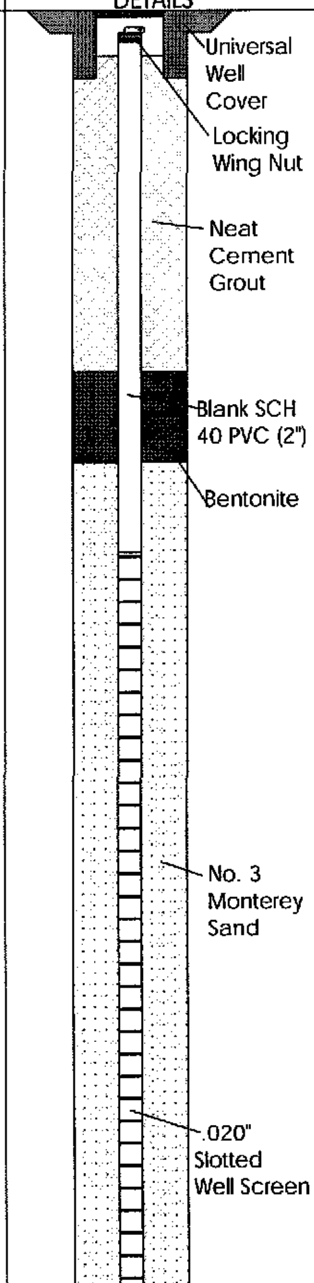
WELL CONSTRUCTION DETAILS



PROJECT: Fidelity Roof Co. # 1540	LOG OF WELL NUMBER: MW-2
BORING LOC.: REFER TO SITE PLAN	ELEVATION, TOC: 44.94'
DRILLING CONTRACTOR: GREGG DRILLING	START DATE: 3/6/97 · END DATE: 3/6/97
DRILLING METHOD: HOLLOW STEM AUGER	TOTAL DEPTH: 21' · SCREEN INT: 6'-21'
DRILLING EQUIPMENT: MOBILE B-53	DEPTH TO WATER: 9' · CASING: 2" PVC
SAMPLING METHOD: 2" DRIVE SAMPLER	LOGGED BY: BC
HAMMER WEIGHT and FALL: 140 lb, 30"	RESPONSIBLE PROFESSIONAL: JPD

DEPTH (feet)	SOIL SYMBOLS	DESCRIPTION	SAMPLE NO.	INTERVAL	BLOW COUNTS
0	AB	0.0 - 0.6; Asphalt, 3" Aggregate Base.			
4–5			5'	X	6, 8, 18
5	CL	0.6 - 21.0: Sandy Gravelly Clay; dark greenish gray with low plasticity; gravel up to 1/8"; slight hydrocarbon odor; 30 ppm.			
9		▼ (water level)			
8.5–10			10'	X	6, 10, 14
10	CL	0.6 - 21.0: Sandy Clay (cont.): moderate yellowish brown with low plasticity; grayish olive mottling; slight hydrocarbon odor; 40 ppm.			
13.5–14				X	6

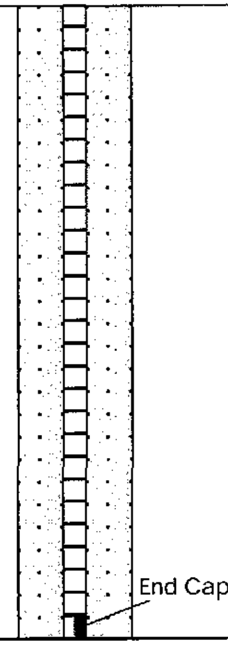
WELL CONSTRUCTION DETAILS



PROJECT:	Fidelity Roof Co. #1540	LOG OF BOREHOLE:	MW-2

DEPTH (feet)	SOIL SYMBOLS	DESCRIPTION	SAMPLES: SAMPLE NO.	SAMPLES: INTERVAL	SAMPLES: BLOW COUNTS
					12
15	CL	0.6 - 21.0: Sandy Clay (cont.): moderate yellowish brown with low plasticity; grayish olive mottling; slight hydrocarbon odor; 40 ppm.	15'		15
16					
17					
18					
19					10
					18
20	CL	0.6 - 21.0: Sandy Gravelly Clay (cont.): moderate yellowish brown with low plasticity; grayish olive mottling; slight hydrocarbon odor; 20 ppm.	20'		25
21		Terminated at 21.0'			
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					

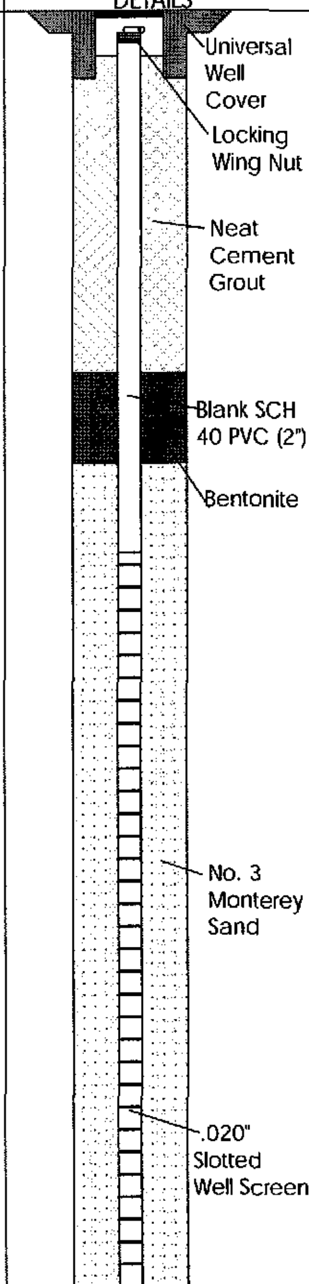
WELL CONSTRUCTION DETAILS



PROJECT: Fidelity Roof Co. # 1540		LOG OF WELL NUMBER: MW-3	
BORING LOC.: REFER TO SITE PLAN		ELEVATION, TOC: 44.32'	
DRILLING CONTRACTOR: GREGG DRILLING		START DATE: 3/6/97	END DATE: 3/6/97
DRILLING METHOD: HOLLOW STEM AUGER		TOTAL DEPTH: 21'	SCREEN INT: 6'-21'
DRILLING EQUIPMENT: MOBILE B-53		DEPTH TO WATER: 9'	CASING: 2" PVC
SAMPLING METHOD: 2" DRIVE SAMPLER		LOGGED BY: BC	
HAMMER WEIGHT and FALL: 140 lb, 30"		RESPONSIBLE PROFESSIONAL: JPD	

DEPTH (feet)	SOIL SYMBOLS	DESCRIPTION	SAMPLE NO.	INTERVAL	BLOW COUNTS
0	AB	0.0 - 0.6; Asphalt, 3" Aggregate Base.			
1					
2					
3					
4					6
					12
5	CL	0.6 - 21.0: Gravelly Clay; grayish brown with low plasticity; gravel up to 1/8"; slight hydrocarbon odor; 10 ppm.	5'		20
6					
7					
8					8
9					16
10	CL	0.6 - 21.0: Sandy Gravelly Clay (cont.): grayish brown with low plasticity; grayish olive mottling; strong hydrocarbon odor; >1,000 ppm.	10'		16
11					
12					
13					
14					6

WELL CONSTRUCTION DETAILS



PROJECT:	Fidelity Roof Co. #1540	LOG OF BOREHOLE:	MW-3

DEPTH (feet)	SOIL SYMBOLS	DESCRIPTION	SAMPLE NO.	INTERVAL	BLOW COUNTS	WELL CONSTRUCTION DETAILS
					8	
15	CL	0.6 - 21.0: Sandy Clay (cont.): moderate yellowish brown with low plasticity; grayish olive mottling; slight hydrocarbon odor; 84 ppm.	15'		10	
16						
17						
18						
					8	
19					15	
20	CL	0.6 - 21.0: Sandy Gravelly Clay (cont.): moderate yellowish brown with low plasticity; grayish olive mottling; slight hydrocarbon odor; 8 ppm.	20'		20	End Cap
21		Terminated at 21.0'				
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

Project No: 3119

Project Name: FIDELITY

Client: M. UPSHAW

Location: YERBA BUENA AVE.

Log of Borehole: MW-4

Depth	USCS Symbol	USCS Label	Subsurface Description	Sample Label	Type	Blow/ft	Recovery	Well Data	Remarks
0			Ground Surface						
0–1.6			**ASPHALT** Asphalt and gravel fill						
1.6–6		rocarb(	**CLAY** Clay with silt and minor sand, damp, moderately plastic	MW-4 5'	SS		100		
6–13.2		rocarb(	**SILT** Sandy silt with gravel up to 0.5 cm						
			Coarse gravel up to 2 cm	MW-4 10'	SS		100		
13.2–20		rocarb(	**SAND** Silty and clayey sand, with up to 50% coarse gravel up to 1.5 cm	MW-4 14'	SS		100		
		ed soil							
		r at 15		MW-4 16'	SS		45		
20									

Drill Date 7/15/99

Drill Method: HOLLOW AUGER

Total Depth: 20 ft.

Depth to Water: 15 ft.

Reviewed by: JPD

Logged by: PJM

AEI Consultants
3210 Old Tunnel Road, Suite B
Lafayette, CA 94549
(925) 283-6000