Letter Work Plan
Former Signal Service Station 0800
800 Center Street
Oakland, California

May 7, 1998
Project 320-162.1B

Mr. Phil Briggs
Chevron Products Company
P.O. Box 5004
San Ramon, California 94583

Re: **Letter Work Plan**
Former Signal Service Station 0800
800 Center Street at Eighth Street
Oakland, California

Dear Mr. Briggs:

This Letter Work Plan is prepared in response to the letter dated January 22, 1998, from Alameda County Health Care Services (ACHCS) to Chevron Products Company (Chevron) that provided comments on the report "Results of the Soil Vapor Investigation" dated July 15, 1997. The report documents a risk-based corrective action (RBCA) evaluation that showed site conditions pose no health risk to ~~future residential housing complex~~ (Appendix A). In the letter, ACHCS requests that Chevron remediate/remove residual hydrocarbons in the vicinity of the former underground storage tanks and pump island.

This Letter Work Plan, prepared by Pacific Environmental Group, Inc. (PEG) on behalf of Chevron, presents a scope of work to address residual subsurface hydrocarbon impact at the site referenced above. Extensive environmental work conducted by Chevron at the site has defined site conditions in accordance with all applicable law and regulations. The Work Plan presents remediation goals based upon a current Tier 2 RBCA evaluation of the site.

SITE BACKGROUND

The site is located at the northeast corner of the intersection of Eighth Street and Center Street in Oakland, California. The former station building and the former pump islands have been removed to grade at the site, however the building foundation and drive slab remain. Land use near the site is commercial and residential.

The site was utilized as a retail service station from 1932 to the early 1970s. Station facilities included four 1,000-gallon fuel underground storage tanks (USTs), a waste oil tank, a product island, and associated piping. The USTs were reportedly removed from the site during 1973.

Previous Investigations/Site Conditions

Previous investigations at the site have been conducted by Subsurface Consultants, Inc. (SCI), Groundwater Technology, Inc. (GTI), and PEG. In August 1989, SCI installed and sampled five soil borings ranging in depth from 4.5 to 26 feet below ground surface (bgs). Temporary groundwater monitoring wells were installed in two of the five borings. In October 1995, GTI drilled three additional soil borings to a depth of 12 feet bgs, and four groundwater monitoring wells to a depth of 15 feet bgs. In March 1996, PEG drilled nine geoprobe borings to depths ranging from 6 to 20 feet bgs, and subsequently installed three groundwater monitoring wells and advanced one soil boring on December 18, 1996. Five probe points were advanced in May 1997 and soil and vapor samples collected from select onsite areas.

A brief discussion of the findings of these investigations is summarized below:

- The lithology encountered during the site investigations has indicated that the site is underlain by soils consisting of sandy clay to sandy clayey silt.
- In August 1989, groundwater was encountered at depths of 11 to 13 feet bgs; in October 1995, groundwater was encountered at depths of 10 to 11 feet bgs; and in March 1996, groundwater was encountered at depths of approximately 6 feet bgs. Based on gauging data obtained from the groundwater monitoring wells, the groundwater flow direction at the site is toward the southwest at a gradient of 0.002 foot per foot.
- Analytical results of soils have indicated that petroleum hydrocarbon concentrations are present in the area adjacent to the former pump island and in the vicinity of the former USTs. Petroleum hydrocarbon concentrations in soils are generally highest at the 10 to 12-foot bgs interval. During the August 1989 soil and groundwater investigation, maximum total purgeable petroleum hydrocarbons calculated as gasoline (TPPH-g) concentrations in soils ranged from 950 parts per million (ppm) in Boring 3 to 31,000 ppm in Boring 2 (beneath the former USTs). Maximum benzene concentrations ranged from not detected in Boring 3 to 500 ppm in Boring 2. During the October 1995 investigation, maximum TPPH-g concentrations in soils ranged

from below detection limit in Wells MW-2, MW-3, MW-4, and SB-3, to 14,000 ppm in Well MW-1. Maximum benzene concentrations ranged from not detected in Wells MW-2, MW-4, and SB-3 to 120 ppm in Well MW-1. During the March 1996 investigation, maximum TPPH-g and benzene concentrations in soils ranged from not detected in Boring P-8 to 13,000 and 41 ppm, respectively, in Boring P-3.

- Analytical results from the October 1995 investigation indicated that dissolved TPPH-g concentrations in groundwater ranged from below the detection limit in Well MW-2 (in the southeastern corner of the site) to 170,000 parts per billion (ppb) in Well MW-1 (near the former UST). Benzene concentrations in the groundwater monitoring wells ranged from below detection limit in Well MW-2 to 19,000 ppb in Well MW-1. Groundwater analytical data from Borings P-1 through P-9 during the March 1996 investigation indicated that TPPH-g and benzene concentrations ranged from not detected in Boring P-9 to 800,000 and 13,000 ppb, respectively in Boring P-2.

- Wells MW-5 through MW-7 were installed by PEG in January 1997 to delineate the extent of gasoline impact to soil and groundwater in the vicinity of the site. Results of analyses of soil samples from the borings did not detect any gasoline hydrocarbons. Groundwater samples from the new wells showed no detectable dissolved gasoline constituents in any of the three wells.

- Five vapor points were set in May 1997 by PEG to collect additional information on hydrocarbon in the subsurface. Soil samples were collected from approximate depths of 3, 6, and 9 feet below grade. Soil samples from the three-foot interval showed less than 1.4 ppm TPHg. Samples from the six-foot interval ranged from <1.0 to 2,100 ppm THPg. Samples collected from saturated soil at nine feet below grade ranged from 3,200 to 10,000 ppm TPHg. Vapor sample were collected at various depths from the probe points.

Results of analyses of soil samples reported in previous investigations are summarized in Appendix B. Groundwater monitoring data are also summarized in Appendix B. Soil and groundwater data indicate that gasoline hydrocarbons are concentrated in the vicinity of the former UST cluster and dispenser island. Figure 1 shows the approximate extent of gasoline hydrocarbon in vadose zone soil at a depth of five feet below grade and dissolved TPHg concentrations in groundwater.

TIER 2 RBCA EVALUATION

A Tier 2 RBCA evaluation was conducted for the site to determine remediation goals for gasoline impacted soil and groundwater beneath the site. Only data collected from beneath the site was used to determine the representative concentration. Site specific parameters used for the evaluation and the evaluation results are included in Appendix C. Salient parameters used in the evaluation are outlined below.

- Groundwater: Groundwater conditions have been periodically monitored since 1995. The most recent event was conducted on January 28, 1998. Measured groundwater has fluctuated from as shallow as five feet below grade to as deep as 13 feet below grade. As soil at five feet below grade is periodically saturated the vadose zone is considered to include only soil above six feet. Data from onsite wells MW-1, MW-2, and MW-3 were used in the evaluation. Offsite well data were not used.

- Subsurface Soil: Various site investigations have been conducted at the site during which soil samples have been collected from the vadose and saturated zones. Data from soil samples collected at less than six feet below grade are used to characterize the vadose zone.

It is understood that site development, consisting of residential housing, is proposed for the subject site and two adjacent parcels which are owned by the City of Oakland. The exposure routes deemed possible at the site are groundwater and subsurface soil (>3 feet bgs) volatilization to inhalation to indoor air and outdoor air (and volatilization and dermal contact from any surface soils that may be impacted). Groundwater ingestion was not examined as a possible exposure route since Oakland does not receive its drinking water from groundwater. All exposure parameters during the Tier 2 evaluation were set for residential exposures with a target risk of 10^{-6} and a hazard quotient of 1. Benzene, toluene, ethylbenzene, and xylenes were used in the evaluation, but because benzene has the lowest risk level it is considered in the following discussion.

The summary of the soil and groundwater RBCA results are included in Tables 1 and 2. Table 1 shows subsurface vadose-zone soils (>3 ft below grade) are characterized by a representative concentration of 0.024 parts per million (ppm) benzene. This concentration is less than both SSTL values of 7.4 ppm for residential indoor air and 5.7E+3 for residential outdoor air. These data indicate that the existing soil conditions do not appear to pose a health risk. The summary evaluation for groundwater shows the site is characterized by a dissolved benzene level of 3.7 ppm. This site representative value exceeds the SSTL value of 0.91 ppm calculated for acceptable risk to residential indoor air. The site-specific representative dissolved benzene level needs to be reduced by a factor of approximately four for an acceptable risk level for future residential use of

the site. The representative value of 0.91 ppm benzene is considered the remediation goal for the site.

PROPOSED REMEDIAL ACTION

Salient site characteristics that affect site remediation are a relatively permeable saturated zone and residual sorbed gasoline hydrocarbon is present throughout the upper 10 feet of the saturated zone. Possible remediation technologies that may be applied to the site are pump and treat, dual vacuum extraction, excavation, and air sparging. Pump and treat is ruled out as an effective technology due to its extended time frame. Dual vacuum extraction cannot effectively deal with the expected volume of water. Excavation is not considered as a primary remediation technology as it cannot cost effectively be applied to the site without dewatering. Air sparging for enhanced biodegradation (biosparging) can be successfully applied as no water is generated and injection points can be set below 15 feet to address the "deeper" residual gasoline source in the saturated zone.

An air injection biosparge system is the select remediation technology for the site and the proposed system layout is shown in Figure 1. Ten injection points/wells at the approximate locations shown adequately cover the known extent of gasoline impact. We anticipate that six months of operation will be necessary to lower dissolved-benzene levels below the site-specific representative value of 0.9 ppm. The possibility exists that future used of the site may not be residential and a higher SSTL value may apply. The remediation goal will change if the future use of the site changes.

Air will be introduced into the vadose zone during biosparging operation. Air flow in the vadose zone will enhance biodegradation and reduce residual gasoline levels in the vadose zone. With the further reduction of gasoline hydrocarbon in vadose-zone soil by enhanced biodegradation, excavation of soil is not expected to be necessary. No closure borings are proposed because remediation activities are not necessary for vadose zone soil. Any localized "hot spots" encountered during intrusive work for site development will be removed for proper disposal.

Excavation and disposal will be used for the localized areas onsite with excessive concentrations of high boiling point hydrocarbons. These areas include the former sump and former hydraulic lift. Because these areas are localized, it is estimated that up to 15 cubic yards of soil will be removed from each location.

SCHEDULE

Upon approval of the work plan by Chevron and ACDHS, the necessary permits for well/point and electrical will be submitted within two weeks. We anticipate that the air injection system will require 40 days for installation and to be placed in operation. The air sparging system will operate for a period of six months at which time dissolved benzene levels are expected to be below the SSTL value of 0.91 ppm.

If you have any questions regarding the contents of this letter, please call.

Sincerely,
Pacific Environmental Group, Inc.

James A. Perkins
Project Geologist

TABLE 1
SUMMARY OF RBCA SUBSURFACE SOIL
FORMER SIGNAL STATION
OAKLAND, CALIFORNIA

RBCA SITE ASSESSMENT — Tier 2 Worksheet 9.2

Site Name: Former Signal Service Station 0800
Site Location: 800 Center Street, Oakland, California
Completed By: Pacific
##

SUBSURFACE SOIL SSTL VALUES (> 3 FT BGS)

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
■ PEL exposure limit?

Calculation Option: 1

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	X Soil Leaching to Groundwater			X Soil Volatilization to Indoor Air		X Soil Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/kg)	Residential (on-site)	Commercial (on-site)	Regulatory(MCL) (on-site)	Residential (on-site)	Commercial (on-site) (PEL)	Residential (on-site)	Commercial (PEL) (on-site)	(mg/kg)	"■" If yes	Only if "yes" left
71-43-2	Benzene	2.4E-2	1.7E-1	NA	NA	7.4E+0	NA	5.7E+3	NA	1.7E-1	☐	<1
100-41-4	Ethylbenzene	5.9E-2	5.1E+2	NA	NA	>Res	NA	>Res	NA	5.1E+2	☐	<1
108-88-3	Toluene	5.9E-2	1.5E+3	NA	NA	>Res	NA	>Res	NA	1.5E+3	☐	<1
1330-20-7	Xylene (mixed isomers)	1.2E-1	>Res	NA	NA	>Res	NA	>Res	NA	>Res	☐	<1

Software: GSI RBCA Spreadsheet Serial: G-309-OEX-828
Version: v 1.0

TABLE 2
SUMMARY RBCA DATA GROUNDWATER
FORMER SIGNAL STATION
OAKLAND, CALIFORNIA

RBCA SITE ASSESSMENT — Tier 2 Worksheet 9.3

Site Name: Former Signal Service Station 0800
Site Location: 800 Center Street, Oakland, California

Completed By: Pacific
##

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
■ PEL exposure limit?

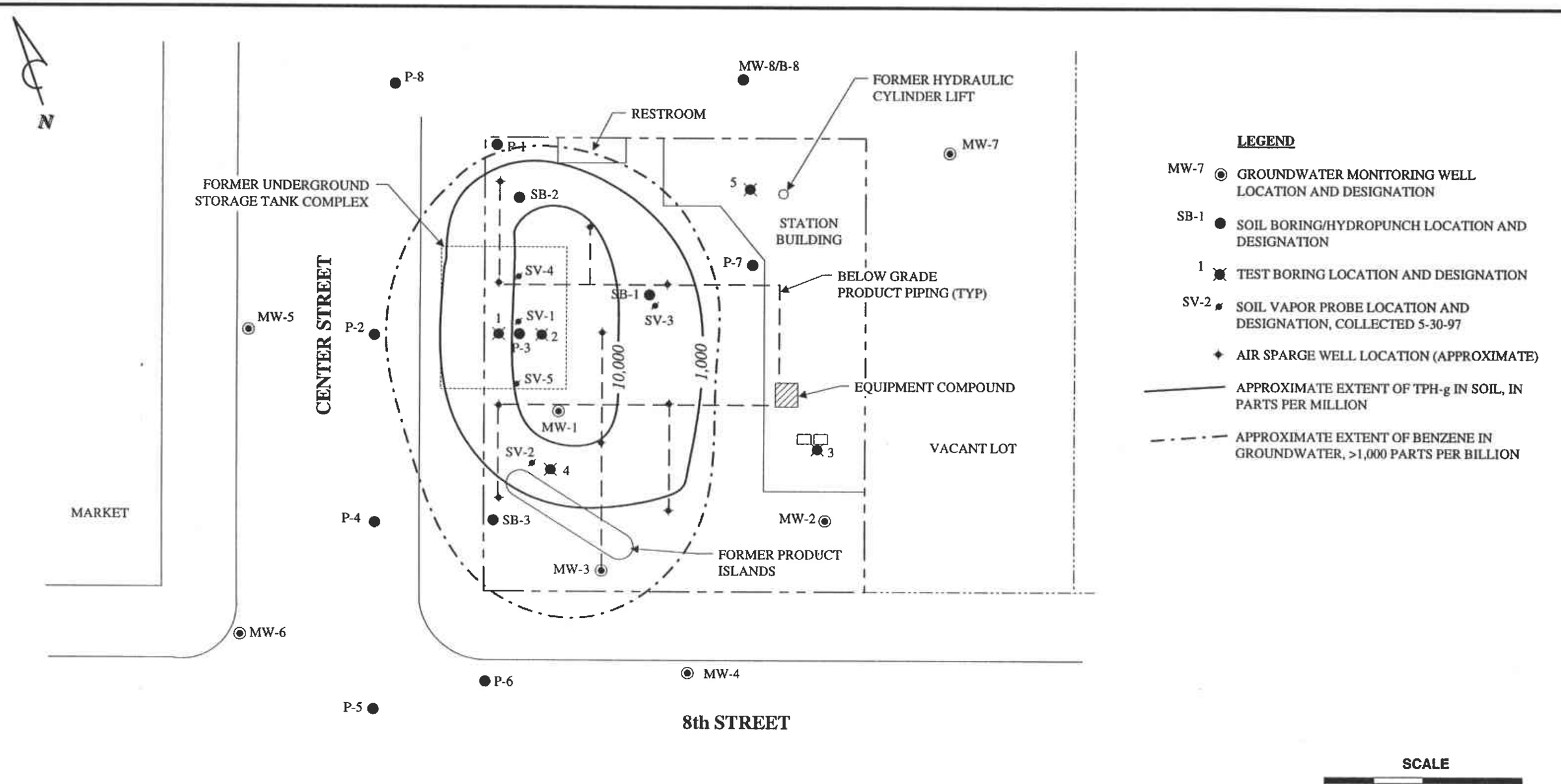
Calculation Option: 1

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration		Groundwater Ingestion			X	Groundwater Volatilization to Indoor Air		X	Groundwater Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)		Residential: (on-site)	Commercial: (on-site) (PEL)		Residential (on-site)	Commercial: (on-site) (PEL)	(mg/L	"■" if yes	Only if "yes" left
71-43-2	Benzene	3.7E+0	NA	NA	NA		9.1E-1	NA		7.1E+2	NA	9.1E-1	■	4.0E+00
100-41-4	Ethylbenzene	8.6E-1	NA	NA	NA		>Sol	NA		>Sol	NA	>Sol	☐	<1
108-88-3	Toluene	3.1E-1	NA	NA	NA		>Sol	NA		>Sol	NA	>Sol	☐	<1
1330-20-7	Xylene (mixed isomers)	2.5E-1	NA	NA	NA		>Sol	NA		>Sol	NA	>Sol	☐	<1

Software: GSI RBCA Spreadsheet
Version: v 1.0

Serial: G-309-OEX-828



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PACIFIC ENVIRONMENTAL GROUP, INC.

TITLE:

SITE MAP

PREPARED FOR:

FORMER SIGNAL SERVICE STATION S0800
800 Center Street at 8th Street
Oakland, California

DATE: 5/6/98	PROJECT: 320-162.1C	FIGURE: 1

APPENDIX A

DRAFT REPORT DATED JULY 15, 1997
RESULTS OF THE SOIL VAPOR INVESTIGATION
FORMER SIGNAL SERVICE STATION
800 CENTER STREET, OAKLAND, CALIFORNIA

PACIFIC
ENVIRONMENTAL
GROUP, INC.

DRAFT
July 15, 1997
Project 320-162.1C

Mr. Phil Briggs
Chevron Products Company
P.O. Box 5004
San Ramon, California 94583

Re: Results of the Soil Vapor Investigation
Former Signal Service Station #[illegible]
800 Center Street at Eighth Street
Oakland, California

Dear Mr. Briggs:

This letter, prepared by Pacific Environmental Group, Inc. (PACIFIC), on behalf of Chevron Products Company (Chevron), presents the results from the soil and soil vapor investigation at the site referenced above (Figure 1). This investigation was performed according to the *Work Plan* prepared by PACIFIC (April 30, 1997), which was approved by Ms. Jennifer Eberle of the Alameda County Health Care Services Agency (ACHCSA), with minor changes, in her letter to Chevron dated May 6, 1997. The changes included collecting soil analytical data as well as soil vapor data, moving Boring SV-1 to the location of former P-3, and adding two additional boring locations (SV-4 and SV-5). These changes were implemented.

SITE BACKGROUND

The site is located at the northeast corner of the intersection of Eighth Street and Center Street in Oakland, California. The former station building and the former pump islands remain at the site, however the site is currently unoccupied. Land use near the site is commercial and residential.

The site was utilized as a retail service station from 1932 to the early 1970s. Station facilities included four 1,000-gallon fuel underground storage tanks (USTs), a waste oil tank, a product island, and associated piping. The USTs were reportedly removed from

the site during 1973. A complete description of the site background is presented in the *Work Plan*.

SOIL VAPOR INVESTIGATION

Soil Borings

As specified in the *Work Plan*, it has been proposed that the site be redeveloped, along with two adjacent properties, into residential housing. In order to determine if the remaining concentrations of petroleum hydrocarbons in the soil and groundwater at the former Signal service station would pose a risk to human health and safety, soil and soil vapor samples were collected from the site using Geoprobe borings. The locations of the five borings, SV-1 through SV-5, are presented on Figure 2.

Soil and Soil Vapor Analyses

The soil vapor samples were analyzed by EPA Method TO-3 (aromatic volatile organics in air) for concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX compounds), and total petroleum hydrocarbons (TPH). Along with the vapor analyses, the soil was analyzed for site-specific physical parameters, such as porosity, pH, and moisture content, by EPA Method 584 and ASTM Method D-2974. For the soil BTEX and TPH calculated as gasoline (TPH-g) concentrations, the soil samples were analyzed by EPA Method 8015/8020. The certified analytical results and the chain-of-custody documentation are presented in Attachment A. The soil vapor and physical data were then used to calculate the risk posed by the remaining petroleum hydrocarbon vapors at the site to indoor air inhalation for a residential population of adults and children (1 to 16 years).

Possible Exposure Routes

As stated in the *Work Plan*, the exposure routes deemed possible at the site are:

1. inhalation from groundwater and soil volatilization to indoor and outdoor air
2. dermal contact from any exposed surficial soils that may be impacted.

These exposure routes may affect both the residents who will live on the property and the construction workers who will build the residential housing complex.

For the inhalation exposure pathway, the risk posed by indoor air inhalation is considered the limiting factor. Since the risk from indoor air inhalation is greater, the risk posed from outdoor air inhalation was not calculated in this risk assessment.

INHALATION RISK MODELING

The soil vapor and physical soil data were entered into several equations from the American Society for Testing and Materials' (ASTM) *Standard Guide for Risk-Based corrective Action Applied at Petroleum Release Sites (E 1739-95)* (RBCA). These ASTM equations were compiled by Tom Fojut, Pleas McNeel, and Tim Utterback of Weiss Associates and by Ravi Arulanantham and Stephen Morse of the Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) in order to more accurately model the risk posed to indoor air from the actual soil vapor concentrations in the surficial soil. This model was developed due to the overly conservative outcomes derived from ASTM's original models of risk posed by impacted soil and groundwater volatilizing into indoor air. These overly conservative outcomes were discussed in the *Work Plan*. Due to the extremely unreasonable cleanup-goals derived by these models during the Tier 1 and Tier 2 RBCAs previously performed for the site (RBCA Analysis, PACIFIC, April 1, 1997), the soil vapor samples described were collected to evaluate the actual risk posed by the remaining petroleum hydrocarbons at the site instead of relying upon a conservative model. The soil vapor measurements include both the volatilization from petroleum hydrocarbons remaining in soil and groundwater.

The new model developed by Weiss Associates and the RWQCB (presented as Attachment B) utilizes several equations already presented in ASTM's RBCA guidelines, however it removes some of the uncertainties associated with the former indoor air inhalation models. The new vapor model removes the idea of estimating a crack factor for the building's foundation; in the new model it is assumed that there is no foundation, only a dirt floor with direct flux from the soil. Therefore, the model incorporates actual physical and analytical data for more accurate outcomes, plus it is as conservative as the previous ASTM models.

The model allows the calculation of the actual risk posed by soil vapor samples from the site. Weiss Associates and the RWQCB also have back-calculated the highest acceptable levels of BTEX compounds (cleanup goals) for residential and commercial receptors based on ASTM's Tier 1 default parameters (also presented in Attachment B). The recommended maximum allowable concentrations or risk based screening levels (RBSL) of BTEX compounds in soil vapor at 3 feet bgs (no building slab assumed) for children aged 1 to 16 years are as follows:

- Benzene: 0.038 µg/L

- Toluene: 103 µg/L
- Ethylbenzene: 304 µg/L
- Xylenes: 2,230 µg/L

The RBSLs presented above are for children in a residential scenario since these are the lowest concentrations allowed among adults and children and are based on a target risk of 10^{-6} for benzene and a hazard quotient of 1 for the non-carcinogenic compounds. As will be shown below, none of the TEX compound soil vapor concentrations collected from 3 feet bgs were greater than these RBSLs. However, Boring SV-1 had a benzene concentration of 0.17 µg/L at a depth of 3 feet. This concentration is slightly above the RBSL of 0.038 µg/L for a target risk level of 10^{-6}.

SOIL VAPOR INVESTIGATION RESULTS

All soil data collected from the site during the investigation was gathered following the protocols set forth in the *Work Plan* and with the ACHCSA changes. The resulting soil vapor TPH-g and BTEX concentrations collected from 3, 6, and 9 feet bgs are presented in Table 1. The physical soil data is presented in Table 2 and the soil analytical data is presented in Table 3. The soil boring logs are presented as Attachment C. Figures 3 through 7 present a graphical representation of the soil vapor BTEX concentrations from each boring plus the amount of oxygen and carbon dioxide collected from Borings SV-1 and SV-2.

As seen on Table 1, the maximum 3 feet bgs soil vapor concentration of benzene was 0.17 micrograms per liter (µg/L) from Boring SV-1, which is located in the former UST complex. Borings SV-2 through SV-5 had no detectable benzene vapor concentrations at 3 feet bgs. The maximum 3 feet bgs soil vapor concentration of toluene was also collected from Boring SV-1, while the 3 feet bgs maximum soil vapor concentrations of ethylbenzene was from Boring SV-3 (1.5 µg/L), xylenes from Boring SV-3 (12 µg/L), and TPH from Boring SV-1 (360 µg/L). The overall maximum soil vapor concentrations of the BTEX compounds and TPH, including each depth, was distributed as follows:

- Maximum benzene: 65 µg/L from Boring SV-1 at 6 feet bgs
- Maximum toluene: 730 µg/L from Boring SV-1 at 9 feet bgs
- Maximum ethylbenzene: 340 µg/L from Boring SV-1 at 9 feet bgs
- Maximum xylenes: 1,400 µg/L from Boring SV-1 at 9 feet bgs
- Maximum TPH: 50,000 µg/L from Boring SV-1 at 6 feet bgs

As shown by the above data and Table 1, the highest soil vapor concentrations of BTEX compounds and TPH are located near the former UST complex.

The graphs presented on Figures 3 through 7 indicate the large degree of bioremediation and natural attenuation that occurs as the petroleum hydrocarbons volatilize upwards. All of the graphs indicate that at 3 feet bgs there are relatively insignificant concentrations of the compounds remaining. The fluctuations of oxygen and carbon dioxide also indicate that bioremediation is occurring at some of the sample locations, such as Boring SV-1 at 6 feet bgs. Bioremediation would be expected to cause a reduction in oxygen and an increase in carbon dioxide; this is seen very clearly in SV-1. On Figure 3, at 6 feet bgs the oxygen concentration dips to 18.97% from 20.97% at 3 feet, while the carbon dioxide concentration increases from 0.87% at 3 feet to 1% at 6 feet bgs. It is clear from the carbon dioxide and oxygen data, plus the soil vapor and soil analytical data, that the largest amount of bioremediation is occurring at approximately 6 feet bgs. Above this, the soil vapor concentrations are relatively minor while below 6 feet bgs the water content of the soil increases to a point where it appears that there is limited bioremediation.

SOIL VAPOR RISK ANALYSES

In order to determine the actual indoor air inhalation risk posed by the remaining petroleum hydrocarbons at the site, the maximum soil vapor concentration of each BTEX compound from 3 feet bgs was utilized in the above mentioned model. The risk to adults and children (ages 1 to 16 years) were calculated and the results are presented in Attachment B.

Model Parameters and Risk Levels

Since benzene is a carcinogen, the risk for indoor air inhalation from benzene was calculated using California's slope factor of 0.1 $(mg/kg\text{-}day)^{-1}$. This slope factor was used in the model to determine if the risk to human health and safety was greater than the target risk level of 10^{-6}. All other BTEX compounds were analyzed for their risk using a hazard quotient of 1. The exposure parameters for adults and children used within the model, such as exposure duration and inhalation rate, were based on ASTM's residential exposure parameters as set forth in the RBCA guidelines (Table X2.4) and by Groundwater Service's Inc. (GSI's) *RBCA Tool Kit*. The building parameters, such as the indoor air exchange rate and indoor volume/infiltration area ratio were also based on ASTM's RBCA guidelines (Table X2.6), as were all of the chemical-specific data, such as the diffusion coefficient for each BTEX compound in air and water (Table X2.7).

Physical Soil Data

The site-specific physical data used in the models are presented on Table 2. The physical soil data used in the model were calculated by averaging the data from Borings SV-1 (2.5 feet bgs) and SV-3 (3.5 feet bgs). Since the model determined the risk posed by vapors at 3 feet bgs, only physical soil data collected near 3 feet bgs were used in the model. The overall average and the vadose zone averages (one at 3.5 feet bgs, the other at 6 feet bgs) are presented in Table 2. The vadose zone average of 6 feet was not utilized in the models since the water content of the physical soil samples increased dramatically with depth and would have produced a less conservative risk analysis if used in the model.

Model Results

The results of the soil vapor flux to indoor air inhalation model determined that the maximum soil vapor BTEX concentrations from the 3 feet bgs depth did not pose a risk above 10^{-5} for benzene, nor did it pose a risk above a hazard quotient of 1 for the TEX compounds.

	Benzene	Toluene	Ethylbenzene	Xylenes
Adult Risk	6.53^{-6}	2.19^{-2}	3.79^{-3}	4.16^{-3}
Child Risk	3.05^{-5}	2.98^{-2}	7.57^{-3}	8.32^{-3}

When the hazard quotients for the non-carcinogenic compounds are added together, the total is 1.99^{-2} for adults and 3.99^{-2} for children. Thus the model outcomes are within the acceptable target risk levels of 10^{-6} and 10^{-5} for benzene, according to the May 6, 1997 ACHCSA's letter, and below the hazard quotient of 1 for the non-carcinogens even when the individual hazard quotients are added together. Therefore, the site is suitable for redevelopment as a residential housing complex.

Uncertainty

It is important to note that a slab on grade building would be suitable for the site as shown by the above risk data, however if another type of building (i.e., with a crawlspace or deep foundation) were to be built, remedial action may be required. Possible remedial action may include the removal of soil in the former UST complex where the largest concentrations of petroleum hydrocarbon vapors were observed.

DERMAL EXPOSURE ROUTE

Per the *Work Plan*, the exposed surficial soil (following development) at the site will be excavated to a depth of 3 feet bgs in order to minimize dermal contact. The risk to a residential population by any petroleum hydrocarbon impacted surficial soils that may be exposed (i.e., landscaped areas) will be minimized by being excavated and replaced with clean fill.

CONSTRUCTION WORKER RISK

Using the physical soil data collected from the site, a Tier 2 RBCA analysis was performed using GSI's *RBCA Tool Kit* to determine the allowable BTEX compound concentrations in surficial soil considering inhalation of dust and particles and dermal contact as the routes of exposure. Again the vadose zone averages (from 3.5 feet) of porosity and moisture content were used in the calculations. The results of the models indicated that 320 milligrams per kilogram (mg/kg) benzene was the maximum allowable concentration for surficial soil exposures at a target risk of 10^{-5}, and for the remaining BTEX compounds, the selected risk level (hazard quotient = 1) is not exceeded for the pure compound present at any concentration. The highest benzene concentration found during this investigation was 36 mg/kg in boring SV-4 at 9 feet bgs. Therefore, based on the soil analytical data collected during this investigation, no benzene concentrations are above the maximum allowed (320 mg/kg) at the site. Thus the surficial and subsurface soil at the site do not pose a risk to construction workers.

All other concerns regarding the remaining petroleum hydrocarbons at the site, and construction worker safety, will be addressed in a detailed site health and safety plan. Waiting for more details regarding the actual building techniques will allow a more thorough and complete assessment of any risks posed to the construction workers during the building of the residential housing complex.

CONCLUSIONS

Based on the soil vapor data, the site poses no indoor air inhalation risk to adults or children who may live at the site in the proposed residential housing complex at the specified risk levels of 10^{-5} and 10^{-6} and with a hazard quotient of 1. The Tier 2 RBCA modeling and the soil analytical data also indicate that the site does not pose a risk to construction workers.

Once there is a definitive layout for the proposed housing complex it would be beneficial to examine what the use of the former UST complex will be and evaluate if limited excavation in that area may be advantageous. For instance, if the proposed housing plan

has the former UST area in use as a parking area, then there would be no advantage to excavate since the soil would be covered. However, if that area is to be overlaid with a residence it may be beneficial to remove the surficial soil in the former UST area in order to reduce any inhalation risk below 10^{-6}.

If you have any questions regarding this letter, please call.

Sincerely,

Pacific Environmental Group, Inc.

Michelle S. Gracia
Senior Staff Scientist

Ross Tinline
Project Geologist
RG 5860

Attachments:
Table 1 - Soil Vapor Data
Table 2 - Physical Soil Data
Table 3 - Analytical Soil Data
Figure 1 - Site Location Map
Figure 2 - Site Map with Boring Locations
Figure 3 - SV-1 Soil Vapor Data
Figure 4 - SV-2 Soil Vapor Data
Figure 5 - SV-3 Soil Vapor Data
Figure 6 - SV-4 Soil Vapor Data
Figure 7 - SV-5 Soil Vapor Data
Attachment A - Certified Analytical Reports and Chain-of-Custody Documentation
Attachment B - Soil Vapor Model and RBSL Tables
Attachment C - Soil Boring Logs
Attachment D - Soil Vapor Model Results

Table 1
Soil Vapor Data

Former Signal Service Station 0800
800 Center Street at Eighth Street
Oakland, California

Sample ID	Sample Date	Sample Depth	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	TPH-g (µg/L)	O_2 %	CO_2 %
SV-1	5/30/97	3	0.17	1.6	0.75	5.3	360	20.97	0.87
		6	65	320	84	430	50,000	18.97	1.00
		9	32	730	340	1,400	24,000	20.97	0.07
SV-2	5/30/97	3	ND	0.11	0.11	0.53	11	15.97	6.00
		6	22	100	19	66	27,000	18.97	2.20
		9	NT	NT	NT	NT	NT	20.97	0.16
SV-3	5/30/97	3	ND	0.54	1.5	12	180	NT	NT
		6	ND	0.42	0.84	5.7	83	NT	NT
		8	6.5	54	30	44	5,400	NT	NT
SV-4	5/30/97	3	ND	0.034	0.17	0.48	71	NT	NT
		6	ND	0.08	0.46	1.4	270	NT	NT
		9	17	150	36	160	5,400	NT	NT
SV-5	5/30/97	3	ND	0.015	0.009	0.071	8	NT	NT
		6	0.84	6.1	0.79	3.3	660	NT	NT
		9	11	84	24	110	1,100	NT	NT

µg/L = Micrograms per liter
TPH-g = Total petroleum hydrocarbons calculated as gasoline
O_2 = Oxygen
CO_2 = Carbon dioxide

Table 2
Physical Soil Data

Former Signal Service Station 0800
800 Center Street at Eighth Street
Oakland, California

Sample ID	Sample Date	Sample Depth feet	Total Porosity %	Air Content %	Water Content %	Saturation %	pH	Foc %	Soil Density g/cc
SV-1	5/30/97	2.5	44.75	36	8.8	19.67	6.31	NT	0.068
		6	39.52	4.3	35.21	89.1	NT	NT	0.275
		8.5	NT	NT	NT	NT	NT	0.12	NT
		9.5	33.6	0.15	33.6	99.57	6.8	NT	0.26
SV-2	5/30/97	3	NT	NT	NT	NT	7.53	NT	NT
		3.5	NT	NT	NT	NT	NT	0.083	NT
		9	NT	NT	NT	NT	NT	0.067	NT
		10	34.02	0.95	33.1	97.21	7.03	NT	0.257
SV-3	5/30/97	3.5	46	30	16	35.01	7.68	NT	0.126
Overall Averages =			39.65	14.3	25.34	68.11	7.07	0.09	0.197
Vadose Zone Average (to 3.5 feet) =			45.57*	33*	12.4*	27.34	6.99*	NT	0.097*
Vadose Zone Average (to 6 feet) =			43.4	23.4	20	47.9	6.99	NT	0.156

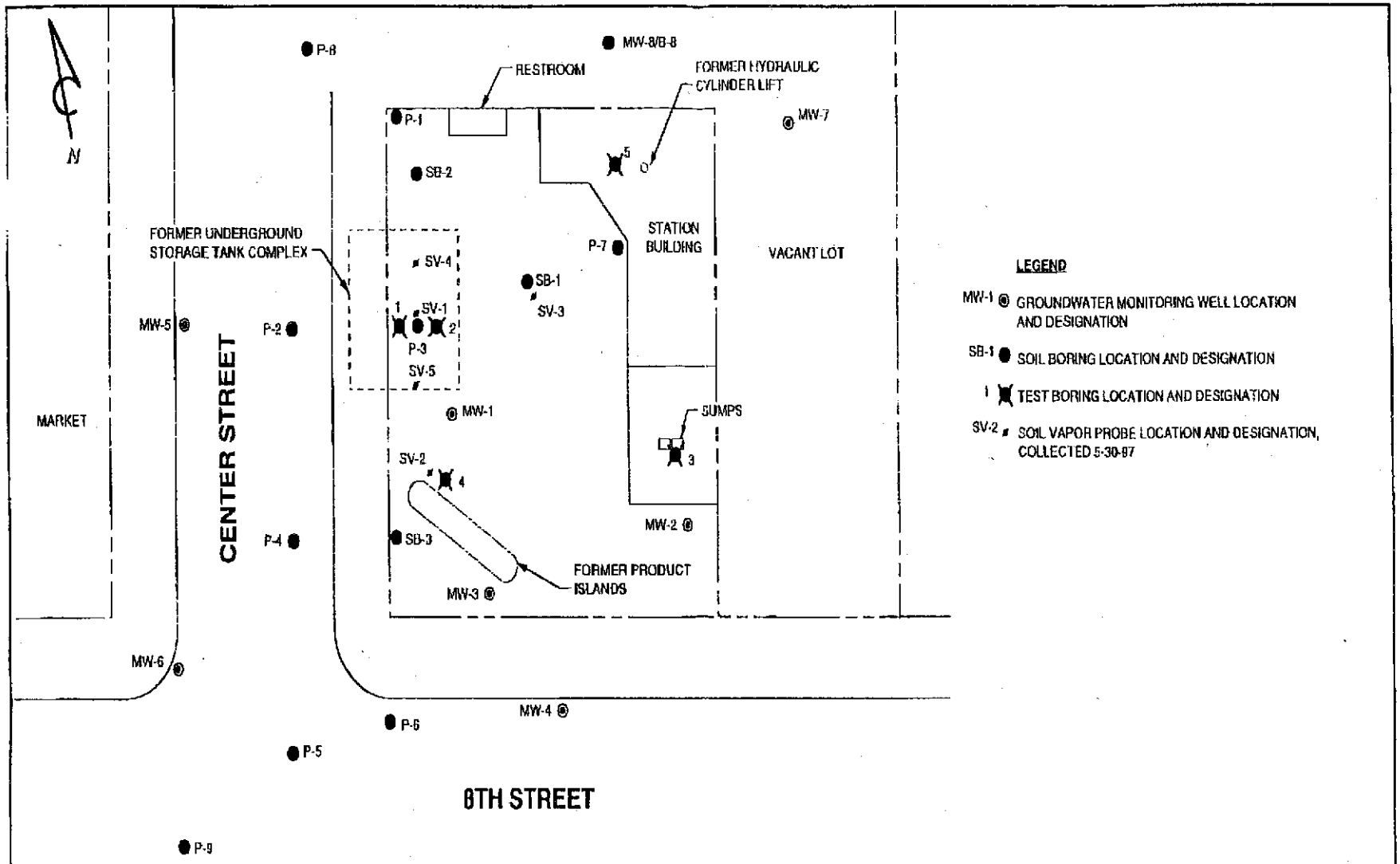
NT = Not tested
Soil Density = Dry density x moisture %
g/cc = grams per cubic centimeter
* = These values were used to calculate the soil vapor model risk and the construction worker RBSL
Foc = Fraction of organic carbon

Table 3
Analytical Soil Data

Former Signal Service Station 0800
800 Center Street at Eighth Street
Oakland, California

Soil Sample ID	Sample Date	Sample Depth	TPHg (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
SV-1	5/30/97	3	<1.0	<0.005	<0.005	<0.005	<0.005
		6	2,100	<2.5	46	57	300
		8.5	7,600	52	380	140	720
SV-2	5/30/97	3.5	<1.0	<0.005	<0.005	<0.005	<0.005
		6	11	<0.005	0.009	0.01	0.057
		9	8,000	12	420	150	710
SV-3	5/30/97	3	1.4	<0.005	0.029	0.014	0.1
		6	84	0.13	0.28	1.4	1.9
		9	11,000	51	130	83	340
SV-4	5/30/97	3	<1.0	<0.005	0.0058	<0.005	0.01
		6	<1.0	<0.005	<0.005	<0.005	<0.005
		9	10,000	86	470	210	960
SV-5	5/30/97	3	<1.0	<0.005	<0.005	<0.005	<0.005
		6	<1.0	<0.005	<0.005	<0.005	<0.005
		9	7,900	20	410	130	690

mg/kg = Milligrams per kilograms
TPH-g = Total petroleum hydrocarbons calculated as gasoline



SOURCE: MAP BY GROUNDWATER TECHNOLOGY; DATED: 9-7-95

PACIFIC ENVIRONMENTAL GROUP, INC.

SCALE
0 20 40 FEET

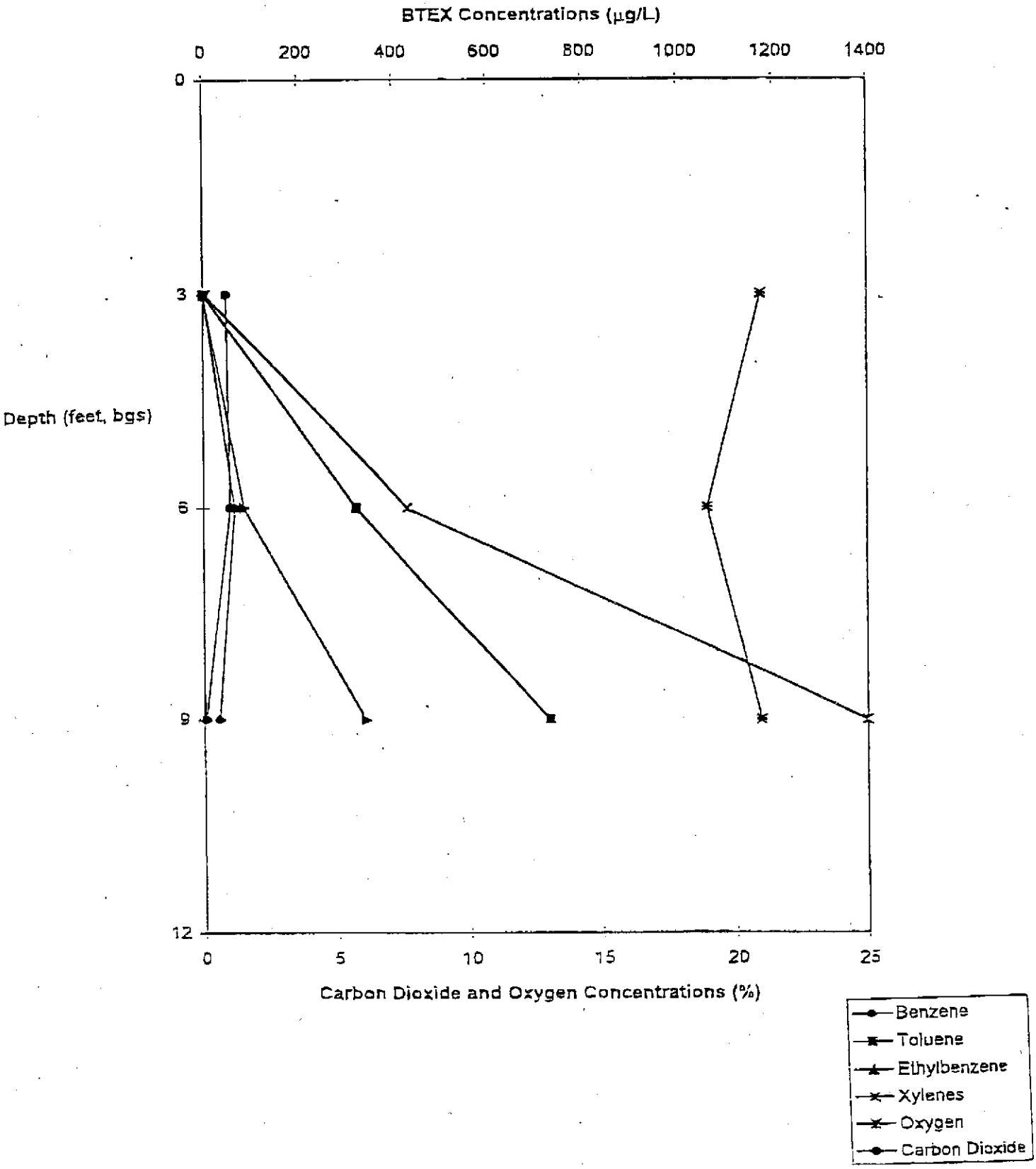
FORMER SIGNAL SERVICE STATION 50800
800 Center Street at 8th Street
Oakland, California

SITE MAP

FIGURE: 2

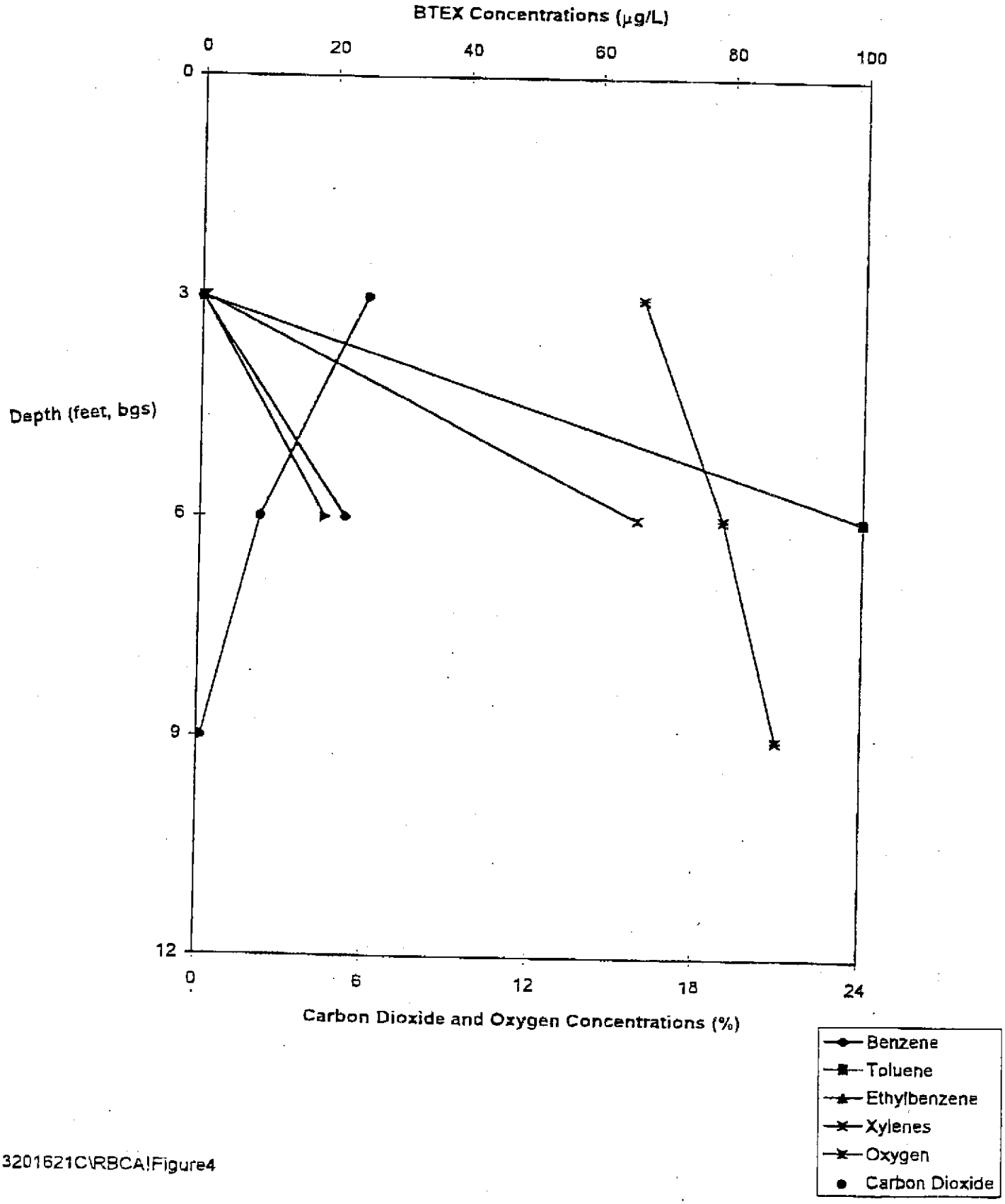
PROJECT: 320-162.1C

Figure 3: SV-1 Soil Vapor Data



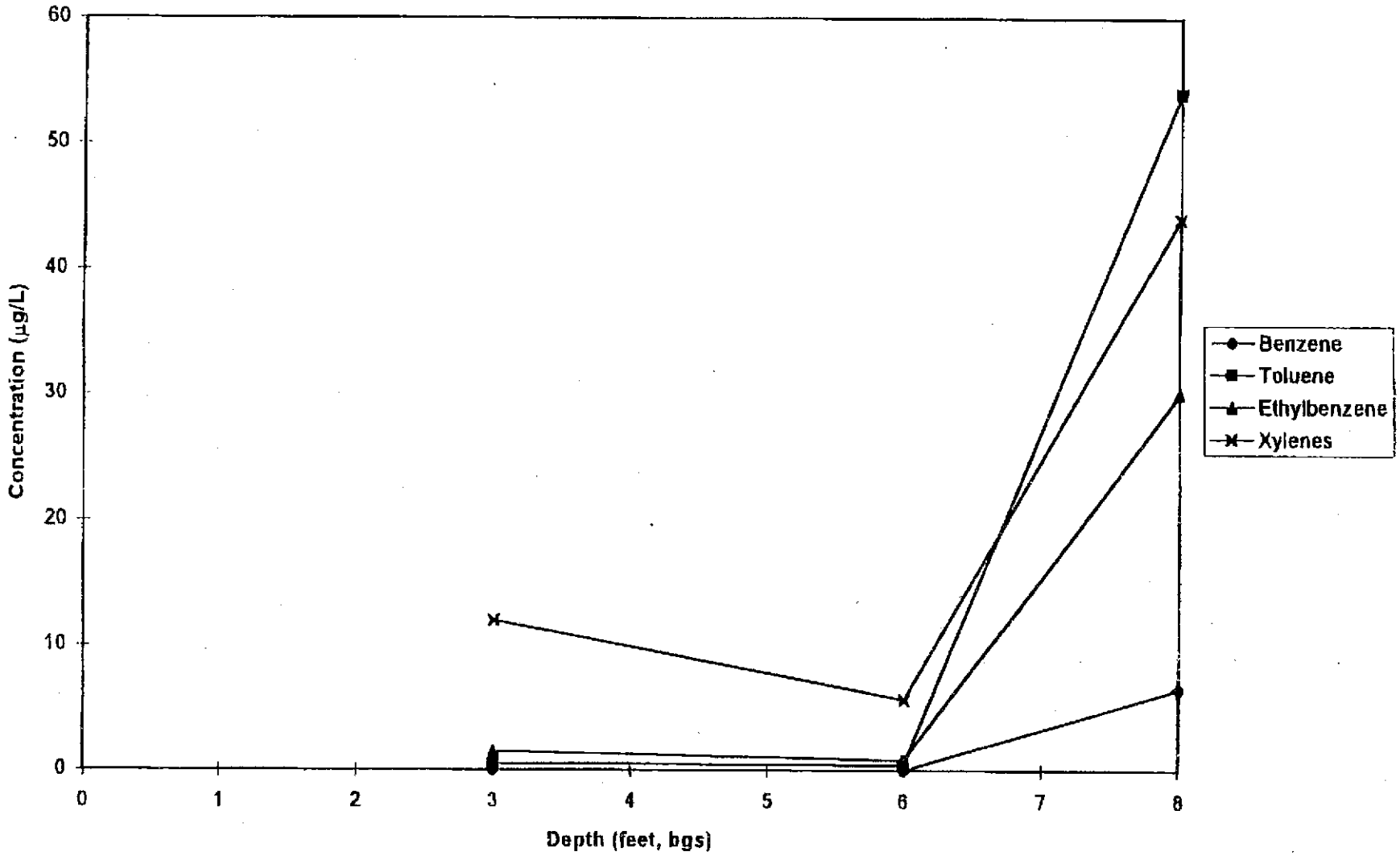
3201521C\RBCAXLS!Figure3

Figure 4: SV-2 Soil Vapor Data



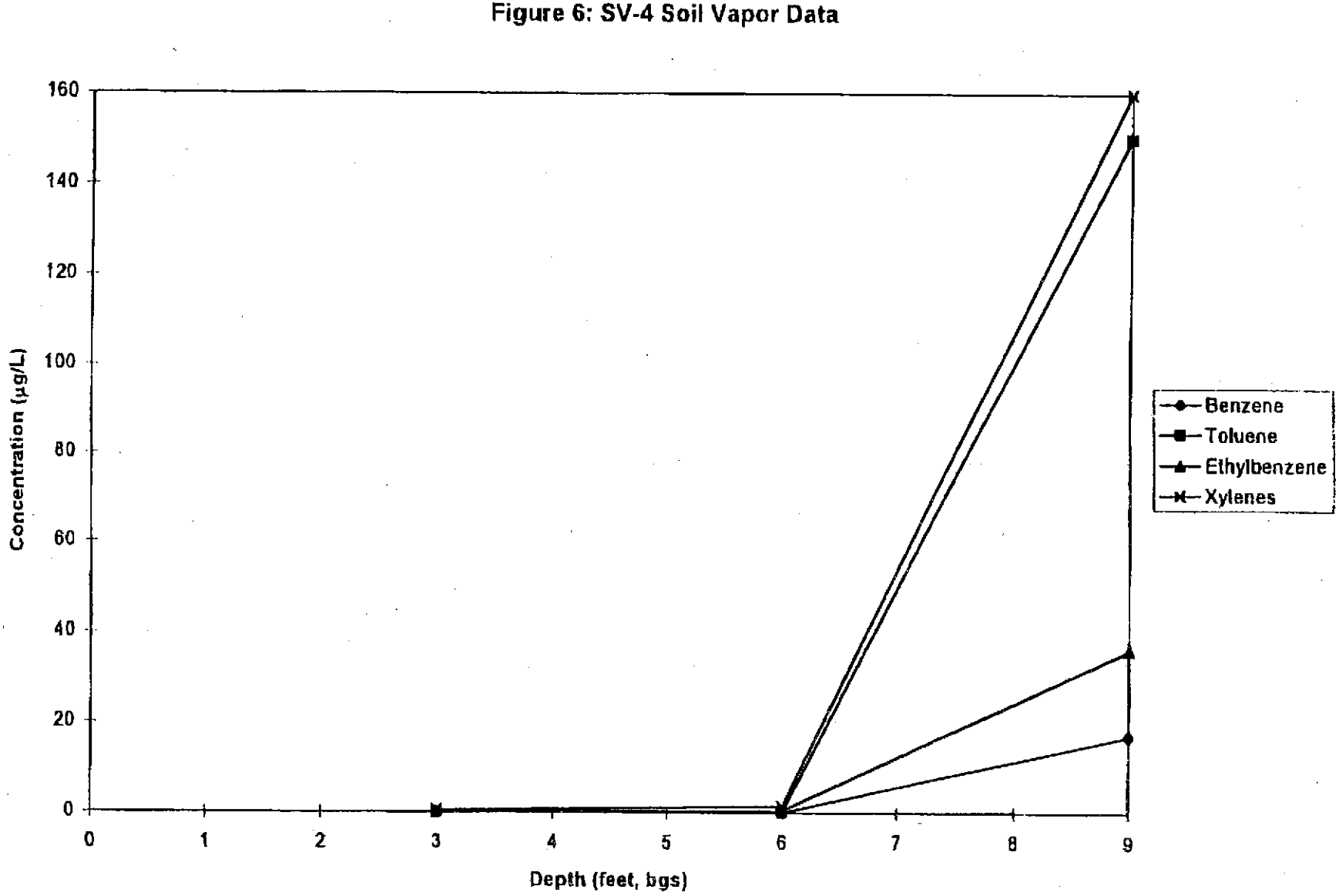
3201621C\RBCA!Figure4

Figure 5: SV-3 Soil Vapor Data



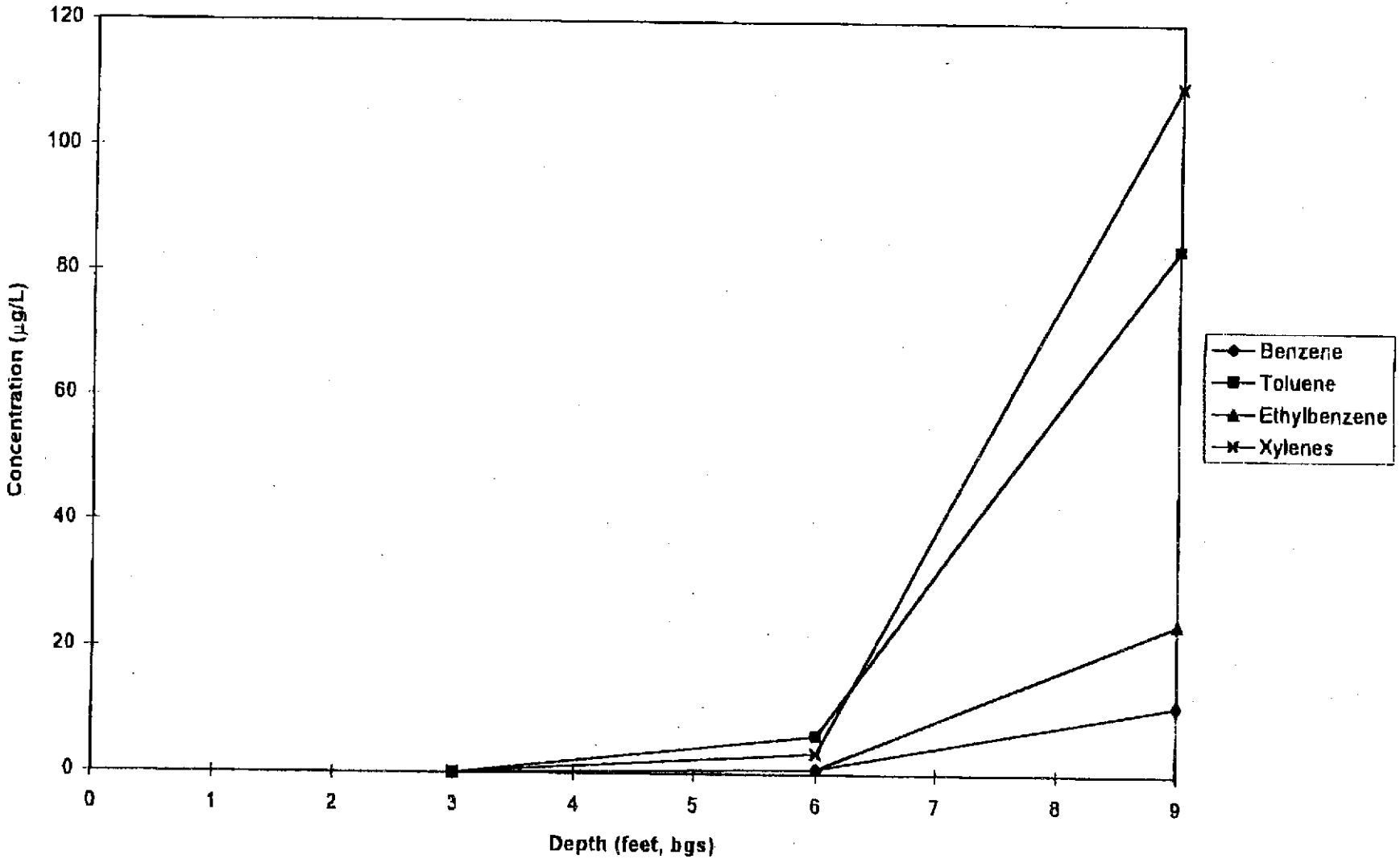
3201621C\RBCA\Figure5

Figure 6: SV-4 Soil Vapor Data



3201621C\RBCA\Figure6

Figure 7: SV-5 Soil Vapor Data



3201621C\RBCA\Figure7

ATTACHMENT B

SOIL VAPOR MODEL AND RBSL TABLES

Determination of Maximum Allowable Concentration of Benzene in Vapor at 3 Feet Below Ground Surface

Residential Receptor - Child Ages 1 Through 16 Years

		Soil Specific Parameters	
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.20	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_T	0.38	Porosity (v/v)
Recommended	d	91	Depth to location of vapor sample (cm) - 3 foot depth
		Diffusivity Parameters	
ASTM 95	H	0.22	Henry's Constant for Benzene
ASTM 95	D^{air}	8.30E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.007258	Effective Diffusion Coefficient soil (cm^2/s)
		Prediction of Flux From Benzene Concentration in Soil Vapor	
Iterative Calc	$C_{v,max}$	116	Maximum Allowable Benzene Concentration in Vapor (ppbv)
Unit Conv	$C_{v,max}$	0.38	Maximum Allowable Benzene Concentration in Vapor (ug/L)
Calculated	F_{max}	2.99E-08	Maximum Diffusive Vapor Flux Predicted by Benzene Concentration in Soil Vapor (ug/cm^2-sec)
		Indoor Air Concentration	
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	$ER_{air-Indoor}$	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{Indoor}	1.07E-06	Enclosed Space Air Concentration (ug/cm^3)
		Dose	
ASTM 95	$IR_{air-Indoor}$	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
USEPA 1985	ED	16	Child Exposure Duration (years)
Calculated	Dose	69.56591	Dose (mg)
		Risk	
CAL EPA	SF_I	0.1	California Cancer Slope Factor for Benzene (kg-day/mg)
USEPA 1985	BW	35	Child Body Weight (kg)
ASTM 95	AT_a	70	Averaging Time for Carcinogens (years)
Calculated	Risk	1.00E-05	Risk (positives/population)

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{Indoor} = \frac{F_{max}}{ER_{air-Indoor} \times L_b}$$

$$Dose = C_{Indoor} \times IR_{air-Indoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF_I}{BW \times AT}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and risk calculations from ASTM 95 guidance. Formulas presented above. Maximum allowable vapor concentration calculated by iteration to achieve acceptable risk level.

Prepared and Reviewed by:
Tim Ulterback, Tom Fojut, Pleas McNeel, Weiss Associates
Ravi Arulanantham, Stephen I. Morse, Regional Water Quality Control Board - San Francisco Bay Region

Residential Receptors (Children Ages 1 Through 16 Years) - Risk Based Screening Levels (RBSLs), Recommended Maximum Allowable Concentration of BTEX in Vapor at 3 Feet Below Ground Surface[a], No Building Slab Assumed (ie. dirt floor).

Units	Benzene[b]		Toluene[c]	Ethylbenzene[c]	Xylenes[c]
	10^{-5} Risk	10^{-6} Risk			
ppbv	116	11.6	27,000	69,000	505,000
µg/L	0.38	0.038	103	304	2,230
µg/m^3	380	38	103,000	304,000	2,230,000

Notes:

a = Calculated using equations and parameters from Tables X2.2, X2.3, X2.4, X2.5, X2.6 and X2.7 of American Society for Testing and Materials, 1995, Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

b = Concentrations for benzene are based on a carcinogenic risk of 1 in 100,000 (10^{-5}) and 1 in 1,000,000 (10^{-6}) using California's standard cancer slope factor of 0.1 kg-day/mg.

c = Concentrations for non-carcinogenic compounds are based on a chronic hazard quotient of 1.0.

Prepared by Tim Utterback, Tom Fojut & Pleas McNeel, Weiss Associates; Ravi Arulanantham & Stephen I. Morse, RWQCB-SFB

Commercial Receptors - Risk Based Screening Levels (RBSLs), Recommended Maximum Allowable Concentration of BTEX in Vapor at 3 Feet Below Ground Surface[a], No Building Slab Assumed (ie. dirt floor).

Units	Benzene[b]		Toluene[c]	Ethylbenzene[c]	Xylenes[c]
	10^{-5} Risk	10^{-6} Risk			
ppbv	384	38.4	140,000	358,000	2,604,000
µg/L	1.24	0.124	535	1,580	11,500
µg/m^3	1,240	124	535,000	1,580,000	11,500,000

Notes:

a = Calculated using equations and parameters from Tables X2.2, X2.3, X2.4, X2.5, X2.6 and X2.7 of American Society for Testing and Materials, 1995, Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

b = Concentrations for benzene are based on a carcinogenic risk of 1 in 100,000 (10^{-5}) and 1 in 1,000,000 (10^{-6}) using California's standard cancer slope factor of 0.1 kg-day/mg.

c = Concentrations for non-carcinogenic compounds are based on a chronic hazard quotient of 1.0.

Prepared by Tim Utterback, Tom Fojut & Pleas McNeel, Weiss Associates; Ravi Arulanantham & Stephen J. Morse, RWQCB-SFB

DRAFT

Determination of Maximum Allowable Concentration of Benzene in Vapor at 3 Feet Below Ground Surface

Commercial Receptor - Adult

		Soil Specific Parameters	
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.28	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_T	0.38	Porosity (v/v)
Recommended	d	91	Depth to (location of) vapor sample (cm) - 3 foot depth
		Diffusivity Parameters	
ASTM 95	H	0.22	Henry's Constant for Benzene
ASTM 95	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.007258	Effective Diffusion Coefficient soil (cm^2/s)
		Prediction of Flux From Benzene Concentration in Soil Vapor	
Iterative Calc	$C_{s,max}$	364	Maximum Allowable Benzene Concentration in Vapor (ppbv)
Unit Conv	$C_{s,max}$	1.24	Maximum Allowable Benzene Concentration in Vapor (ug/L)
Calculated	F_{max}	9.87E-08	Maximum Diffusive Vapor Flux Predicted by Benzene Concentration in Soil Vapor (ug/cm^2-sec)
		Indoor Air Concentration	
ASTM 95	Lb	300	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-Indoor	0.00023	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	1.43E-08	Enclosed Space Air Concentration (ug/cm^3)
		Dose	
ASTM 95	IR_{air}-Indoor	20	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	250	Exposure Frequency (days/year)
ASTM 95	ED	25	Exposure Duration (years)
Calculated	Dose	178.8558	Dose (mg)
		Risk	
CAL EPA	SF_I	0.1	Calfornia Cancer Slope Factor for Benzene (kg-day/mg)
ASTM 95	BW	70	Body Weight (kg)
ASTM 95	AT_c	70	Averaging Time for Carcinogens (years)
Calculated	Risk	1.00E-05	Risk (positives/population)

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{s,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF_I}{BW \times AT_c}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

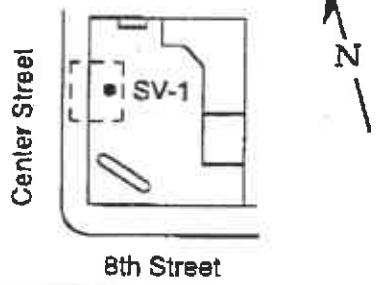
Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and risk calculations from ASTM 95 guidance. Formulas presented above. Maximum allowable vapor concentration calculated by iteration to achieve acceptable risk level.

Prepared and Reviewed by:
Tim Ulterback, Tom Fojut, Pleas McNeil, Weiss Associates
Ravi Arulanantham, Stephen I. Morse, Regional Water Quality Control Board - San Francisco Bay Region

ATTACHMENT C

SOIL BORING LOGS

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

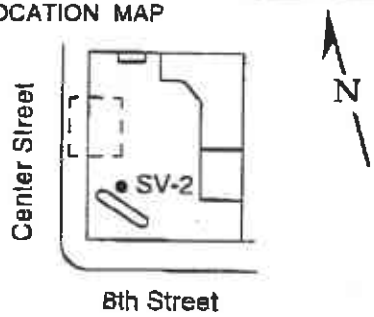
BORING NO. SV-1
PAGE 1 OF 1

PROJECT NO. 320-162.1C
LOGGED BY: T.F.B.
DRILLER: VIRONEX
DRILLING METHOD: GEOPROBE
SAMPLING METHOD: GEOPROBE
CASING TYPE: NA
SLOT SIZE: NA
SAND PACK: NA

CLIENT: CHEVRON
DATE DRILLED: 5-30-97
LOCATION: 800 Center Street
HOLE DIAMETER: 2"
HOLE DEPTH: 12'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	FID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Backfilled With Grout				1–7			SM	ASPHALT; TANK BACKFILL SILTY SAND: dark brown; 35% fines; 65% fine sand; faint product odor.
	Dry	20						
	Mst	high		8			CL	SANDY CLAY: dark brown;70% fines; 30% fine sand; strong product odor.
				9–11			SM	SILTY SAND: dark brown; 30% fines; 70% fine sand; strong product odor.
	Wt	high		12				@12': dark brown.
				13–22				BOTTOM OF BORING AT 12'

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

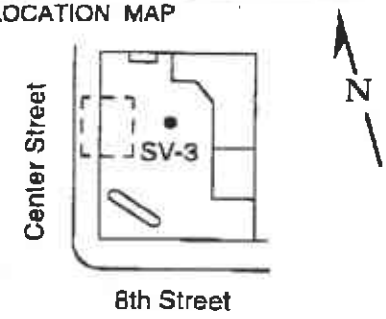
BORING NO. SV-2
PAGE 1 OF 1

PROJECT NO. 320-162.1C
LOGGED BY: T.F.B.
DRILLER: VIRONEX
DRILLING METHOD: GEOPROBE
SAMPLING METHOD: GEOPROBE
CASING TYPE: NA
SLOT SIZE: NA
SAND PACK: NA

CLIENT: CHEVRON
DATE DRILLED: 5-30-97
LOCATION: 800 Center Street
HOLE DIAMETER: 2"
HOLE DEPTH: 10.5'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	FID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Backfilled With Grout	Dry	50		1–10			ML	ASPHALT SANDY SILT: dark brown; 65% fines; 35% fine sand; faint product odor.
	Mst							@6': as above; gray mottling; moderate product odor.
	Wt							@9': as above; some gray and yellow mottling; strong product odor.
				11–22				BOTTOM OF BORING AT 10.5'

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

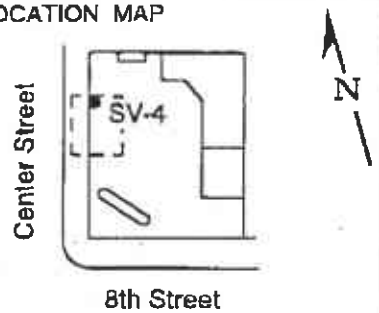
BORING NO. SV-3
PAGE 1 OF 1

PROJECT NO. 320-162.1C
LOGGED BY: T.F.B.
DRILLER: VIRONEX
DRILLING METHOD: GEOPROBE
SAMPLING METHOD: GEOPROBE
CASING TYPE: NA
SLOT SIZE: NA
SAND PACK: NA

CLIENT: CHEVRON
DATE DRILLED: 5-30-97
LOCATION: 800 Center Street
HOLE DIAMETER: 2"
HOLE DEPTH: 10'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	FID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Backfilled With Grout	Dry	10		1–10			SM	ASPHALT SILTY SAND: dark brown; 35% fines; 65% fine sand; faint product odor.
	Wt			6				@6': as above; dark brown; 40% fines; 60% fine sand.
	Wt			9				@9': as above; dark brown; 45% fines; 55% fine sand; strong product odor.
				10–22				BOTTOM OF BORING AT 10'

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

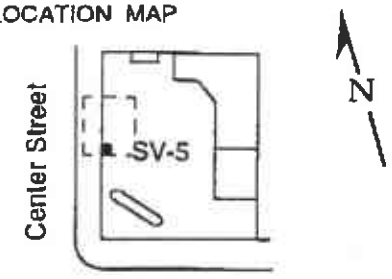
BORING NO. SV-4
PAGE 1 OF 1

PROJECT NO. 320-162.1C
LOGGED BY: T.F.B.
DRILLER: VIRONEX
DRILLING METHOD: GEOPROBE
SAMPLING METHOD: GEOPROBE
CASING TYPE: NA
SLOT SIZE: NA
SAND PACK: NA

CLIENT: CHEVRON
DATE DRILLED: 5-30-97
LOCATION: 800 Center Street
HOLE DIAMETER: 2"
HOLE DEPTH: 9.5'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	FID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Backfilled With Grout				1–22			SM	ASPHALT; TANK BACKFILL SILTY SAND: dark brown; 30% fines; 70% fine sand; faint product odor.
	Dry	30		3				
	Mst	High		6				@6': as above; dark brown; 30% fines; 70% fine sand; moderate product odor.
	Wt	High		9				@9': as above; 35% fines; 65% fine sand; strong product odor.
								BOTTOM OF BORING AT 9.5'

LOCATION MAP



PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. SV-5
PAGE 1 OF 1

PROJECT NO. 320-162.1C
LOGGED BY: T.F.B.
DRILLER: VIRONEX
DRILLING METHOD: GEOPROBE
SAMPLING METHOD: GEOPROBE
CASING TYPE: NA
SLOT SIZE: NA
SAND PACK: NA

CLIENT: CHEVRON
DATE DRILLED: 5-30-97
LOCATION: 800 Center Street
HOLE DIAMETER: 2"
HOLE DEPTH: 9.5'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	FID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY / SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Backfilled With Grout				1			ML	ASPHALT SANDY SILT: dark brown; 65% fines; 35% fine sand; slight product odor.
	Dp	40		3				
	Wt	High		6				@6': as above; 70% fines; 30% fine sand; strong product odor.
	Wt	High		9				@9': as above; strong product odor.
				10				BOTTOM OF BORING AT 9.5'
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

ATTACHMENT D

SOIL VAPOR MODEL RESULTS

Table 1
Benzene Adult Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-1 = 0.17 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration
$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^{2})) + ((D^{wat} * 1/H * (\theta ws^{3.33}/\theta T^{2})))$

$D^{eff}s$ =	0.0112	(cm^2/s)
D^{air} = diffusion coefficient in air =	0.093	(cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils =	0.33	
Θ_{ws} = volumetric water content of vadose zone soils	0.124	
Θ_T = total soil porosity =	0.4557	
D^{wat} = diffusion coefficient in water =	1.10E-05	(cm^2/s)
H = Henry's law constant =	0.22	(L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by benzene concentration in soil vapor

$F_{max} = D^{eff}s^* (Cv/d)$ =	2.08E-08	(µg/cm^2 - sec)	
Cv = maximum benzene concentration in vapor =	0.00017	(µg/cm^3) or	0.17 (µg/L)
d = depth of vapor sample =	91.44	(cm) or	3 (ft)

C_{indoor} = Indoor benzene concentration =	7.41E-07	(µg/cm^3)	
$C_{indoor} = F_{max}/ER_{air\text{-}indoor} * L_B$			
$ER_{air\text{-}indoor}$ = indoor air exchange rate =	0.00014	(sec^{-1})	
L_B = Indoor volume/infiltration area ratio =	200	(cm)	
Dose = $C_{indoor} * IR_{air\text{-}indoor} * EF * ED$ =	117	(mg)	
C_{indoor} =	7.41E-01	(µg/m^3) or	7.41E-07 (µg/cm^3)
$IR_{air\text{-}indoor}$ = Daily indoor inhalation rate =	15	(m^3/day)	
EF = exposure frequency =	350	(days/year)	
ED = exposure duration =	30	(years)	

Risk = ((Dose*SF)/(BW*AT))	6.53E-06	
Dose =	117	(mg)
SF = Slope factor =	0.1	$(mg/kg\text{-}day)^{-1}$
BW = Body weight =	70	(kg)
AT = Averaging time =	25550	(70 years * 365 days)

Therefore, adult carcinogenic risk from maximum benzene soil vapor at 3 feet is 6.53E-06

Table 2
Benzene Child (1 to 16 years) Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-1 = 0.17 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration
$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^{2}))+((D^{wat}*1/H*(\theta ws^{3.33}/\theta T^{2})))$

$D^{eff}s$ =	0.0112	(cm^2/s)
D^{air} = diffusion coefficient in air =	0.093	(cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils =	0.33	
Θ_{ws} = volumetric water content of vadose zone soils	0.124	
Θ_T = total soil porosity =	0.4557	
D^{wat} = diffusion coefficient in water =	1.10E-05	(cm^2/s)
H = Henry's law constant =	0.22	(L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by benzene concentration in soil vapor

$F_{max} = D^{eff}s^* (Cv/d)$ =	2.08E-08	(µg/cm2 - sec)	
Cv = maximum benzene concentration in vapor =	0.00017	(µg/cm^3) or	0.17 (µg/L)
d = depth of vapor sample =	91.44	(cm) or	3 (ft)

C_{indoor} = Indoor benzene concentration

$C_{indoor} = F_{max}/ER_{air-indoor}* L_B$ =	7.41E-07	(µg/cm^3)
$ER_{air-indoor}$ = indoor air exchange rate =	0.00014	(sec^{-1})
L_B = indoor volume/infiltration area ratio =	200	(cm)

Dose = C_{indoor}*$IR_{air-indoor}$*EF*ED =	62	(mg)	
C_{indoor} =	7.41E-01	(µg/m^3) or	7.41E-07 (µg/cm^3)
$IR_{air-indoor}$ = Daily indoor inhalation rate =	15	(m^3/day)	
EF = exposure frequency =	350	(days/year)	
ED = exposure duration =	16	(years)	

Risk = ((Dose*SF)/(BW*AT))	3.05E-05	
Dose =	62.261	(mg)
SF = Slope factor =	0.1	(mg/kg-day)$^{-1}$
BW = Body weight =	35	(kg)
AT = Averaging time =	5840	(16 years * 365 days)

Therefore, child carcinogenic risk from maximum benzene soil vapor at 3 feet is 3.05E-05

Table 3
Toluene Adult Non-Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-1 = 1.6 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration

$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^{2}))+((D^{water}1/H*(\theta ws^{3.33}/\theta T^{2})))$

$D^{eff}s$ =	0.0102	(cm^2/s)
D_{air} = diffusion coefficient in air =	0.085	(cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils =	0.33	
Θ_{ws} = volumetric water content of vadose zone soils	0.124	
Θ_T = total soil porosity =	0.4557	
D_{water} = diffusion coefficient in water =	9.40E-06	(cm^2/s)
H = Henry's law constant =	0.26	(L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by toluene concentration in soil vapor

$F_{max} = D^{eff}s * (Cv/d)$ =	1.79E-07	(µg/cm^2 - sec)	
Cv = maximum toluene concentration in soil vapor	0.0016	(µg/cm^3) or	1.6 (µg/L)
d = depth of vapor sample =	91.44	(cm) or	3 (ft)

C_{indoor} = Indoor toluene concentration

$C_{indoor} = F_{max}/ER_{air-indoor} * L_s$ =	6.38E-06	(µg/cm^3)
$ER_{air-indoor}$ = indoor air exchange rate =	0.00014	(sec^{-1})
L_s = indoor volume/infiltration area ratio =	200	(cm)

Dose = $C_{indoor} * IR_{air-indoor} * EF * ED$ =	1004	(mg)	
C_{indoor} =	6	(µg/m^3) or	6.38E-06 (µg/cm^3)
$IR_{air-indoor}$ = Daily indoor inhalation rate =	15	(m^3/day)	
EF = exposure frequency =	350	(days/year)	
ED = exposure duration =	30	(years)	

Risk = (Dose/(Rfd*BW*AT))	1.19E-02	
Dose =	1004	(mg)
Rfd = Inhalation reference dose =	0.11	(mg/kg-day)$^{-1}$
BW = Body weight =	70	(kg)
AT = Averaging time =	10950	(30 years * 365 days)

Therefore, adult non-carcinogenic risk from maximum toluene soil vapor at 3 feet is 1.19E-02

Table 4
Toluene Child (1 to 16 years) Non-Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-1 = 1.6 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration

$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^{2}))+((D^{wat}*1/H*(\theta ws^{3.33}/\theta T^{2})))$

$D^{eff}s$ =	0.0102	(cm^2/s)
D_{air} = diffusion coefficient in air =	0.085	(cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils =	0.33	
Θ_{ws} = volumetric water content of vadose zone soils	0.124	
Θ_T = total soil porosity =	0.4557	
D_{wat} = diffusion coefficient in water =	9.40E-06	(cm^2/s)
H = Henry's law constant =	0.26	(L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by toluene concentration in soil vapor

$F_{max} = D^{eff}s * (Cv/d)$ =	1.79E-07	(µg/cm^2 - sec)
Cv = maximum toluene concentration in soil vapor	0.0016 (µg/cm^3) or	1.6 (µg/L)
d = depth of vapor sample =	91.44 (cm) or	3 (ft)

C_{indoor} = Indoor toluene concentration

$C_{indoor} = F_{max}/ER_{air-indoor} * L_B$ =	6.38E-06	(µg/cm^3)
$ER_{air-indoor}$ = indoor air exchange rate =	0.00014	(sec^{-1})
L_B = indoor volume/infiltration area ratio =	200	(cm)

Dose = $C_{indoor} * IR_{air-indoor} * EF * ED$ =	536	(mg)
C_{indoor} =	6.38E+00 (µg/m^3) or	6.38E-06 (µg/cm^3)
$IR_{air-indoor}$ = Daily indoor inhalation rate =	15	(m^3/day)
EF = exposure frequency =	350	(days/year)
ED = exposure duration =	16	(years)

Risk = (Dose/(Rfd*BW*AT))	2.38E-02	
Dose =	536	(mg)
Rfd = Inhalation reference dose =	0.11	(mg/kg-day)$^{-1}$
BW = Body weight =	35	(kg)
AT = Averaging time =	5840	(16 years * 365 days)

Therefore, child non-carcinogenic risk from maximum toluene soil vapor at 3 feet is 2.38E-02

Table 5
Ethylbenzene Adult Non-Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-3 = 1.5 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration
$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^2))+((D^{wat}*1/H*(\theta ws^{3.33}/\theta T^2)))$

$D^{eff}s$ =	0.0091	(cm^2/s)
D_{air} = diffusion coefficient in air =	0.076	(cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils =	0.33	
Θ_{ws} = volumetric water content of vadose zone soils =	0.124	
Θ_T = total soil porosity =	0.4557	
D_{wat} = diffusion coefficient in water =	8.50E-06	(cm^2/s)
H = Henry's law constant =	0.32	(L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by ethylbenzene concentration in soil vapor
$F_{max} = D^{eff}s^* (Cv/d)$ = 1.50E-07 (µg/cm^2 - sec)

Cv = maximum ethylbenzene concentration in soil vapor	0.0015	(µg/cm^3) or	1.5 (µg/L)
d = depth of vapor sample =	91.44	(cm) or	3 (ft)

C_{indoor} = Indoor ethylbenzene concentration

$C_{indoor} = F_{max}/ER_{air-indoor}* L_B$ =	5.34E-06	(µg/cm^3)
$ER_{air-indoor}$ = indoor air exchange rate =	0.00014	(sec^{-1})
L_B = indoor volume/infiltration area ratio =	200	(cm)

Dose = $C_{indoor}*IR_{air-indoor}*EF*ED$ =	842	(mg)	
C_{indoor} =	5	(µg/m^3) or	5.34E-06 (µg/cm^3)
$IR_{air-indoor}$ = Daily indoor inhalation rate =	15	(m^3/day)	
EF = exposure frequency =	350	(days/year)	
ED = exposure duration =	30	(years)	

Risk = (Dose/(Rfd*BW*AT))	3.79E-03	
Dose =	842	(mg)
Rfd = Inhalation reference dose =	0.29	(mg/kg-day)$^{-1}$
BW = Body weight =	70	(kg)
AT = Averaging time =	10950	(30 years * 365 days)

Therefore, adult non-carcinogenic risk from maximum ethylbenzene soil vapor at 3 feet is 3.79E-03

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Table 6
Ethylbenzene Child (1 to 16 years) Non-Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-3 = 1.5 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration
$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^{2})) + ((D^{wat} * 1/H * (\theta ws^{3.33}/\theta T^{2}))$

$D^{eff}s$ =	0.0091	(cm^2/s)
D_{air} = diffusion coefficient in air =	0.076	(cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils =	0.33	
Θ_{ws} = volumetric water content of vadose zone soils =	0.124	
Θ_T = total soil porosity =	0.4557	
D_{wat} = diffusion coefficient in water =	8.50E-06	(cm^2/s)
H = Henry's law constant =	0.32	(L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by ethylbenzene concentration in soil vapor

$F_{max} = D^{eff}s * (Cv/d)$ =	1.50E-07	(µg/cm^2 - sec)	
Cv = maximum ethylbenzene concentration in soil vapor	0.0015	(µg/cm^3) or	1.5 (µg/L)
d = depth of vapor sample =	91.44	(cm) or	3 (ft)

C_{indoor} = Indoor ethylbenzene concentration

$C_{indoor} = F_{max}/ER_{air\text{-}indoor} * L_B$ =	5.34E-06	(µg/cm^3)	
$ER_{air\text{-}indoor}$ = indoor air exchange rate =	0.00014	(sec^{-1})	
L_B = indoor volume/infiltration area ratio =	200	(cm)	
Dose = $C_{indoor} * IR_{air\text{-}indoor} * EF * ED$ =	449	(mg)	
C_{indoor} =	5	(µg/m^3) or	5.34E-06 (µg/cm^3)
$IR_{air\text{-}indoor}$ = Daily indoor inhalation rate =	15	(m^3/day)	
EF = exposure frequency =	350	(days/year)	
ED = exposure duration =	16	(years)	
Risk = (Dose/(Rfd*BW*AT))	7.57E-03		
Dose =	449	(mg)	
Rfd = Inhalation reference dose =	0.29	$(mg/kg\text{-}day)^{-1}$	
BW = Body weight =	35	(kg)	
AT = Averaging time =	5840	(16 years * 365 days)	

Therefore, child non-carcinogenic risk from maximum ethylbenzene soil vapor at 3 feet is 7.57E-03

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Table 7
Xylene Adult Non-Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-3 = 12 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration
$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^2))+((D^{wat}*1/H*(\theta ws^{3.33}/\theta T^2)))$
$D^{eff}s$ = 0.0086 (cm^2/s)

D_{air} = diffusion coefficient in air = 0.072 (cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils = 0.33
Θ_{ws} = volumetric water content of vadose zone soils 0.124
Θ_T = total soil porosity = 0.4557
D_{wat} = diffusion coefficient in water = 8.50E-06 (cm^2/s)
H = Henry's law constant = 0.29 (L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by xylene concentration in soil vapor
$F_{max} = D^{eff}s^* (Cv/d)$ = 1.13E-06 (µg/cm^2 - sec)

Cv = maximum xylene concentration in soil vapor = 0.012 (µg/cm^3) or 12 (µg/L)
d = depth of vapor sample = 91.44 (cm) or 3 (ft)

C_{indoor} = Indoor xylene concentration
$C_{indoor} = F_{max}/ER_{air-indoor} * L_B$ = 4.05E-05 (µg/cm^3)
$ER_{air-indoor}$ = indoor air exchange rate = 0.00014 (sec^{-1})
L_B = indoor volume/infiltration area ratio = 200 (cm)

Dose = $C_{indoor}*IR_{air-indoor}*EF*ED$ = 6380 (mg)
C_{indoor} = 41 (µg/m^3) or 4.05E-05 (µg/cm^3)
$IR_{air-indoor}$ = Daily indoor inhalation rate = 15 (m^3/day)
EF = exposure frequency = 350 (days/year)
ED = exposure duration = 30 (years)

Risk = (Dose/Rfd*BW*AT) 4.16E-03
Dose = 6380 (mg)
Rfd = Inhalation reference dose = 2 (mg/kg-day)$^{-1}$
BW = Body weight = 70 (kg)
AT = Averaging time = 10950 (30 years * 365 days)

Therefore, adult non-carcinogenic risk from maximum xylene soil vapor at 3 feet is 4.16E-03

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3201621C\VAPOR.XLS!Xylene adult

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Table 8
Xylene Child (1 to 16 years) Non-Carcinogenic Risk
maximum concentration from 3 feet below ground surface
SV-3 = 12 µg/L

Former Signal Service Station
800 Center Street
Oakland, California

$D^{eff}s$ = Effective diffusion coefficient in soil based on vapor-phase concentration
$D^{eff}s = ((D^{air} * (\theta as^{3.33}/\theta T^{2}))+((D^{wat}*1/H*(\theta ws^{3.33}/\theta T^{2})))$

$D^{eff}s$ =	0.0086	(cm^2/s)
D_{air} = diffusion coefficient in air =	0.072	(cm^2/s)
Θ_{as} = volumetric air content of vadose zone soils =	0.33	
Θ_{ws} = volumetric water content of vadose zone soils	0.124	
Θ_T = total soil porosity =	0.4557	
D_{wat} = diffusion coefficient in water =	8.50E-06	(cm^2/s)
H = Henry's law constant =	0.29	(L - H_2O/L - air)

F_{max} = Diffusive vapor flux predicted by xylene concentration in soil vapor

$F_{max} = D^{eff}s^* (Cv/d)$ =	1.13E-06	(µg/cm^2 - sec)	
Cv = maximum xylene concentration in soil vapor =	0.012	(µg/cm^3) or	12 (µg/L)
d = depth of vapor sample =	91.44	(cm) or	3 (ft)

C_{indoor} = Indoor xylene concentration

$C_{indoor} = F_{max}/ER_{air-indoor}* L_B$ =	4.05E-05	(µg/cm^3)	
$ER_{air-indoor}$ = indoor air exchange rate =	0.00014	(sec^{-1})	
L_B = indoor volume/infiltration area ratio =	200	(cm)	
Dose = C_{indoor}*$IR_{air-indoor}$*EF*ED =	3403	(mg)	
C_{indoor} =	41	(µg/m^3) or	4.05E-05 (µg/cm^3)
$IR_{air-indoor}$ = Daily indoor inhalation rate =	15	(m^3/day)	
EF = exposure frequency =	350	(days/year)	
ED = exposure duration =	16	(years)	

Risk = (Dose/(Rfd*BW*AT))	8.32E-03	
Dose =	3403	(mg)
Rfd = Inhalation reference dose =	2	(mg/kg-day)$^{-1}$
BW = Body weight =	35	(kg)
AT = Averaging time =	5840	(16 years * 365 days)

Therefore, child non-carcinogenic risk from maximum xylene soil vapor at 3 feet is 8.32E-03

GROUNDWATER TECHNOLOGY

Drilling Log

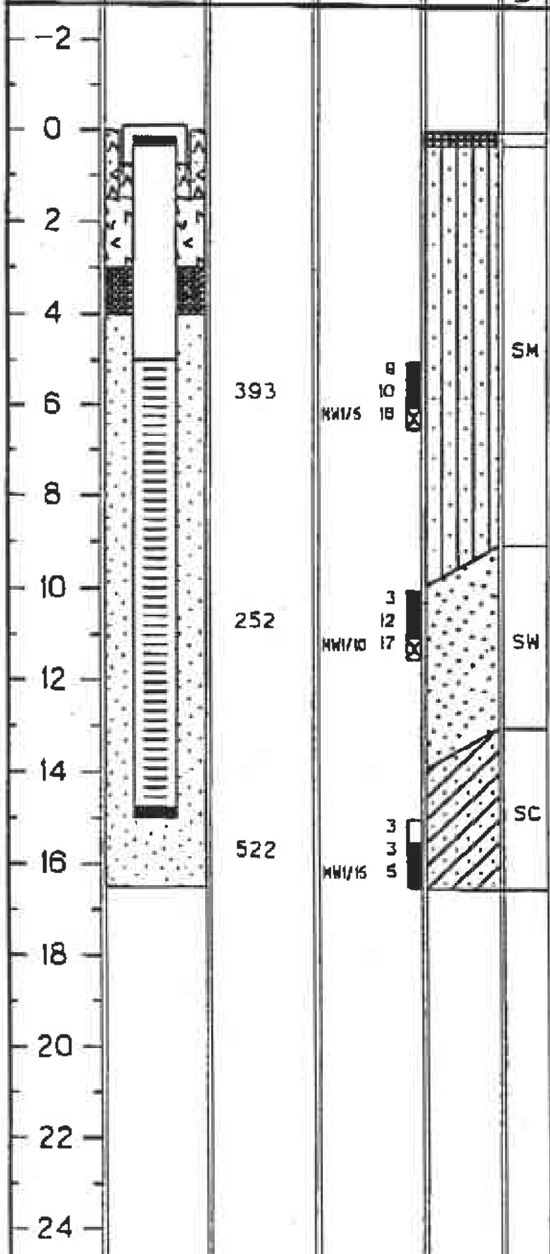
Monitoring Well MW-1

Project	Signal S0800
Owner	CHV/USA
Location	800 Center St.
Project No.	020200105
Date drilled	10/17/95
Surface Elev.	16.2 ft.
Total Hole Depth	16.5 ft.
Diameter	8.25 in.
Top of Casing	15.69 ft.
Water Level Initial	10 ft.
Static	10.54 ft.
Screen: Dia	2 in.
Length	10 ft.
Type/Size	PVC/0.020 in.
Casing: Dia	2 in.
Length	5 ft.
Type	PVC
Filter Pack Material	#3 Monterey Sand
Rig/Core Type	CME 75/Splitspoon
Drilling Company	Bay Area Explor.
Method	Hollow Stem Auger
Permit #	65664
Driller	Scott Fitche
Log By	Terry James
Checked By	E K Simonis
License No.	R.G. 4422

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0						Vacant lot
4–9		393	MW1/5 8, 10, 18		SM	Clayey, silty, very fine SAND (10,30,60):, red-yellow, dry, medium dense, moderate hydrocarbon odor.
9–13		252	MW1/10 3, 12, 17		SW	Fine SAND: light brown, moist, loose, strong hydrocarbon odor. *Groundwater encountered during drilling* *Static water level after 24 hours*
13–16.5		522	MW1/15 3, 3, 5		SC	Silty, clayey, very fine SAND (10,30,60):, green-gray, wet, loose, strong hydrocarbon odor.
16.5						End of boring. (All percentages are approximate.)



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Drilling Log

GROUNDWATER TECHNOLOGY

Monitoring Well MW-2

Project Signal S0800 Owner CHV/USA

Location 800 Center St. Project No. 020200105 Date drilled 10/17/95

Surface Elev. 16.3 ft. Total Hole Depth 16.5 ft. Diameter 8.25 in.

Top of Casing 15.77 ft. Water Level Initial 10 ft. Static 10.60 ft.

Screen: Dia 2 in. Length 10 ft. Type/Size PVC/0.020 in.

Casing: Dia 2 in. Length 5 ft. Type PVC

Filter Pack Material #3 Monterey Sand Rig/Core Type CME 75/Splitspoon

Drilling Company Bay Area Explor. Method Hollow Stem Auger Permit # 65664

Driller Scott Fitche Log By Terry James

Checked By E K Simonis License No. R.G. 4422

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2 to 24						Thin Asphalt
		4	MW2/5: 3, 7, 12		SM	Clayey, silty, very fine SAND (10,20,70): red-yellow, damp, medium dense, no hydrocarbon odor.
		3	MW2/10: 7, 20, 25			Grades fine sand, reddish-brown, wet.
						Groundwater encountered during drilling
						Static water level after 24 hours
		3	MW2/15: 4, 10, 10		SC	Silty, clayey, very fine SAND (10,30,60): saturated, soft, no hydrocarbon odor.
						End of boring.
						(All percentages are approximate.)

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GROUNDWATER TECHNOLOGY

Drilling Log

Monitoring Well **MW-3**

Project *Signal S0800* Owner *CHV/USA*
Location *800 Center St.* Project No. *020200105* Date drilled *10/17/95*
Surface Elev. *18.1 ft.* Total Hole Depth *16.5 ft.* Diameter *8.25 in.*
Top of Casing *15.46 ft.* Water Level Initial *10 ft.* Static *10.37 ft.*
Screen: Dia *2 in.* Length *10 ft.* Type/Size *PVC/0.020 in.*
Casing: Dia *2 in.* Length *5 ft.* Type *PVC*
Filter Pack Material *#3 Monterey Sand* Rig/Core Type *CME 75/Splitspoon*
Drilling Company *Bay Area Explor.* Method *Hollow Stem Auger* Permit # *65664*
Driller *Scott Fitche* Log By *Terry James*
Checked By *E K Simonis* License No. *R.G. 4422*

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0						Thin Asphalt
4–9		7	7, 6, MW3/5 18		SM	Clayey, silty, very fine SAND (10,20,70): red-yellow, damp, loose, no hydrocarbon odor, trace root stems.
9–13		83	7, 15, MW3/10 17		SW	Fine SAND: green-gray, wet, loose, strong hydrocarbon odor. ▽ *Groundwater encountered during drilling* ▼ *Static water level after 24 hours*
13–16.5		82	4, 7, MW3/15 8		SC	Silty, clayey, very fine SAND (10,20,70): mottled orange-brown/green-gray, saturated, loose, slight hydrocarbon odor
16.5						End of boring. (All percentages are approximate.)

Depth scale: -2, 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

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GROUNDWATER TECHNOLOGY

Drilling Log

Monitoring Well MW-4

Project Signal S0800 Owner CHV/USA

Location 800 Center St. Project No. 020200105 Date drilled 10/18/95

Surface Elev. 14.84 ft. Total Hole Depth 16.5 ft. Diameter 8.25 in.

Top of Casing 14.45 ft. Water Level Initial 10 ft. Static 9.37 ft.

Screen: Dia 2 in. Length 10 ft. Type/Size PVC/0.020 in.

Casing: Dia 2 in. Length 5 ft. Type PVC

Filter Pack Material #3 Monterey Sand Rig/Core Type CME 55/Splitspoon

Drilling Company Bay Area Explor. Method Hollow Stem Auger Permit # 65864

Driller Scott Fitche Log By Terry James

Checked By E K Simonis License No. R.G. 4422

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0						Thin Asphalt
4		10	HA4/5 4 8 8		SM	Very fine SAND (30,70): red-yellow, damp, loose, no hydrocarbon odor.
10		23	HA4/10 3 13 15		SW	Fine SAND: orange-brown, moist, loose *Static water level after 24 hours* *Groundwater encountered during drilling*
14		19	HA4/15 3 4 8		SM	Clayey, silty, very fine SAND (10,20,70): olive, wet, loose, slight hydrocarbon odor.
16						End of boring. (All percentages are approximate.)

PACIFIC ENVIRONMENTAL GROUP, INC.

11/29/1995 lithlog-jan93

2025 Gateway Place, Suite 440 • San Jose, California 95110-1014 (408) 441-7500 FAX (408) 441-7539

GROUNDWATER TECHNOLOGY

Drilling Log

Soil Boring SB-2

Project Signal 50800 Owner CHV/USA
Location 800 Center St. Project No. 020200105 Date drilled 10/17/95
Surface Elev. ____ Total Hole Depth 11.5 ft. Diameter 6.25 in.
Top of Casing ____ Water Level Initial 10.0 ft. Static -- ft.
Screen: Dia -- in. Length -- ft. Type/Size -- in.
Casing: Dia -- in. Length -- ft. Type --
Filter Pack Material Neat cement Rig/Core Type CME 55/Splitspoon
Drilling Company Bay Area Explor. Method Hollow Stem Auger Permit # 65664
Driller Tim Dunn Log By Terry James
Checked By E K Simonis License No. R.G. 4422

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class	Description (Color, Texture, Structure) Trace < 10%. Little 10% to 20%. Some 20% to 35%. And 35% to 50%
-2					
0					Thin Asphalt
2					
4					
6	641	8 15 SB2/5 18		SM	Clayey, silty, very fine SAND (10,30,60): mottled yellow-brown/ green-gray, dry, medium dense, strong hydrocarbon odor, trace root stems.
8					
10	800	8 15 SB2/10 21		SW	▽ *Groundwater encountered during drilling* Fine SAND: brown, wet, loose, strong hydrocarbon odor.
12					End of boring. (All percentages are approximate.)
14					
16					
18					
20					
22					
24					

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GROUNDWATER TECHNOLOGY

Drilling Log

Soil Boring SB-1

Project Signal SO800 Owner CHV/USA

Location 800 Center St. Project No. 020200105 Date drilled 10/17/95

Surface Elev. -- ft. Total Hole Depth 11.5 ft. Diameter 8.25 in.

Top of Casing -- ft. Water Level Initial 10.0 ft. Static -- ft.

Screen: Dia -- in. Length -- ft. Type/Size -- in.

Casing: Dia -- in. Length -- ft. Type --

Filter Pack Material Neat cement Rig/Core Type CME 55/Splitspoon

Drilling Company Bay Area Explor. Method Hollow Stem Auger Permit # 65664

Driller Tim Dunn Log By Terry James

Checked By E.K Simonis License No. R.G. 4422

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2					
0					Thin Asphalt
2				FILL	Silty SAND with rubbish, brick fragments
4					
6	408	SB1/5 2 4 9		SM	Clayey, silty, very fine SAND (10,30,60): olive, damp, loose, strong hydrocarbon odor.
8					
10	781	SB1/10 7 16 21		SM	Fine SAND: red-brown, wet, loose, strong hydrocarbon odor. ▽ *Groundwater encountered during drilling*
12					End of boring. (All percentages are approximate.)
14					
16					
18					
20					
22					
24					

PACIFIC ENVIRONMENTAL GROUP, INC.

2025 Gateway Place, Suite 440 • San Jose, California 95110-1014 (408) 441-7500 FAX (408) 441-7539

GROUNDWATER TECHNOLOGY

Drilling Log

Soil Boring SB-3

Project Signal 50800 Owner CHV/USA
Location 800 Center St. Project No. 020200105 Date drilled 10/18/95
Surface Elev. ____ Total Hole Depth 10.5 ft. Diameter 4.25 in.
Top of Casing ____ Water Level Initial -- ft. Static -- ft.
Screen: Dia -- in. Length -- ft. Type/Size -- in.
Casing: Dia -- in. Length -- ft. Type --
Filter Pack Material Neat cement Rig/Core Type Hand Auger/ Impact Sampler
Drilling Company GTI Method Hand Auger Permit # 65664
Driller Terry James Log By Terry James
Checked By E K Simonis License No. R.G. 4422

See Site Map For Boring Location

COMMENTS:

Depth (ft.)	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2					
0					Thin Asphalt
2					
4				SM	
6	3	SB3/5			Silty, very fine SAND (40,60), light brown, dry, no hydrocarbon odor.
8					
10	17	SB3/10		SW	Fine SAND:brown, moist, loose, faint hydrocarbon odor.
12					End of boring. (All percentages are approximate.)
14					
16					
18					
20					
22					
24					

11/29/1995 kthlog-jan93

APPENDIX B

SUMMARY OF RESULTS OF ANALYSES OF
SOIL AND GROUNDWATER SAMPLES

Table 1
Soil Analytical Data
Total Petroleum Hydrocarbons
(TPPH as Gasoline, BTEX Compounds, and MTBE)

Former Signal Service Station S0800
800 Center Street at 8th Street
Oakland, California

Well Number	Sample Depth (feet)	Date Sampled	TPPH as Gasoline (ppm)	Benzene (ppm)	Toluene (ppm)	Ethyl-benzene (ppm)	Xylenes (ppm)	MTBE (ppm)
P-1	6	03/22/96	ND	ND	ND	ND	ND	ND
	10		510	ND	18	9.7	46	ND
	17		ND	ND	ND	0.008	0.009	ND
P-2	6	03/22/96	4,000	ND	120	71	330	ND
P-3	10	03/22/96	13,000	38	780	280	1,400	ND
	16		5,400	41	310	110	1,400	ND
	20		260	3.7	21	6.2	27	ND
P-7	6	03/22/96	ND	ND	ND	ND	ND	ND
	10		1	ND	ND	ND	ND	ND
	15		13	ND	0.31	0.15	0.71	ND
P-8	6	03/22/96	ND	ND	ND	ND	ND	ND
	12		ND	ND	ND	0.0068	ND	ND

TPPH = Total purgeable petroleum hydrocarbons
MTBE = Methyl t-butyl ether
ppm = Parts per million
ND = Not detected
See certified analytical reports for detection limits.

Table 3
Analytical Soil Data

Former Signal Service Station 0800
800 Center Street at Eighth Street
Oakland, California

Soil Sample ID	Sample Date	Sample Depth	TPHg (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
SV-1	5/30/97	3	<1.0	<0.005	<0.005	<0.005	<0.005
		6	2,100	<2.5	46	57	300
		8.5	7,600	52	160	140	720
SV-2	5/30/97	3.5	<1.0	<0.005	<0.005	<0.005	<0.005
		6	11	<0.005	0.009	0.01	0.057
		9	8,000	12	420	150	710
SV-3	5/30/97	3	1.4	<0.005	0.029	0.014	0.1
		6	84	1.3	0.28	1.4	1.9
		9	2,200	5.8	130	83	340
SV-4	5/30/97	3	<1.0	<0.005	0.0058	<0.005	0.01
		6	<1.0	<0.005	<0.005	<0.005	<0.005
		9	16,000	86	470	210	960
SV-5	5/30/97	3	<1.0	<0.005	<0.005	<0.005	<0.005
		6	<1.0	<0.005	<0.005	<0.005	<0.005
		9	7,900	20	410	130	690

mg/kg = Milligrams per kilograms
TPH-g = Total petroleum hydrocarbons calculated as gasoline

TABLE 1
Analytical Results of Soil Samples
(Results expressed as milligrams per kilogram)

Former Signal Service Station No. S0800
800 Center Street
Oakland, California

Date	Sample ID	Sample Depth (ft)[a]	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH-g[b]
10-17-95	MW-1-5	5	0.091	0.49	0.14	1.9	11
10-17-95	MW-1-10	10	120	800	270	1,300	14,000
10-17-95	MW-2-5	5	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
10-17-95	MW-2-10	10	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
10-17-95	MW-3-5	5	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
10-17-95	MW-3-10	10	0.24	0.010	0.016	0.019	<1.0
10-18-95	MW-4-5	5	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
10-18-95	MW-4-10	10	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
10-17-95	SB-1-5	5	0.34	1.2	1.2	1.3	87
10-17-95	SB-1-10	10	72	640	240	1,100	8,100
10-17-95	SB-2-5	5	0.19	4.8	5.1	26	240
10-17-95	SB-2-10	10	28	440	150	630	4,700
10-18-95	SB-3-5	5	<0.0050	0.019	0.0087	0.049	<1.0
10-18-95	SB-3-10	10	<0.0050	<0.0050	<0.0050	<0.0050	<1.0
10-18-95	COMP	N/A	0.036	1.5	0.75	3.2	13

[a] feet below surface grade
[b] total petroleum hydrocarbons as gasoline

BLAINE
TECH SERVICES inc

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March 4, 1998

Phil Briggs
Chevron U.S.A. Products Company
P.O. Box 6004
San Ramon, CA 94583-0904

1st Quarter 1998 Monitoring at S-800

First Quarter 1998 Groundwater Monitoring at
Former Chevron Service Station Number S-800
800 Center St.
Oakland, CA

Monitoring Performed on January 28, 1998

Groundwater Sampling Report **980128-A-1**

This report covers the routine monitoring of groundwater wells at this Chevron facility. Blaine Tech Services, Inc.'s work at the site includes inspection, gauging, evacuation, purgewater containment, sample collection and sample handling in accordance with standard procedures that conform to Regional Water Quality Control Board requirements.

Routine field data collection includes depth to water, total well depth, thickness of any separate immiscible layer, water column volume, calculated volume of a three-case volume purge, elapsed evacuation time, total volume of water removed, and standard water parameter instrument readings. Sample material is collected, contained, stored, and transported to the laboratory in conformance with EPA standards. Purgewater is, likewise, collected and transported to McKittrick Waste Treatment Site for disposal.

Basic field information is presented alongside analytical values excerpted from the laboratory report in the cumulative table of **WELL DATA AND ANALYTICAL RESULTS**. The full analytical report for the most recent samples is located in the **Analytical Appendix**. The table also contains new groundwater elevation calculations taken from the computer plotted gradient map which is located in the **Professional Engineering Appendix**.

At a minimum, Blaine Tech Services, Inc. field personnel are certified upon completion of a forty-hour Hazardous Materials and Emergency Response training course per 29 CFR 1910.120. Field personnel are also enrolled in annual eight hour refresher courses.

Blaine Tech Services, Inc. conducts sampling and documentation assignments of this type as an independent third party. In order to avoid compromising the objectivity necessary for the proper and disinterested performance of this work, Blaine Tech Services, Inc. concentrates on objective data collection and does not participate in the interpretation of analytical results, the definition of geological or hydrological conditions, the formulation of recommendations, or the marketing of remedial systems.

Please call if you have any questions.

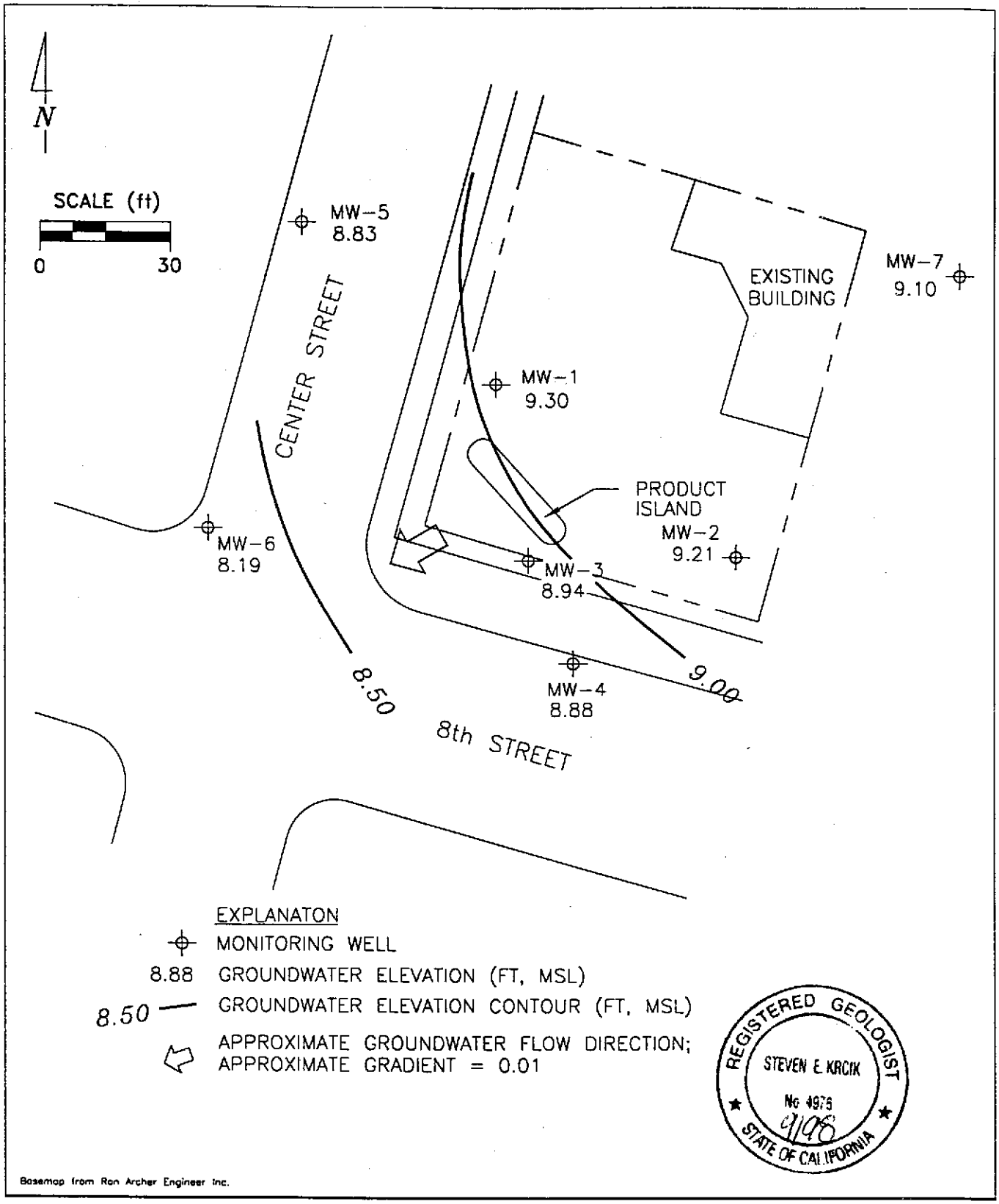
Yours truly,

Francis Thie
Vice President

FPT/ew

attachments: Professional Engineering Appendix
Cumulative Table of Well Data and Analytical Results
Analytical Appendix
Field Data Sheets

Professional Engineering Appendix



PREPARED BY RRM engineering contracting firm	**Former Signal Service Station S-800** 800 Center Street Oakland, California **GROUNDWATER ELEVATION CONTOUR MAP, JANUARY 28, 1998**	FIGURE: 1 PROJECT: DAC04

Table of
Well Data and
Analytical Results

Cumulative Table of Well Data and Analytical Results

Vertical Measurements are in feet. Analytical results are in parts per billion (ppb)

DATE	Well Head Elev.	Ground Water Elev.	Depth To Water	Notes	TPH-Gasoline	Benzene	Toluene	Ethyl-Benzene	Xylene	MTBE
MW-1										
10/27/95	15.69	10.54	5.15	--	170,000	19,000	34,000	4800	26,000	--
02/20/97	15.64	8.96	6.68	--	18,000	870	3500	470	2100	<250
04/24/97	15.64	7.30	8.34	--	76,000	4600	16,000	1600	8300	1000
07/23/97	15.64	5.90	9.74	--	37,000	2700	8000	870	6100	<250
10/29/97	15.64	--	--	Inaccessible	--	--	--	--	--	--
01/28/98	15.64	9.30	6.34	--	10,000	380	2000	300	1500	<25
MW-2										
10/27/95	15.77	10.60	5.17	--	<50	<0.5	<0.5	<0.5	<0.5	--
02/20/97	15.72	8.51	7.21	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
04/24/97	15.72	7.82	7.90	--	83*	<0.5	<0.5	<0.5	<0.5	<2.5
07/23/97	15.72	5.92	9.80	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
10/29/97	15.72	5.13	10.59	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
01/28/98	15.72	9.21	6.51	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
MW-3										
10/27/95	15.46	10.37	5.09	--	33,000	11,000	1700	2300	4200	--
02/20/97	15.42	8.37	7.05	--	260	56	<1.0	7.6	5.9	<5.0
04/24/97	15.42	7.29	8.13	--	1400	310	28	76	75	74
07/23/97	15.42	5.84	9.58	--	37,000	10,000	1500	2700	4200	2500
10/29/97	15.42	5.09	10.33	--	53,000	12,000	1200	3000	3100	2500
01/28/98	15.42	8.94	6.48	--	210	43	1.5	1.7	3.9	10
MW-4										
10/27/95	14.45	9.37	5.08	--	66	6.8	<0.5	<0.5	<0.5	--
02/20/97	14.40	8.12	6.28	--	54	<0.5	<0.5	<0.5	7.4	39
04/24/97	14.40	7.29	7.11	--	54	1.4	<0.5	0.65	3.0	100
07/23/97	14.40	5.80	8.60	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
10/29/97	14.40	5.74	8.66	Inaccessible	--	--	--	--	--	--
11/13/97	14.40	4.97	9.43	--	<50	<0.5	0.79	<0.5	<0.5	<2.5
01/28/98	14.40	8.88	5.52	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5

* Chromatogram pattern indicates an unidentified hydrocarbon.

Cumulative Table of Well Data and Analytical Results

Vertical Measurements are in feet. Analytical results are in parts per billion (ppb)

DATE	Well Head Elev.	Ground Water Elev.	Depth To Water	Notes	TPH-Gasoline	Benzene	Toluene	Ethyl-Benzene	Xylene	MTBE
MW-5										
01/03/97	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	--
02/20/97	15.03	--	--	Inaccessible	--	--	--	--	--	--
04/24/97	15.03	--	--	Inaccessible	--	--	--	--	--	--
04/30/97	15.03	7.06	7.97	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
07/23/97	15.03	--	--	Inaccessible	--	--	--	--	--	--
10/29/97	15.03	--	--	Inaccessible	--	--	--	--	--	--
01/28/98	15.03	8.83	6.20	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
MW-6										
01/03/97	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	--
02/20/97	14.73	8.11	6.62	--	800	310	23	11	28	<12
04/24/97	14.73	7.13	7.60	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
07/23/97	14.73	5.73	9.00	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
10/29/97	14.73	4.98	9.75	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
01/28/98	14.73	8.19	6.54	--	160	38	<0.5	<0.5	<0.5	<2.5
MW-7										
01/03/97	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	--
02/20/97	16.36	8.86	7.50	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
04/24/97	16.36	7.59	8.77	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
07/23/97	16.36	6.09	10.27	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
10/29/97	16.36	5.28	11.08	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
01/28/98	16.36	9.10	7.26	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5

Cumulative Table of Well Data and Analytical Results

Vertical Measurements are in feet. Analytical results are in parts per billion (ppb)

DATE	Well Head Elev.	Ground Water Elev.	Depth To Water	Notes	TPH-Gasoline	Benzene	Toluene	Ethyl-Benzene	Xylene	MTBE
TRIP BLANK										
02/20/97	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
04/24/97	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
07/23/97	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
10/29/97	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5
01/28/98	--	--	--	--	<50	<0.5	<0.5	<0.5	<0.5	<2.5

Note: Blaine Tech Services, Inc. began routine monitoring of the groundwater wells at this site on February 20, 1997.
Earlier field data and analytical results are drawn from the January 24, 1997 Groundwater Technology, Inc. report.

ABBREVIATIONS:
TPH = Total Petroleum Hydrocarbons
MTBE = Methyl t-Butyl Ether
ND = Not detected at or above the minimum quantitation limit. See laboratory reports for minimum quantitation limits.

APPENDIX C

SUMMARY OF RBCA DATA AND RESULTS

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Former Signal Service Station
Site Location: 800 Center Street, Oakland, CA
Job Identification: 320-182.18
Date Completed: DRAFT
Completed By: Pacific

Software: GSI RBCA Spreadsheet
Version: v 1.0

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined

DEFAULT PARAMETERS

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (l/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil ing. rate (mg*yr/kg*d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	5.8E+03		2.0E+03	5.8E+03	5.8E+03
SAadj	Adjusted dermal area (cm^2*yr/kg)	2.1E+03			1.7E+03	
M	Soil to Skin adherence factor	1				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)	***FALSE***				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	FALSE	
GW.v	Volatilization to Outdoor Air	TRUE	FALSE	
GW.b	Vapor Intrusion to Buildings	TRUE	FALSE	
Soil Pathways				
S.v	Volatiles from Subsurface Soils	TRUE	FALSE	
SS.v	Volatiles and Particulate Inhalation	FALSE	FALSE	FALSE
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	FALSE
S.l	Leaching to Groundwater from all Soils	TRUE	FALSE	
S.b	Intrusion to Buildings - Subsurface Soils	TRUE	FALSE	

Matrix of Receptor Distance and Location on- or off-site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)		TRUE		TRUE
S	Inhalation receptor (cm)		TRUE		TRUE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	1.0E-06	
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	
Opt	Calculation Option (1, 2, or 3)	1	
Tier	RBCA Tier	2	

Surface Parameters	Definition (Units)	Residential	Commercial/Industrial Chronic	Commercial/Industrial Construction
t	Exposure duration (yr)	30	25	1
A	Contaminated soil area (cm^2)	***9.7E+06***		1.0E+06
W	Length of affected soil parallel to wind (cm)	***1.5E+03***		1.0E+03
W.gw	Length of affected soil parallel to groundwater (c	***1.5E+03***		
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02		
delta	Air mixing zone height (cm)	2.0E+02		
Lss	Definition of surficial soils (cm)	***9.1E+01***		
Pe	Particulate areal emission rate (g/cm^2/s)	2.2E-10		

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	***6.3E+02***
Ugw.tr	Groundwater Transport velocity (cm/yr)	***1.7E+03***
Ks	Saturated Hydraulic Conductivity(cm/s)	1.0E-02
grad	Groundwater Gradient (cm/cm)	2.0E-03
Sw	Width of groundwater source zone (cm)	
Sd	Depth of groundwater source zone (cm)	
BC	Biodegradation Capacity (mg/L)	
BIO?	Is Bioattenuation Considered	FALSE
phi.eff	Effective Porosity in Water-Bearing Unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	***1.0E-02***

Soil	Definition (Units)	Value		
hc	Capillary zone thickness (cm)	***3.0E+01***		
hv	Vadose zone thickness (cm)	***1.8E+02***		
rho	Soil density (g/cm^3)	***1.42***		
foc	Fraction of organic carbon in vadose zone	***0.39***		
phi	Soil porosity in vadose zone	***0.336***		
Lgw	Depth to groundwater (cm)	***2.1E+02***		
Ls	Depth to top of affected soil (cm)	***1.1E+02***		
Lsubs	Thickness of affected subsurface soils (cm)	***3.5E+02***		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	***0.302***	***0.331***	***0.11***
phi.a	Volumetric air content	***0.034***	***0.005***	***0.226***

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	0.01	

Dispersive Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersion coefficient (cm)		
ay	Transverse dispersion coefficient (cm)		
az	Vertical dispersion coefficient (cm)		
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

Site Name: Former Signal Service Station 0800 Site Location: 800 Center Street, Oaklan Completed By: Pacific #VALUE! 3 OF 3

TIER 2 PATHWAY RISK CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAYS ARE ACTIVE)

	CARCINOGENIC RISK						TOXIC EFFECTS				
Constituents of Concern	(1) EPA Carcinogenic Classification	(2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site Residential		(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site Residential		(5) Total Toxicant Intake Rate (mg/kg/day) On-Site Residential		(6) Oral Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site Residential	
Benzene	A	4.9E-6		2.9E-2	1.4E-7						
Ethylbenzene	D						1.1E-5		1.0E-1	1.1E-4	
Toluene	D						8.1E-6		2.0E-1	4.0E-5	
Xylene (mixed isomers)	D						9.6E-6		2.0E+0	4.8E-6	
Total Pathway Carcinogenic Risk =					1.4E-7	0.0E+0	*Total Pathway Hazard Index =*			1.6E-4	0.0E+0

Site Name: Former Signal Service Station 0800 | Site Location: 800 Center Street, Oakland, Calif | Completed By: Pacific | #VALUE! | 5 OF 6

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

SOIL: LEACHING TO GROUNDWATER/ INGESTION

Constituents of Concern	Exposure Concentration 1) Source Medium: Soil Concentration (mg/kg)	2) NAF Value (L/kg) Receptor: On-Site Residential		3) Exposure Medium: Groundwater Concentration (mg/L) (1)/(2) On-Site Residential		4) Exposure Multiplier (IRxEFxED)/(BWxAT) (L/kg-day) On-Site Residential		5) Average Daily Intake Rate (mg/kg-day) On-Site Residential	
Benzene	2.4E-2	5.7E+1		4.2E-4		1.2E-2		4.9E-6	
Ethylbenzene	5.9E-2	1.4E+2		4.2E-4		2.7E-2		1.1E-5	
Toluene	5.9E-2	2.0E+2		3.0E-4		2.7E-2		8.1E-6	
Xylene (mixed isomers)	1.2E-1	3.5E+2		3.5E-4		2.7E-2		9.6E-6	

NOTE: AT = Averaging time (days) | BW = Body Weight (kg) | CF = Units conversion factor | ED = Exp. duration (yrs) | EF = Exposure frequencey (days/yr) | IR = Intake rate (L/day) | POE = Point of exposure

Site Name: Former Signal Service Station 0800 Site Location: 800 Center Street, Oakland, Califo Completed By: Pacific #VALUE! 6 OF 6

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: INGESTION

Constituents of Concern	Exposure Concentration: 1) Source Medium — Groundwater Concentration (mg/L)	2) NAF Value (dim) — Receptor		3) Exposure Medium — Groundwater: POE Conc. (mg/L) (1)/(2)		4) Exposure Multiplier — (IRxEFxED)/(BWxAT) (L/kg-day)		5) Average Daily Intake Rate (mg/kg-day)		MAX. PATHWAY INTAKE (mg/kg-day) (Maximum intake of active pathways soil leaching & groundwater routes.) — On-Site Residential	
Benzene	3.7E+0									4.9E-6	
Ethylbenzene	8.6E-1									1.1E-5	
Toluene	3.1E-1									8.1E-6	
Xylene (mixed isomers)	2.5E-1									9.6E-6	

NOTE: AT = Averaging time (days) BW = Body Weight (kg) CF = Units conversion factor ED = Exp. duration (yrs) EF = Exposure frequencey (days/yr) IR = Intake rate (L/day or mg/day) POE = Point of exposure

Site Name: Former Signal Service Station 0800 Completed By: Pacific
Site Location: 800 Center Street, Oakland, Califor #VALUE!

TIER 2 SUBSURFACE SOIL CONCENTRATION DATA SUMMA (e.g., >3 FT BGS)

CONSTITUENTS DETECTED		Analytical Method			Detected Concentrations		
CAS No.	Name	Typical Detection Limit (mg/kg)	No. of Samples	No. of Detects	Maximum Conc. (mg/kg)	Mean Conc. (mg/kg)	UCL on Mean Conc. (mg/kg)
71-43-2	Benzene		13	13	2.5E+00	2.4E-02	5.4E-02
100-41-4	Ethylbenzene		13	13	5.7E+01	5.9E-02	2.0E-01
108-88-3	Toluene		13	13	4.6E+01	5.9E-02	1.9E-01
1330-20-7	Xylene (mixed isomers)		13	13	3.0E+02	1.2E-01	5.2E-01

Site Name: Former Signal Service Station 080 Completed By: Pacific
Site Location: 800 Center Street, Oakland, Ca #VALUE!

TIER 2 GROUNDWATER CONCENTRATION DATA SUMMARY

CONSTITUENTS DETECTED		Analytical Method			Detected Concentrations		
CAS No.	Name	Typical Detection Limit (mg/L)	No. of Samples	No. of Detects	Maximum Conc. (mg/L)	Mean Conc. (mg/L)	UCL on Mean Conc. (mg/L)
71-43-2	Benzene	5.0E-03	3	3	5.6E+00	3.7E+00	7.2E+00
100-41-4	Ethylbenzene		3	3	1.6E+00	8.6E-01	1.7E+00
108-88-3	Toluene		3	3	1.3E+01	3.1E-01	1.3E+02
1330-20-7	Xylene (mixed isomers)		3	3	8.8E+00	2.5E-01	9.0E+01

RBCA CHEMICAL DATABASE

Physical Property Data

CAS Number	Constituent	type	Molecular Weight (g/mole) MW	ref	Diffusion Coefficients in air (cm2/s) Dair	re	Diffusion Coefficients in water (cm2/s) Dwat	re	log (Koc) or log(Kd) (@ 20 - 25 C) (l/kg) Koc	ref	Henry's Law Constant (@ 20 - 25 C) (atm-m3/mol)	(unitless)	re	Vapor Pressure (@ 20 - 25 C) (mm Hg) Pure Component	ref	Solubility (@ 20 - 25 C) (mg/l) Pure Component	ref	acid pKa	base pKb	ref
71-43-2	Benzene	A	78.1	5	9.30E-02	A	1.10E-05	A	1.58	A	5.29E-03	2.20E-01	A	9.52E+01	4	1.75E+03	A			
100-41-4	Ethylbenzene	A	106.2	5	7.60E-02	A	8.50E-06	A	1.98	A	7.69E-03	3.20E-01	A	1.00E+01	4	1.52E+02	5			
108-88-3	Toluene	A	92.4	5	8.50E-02	A	9.40E-06	A	2.13	A	6.25E-03	2.60E-01	A	3.00E+01	4	5.15E+02	29			
1330-20-7	Xylene (mixed isomers)	A	106.2	5	7.20E-02	A	8.50E-06	A	2.38	A	6.97E-03	2.90E-01	A	7.00E+00	4	1.98E+02	5			

Site Name: Former Signal Servi Site Location: 800 Center Street, Completed By: Pacific #VALUE!

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RBCA CHEMICAL DATABASE

Toxicity Data

CAS Number	Constituent	Reference Dose (mg/kg/day) Oral RfD_oral	ref	Inhalation RfD_inhal	re	Slope Factors 1/(mg/kg/day) Oral SF_oral	ref	Inhalation SF_inhal	ref	EPA Weight of Evidence	Is Constituent Carcinogenic ?
71-43-2	Benzene	-	R	1.70E-03	R	2.90E-02	A	2.90E-02	A	A	TRUE
100-41-4	Ethylbenzene	1.00E-01	A	2.86E-01	A	-	R	-	R	D	FALSE
108-88-3	Toluene	2.00E-01	A,R	1.14E-01		-	R	-	R	D	FALSE
1330-20-7	Xylene (mixed isomers)	2.00E+00	A,R	2.00E+00	A	-	R	-	R	D	FALSE

Site Name: Former Signal Site Location: 800 Center Street, Oak Completed By: Pacific #VALUE!

Software version: v 1.0

RBCA CHEMICAL DATABASE

Miscellaneous Chemical Data

CAS Number	Constituent	Maximum Contaminant Level MCL (mg/L)	Maximum Contaminant Level reference	Permissible Exposure Limit PEL/TLV (mg/m3)	ref	Relative Absorption Factors Oral	Relative Absorption Factors Dermal	Detection Limits Groundwater (mg/L)	ref	Detection Limits Soil (mg/kg)	re	Half Life (First-Order Decay) (days) Saturated	Half Life (First-Order Decay) (days) Unsaturated	ref
71-43-2	Benzene	5.00E-03	52 FR 25690	3.20E+00	OSHA	1	0.5	0.002	C	0.005	S	720	720	H
100-41-4	Ethylbenzene	7.00E-01	6 FR 3526 (30 Jan 91	4.34E+02	ACGIH	1	0.5	0.002	C	0.005	S	228	228	H
108-88-3	Toluene	1.00E+00	6 FR 3526 (30 Jan 91	1.47E+02	ACGIH	1	0.5	0.002	C	0.005	S	28	28	H
1330-20-7	Xylene (mixed isomers)	1.00E+01	6 FR 3526 (30 Jan 91	4.34E+02	ACGIH	1	0.5	0.005	C	0.005	S	360	360	H

Site Name: Former Signal Site Location: 800 Center Street, Oakland, California Completed By: Pacific #VALUE!

Software version: v 1.0