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Engineering & Environmental Services

A Report Prepared For:

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Attention: Mr. Barney Chan

CORRECTIVE ACTION PLAN
PACIFIC ELECTRIC MOTOR COMPANY
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1.0 INTRODUCTION

This Corrective Action Plan (CAP) has been prepared by PES Environmental, Inc. (PES) on behalf of Pacific Electric Motor Company (PEM) for the property located at 1009 66th Avenue, Oakland, California (Plate 1). This document has been prepared in response to a letter dated July 14, 1999 from the Alameda County Environmental Health Services (ACEHS), to Mr. Rand Perry and Mr. Steve Boyd of PEM.

The ACEHS letter requested the preparation of a CAP that would propose methods to: (1) reduce the concentrations of petroleum hydrocarbon compounds (PHCs) in groundwater onsite, and (2) stop migration of PHCs. The letter also requested a feasibility study discussing remediation options and the rationale in deciding on the proposed method.

The CAP follows the recommendations of the ACEHS and RWQCB for cleanup at fuel tank sites. This CAP utilizes the data collected to date, and allows for calculation of risk-based cleanup levels and selection of an appropriate remedial alternative. The data evaluated for the CAP includes the results of analysis of 66 soil samples collected from the site, and the results of 7 groundwater monitoring events.

1.1 Corrective Action Plan Objectives

The objectives of the CAP are to: (1) evaluate human health risks of PHCs, especially benzene and methyl tert-butyl ether (MTBE), in unsaturated soil and groundwater at the site; (2) establish risk-based site-specific cleanup levels for PHCs in unsaturated soils and groundwater; (3) evaluate available remedial alternative measures; and (4) select the most appropriate remedial measure that can achieve site-specific cleanup levels.

1.2 Organization

The CAP includes the following sections:

Section 1.0 - Introduction. The introduction presents a general explanation of the objectives and organization of the CAP.

Section 2.0 – Background Information. This section discusses the physical and chemical characteristics of the PHCs encountered in soil and groundwater at the site.

Section 3.0 - Determination of Applicable Cleanup Levels. A risk-based approach is used to develop alternative site-specific cleanup levels in this section.

Section 4.0 - Evaluation of Remedial Alternatives. This section presents an evaluation of remedial action alternatives considered applicable for implementation at the site.

Section 5.0 - Corrective Action Plan Implementation. This section discusses the recommended remedial action alternatives for the site and presents a schedule for corrective action implementation, monitoring, and reporting.

Section 6.0 - Summary and Conclusions. This section summarizes the findings of the CAP and provides conclusions based on the available data.

2.0 BACKGROUND INFORMATION

A description of the site and a discussion of the characteristics of site contaminants are presented below.

2.1 Site Description

The site is located in a light industrial and residential area in Oakland, California and is presently used to repair large electric motors. PEM formerly operated a 2,000-gallon steel gasoline underground storage tank (UST) on the east side of the warehouse building (Plate 2). The tank was reportedly installed in approximately 1975 (ENVIRON, 1997). A compilation of petroleum hydrocarbon concentrations in soil samples from historical site investigations is included as Table 1. Historical groundwater sample analytical results are presented as Table 2. A groundwater flow direction map from the most recent (July 1999) groundwater monitoring event is presented on Plate 3.

2.2 Previous Investigations

2.2.1 UST Removal

In February 1995, the UST was removed by W. A. Craig, Inc. (WAC). Observations at the time of removal indicated that the tank was in good condition and no holes were evident. However, free-phase gasoline product was observed on the water surface in the tank excavation. Soil samples collected from the UST excavation and associated piping trenches detected total petroleum hydrocarbons as gasoline (TPH-g) at concentrations up to 10,000 milligrams per kilogram (mg/kg).

2.2.2 1995 Soil Investigation and Excavation

In April 1995, WAC performed a soil investigation consisting of nine soil borings (GP-1 through GP-9) to delineate the lateral and vertical extent of the petroleum hydrocarbons in soil (WAC, 1995). Sampling locations are shown on Plate 2. Benzene and TPH-g were detected in soil samples at concentrations up to 1,900 mg/kg (GP2 at 8 feet bgs) and 16 mg/kg (GP7 at 8 feet bgs), respectively (Table 1). Excerpts from WAC's investigation report are presented in Appendix A.

On the basis of the results of the soil investigation, WAC prepared and implemented a remediation program to remove soil affected by petroleum hydrocarbons (WAC, 1997). WAC excavated affected soil from the vicinity of the UST and dispenser island to depths of up to 24 feet below ground surface (bgs). Approximately 1,500 cubic yards of soil were excavated and stockpiled onsite, and 116,000 gallons of petroleum hydrocarbon-affected water were pumped from the excavation and disposed. Residual concentrations of TPH-g and benzene in confirmation soil samples generally ranged up to 930 mg/kg and 7.4 mg/kg, respectively; however, at sampling location 11-TB, TPH-g and benzene were detected at concentrations of 2,800 mg/kg and 18 mg/kg, respectively (Plate 2). Excerpts from WAC's report summarizing the UST excavation program are presented in Appendix A.

2.2.3 June 1997 Well Installation

ENVIRON, Inc. (ENVIRON) installed and sampled three shallow monitoring wells (MW-1, MW-2, MW-3) in June 1997 to evaluate groundwater conditions in the vicinity of the former UST (Plate 2). The well installation program and associated soil and groundwater sampling program were summarized in the ENVIRON report *Soil and Ground Water Investigation, Summary Report, Pacific Electric Motor Co., 1009-66th Avenue, Oakland, California*, dated July 17, 1997 (ENVIRON, 1997). ENVIRON concluded that the remediation performed had successfully removed the source of the petroleum hydrocarbons (i.e., the former UST), and that residual concentrations of petroleum hydrocarbons in soil and groundwater were present only in the immediate vicinity of the former UST. Excerpts from ENVIRON's report are presented in Appendix A.

2.2.4 June 1997 Subsurface Investigation and Well Installation

In September 1998, PES conducted additional soil and groundwater sampling in the vicinity of the former UST, as requested by the ACEHS in a May 13, 1998 letter to PEM (ACEHS, 1998a). Two soil borings (SB-1 and SB-2) were drilled within the backfill of the former UST excavation, and one monitoring well was installed downgradient of the former UST. Petroleum hydrocarbons were generally not detected in the excavation backfill, although groundwater samples collected from both soil borings indicated the presence of methyl tert-butyl ether (MTBE), a gasoline additive. Elevated petroleum hydrocarbons were found in soil (TPH-g up to 660 mg/kg and benzene up to 2.8 mg/kg) and in groundwater (TPH-g up to 170,000 micrograms per liter [µg/L], benzene up to 26 [µg /L], and MTBE up to 26 [µg /L]) downgradient of the UST excavation during installation and groundwater sampling of monitoring well MW-4. On the basis of the elevated concentrations of petroleum hydrocarbons, PES recommended four quarters of additional groundwater monitoring. The additional investigation was summarized in the PES report *Results of Additional Soil and Groundwater Investigation, 1009 66th Avenue, Oakland, California*, dated November 11, 1998 (PES, 1998a). Compiled soil and groundwater data collected by PES are presented in Tables 1 and 2, respectively.

2.2.5 Quarterly Groundwater Monitoring

A quarterly groundwater monitoring program, which began in June 1997, is ongoing. Sampling results for the four monitoring wells from the most recent sampling event in July 1999 indicate that elevated concentrations of PHCs are present in groundwater at monitoring wells MW-1 and MW-4. No PHCs were detected in samples from well MW-2 and MW-3 in July 1999; however, in April 1999 both wells had low concentrations of PHCs indicating that the groundwater plume may be moving in an offsite direction.

2.3 Physical and Chemical Characteristics of Site Contaminants

The unsaturated soil and groundwater at the site has been affected by releases of gasoline from the former underground storage tank. Gasoline is comprised of relatively light fraction hydrocarbons and additives that are blended with the fuel to improve performance. The light-fraction hydrocarbons in gasoline are highly volatile and rapidly evaporate. Chemicals of concern at the site are constituents of gasoline, particularly the aromatic BTEX compounds and MTBE. These aromatic hydrocarbons typically comprise about 10 to 40 percent of fresh (unweathered) gasoline (ASTM, 1995).

2.4 Hydrogeologic Characteristics

This section discusses the effect of petroleum hydrocarbons detected at the site on nearby surface water bodies and groundwater.

2.4.1 Surface Water

The nearest surface water body is Lion Creek; a small stream located approximately 200 feet to the southeast of the sites that flows to San Leandro Channel. Groundwater monitoring data collected at the site since 1997 indicate the PHCs in groundwater are slowly migrating toward the southwest, away from Lion Creek.

2.4.2 Groundwater

Historical water levels in the four monitoring wells have ranged from 2.89 to 7.71 feet bgs (PES, 1999). These data indicate that groundwater flow is generally to the west-southwest. The groundwater gradient is approximately 0.004 foot per foot (ft/ft).

Prior to the April 1999 event, the groundwater plume appeared to be static and localized in the area immediately adjacent to the UST excavation. The results of the April 1999 groundwater monitoring event appear to indicate that the petroleum hydrocarbon plume associated with the former UST was migrating west to southwest towards the property boundary. The results of the most recent sampling event (July 1999) from the downgradient monitoring wells appear to indicate that the petroleum hydrocarbon plume associated with the former UST is limited to

minimal lateral migration and remains localized. Concentrations of petroleum hydrocarbons in samples from Wells MW-1 and MW-4 are comparable to previously observed conditions.

3.0 RBCA EVALUATION OF APPLICABLE CLEANUP LEVELS

This section presents the methodology and results of a Risk-Based Corrective Action (RBCA) evaluation of site chemical hazards and determination of site-specific health-based cleanup levels for unsaturated soil and groundwater. The use of the RBCA approach, following the standard procedures as published by the American Society for Testing and Materials *Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM E 1739-95), is routinely used at fuel hydrocarbon sites and is described below.

3.1 Methodology

The RBCA process allows for assessment and evaluation of the need for a response to subsurface contamination associated with PHC releases. The RBCA process integrates U.S. Environmental Protection Agency (U.S. EPA) risk assessment practices with site investigation and remedial action in order to determine applicable and appropriate measures for protection of human health and the environment. RBCA Tier 1 Risk-Based Screening Levels (RBSLs) and Tier 2 Site Specific Target Levels (SSTLs) are based on achieving protection of human health and the environment. For evaluation of carcinogens, Tier 1 RBSLs and Tier 2 SSTLs are based on acceptable lifetime exposure cancer risk of 10^{-6} to 10^{-4}. For evaluation of non-carcinogens, a toxic hazard quotient value of 0.2 to 1.0 was used.

3.1.1 Tier 1 RBCA Methodology

The RBCA process evaluates petroleum release sites in terms of sources, transport mechanisms, and receptors. Tier 1 of the RBCA process consists of comparing maximum concentrations of constituents of concern detected at the site to generic RBSLs to determine whether further evaluation is necessary. RBSL values are derived from standard exposure equations and reasonable maximum exposure estimates as recommended in U.S. EPA risk assessment practices. The standard exposure equations and maximum exposure estimates include several conservative assumptions and therefore, result in calculation of a very conservative safe maximum exposure value for a chronic (long-term) exposure scenario. These exposure factors are designed to protect not just the average person, but the most sensitive groups over a lifetime of exposure.

If Tier 1 levels are not exceeded, the appropriate action is to proceed directly to compliance monitoring and, if appropriate, no further action. If the generic Tier 1 levels are exceeded, the PHC affected soil or groundwater may be addressed by proceeding with remediation to generic Tier 1 levels or conducting a Tier 2 RBCA evaluation.

3.1.2 Tier 2 RBCA Methodology

Tier 2 of the RBCA process involves development of site-specific target levels (SSTLs), which are then compared to concentrations of the chemical(s) of concern for the subject site. The SSTL values are derived from standard exposure equations and reasonable maximum exposure estimates per U.S. Environmental Protection Agency (USEPA) guidelines. These values are designed to be protective of human health, even if exposure occurs within the onsite area of impacted soil or groundwater.

3.2 Primary Exposure Scenarios

For the former UST at the subject site, three primary exposure scenarios were evaluated: (1) volatilization of residual petroleum hydrocarbon constituents from soil and/or groundwater to outdoor air; (2) volatilization of residual petroleum hydrocarbon constituents from soil and/or groundwater to the air inside buildings at the site (the existing warehouse or future buildings in the vicinity of the residual contamination); and (3) construction workers during future site development. To perform the RBCA evaluation, PES used the *Tier 1 and Tier 2 RBCA Spreadsheet System* Version 1.0.1 software package by Groundwater Services, Inc. The worksheets listing input data and output results used for this model are presented in Appendix B.

3.3 Constituents of Concern

All soil and groundwater analytical data collected to date was evaluated for use as input to the RBCA Spreadsheet System. The maximum concentrations of MTBE, benzene, toluene, ethylbenzene and xylenes detected in soil and groundwater from monitoring wells were selected as input concentrations for the RBCA model used to present a worst-case scenario. Following standard RBCA protocol, concentrations of TPH quantified as gasoline and diesel, and total recoverable petroleum hydrocarbons were not evaluated in the RBCA process.

The RBCA input data are as follows:

Surface Soil

- Benzene – 0.085 mg/kg (MW-4 at 5.0 feet bgs)
- Toluene – 0.28 mg/kg (MW-4 at 5.0 feet bgs)
- Ethylbenzene – 0.23 mg/kg (MW-4 at 5.0 feet bgs)
- Total xylenes – 0.31 mg/kg (MW-4 at 5.0 feet bgs)
- MTBE – 0.125 mg/kg (MW-4 at 5.0 feet bgs)

Subsurface Soil

- Benzene – 18 mg/kg (11-TB at 6.0 feet bgs) — What about 1-SW-SW 13' 22ppm B
- Toluene – 150 mg/kg (11-TB at 6.0 feet bgs)
- Ethylbenzene – 72 mg/kg (11-TB at 6.0 feet bgs)
- Total xylenes – 420 mg/kg (11-TB at 6.0 feet bgs)

Groundwater

Benzene – 28,000 μg/L (MW-4; April 1999)
Toluene – 32,000 μg/L (MW-4; September 1998)
Ethylbenzene – 3,700 μg/L (MW-4; April 1999)
Total xylenes – 19,000 μg/L (MW-4; April 1999)
MTBE – 68,000 μg/L (MW-4; July 1999)

3.4 RBCA Risk Assessment Results

PES used the evaluation and assessment procedures recommended by ASTM E-1739 for determining the appropriate hazard identification, exposure assessment, risk characterization, and acceptable exposure limits for the constituents of concern at the site. The RBCA analysis assessed worst-case conditions at the PEM site by evaluating maximum concentrations of constituents of concern in affected unsaturated soil and groundwater through indirect exposure to affected soil vapor over the contaminant plume, and direct exposure to soil during construction activities. The maximum concentrations used in the Tier 1 analyses were presented in Section 3.2, above. The data output and results of the Tier 1 analyses are presented in Appendix B.

3.4.1 Tier 1 RBCA Analysis

Tier 1 of the RBCA process consisted of comparing site-specific COC concentrations to generic RBSLs to determine whether further evaluation was necessary. The RBSLs are presented on Table 3. In accordance with California policy for use of RBCA analysis, the applicable RBSL for benzene was multiplied by 0.29 for regulatory acceptance (RWQCB, 1996) due to the California EPA's higher estimate of benzene toxicity.

The results of the Tier 1 analysis indicate: (1) the concentration of benzene and toluene in subsurface soil exceed the calculated RBSLs for the volatilization into indoor air exposure pathway; and (2) the RBSL for benzene in groundwater is exceeded for the volatilization into indoor and outdoor air exposure pathways. Concentrations of ethylbenzene, MTBE, and xylenes do not exceed their respective applicable RBSLs. According to the Tier 1 evaluation, future construction workers would not be exposed to unacceptable concentrations of PHCs in surface soil.

The Tier 1 model assumes that a worker in a building situated over the area of highest soil and groundwater concentrations (no buildings exist at the locations corresponding to the maximum COC concentrations) will be exposed to benzene for eight hours per day for 25 years. This scenario currently does not and is not expected to occur at this site.

3.4.2 Tier 2 RBCA Analysis

The Tier 2 RBCA process consisted of further evaluating COCs with concentrations in excess of applicable Tier 1 RBSLs. COCs with concentrations in excess of applicable RBSLs were evaluated to determine whether the concentrations in soil and groundwater exceed applicable SSTL concentrations. If any COCs exceed the SSTLs, a constituent reduction factor required to meet the cleanup goal is calculated. The SSTL for each COC represents the target clean up goal for that COC.

The results of the Tier 2 analysis indicate that the calculated SSTL for benzene and toluene is identical to the RBSL value (Table 3). The applicable SSTL in subsurface soil for benzene and toluene at the site is 0.1 and 230 mg/kg, respectively. The applicable SSTL for benzene in groundwater at the site is 150 μg/L

3.5 Selection of Soil and Groundwater Cleanup Levels

The RBCA Tier 1 and Tier 2 analyses evaluated maximum BTEX and MTBE concentrations detected in subsurface soil and groundwater at the site. The findings for each media are discussed below.

Additionally, the concentration of benzene in groundwater at well MW-4 exceeds the respective SSTLs for the volatilization of benzene into an enclosed airspace pathway and outdoor air. Though no buildings exist over the areas of highest benzene and toluene concentrations, the volatilization into indoor air space exposure pathway was included to develop a more conservative and protective site risk level. The following sections will discuss and select the most appropriate remedial measure to reduce the risk to acceptable levels.

3.5.1 Soil

The results of the RBCA evaluation indicate that concentrations of benzene and/or toluene in subsurface soil at 19 sampling locations exceed the respective SSTLs for the volatilization of benzene and toluene into an enclosed airspace pathway (Table 3). Of these 19 locations, soil samples from 14 locations were collected below the water table. Because dissolved PHCs in groundwater may have affected the results of the soil analysis, samples collected from saturated soil are not considered further (the RBCA evaluation results for groundwater are used to address saturated soil conditions). One of the soil sampling locations (GP7) was removed during over-excavation of the UST area.

GW is confined & rises to current level

The four remaining sampling locations considered for further discussion are in two general areas: (1) south of the UST excavation area (confirmation sample 11-TB and boring GP1); and (2) beneath the warehouse on the west side of the UST excavation area (borings GP4 and GP9).

Sampling Location 11-TB and Boring GP1

Concentrations of benzene (18 mg/kg) and toluene (150 mg/kg) from sampling location 11-TB and benzene (up to 13 mg/kg at 9.5 feet bgs) in soil at boring GP1 exceed the SSTLs for indoor air. The soil sample collected from 11-TB was from 6 feet bgs in a trench extending from the south side of the UST excavation area (Plate 2). Boring GP1 is located approximately 20 feet south of 11-TB. Both sampling locations are in a parking area covered with asphaltic pavement at the rear of the main PEM building.

On the basis of soil analytical results from other nearby excavation soil samples and the 5-foot sample from monitoring well MW-4 (benzene at 0.085 mg/kg and toluene at 0.28 mg/kg in the sample from 5 feet bgs), the extent of the elevated benzene and/or toluene observed at 11-TB and GP1 is limited to a small area immediately adjacent to the former UST excavation. There are no structures overlying this area and no development plans that include development and construction of buildings in the future. There is no complete enclosed air pathway for PHCs in soil at this area of the site and no soil remediation is required.

Borings GP4 and GP9

Concentrations of benzene in soil samples from borings GP4 and GP9 range up to 14 mg/kg. These samples were collected from beneath the warehouse on the west side of the UST excavation area. The warehouse overlying the sampling locations is a corrugated metal structure that is not sealed and permits outdoor air to freely circulate through the building. As such, soil analytical results should be compared to SSTLs for outdoor air, rather than indoor air. The concentrations in soil samples from GP4 and GP9 are below the outdoor air SSTL for benzene. There is no complete enclosed air pathway for PHCs in soil at this area of the site and no soil remediation is required.

3.5.2 Groundwater

Based on the evaluation of cleanup levels, the most conservative cleanup goals for benzene and toluene in groundwater are MCLs. However, the RWQCB acknowledges that remediation of shallow groundwater to drinking water MCLs is, in many cases, technically impractical, and unnecessary in most situations. Due to low inferred permeability of the Bay Mud, and flat gradient of the site, the groundwater movement is expected to be slow. Previous environmental investigations have also determined that PHCs have generally remained within the site boundary and have not migrated offsite to any ecologically sensitive areas. Further, all local domestic water is supplied by East Bay Municipal Utility District. There is no evidence of groundwater use in this area, and therefore, little risk to human heath from consumption of groundwater. Consequently, remedial actions should be developed for the COCs present in the groundwater at concentrations in excess of the human health risk-based SSTLs. The SSTLs for groundwater affected by benzene and toluene are 150 and 25,000 μg/L, respectively.

With regard to MTBE in groundwater, there are no clear regulatory guidelines for use in establishing cleanup goals. The State of California is considering adoption of a primary MCL for MTBE of 13 µg/L. However, as noted above, groundwater at the site is not used as a drinking water supply. PES proposes a cleanup goal for MTBE of 680 µg/L. This results in a one-hundred fold decrease from the maximum detected concentration.

4.0 EVALUATION OF REMEDIAL ALTERNATIVES

As discussed in Sections 3.4 and 3.5, soil and groundwater chemistry data for the PEM facility are above SSTLs; therefore remediation based on risk to human health may be appropriate. Based on the exceedence of the SSTLs, remedial measures were evaluated by PES. Cleanup goals, as discussed in Section 3.5, are presented in Table 3.

Six remedial measures were considered for this site: (1) no action; (2) soil excavation, (3) enhanced in-situ bioremediation of groundwater; (4) a combination of soil excavation and enhanced in-situ bioremediation of groundwater; (5) installing several recovery wells and extracting and treating affected groundwater; and (6) a combination of extracting and treating affected groundwater and soil excavation. A task matrix identifying applicable work components of the six alternatives is included as Table 4. This section briefly describes each of these remedial measures and discusses the relative advantages of each. Criteria used in evaluating whether remedial alternative is appropriate included technical practicability, effectiveness, risk, and regulatory acceptance.

4.1 Alternative 1 - No Action

Following ACEHS guidance at sites where the ecological and/or human health risk evaluation has determined that no significant risk to human health or the environment is present, a no action alternative may be appropriate if natural biological degradation of petroleum hydrocarbons at the site could be demonstrated to be occurring. In order to implement a "no action" alternative, strategies for administrative controls may need to be developed between the property owners, ACEHS, and the RWQCB. Administrative controls could include deed restrictions, zoning restrictions, appropriate building ventilation operation, and access barriers. Since the only pathways identified which exceeded SSTLs were inhalation of benzene and toluene inside a building situated in the vicinity of monitoring well MW-4, prohibiting construction of buildings over these locations and maintaining the paved ground surface would also achieve the objective of protecting worker health.

The "no action" alternative does not actively reduce the threat to human health or the toxicity or volume of affected soils and or groundwater. Implementability of the "no action" alternative would be relatively simple but is not feasible because PHCs have already been detected near the property boundary and ACEHS has requested that plume migration be stopped. For these reasons, the "no action" alternative was not chosen.

4.2 Alternative 2 - Soil Excavation

As discussed in Section 3.5.1, there is currently no complete enclosed air pathway for PHCs in soil at the site and no soil remediation is required. Soil excavation could be performed over the two limited areas (immediately south and west of the UST excavation) to address potential exposure if development occurs in the future.

Excavation of affected soil, and replacement with clean, imported fill materials would result in the reduction of the volume of soil containing aromatic hydrocarbons and therefore, lower the risk to human health at the subject site. The excavated soil would be sent to an offsite permitted landfill for proper disposal. Soil used for backfilling the excavation would be of an equivalent hydraulic conductivity of the native soils excavated, and would be compacted to 90 percent relative density.

The soil excavation alternative would result in the generation of solid wastes, which would require characterization and profiling prior to receiving approval from the landfill for the material. Based on the expected areas of excavation, an estimated 7,500 cubic yards of soil would be generated (assumes a 35 foot x 35 foot x 10 foot excavation south of the former UST excavation, a 40 foot x 30 foot x 10 foot excavation west of the former UST excavation, and a 50 percent soil bulking factor.)

Confirmation sidewall soil samples would be collected and analyzed to demonstrate that the cleanup objectives were reached. Groundwater is not expected to be encountered during the excavation. However, if groundwater is encountered, samples would be collected and analyzed to evaluate disposal options.

The soil excavation alternative is relatively simple to perform and would be effective in further reducing the overall onsite risk to human health. However, this alternative would result in demolition of at least a portion of the warehouse at the site and create a significant disruption of day to day activities at PEM. The soil excavation alternative may not result in a significant reduction of concentrations of PHCs dissolved in groundwater.

The soil excavation alternative is likely to be acceptable to the ACEHS.

4.3 Alternative 3 - Enhanced In-Situ Bioremediation of Groundwater

In-situ bioremediation utilizes naturally occurring microbes that oxidize or degrade petroleum hydrocarbons. Bioremediation involves stimulating native bacteria through the addition of oxygen and possibly nutrients to the affected zone, which results in the accelerated degradation of petroleum hydrocarbons by these microbes. This remedial technology has been previously

approved by the RWQCB and implemented at similar sites in California. The equation below describes the complete microbial aerobic degradation of a petroleum hydrocarbon to carbon dioxide and water:

$$C_6H_{14} + 9.5O_2 \longrightarrow 6CO_2 + 7H_2O$$

Typically, oxygen concentration in the subsurface has been found to be the limiting factor to biological activity (Wilson and Brown, 1989). Based on the stochiometry of the above equation, approximately 3.5 pounds of oxygen is required to degrade one pound of petroleum hydrocarbons with the formula C_6H_{14}. As oxygen is utilized by the native bacteria to degrade hydrocarbons, dissolved oxygen concentrations are expected to decline exponentially over time. Dissolved oxygen is therefore an indirect indicator of hydrocarbon concentration.

Enhanced in-situ bioremediation methods are designed to introduce oxygen and nutrients into groundwater at the site to enhance biodegradation rates of petroleum hydrocarbons. The methods include: (1) adding a nutrient- and hydrogen peroxide-enriched water (hereinafter referred to as enriched water), and (2) placement of Oxygen Releasing Compound (ORC) in selected wells at the site.

Enriched water consists of concentrated hydrogen peroxide and nutrients mixed with dechlorinated potable water. When the enriched water is introduced, the hydrogen peroxide decomposes into water and oxygen. The introduction of enriched water provides several advantages over other techniques for supplying oxygen to groundwater. Enriched water carries more oxygen than ORC- or oxygen-saturated water and the use of concentrated hydrogen peroxide can prevent biofouling in wells. Periodic addition of enriched water does not require installation of a permanent distribution system and does not preclude the subsequent use of other remedial actions should they be required.

ORC is a powder form of time release magnesium peroxide. The ORC is blended with an inert carrier matrix of sand and the blend is contained in an approximately two-inch diameter polyethylene webbed sock in one-foot lengths (ORC Filter Sock). The ORC Filter Socks become saturated following insertion into groundwater, and begin releasing oxygen into the subsurface. The ORC product contains both magnesium oxide and magnesium peroxide (the active ingredient). Essentially, ORC is "oxygenated magnesia" and releases the oxygen upon contact with water. The spent magnesium peroxide is converted to magnesium hydroxide (a suspension of magnesium hydroxide in water is ordinary "milk of magnesia"). ORC releases of oxygen have been documented to enhance microbial growth in both soil and groundwater, and in turn, accelerate biodegradation rates of petroleum hydrocarbons.

Enhanced in-situ bioremediation of groundwater is an effective method of utilizing naturally occurring processes to remediate petroleum hydrocarbon contamination. It is quickly implemented, effective in reducing the mass of contaminants, and causes little disturbance to site activities. In addition, in-situ bioremediation destroys, rather than transfers contaminants

like several common above-ground treatment technologies (i.e., air stripping and granular activated carbon). The passive bioremediation alternative is likely to be acceptable to ACEHS.

Due to the ease of implementability and demonstrated effectiveness at other sites, the use of ORC was chosen as the preferred method of oxygen addition to groundwater.

4.4 Alternative 4 - Soil Excavation and Enhanced In-Situ Bioremediation

Combining and implementing Alternatives 2 and 3, soil excavation and enhanced in-situ bioremediation, would result in a significant reduction of the mass of contaminants, in both soil and groundwater at the site.

4.5 Alternative 5 - Groundwater Extraction and Treatment

Groundwater extraction is accomplished using a submersible pump installed within a groundwater extraction well. The groundwater is pumped from the well and directed via underground piping to a treatment system. Once extracted, the groundwater may be treated by air stripping, adsorption (i.e., activated carbon), or ex-situ bioremediation depending upon the nature of the chemicals of concern. However, dissolved-phase MTBE is difficult to strip from the water and may require significant treatment prior to discharge. After treatment, the groundwater is disposed by discharge to the sanitary or storm sewer system. Discharge to the sanitary sewer requires approval from the local publicly-owned treatment works (POTW), while discharge to the storm sewer requires a National Pollutant Discharge and Elimination System (NPDES) permit.

The groundwater extraction technique requires periodic monitoring and sampling of monitoring wells to identify changes in chemical concentrations and potential exposures at the site. The groundwater extraction technique would provide migration control for the affected groundwater but may not significantly reduce the PHC mass in groundwater. For groundwater extraction to be effective, the water-bearing zone must be sufficiently transmissive to provide an adequate pumping rate and capture zone. Under the ideal environment, groundwater extraction and treatment could effectively reduces the toxicity, mobility, and volume of affected groundwater. Groundwater extraction and treatment would likely be acceptable to regulatory agencies.

In general, groundwater extraction may reduce contaminant migration; however, it is not effective at the site where the water-bearing zone is low in transmissivity. In addition, groundwater extraction is a lengthy and expensive remedial process. For this reason, groundwater extraction is not a suitable technology for use at this site.

4.6 Alternative 6 - Soil Excavation and Groundwater Extraction and Treatment

Combining and implementing Alternatives 2 and 5, soil excavation and groundwater extraction and treatment, would result in a significant reduction of the mass of contaminants, in both soil and groundwater at the site.

4.7 Preferred Remedial Action Alternative

The objective for all remedial alternatives evaluated is to meet the cleanup goals in accordance with ACEHS policies for fuel leaks. PES has evaluated six remedial alternatives and recommends that Alternative 3 be chosen. Alternative 3 consists of enhanced in-situ bioremediation of groundwater. In PES' opinion, Alternative 3 meets the objective of achieving cleanup goals and is expected to be acceptable to ACEHS.

5.0 CORRECTIVE ACTION PLAN IMPLEMENTATION

This section discusses the rationale for selection of the preferred remedial alternative as well as the preliminary design of the recommended corrective action. Schedules for corrective action implementation, monitoring, and reporting are also presented.

5.1 Selection of Corrective Action

As discussed in Section 4.0, six remedial alternatives were considered for this site. All options were carefully evaluated with respect to site conditions, technical practicability, effectiveness, risk, ease of implementation, and regulatory acceptance. Enhanced in-situ bioremediation was selected as the preferred remedial alternative for the following reasons:

- The technique will effectively reduce the mass of contaminants onsite, limit migration of the groundwater plume, and provide a further measure of reduced risk to human health and the environment;
- The selected alternative can be quickly implemented at the site and cause minor disruption of existing or potential future site activities; and
- Enhanced in-situ bioremediation can be performed economically.

Based on the above-stated reasons, enhanced in-situ bioremediation is technically feasible at the site, provides an additional measure of safety compared to existing conditions, and is cost-effective. Therefore, PES recommends the implementation of this remedial measure at this site.

5.2 Preliminary Corrective Action Design

The in-situ bioremediation system will consist of ORC injected by direct push drilling, placement of ORC socks placed in wells, and quarterly groundwater monitoring.

5.2.1 ORC Injection

ORC will be injected into the saturated zone as a slurry using direct-push drilling methodology. On the basis of the site lithology consisting primarily of silts and sands, and the relatively flat water table, a grid spacing of approximately 10 feet will provide adequate density to release oxygen over the plume area. PES estimates that the borings will cover an 50-foot by 80-foot area between the former UST excavation area and the south property line. The area of application is superimposed on the July 1999 water-level elevation map (Plate 3).

5.2.2 ORC Placement in Wells

ORC filter socks will be placed in wells MW-1, WAC-1, and MW-4 (Plate 3). The ORC Filter Socks will provide a continuous supply of oxygen, and will be replaced when they no longer maintain elevated dissolved oxygen concentrations.

To monitor the effectiveness of ORC, periodic dissolved oxygen measurements will be collected from all five monitoring wells. Initially, following installation of the ORC filter socks, dissolved oxygen measurements will be collected once per month to determine an initial rate of consumption of ORC. PES estimates that the ORC will be replaced after approximately every three months of use.

5.2.3 Quarterly Groundwater Monitoring

A quarterly groundwater monitoring program will be performed concurrently with passive in-situ bioremediation. The current groundwater monitoring program, in progress since 1997, will continue. The program includes the collection and analysis of groundwater samples from wells MW-1 through MW-4 for TPHg, BTEX, and MTBE. In addition, groundwater samples will be analyzed in the field for dissolved oxygen to demonstrate that biological degradation of petroleum hydrocarbons is occurring.

5.3 Schedule of Corrective Action Implementation, Monitoring, and Reporting

Upon ACEHS approval of this CAP, the corrective action will be implemented. The remediation program will consist of the following elements: (1) ORC placement; and (2) quarterly monitoring. Each of these activities is described below.

5.3.1 ORC Injection

Prior to performing the direct-push injection of ORC slurry, PES will obtain appropriate permits from Alameda County and clear the area for underground utilities. We anticipate that the field work will require approximately three weeks to complete, assuming prompt availability of subcontractors and materials.

5.3.2 ORC Placement in Monitoring Wells

The ORC filter socks will be installed in wells MW-1, WAC-1, and MW-4. PES estimates that the ORC filter socks will require replacement every 3 months, and will perform bioremediation for one year.

5.3.3 Quarterly Groundwater Monitoring

Quarterly groundwater monitoring at the site will continue in accordance with the current quarterly groundwater monitoring program for a period of one year. Samples will be collected from monitoring wells MW-1 through and MW-4 for laboratory analysis. Water-levels in all the wells will be measured and converted to water-level elevations to evaluate groundwater gradient. Water-level measurements will be obtained using an electronic water-level sounder.

Prior to sampling each well, a minimum of three well volumes will be purged using a clean stainless steel bailer, bladder pump, or Teflon bailer. During purging, the discharge water will be monitored for pH, temperature, and electrical conductivity. Once the water quality parameters have stabilized, groundwater samples will be collected using a Teflon bailer. Well development water and purge water will be stored onsite in 55-gallon drums for later disposal. The groundwater samples collected from the wells will be submitted to a California certified analytical laboratory under chain-of-custody procedures for laboratory analyses of TPHg by EPA Method 5030/8015 modified, and BTEX and MTBE by EPA Method 8020. Detected concentrations of MTBE will be confirmed using EPA Test Method 8260.

Quarterly groundwater monitoring will continue for a period of one year following performance of the passive bioremediation program and then convert to an annual compliance program, if warranted. The annual program is expected to continue for a period of two years.

5.4 Performance Criteria

PES will evaluate the progress of the bioremediation program on a quarterly basis and adjust the ORC usage and monitoring programs as necessary to maximize biodegradation of hydrocarbons. Any modifications to the bioremediation program will be discussed in the quarterly reports.

At the end of the first year of corrective action, PES will evaluate the monitoring data and analytical results of groundwater samples. The concentrations of BTEX remaining in the groundwater will be compared to the site-specific cleanup levels.

5.5 Reporting

PES will prepare quarterly reports summarizing the results of ongoing groundwater monitoring activities. In addition, these reports will provide data regarding the bioremediation program. The reports will include a discussion of remedial activities, water-level measurements, a brief description of sampling procedures, a summary of chemical analysis results, and a brief evaluation and interpretation of results. Copies of laboratory reports and chain-of-custody forms will be included. The initial quarterly report will include a description of the ORC injection program.

At the end of one year, PES will review and summarize the results and assess whether the program is effective in remediating hydrocarbon affected groundwater at the site. Recommendations will be developed for future remedial actions at the site, which may include continuation of the enhanced in-situ bioremediation program, or if appropriate, a different remedial response. A petition to ACEHS or RWQCB for case closure will be prepared once site data and regulatory environment suggests that closure is appropriate.

6.0 SUMMARY AND CONCLUSIONS

Based on the evaluation of site-specific data, site-specific soil and groundwater cleanup goals were established for unsaturated soil and groundwater following RBCA guidelines. These cleanup goals were developed utilizing very conservative U.S. EPA exposure factors, and are designed to be protective of sensitive receptors in a chronic, lifetime exposure scenario. The results of this assessment indicated that benzene in unsaturated soil at the Excavation 2 area and groundwater and surficial soil at the Excavation 1 area exceed risk-based screening levels. Because benzene concentrations in soil and groundwater exceed the RBSLs, corrective action for petroleum hydrocarbon affected soil and groundwater may be warranted.

For this site, PES recommends enhanced in-situ bioremediation of groundwater as the remedial approach. To ensure that the bioremediation program is implemented in the most effective manner, PES will perform monitoring activities on a periodic basis. In addition, performance criteria have been established to provide a basis for evaluating the need for additional remedial efforts or for case closure.

7.0 REFERENCES

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Table 1. Summary of Historical Analytical Results for Soil Samples
Pacific Electric Motor Company
1009 66th Avenue, Oakland, California

Sample Location	Date Sampled	Depth	TPH-g	Benzene	Toluene	EB	Total Xylenes	MTBE
1995 WAC Investigation[1]								
GP1	8/24/95	5	130	0.33	3.1	2.2	13	--
	8/24/95	10	1100	13	72	28	150	--
	8/24/95	17	ND	ND	ND	ND	ND	--
GP2	8/24/95	8	1900	ND	6	40	220	--
	8/24/95	13	530	ND	12	1.4	53	--
	8/24/95	18	ND	ND	0.005	ND	0.012	--
	8/24/95	23	5.2	0.01	0.083	0.034	0.14	--
GP3	8/24/95	4.5	ND	ND	ND	ND	ND	--
	8/24/95	11	ND	ND	ND	ND	ND	--
	8/24/95	15.5	ND	ND	ND	ND	ND	--
	8/24/95	20	ND	ND	ND	ND	ND	--
GP4	8/24/95	5	1.3	0.024	0.007	0.006	0.18	--
	8/24/95	10.5	970	11	47	23	130	--
	8/24/95	15.5	ND	ND	0.006	ND	0.013	--
	8/24/95	20	ND	ND	ND	0.007	0.008	--
GP5	8/24/95	5	ND	ND	0.006	0.006	0.049	--
	8/24/95	12.25	230	0.97	10	4.9	27	--
	8/24/95	20	ND	ND	ND	ND	ND	--
GP6	8/25/95	5	ND	ND	ND	ND	ND	--
	8/25/95	10.5	ND	ND	ND	ND	ND	--
	8/25/95	15.5	ND	ND	ND	ND	ND	--
	8/25/95	20	ND	ND	ND	ND	ND	--
	8/25/95	25	ND	ND	ND	ND	ND	--
GP7	8/25/95	8	1300	16	99	31	170	--
	8/25/95	14	260	1.5	8.9	5.1	27	--
	8/25/95	19	ND	ND	ND	ND	ND	--
	8/25/95	24	6.5	0.03	0.18	0.086	0.44	--
	8/25/95	29	ND	ND	0.017	ND	0.012	--
GP8	8/25/95	5	ND	ND	0.012	ND	0.023	--
	8/25/95	12	ND	ND	ND	ND	ND	--
	8/25/95	19	ND	ND	ND	ND	ND	--
GP9	8/25/95	5	1.2	0.16	ND	0.1	0.17	--
	8/25/95	10	1300	14	75	28	160	--
	8/25/95	15	32	1.5	2.2	0.85	4.4	--
	8/25/95	19.5	1.3	0.011	0.02	0.027	0.13	--
1995 WAC UST Excavation Limits[2]								
11-TB-0-W	4/11/95	6	2,800	18	150	72	420	--
1 SWN	8/24/95	11	260	4.4	10	8.1	38	--
2 SWN	8/24/95	20	ND	ND	ND	ND	ND	--
3 SWN	8/24/95	10	530	6.6	41	14	82	--
4 SWN	8/24/95	14	51	0.37	0.11	2.3	0.21	--

Table 1. Summary of Historical Analytical Results for Soil Samples
Pacific Electric Motor Company
1009 66th Avenue, Oakland, California

Sample Location	Date Sampled	Depth	TPH-g	Benzene	Toluene	EB	Total Xylenes	MTBE
(continued)								
5 SWN	8/24/95	21	300	1.4	1.1	0.52	0.33	--
6 PBN	8/24/95	22	300	2.3	1.2	3.2	0.96	--
7 PBN	8/24/95	24	58	0.98	0.1	0.86	0.35	--
8 SWN	8/24/95	13	930	7.4	50	19	110	--
9 SWN	8/24/95	20	1.7	0.026	0.02	0.034	0.13	--
10 PBS	8/24/95	21	93	0.75	0.33	0.55	1.5	--
11 PBS	8/24/95	12	320	0.71	1.1	5.9	7.9	--
12 SWE	8/24/95	21	120	1.6	0.61	2.1	1.5	--
1-82595	8/25/95	23	ND	ND	ND	ND	ND	--
4-82595	8/25/95	9	ND	ND	ND	ND	0.014	--
5-82595	8/25/95	3	1.2	ND	0.005	ND	0.04	--
6-82595	8/25/95	5	ND	ND	ND	ND	0.012	--
1-SW-SSW	8/29/95	13	690	22	22	16	90	--
3-PB-N	8/29/95	24	ND	ND	ND	ND	ND	--
PBSE	11/8/95	19	ND	ND	ND	ND	ND	ND
PBSM	11/9/95	19	ND	ND	ND	ND	ND	ND
PBSW	11/10/95	14	ND	ND	ND	ND	ND	ND
PSSW	11/10/95	13	ND	ND	ND	ND	ND	ND
1997 ENVIRON Investigation[3]								
MW-1	6/10/97	16	480	1.4	0.71	11	35	--
MW-2	6/10/97	16	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	--
MW-3	6/10/97	10	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	--
1998 PES Investigation[4]								
SB-1	9/14/98	5.5	<1.0	<0.005	<0.005	<0.005	0.012	<0.05
SB-2	9/14/98	5.5	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
MW-4	9/14/98	5	21	0.085	0.28	0.23	1.7	<0.25
	9/14/98	10.5	660	2.8	34	13	70	<0.25
	9/14/98	15.5	3.9	0.77	0.037	0.10	0.31	3.8

Notes:
All results in milligrams per kilogram (mg/kg)
TPH-g = Total petroleum hydrocarbons quantified as gasoline
EB = Ethyl benzene
MTBE = Methyl tert-butyl ether
-- = Not analyzed
ND = Not detected at or above laboratory reporting limit (not provided in W.A. Craig reports)
<1.0 = Not detected at or above laboratory reporting limit indicated
[1] = W.A. Craig, May 16, 1995
[2] = W.A. Craig, May 12, 1997
[3] = ENVIRON, July 9, 1997
[4] = PES, November 11, 1998

Table 2. Summary of Historical Analytical Results for Groundwater Samples
Pacific Electric Motor Company
1009 66th Avenue, Oakland, California

Sample Location	Date Sampled	Sampled By	TPH-g (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Xylenes (µg/L)	MTBE EPA 8020 (µg/L)	MTBE EPA 8260 (µg/L)
MW-1	6/19/97	ENVIRON	18,000	3,300	200	1,100	4,900	<250	--
	9/29/97	PES	29,000	4,800	<25	2,000	3,500	<250	--
	12/16/97	PES	<50	1.3	<0.5	0.6	0.7	<5	--
	3/10/98	PES	190	2.0	<0.5	5.7	1.7	<5	--
	1/19/99	PES	1,000	40	<0.5	18	68	8.3	6.9
	4/15/99	PES	<50	0.92	0.9	0.7	0.87	<5.0	--
	7/30/99	PES	1,400	60	<0.5	63	120	13	<5.0
MW-2	6/19/97	ENVIRON	<50	<0.5	<0.5	<0.5	<0.5	<5.0	--
	9/29/97	PES	<50	<0.5	<0.5	<0.5	<0.5	<5	--
	12/16/97	PES	<50	<0.5	<0.5	<0.5	<0.5	<5	--
	3/10/98	PES	<50	<0.5	<0.5	<0.5	<0.5	<5.0	--
	1/19/99	PES	<50	<0.5	<0.5	<0.5	<0.5	<5.0	<5.0
	4/15/99	PES	<50	0.75	0.64	<0.5	0.74	<5.0	--
	7/30/99	PES	<50	<0.5	<0.5	<0.5	<0.5	<5.0	--
MW-3	6/19/97	ENVIRON	<50	<0.5	<0.5	<0.5	<0.5	<5.0	--
	9/29/97	PES	<50	<0.5	<0.5	<0.5	<0.5	<5	--
	12/16/97	PES	<50	<0.5	<0.5	<0.5	<0.5	<5	--
	3/10/98	PES	<50	<0.5	<0.5	<0.5	<0.5	<5.0	--
	1/19/99	PES	<50	0.78	<0.5	<0.5	<0.5	8.7	<5.0
	4/15/99	PES	<50	5.4	3.9	1.7	5.6	23	25
	7/30/99	PES	<50	<0.5	<0.5	<0.5	<0.5	<5.0	--
MW-4	9/15/98	PES	170,000	26,000	32,000	2,900	18,000	26,000	--
	1/19/99	PES	2,600	1,700	3.8	25	29	13,000	16,000
	4/15/99	PES	210,000	28,000	15,000	3,700	19,000	52,000	67,000
	7/30/99	PES	91,000	16,000	7,500	2,300	8,500	68,000	67,000

Notes:
TPH-g = Total petroleum hydrocarbons quantified as gasoline (EPA 8015M).
MTBE = Methyl tert-butyl ether (EPA 8020; detected concentrations were confirmed by EPA 8260.)
µg/L = Micrograms per liter.
<50 = Not detected at or above the indicated laboratory reporting limit.

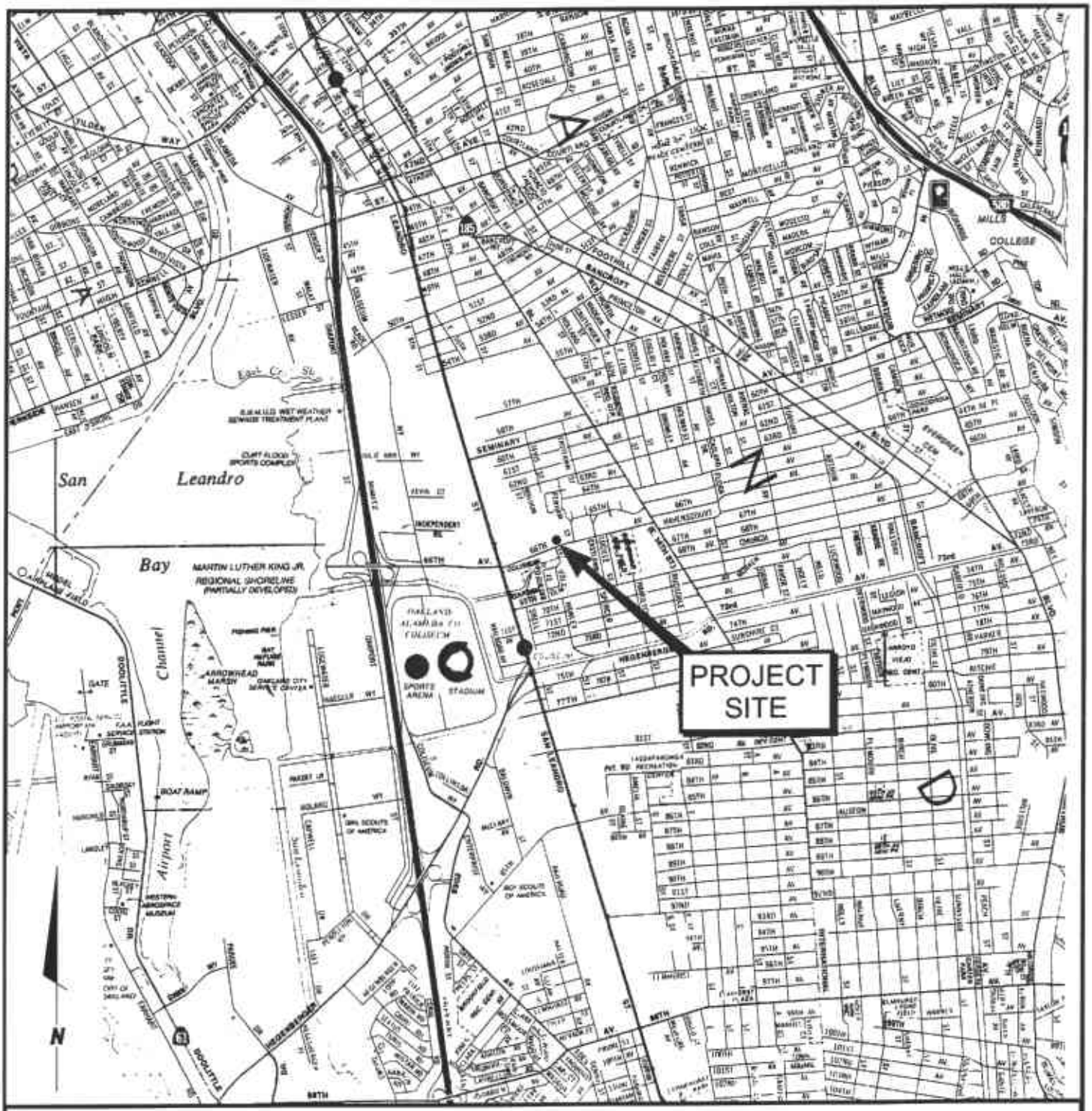
Table 3. Maximum PHC Concentrations and Applicable RBSLs and SSTLs
Pacific Electric Motor Company
1009 66th Avenue, Oakland, California

Sample Location	Soil Sample Depth (feet bgs)	Volatilization From Subsurface Soil (mg/kg) To: Indoor Air		Volatilization From Subsurface Soil (mg/kg) To: Outdoor Air		Volatilization From Groundwater (µg/L) To: Indoor Air	Volatilization From Groundwater (µg/L) To: Outdoor Air
		Benzene	Toluene	Benzene	Toluene	Benzene	Benzene
1 SWN	11	4.4*					
3 SWN	10	6.6*					
4 SWN	14	0.37*					
5 SWN	21	1.4*					
6 PBN	22	2.3*					
7 PBN	24	0.98*					
8 SWN	13	7.4*					
10 PBS	21	0.75*					
11 PBS	12	0.71*					
12 SWE	21	1.6*					
1-SW-SSW	13	3.1*					
11-TB-0-W	6	18	150				
GP1	4.5	0.33					
	9.5	13					
GP4	10	11					
GP5	12	0.97*					
GP7	7.5	16 #					
	12	1.5 #					
GP9	9.5	14					
	14.5	1.5					
MW-1	15.5	1.4*					
MW-4	10.5	2.8*				28,000	28,000
	15.5	0.77*					
RBSL		0.1	120	22	>res	150	25,000
SSTL		0.1	120	22	>res	150	25,000

Notes:
RBSL = Applicable Risk-Based Screening Level
SSTL = Applicable Site-Specific Target Level
bgs = Below ground surface
mg/kg = Miilligrams per kilogram
µg/L = Micrograms per liter
MTBE = Methyl tert-butyl ether
* = Sample collected below water table
# - Samples removed during overexcavation
>res = Risked based target concentration greater than constituent saturation value

Table 4. Remedial Alternatives Task Matrix
Pacific Electric Motor Company
1009 66th Avenue, Oakland, California

Alternative	Institutional Controls	Soil Excavation	Enhanced Bioremediation of Groundwater	Groundwater Extraction & Treatment	Monitoring and Reporting
1) No Action	X				X
2) Soil Excavation		X			X
3) Enhanced Bioremediation of Groundwater			X		X
4) Soil Excavation and Enhanced Bioremediation of Groundwater		X	X		X
5) Groundwater Extraction and Treatment	X			X	X
6) Soil Excavation and Groundwater Extraction/ Treatment	X	X		X	X



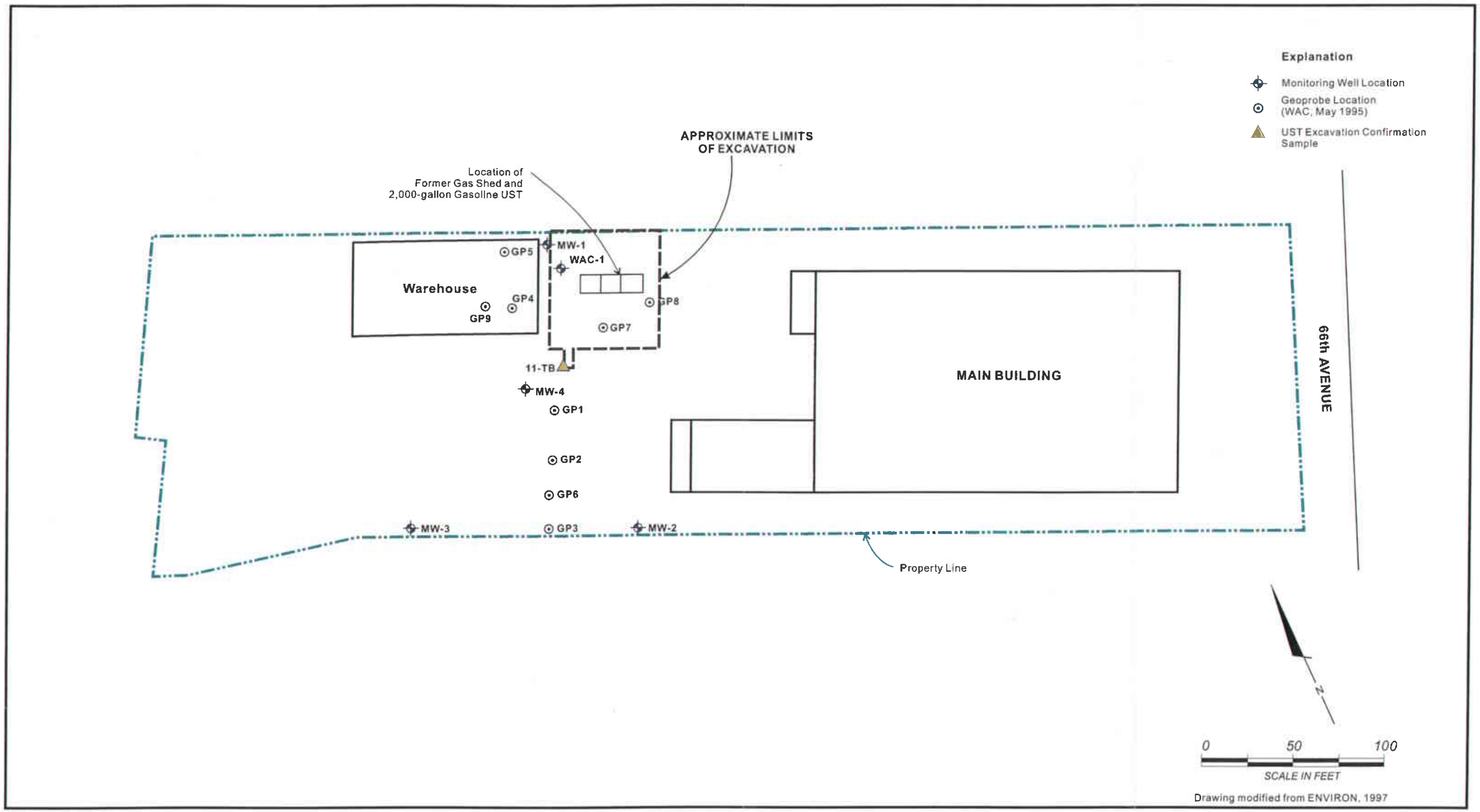
Oakland Map, California State Automobile Association, 1997.

PES Environmental, Inc.
Engineering & Environmental Services

Site Location Map
Pacific Electric Motor Company
1009 66th Avenue
Oakland, California

PLATE 1

618.00102.001	61800102001_V1.CDR		12/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE



Drawing modified from ENVIRON, 1997

PES Environmental, Inc.
Engineering & Environmental Services

Site Plan and Sampling Location Map
Pacific Electric Motor Company
1009 66th Avenue
Oakland, California

PLATE 2

618.00102.001	61800102001_WP.CDR		12/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

Explanation

- Monitoring Well Location
- 95.18 Water-Level Elevation (in feet, referenced to site datum.
- Groundwater contour (in feet referenced to site datum: dashed where inferred)
- ORC Application Area (refer to text for details)

Water levels measured on July 30, 1999.

APPROXIMATE LIMITS OF EXCAVATION

Location of Former Gas Shed and 2,000-gallon Gasoline UST

95.18
MW-1
WAC-1

Warehouse

MW-4
95.14

95.10

95.00

94.90

94.80

94.79
MW-3

95.06
MW-2

MAIN BUILDING

66th AVENUE

Property Line

N

0 50 100

SCALE IN FEET

Drawing modified from ENVIRON, 1997

PES Environmental, Inc.
Engineering & Environmental Services

Water-Level Elevation Map (July 1999) and ORC Application Area
Pacific Electric Motor Company
1009 66th Avenue
Oakland, California

PLATE 3

618.00102.001	61800102001_WP.CDR		12/99
JOB NUMBER	DRAWING NUMBER	REVIEWED BY	DATE

APPENDIX A

SELECTED ILLUSTRATIONS AND ANALYTICAL DATA FROM W.A. CRAIG AND ENVIRON REPORTS

TABLE 1

Soil Sample Analytical Results - Preliminary Excavation
1009 66th Avenue, Oakland, California
Analytical Results in milligrams per kilogram

Sample	Depth in feet	Date	ANALYTES						
			TPH-d	TPH-g	Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-mo
1D1W	1.75	4-7-95	160	460	1.9	3.1	8.1	24	15
1-SW-1-S	9	4-11-95	NA	1100	16	94	25	140	NA
2-PB-1-W	10.5		NA	400	5.8	33	8.9	53	NA
3-SW-1-W	9		NA	3.6	0.024	0.12	0.054	0.36	NA
4-SW-1-S	9		NA	980	15	82	21	120	NA
5-SW-1-S	9		NA	900	17	90	22	130	NA
6-PB-1-E	10.5		NA	310	4.2	3	8.2	16	NA
7-TB-0-E	10		NA	1200	14	84	26	150	NA
8-TB-0-S	10		NA	500	7.2	16	11	41	NA
9-TB-0-S	10		NA	1	0.018	0.035	0.024	0.1	NA
10-TB-0-W	13		NA	5700	62	420	130	770	NA
11-TB-0-W	6		NA	2800	18	150	72	420	NA

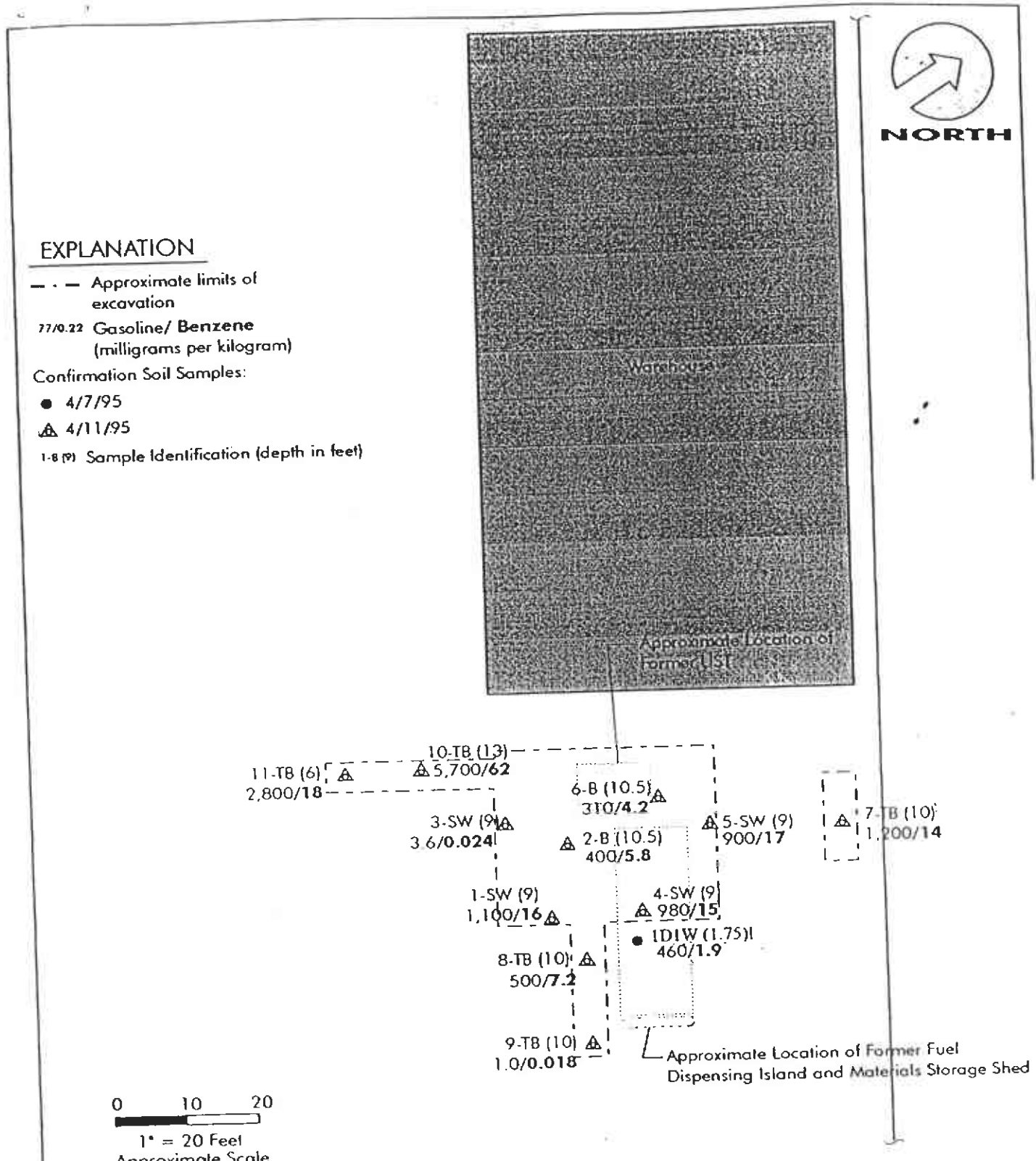
Notes: NA = Not analyzed.

TABLE 2

Soil Sample Analytical Results - Final Excavation Limits
1009 66th Avenue, Oakland, California
Analytical Results in milligrams per kilogram

Sample	Depth in feet	Date	ANALYTES								
			TPH-g	MTBE	Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-o&g	VOCs	PCBs
1 SWN	11	8-24-95	260	NA	4.4	10	8.1	38	NA	NA	NA
2 SWN	20		ND	NA	ND	ND	ND	ND	NA	NA	NA
3 SWN	10		530	NA	6.6	41	14	82	NA	NA	NA
4 SWN	14		51	NA	0.37	0.11	2.3	0.21	NA	NA	NA
5 SWN	21		300	NA	1.4	1.1	0.52	0.33	NA	NA	NA
6 PBN	22		300	NA	2.3	1.2	3.2	0.96	NA	NA	NA
7 PBN	24		58	NA	0.98	0.1	0.86	0.35	NA	NA	NA
8 SWN	13		930	NA	7.4	50	19	110	NA	NA	NA
9 SWN	20		1.7	NA	0.026	0.02	0.034	0.13	NA	NA	NA
10 PBS	21		93	NA	0.75	0.33	0.55	1.5	NA	NA	NA
11 PBS	12		320	NA	0.71	1.1	5.9	7.9	NA	NA	NA
12 SWE	21		120	NA	1.6	0.61	2.1	1.5	NA	NA	NA
1-82595	23	8-25-95	ND	NA	ND	ND	ND	ND	ND	NA	NA
4-82895	9	8-28-95	ND	NA	ND	ND	ND	0.014	ND	ND	ND
5-82895	3		1.2	NA	ND	0.005	ND	0.04	ND	ND	ND
6-82895	5		ND	NA	ND	ND	ND	0.012	ND	NA	NA
1-SW-SSW	13	8-29-95	690	NA	3.1	22	16	90	210	NA	NA
3-PB-N	24		ND	NA	ND	ND	ND	ND	ND	NA	NA
PBSE	19	11-8-95	ND	ND	ND	ND	ND	ND	ND	ND*	NA
PBSM	19	11-9-95	ND	ND	ND	ND	ND	ND	ND	ND*	NA
PBSW	14	11-10-95	ND	ND	ND	ND	ND	ND	NA	ND*	NA
PSSW	13		ND	ND	ND	ND	ND	ND	NA	ND*	NA

Notes:
NA = Not Analyzed
ND = Not detected at the laboratory reported limit of detection.
*Acetone analyzed only.



Project No. 3471.3

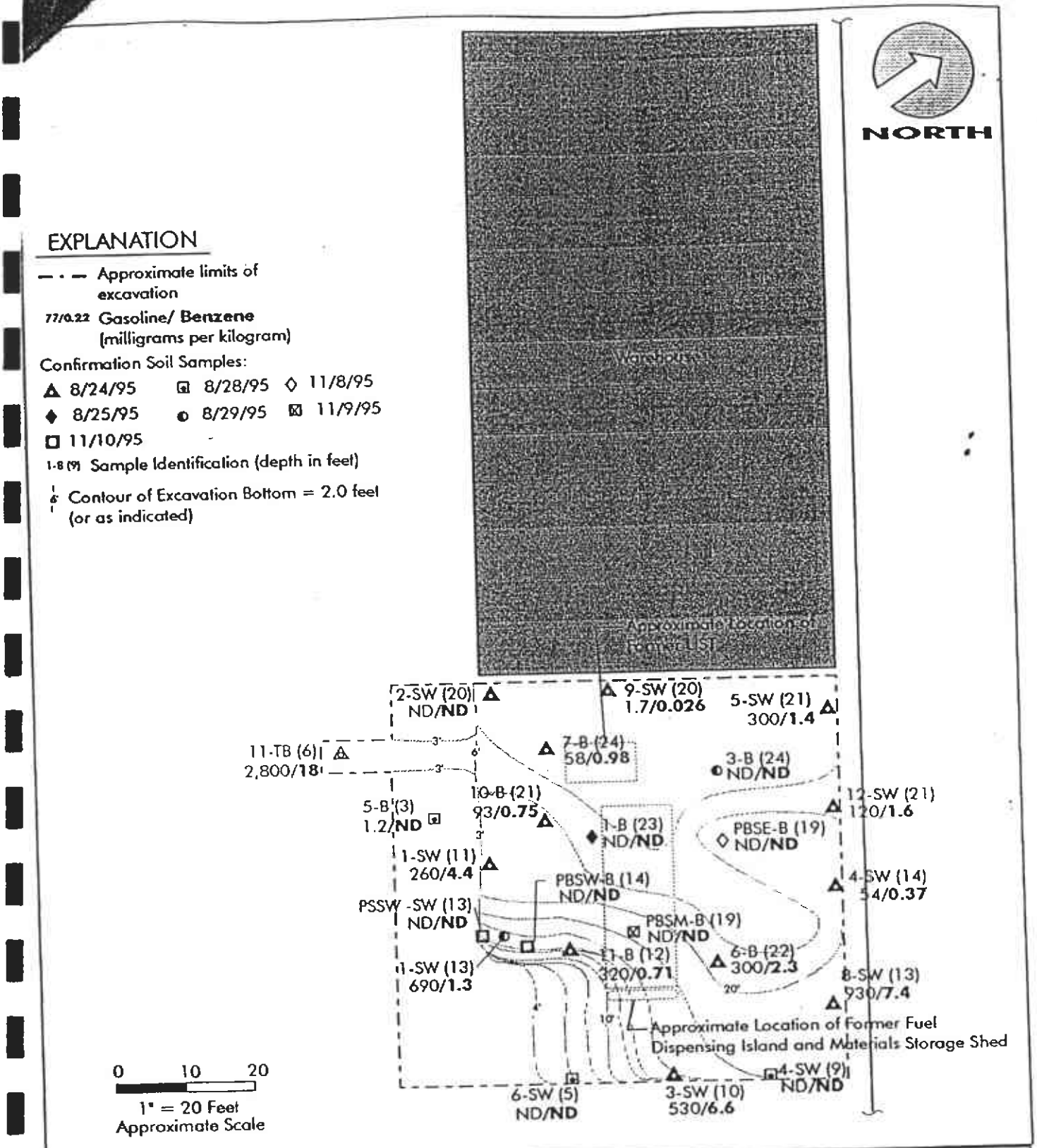
December 1996

Preliminary Excavation Limits
PEM
1009 66th Avenue
Oakland, CA

Figure 3

Checked by:

W. A. CRAIG, INC.
Environmental Contracting and Consulting
P. O. Box 448
Napa, California 94559-0448
Cal License #455752
(707) 252-3353
FAX (707) 252-3385



Project No. 3471.3

December 1996

Final Excavation Limits
PEM
1009 66th Avenue
Oakland, CA

Figure 4

Checked by:

W. A. CRAIG, INC.
Environmental Contracting and Consulting
P.O. Box 448
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McCAMPBELL ANALYTICAL INC.
110 2nd Avenue South, #D7, Pacheco, CA 94553
Tele: 510-798-1620 Fax: 510-798-1622

W.A. Craig, Inc.	Client Project ID: PEM	Date Sampled: 04/24-04/25/95
P.O. Box 448		Date Received: 04/25/95
Napa, CA 94559-0448	Client Contact: Bill Craig	Date Extracted: 04/25-04/26/95
	Client P.O:	Date Analyzed: 04/25-04/26/95

Gasoline Range (C6-C12) Volatile Hydrocarbons as Gasoline*, with BTEX*

EPA methods 5030, modified 8015, and 8020 or 602; California RWQCB (SF Bay Region) method GCFID(5030)

Lab ID	Client ID	Matrix	TPH(g)+	Benzene	Toluene	Ethylben-zene	Xylenes	% Rec. Surrogate
51957	GP1-4.5'-5'	S	130,b,d	0.33	3.1	2.2	13	97
51958	GP1-9.5'-10'	S	1100,b,d	13	72	28	150	101
51959	GP1-16.5'-17'	S	ND	ND	ND	ND	ND	105
51960	GP2-7.5'-8'	S	1900,b,d	ND< 0.2	6.0	40	220	103
51961	GP2-12.5'-13'	S	530,b,d	ND< 0.04	12	1.4	53	100
51962	GP2-17.5'-18'	S	ND	ND	0.005	ND	0.012	104
51963	GP2-22.5'-23'	S	5.2,b,d	0.010	0.083	0.034	0.14	100
51964	GP3-4'-4.5'	S	ND	ND	ND	ND	ND	109
51965	GP3-10.5'-11'	S	ND	ND	ND	ND	ND	104
51966	GP3-15'-15.5'	S	ND	ND	ND	ND	ND	108
51967	GP3-19.5'-20'	S	ND	ND	ND	ND	ND	107
51968	GP4-4.5'-5'	S	1.3,b,d	0.024	0.007	0.006	0.18	104
51969	GP4-10'-10.5'	S	970,b,d	11	47	23	130	106
51970	GP4-15'-15.5'	S	ND	ND	0.006	ND	0.013	104
Reporting Limit unless otherwise stated; ND means not detected above the reporting limit		W	50 ug/L	0.5	0.5	0.5	0.5	
		S	1.0 mg/kg	0.005	0.005	0.005	0.005	

* water and vapor samples are reported in ug/L, soil samples in mg/kg, and all TCLP extracts in mg/L

cluttered chromatogram; sample peak coelutes with surrogate peak

+ The following descriptions of the TPH chromatogram are cursory in nature and McCampbell Analytical is not responsible for their interpretation: a) unmodified or weakly modified gasoline is significant; b) heavier gasoline range compounds are significant(aged gasoline?); c) lighter gasoline range compounds (the most mobile fraction) are significant; d) gasoline range compounds having broad chromatographic peaks are significant; biologically altered gasoline?; e) TPH pattern that does not appear to be derived from gasoline (?); f) one to a few isolated peaks present; g) strongly aged gasoline or diesel range compounds are significant; h) lighter than water immiscible sheen is present; i) liquid sample that contains greater than ~ 5 vol. % sediment; j) no recognizable pattern

DHS Certification No. 1644

Edward Hamilton, Lab Director

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Tele: 510-798-1620 Fax: 510-798-1622

W.A. Craig, Inc.	Client Project ID: PEM	Date Sampled: 04/24-04/25/95
P.O. Box 448		Date Received: 04/25/95
Napa, CA 94559-0448	Client Contact: Bill Craig	Date Extracted: 04/25-04/26/95
	Client P.O:	Date Analyzed: 04/25-04/26/95

Gasoline Range (C6-C12) Volatile Hydrocarbons as Gasoline*, with BTEX*

EPA methods 5030, modified 8015, and 8020 or 602; California RWQCB (SF Bay Region) method GCFID(5030)

Lab ID	Client ID	Matrix	TPH(g)+	Benzene	Toluene	Ethylbenzene	Xylenes	% Rec. Surrogate
51971	GP4-19.5'-20'	S	ND	ND	ND	0.007	0.008	107
51972	GP5-4.5'-5'	S	ND,b,d	ND	0.006	0.006	0.049	106
51973	GP5-12'-12¼'	S	230,b,d	0.97	10	4.9	27	96
51974	GP5-19.5'-20'	S	ND	ND	ND	ND	ND	111
51975	GP6-4.5'-5'	S	ND	ND	ND	ND	ND	112
51976	GP6-10'-10.5'	S	ND	ND	ND	ND	ND	109
51977	GP6-15'-15.5'	S	ND	ND	ND	ND	ND	110
51978	GP6-19.5'-20'	S	ND	ND	ND	ND	ND	101
51979	GP6-24.5'-25'	S	ND	ND	ND	ND	ND	102
51980	GP7-7.5'-8'	S	1300,b,d	16	99	31	170	103
51981	GP7-13.5'-14'	S	260,b,d	1.5	8.9	5.1	27	102
51982	GP7-18.5'-19'	S	ND	ND	ND	ND	ND	101
51983	GP7-23.5'-24'	S	6.5,b,d	0.030	0.18	0.086	0.44	108
51984	GP7-28.5'-29'	S	ND,b	ND	0.017	ND	0.012	105
Reporting Limit unless otherwise stated; ND means not detected above the reporting limit		W	50 ug/L	0.5	0.5	0.5	0.5	
		S	1.0 mg/kg	0.005	0.005	0.005	0.005	

* water and vapor samples are reported in ug/L, soil samples in mg/kg, and all TCLP extracts in mg/L

cluttered chromatogram; sample peak coelutes with surrogate peak

+ The following descriptions of the TPH chromatogram are cursory in nature and McCampbell Analytical is not responsible for their interpretation: a) unmodified or weakly modified gasoline is significant; b) heavier gasoline range compounds are significant(aged gasoline?); c) lighter gasoline range compounds (the most mobile fraction) are significant; d) gasoline range compounds having broad chromatographic peaks are significant; biologically altered gasoline?; e) TPH pattern that does not appear to be derived from gasoline (?); f) one to a few isolated peaks present; g) strongly aged gasoline or diesel range compounds are significant; h) lighter than water immiscible sheen is present; i) liquid sample that contains greater than ~ 5 vol. % sediment; j) no recognizable pattern.

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Tele: 510-798-1620 Fax: 510-798-1622

W.A. Craig, Inc.	Client Project ID: PEM	Date Sampled: 04/24-04/25/95
P.O. Box 448		Date Received: 04/25/95
Napa, CA 94559-0448	Client Contact: Bill Craig	Date Extracted: 04/25-04/26/95
	Client P.O:	Date Analyzed: 04/25-04/26/95

Gasoline Range (C6-C12) Volatile Hydrocarbons as Gasoline*, with BTEX*

EPA methods 5030, modified 8015, and 8020 or 602; California RWQCB (SF Bay Region) method GCFID(5030)

Lab ID	Client ID	Matrix	TPH(g)+	Benzene	Toluene	Ethylben-zene	Xylenes	% Rec. Surrogate
51985	GP8-4.5'-5'	S	ND	ND	0.012	ND	0.023	103
51986	GP8-11.5'-12'	S	ND	ND	ND	ND	ND	93
51987	GP8-18.5'-19'	S	ND	ND	ND	ND	ND	98
51988	GP9-4.5'-5'	S	1.2,b,d	0.016	ND	0.10	0.17	105
51989	GP9-14.5'-15'	S	32,a	1.5	2.2	0.85	4.4	105
51990	GP9-19'-19.5'	S	1.3,a	0.011	0.020	0.027	0.13	101
51991	GP9-9.5'-10'	S	1300,b,d	14	75	28	160	101
Reporting Limit unless otherwise stated; ND means not detected above the reporting limit		W	50 ug/L	0.5	0.5	0.5	0.5	
		S	1.0 mg/kg	0.005	0.005	0.005	0.005	

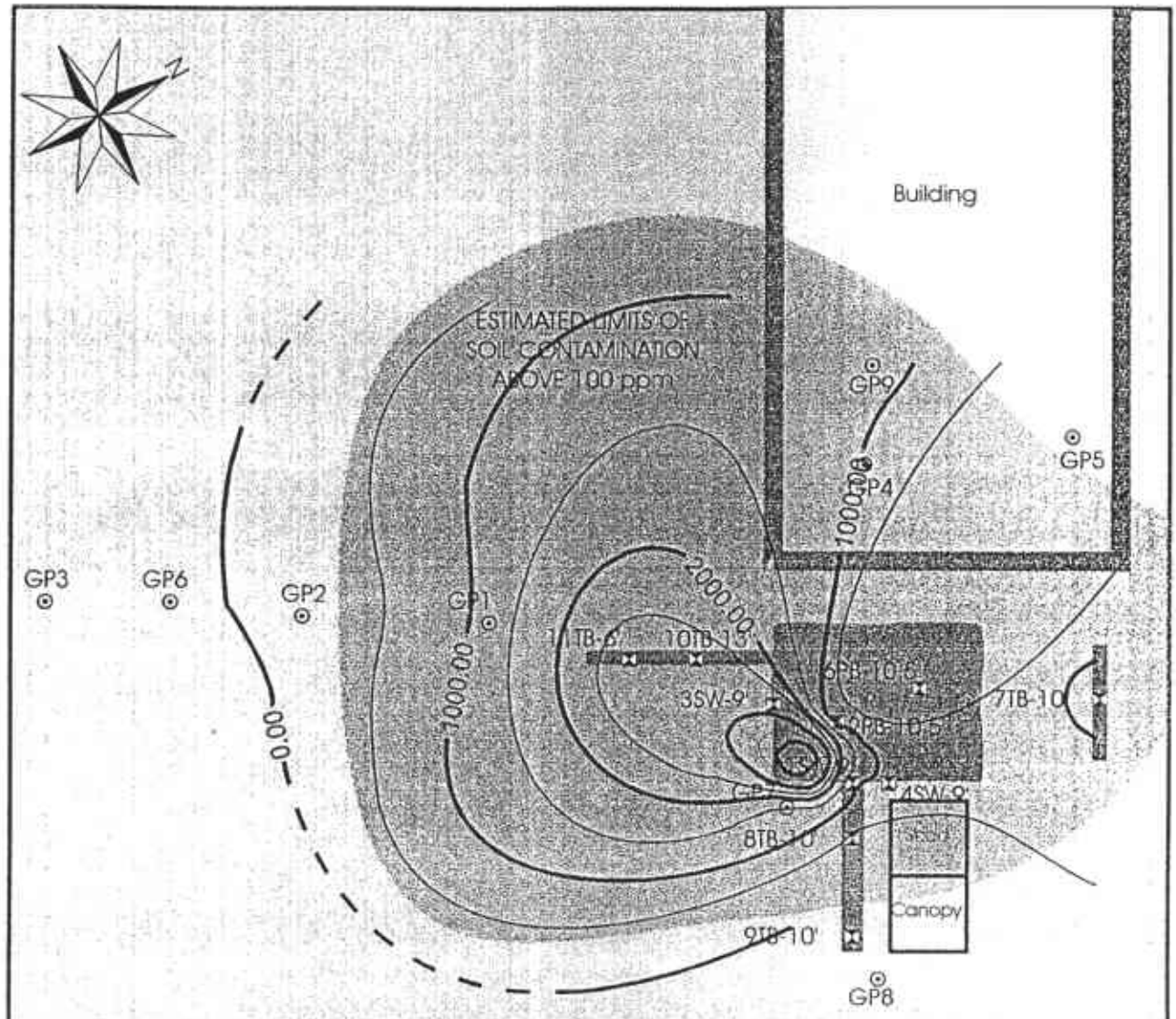
* water and vapor samples are reported in ug/L, soil samples in mg/kg, and all TCLP extracts in mg/L

cluttered chromatogram; sample peak coelutes with surrogate peak

+ The following descriptions of the TPH chromatogram are cursory in nature and McCampbell Analytical is not responsible for their interpretation: a) unmodified or weakly modified gasoline is significant; b) heavier gasoline range compounds are significant(aged gasoline?); c) lighter gasoline range compounds (the most mobile fraction) are significant; d) gasoline range compounds having broad chromatographic peaks are significant; biologically altered gasoline?; e) TPH pattern that does not appear to be derived from gasoline (?); f) one to a few isolated peaks present; g) strongly aged gasoline or diesel range compounds are significant; h) lighter than water immiscible sheen is present; i) liquid sample that contains greater than ~ 5 vol. % sediment; j) no recognizable pattern.

DHS Certification No. 1644

Edward Hamilton, Lab Director



Approximate Scale

0 20 40 FEET

Contour Interval 500 ppm

Lines with equal concentration are based on the highest TPH value between 4.5' and 10.5' per sampling location

Sample 3SW-9 is not included in the contours

Warehouse

W.A. CRAIG, INC.

P.O. BOX 448, NAPA, CALIFORNIA 94559-0448

DRAWING NO. 1
P.E.M. SAMPLE LOCATIONS
AND PLUME MAP

JOB # 3471C

1009 66th Avenue
Oakland, California

TABLE 2: SOIL ANALYTICAL RESULTS
Pacific Electric Motor Company, 1009 66th Avenue, Oakland, California

Well	MW-1	MW-2	MW-3	MW-3EB	MW-1TB
Depth	15.5-16.0	15.5-16.0	9.5-10.0	--	--
Sample Code	Sample	Sample	Sample	Equipment Blank	Trip Blank
Sample ID	MW1-10C-15.5	MW2-10C-15.5	MW3-6C-9.5	MW-3EB	MW-1TB
Date Sampled	6/10/97	6/10/97	6/10/97	6/10/97	6/10/97
Date Analyzed	6/18/97	6/18/97	6/18/97	6/13/97	6/13/97
Lab Report	9706106	9706106	9706106	9706106	9706106
Analytical Method	8020A/8015M	8020A/8015M	8020A/8015M	8020A/8015M	8020A
Units	mg/kg	mg/kg	mg/kg	µg/L	µg/L
Gasoline	480	<1.0	<1.0	<50	na
Benzene	1.4	<0.0050	<0.0050	<0.50	<0.50
Toluene	0.71	<0.0050	<0.0050	<0.50	<0.50
Ethylbenzene	11	<0.0050	<0.0050	<0.50	<0.50
Xylenes	35	<0.0050	<0.0050	<0.50	<0.50

Notes:

<xx = not detected above detection limit xx.
na = not analyzed

APPENDIX B

RISK-BASED CORRECTIVE ACTION MODEL DATA INPUT AND CALCULATED OUTPUT

RBCA CHEMICAL DATABASE

Physical Property Data

CAS Number	Constituent	type	Molecular Weight (g/mole) MW	ref	Diffusion Coefficients in air (cm2/s) Dair	ref	in water (cm2/s) Dwat	ref	log (Koc) or log(Kd) (@ 20 - 25 C) log(l/kg)	ref	Henry's Law Constant (@ 20 - 25 C) (atm-m3/mol	(unitless)	ref	Vapor Pressure (@ 20 - 25 C) (mm Hg)	ref	Solubility (@ 20 - 25 C) (mg/L)	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			
1634-04-4	Methyl t-Butyl Ether	O	88.146	5	7.92E-02	6	9.41E-05	7	1.08	A	5.77E-04	2.40E-02		2.49E+02		4.80E+04	A			
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: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakl Completed By: Ann Loomis Date Completed: 10/14/1999

Software version: 1.0.1

RBCA CHEMICAL DATABASE

Toxicity Data

CAS Number	Constituent	Reference Dose (mg/kg/day) Oral RfD_oral	ref	Inhalation RfD_inhal	ref	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	-		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	-		-		D	FALSE
1634-04-4	Methyl t-Butyl Ether	5.00E-03	R	8.57E-01	R	-		-			FALSE
108-88-3	Toluene	2.00E-01	A,R	1.14E-01	A,R	-		-		D	FALSE
1330-20-7	Xylene (mixed isomers)	2.00E+00	A,R	2.00E+00	A	-		-		D	FALSE

Site Name: Pacific Electric Motor Comp Site Location: 1009 66th Avenue, O Completed By: Ann Loomis Date Completed: 10/14/1999

Software version: 1.0.1

RBCA CHEMICAL DATABASE

Miscellaneous Chemical Data

CAS Number	Constituent	Maximum Contaminant Level MCL (mg/L)	reference	Permissible Exposure Limit PEL/TLV (mg/m3)	ref	Relative Absorption Factors Oral	Dermal	Detection Limits Groundwater (mg/L)	ref	Soil (mg/kg)	ref	Half Life (First-Order Decay) (days) Saturated	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	56 FR 3526 (30 Jan 91)	4.34E+02	ACGIH	1	0.5	0.002	C	0.005	S	228	228	H
1634-04-4	Methyl t-Butyl Ether			1.44E+02	ACGIH	1	0.5					360	180	H
108-88-3	Toluene	1.00E+00	56 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	56 FR 3526 (30 Jan 91)	4.34E+02	ACGIH	1	0.5	0.005	C	0.005	S	360	360	H

Site Name: Pacific Electric Motor Comp Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

Software version: 1.0.1

RBCA SITE ASSESSMENT | **Input Screen 7**

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

(Complete the following table)

CONSTITUENT	Representative COC Concentration					
	in Groundwater		in Surface Soil		in Subsurface Soil	
	value (mg/L)	note	value (mg/kg)	note	value (mg/kg)	note
Benzene	2.8E+1				1.8E+1	
Ethylbenzene	3.7E+0				7.2E+1	
Methyl t-Butyl Ether	6.8E+1					
Toluene	3.2E+1				1.5E+2	
Xylene (mixed isomers)	1.9E+1				4.2E+2	

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

RBCA SITE ASSESSMENT | **Input Screen 6.3**

CONSTITUENT MOLE FRACTIONS

(Complete the following table)

CONSTITUENT	Mole Fraction of Constituent in Source Material
Benzene	
Ethylbenzene	
Methyl t-Butyl Ether	
Toluene	
Xylene (mixed isomers)	

Site Name: Pacific Electric Motor Comp Completed By: Ann Loomis
Site Location: 1009 66th Avenue, Oakla Date Completed: 10/14/1999

RBCA SITE ASSESSMENT | **Input Screen 9.4**

GROUNDWATER DAF VALUES

(Enter DAF values in the grey area of the following table)

CONSTITUENT	Dilution Attenuation Factor (DAF) in Groundwater	
	Residential Receptor	Comm./Ind. Receptor
Benzene	1.0E+0	1.0E+0
Ethylbenzene	1.0E+0	1.0E+0
Methyl t-Butyl Ether	1.0E+0	1.0E+0
Toluene	1.0E+0	1.0E+0
Xylene (mixed isomers)	1.0E+0	1.0E+0

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

RBCA SITE ASSESSMENT | **Input Screen 9.1**

CONSTITUENT HALF-LIFE VALUES

(Complete the following table)

CONSTITUENT	Half-Life of Constituent (day)
Benzene	720
Ethylbenzene	228
Methyl t-Butyl Ether	
Toluene	28
Xylene (mixed isomers)	360

Site Name: Pacific Electric Motor Compa Completed By: Ann Loomis
Site Location: 1009 66th Avenue, Oaklan Date Completed: 10/14/1999

RBCA SITE ASSESSMENT

EXPOSURE LIMITS IN GROUNDWATER AND AIR

CONSTITUENT	Exposure Limits Applied to Receptors	
	Groundwater (MCL) (mg/L)	Air (Comm. only) (PEL/TLV) (mg/m^3)
Benzene		
Ethylbenzene		
Methyl t-Butyl Ether		
Toluene		
Xylene (mixed isomers)		

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

TIER 1 COMMERCIAL EXPOSURE SCENARIO

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Pacific Electric Motor Compadgb Identification: 618.0102.001
Site Location: 1009 66th Avenue, Oakland Date Completed: 10/14/1999
Completed By: Ann Loomis

Software: GSI RBCA Spreadsheet
Version: 1.0.1

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

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
t	Averaging time for vapor flux (yr)	30			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)?	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Outdoor Air Pathways:				
SS.v	Volatiles and Particulates from Surface Soil	FALSE	FALSE	TRUE
S.v	Volatilization from Subsurface Soils	FALSE	TRUE	
GW.v	Volatilization from Groundwater	FALSE	TRUE	
Indoor Air Pathways:				
S.b	Vapors from Subsurface Soils	FALSE	TRUE	
GW.b	Vapors from Groundwater	FALSE	TRUE	
Soil Pathways:				
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	TRUE
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	FALSE	
S.l	Leaching to Groundwater from all Soils	FALSE	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	1	

Surface Parameters	Definition (Units)	Residential	Constrctn
A	Contaminated soil area (cm^2)	***6.5E+06***	***4.6E+06***
W	Length of affect. soil parallel to wind (cm)	***3.0E+03***	***3.0E+03***
W.gw	Length of affect. soil parallel to groundwater (c	***3.0E+03***	
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02	
delta	Air mixing zone height (cm)	2.0E+02	
Lss	Thickness of affected surface soils (cm)	***1.5E+02***	
Pe	Particulate areal emission rate (g/cm^2/s)	6.9E-14	

Groundwate	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	***3.0E+02***
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	2.5E+03
Ugw.tr	Groundwater seepage velocity (cm/yr)	6.6E+03
Ks	Saturated hydraulic conductivity(cm/s)	
grad	Groundwater gradient (cm/cm)	
Sw	Width of groundwater source zone (cm)	
Sd	Depth of groundwater source zone (cm)	
phi.eff	Effective porosity in water-bearing unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	1.0E-03
BIO?	Is bioattenuation considered?	FALSE
BC	Biodegradation Capacity (mg/L)	

Soil	Definition (Units)	Value	capillary	vadose	foundation
hc	Capillary zone thickness (cm)	***1.5E+01***			
hv	Vadose zone thickness (cm)	***2.9E+02***			
rho	Soil density (g/cm^3)	1.7			
foc	Fraction of organic carbon in vadose zone	0.01			
phi	Soil porosity in vadose zone	0.38			
Lgw	Depth to groundwater (cm)	***3.0E+02***			
Ls	Depth to top of affected subsurface soil (cm)	***1.5E+02***			
Lsubs	Thickness of affected subsurface soils (cm)	***1.5E+02***			
pH	Soil/groundwater pH	6.5			
phi.w	Volumetric water content		0.342	0.12	0.12
phi.a	Volumetric air content		0.038	0.26	0.26

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	

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

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 |

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS: VAPOR AND DUST INHALATION

Constituents of Concern	Exposure Concentration 1) Source Medium: Surface Soil Conc. (mg/kg)	2) NAF Value (m^3/kg) Receptor		3) Exposure Medium: Outdoor Air: POE Conc. (mg/m^3) (1) / (2)		4) Exposure Multiplier (IRxEFxED)/(BWxAT) (m^3/kg-day)		5) Average Daily Intake Rate (mg/kg-day) (3) X (4)	
Benzene	8.5E-2								
Ethylbenzene	2.3E-1								
Methyl t-Butyl Ether	1.3E-1								
Toluene	2.8E-1								
Xylene (mixed isomers)	1.7E+0								

NOTE: ABS = Dermal absorption factor (dim); AF = Adherance factor (mg/cm^2); AT = Averaging time (days); BW = Body weight (kg); CF = Units conversion factor; ED = Exposure duration (yrs); EF = Exposure frequencey (days/yr); ET = Exposure time (hrs/day); IR = Inhalation rate (m^3/day); POE = Point of exposure; SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | 2 OF 9

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

SUBSURFACE SOILS: VAPOR INHALATION

Constituents of Concern	Exposure Concentration 1) Source Medium: Subsurface Soil Conc (mg/kg)	2) NAF Value (m^3/kg) Receptor: On-Site Commercial		3) Exposure Medium: Outdoor Air: POE Conc. (mg/m^3) (1) / (2) On-Site Commercial		4) Exposure Multiplier (IRxEFxED)/(BWxAT) (m^3/kg-day) On-Site Commercial		5) Average Daily Intake Rate (mg/kg-day) (3) X (4) On-Site Commercial	
Benzene	1.8E+1	4.5E+4		4.0E-4		7.0E-2		2.8E-5	
Ethylbenzene	7.2E+1	4.5E+4		1.6E-3		2.0E-1		3.1E-4	
Methyl t-Butyl Ether	1.3E-1	4.5E+4		2.8E-6		2.0E-1		5.4E-7	
Toluene	1.5E+2	4.5E+4		3.3E-3		2.0E-1		6.5E-4	
Xylene (mixed isomers)	4.2E+2	4.5E+4		9.3E-3		2.0E-1		1.8E-3	

NOTE: ABS = Dermal absorption factor (dim); AF = Adherance factor (mg/cm^2); AT = Averaging time (days); BW = Body weight (kg); CF = Units conversion factor; ED = Exposure duration (yrs); EF = Exposure frequencey (days/yr); ET = Exposure time (hrs/day); IR = Inhalation rate (m^3/day); POE = Point of exposure; SA = Skin exposue area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | *3 OF 9*

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: VAPOR INHALATION

Constituents of Concern	Exposure Concentration 1) Source Medium: Groundwater Conc. (mg/L)	2) NAF Value (m^3/L) Receptor: On-Site Commercial		3) Exposure Medium: Outdoor Air: POE Conc. (mg/m^3) (1) / (2): On-Site Commercial		4) Exposure Multiplier (IRxEFxED)/(BWxAT) (m^3/kg-day): On-Site Commercial		5) Average Daily Intake Rate (mg/kg-day) (3) X (4): On-Site Commercial		TOTAL PATHWAY INTAKE (mg/kg-day) (Sum intake values from surface, subsurface & groundwater routes.): On-Site Commercial	
Benzene	2.8E+1	5.0E+4		5.6E-4		7.0E-2		3.9E-5		6.7E-5	
Ethylbenzene	3.7E+0	4.9E+4		7.5E-5		2.0E-1		1.5E-5		3.3E-4	
Methyl t-Butyl Ether	6.8E+1	4.1E+4		1.7E-3		2.0E-1		3.3E-4		3.3E-4	
Toluene	3.2E+1	5.1E+4		6.3E-4		2.0E-1		1.2E-4		7.8E-4	
Xylene (mixed isomers)	1.9E+1	5.4E+4		3.5E-4		2.0E-1		6.8E-5		1.9E-3	

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | 4 OF 9

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

SUBSURFACE SOILS: **Exposure Concentration**

VAPOR INTRUSION TO BUILDINGS

Constituents of Concern	1) Source Medium: Subsurface Soil Conc. (mg/kg)	2) NAF Value (m^3/kg) Receptor: On-Site Commercial	3) Exposure Medium: Indoor Air: POE Conc. (mg/m^3) (1) / (2): On-Site Commercial	4) Exposure Multiplier: (IRxEFxED)/(BWxAT) (m^3/kg-day): On-Site Commercial	5) Average Daily Intake Rate: (mg/kg-day) (3) X (4): On-Site Commercial
Benzene	1.8E+1	2.1E+2	8.6E-2	7.0E-2	6.0E-3
Ethylbenzene	7.2E+1	2.1E+2	3.4E-1	2.0E-1	6.7E-2
Methyl t-Butyl Ether	1.3E-1	2.1E+2	6.0E-4	2.0E-1	1.2E-4
Toluene	1.5E+2	2.1E+2	7.1E-1	2.0E-1	1.4E-1
Xylene (mixed isomers)	4.2E+2	2.1E+2	2.0E+0	2.0E-1	3.9E-1

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | 5 OF 9

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER:
VAPOR INTRUSION TO BUILDINGS

Constituents of Concern	Exposure Concentration 1) Source Medium: Groundwater Conc. (mg/L)	2) NAF Value (m^3/L) Receptor: On-Site Commercial	3) Exposure Medium: Indoor Air: POE Conc. (mg/m^3) (1) / (2): On-Site Commercial	4) Exposure Multiplier (IRxEFxED)/(BWxAT) (m^3/kg-day): On-Site Commercial	5) Average Daily Intake Rate (mg/kg-day) (3) X (4): On-Site Commercial	TOTAL PATHWAY INTAKE (mg/kg-day) (Sum intake values from subsurface & groundwater routes.): On-Site Commercial
Benzene	2.6E+1	3.0E+2	9.4E-2	7.0E-2	6.6E-3	1.3E-2
Ethylbenzene	3.7E+0	2.8E+2	1.3E-2	2.0E-1	2.5E-3	7.0E-2
Methyl t-Butyl Ether	6.8E+1	8.9E+2	7.7E-2	2.0E-1	1.5E-2	1.5E-2
Toluene	3.2E+1	3.0E+2	1.1E-1	2.0E-1	2.1E-2	1.6E-1
Xylene (mixed isomers)	1.9E+1	3.2E+2	6.0E-2	2.0E-1	1.2E-2	4.0E-1

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomi Date Completed: 10/14/1999

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SOIL EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS OR SEDIMENTS: **Exposure Concentration**

DERMAL CONTACT

Constituents of Concern	1) Source Medium: Surface Soil Conc. (mg/kg)	2) Exposure Multiplier (SAxAFxABSxCFxEFxED)/(BWxAT) (kg/kg-day): On-Site Residential	2) Exposure Multiplier (SAxAFxABSxCFxEFxED)/(BWxAT) (kg/kg-day): On-Site Commercial	3) Average Daily Intake Rate (mg/kg-day) (1) x (2): On-Site Residential	3) Average Daily Intake Rate (mg/kg-day) (1) x (2): On-Site Commercial
Benzene	8.5E-2				
Ethylbenzene	2.3E-1				
Methyl t-Butyl Ether	1.3E-1				
Toluene	2.8E-1				
Xylene (mixed isomers)	1.7E+0				

NOTE: ABS = Dermal absorption factor (dim) BW = Body weight (kg) EF = Exposure frequencey (days/ POE = Point of exposure
AF = Adherance factor (mg/cm^2) CF = Units conversion factor ET = Exposure time (hrs/day) SA = Skin exposure area (cm^2/day)
AT = Averaging time (days) ED = Exposure duration (yrs) IR = Intake rate (mg/day)

Site Name: Pacific Electric Motor C Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999 *7 OF 9*

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SOIL EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS OR SEDIMENTS: INGESTION	Exposure Concentration	2) Exposure Multiplier (IRxCFxEFxED)/(BWxAT) (kg/kg-day)		3) Average Daily Intake Rate (mg/kg-day) (1) x (2)		TOTAL PATHWAY INTAKE (mg/kg-day) (Sum intake values from dermal & ingestion routes.)	
	1) Source Medium						
Constituents of Concern	Surface Soil Conc. (mg/kg)	On-Site Residential	On-Site Commercial	On-Site Residential	On-Site Commercial	On-Site Residential	On-Site Commercial
Benzene	8.5E-2						
Ethylbenzene	2.3E-1						
Methyl t-Butyl Ether	1.3E-1						
Toluene	2.8E-1						
Xylene (mixed isomers)	1.7E+0						

NOTE: ABS = Dermal absorption factor (dim) BW = Body weight (kg) EF = Exposure frequencey (days/yr) POE = Point of exposure
AF = Adherance factor (mg/cm^2) CF = Units conversion factor ET = Exposure time (hrs/day) SA = Skin exposure area (cm^2/day)
AT = Averaging time (days) ED = Exposure duration (yrs) IR = Intake rate (mg/day)

Site Name: Pacific Electric Motor C Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SOIL: LEACHING TO GROUNDWATER/ GROUNDWATER INGESTION

Constituents of Concern	Exposure Concentration 1) Source Medium: Soil Concentration (mg/kg)	2) NAF Value (L/kg) 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) (3) x (4)	
Benzene	1.8E+1								
Ethylbenzene	7.2E+1								
Methyl t-Butyl Ether	1.3E-1								
Toluene	1.5E+2								
Xylene (mixed isomers)	4.2E+2								

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body Weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Intake rate (L/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor C Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | 9 OF 9

TIER 1 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: INGESTION

Constituents of Concern	Exposure Concentration: 1) Source Medium — Groundwater Conc. (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) (3) x (4)		MAX. PATHWAY INTAKE (mg/kg-day) *(Maximum intake of active pathways soil leaching & groundwater routes.)*	
Benzene	2.8E+1										
Ethylbenzene	3.7E+0										
Methyl t-Butyl Ether	6.8E+1										
Toluene	3.2E+1										
Xylene (mixed isomers)	1.9E+1										

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Intake rate (L/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

RBCA SITE ASSESSMENT | **Tier 1 Worksheet 8.2**

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 1 PATHWAY RISK CALCULATION

OUTDOOR AIR 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 Commercial		(3) Inhalation Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site Commercial		(5) Total Toxicant Intake Rate (mg/kg/day) On-Site Commercial		(6) Inhalation Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site Commercial	
Benzene	A	6.7E-5		2.9E-2	2.0E-6		1.9E-4		1.7E-3	1.1E-1	
Ethylbenzene	D						3.3E-4		2.9E-1	1.1E-3	
Methyl t-Butyl Ether							3.3E-4		8.6E-1	3.8E-4	
Toluene	D						7.8E-4		1.1E-1	6.8E-3	
Xylene (mixed isomers)	D						1.9E-3		2.0E+0	9.5E-4	
Total Pathway Carcinogenic Risk =					2.0E-6	0.0E+0	***Total Pathway Hazard Index =***			1.2E-1	0.0E+0

[redacted]

Tier 1 Worksheet 8.2

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999 *2 OF 4*

TIER 1 PATHWAY RISK CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAYS ARE ACTIVE)

Constituents of Concern	(1) EPA Carcinogenic Classification	CARCINOGENIC RISK: (2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site Commercial	(3) Inhalation Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site Commercial	TOXIC EFFECTS: (5) Total Toxicant Intake Rate (mg/kg/day) On-Site Commercial	(6) Inhalation Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site Commercial
Benzene	A	1.3E-2	2.9E-2	3.6E-4	3.5E-2	1.7E-3	2.1E+1
Ethylbenzene	D				7.0E-2	2.9E-1	2.4E-1
Methyl t-Butyl Ether					1.5E-2	8.6E-1	1.8E-2
Toluene	D				1.6E-1	1.1E-1	1.4E+0
Xylene (mixed isomers)	D				4.0E-1	2.0E+0	2.0E-1
Total Pathway Carcinogenic Risk =				0.0E+0 / 3.6E-4	***Total Pathway Hazard Index =***		0.0E+0 / 2.3E+1

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 1 PATHWAY RISK CALCULATION

SOIL EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAYS ARE ACTIVE)

Constituents of Concern	(1) EPA Carcinogenic Classification	CARCINOGENIC RISK: (2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site Residential	(2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site Commercial	(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site Residential	(4) Individual COC Risk (2) x (3) On-Site Commercial	TOXIC EFFECTS: (5) Total Toxicant Intake Rate (mg/kg/day) On-Site Residential	(5) Total Toxicant Intake Rate (mg/kg/day) On-Site Commercial	(6) Oral Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site Residential	(7) Individual COC Hazard Quotient (5) / (6) On-Site Commercial
Benzene	A			2.9E-2							
Ethylbenzene	D								1.0E-1		
Methyl t-Butyl Ether									5.0E-3		
Toluene	D								2.0E-1		
Xylene (mixed isomers)	D								2.0E+0		

Total Pathway Carcinogenic Risk = 0.0E+0 | 0.0E+0 ***Total Pathway Hazard Index =*** 0.0E+0 | 0.0E+0

RBCA SITE ASSESSMENT | **Tier 1 Worksheet 8.2**

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 1 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)		(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3)		(5) Total Toxicant Intake Rate (mg/kg/day)		(6) Oral Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6)	
Benzene	A			2.9E-2							
Ethylbenzene	D								1.0E-1		
Methyl t-Butyl Ether									5.0E-3		
Toluene	D								2.0E-1		
Xylene (mixed isomers)	D								2.0E+0		
Total Pathway Carcinogenic Risk =					0.0E+0	0.0E+0	*Total Pathway Hazard Index =*			0.0E+0	0.0E+0

RBCA SITE ASSESSMENT | **Tier 1 Worksheet 8.3**

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

TIER 1 BASELINE RISK SUMMARY TABLE

	BASELINE CARCINOGENIC RISK					BASELINE TOXIC EFFECTS				
	Individual COC Risk		Cumulative COC Risk		Risk Limit(s) Exceeded?	Hazard Quotient		Hazard Index		Toxicity Limit(s) Exceeded?
EXPOSURE PATHWAY	Maximum Value	Target Risk	Total Value	Target Risk		Maximum Value	Applicable Limit	Total Value	Applicable Limit	
OUTDOOR AIR EXPOSURE PATHWAYS										
Complete:	2.0E-6	1.0E-6	2.0E-6	N/A	■	1.1E-1	1.0E+0	1.2E-1	N/A	☐
INDOOR AIR EXPOSURE PATHWAYS										
Complete:	3.6E-4	1.0E-6	3.6E-4	N/A	■	2.1E+1	1.0E+0	2.3E+1	N/A	■
SOIL EXPOSURE PATHWAYS										
Complete:	NC	1.0E-6	NC	N/A	■	NC	1.0E+0	NC	N/A	■
GROUNDWATER EXPOSURE PATHWAYS										
Complete:	NC	1.0E-6	NC	N/A	■	NC	1.0E+0	NC	N/A	■
CRITICAL EXPOSURE PATHWAY (Select Maximum Values From Complete Pathways)										
	3.6E-4	1.0E-6	3.6E-4	N/A	■	2.1E+1	1.0E+0	2.3E+1	N/A	■

RBCA SITE ASSESSMENT

Tier 1 Worksheet 6.1

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

SURFACE SOIL RBSL VALUES (< 5 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

RBSL Results For Complete Exposure Pathways ("x" If Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	Soil Leaching to Groundwater			Ingestion, Inhalation and Dermal Contact		X Construction Worker	Applicable RBSL	RBSL Exceeded ?	Required CRF
CAS No.	Name	(mg/kg)	Residential (on-site)	Commercial (on-site)	Regulatory(MCL) (on-site)	Residential (on-site)	Commercial (on-site)	Commercial (on-site)	(mg/kg)	"■" If yes	Only if "yes" left
71-43-2	Benzene	8.5E-2	NA	NA	NA	NA	NA	4.0E+1	4.0E+1	☐	<1
100-41-4	Ethylbenzene	2.3E-1	NA	NA	NA	NA	NA	>Res	>Res	☐	<1
1634-04-4	Methyl t-Butyl Ether	1.3E-1	NA	NA	NA	NA	NA	2.3E+2	2.3E+2	☐	<1
108-88-3	Toluene	2.8E-1	NA	NA	NA	NA	NA	>Res	>Res	☐	<1
1330-20-7	Xylene (mixed isomers)	1.7E+0	NA	NA	NA	NA	NA	>Res	>Res	☐	<1

>Res indicates risk-based target concentration greater than constituent residual saturation value

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-353-LXX-890

RBCA SITE ASSESSMENT

Tier 1 Worksheet 6.2

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

SUBSURFACE SOIL RBSL VALUES (> 5 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

RBSL Results For Complete Exposure Pathways ("x" If Complete)

CONSTITUENTS OF CONCERN		Representative Concentration		Soil Leaching to Groundwater			X	Soil Volatilization to Indoor Air		X	Soil Volatilization to Outdoor Air		Applicable RBSL	RBSL Exceeded ?	Required CRF
CAS No.	Name	(mg/kg)	Residential (on-site)	Commercial (on-site)	Regulatory(MCL) (on-site)		Residential (on-site)	Commercial (on-site)		Residential (on-site)	Commercial (on-site)	(mg/kg)	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E+1	NA	NA	NA		NA	1.0E-1		NA	2.2E+1	1.0E-1	■	1.7E+02
100-41-4	Ethylbenzene	7.2E+1	NA	NA	NA		NA	>Res		NA	>Res	>Res	☐	<1
1634-04-4	Methyl t-Butyl Ether	1.3E-1	NA	NA	NA		NA	9.2E+2		NA	>Res	9.2E+2	☐	<1
108-88-3	Toluene	1.5E+2	NA	NA	NA		NA	1.2E+2		NA	>Res	1.2E+2	■	1.0E+00
1330-20-7	Xylene (mixed isomers)	4.2E+2	NA	NA	NA		NA	>Res		NA	>Res	>Res	☐	<1

>Res indicates risk-based target concentration greater than constituent residual saturation value

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-353-LXX-890

RBCA SITE ASSESSMENT | **Tier 1 Worksheet 6.3**

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

GROUNDWATER RBSL 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

RBSL 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 RBSL	RBSL Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)	Residential: (on-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	2.8E+1	NA	NA	NA	NA	1.5E-1	NA	2.5E+1	1.5E-1	■	1.9E+02
100-41-4	Ethylbenzene	3.7E+0	NA	NA	NA	NA	>Sol	NA	>Sol	>Sol	☐	<1
1634-04-4	Methyl t-Butyl Ether	6.8E+1	NA	NA	NA	NA	3.9E+3	NA	>Sol	3.9E+3	☐	<1
108-88-3	Toluene	3.2E+1	NA	NA	NA	NA	1.7E+2	NA	>Sol	1.7E+2	☐	<1
1330-20-7	Xylene (mixed isomers)	1.9E+1	NA	NA	NA	NA	>Sol	NA	>Sol	>Sol	☐	<1

>Sol indicates risk-based target concentration greater than constituent solubility

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-353-LXX-890

TIER 2 COMMERCIAL EXPOSURE SCENARIO

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Pacific Electric Motor Compa9b Identification: 618.0102.001
Site Location: 1009 66th Avenue, Oakland Date Completed: 10/14/1999
Completed By: Ann Loomis

Software: GSI RBCA Spreadsheet
Version: 1.0.1

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

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
t	Averaging time for vapor flux (yr)	30			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)?	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Outdoor Air Pathways:				
SS.v	Volatiles and Particulates from Surface Soil	FALSE	FALSE	TRUE
S.v	Volatilization from Subsurface Soils	FALSE	TRUE	
GW.v	Volatilization from Groundwater	FALSE	TRUE	
Indoor Air Pathways:				
S.b	Vapors from Subsurface Soils	FALSE	TRUE	
GW.b	Vapors from Groundwater	FALSE	TRUE	
Soil Pathways:				
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	TRUE
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	FALSE	
S.l	Leaching to Groundwater from all Soils	FALSE	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	Constrctn
A	Contaminated soil area (cm^2)	***6.5E+06***	***4.6E+06***
W	Length of affect. soil parallel to wind (cm)	***3.0E+03***	***3.0E+03***
W.gw	Length of affect. soil parallel to groundwater (c	***3.0E+03***	
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02	
delta	Air mixing zone height (cm)	2.0E+02	
Lss	Thickness of affected surface soils (cm)	***1.5E+02***	
Pe	Particulate areal emission rate (g/cm^2/s)	6.9E-14	

Groundwate	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	***3.0E+02***
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	2.5E+03
Ugw.tr	Groundwater seepage velocity (cm/yr)	6.6E+03
Ks	Salurated hydraulic conductivity(cm/s)	
grad	Groundwater gradient (cm/cm)	
Sw	Width of groundwater source zone (cm)	
Sd	Depth of groundwater source zone (cm)	
phi.eff	Effective porosity in water-bearing unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	1.0E-03
BIO?	Is bioattenuation considered?	FALSE
BC	Biodegradation Capacity (mg/L)	

Soil	Definition (Units)	Value		
hc	Capillary zone thickness (cm)	***1.5E+01***		
hv	Vadose zone thickness (cm)	***2.9E+02***		
rho	Soil density (g/cm^3)	1.7		
foc	Fraction of organic carbon in vadose zone	0.01		
phi	Soil porosity in vadose zone	0.38		
Lgw	Depth to groundwater (cm)	***3.0E+02***		
Ls	Depth to top of affected subsurface soil (cm)	***1.5E+02***		
Lsubs	Thickness of affected subsurface soils (cm)	***1.5E+02***		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	0.342	0.12	0.12
phi.a	Volumetric air content	0.038	0.26	0.26

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	

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

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 |

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS: VAPOR AND DUST INHALATION Constituents of Concern	Exposure Concentration 1) Source Medium Surface Soil Conc. (mg/kg)	2) NAF Value (m^3/kg) Receptor		3) Exposure Medium Outdoor Air: POE Conc. (mg/m^3) (1) / (2)		4) Exposure Multiplier (IRxEFxED)/(BWxAT) (m^3/kg-day)		5) Average Daily Intake Rate (mg/kg-day) (3) X (4)	
Benzene	8.5E-2								
Ethylbenzene	2.3E-1								
Methyl t-Butyl Ether	1.3E-1								
Toluene	2.8E-1								
Xylene (mixed isomers)	1.7E+0								

NOTE: ABS = Dermal absorption factor (dim); AF = Adherance factor (mg/cm^2); AT = Averaging time (days); BW = Body weight (kg); CF = Units conversion factor; ED = Exposure duration (yrs); EF = Exposure frequencey (days/yr); ET = Exposure time (hrs/day); IR = Inhalation rate (m^3/day); POE = Point of exposure; SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | *2 OF 9*

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

SUBSURFACE SOILS: VAPOR INHALATION

Constituents of Concern	Exposure Concentration 1) Source Medium: Subsurface Soil Conc (mg/kg)	2) NAF Value (m^3/kg) Receptor: On-Site Commercial		3) Exposure Medium: Outdoor Air: POE Conc. (mg/m^3) (1) / (2) On-Site Commercial		4) Exposure Multiplier (IRxEFxED)/(BWxAT) (m^3/kg-day) On-Site Commercial		5) Average Daily Intake Rate (mg/kg-day) (3) X (4) On-Site Commercial	
Benzene	1.8E+1	4.5E+4		4.0E-4		7.0E-2		2.8E-5	
Ethylbenzene	7.2E+1	4.5E+4		1.6E-3		2.0E-1		3.1E-4	
Methyl t-Butyl Ether	1.3E-1	4.5E+4		2.8E-6		2.0E-1		5.4E-7	
Toluene	1.5E+2	4.5E+4		3.3E-3		2.0E-1		6.5E-4	
Xylene (mixed isomers)	4.2E+2	4.5E+4		9.3E-3		2.0E-1		1.8E-3	

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposue area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | 3 OF 9

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: VAPOR INHALATION

Constituents of Concern	Exposure Concentration 1) Source Medium: Groundwater Conc. (mg/L)	2) NAF Value (m^3/L) Receptor: On-Site Commercial		3) Exposure Medium: Outdoor Air: POE Conc. (mg/m^3) (1) / (2) On-Site Commercial		4) Exposure Multiplier (IRxEFxED)/(BWxAT) (m^3/kg-day) On-Site Commercial		5) Average Daily Intake Rate (mg/kg-day) (3) X (4) On-Site Commercial		TOTAL PATHWAY INTAKE (mg/kg-day) (Sum intake values from surface, subsurface & groundwater routes.) On-Site Commercial	
Benzene	2.8E+1	5.0E+4		5.6E-4		7.0E-2		3.9E-5		6.7E-5	
Ethylbenzene	3.7E+0	4.9E+4		7.5E-5		2.0E-1		1.5E-5		3.3E-4	
Methyl t-Butyl Ether	6.8E+1	4.1E+4		1.7E-3		2.0E-1		3.3E-4		3.3E-4	
Toluene	3.2E+1	5.1E+4		6.3E-4		2.0E-1		1.2E-4		7.8E-4	
Xylene (mixed isomers)	1.9E+1	5.4E+4		3.5E-4		2.0E-1		6.8E-5		1.9E-3	

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | 4 OF 9

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

SUBSURFACE SOILS: Exposure Concentration

VAPOR INTRUSION TO BUILDINGS

Constituents of Concern	1) Source Medium: Subsurface Soil Conc. (mg/kg)	2) NAF Value (m^3/kg) Receptor: On-Site Commercial	3) Exposure Medium: Indoor Air: POE Conc. (mg/m^3) (1) / (2): On-Site Commercial	4) Exposure Multiplier: (IRxEFxED)/(BWxAT) (m^3/kg-day): On-Site Commercial	5) Average Daily Intake Rate: (mg/kg-day) (3) X (4): On-Site Commercial
Benzene	1.8E+1	2.1E+2	8.6E-2	7.0E-2	6.0E-3
Ethylbenzene	7.2E+1	2.1E+2	3.4E-1	2.0E-1	6.7E-2
Methyl t-Butyl Ether	1.3E-1	2.1E+2	6.0E-4	2.0E-1	1.2E-4
Toluene	1.5E+2	2.1E+2	7.1E-1	2.0E-1	1.4E-1
Xylene (mixed isomers)	4.2E+2	2.1E+2	2.0E+0	2.0E-1	3.9E-1

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Company | Site Location: 1009 66th Avenue, Oakland | Completed By: Ann Loomis | Date Completed: 10/14/1999 | 5 OF 9

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER:
VAPOR INTRUSION TO BUILDINGS

Constituents of Concern	Exposure Concentration 1) Source Medium: Groundwater Conc. (mg/L)	2) NAF Value (m^3/L) Receptor: On-Site Commercial	3) Exposure Medium: Indoor Air: POE Conc. (mg/m^3) (1) / (2) — On-Site Commercial	4) Exposure Multiplier: (IRxEFxED)/(BWxAT) (m^3/kg-day) — On-Site Commercial	5) Average Daily Intake Rate: (mg/kg-day) (3) X (4) — On-Site Commercial	TOTAL PATHWAY INTAKE (mg/kg-day) (Sum intake values from subsurface & groundwater routes.) — On-Site Commercial
Benzene	2.8E+1	3.0E+2	9.4E-2	7.0E-2	6.6E-3	1.3E-2
Ethylbenzene	3.7E+0	2.8E+2	1.3E-2	2.0E-1	2.5E-3	7.0E-2
Methyl t-Butyl Ether	6.8E+1	8.9E+2	7.7E-2	2.0E-1	1.5E-2	1.5E-2
Toluene	3.2E+1	3.0E+2	1.1E-1	2.0E-1	2.1E-2	1.6E-1
Xylene (mixed isomers)	1.9E+1	3.2E+2	6.0E-2	2.0E-1	1.2E-2	4.0E-1

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomi Date Completed: 10/14/1999

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SOIL EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS OR SEDIMENTS: **Exposure Concentration**

DERMAL CONTACT

	1) Source Medium	2) Exposure Multiplier (SAxAFxABSxCFxEFxED)/(BWxAT) (kg/kg-day)		3) Average Daily Intake Rate (mg/kg-day) (1) x (2)	
Constituents of Concern	Surface Soil Conc. (mg/kg)	On-Site Residential	On-Site Commercial	On-Site Residential	On-Site Commercial
Benzene	8.5E-2				
Ethylbenzene	2.3E-1				
Methyl t-Butyl Ether	1.3E-1				
Toluene	2.8E-1				
Xylene (mixed isomers)	1.7E+0				

NOTE: ABS = Dermal absorption factor (dim) BW = Body weight (kg) EF = Exposure frequencey (days/ POE = Point of exposure
AF = Adherance factor (mg/cm^2) CF = Units conversion factor ET = Exposure time (hrs/day) SA = Skin exposure area (cm^2/day)
AT = Averaging time (days) ED = Exposure duration (yrs) IR = Intake rate (mg/day)

RBCA SITE ASSESSMENT | **Tier 2 Worksheet 8.1**

Site Name: Pacific Electric Motor C Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SOIL EXPOSURE PATHWAYS ☐ = (CHECKED IF PATHWAY IS ACTIVE)

SURFACE SOILS OR SEDIMENTS: INGESTION	Exposure Concentration	2) Exposure Multiplier (IRxCFxEFxED)/(BWxAT) (kg/kg-day)		3) Average Daily Intake Rate (mg/kg-day) (1) x (2)		TOTAL PATHWAY INTAKE (mg/kg-day) (Sum intake values from dermal & ingestion routes.)	
	1) Source Medium						
Constituents of Concern	Surface Soil Conc. (mg/kg)	On-Site Residential	On-Site Commercial	On-Site Residential	On-Site Commercial	On-Site Residential	On-Site Commercial
Benzene	8.5E-2						
Ethylbenzene	2.3E-1						
Methyl t-Butyl Ether	1.3E-1						
Toluene	2.8E-1						
Xylene (mixed isomers)	1.7E+0						

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequency (days/yr)
ET = Exposure time (hrs/day)
IR = Intake rate (mg/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor C Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SOIL: LEACHING TO GROUNDWATER/ GROUNDWATER INGESTION Constituents of Concern	Exposure Concentration 1) Source Medium Soil Concentration (mg/kg)	2) NAF Value (L/kg) 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) (3) x (4)	
Benzene	1.8E+1								
Ethylbenzene	7.2E+1								
Methyl t-Butyl Ether	1.3E-1								
Toluene	1.5E+2								
Xylene (mixed isomers)	4.2E+2								

NOTE: ABS = Dermal absorption factor (dim); AF = Adherance factor (mg/cm^2); AT = Averaging time (days); BW = Body Weight (kg); CF = Units conversion factor; ED = Exposure duration (yrs); EF = Exposure frequency (days/yr); ET = Exposure time (hrs/day); IR = Intake rate (L/day); POE = Point of exposure; SA = Skin exposure area (cm^2/day)

Site Name: Pacific Electric Motor C Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999 *9 OF 9*

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 Conc. (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) (3) x (4)		MAX. PATHWAY INTAKE (mg/kg-day) *(Maximum intake of active pathways soil leaching & groundwater routes.)*	
Benzene	2.8E+1										
Ethylbenzene	3.7E+0										
Methyl t-Butyl Ether	6.8E+1										
Toluene	3.2E+1										
Xylene (mixed isomers)	1.9E+1										

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Intake rate (L/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

RBCA SITE ASSESSMENT | **Tier 2 Worksheet 8.2**

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 2 PATHWAY RISK CALCULATION

OUTDOOR AIR 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 Commercial		(3) Inhalation Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site Commercial		(5) Total Toxicant Intake Rate (mg/kg/day) On-Site Commercial		(6) Inhalation Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site Commercial	
Benzene	A	6.7E-5		2.9E-2	2.0E-6		1.9E-4		1.7E-3	1.1E-1	
Ethylbenzene	D						3.3E-4		2.9E-1	1.1E-3	
Methyl t-Butyl Ether							3.3E-4		8.6E-1	3.8E-4	
Toluene	D						7.8E-4		1.1E-1	6.8E-3	
Xylene (mixed isomers)	D						1.9E-3		2.0E+0	9.5E-4	

Total Pathway Carcinogenic Risk = 2.0E-6 | 0.0E+0

Total Pathway Hazard Index = 1.2E-1 | 0.0E+0

[redacted]

Tier 2 Worksheet 8.2

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999

TIER 2 PATHWAY RISK CALCULATION

INDOOR AIR EXPOSURE PATHWAYS S16.1 ■ (CHECKED IF PATHWAYS ARE ACTIVE)

Constituents of Concern	(1) EPA Carcinogenic Classification	(2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site	(2) Total Carcinogenic Intake Rate (mg/kg/day) Commercial	(3) Inhalation Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site	(4) Individual COC Risk (2) x (3) Commercial
Benzene	A		1.3E-2	2.9E-2		3.6E-4
Ethylbenzene	D					
Methyl t-Butyl Ether						
Toluene	D					
Xylene (mixed isomers)	D					
Total Pathway Carcinogenic Risk =					0.0E+0	3.6E-4

Constituents of Concern	(5) Total Toxicant Intake Rate (mg/kg/day) On-Site	(5) Total Toxicant Intake Rate (mg/kg/day) Commercial	(6) Inhalation Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site	(7) Individual COC Hazard Quotient (5) / (6) Commercial
Benzene		3.5E-2	1.7E-3		2.1E+1
Ethylbenzene		7.0E-2	2.9E-1		2.4E-1
Methyl t-Butyl Ether		1.5E-2	8.6E-1		1.8E-2
Toluene		1.6E-1	1.1E-1		1.4E+0
Xylene (mixed isomers)		4.0E-1	2.0E+0		2.0E-1
Total Pathway Hazard Index =				0.0E+0	2.3E+1

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999 *3 OF 4*

TIER 2 PATHWAY RISK CALCULATION

SOIL EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAYS ARE ACTIVE)

	CARCINOGENIC RISK							TOXIC EFFECTS		
	(1) EPA Carcinogenic Classification	(2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site Residential	(2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site Commercial	(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site Residential	(4) Individual COC Risk (2) x (3) On-Site Commercial	(5) Total Toxicant Intake Rate (mg/kg/day) On-Site Residential	(5) Total Toxicant Intake Rate (mg/kg/day) On-Site Commercial	(6) Oral Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site Residential	(7) Individual COC Hazard Quotient (5) / (6) On-Site Commercial
Constituents of Concern											
Benzene	A			2.9E-2							
Ethylbenzene	D								1.0E-1		
Methyl t-Butyl Ether									5.0E-3		
Toluene	D								2.0E-1		
Xylene (mixed isomers)	D								2.0E+0		
Total Pathway Carcinogenic Risk =					0.0E+0	0.0E+0			*Total Pathway Hazard Index =*	0.0E+0	0.0E+0

Site Name: Pacific Electric Motor Company Site Location: 1009 66th Avenue, Oakland Completed By: Ann Loomis Date Completed: 10/14/1999 *4 OF 4*

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)		(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3)		(5) Total Toxicant Intake Rate (mg/kg/day)		(6) Oral Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6)	
Benzene	A			2.9E-2							
Ethylbenzene	D								1.0E-1		
Methyl t-Butyl Ether									5.0E-3		
Toluene	D								2.0E-1		
Xylene (mixed isomers)	D								2.0E+0		
Total Pathway Carcinogenic Risk =					0.0E+0	0.0E+0	***Total Pathway Hazard Index =***			0.0E+0	0.0E+0

RBCA SITE ASSESSMENT | **Tier 2 Worksheet 9.1**

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

SURFACE SOIL SSTL VALUES (< 5 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	Soil Leaching to Groundwater			Ingestion, Inhalation and Dermal Contact		X Construction Worker	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)	Commercial: (on-site)	(mg/kg)	"■" If yes	Only if "yes" left
71-43-2	Benzene	8.5E-2	NA	NA	NA	NA	NA	4.0E+1	4.0E+1	☐	<1
100-41-4	Ethylbenzene	2.3E-1	NA	NA	NA	NA	NA	>Res	>Res	☐	<1
1634-04-4	Methyl t-Butyl Ether	1.3E-1	NA	NA	NA	NA	NA	2.3E+2	2.3E+2	☐	<1
108-88-3	Toluene	2.8E-1	NA	NA	NA	NA	NA	>Res	>Res	☐	<1
1330-20-7	Xylene (mixed isomers)	1.7E+0	NA	NA	NA	NA	NA	>Res	>Res	☐	<1

>Res indicates risk-based target concentration greater than constituent residual saturation value

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-353-LXX-890

RBCA SITE ASSESSMENT | **Tier 2 Worksheet 9.2**

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

SUBSURFACE SOIL SSTL VALUES (> 5 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		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)	Residential: (on-site)	Commercial: (on-site)	(mg/kg)	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E+1	NA	NA	NA	NA	1.0E-1	NA	2.2E+1	1.0E-1	■	1.7E+02
100-41-4	Ethylbenzene	7.2E+1	NA	NA	NA	NA	>Res	NA	>Res	>Res	☐	<1
1634-04-4	Methyl t-Butyl Ether	1.3E-1	NA	NA	NA	NA	9.2E+2	NA	>Res	9.2E+2	☐	<1
108-88-3	Toluene	1.5E+2	NA	NA	NA	NA	1.2E+2	NA	>Res	1.2E+2	■	1.0E+00
1330-20-7	Xylene (mixed isomers)	4.2E+2	NA	NA	NA	NA	>Res	NA	>Res	>Res	☐	<1

>Res indicates risk-based target concentration greater than constituent residual saturation value

Software: GSI RBCA Spreadsheet Serial: G-353-LXX-890
Version: 1.0.1

RBCA SITE ASSESSMENT

Tier 2 Worksheet 9.3

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

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)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	2.8E+1	NA	NA	NA	NA	1.5E-1	NA	2.5E+1	1.5E-1	■	1.9E+02
100-41-4	Ethylbenzene	3.7E+0	NA	NA	NA	NA	>Sol	NA	>Sol	>Sol	☐	<1
1634-04-4	Methyl t-Butyl Ether	6.8E+1	NA	NA	NA	NA	3.9E+3	NA	>Sol	3.9E+3	☐	<1
108-88-3	Toluene	3.2E+1	NA	NA	NA	NA	1.7E+2	NA	>Sol	1.7E+2	☐	<1
1330-20-7	Xylene (mixed isomers)	1.9E+1	NA	NA	NA	NA	>Sol	NA	>Sol	>Sol	☐	<1

>Sol indicates risk-based target concentration greater than constituent solubility

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-353-LXX-890

RBCA SITE ASSESSMENT | **Tier 2 Worksheet 8.3**

Site Name: Pacific Electric Motor Company
Site Location: 1009 66th Avenue, Oakland

Completed By: Ann Loomis
Date Completed: 10/14/1999

TIER 2 BASELINE RISK SUMMARY TABLE

	BASELINE CARCINOGENIC RISK					BASELINE TOXIC EFFECTS				
	Individual COC Risk		Cumulative COC Risk		Risk Limit(s) Exceeded?	Hazard Quotient		Hazard Index		Toxicity Limit(s) Exceeded?
EXPOSURE PATHWAY	Maximum Value	Target Risk	Total Value	Target Risk		Maximum Value	Applicable Limit	Total Value	Applicable Limit	
OUTDOOR AIR EXPOSURE PATHWAYS										
Complete:	2.0E-6	1.0E-6	2.0E-6	N/A	■	1.1E-1	1.0E+0	1.2E-1	N/A	□
INDOOR AIR EXPOSURE PATHWAYS										
Complete:	3.6E-4	1.0E-6	3.6E-4	N/A	■	2.1E+1	1.0E+0	2.3E+1	N/A	■
SOIL EXPOSURE PATHWAYS										
Complete:	NC	1.0E-6	NC	N/A	■	NC	1.0E+0	NC	N/A	■
GROUNDWATER EXPOSURE PATHWAYS										
Complete:	NC	1.0E-6	NC	N/A	■	NC	1.0E+0	NC	N/A	■
CRITICAL EXPOSURE PATHWAY (Select Maximum Values From Complete Pathways)										
	3.6E-4	1.0E-6	3.6E-4	N/A	■	2.1E+1	1.0E+0	2.3E+1	N/A	■

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PACIFIC ELECTRIC MOTOR COMPANY
1009 66TH AVENUE
OAKLAND, CALIFORNIA
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DECEMBER 20, 1999

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