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Exposure Assessment/Estimation
Quantitative Risk Assessments
Industrial Hygiene
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Real Property Environmental Assessments
Compliance Audits
Air Pollution Dispersion Modeling
Hazardous Waste Management
Air Sampling and Analysis

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Corrective Action Plan
3810 Broadway
Oakland, California

STID 435

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1.0 INTRODUCTION

This report, prepared by Toxichem Management Systems, Inc. (Toxichem) on behalf of Equiva Services LLC, presents a corrective action plan for the subject site located at 3810 Broadway, Oakland, California (Figure 1). The purpose of the plan is to provide a framework for remediation, considering all pertinent regulatory guidance, site conditions, site remediation constraints, and probable future uses of the site. This corrective action plan was prepared pursuant to Article 11, Chapter 16, Division 3, Title 23, California Code of Regulations.

1.1 Site Background

The site was formerly owned by Texaco from 1963 to 1985. During this time, the site was leased to various parties for utilization as a retail gasoline station. Texaco divested interest in the property in 1985. Five underground storage tanks (USTs) were utilized at the site including four 6,000-gallon USTs for product storage and one 550-gallon UST for used oil storage. The four 6,000-gallon USTs were removed from the site during February 1980; the 550-gallon used oil tank was removed from the site during May 1991.

Topographically, the site is located within the City of Oakland along the eastern margin of the San Francisco Bay and is within the East Bay Plain. The East Bay Plain lies within the Coast Range Geomorphic Province and is characterized by broad alluvial fan margins sloping westward towards the San Francisco Bay. The eastern site of the plain in the Oakland area is marked by the active Hayward Fault, which runs along the base of the Diablo Range Escarpment. Site elevation is approximately 100 feet above mean sea level.

The nearest surface waters relative to the site are Lake Merritt, located approximately 1 mile to the south, and San Francisco Bay, located approximately 2 miles to the west of the site. Regional groundwater gradient in the site vicinity, based on topography and the pre-development slope of the alluvial fans is toward the southwest. The observed local groundwater gradient at the site, based on groundwater monitoring has been variable. Groundwater depressions and groundwater mounding occurs beneath the site as water table elevations increase and decrease seasonally; this has given rise to fluctuations in groundwater flow direction.

1.2 Previous Investigations

A summary of all previous soil and groundwater investigations is presented below.

1.2.1 SEMCO Used Oil Tank Excavation

Soil sampling of the former used oil tank excavation was performed by SEMCO during tank removal activities in May 1991. Petroleum hydrocarbon impacted soils were identified within the tank excavation to a depth of 10 feet below ground surface (bgs). This soil was excavated and removed from the site; the excavation was backfilled with clean imported aggregate. Subsequent investigations at the site have been performed by Harza Kaldveer (Kaldveer), McLaren/Hart, Fluor Daniel GTI (GTI), and Toxichem. The investigation work performed has included the installation of 10 groundwater monitoring wells (Wells MW-1 through MW-10) and 12 soil borings (B-1 through B-6, SB-1 through SB-6).

1.2.2 Kaldveer Soil and Groundwater Investigations

During November 1991, Kaldveer installed 1 groundwater monitoring well (Well MW-1) within the former used oil tank excavation. Soil samples were collected at depths of 10.5, 15.5, 20.5, and 25.5 feet bgs and oil and grease and hydrocarbons; additionally, the 10.5 feet bgs sample was analyzed for total petroleum hydrocarbons as gasoline (TPHg), benzene, toluene, and xylene (BTEX) compounds. None of the analyzed parameters were detected in the soil samples submitted for analysis. Petroleum hydrocarbons were detected in groundwater from Well MW-1; these included oil and grease (1,000 parts per billion [ppb]), TPHg (300 ppb), and benzene (4.1 ppb).

As a result of the petroleum hydrocarbon detections in Well MW-1, Kaldveer installed one additional groundwater monitoring well (Well MW-2) at the site during January 1992. One soil sample was collected at a depth of 30 feet bgs and analyzed for oil and grease, hydrocarbons, TPHg, and BTEX compounds. None of the analyzed parameters were detected in the soil sample. Petroleum hydrocarbons were detected in groundwater at Well MW-2; these included oil and grease (1,000 ppb), TPHg (4,000 ppb), and benzene (470 ppb).

1.2.3 McLaren/Hart Soil and Groundwater Investigation

A supplemental site investigation was performed by McLaren/Hart during September and October 1995; six soil borings (B-1 through B-6) and two additional groundwater monitoring wells (MW-3 and MW-4) were installed during the investigation. The purpose of this investigation was to verify groundwater flow direction and to further define the extent of petroleum hydrocarbons in soil and groundwater beneath the site.

Maximum petroleum hydrocarbons were detected in soils at Well MW-3, adjacent to the former USTs at 8.5 feet bgs; concentrations of TPHg and benzene were 65,000 and 88 ppm, respectively. Petroleum hydrocarbons in soils attenuated rapidly with depth in the boring at Well MW-3; at 15.5 feet bgs TPHg and benzene concentrations were 2.8 and <0.005 ppm, respectively. TPHg and benzene were not detected in Borings B-3, B-6, and Well MW-4. At Borings B-1, B-2, B-4, and B-5, maximum TPHg concentrations ranged from of 2,200 to 4,800 ppm and maximum benzene concentrations ranged from 3.8 to 48 ppm.

1.2.4 Fluor Daniel GTI Investigation

During September 1996, GTI performed soil and groundwater assessment activities at the site including the installation and sampling of 5 additional groundwater monitoring wells (Wells MW-5 through MW-10) both on- and off-site in order to further delineate petroleum hydrocarbons in groundwater. Additionally, Wells MW-1, MW-2, and MW-3 were redrilled and new monitoring wells were installed with screen intervals intercepting the groundwater/vadose zone interface.

The highest concentrations of hydrocarbons in soil were detected at a depth of 20 feet in the boring for Well MW-8 located adjacent to the former pump islands; TPHg and benzene concentrations at this location were 14,000 and 25 ppm, respectively. TPHg and benzene were not detected in soils at Wells MW-5, MW-7, and MW-10. Maximum concentrations of TPHd were present in soil at 20 feet bgs at Well MW-9 at a concentration of 69 ppm.

Groundwater analytical data from Wells MW-5 through MW-10 indicated that maximum concentrations of TPHg and benzene were present in samples from Well MW-6 at concentrations of 45,000 and 8,300 ppb, respectively. TPHg were not detected in the groundwater samples collected from Wells MW-7 and MW-10. TPHg concentrations in groundwater samples from Wells MW-5, MW-8, and MW-9 ranged from 80 to 17,000 ppb.

1.2.5 Toxichem Investigation

Toxichem Management Sytems Inc , performed additional soils characterization during July 1998; at that time, six soil borings were drilled at the site (SB-1 through SB-6). These soil borings were advanced to depths ranging from 8 to 20 feet below ground surface (bgs). The purpose of the investigation was to increase the definition of soils impact, collect physical soil parameter data (porosity, moisture content, organic carbon), and collect soil vapor information. TPHg were present in Borings SB-1 and SB-2 at concentrations of 430 and 2,900 ppm, respectively; benzene was present in Borings SB-1 and SB-2 at concentrations of 2.8 and 16 ppm, respectively. TPHg and BTEX were not detected in Borings SB-3 through SB-6.

Soil vapor samples collected at a depth of 5 feet bgs from borings SB1, SB3, and SB6 yielded TPHg and benzene at 22 mg/m3 and 10 mg/m3 respectively from SB1 only.

1.3 Depth to Groundwater, Flow Direction, and Gradient

Groundwater beneath the site has been measured at depths ranging from 14.00 to 23.27 feet bgs. Recent groundwater elevations (April 1998) are at their data set maximums. Based on calculated groundwater elevations, groundwater flow at the site has been variable. Recent groundwater flow elevation contour maps (December 1997 and April 1998) indicate that flow direction is to the southwest and northeast, toward the southern portion of the site. The southerly groundwater flow direction predominates at an approximate gradient of 0.06.

1.4 Chemical Soil Characterization.

Petroleum hydrocarbons were found in both the capillary fringe and vadose soils beneath the site. Capillary fringe soils (between 14 and 23 feet bgs) impacted at concentrations exceeding 1,000 ppm TPHg were found at Borings B-1, B-2, B-4, MW-8, and SB-2. Shallow soil impact exceeding 1,000 ppm TPHg was noted at 8.5 feet bgs at Well MW-3 (adjacent to the former USTs) and at 12.5 feet at Boring B-5 (beneath a former fuel pump). Shallow soil impact exceeding 100 ppm TPHg were noted at Well MW-8 (adjacent to the former pump islands), and at Boring SB-2 (adjacent to the former UST location). It is apparent that the vertical and lateral extent of hydrocarbons in soil are limited; TPHg concentrations attenuate rapidly with depth and with distance from an apparent former source area.

1.5 Chemical Groundwater Characterization.

Within the past three sampling events (December 1997, April 1998, and June 1998), maximum petroleum hydrocarbons were identified in Well MW-3; during December 1997 TPHg and benzene concentrations were 180,000 and 1,500 ppb, respectively. During April 1998 0.05 foot of separate phase hydrocarbons (SPH) were measured in Well MW-3; SPH was also identified in this well during June 1998. SPH had previously been measured in Well MW-3 at a thickness of up to 1.35 feet (June 1996). Additionally, SPH has been identified in Well MW-2 (to the northeast of the former pump islands) at thicknesses ranging from 0.01 feet (November 1996) to 1.35 feet (June 1996). During June 1998, TPHg and benzene were present in groundwater at Well MW-2 at concentrations of 20,000 and 240 ppb, respectively. During June 1998 TPHg concentrations in groundwater at Wells MW-6 and MW-8 were 23,000 and 74,000 ppb, respectively; benzene concentrations were 2,600 and 5,400 ppb, respectively.

Groundwater conditions off-site have been investigated to the southwest, northwest, and west at Wells MW-7, MW-9, and MW-10, respectively. Analysis of historical groundwater monitoring indicates that while petroleum hydrocarbons have not been detected in Wells MW-7 and MW-9, TPHg and BTEX compounds were detected in Well MW-10 during the past two groundwater monitoring events. During April 1998, TPHg and benzene concentrations in groundwater at Well MW-10 were 2,300 and 224 ppb, respectively; during June 1998, TPHg and benzene concentrations in groundwater at Well MW-10 were 7,200 and 310 ppb, respectively.

Methyl tert butyl ether (MTBE) has been detected in Wells MW-1, MW-5, and MW-6. During the April 1998 groundwater monitoring event, MTBE was detected in Wells MW-1 and MW-5 at concentrations of 38.3 and 38 ppb, respectively. During the June 1998 groundwater monitoring event, MTBE was not detected in any site wells; however, the detection limits were increased at some wells due to elevated petroleum hydrocarbon concentrations. This station was divested by Texaco in 1985, prior to the mandatory introduction of oxygenates such as MTBE.

1.2 Document Format

- **Section 2.0 - Conceptual Site Model:** Relevant site characteristics are summarized.
- **Section 3.0 - Corrective Action Goals:** Applicable cleanup goals are developed.
- **Section 4.0 - Corrective Action Requirements:** Site conditions are compared to cleanup goals and the need for corrective action is assessed.
- **Section 5.0 - Corrective Action:** Corrective action objectives and applicable remediation technologies are identified. The section closes with a recommendation regarding the most feasible corrective action alternative.

2.0 CONCEPTUAL SITE MODEL

2.1 Physical Characteristics

The subject site is located in northwestern Oakland at 3810 Broadway, Oakland, California. The site is situated on the northeast corner of the intersection of 38th Street and Broadway. The nearest surface waters relative to the site are Lake Merritt located approximately 1 mile to the south and San Francisco Bay located approximately 2 miles to the west of the site. Topography at the site slopes gently toward the southwest; elevation at the site is approximately 85 feet above mean sea level.

2.2 Source Composition, Distribution, and Residual Levels

2.2.1 Primary Source

Investigative data documenting the occurrence of petroleum hydrocarbon residuals in soil and groundwater are extensive, but there is no specific release information. Available data (soil sampling and groundwater monitoring) indicate that the primary source of petroleum hydrocarbons was the former gasoline and used oil tank and the former product piping. The former gasoline USTs were removed from the property during February 1980, the used oil tank was removed from the property during May 1991; it is probable that all primary sources have been removed from the site.

2.2.2 Source Composition

Soil and groundwater chemistry data for samples collected from the site suggest that impact consists of compounds typically found in gasoline and diesel. Laboratory analyses have identified TPHg, BTEX, and TPHd. Low concentrations of MTBE have also been identified in groundwater samples. This information is consistent with the typical UST uses.

2.2.3 Source Distribution and Residual Levels

The secondary sources of petroleum hydrocarbon residuals are: (1) soils impacted with petroleum hydrocarbons; (2) groundwater containing dissolved petroleum hydrocarbons, and (3) vapor phase hydrocarbons. The distribution and residual levels associated with these secondary sources are described in this section.

Soil

The primary aerial extent of impact is defined by the analytical results from monitoring wells MW3 and MW8, and from soil borings B1, B2, B4, B5, SB1, SB2, and SB4. The distribution of the residual hydrocarbons in soils is characterized by the following analytical data (see Table 1).

- Soil chemistry data collected between October 1991 and July 1998 indicate that the hydrocarbon impact is primarily centered below and adjacent to the former USTs and former pump islands and is characterized by former tank pit soil analytical data (1.1 to 65,000 ppm TPHg and 0.27 to 88 ppm benzene). Maximum TPHg were present in soils located in the boring groundwater monitoring well MW-3 located approximately 15 feet to the northwest of the former UST location. These hydrocarbon concentrations were characterized by samples collected at 8.5, 15.5, and 19.5 feet bgs where TPHg concentrations were 65,000, 2.8, and 6.2 ppm, respectively; benzene concentrations were 88, not detected, and 1.3 ppm, respectively.

- Soil samples at Boring B-1 beneath the former northern UST were collected at 12.5, 19, and 26.5 feet bgs where TPHg concentrations were 310, 3,600, and 1.1 ppm, respectively; benzene concentrations were 0.15, 33, and 0.27 ppm, respectively. Soil samples at Boring B-4 beneath the former southern UST were collected at 12.5, 18, and 26.5 feet bgs where TPHg concentrations were 83, 4,800, and 19 ppm, respectively; benzene concentrations were 0.06, 3.8, and 0.52 ppm, respectively.

- Soil samples at Boring B-5 beneath the former eastern pump island were collected at 12.5 and 29.5 feet bgs where TPHg concentrations were 4,800 ppm and not detected, respectively; benzene concentrations were 48 and 0.055 ppm, respectively. At Boring B-2 beneath the former western pump island, soil samples were collected at 12.5, 16.5, and 26.5 feet bgs where TPHg concentrations were 3.1 and 2,200 ppm and not detected; benzene concentrations were 0.69 and 15.0, and not detected.

- At off-site Wells MW-7, MW-9, and MW-10, petroleum hydrocarbon concentrations have not been detected in soils; petroleum hydrocarbon impact to soils have therefore been defined in the downgradient direction to the south, southwest, and west of the site. For the most part, TPHg concentrations in soils appear to diminish as a function of distance from the former USTs and the former pump island locations.

In the primary vertical zone of impact (8 to 20 feet bgs), the average soil column concentrations are summarized below

Average Soil Concentrations in the Area of Impact

TPHg	Benzene	Toluene	Ethyl Benzene	Xylenes
6174 mg/kg	14.8 mg/kg	90.7 mg/kg	36.8 mg/kg	202 mg/kg

Groundwater

Table 2 presents groundwater quality data obtained between October 1991 and June 1998. Petroleum hydrocarbons have been detected in groundwater samples collected from on-site Wells MW-1 through MW-6 and MW-8, and from off-site Wells MW-7, MW-9, and MW-10. Low concentrations of MTBE have been detected groundwater samples collected from on-site Wells MW-1, MW-5, and MW-6.

It appears that the dissolved petroleum hydrocarbon plume configuration is nearly the same as that delineated for soil. The recorded depth to groundwater has ranged from approximately 14.39 to 22.60 feet bgs; within the range of greatest soil impact. Current trends in data suggest that the dissolved plume may be expanding in the western direction toward Well MW-10. During the past three groundwater monitoring events, TPHg concentrations at Well MW-10 have increased from 350 ppb to 2,300 ppb to 7,200 ppb.

The range of residual levels, considering data sets for Wells MW-1 through MW-6 and for Borings B-2, B-3, B-4, and B-6 are given below.

- **Minimum Levels Detected:** 80 ppb TPHg; 9.5 ppb TPHd; 0.6 ppb benzene; 0.8 ppb toluene; 0.36 ppb ethylbenzene; 0.77 ppb xylenes; and 5.0 ppb MTBE.
- **Maximum Levels Detected:** 180,000 ppb TPHg; 6,100,000 ppb TPHd; 12,000 ppb benzene; 16,000 ppb toluene; 4,600 ppb ethylbenzene; 23,000 ppb xylenes; and 72 ppb MTBE.

2.3 Geology/Hydrogeology

Subsurface lithology was described in a Supplemental Site Investigation Report prepared by McLaren/Hart dated January 11, 1996. This report indicated that the lithology generally consisted of unconsolidated fill material overlying fine grained sediments such as sandy silts and clays, interbedded with more transmissive well-sorted sands and silty sands. Geologic cross section locations are shown on Figure 5, geologic cross sections are shown on Figures 6 and 7.

McLaren/Hart reported that the unsaturated soils above the water-bearing zones are generally clay rich. However, sandier stringers appear to be present, particularly in the 16-20 feet bgs range. Vadose soils at Well MW-3 are much sandier than elsewhere on the site, indicating a transition in the depositional environment, perhaps to stream channel/levee from overbank/flood plain.

Water-bearing zones were encountered at two different depths during the McLaren /Hart investigation; it was not determined whether these two zones were hydraulically connected. The first zone was encountered at approximate depths ranging between 19 and 24.5 feet bgs. This laterally discontinuous zone was generally less than one foot thick and in most cases, did not yield a sufficient amount of groundwater to collect samples. At Well MW-3, the thickness of the saturated zone was 4.5 feet; however this thickness appeared to be limited to the portion of the site adjacent to Well MW-3.

The second zone was encountered at approximate depths ranging between 28 and 35.5 feet bgs with an approximate thickness of 4 feet. As shown in the cross sections A-A' and B-B', data suggests that this zone is laterally continuous throughout the site.

2.4 Interim Remediation

Site remediation to date has consisted of excavating and removing the former product storage facilities, removal of the former pump islands, site assessment activities, and groundwater monitoring.

2.5 Transport Mechanisms and Exposure Pathway

Since gasoline and diesel constituents have been detected in soils and groundwater beneath the site, it is reasonable to expect that the most probable transport mechanisms are vapor phase diffusion with atmospheric dispersion and advective transport with groundwater flow. Exposure pathways include shallow groundwater use and inhalation.

3.0 Corrective Action Goals

Site-specific numeric corrective action goals are necessary to formulate final remedial objectives for the site. Until recently, goals regarding the clean-up of leaking underground storage tank (UST) sites focused primarily on restoring water quality and water quality protection. New State Water Resources Control Board (SWRCB) recommendations and Interim Guidance issued by the San Francisco Bay Regional Water Quality Control Board (RWQCB) have, to a degree, realigned this focus. The emphasis is currently based on public health risk. Regulatory policy has yet to fully reconcile risk-based goals with water quality goals, but the policy on water quality protection remains clear.

With respect to developing remediation goals with a focus on public health risk, recent guidance documents suggest using the American Society for Testing and Materials (ASTM) Standard E1739 for Risk-Based Corrective Action at Petroleum Release Sites (RBCA). These subjects are addressed below in an effort to develop applicable remediation goals that consider public health risk and water quality

3.1 Site Water Quality Goals and Protection Standards

Since petroleum hydrocarbon impact is restricted to groundwater, and surface water is not threatened, only groundwater is considered here. Guidance for developing water quality goals and protection standards was obtained from: *A Compilation of Water Quality Goals* (Marshack, 1993); and State Board Resolutions 68-16, 88-63 and 92-49 (Draft Version, January 18, 1995). The development of site-specific water quality restoration goals and protection standards begins with identification of beneficial uses.

The existing and potential beneficial uses of groundwater underlying the site include municipal and domestic supply (potential use may require treatment to reduce salt levels), and agricultural supply. Comprehensive water quality protection standards are meant to protect the relevant beneficial uses of ground and surface water, while water quality goals are used as a benchmark for water quality restoration. To develop water quality restoration goals and protection standards, it is recognized that working to restore or protect the beneficial use with the most stringent numeric water quality goals will protect or restore all other uses. Below, site specific water quality protection standards and restoration goals are developed.

3.1.1 Water Quality Protection Standards

In general, water quality protection standards focus on protecting the existing water quality, whenever that water quality is better than that required to protect all present and potential beneficial uses (Resolution 68-16). Numeric water quality standards based on Resolution 68-16 are associated with the background levels, which in turn are subject to the reasonable limit of detection for the residual constituent of concern. As previously indicated, the constituents of concern are TPHg, TPHd, BTEX, and MTBE. Parameters mentioned in the regional basin plan that are not relevant to the development of water quality protection standards for the site are: pH; electric conductivity; total dissolved solids; chloride; total oil and grease; metal contaminants; and volatile organics. These parameters are either: (1) not found beneath the site (i.e., total oil and grease); (2) not associated with impact identified beneath the site (i.e., pH, total dissolved solids); or (3) naturally occurring (i.e., metals). Reasonable limits of detection for the residual target compounds found beneath the site are shown below.

Compound	Concentration (parts per billion)
Benzene	0.5
Toluene	0.5
Ethylbenzene	0.5
Xylenes	0.5
MTBE	5.0
TPHg/TPHd	50

Where groundwater degradation has occurred, Resolution 68-16 may not strictly apply. This is because the existing water quality within the residual plume boundary does not warrant protection; in other words, the residual plume water quality is not better than that required to protect all other beneficial water uses It seems reasonable to presume that protection, the primary objective of Resolution 68-16, pertains only to water outside the residual plume boundary. The ramification of this interpretation is that flow (or discharge) of groundwater across the residual plume boundary with residual concentrations greater than those identified above, is not consistent with Resolution 68-16. Locating the exact position of the residual plume boundary is difficult; but the general configuration of the plume can be monitored. Consequently, it is proposed that a compliance boundary be established that encompasses the current plume configuration. The compliance boundary should allow for a reasonable downgradient attenuation zone. The water quality protection standards will apply to groundwater outside the compliance boundary. This feature is consistent with State and Regional Board policy.

3.1.2 Water Quality Restoration Goals

Within the compliance boundary, where background groundwater conditions do not warrant protection, restoration takes precedent. Numeric water quality goals for the residual plume are associated with restoring the relevant beneficial water use that restores all other relevant uses. To identify numeric goals, the relevant beneficial water use with the most stringent set of numeric water quality goals is identified. Resolution 88-63 provides relevant guidance, as does California Code of Regulations, Title 22.

Resolution 88-63 specifies that all groundwater is suitable for municipal and domestic supply, unless conditions preclude its use. Since groundwater conditions beneath the site do not preclude its possible use as a municipal and domestic supply, numeric water quality goals associated with restoring this use pertain to the residual plume. Municipal and domestic supply is the relevant beneficial use with the most stringent set of water quality goals. The water quality goals are noted below.

Compound	Concentration (parts per billion)	Source
Benzene	1	California Maximum Contaminant Levels
Toluene	1,000	Federal Maximum Contaminant Levels
Ethylbenzene	680	California Maximum Contaminant Levels
Xylenes	1,750	California Maximum Contaminant Levels
TPHg/TPHd	1,000	Taste and Odor Threshold

The state of California has not yet developed water quality goals for MTBE. The Environmental Protection Agency has provided some guidance in a document entitled *Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl tertiary-Butyl Ether* which recommends MTBE concentrations of 20 to 40 ppb as an appropriate taste and odor threshold.

It should be noted that other conditions may make the use of shallow occurring groundwater for municipal and domestic supply unlikely. As such, use as a drinking water source may necessitate water treatment; regardless of petroleum hydrocarbon impact.

The aforementioned water quality restoration goals apply to the site during remediation and beyond; however, they may be modified at any time if it can be shown that changes are: (1) consistent with the maximum benefit to the people of the State; and (2) will not unreasonably affect present or probable future beneficial uses of groundwater.

To summarize, water quality protection standards and water quality restoration goals were developed. Water quality protection standards were established to protect unaffected groundwater outside the dissolved hydrocarbon plume (proposed compliance boundary). Water quality restoration goals were specified to direct restoration of affected groundwater within the compliance boundary.

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3.2 Health Risk Based Goals

For consistency with recent regulatory policy, an ASTM RBCA evaluation was applied for the development of corrective action goals. Figure 2 (Exposure Evaluation Flowchart) of the standard was used to characterize primary and secondary sources, transport mechanisms, exposure pathways, and receptors. Given the exposure pathway and exposure scenario, Table X2.1 was initially consulted to identify Tier 1 risk-based screening levels (RBSLs) for the constituents of concern. Since site specific groundwater concentrations exceeded the ASTM Tier 1 RBSLS (adjusted for the California benzene carcinogenic potency value), a higher level assessment was completed to address site specific risk- based corrective action goals. Appendix A contains a description of methods and results of the site specific risk-based concentration (RBC) calculations.

3.2.1 Data Collection

During July of 1998, additional site data was collected to support the Site CAP. Soil samples collected at 5 feet bgs from SB-1, 2, 3, and SB-6 were analyzed for total porosity, moisture, and organic carbon content. In addition, soil vapor samples were collected from SB-1, SB-3, and SB-6 at a depth of 5 feet bgs, and analyzed for TPHg and BTEX compounds. The table below summarizes the results of the additional data collected and analytical results are included in Appendix A of this document.

?

calculation

Parameter	SB-1-5	SB-2-5	SB-3-5[a]	SB-6-5
Total Porosity	.349	.366	.782	.347
Saturation %	.998	.828	.024	.777
Moisture Content (cm^3/cm^3)	.348	.303	.019	.270
Air Porosity (cm^3/cm^3)	.0007	.063	.763	.0775
Foc	.012	.015	.011	.022
Vapor Conc. (mg/m^3)	22 TPHg .10 benzene .27 toluene .99 xylene	NS	ND	.11 toluene

Table notes: a. Disturbed sample. NS = not sampled ND = not detected; detection limits for TPHg was 10 mg/m^3 d for benzene, toluene, ethyl benzene(BTE) 0.10 mg/m^3, f or xylenes 0.3 mg/m3.

3.2.2 Calculation of Risk Based Clean Up Goals

Exposure Pathways & Receptors

Four exposure pathways are noted on the ASTM Exposure Evaluation Flowchart. They include soil ingestion/skin absorption; inhalation; potable water use; and recreation use/sensitive habitat. Inhalation of secondary source hydrocarbons was considered the only complete exposure pathway. Calculations incorporated the commercial receptor scenario since the site is currently used as an automotive repair facility, and it planned use for automotive repair and fuel dispensing operations.

Calculation Methods

The calculation of a site specific risk based remedial goals incorporate site specific data, exposure parameters and exposure point estimation with a toxicity value for the chemical of interest to obtain a chemical concentration in the groundwater or soil which equates to an acceptable risk level.

For the groundwater and soil to indoor air exposure pathway, volatilization factors (VF) from ASTM are used. VFs are expressions which define the relationship between the dissolved chemical concentration in groundwater (or sorbed soil concentration) and the volatilized chemical vapor concentration (exposure point) within the occupied space. VFs are infinite source methods which assume there is no mass loss due to volatilization and/or biodegradation over the exposure period. VFs incorporate site specific parameters for porosity, moisture content, and diffusion path length.

Methods used to calculate chemical intakes for chronic exposure, or chronic daily intakes (CDIs), are described in Risk Assessment Guidance (RAGS) (U.S. EPA 1989a) and Department of Toxic Substances Control (DTSC) supplemental guidance (CALEPA 1992). For the commercial exposure scenario, the default body weight of 70 kg, an exposure duration of 25 years, and default inhalation rate of 20 m^3 is assumed for indoor workers

Results

Estimated risk based remedial goals were calculated setting the target carcinogenic risk to 10E-05 and the non-carcinogenic hazard index to unity. Calculations and parameters are described in Appendix A. RBCs for soil are average column concentrations for the chemical of concern. With an increasing diffusion path (thicker layer of clean soil above the zone of impact), RBCs for soil will increase. The RBCs for groundwater are average groundwater concentrations for the aerial extent of the plume.

Risk Based Soil and Groundwater Concentrations (RBCs)

For a Carcinogenic Risk of 10E-05 or Hazard Index of Unity

	RBC Soil (mg/kg)	RBC Groundwater (mg/l)
Benzene	0.5 @ 8 ft 0.8 @ 15 ft 1@ 20 ft	2
Toluene	464	520
Ethyl benzene	917*	1269*
Xylenes	9822*	5833*
MTBE	1667	14,998

Table notes: * exceeds the sorptive limits of soil or exceeds the solubility of the compound

Measured Soil Vapor Concentrations versus Calculated Vapor Concentrations

Using site specific parameters and the risk based soil and groundwater concentrations specified in the table above, ASTM VFs were used to calculate vapor concentrations at a depth of 5 ft bgs. The resultant risk based vapor concentrations are compared to the maximum detected vapor concentrations from SB-1-5 in the table below. The soil vapor data suggests RBCs are conservative.

Risk –Based Vapor Concentrations versus Measured Vapor Concentrations

	Predicted Vapor Concentration (mg/m^3)	Measured Vapor Concentration (mg/m^3)
Benzene	68	0.1
Toluene	20,540	0.27
Ethyl benzene	56,400	<0.1
Xylenes	386,500	99

3.3 Site Public Health and Safety Goals

According to guidance presented in Title 23, Chapter 16, Article 11 of the California Code of Regulations (CCR), any remediation approach considered must be designed to mitigate nuisance conditions and risk of fire or explosion posed by residual hydrocarbon impact To assure remedial objectives address the requirements of Article 11, site-specific public health and safety goals are necessary. The site-specific goal is calculated in order to eliminate any threat to public health and safety associated with subsurface hydrocarbon impact, including the potential threat posed by nuisance conditions and risk of fire or explosion. Additionally, use of, or exposure to, hydrocarbon impacted groundwater or soil will be restricted.

3.4 Application of Corrective Action Goals

In the preceding discussion, the following corrective action goals were identified: water quality protection standards; water quality restoration goals; groundwater RBCs; soil RBCs; and public health and safety goals. All these goals are relevant, but they need to be applied in a consistent manner. Application of each set of goals is proposed below.

Water Quality Protection Standards: These apply to unaffected groundwater outside the dissolved hydrocarbon plume. Compliance with water quality protection standards requires that the dissolved hydrocarbon plume is stable, and that intrinsic attenuation mechanisms (i.e., biodegradation, absorption/adsorption, and chemical reactions) work to control contaminant migration. If evidence suggests the dissolved hydrocarbon plume is expanding, then action may be required to remain in compliance with protection standards. The time frame for compliance with water quality protection standards should be consistent with groundwater flow velocities within preferential flow paths.

Water Quality Restoration Goals: These goals apply to the dissolved hydrocarbon plume and serve as a restoration baseline. They may be achieved by active remediation (e.g., air sparging) or by intrinsic remediation (e.g., biodegradation). There are no specific time constraints on meeting water quality goals; if there is pressure to use the impacted groundwater before water quality goals are met, well head water treatment can be applied. Also, as long as water quality protection standards are being complied with, only public health and environmental protection concerns related to the dissolved hydrocarbon plume are relevant.

Groundwater RBCs: These directly relate to public health concerns associated with the dissolved hydrocarbon plume. As such, compliance with groundwater RBCs should be achieved as soon as practical. It is possible to be in compliance with groundwater RBCs without being in compliance with water quality restoration goals. According to recent regulatory guidelines, a site groundwater contamination case may be considered low-risk if certain conditions are met (among them compliance with RBCs). If it can be shown that water quality protection standards will be complied with (evidence of a stable dissolved hydrocarbon plume), and that water quality restoration goals will be achieved (evidence of biodegradation and/or plume attenuation), then a low-risk groundwater case may be closed.

Soil RBCs: As with groundwater RBCs, these directly relate to public health concerns associated with hydrocarbon-affected soil. Accordingly, the conditions described for groundwater RBCs apply for soil RBCs. It is important to note that the potential for leachate from impacted soil to enter the groundwater is considered, but not necessarily with a focus on water quality goals or protection standards. Instead, the focus is typically on groundwater RBCs. It is possible for soil RBCs to be achieved in such a way that leachate from that soil meets groundwater RBCs, but does not meet water quality restoration goals or protection standards.

Public Health and Safety Goals: These goals are closely related to groundwater and soil RBCs. Because of this, achievement of RBCs assure compliance with public health and safety goals.

4.0 CORRECTIVE ACTION REQUIREMENTS

To identify corrective action requirements and develop remedial objectives, current site conditions are compared to those necessary to achieve the site-specific corrective action goals outlined in the previous section. Where goals are achieved, remedial action is not required; conversely, where goals are not achieved, action may be required. In this section, corrective action requirements are specified.

Review of data for the three previous groundwater monitoring events reveals that groundwater quality within the area defined by Wells MW-1, MW-2, MW-3, MW-5, MW-6, MW-8, and MW-10 did not meet water quality restoration goals. During the past three quarters, the following water quality restoration goals for groundwater were exceeded; TPHg goals (1,000 ppb) were exceeded at Wells MW-2, MW-3, MW-6, MW-8, and MW-10; benzene goals (1 ppb) were exceeded at Wells MW-1, MW-2, MW-3, MW-5, MW-6, MW-8, and MW-10; toluene goals (1,000 ppb) and ethylbenzene goals (680 ppb) were exceeded at Wells MW-3 and MW-8; xylene goals were exceeded at Wells MW-3, MW-6, and MW-8; TPHd goals (1,000 ppb) were exceeded at Wells MW-2, MW-3, MW-6, and MW-8.

Considering groundwater RBCs, concentrations of benzene at wells MW-3, MW-6, and MW-8 exceeded the benzene RBC of 2 mg/l during the past three groundwater monitoring events. Groundwater RBCs for toluene, ethylbenzene, and xylenes were not exceeded during the past three groundwater monitoring events. A review of soil chemistry data indicates that the average benzene soil column concentration in the area of impact as defined in Section 2.2.3 , is above the soil RBC of 0.49 mg/kg. However, soil vapor samples collected directly over impacted soils and groundwater suggest that current site risks are negligible.

With respect to the site public health and safety goal, there is no apparent condition that could be construed as a nuisance and there are no risks of fire or explosion. At this time, the site public health and safety goal is achieved and no associated corrective action is necessary. The public health and safety goal would be compromised if use of, or exposure to, groundwater within the compliance boundary was allowed. Also, the public health and safety goal could be compromised if extensive excavation occurred in the area of soil impact.

5.0 CORRECTIVE ACTION

5.1 Corrective Action Objectives

Objectives are identified to provide direction in developing the corrective actions necessary to achieve remediation goals. Objectives also serve as a baseline for measuring achievement. Soil- and groundwater-based objectives are identified below.

- **Groundwater:** Within technical and economic constraints: (1) achieve the groundwater RBCs; (2) prevent or facilitate the use of, or exposure to, impacted groundwater until groundwater quality restoration goals are met; and (3) maintain compliance with groundwater protection standards.
- **Soil:** Within technical and economic constraints, achieve the soil RBC for benzene.

The groundwater-based remedial objectives apply to groundwater beneath the site, and off-site. Groundwater delineation has been nearly completed, and the petroleum hydrocarbon plume boundaries have been adequately defined. The soil-based objective applies to a specific soil volume that is situated approximately 10 to 20 feet bgs (at the capillary fringe). Laterally, residual soil impact appears to be restricted to the area adjacent, cross-gradient, and downgradient to the former subsurface gasoline storage tanks.

Achievement of soil- and groundwater-based objectives will be subject to technical and economic constraints; therefore, modifications to remediation goals (and associated remedial objectives) may be necessary. Remedial objective achievement will be evaluated through analysis of data resulting from implementation of the recommended remedial alternative.

5.2 Technology Identification and Screening

The general response actions necessary to achieve the remedial objectives are:

1. Manage the dissolved petroleum hydrocarbon plume.
2. Manage the risk of exposure to impacted groundwater and soil.
3. Reduce the mass of petroleum hydrocarbons identified in groundwater and soil.

The general response actions are used to focus the transition from remedial objectives to technological applications. Each response action addresses one or more of the remedial objectives. The proposed strategy for effecting the general response actions and achieving the remedial objectives is outlined below.

- Utilize physical remediation techniques, within technical and economic constraints, to achieve RBCs.
- Document the occurrence of biodegradation at the site.
- Utilize institutional controls to restrict exposure to subsurface hydrocarbon impact.
- In the long-term, rely on natural biodegradation to achieve groundwater restoration and maintain compliance with groundwater protection standards.

5.2.1 Technology Screening

To identify applicable technologies, key site conditions must be considered. These conditions were outlined as part of the conceptual site model. Resolution 92-49 was consulted for applicable technologies, as was available literature. Only technologies that would apply to site-specific conditions were considered, and technologies were eliminated from further consideration on the basis of implementability. Technologies that passed the screening process and were found suitable for constructing remedial alternatives are:

- (1) Excavation and Aeration/Disposal
- (2) Soil Vapor Extraction
- (3) Bioventing/Air Injection — Soils in cap fringe & saturated zone not affected
- (4) Intrinsic (Natural) Remediation
- Thermal Oxidation
- Carbon/Resin Adsorption — gw extraction
- Remediation Monitoring/Data Collection — required regardless
- Institutional Control

Remediation monitoring/data collection was chosen in association with all the response actions identified. Monitoring will provide information necessary to manage the dissolved hydrocarbon plume, evaluate remediation progress, and demonstrate intrinsic remediation. The aforementioned technologies were chosen because they are either established mass removal technologies, or facilitate intrinsic attenuation mechanisms. Thermal oxidation and carbon/resin adsorption were considered in conjunction with mass removal technologies that would result in discharges of hydrocarbon-affected media (i.e., soil vapor and groundwater). Finally, institutional control was selected as a method to prevent use of, or exposure to, impacted groundwater.

5.3 Recommended Remedial Alternative

According to CCR Title 23, Chapter 16, Article 11, at least two alternatives must be identified and evaluated for restoring or protecting beneficial water uses. In addition, each alternative must be designed to mitigate nuisance conditions and risk of fire or explosion. Alternatives are briefly described below beginning with elements common to all alternatives.

5.3.1 Elements Common to Alternatives

- **Remediation Monitoring.** Remediation monitoring is an aspect of the existing site remediation program, and will continue to be a key aspect of any remedial alternative. In addition to the current monitoring program, remediation monitoring will be performed to maintain compliance with any implementation permits, and to evaluate progress toward attaining the remedial objectives. Also, monitoring will be used as a tool to manage the dissolved hydrocarbon plume and risk of exposure to subsurface impact.
- **Institutional Control.** This management technology will be used to reduce the possibility of exposure to petroleum hydrocarbon-affected media at, or from, the site. Generally, this is accomplished by restricting access to impacted media. For example, since impacted groundwater will persist for some time during remediation, use would be restricted by prohibiting installation of drinking water wells at, or near, the site.

5.3.2 Alternative 1: Excavation and Aeration or Disposal

This alternative consists of excavating hydrocarbon impacted soils exceeding the soil based RBCs. Excavation would be limited by on-site structures and underground utilities. Excavated materials would then either be aerated and backfilled into the excavation or transported off-site for proper disposal. New fill would be used to fill the excavation as necessary; soil would be compacted in lifts and tested for density. The graded soil surface would be paved. Soils that were previously excavated would also be transported off-site for disposal.

The United States Environmental Protection Agency (EPA) suggests that excavation with off-site landfill disposal should be considered for small soil volumes (less than 1,000 cubic yards) with high contaminant concentrations. The benefits of this alternative are that it is relatively quick to implement and it is relatively effective for small accessible areas. The results of this alternative are almost immediately available; hydrocarbon concentrations in the remaining soils are easily determined. Limitations of this alternative include: contaminants are moved - not treated, the alternative is not cost effective for large soil volumes or soil with low impact concentrations;

physical site conditions (structures) may determine the limits of the excavation; and the alternative can pose long term liability associated with landfill disposal.

5.3.3 Alternative 2: Bioventing/Air Injection

Application of this alternative would require installation of an air injection system, a soil vapor extraction system, and a vapor abatement unit. Air injection and vapor extraction flow rates would be optimized to enhance mass transfer and biodegradation. Operational flexibility is proposed as a means to address seasonal groundwater elevation changes and to maximize biodegradation. During periods of high groundwater elevation, air injection and soil vapor extraction flow rates would be minimized; during periods of low groundwater elevation, soil vapor extraction flows would be increased. These actions will optimize biodegradation and maintain mass transfer at the capillary fringe and in the vadose zone.

This technique is able to treat large volumes of soil and groundwater effectively with minimal disruption to property use. Advantages of this alternative are that it treats both groundwater and soils, it is effective on low and high molecular weight hydrocarbons, and treatment times are relatively short (6 months to one year under optimal conditions). Disadvantages include the cost to build, maintain, and operate the system; and the expense of soil vapor treatment (it requires specialized equipment with sophisticated control capability, and it requires complex monitoring and control during operation). It has been Toxichem's experience that, given a proper design and optimal operation, the effectiveness of this alternative is exhausted within a 2 year period.

5.4 Alternative Evaluation

Technical, institutional, environmental safety, and economic criteria were used to evaluate the alternatives. Because some remedial alternative elements are common to both alternatives, only the characteristic elements (described above) were considered during the evaluation process. It was determined that Alternative 1 was the most feasible for long-term application. Alternative 1 was chosen on the following basis:

Technical. Technical criteria considerations included: short- and long-term effectiveness; reduction in the toxicity, mobility, and volume of affected media; and implementability. With regard to implementability, Alternative 1 is favored over Alternative 2 because the lead time for planning and implementation of Alternative 1 is more expeditious than for Alternative 2. In terms of effectiveness, Alternative 1 is anticipated to be more effective in the short-term. This is because the excavation and removal of hydrocarbon impacted soils would be accomplished in a shorter period of time than for bioventing and air injection.

Over the long-term, Alternatives 1 and 2 approach parity because bioventing/air injection will eventually complete remediation. However, it is important to note that the term of remediation associated with Alternative 1 is shorter. Both alternatives allow for a reduction in toxicity, mobility, and volume of hydrocarbon-affected media.

Based on the foregoing discussion, Alternative 1 appears to be the most appropriate for implementation with respect to technical criteria. The application of Alternative 1 would result in accelerated implementation, short term effectiveness is greater for Alternative 1 than for Alternative 2, and long term effectiveness is equal for each of the alternatives.

Institutional. It is anticipated that implementation of Alternatives 1 or 2 would be consistent with applicable, relevant, and appropriate requirements. The regulatory community favors active treatment at sites that are not defined as low risk soils and/or groundwater cases. Because of factors described above, Alternative 1 and Alternative 2 rated equally with respect to institutional criteria.

Human Health and Environmental Protection. Both of the alternatives provide protection of human health and the environment; however, when compared to Alternative 2, implementation of Alternative 1 would increase the potential for exposure to hydrocarbon-affected media and risk of injury. The increase in risk stems from excavation and backfilling activities and transporting relatively isolated hydrocarbon compounds to the surface for treatment. On this basis, Alternative 2 was favored over Alternative 1.

Economic. Based on economic analyses, the alternatives were ranked from most economical to least economical. It was estimated that implementation of Alternative 1 would cost up to $106,000 considering 1,150 cubic yards of excavated soil, an estimated half of which will require disposal at a cost of up to $185 per cubic yard for disposal. Alternative 2 is associated with moderate capital outlay, and a longer operation period. It was estimated that the implementation of Alternative 2 would cost $200,000. The project life span for Alternative 2, with respect to active remediation, was assumed to be 24 months. The most cost-effective alternative will minimize the burden of remediation on the people of the State, and on this basis Alternative 1 was ranked over Alternative 2.

show calc for estimate

In summary, Alternative 1 was found to be the most applicable because: (1) it is known to be effective, (2) short term effectiveness is greater than for Alternative 2, and (3) the resource cost to the public is more reasonable than that for Alternative 2. Based on the information provided herein, Toxichem recommends implementation of Alternative 1.

5.5 Recommended Alternative Implementation

Tasks necessary for implementation of the recommended corrective action are outlined below.

- **Characterize Soils for Excavation Limits and for Landfill Profiling:** This action has been completed as of July 1998. Based on the results of the analyses, a soil excavation plan will be prepared and soils will be pre-profiled into an appropriate landfill.
- **Implement a Free Product Recovery Program:** Immediately install a free product skimmer and implement a free product removal program in concert with the current quarterly monitoring program. OK

- **Locate Underground Utilities:** Prior to soil excavation activities at the site, all underground utility and piping lines will be marked at the surface using both Underground Service Alert and a private utility locator .

- **Excavate and Transport Impacted Soils:** Subsequent to landfill determination and analysis of the limits of excavation, soils shall be excavated and either; (1) set aside for backfilling as for the overburden materials, (2) set aside for aeration and backfilling as for minimally impacted soils, or (3) off-hauled to an appropriate predetermined landfill.

- **Removal and Treatment of Groundwater:** A plan shall be developed that will provide for the removal, treatment, and discharge of standing water within the excavation.

- **Implementation of a Post Excavation Sampling Plan:** After the limits of the excavation are achieved, a sampling plan will be utilized to determine the residual hydrocarbon concentrations remaining in soils.

- **Excavation Backfilling and Compaction Testing:** Subsequent to soil excavation activities, the excavation will be backfilled either with overburden materials, aerated soils, or imported fill. Compaction will occur in accordance with building requirements as fill material is placed within the excavation. The backfilled excavation will be covered with concrete and/or asphalt to match existing surfaces.

- **Establish an Institutional Controls Plan:** At the close of active remediation, an Institutional Controls Plan would be specified based on post-remediation subsurface conditions, regulatory input, and property owner input.

- **Groundwater Monitoring:** Groundwater monitoring shall continue, and up to one year of post-remediation monitoring would be provided to document trends. At minimum, groundwater monitoring would take place twice a year, at the close of the wet and dry seasons. After post-remediation groundwater monitoring is complete, case closure would be applied for.

5.6 Implementation Schedule

Implementation of the excavation program will commence at the time the site owner operator is ready to install new fuel tanks. A Use Permit, for fueling operations, has been applied for by the site owner/operator.

TABLES, FIGURES, AND APPENDICES

TABLES

FIGURES

APPENDICES

Table 1
Summary of Soil Analytical Data for Groundwater Monitoring Wells and Soil Borings

Former Texaco Facility
3810 Broadway
Oakland, California

Boring/ Well Number	Consultant	Date Sampled	Sample Depth (feet)	TPH as Gasoline (ppm)	Benzene (ppm)	Toluene (ppm)	Ethyl-benzene (ppm)	Xylenes (ppm)	TPH as Diesel (ppm)	Total Hydrocarbons (ppm)	Oil and Grease (ppm)
MW-1	HZ	10/17/91	10.5	ND	ND	ND	ND	ND	NA	ND	ND
			15.5	NA	NA	NA	NA	NA	NA	ND	ND
			20.5	NA	NA	NA	NA	NA	NA	ND	ND
			25.5	NA	NA	NA	NA	NA	NA	ND	ND
MW-2	HZ	01/28/92	30	ND	ND	ND	ND	ND	NA	ND	ND
B-1	M/H	09/11/95	12.5	310	0.15	0.29	6.2	31.2	NA	NA	NA
			19	3,600	33.0	310	67	361	NA	NA	NA
			26.5	1.1	0.27	0.06	0.018	0.023	NA	NA	NA
B-2	M/H	09/11/95	12 5	3.1	0.69	0.11	0.69	0.103	NA	NA	NA
			16.5	2,200	15 0	120	37	445	NA	NA	NA
			26.5	<1	<0 005	0.011	<0.005	<0.005	NA	NA	NA
B-3	M/H	09/12/95	27	<1	<0.005	<0.005	<0.005	<0.005	<1	NA	NA
B-4	M/H	09/11/95	12.5	83	0.06	<0.050	1.2	7.2	NA	NA	NA
			18	4,800	3.8	44	18	101	NA	NA	NA
			26.5	19	0.52	0.078	0.039	0.07	<20	NA	NA
B-5	M/H	09/12/95	12.5	4,800	48	390	93	466	NA	NA	NA
			29 5	<1	0.055	0.009	<0 005	<0 005	NA	NA	NA
B-6	M/H	09/12/95	29	<1	<0 005	<0 005	<0.005	<0.005	NA	NA	NA
MW-3	M/H	10/26/95	8.5	65,000	88	550	140	690	NA	NA	NA
			15.5	2.8	<0.005	0 027	0.0064	0.0265	NA	NA	NA
			19.5	6.2	1.3	1.5	0.11	0 43	NA	NA	NA
MW-4	M/H	10/26/95	29	<1	<0 005	<0.005	<0.005	<0.005	NA	NA	NA
MW-5	FD	09/19/96	5	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA
			15	<1	<0 005	<0.005	<0 005	<0 005	<10	NA	NA
			20	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA
			25	<1	<0.005	<0 005	<0.005	<0.005	<10	NA	NA
			35	<1	<0 005	<0.005	<0.005	<0.005	<10	NA	NA
MW-6	FD	09/19/96	5	<1	<0.005	<0.005	<0 005	<0 005	<10	NA	NA
			15	<1	0.032	<0.005	<0.005	<0.005	<10	NA	NA
			20	<1	0.027	<0 005	<0.005	<0.005	<10	NA	NA
			25	<1	0.110	0.0053	0.0058	0 0094	<10	NA	NA
			35	1.3	<0.005	0.010	0 014	0.120	<10	NA	NA
MW-7	FD	09/19/96	5	<1	<0.005	<0.005	<0.005	0.089	<10	NA	NA
			15	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA
			20	<1	<0 005	<0.005	<0.005	<0 005	<10	NA	NA
			25	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA
			35	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA

Table 1

Summary of Soil Analytical Data for Groundwater Monitoring Wells and Soil Borings

Former Texaco Facility
3810 Broadway
Oakland, California

Boring/ Well Number	Consultant	Date Sampled	Sample Depth (feet)	TPH as Gasoline (ppm)	Benzene (ppm)	Toluene (ppm)	Ethyl-benzene (ppm)	Xylenes (ppm)	TPH as Diesel (ppm)	Total Hydrocarbons (ppm)	Oil and Grease (ppm)
MW-8	FD	09/19/96	5	120	0 77	3 5	1.2	7.3	<10	NA	NA
			15	520	2.6	0 66	5 6	10	<10	NA	NA
			20	14,000	25	7.1	160	840	53	NA	NA
			25	53	0.08	0.63	0.20	1.1	<10	NA	NA
			35	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA
MW-9	FD	09/19/96	5	11	<0.005	<0.005	<0.005	<0.005	62	NA	NA
			15	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA
			20	<1	<0.005	<0.005	<0.005	<0.005	69	NA	NA
			25	<1	<0.005	<0.005	<0.005	<0.005	<10	NA	NA
			35	<1	<0 005	<0 005	<0 005	<0 005	<10	NA	NA
MW-10	FD	09/19/96	5	<1	<0 005	<0.005	<0.005	<0.005	<10	NA	NA
			15	<1	<0.005	<0 005	<0.005	<0.005	<10	NA	NA
			20	<1	<0.005	<0.005	<0.005	0 025	<10	NA	NA
			25	<1	<0 005	<0 005	<0.005	<0.005	<10	NA	NA
			35	<1	<0.005	<0.005	<0.005	<0 005	<10	NA	NA
SB-1	RRM	07/03/98	8	430	2 8	5.0	4.8	23	NA	NA	NA
SB-2	RRM	07/03/98	14	2,900	16	19	54	250	NA	NA	NA
SB-3	RRM	07/03/98	14	<1.0	<0.0050	<0 0050	<0.0050	<0.0050	NA	NA	NA
SB-4	RRM	07/03/98	15	<1.0	<0 0050	<0 0050	<0.0050	<0.0050	NA	NA	NA
SB-5	RRM	07/03/98	8	<1 0	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA
SB-6	RRM	07/03/98	10	<1.0	<0 0050	<0.0050	<0.0050	0.0087	NA	NA	NA

Notes:

TPH = Total petroleum hydrocarbons
ppm = Parts per million
HZ = Harza Kaldveer
M/H = McLaren/Hart
FD = Fluor Daniel GTI
RRM = RRM, Inc

Table 2
Summary of Groundwater Monitoring and Sampling Data

Former Texaco Service Station
3810 Broadway
Oakland, California

Well Number	Date Sampled	Top of Casing Elevation (feet, MSL)	Depth to Groundwater (feet)	Groundwater Elevation (feet, MSL)	TPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MTBE (ppb)	TPH as Diesel (ppb)
MW-1	10/19/91		NA	NA	300	4.1	ND	ND	20	NA	1,700
	01/30/92		NA	NA	80	0.7	0.5	ND	2	NA	670
	11/03/95	86.69	22.98	63 71	<50	<0.3	<0.3	0.36	<0.3	NA	NA
	06/28/96	86 69	21.77	64.92	<100	<0.5	<1.0	<1.0	<2.0	NA	<50
	10/10/96		23.26	63.43	520	9.2	53	17	70	16	<400
	11/07/96		23.27	63.42	NA	NA	NA	NA	NA	NA	NA
	12/18/97		19.70	66.99	2,200	<3	<3	<3	<3	<200	<50
	04/06/98		16.88	69.81	1,600	16	0.8	<0.5	<0.5	38.3	<50
	06/18/98		19.78	66.91	330	7.8	<0.5	<0.5	<0.5	<0 5	280
MW-2	01/30/92		NA	NA	4,000	470	560	160	540	NA	ND
	11/03/95	85.96	22.26	63.70			Separate Phase Hydrocarbons present				
	06/28/96	85.83	22.10	63 73			1.35 feet Separate Phase Hydrocarbons				
	10/10/96		22.36	63.47	99,000	4,100	9,400	2,300	9,900	<25	1,800
	11/07/96		22.39	63.44			0.01 foot Separate Phase Hydrocarbons				
	12/18/97		20.19	65.64	24,000	600	1,800	750	2,400	<2,000	4,700
	04/06/98		18.00	67.83	20,100	252	448	430	1,410	<200	9.5
	06/18/98		19.63	66.20	20,000	240	370	270	790	<50	5,200
MW-3	11/03/95	83.43	19.40	64.03	67,000	12,000	15,000	980	4,700	NA	NA
	06/28/96	83.18	19.04	64.14			1.45 feet Separate Phase Hydrocarbons				
	10/10/96		19.51	63.67	110,000	6,600	16,000	2,200	12,000	<250	1,200
	11/07/96		19.40	63 78			0.01 foot Separate Phase Hydrocarbons				
	12/18/97		18.79	64.39	180,000	1,500	16,000	4,600	23,000	<3,000	6,100,000
	04/06/98		16.58	66.60			0.05 foot Separate Phase Hydrocarbons				
	06/18/98						Separate Phase Hydrocarbons present				
MW-4	11/03/95	83.62	19.89	63.73	<50	<0.3	<0.3	<0.3	<0.3	NA	NA
	06/28/96	83.31	18.83	64.48	<100	<0.5	<1.0	<1.0	<2.0	NA	<50
	10/10/96		19.84	63.47	850	3.9	65	22	120	<5 0	<50
	11/07/96		19.84	63.47	NA	NA	NA	NA	NA	NA	NA

Table 2
Summary of Groundwater Monitoring and Sampling Data

Former Texaco Service Station
3810 Broadway
Oakland, California

Well Number	Date Sampled	Top of Casing Elevation (feet, MSL)	Depth to Groundwater (feet)	Groundwater Elevation (feet, MSL)	TPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MTBE (ppb)	TPH as Diesel (ppb)
	12/18/97		17.77	65.54	<50	<0.5	<0.5	<0.5	<0.5	<30	2,000
	04/06/98		15.45	67.86	<50	<0.5	<0.5	<0.5	<0.5	<30	<50
	06/18/98		16.89	66.42	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<50
MW-5	10/10/96	85.41	21.93	63.48	1,800	34	4.7	11	44	5.0	<50
	11/07/96		21.96	63.45	NA	NA	NA	NA	NA	NA	NA
	12/18/97		19.81	65.60	1,200	15	<1	15	<1	72	<50
	04/06/98		17.43	67.98	1,600	16	1	<0.5	<0.5	38	<50
	06/18/98		19.15	66.26	110	7	<0.5	<0.5	<0.5	<0.5	100
MW-6	10/10/96	86.09	22.44	62.97	45,000	8,300	2,900	810	3,100	40	500
	11/07/96		22.60	62.81	NA	NA	NA	NA	NA	NA	NA
	12/18/97		22.28	63.13	60,000	12,000	9,800	1,800	8,600	<2,000	1,900
	04/06/98		19.90	65.51	30,500	5,950	3,720	952	3,750	<1,000	<50
	06/18/98		20.49	64.92	23,000	2,600	540	410	1,300	<250	1,100
MW-7	10/10/96	84.11	20.78	63.33	<50	0.6	<0.5	<0.5	<0.5	<5.0	<50
	11/07/96		20.80	63.31	NA	NA	NA	NA	NA	NA	NA
	12/18/97		17.27	66.84	<50	<0.5	<0.5	<0.5	<0.5	<5.0	<50
	04/06/98		15.91	68.20	<50	<0.5	<0.5	<0.5	<0.5	<5.0	<50
	06/18/98		17.95	66.16	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<50
MW-8	10/10/96	84.01	20.82	63.19	17,000	1,300	1,200	64	1,300	<5.0	110
	11/07/96		20.44	63.57	NA	NA	NA	NA	NA	NA	NA
	12/18/97		19.36	64.65	15,000	3,600	1,800	410	930	<600	630
	04/06/98		16.19	67.82	32,300	8,230	5,900	718	2,120	<1,000	<50
	06/18/98		17.75	66.26	74,000	5,400	4,500	700	2,200	<50	2,400
MW-9	10/10/96	82.17	18.62	63.55	80	3	13	2	13	<5.0	<50
	11/07/96		18.64	63.53	NA	NA	NA	NA	NA	NA	NA
	12/18/97		16.42	65.75	<50	<0.5	<0.5	<0.5	<0.5	<5.0	<50
	04/06/98		14.00	68.17	<50	<0.5	<0.5	<0.5	<0.5	<5.0	<50

Table 2
Summary of Groundwater Monitoring and Sampling Data

Former Texaco Service Station
3810 Broadway
Oakland, California

Well Number	Date Sampled	Top of Casing Elevation (feet, MSL)	Depth to Groundwater (feet)	Groundwater Elevation (feet, MSL)	TPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MTBE (ppb)	TPH as Diesel (ppb)
	06/18/98		15.33	66.84	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<50

Table 2

Summary of Groundwater Monitoring and Sampling Data

Former Texaco Service Station
3810 Broadway
Oakland, California

Well Number	Date Sampled	Top of Casing Elevation (feet, MSL)	Depth to Groundwater (feet)	Groundwater Elevation (feet, MSL)	TPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MTBE (ppb)	TPH as Diesel (ppb)
MW-10	10/10/96	81.83	18.40	63 43	<50	<0.5	<0.5	<0.5	<0.5	<5.0	<50
	11/07/96		18.43	63.40	NA	NA	NA	NA	NA	NA	NA
	12/18/97		16.18	65.65	350	6.9	0.87	0.88	0.77	<30	<50
	04/06/98		14.39	67.44	2,300	224	168	81.4	253	<30	<50
	06/18/98		15.11	66 72	7,200	310	210	83.0	280	<0.5	320

Notes

MSL = Mean sea level
TPH = Total petroleum hydrocarbons
MTBE = Methyl tert butyl ether
ppb = Parts per billion
NA = Not analyzed

Table 1A

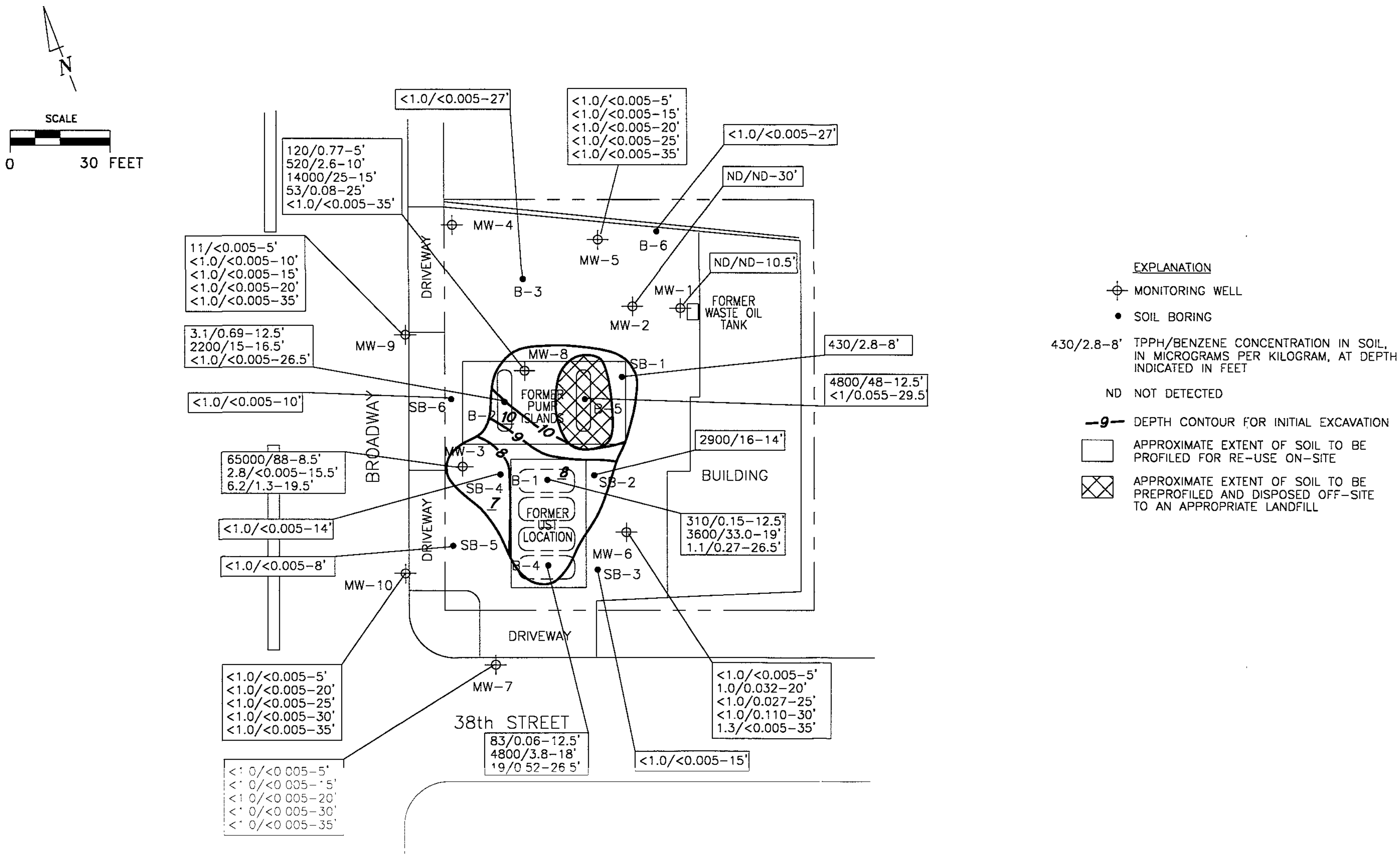
Summary of Soil Analytical Data for Groundwater Monitoring Wells and Soil Borings

Former Texaco Facility
3810 Broadway
Oakland, California

Boring/ Well Number	Consultant	Date Sampled	Sample Depth (feet)	TPH as Gasoline (ppm)	Benzene (ppm)	Toluene (ppm)	Ethyl-benzene (ppm)	Xylenes (ppm)	TPH as Diesel (ppm)	Total Hydrocarbons (ppm)	Oil and Grease (ppm)
B-1	M/H	09/11/95	12 5	310	0.15	0.29	6 2	31.2	NA	NA	NA
			19	3,600	33.0	310	67	361	NA	NA	NA
B-2	M/H	09/11/95	12.5	3.1	0.69	0.11	0.69	0.103	NA	NA	NA
			16.5	2,200	15.0	120	37	445	NA	NA	NA
B-4	M/H	09/11/95	12 5	83	0 06	0 025	1.2	7.2	NA	NA	NA
			18	4,800	3.8	44	18	101	NA	NA	NA
B-5	M/H	09/12/95	12.5	4,800	48	390	93	466	NA	NA	NA
MW-3	M/H	10/26/95	8.5	65,000	88	550	140	690	NA	NA	NA
			15.5	2 8	0.0025	0.027	0.0064	0 0265	NA	NA	NA
			19.5	6.2	1 3	1.5	0.11	0.43	NA	NA	NA
MW-8	FD	09/19/96	5	120	0.77	3.5	1 2	7 3	<10	NA	NA
			15	520	2.6	0.66	5 6	10	<10	NA	NA
			20	14,000	25	7.1	160	840	53	NA	NA
SB-1	Toxichem	07/03/98	8	430	2.8	5.0	4.8	23	NA	NA	NA
SB-2	Toxichem	07/03/98	14	2,900	16	19	54	250	NA	NA	NA
SB-4	Toxichem	07/03/98	15	0.5	0.0025	0 0025	0.0025	0.0025	NA	NA	NA
		Avg		6173 475	14.823438	90 700906	36.80056	202.016375			
				98775 6							
				16							

Notes.

TPH = Total petroleum hydrocarbons
ppm = Parts per million
HZ = Harza Kaldveer
M/H = McLaren/Hart
FD = Fluor Daniel GTI



Ref: EQ-02 'A/Sitemap.dwg
Basemap from Fluor Daniel GT

PREPARED BY

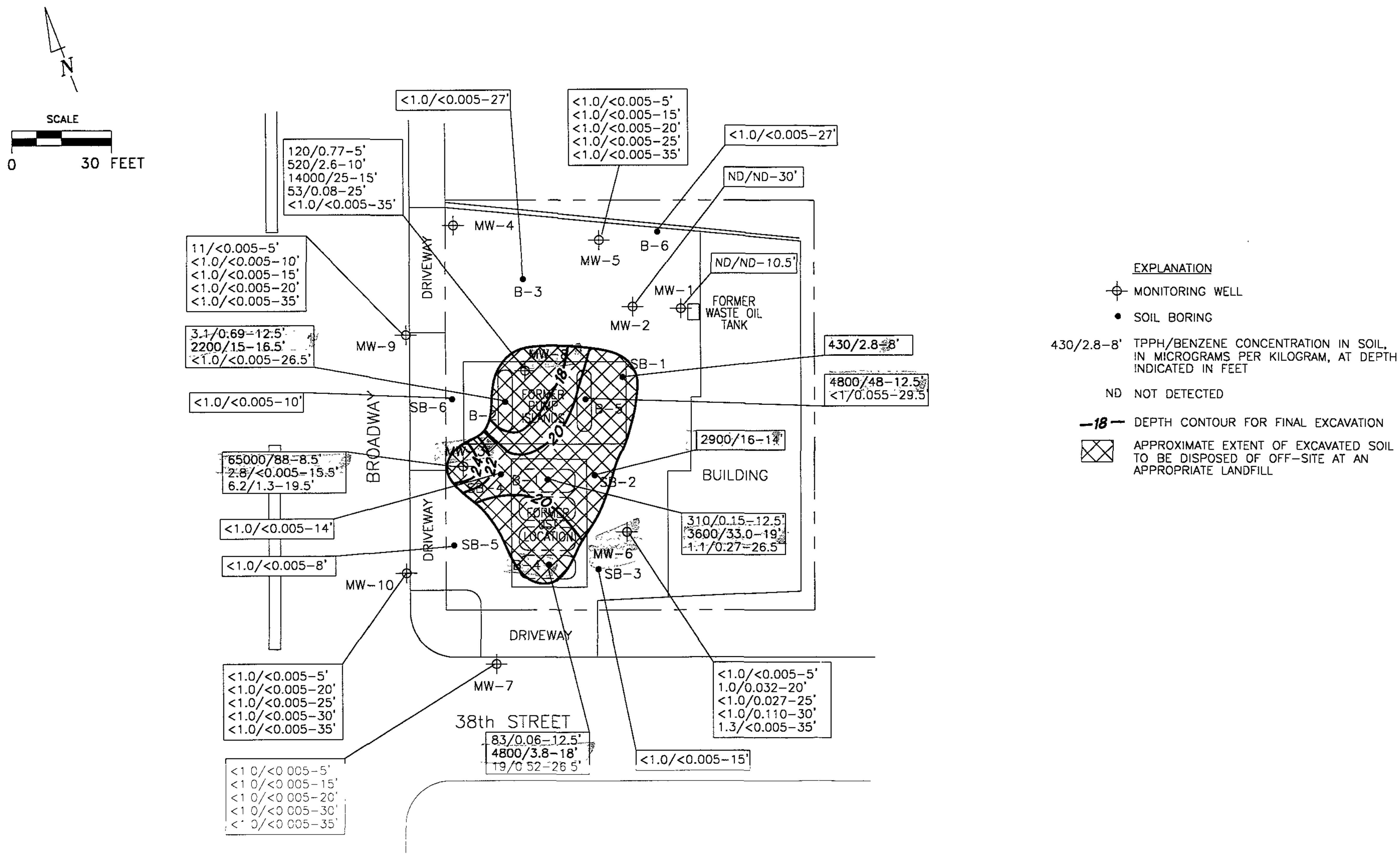
TOXICHEM Management Systems, Inc.
Environmental & Occupational Health Services

INITIAL SOIL EXCAVATION LIMITS

Former Texaco Service Station
38[illegible]0 Broadway
Oakland, California

FIGURE: 1

PROJECT: EQ-02 'A



PREPARED BY
TOXICHEM Management Systems, Inc.
Environmental & Occupational Health Services

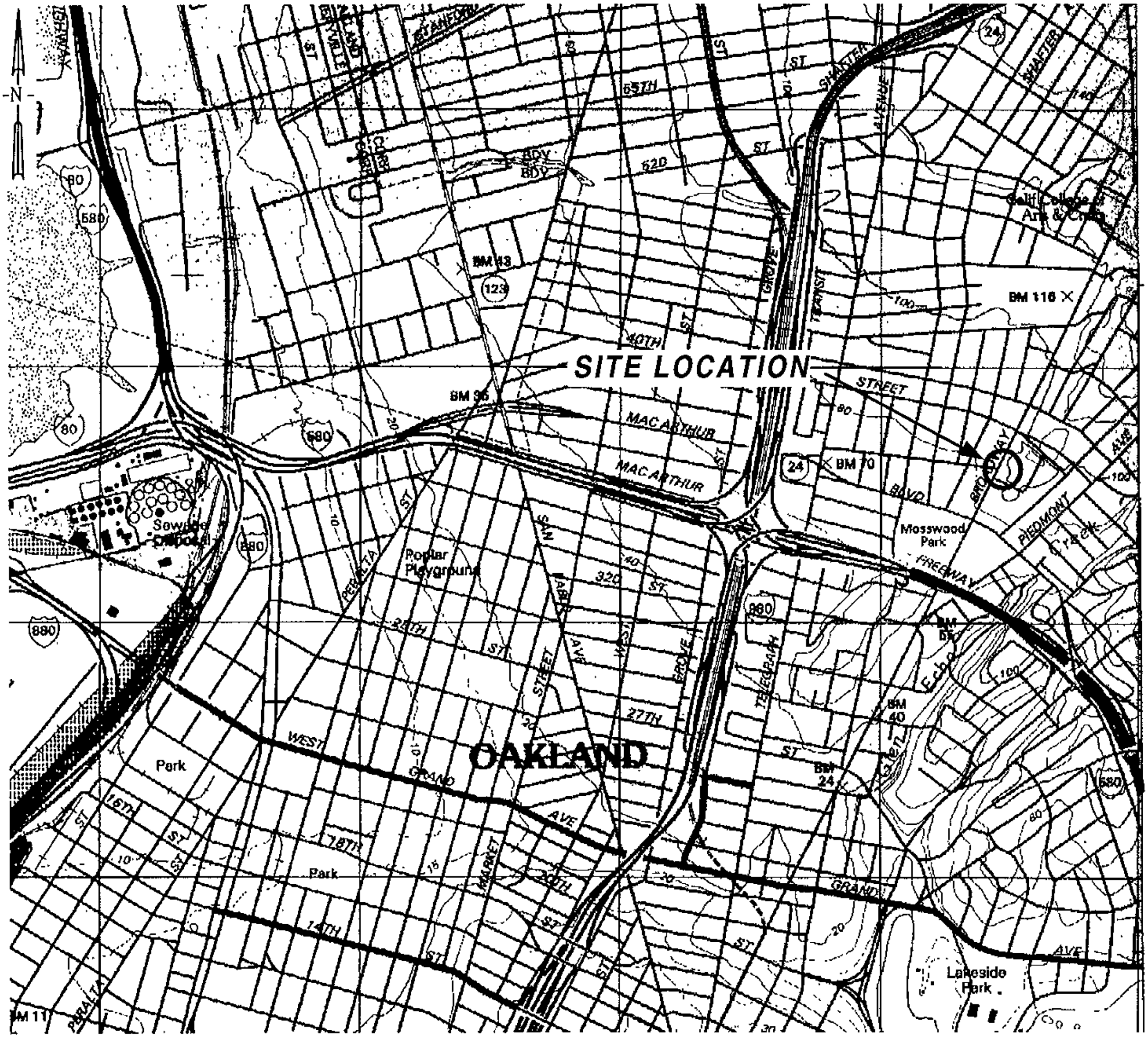
FINAL SOIL EXCAVATION LIMITS

Former Texaco Service Station
3810 Broadway
Oakland, California

FIGURE: 2
PROJECT: EQ-02.1A

Ref EQ-02.1A/Sitemap.dwg
Basemap from Fluor Daniel GTI

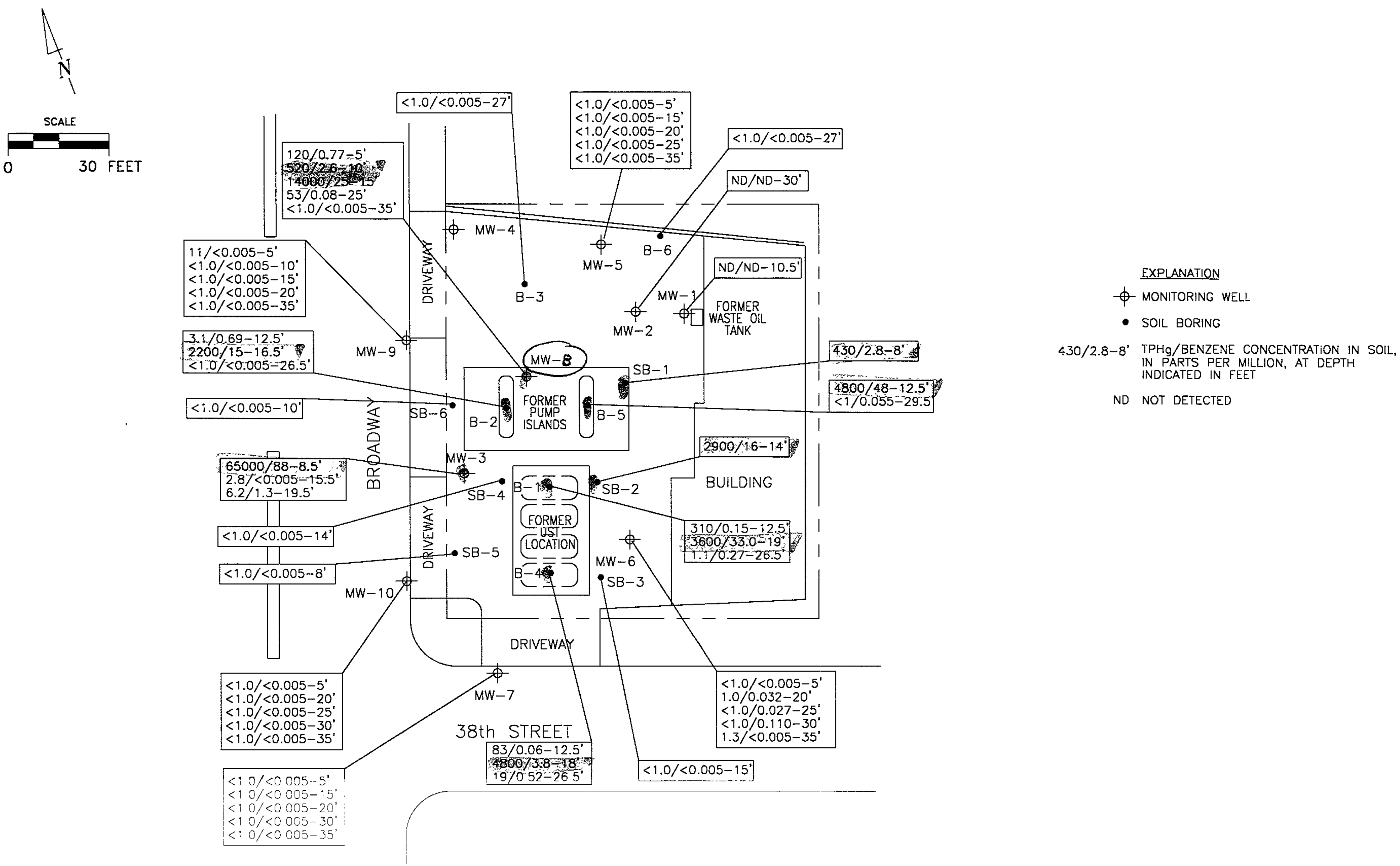
APPENDIX A
RBCA ANALYSIS



QUADRANGLE LOCATION

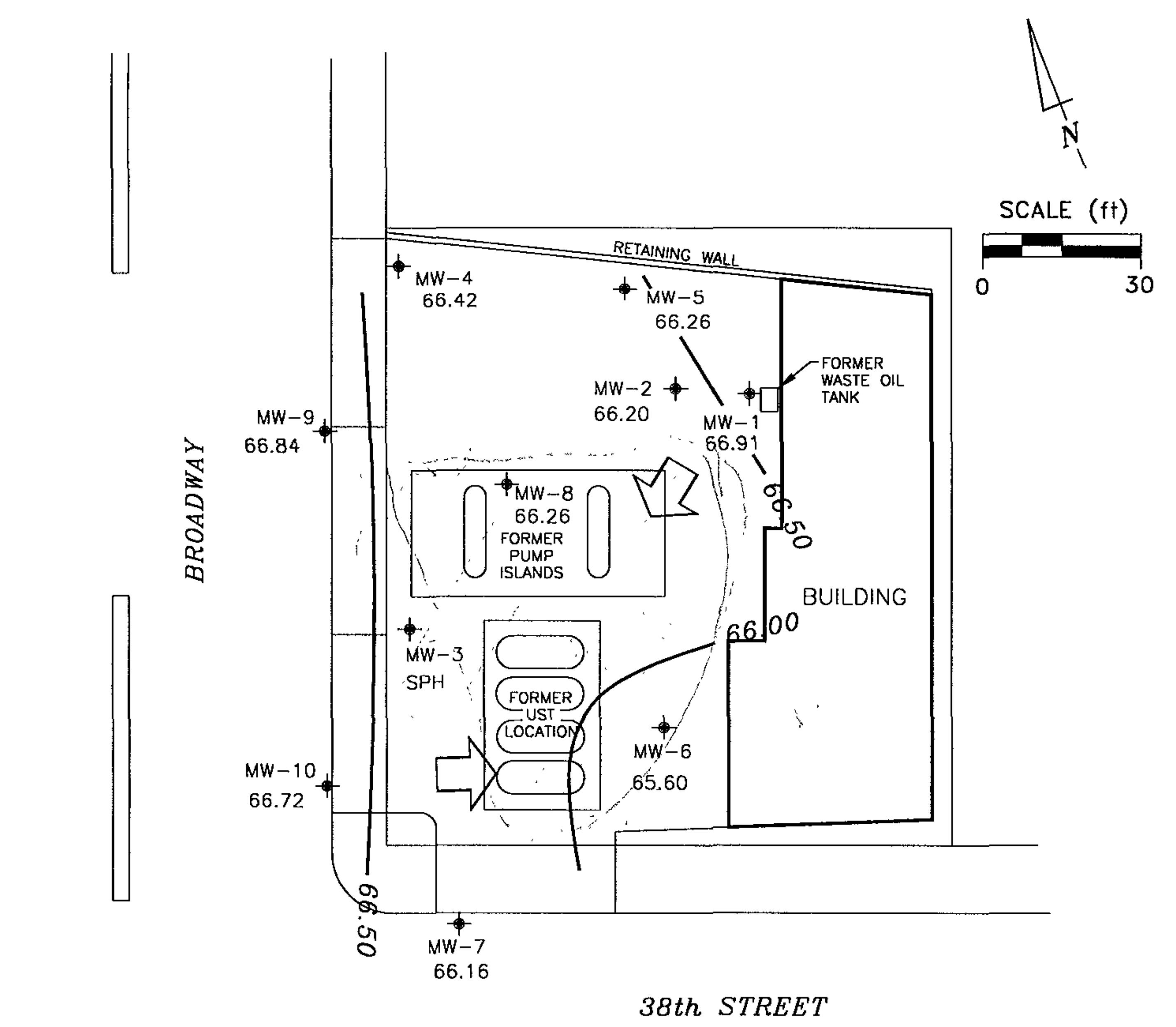
Reference:
USGS 7.5 MIN. TOPOGRAPHIC MAP
TITLED: OAKLAND WEST, CALIFORNIA
REVISED: 1993

TOXICHEM Management Systems, Inc.	SCALE: 0 FEET 2000	SITE LOCATION MAP	FIGURE 1
	DRAWN BY.	3810 Broadway Oakland, California	PROJECT TBA02
	DATE: November 11, 1998		



Basemap from Fluor Daniel GTI

PREPARED BY TOXICHEM Management Systems, Inc.	SITE MAP 38[illegible]0 Broadway Oakland, California	FIGURE: 2 PROJECT: TBA02

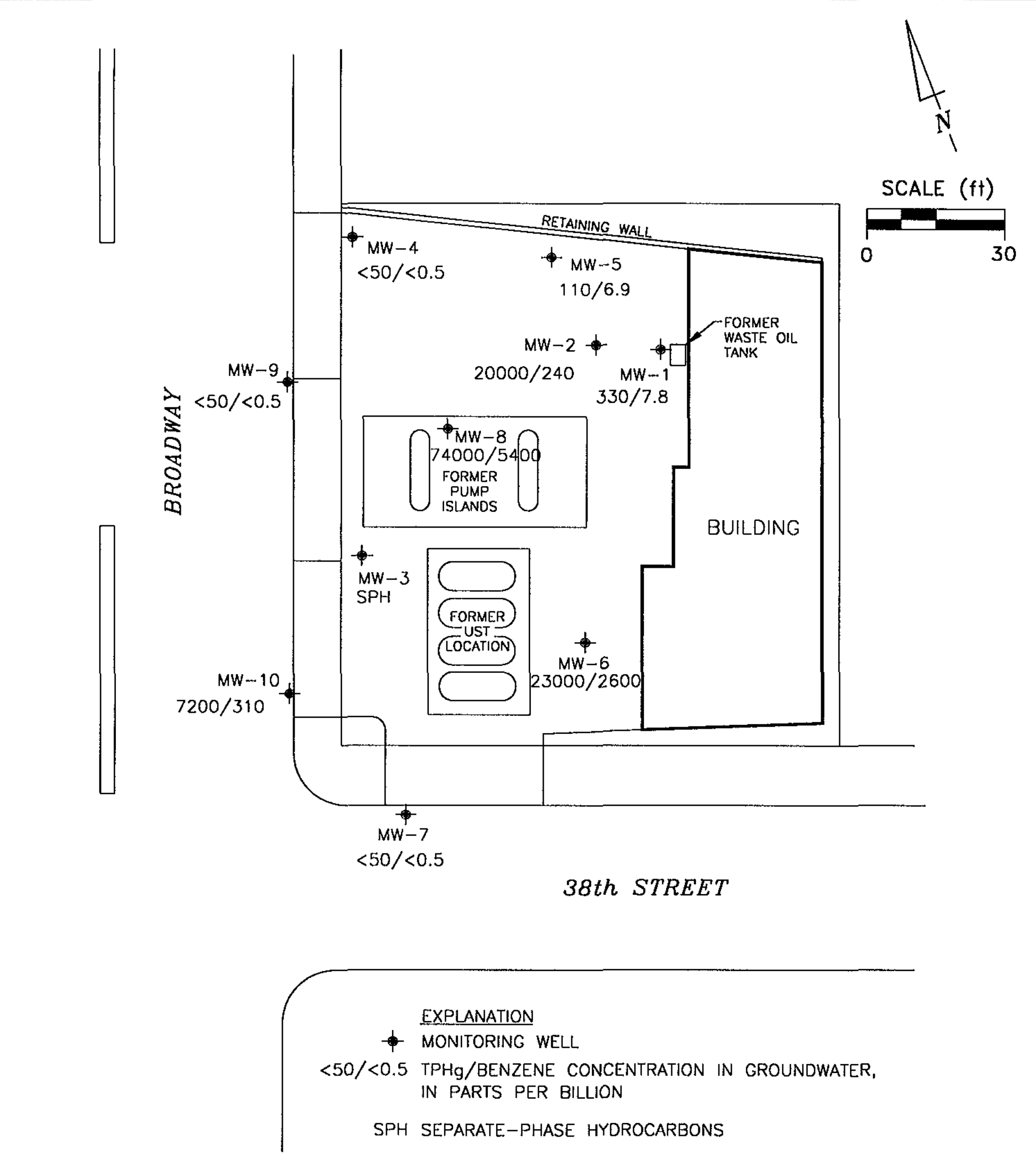


EXPLANATION

- MONITORING WELL
- 67.86 GROUNDWATER ELEVATION (FT, MSL)
- 66.00 GROUNDWATER ELEVATION CONTOUR (FT, MSL)
- SPH SEPARATE-PHASE HYDROCARBONS
- NA DATA NOT AVAILABLE
- APPROXIMATE GROUNDWATER FLOW DIRECTION; APPROXIMATE GRADIENT = 0.02

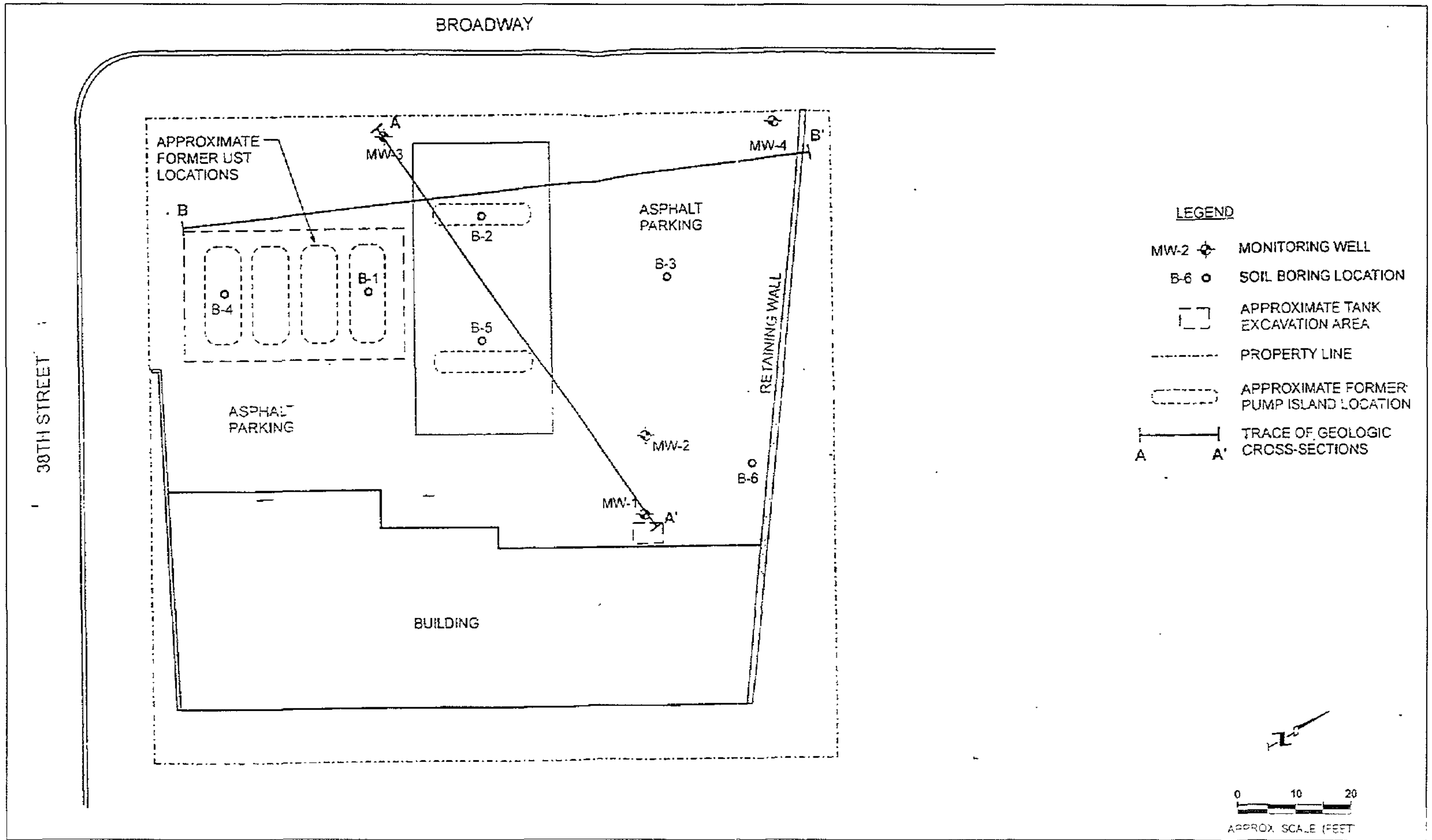
Reference: TBA02/Site.dwg
Basemap from Fluor Daniel GTI

PREPARED BY TOXICHEM Management Systems, Inc.	FORMER TEXACO SERVICE STATION 3810 Broadway Oakland, California **GROUNDWATER ELEVATION CONTOUR MAP, JUNE 18, 1998**	FIGURE: 3 PROJECT: TBA02



Reference: TBA02/Site.dwg
Basemap from Fluor Daniel GTI

PREPARED BY TOXICHEM Management Systems, Inc.	**FORMER TEXACO SERVICE STATION** 3810 Broadway Oakland, California **TPHg/BENZENE CONCENTRATION MAP, JUNE 18, 1998**	FIGURE: 4 PROJECT: TBA02



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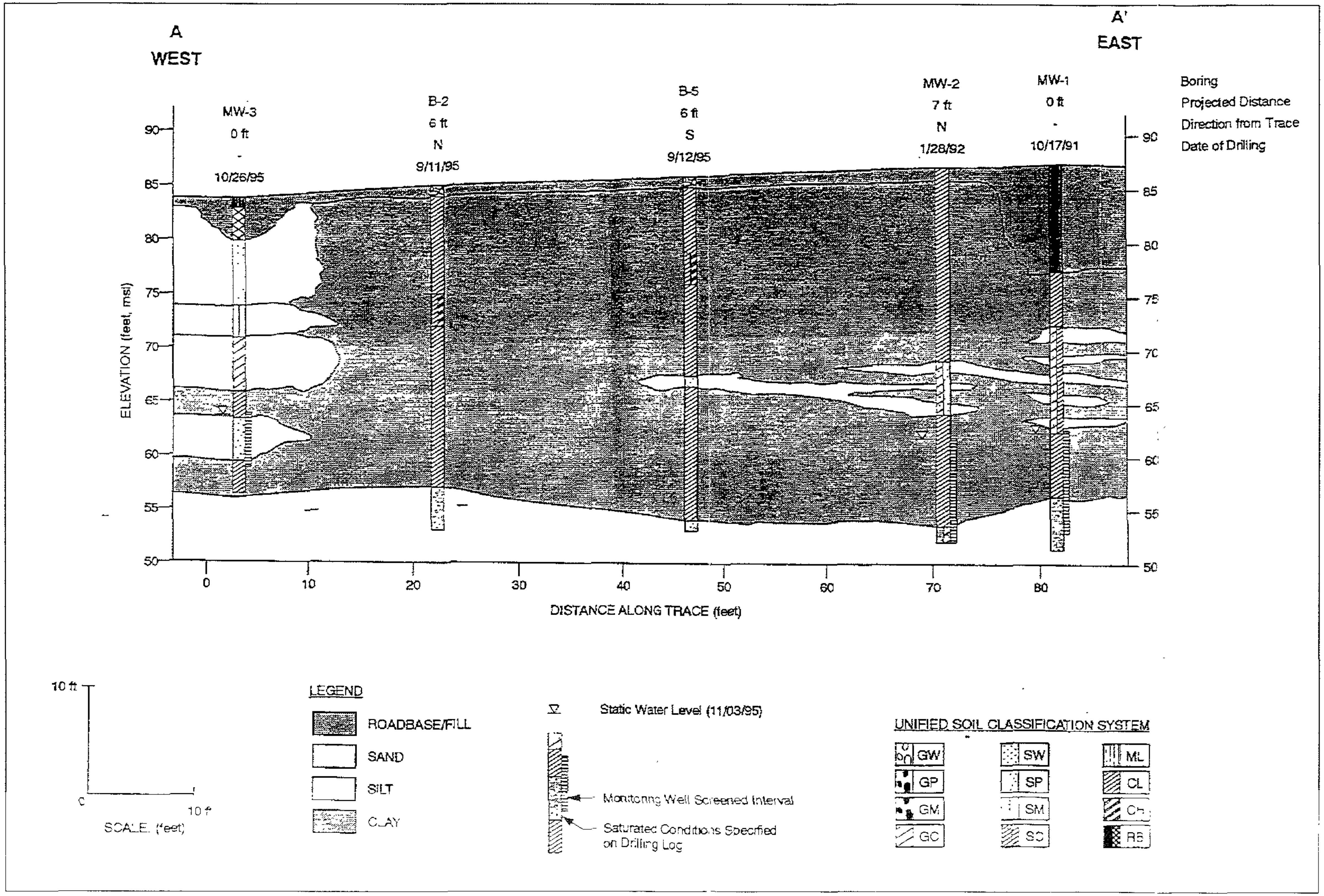
GEOLOGIC CROSS-SECTION LOCATION MAP

3810 Broadway
Oakland, California

FIGURE: 5

PROJECT: TBA02

Ref Drawing from McLaren Hart



PREPARED BY

TOXICHEM Management Systems, Inc.

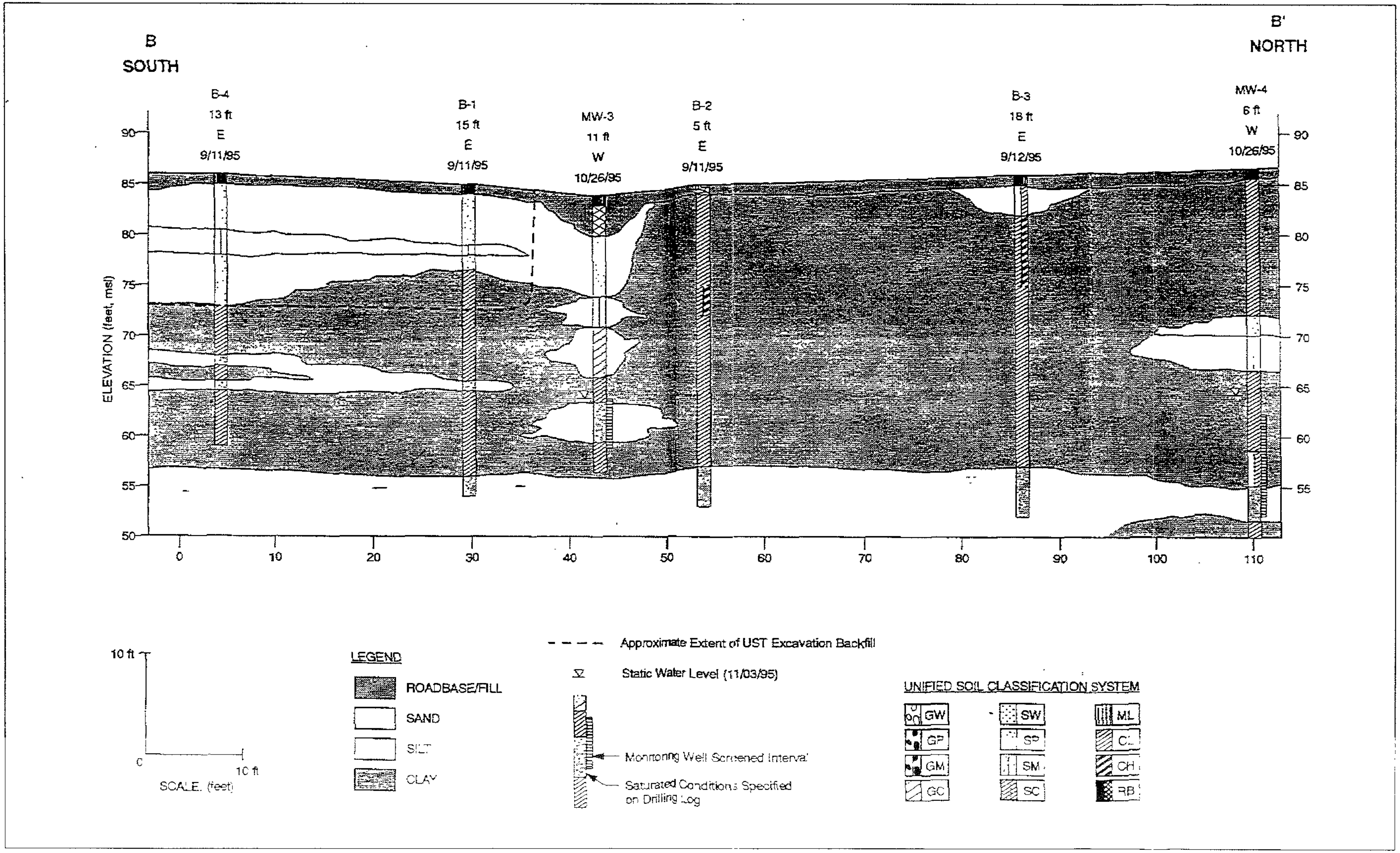
GEOLOGIC CROSS-SECTION A-A'

3810 Broadway
Oakland, California

FIGURE: 6

PROJECT: TBA02

Ref Drawing from McLaren Hart



Ref Drawing from McLaren Hart

PREPARED BY
TOXICHEM
Management Systems, Inc.

GEOLOGIC CROSS-SECTION B-B'

3810 Broadway
Oakland, California

FIGURE:
7

PROJECT:
TBA02

APPENDIX A
RBCA ANALYSIS

Health Risk Based Goals

For consistency with recent regulatory policy, an ASTM RBCA evaluation was applied for the development of corrective action goals. Figure 2 (Exposure Evaluation Flowchart) of the standard was used to characterize primary and secondary sources, transport mechanisms, exposure pathways, and receptors. Given the exposure pathway and exposure scenario, Table X2.1 was initially consulted to identify Tier 1 risk-based screening levels (RBSLs) for the constituents of concern. Table X2.1 is an example look-up table developed for compounds of concern associated with petroleum releases. Values listed in Table X2.1 were generated using conservative exposure scenarios and input parameters as described in the next section. Since site specific groundwater concentrations in some cases exceeded the ASTM Tier 1 RBSLS (adjusted for the California benzene carcinogenic potency value), a higher level assessment was completed to address site specific risk- based corrective action goals. Appendix A contains a description of methods and parameters used and results of the site specific remedial goal calculations.

Data Collection

During July of 1998, additional site data was collected to support the Site CAP. Soil samples collected at 5 feet bgs from SB-1, 2, 3, and SB-6 were analyzed for total porosity, moisture, and organic carbon content. In addition, soil vapor samples were collected from SB-1, SB-3, and SB-6 at a depth of 5 feet bgs, and analyzed for TPHg and BTEX compounds. The table below summarizes the results of the additional data collected and analytical results are included in Appendix A of this document.

Parameter	SB-1-5	SB-2-5	SB-3-5[a]	SB-6-5
Total Porosity	.349	.366	.782	.347
Saturation %	.998	.828	.024	.777
Moisture Content (cm^3/cm^3)	.348	.303	.019	.270
Air Porosity (cm^3/cm^3)	.0007	.063	.763	.0775
Foc	.012	.015	.011	.022
Vapor Conc. (mg/m^3)	22 TPHg 10 benzene .27 toluene .99 xylene	NS	ND	.11 toluene

Table notes: a. Disturbed sample. NS = not sampled ND = not detected; detection limits for TPHg was 10 mg/m^3 and for BTEX 0.10 mg/m^3

Calculation of Risk Based Clean Up Goals

Exposure Pathways

An exposure pathway is the course a chemical takes from a source to an exposed organism Exposure pathways include the following four elements: (1) a source; (2) a mechanism for release, retention, or transport of a chemical in a given medium (e.g., air, water, soil); (3) a point of contact with the affected medium; and (4) an exposure route at the point of contact (e.g., ingestion, inhalation). If any of these elements is missing, the pathway is considered "incomplete" (i.e., it does not present a means of exposure). Four exposure pathways are noted on the ASTM Exposure Evaluation Flowchart. They include soil ingestion/skin absorption; inhalation; potable water use; and recreation use/sensitive habitat. Ingestion/absorption was discounted as an exposure pathway because there are no impacted surficial soils at the site. Potable water use was not considered an applicable exposure pathway because shallow occurring groundwater in the vicinity of the site is not used as a potable water source. Finally, the site and the immediate area surrounding the site are not considered a sensitive habitat, nor are there any recreational uses associated with surface water or groundwater on or adjacent to the site. Inhalation of secondary source hydrocarbons was identified as the most likely exposure pathway.

Receptor Characterization

Receptors were characterized considering that land use in the vicinity of the site is mixed commercial and residential. For the purposes of this analysis, the commercial receptor scenario is applied since the site is currently used as an automotive repair facility, and it planned use for automotive repair and fuel dispensing operations.

Calculation Methods

The calculation of a site specific risk based remedial goals incorporate site specific data, exposure parameters and exposure point estimation with a toxicity value for the chemical of interest to obtain a chemical concentration in the groundwater or soil which equates to an acceptable risk level. The following relationships are used in the calculation:

For carcinogenic chemicals (commercial indoor worker):

$$Target\ Risk = (CDI_{indoor\ inh.} \times SF_i)$$

where:

TR	=	target risk level (10E-05)
CDI	=	chronic daily intake by exposure route;
		(CDI = Exposure Factor x media concentration)
SF	=	chemical specific carcinogenic slope factor

In the equation above, the CDI can be rewritten as the route specific exposure factor (EF) multiplied by the media concentration of the contaminant of interest. In addition, the chemical at the exposure point can be expressed in terms of the chemical in the site media of concern. As, an example, the risk based concentration for the groundwater volatilization pathway is as follows:

$$C_{gw} = \frac{TR \text{ of } 10^{-5}}{(VF_{wesp} \ x \ EF_{inhalation} \ x \ SF_i)}$$

where:

C_{gw} = contaminant concentration in groundwater (mg/l)

EF = exposure factor (inhalation)
(CDI = EF x C_{gw})

SF = chemical specific slope factor

VF_{wesp} = groundwater to indoor air volatilization factor (mg/m^3 / mg/l)

Similarly, for non-carcinogenic chemicals, the risk based remedial goal for the soil volatilization exposure pathway is as follows:

$$C_s = \frac{HI}{\left(\frac{1}{VF} \ x \ EF_{inh} \right) \div RfD_i)}$$

where:

C_s = contaminant concentration in soil (mg/kg)

HI = Hazard Quotient (unity)

RfD = chemical specific reference dose

VF = soil to indoor air volatilization factor (mg/m^3 / mg/kg)

EF = exposure factor (inhalation)
(CDI = EF x C_s)

Volatilization Factors

For the groundwater and soil to indoor air exposure pathway, volatilization factors (VF) from ASTM are used. The VF is an expression which defines the relationship between the dissolved chemical concentration in groundwater and the volatilized chemical vapor concentration (exposure point) within the occupied space Volatilization factors assume (1) chemical concentrations in groundwater and/or soil over time remain constant, (2) isotropic soils, (3) linear equilibrium partitioning within the soil matrix between sorbed, dissolved and vapor phases (soil contaminants); equilibrium partitioning between dissolved chemicals in groundwater and chemical vapors at the groundwater table, and (4) steady state vapor – and liquid – phase diffusion through the capillary fringe, vadose zone, and foundation cracks. The intrusion of vapor into a building is assumed to be governed by the relative rates of diffusion (fickian) through the soil and foundation. In addition, VFs are infinite source methods which assume there is no mass loss due to volatilization and/or biodegradation over the exposure period.

Site Parameters

Remedial goal calculations are sensitive to the use of several key parameters With respect to vapor transport through the capillary fringe, sensitive parameters include moisture and density profile, and thickness of the fringe. The ASTM expression assumes a fringe thickness of 5 cm, which is characteristic of a porous media. Site specifically, a much thicker fringe is supportable since site stratigraphy indicates fine grained materials. A capillary fringe thickness of 60 cm is assigned, based on silty clays encountered to 25ft. BGS.

ASTM uses a default diffusion path length (distance between source and foundation) of 300 cm. Onsite, depth to ground water is approximately 18.5 to 21.7 ft. bgs, therefore for the groundwater volatilization pathway, this assessment assigns a 550 cm total diffusion path, which includes the capillary fringe. For the soil volatilization pathway, the diffusion path length is 8 feet(244 cm).

Since vapor flux increases geometrically with incremental increases in air filled porosity, vapor transport through the vadose zone is most sensitive to the air filled porosity of the soils. ASTM uses default factors characteristic of porous media including 0.38, 0.12, and 0.26 for volumetric total porosity, moisture content, and air filled porosity respectively. Based on site measurements, average parameters (excluding the disturbed sample) are 0.354, 0.307, and 0.047 total porosity, moisture content, and air filled porosity respectively. **However, since SB-3-5 was collected in sandy fill, ASTM default parameters are assigned to represent that sample. Incorporating ASTM default values for the disturbed sample yields site average parameters of 0.36, 0.26, and 0.10 for total porosity, moisture content, and air filled porosity, respectively. The latter values are used for remedial goal calculations.**

ASTM methods also assume that a building sits directly above the source of soil and/or groundwater contamination, and that the source area is equivalent to the building's footprint. Site specifically, this is conservative assumption since the current onsite building is not directly over contaminated soil and or groundwater.

Exposure Parameters

Methods used to calculate chemical intakes for chronic exposure, or chronic daily intakes (CDIs), are described in Risk Assessment Guidance (RAGS) (U.S. EPA 1989a) and Department of Toxic Substances Control (DTSC) supplemental guidance (CALEPA 1992. Exposure factors (body weights, breathing rates, etc.) used in the exposure algorithms were also taken from DTSC (1992) and U.S. EPA (1997). For the commercial exposure scenario, the default body weight of 70 kg, an exposure duration of 25 years, and default inhalation rate of 20 m^3 is assumed for indoor workers.

For assessing carcinogenic effects, CDIs are calculated by prorating the exposure period cumulative dose over a lifetime; the average lifespan is assumed to be 70 years (U.S. EPA 1991a). For assessing noncancer effects, CDIs are calculated by averaging intakes only over the period of exposure

Chemical Parameters

The physico-chemical parameters used in this assessment and the sources of the information are summarized in the table below.

Physico-Chemical Parameters

Chemical	Henry's Constant Dimensionless	Carbon-Water Sorption K_{oc} (cm^3/g)	Diffusivity Air (cm^2/s)	Diffusivity Water (cm^2/s)
Benzene	.22	57	.087	9.8E-06
Toluene	.27	260	7.8E-02	8.6E-06
ethyl benzene	.32	220	7.5E-02	7.8E-06
Xylenes	22	240	7E-02	8.4E-06
MTBE	.042	12.02	.081	7.1E-07

Table notes: Henry's Constant, K_{oc}, and diffusivities are from U.S. EPA 1996 PRGs. Diffusivities and K_{oc} for benzene are from U.S. EPA 1996b. MTBE parameters are estimated at 25 deg.C using methods by Lyman and peer reviewed solubility data and vapor pressure (51g/l and 245 mm Hg respectively), K_{oc} and Henry's Constant from ASTM.

Toxicity Parameters

Toxicity values used in the remedial goal calculations are termed slope factors and reference doses (RfDs). Slope factors are used to estimate the incremental lifetime risk of developing cancer corresponding to calculated CDIs. The potential for noncancer health effects is evaluated by comparing estimated daily intakes with reference doses (RfDs) or reference concentrations (RfCs). The toxicity parameters (slope factors and reference doses) used in the remedial goal calculations are summarized in the table below.

Toxicity Parameters

	SFo Per mg/kg-day	Sfi Per mg/kg-day	RfDi mg/kg-day	RfDo mg/kg-day
Benzene	.10c	.10c	.0017 r	.0017 n
Toluene	NA	NA	.11	2
Ethyl benzene	NA	NA	.29	.1
Xylenes	NA	NA	.2	2
MTBE	NA	NA	.857I	.005

Table notes: c = California Value, I = IRIS, all other values from U.S. EPA 1996 PRGs. NA =not applicable

Results

Estimated risk based remedial goals calculated using the method described above are shown in the table below. The RBCs for soil is the average column concentration for the chemical of concern. With an increasing diffusion path (thicker layer of clean soil above the zone of impact), the RBCs for soil will increase. The RBCs for groundwater are average groundwater concentrations for the aerial extent of the plume.

Risk Based Soil and Groundwater Concentrations (RBCs)

For a Carcinogenic Risk of 10E-05 or Hazard Index of Unity

	RBC Soil (mg/kg)	RBC Groundwater (mg/l)
Benzene	0.5 @ 8 ft 0.8 @ 15 ft 1@ 20 ft	2
Toluene	464	520
Ethyl benzene	917*	1269*
Xylenes	9822*	5833*
MTBE	1667	14,998

Table notes: * exceeds the sorptive limits of soil or exceeds the solubility of the compound

Measured Soil Vapor Concentrations versus Calculated Vapor Concentrations

Using site specific parameters and the risk based soil and groundwater concentrations specified in the table above, VFs were used to calculate vapor concentrations at a depth of 5 ft bgs. The resultant risk based vapor concentrations are compared to the maximum detected vapor concentrations from SB-1-5 in the table below.

Risk –Based Vapor Concentrations versus Measured Vapor Concentrations

	Predicted Vapor Concentration (mg/m^3)	Measured Vapor Concentration (mg/m^3)
Benzene	68	0.1
Toluene	20,540	0.27
Ethyl benzene	56,400	<0.1
Xylenes	386,500	.99

Conclusions

Risk based concentrations – which are protective of public health have been calculated using site-specific parameters and conservative assumptions. The calculations are most sensitive to air filled porosity of the soils. Higher concentrations are supportable based on soil vapor data and site specific soil moisture and porosity parameters.

APPENDIX A

Exposure Algorithms, Volatilization Models, And Input Parameters

TABLE A1. INHALATION EXPOSURE ALGORITHM

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

where:

CA = chemical concentration in air (mg/m^3)
IR = inhalation rate (m^3/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time(days)
- carcinogenic effects:70-year lifetime × 365 days/year
- noncarcinogenic effects: ED × 365 days/year

Exposure Assumptions[a]

Parameter	Indoor Worker Commercial Scenario
CA	Chemical Specific
IR	(20 indoor)
EF	250
ED	25
BW	70

[a] See text Section

GROUNDWATER VOLATILIZATION

For indoor air exposure estimates, volatile groundwater contaminant flux is estimated by the following volatization factor (based on ASTM 1994) :

Migration to enclosed spaces:

$$VF_{WESP}\frac{(mg/m3)}{(mg/l)} = \frac{H((D_{effws}/L_{GW})/(ERxL_B))}{1+((D_{effws}/L_{GW})/(ERxL_B))+((D_{effws}/L_{GW})/(D_{effcrk}/L_{crk})n))} x10^3 L/m3$$

Where:

$$D_{effws}(cm2/s) = \frac{(h_c+h_v)}{(h_c/D_{effcap})+(h_v/D_{effs})}$$

$$D_{effs}(cm2/s) = D_a(\theta_{as}^{3.33}/\theta_t^2)+D_w(\theta_{ws}^{3.33})/(H\theta_t^2)$$

$$D_{effcrk}(cm2/s) = D_a(\theta_{acrk}^{3.33})/(\theta_t^2)+D_w(\theta_{wcrk}^{3.33})/(H\theta_t^2)$$

$$D_{effcap}(cm2/s) = D_a(\theta_{acap}^{3.33})/(\theta_t^2)+D_w(\theta_{wcap}^{3.33})/(H\theta_t^2)$$

Soil Volatilization

For indoor air exposure estimates, volatile soil contaminant flux is estimated by the following volatization factor (based on ASTM 1994) :

Migration to enclosed spaces:

$$VF\ \frac{(mg/m3)}{(mg/kg)} = \frac{((H\rho_s)/(\theta_{ws}+k_s\rho_s+H\theta_{as}))((D^{effsoil}/L_s)/ERL_B))}{1+((D^{effsoil}/L_s)/(ERL_B))+((D^{effsoil}/L_s)/(D^{effcrack}/L_{crack})\eta)} x(10^3 cm3-kg/m3-g)$$

where:

$$D^{effcrack}(cm2/s) = D^{air}\frac{\theta crack^{3.33}}{\theta T^2} + D^{wat}(1/H)\frac{\theta wcrack^{3.33}}{\theta T^2}$$

$$D^{effsoil}(cm2/s) = D^{air}\frac{\theta s^{3.33}}{\theta T^2} + D^{wat}(1/H)\frac{\theta ws^{3.33}}{\theta T^2}$$

Parameter definition table follows:

VF Parameters:

Parameter	Definition (units)	Value
VF	Volatilization factor (mg/m^3/mg/kg, mg/m^3/mg/l)	Calculation
ρ_b	Dry soil bulk density (g/cm^3)	1.65 Site Specific
Θ_{as}	Air filled soil porosity (L_{air}/L_{soil})	Site specific
Θ_t	Total soil porosity (L_{pore}/L_{soil})	Site specific
Θ_{ws}	Water-filled soil porosity (L_{water}/L_{soil})	Site specific
ρ_s	Soil particle density (g/cm^3)	2.65 Site Specific
D_a	Diffusivity in air (cm^2/s)	Chemical-specific
H	Henry's Law constant (atm-m^3/mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	Chemical -specific
D_w	Diffusivity in water (cm^2/s)	Chemical-specific
K_d	Soil-water partition coefficient (cm^3/g) = $K_{oc}\ f_{oc}$	Chemical-specific
K_{oc}	Soil organic carbon-water partition coefficient (cm^3/g)	Chemical-specific
f_{oc}	Fraction organic carbon in soil (g/g)	See text
n	Aerial fraction of cracks in foundation wall (cm^2-cracks/cm^2-total area)	.01(ASTM-default)
L_{gw}	depth to subsurface sources, cm	Site specific
D_{effs}	effective diffusion coefficient in soil (cm^2/sec)	calculated
D_{effws}	effective diffusion coefficient between groundwater and soil surface (cm^2/sec)	calculated
D_{effcap}	effective diffusion coefficient through capillary fringe	calculated
ER	enclosed space air exchange rate (s^{-1})	.00023(ASTM-default)
LB	enclosed space volume /infiltration ratio (cm)	300(ASTM-default)
D_{effcrk}	effective diffusion coefficient through foundation cracks (cm^2/s)	Calculated
Θ_{acrk}	volumetric air content in foundation /wall cracks (cm^{3}air/cm^3 total volume)	.26 (ASTM - default)
Θ_{wcrk}	volumetric water content in foundation /wall cracks (cm^3 air/ cm^3 soil)	.12 (ASTM - default)
Θ_{tcrk}	total soil porosity in foundation cracks (cm^3/cm^3-soil)	.38 (ASTM - default)
L_{crck}	enclosed-space foundation or wall thickness (cm)	15 (ASTM - default)
Θ_{acap}	volumetric air content in capillary fringe (cm^{3}air/cm^3 total volume)	.038 (ASTM - default)
Θ_{wcap}	volumetric water content in capillary fringe (cm^3 air/ cm^3 soil)	.342 (ASTM - default)
hv	thickness of the vadose zone	Site specific
hc	thickness of the vadose zone	Site specific

APPENDIX B
FIELD AND LABORATORY PROCEDURES

APPENDIX B
SITE SPECIFIC FIELD PROCEDURES FOR ADDITIONAL DATA COLLECTION

DRILLING AND SOIL SAMPLING PROCEDURES

Soil samples

Drilling of the soil borings was accomplished using 1-/12 inch diameter Geoprobe® drilling equipment. The soil borings were drilled to the depth of 20 feet below ground surface. Soil sampling was conducted through the 1-1/2 inch diameter push rod. Clean push rods were used between borings to prevent the possibility of cross contamination. A Toxichem field geologist collected soil samples Soil samples for chemical analysis were collected from each boring at five foot intervals between the ground surface and 20 feet bgs. Soil samples were obtained using the push rods equipped with four 6-inch by 1-1/2 inch diameter brass liners. The sampler was driven at the desired sample interval with a hydraulically driven hammer. The lower most liner of each sample interval was sealed with Teflon™ film, then capped, labeled, and placed in a cooler filled with ice for transport to the laboratory. The second liner was screened in the field for total organic vapors using a photo-ionization detector (PID). Screening with the PID was performed by placing a small quantity of soil into a sealable plastic bag, and then warmed for approximately 10 minutes. The probe of the PID was then placed into the plastic bag and into the head space for analysis. The PID readings represented relative levels of organic vapors for the site conditions at the time of drilling. The soil samples selected for analysis were analyzed by EPA Method 8015M/8020 for petroleum product related compounds and EPA Method 6010 for selected metals, at Sequoia Analytical. Analysis for moisture, porosity, and organic carbon content was conducted at Cooper Analytical of Mt. View, CA.

Soil Vapor Samples

Each probe is hydraulically driven into the ground to the desired depth of five feet, then the pipe is retracted mechanically, leaving a void space between the probe and tip. A compression fitting, to which Teflon tubing is attached, is then fastened onto the above ground end of the probe. Extraction of soil gases and vapors is accomplished through a vacuum pump. During the extraction of soil gases, the operator monitors short circuiting (sampling of ambient air) by monitoring system vacuum and flow rate. Soil gas samples for offsite analysis were taken by drawing soil gas into tedlar bags. Each sample was transported to Entec Analytical Labs, Inc., under chain of custody, for analysis. The analytical procedures employed included EPA Method 8015M/8020 for petroleum product related compounds.

Sequoia Analytical

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819 Striker Avenue, Suite 8 | Sacramento, CA 95834 | (916) 921-9600 | FAX (916) 921-0100
1455 McDowell Blvd. North, Ste. D | Petaluma, CA 94954 | (707) 792-1865 | FAX (707) 792-0342

RRM, Inc.
3912 Portola Dr., #8
Santa Cruz, CA 95062

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-1-8'
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807350-01

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/09/98
Reported: 07/20/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP18

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	**100**	**430** ✓
Benzene	**0.50**	**2.8**
Toluene	**0.50**	**5.0**
Ethyl Benzene	**0.50**	**4.8**
Xylenes (Total)	**0.50**	**23**
Chromatogram Pattern:		**C6-C12**

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	110
4-Bromofluorobenzene	60	140	6 Q

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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RRM, Inc.
3912 Portola Dr., #8
Santa Cruz, CA 95062

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-2-14'
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807350-02

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/09/98
Reported: 07/20/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP18

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	250	2900
Benzene	1.2	16
Toluene	1.2	19
Ethyl Benzene	1.2	54
Xylenes (Total)	1.2	250
Chromatogram Pattern:		C6-C12

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	136 Q
4-Bromofluorobenzene	60	140	Q

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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RRM, Inc.
3912 Portola Dr., #8
Santa Cruz, CA 95062

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-3-14'
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807350-03

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/10/98
Reported: 07/20/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP22

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	1.0	N.D.
Benzene	0.0050	N.D.
Toluene	0.0050	N.D.
Ethyl Benzene	0.0050	N.D.
Xylenes (Total)	0.0050	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	98
4-Bromofluorobenzene	60	140	114

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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RRM, Inc.
3912 Portola Dr., #8
Santa Cruz, CA 95062

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-4-15'
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807350-04

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/10/98
Reported: 07/20/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP07

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	1.0	N.D.
Benzene	0.0050	N.D.
Toluene	0.0050	N.D.
Ethyl Benzene	0.0050	N.D.
Xylenes (Total)	0.0050	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	80
4-Bromofluorobenzene	60	140	111

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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RRM, Inc.
3912 Portola Dr., #8
Santa Cruz, CA 95062

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-5-8'
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807350-05

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/10/98
Reported: 07/20/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP07

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	1.0	N.D.
Benzene	0.0050	N.D.
Toluene	0.0050	N.D.
Ethyl Benzene	0.0050	N.D.
Xylenes (Total)	0.0050	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	85
4-Bromofluorobenzene	60	140	91

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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RRM, Inc.
3912 Portola Dr., #8
Santa Cruz, CA 95062

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-6-10'
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807350-06

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/15/98
Reported: 07/20/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP01

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	1.0	N.D.
Benzene	0.0050	N.D.
Toluene	0.0050	N.D.
Ethyl Benzene	0.0050	N.D.
Xylenes (Total)	**0.0050**	**0.0087**
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	100
4-Bromofluorobenzene	60	140	109

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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RRM, Inc.
3912 Portola Dr., #8
Santa Cruz, CA 95062
Attention: Dan Hernandez

Client Project ID: Texaco 3810 Broadway

QC Sample Group: 9807350-01-06

Reported Jul 20, 1998

QUALITY CONTROL DATA REPORT

Matrix: Solid
Method: EPA 8015
Analyst: G. PESHINA

ANALYTE Gasoline

QC Batch #: GC070998BTEXEXA

Sample No.: GS9807350-3
Date Prepared: 7/9/98
Date Analyzed: 7/9/98
Instrument I.D.#: GCHP7

ample Conc., mg/Kg: N.D
Conc. Spiked, mg/Kg: 5.0

Matrix Spike, mg/Kg: 6.6
% Recovery: 132

Matrix
ike Duplicate, mg/Kg: 6 1
% Recovery: 122

elative % Difference: 7.9

RPD Control Limits: 0-25

LCS Batch#: GSBLK070998A

Date Prepared: 7/9/98
Date Analyzed: 7/9/98
Instrument I.D.#: GCHP7

Conc. Spiked, mg/Kg: 5 0

Recovery, mg/Kg: 5 8
LCS % Recovery: 116

Percent Recovery Control Limits:

MS/MSD	60-140
LCS	70-130

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Peggy Penner
Project Manager

Please Note
The LCS is a control sample of known, interferent free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch

Sequoia Analytical

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RRM, Inc.	Client Proj. ID: Texaco 3810 Broadway	Received: 07/07/98
3912 Portola Dr., #8		
Santa Cruz, CA 95062	Lab Proj. ID: 9807350	Reported: 07/20/98
Attention: Dan Hernandez		

LABORATORY NARRATIVE

In order to properly interpret this report, it must be reproduced in its entirety. This report contains a total of_______ pages including the laboratory narrative, sample results, quality control, and related documents as required (cover page, COC, raw data, etc.).

SEQUOIA ANALYTICAL

Peggy Penner
Project Manager

RRM, Inc.

3912 Portola Drive, Suite 8 - Santa Cruz, California - Telephone (408) 475-8141 - Fax (408) 475-8249

FAX & SEND RESULTS TO:

Chain of Custody/Analysis Work Order

BILL TO TEXACO

Client: TOXICHEM MGMT. SYSTEMS
Address: 1461 NEWPORT AVENUE
SAN JOSE, CA. 95125
Contact: DAN HERNANDEZ
Telephone #: (408) 292-3266 FAX 298-6591
Date Received:
Turn Around: STANDARD

Project ID: 3810 BROADWAY OAKLAND, CA.
Purchase Order #: BA02

Sampler/Company: MATT KAEMPF/RRM
Telephone #: (408) 475-8141

Special Instructions/Comments
BILL TEXACO DIRECT

LAB USE ONLY

Samples arrived chilled and intact:
Yes No
Notes:

Sample Information 9807350

Requested Analysis

Lab #	Sample ID	Grab/ Composite	Matrix	Date Collected	Time Collected	Pres.	Sample Container	TPHg/ BTEX							
1	SB-1-8'	GRAB	SOIL	7/3/98	1446	NO	ACETATE LINER	X							
2	SB-2-14'	↓	↓	↓	1353	↓	↓	X							
3	SB-3-14'	↓	↓	↓	1238	↓	↓	X							
4	SB-4-15'	↓	↓	↓	1015	↓	BRASS LINER	X							
5	SB-5-8'	↓	↓	↓	0830	↓	ACETATE LINER	X							
6	SB-6-10'	↓	↓	↓	1145	↓	↓	X							

Relinq By: Matt Kaempf	Received By: [signature]	Date 070798	Time 1215
Relinq By:	Received By:	Date	Time
Relinq/ By:	Received By:	Date	Time

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Client Proj. ID: Texaco 3810 Broadway

Lab Proj. ID: 9807353

Sampled: 07/03/98
Received: 07/07/98
Analyzed: see below

Attention: Dan Hernandez

Reported: 07/22/98

LABORATORY ANALYSIS

Analyte	Units	Date Analyzed	Detection Limit	Sample Results
Lab No: 9807353-01 Sample Desc : **SOLID,SB-1-Comp(5',10',15',20')**				
Lead by ICP	**mg/Kg**	**07/14/98**	**5.0**	**10**
Lab No: 9807353-02 Sample Desc : **SOLID,SB-2-Comp(5',10',15',20')**				
Lead by ICP	**mg/Kg**	**07/14/98**	**5.0**	**12**
Lab No: 9807353-03 Sample Desc : **SOLID,SB-3-Comp(8',10',14',20')**				
Lead by ICP	**mg/Kg**	**07/14/98**	**5.0**	**11**
Lab No: 9807353-04 Sample Desc : **SOLID,SB-4-Comp(5',9',12',20')**				
Lead by ICP	**mg/Kg**	**07/14/98**	**5.0**	**22**
Lab No: 9807353-05 Sample Desc : **SOLID,SB-5-Comp(5',11',15',20')**				
Lead by ICP	**mg/Kg**	**07/14/98**	**5.0**	**7.7**
Lab No: 9807353-06 Sample Desc : **SOLID,SB-6-Comp(5',10',15',20')**				
Lead by ICP	**mg/Kg**	**07/14/98**	**5.0**	**6.6**

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical
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1455 McDowell Blvd. North, Ste. D, Petaluma, CA 94954, (707) 792-1865, FAX (707) 792-0342

Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-1-Comp(5',10',15',20')
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807353-01

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/09/98
Reported: 07/22/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP22

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	20	94
Benzene	0.10	0.32
Toluene	0.10	1.8
Ethyl Benzene	0.10	1.2
Xylenes (Total)	0.10	5.8
Chromatogram Pattern:		Gas

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	137 Q
4-Bromofluorobenzene	60	140	8 Q

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-1-Comp(5',10',15',20')
Matrix: SOLID
Analysis Method: EPA 8015 Mod
Lab Number: 9807353-01

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/15/98
Analyzed: 07/16/98
Reported: 07/22/98

QC Batch Number: GC0715980HBPEXA
Instrument ID: GCHP5A

Total Extractable Petroleum Hydrocarbons (TEPH)

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TEPH as Diesel	1.0	8.7
Chromatogram Pattern:		
Unidentified HC		C9-C13
Weathered Diesel		C9-C24

Surrogates	Control Limits %		% Recovery
n-Pentacosane (C25)	50	150	83

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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1455 McDowell Blvd. North, Ste D, Petaluma, CA 94954, (707) 792-1865, FAX (707) 792-0342

Toxichem Mgmt Systems	Client Proj. ID: Texaco 3810 Broadway	Sampled: 07/03/98
1461 Newport Ave.	Sample Descript: SB-2-Comp(5',10',15',20')	Received: 07/07/98
San Jose, CA 95125	Matrix: SOLID	Extracted: 07/09/98
	Analysis Method: 8015Mod/8020	Analyzed: 07/09/98
Attention: Dan Hernandez	Lab Number: 9807353-02	Reported: 07/22/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP22

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	50	400
Benzene	0.25	0.32
Toluene	0.25	2.0
Ethyl Benzene	0.25	2.7
Xylenes (Total)	0.25	15
Chromatogram Pattern:		Gas

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	149 Q
4-Bromofluorobenzene	60	140	6 Q

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-2-Comp(5',10',15',20')
Matrix: SOLID
Analysis Method: EPA 8015 Mod
Lab Number: 9807353-02

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/15/98
Analyzed: 07/16/98
Reported: 07/22/98

QC Batch Number: GC0715980HBPEXA
Instrument ID: GCHP5A

Total Extractable Petroleum Hydrocarbons (TEPH)

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TEPH as Diesel	1.0	14
Chromatogram Pattern:		
Unidentified HC		C9-C13
Weathered Diesel		C9-C24

Surrogates	Control Limits %		% Recovery
n-Pentacosane (C25)	50	150	61

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-3-Comp(8',10',14',20')
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807353-03

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/13/98
Reported: 07/22/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP07

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	**1.0**	**1.3**
Benzene	0.0050	N.D.
Toluene	0.0050	N.D.
Ethyl Benzene	0.0050	N.D.
Xylenes (Total)	**0.0050**	**0.0056**
Chromatogram Pattern:		
Unidentified HC		**C6-C12**

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	83
4-Bromofluorobenzene	60	140	96

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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1455 McDowell Blvd North, Ste. D, Petaluma, CA 94954, (707) 792-1865, FAX (707) 792-0342

Toxichem Mgmt Systems	Client Proj. ID: Texaco 3810 Broadway	Sampled: 07/03/98
1461 Newport Ave.	Sample Descript: SB-3-Comp(8',10',14',20')	Received: 07/07/98
San Jose, CA 95125	Matrix: SOLID	Extracted: 07/17/98
	Analysis Method: EPA 8015 Mod	Analyzed: 07/21/98
Attention: Dan Hernandez	Lab Number: 9807353-03	Reported: 07/22/98

QC Batch Number: GC0717980HBPEXA
Instrument ID: GCHP5B

Total Extractable Petroleum Hydrocarbons (TEPH)

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TEPH as Diesel	**1.0**	**2.0**
Chromatogram Pattern:		
Unidentified HC		**C9-C24**

Surrogates	Control Limits %		% Recovery
n-Pentacosane (C25)	50	150	67

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-4-Comp(5',9',12',20')
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807353-04

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/10/98
Reported: 07/22/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP22

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	1.0	1.5
Benzene	0.0050	0.011
Toluene	0.0050	0.023
Ethyl Benzene	0.0050	0.0093
Xylenes (Total)	0.0050	0.038
Chromatogram Pattern:		
Weathered Gas		C6-C12

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	105
4-Bromofluorobenzene	60	140	122

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-4-Comp(5',9',12',20')
Matrix: SOLID
Analysis Method: EPA 8015 Mod
Lab Number: 9807353-04

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/15/98
Analyzed: 07/16/98
Reported: 07/22/98

QC Batch Number: GC0715980HBPEXA
Instrument ID: GCHP5A

Total Extractable Petroleum Hydrocarbons (TEPH)

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TEPH as Diesel	**1.0**	**3.5**
Chromatogram Pattern:		
Unidentified HC		**C9-C24**

Surrogates	**Control Limits %**		**% Recovery**
n-Pentacosane (C25)	50	150	91

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-5-Comp(5',11',15',20')
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807353-05

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/09/98
Reported: 07/22/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP22

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	**50**	**880**
Benzene	**0.25**	**4.9**
Toluene	**0.25**	**2.3**
Ethyl Benzene	**0.25**	**8.5**
Xylenes (Total)	**0.25**	**46**
Chromatogram Pattern:		**Gas**

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	225 Q
4-Bromofluorobenzene	60	140	8 Q

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

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1455 McDowell Blvd North, Ste. D, Petaluma, CA 94954, (707) 792-1865, FAX (707) 792-0342

Toxichem Mgmt Systems	Client Proj. ID: Texaco 3810 Broadway	Sampled: 07/03/98
1461 Newport Ave.	Sample Descript: SB-5-Comp(5',11',15',20')	Received: 07/07/98
San Jose, CA 95125	Matrix: SOLID	Extracted: 07/15/98
	Analysis Method: EPA 8015 Mod	Analyzed: 07/16/98
Attention: Dan Hernandez	Lab Number: 9807353-05	Reported: 07/22/98

QC Batch Number: GC0715980HBPEXA
Instrument ID: GCHP5A

Total Extractable Petroleum Hydrocarbons (TEPH)

Analyte	Detection Limit mg/Kg		Sample Results mg/Kg
TEPH as Diesel	**1.0**		**45**
Chromatogram Pattern:			
Unidentified HC			**C9-C24**
Surrogates	**Control Limits %**		**% Recovery**
n-Pentacosane (C25)	50	150	65

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125

Attention: Dan Hernandez

Client Proj. ID: Texaco 3810 Broadway
Sample Descript: SB-6-Comp(5',10',15',20')
Matrix: SOLID
Analysis Method: 8015Mod/8020
Lab Number: 9807353-06

Sampled: 07/03/98
Received: 07/07/98
Extracted: 07/09/98
Analyzed: 07/13/98
Reported: 07/22/98

QC Batch Number: GC070998BTEXEXA
Instrument ID: GCHP07

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TPPH as Gas	1.0	N.D.
Benzene	**0.0050**	**0.021**
Toluene	0.0050	N.D.
Ethyl Benzene	**0.0050**	**0.014**
Xylenes (Total)	**0.0050**	**0.082**
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	79
4-Bromofluorobenzene	60	140	90

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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1455 McDowell Blvd North, Ste D — Petaluma, CA 94954 — (707) 792-1865 — FAX (707) 792-0342

Toxichem Mgmt Systems	Client Proj. ID: Texaco 3810 Broadway	Sampled: 07/03/98
1461 Newport Ave.	Sample Descript: SB-6-Comp(5',10',15',20')	Received: 07/07/98
San Jose, CA 95125	Matrix: SOLID	Extracted: 07/15/98
	Analysis Method: EPA 8015 Mod	Analyzed: 07/16/98
Attention: Dan Hernandez	Lab Number: 9807353-06	Reported: 07/22/98

QC Batch Number: GC0715980HBPEXA
Instrument ID: GCHP5A

Total Extractable Petroleum Hydrocarbons (TEPH)

Analyte	Detection Limit mg/Kg	Sample Results mg/Kg
TEPH as Diesel	**1.0**	**4.2**
Chromatogram Pattern:		
Unidentified HC		**C9-C24**

Surrogates	Control Limits %		% Recovery
n-Pentacosane (C25)	50	150	60

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Peggy Penner
Project Manager

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Ave
San Jose, CA 95125
Attention: Dan Hernandez

Client Project ID: Texaco 3810 Broadway

QC Sample Group: 9807353-03

Reported: Jul 22, 1998

QUALITY CONTROL DATA REPORT

Matrix: Solid
Method: EPA 8015M
Analyst: A PORTER

ANALYTE Diesel

QC Batch #: GC0717980HBPEXA

Sample No.: 9807911-1
Date Prepared: 7/17/98
Date Analyzed: 7/21/98
Instrument I.D.#: GCHP5B

ample Conc., mg/Kg: 11 mg/Kg
Conc. Spiked, mg/Kg: 17

Matrix Spike, mg/Kg: 45
% Recovery: 200

Matrix
ike Duplicate, mg/Kg: 34
% Recovery: 135

elative % Difference: 39

RPD Control Limits: 0-50

LCS Batch#: BLK071798AS

Date Prepared: 7/17/98
Date Analyzed: 7/21/98
Instrument I.D.#: GCHP5B

Conc. Spiked, mg/Kg: 17

Recovery, mg/Kg: 16
LCS % Recovery: 94

Percent Recovery Control Limits:

MS/MSD	50-150
LCS	60-140

Quality Assurance Statement All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Peggy Penner
Project Manager

Please Note:
The LCS is a control sample of known, interferent free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125
Attention: Dan Hernandez

Client Project ID: Texaco 3810 Broadway

QC Sample Group: 9807353-01-02, -04-06

Reported Jul 22, 1998

QUALITY CONTROL DATA REPORT

Matrix: Solid
Method: EPA 8015M
Analyst: A PORTER

ANALYTE Diesel

QC Batch #: GC0715980HBPEXA

Sample No.: 9807497-39
Date Prepared: 7/13/98
Date Analyzed: 7/16/98
Instrument I.D.#: GCHP5A

ample Conc., mg/Kg: N.D.
Conc. Spiked, mg/Kg: 17

Matrix Spike, mg/Kg: 13
% Recovery: 76

Matrix ike Duplicate, mg/Kg: 13
% Recovery: 76

elative % Difference: 0.0

RPD Control Limits: 0-50

LCS Batch#: BLK071598AS

Date Prepared: 7/15/98
Date Analyzed: 7/16/98
Instrument I.D.#: GCHP5A

Conc. Spiked, mg/Kg: 17

Recovery, mg/Kg: 14
LCS % Recovery: 82

Percent Recovery Control Limits:

MS/MSD	50-150
LCS	60-140

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Peggy Penner
Project Manager

Please Note:
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Toxichem Mgmt Systems
1461 Newport Ave.
San Jose, CA 95125
Attention: Dan Hernandez

Client Project ID: Texaco 3810 Broadway

QC Sample Group: 9807353-01-06

Reported. Jul 22, 1998

QUALITY CONTROL DATA REPORT

Matrix: Solid
Method: EPA 8015
Analyst: G. PESHINA

ANALYTE Gasoline

QC Batch #: GC070998BTEXEXA

Sample No.: GS9807350-3
Date Prepared: 7/9/98
Date Analyzed: 7/9/98
Instrument I.D.#: GCHP7

ample Conc., mg/Kg: N.D.
Conc. Spiked, mg/Kg: 5.0

Matrix Spike, mg/Kg: 6.6
% Recovery: 132

Matrix
ike Duplicate, mg/Kg: 6.1
% Recovery: 122

elative % Difference: 7.9

RPD Control Limits: 0-25

LCS Batch#: GSBLK070998A

Date Prepared: 7/9/98
Date Analyzed: 7/9/98
Instrument I.D.#: GCHP7

Conc. Spiked, mg/Kg: 5 0

Recovery, mg/Kg: 5.8
LCS % Recovery: 116

Percent Recovery Control Limits:

MS/MSD	60-140
LCS	70-130

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met

Please Note.
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SEQUOIA ANALYTICAL

Peggy Penner
Project Manager

Sequoia Analytical

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Toxichem Mgmt Systems
1461 Newport Avenue
San Jose, CA 95125
Attention: Dan Hernandez

Client Project ID: Texaco 3810 Broadway
Matrix: Solid
Work Order #: 9807353 -01-06
Reported: Jul 24, 1998

QUALITY CONTROL DATA REPORT

Analyte:	Beryllium	Cadmium	Chromium	Nickel
QC Batch#:	ME0714986010MDC	ME0714986010MDC	ME0714986010MDC	ME0714986010MDC
Analy. Method:	EPA 6010	EPA 6010	EPA 6010	EPA 6010
Prep. Method:	EPA 3050	EPA 3050	EPA 3050	EPA 3050
Analyst:	C. Caoile	C. Caoile	C. Caoile	C. Caoile
MS/MSD #:	980773801	980773801	980773801	980773801
Sample Conc.:	0.79	N.D.	60	95
Prepared Date:	7/14/98	7/14/98	7/14/98	7/14/98
Analyzed Date:	7/14/98	7/14/98	7/14/98	7/14/98
Instrument I.D.#:	MTJA5	MTJA5	MTJA5	MTJA5
Conc. Spiked:	50 mg/Kg	50 mg/Kg	50 mg/Kg	50 mg/Kg
Result:	44	45	110	140
MS % Recovery:	86	90	100	90
Dup. Result:	45	47	110	130
MSD % Recov.:	88	94	100	70
RPD:	2.2	4.3	0.0	7.4
RPD Limit:	0-20	0-20	0-20	0-20
LCS #:	BLK071498	BLK071498	BLK071498	BLK071498
Prepared Date:	7/14/98	7/14/98	7/14/98	7/14/98
Analyzed Date:	7/14/98	7/14/98	7/14/98	7/14/98
Instrument I.D.#:	MTJA5	MTJA5	MTJA5	MTJA5
Conc. Spiked:	50 mg/Kg	50 mg/Kg	50 mg/Kg	50 mg/Kg
LCS Result:	54	54	53	53
LCS % Recov.:	108	108	106	106

Control Limits				
MS/MSD	80-120	80-120	80-120	80-120
LCS	80-120	80-120	80-120	80-120

SEQUOIA ANALYTICAL

Peggy Penner
Project Manager

Please Note:
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** MS=Matrix Spike, MSD=MS Duplicate, RPD=Relative % Difference

RRM, Inc.

3912 Portola Drive, Suite 8 - Santa Cruz, California - Telephone (408) 475-8141 - Fax (408) 475-8249

Chain of Custody/Analysis Work Order

BILL TO TEXACO

FAX AND SEND RESULTS TO:

Client: TOXICHEM MGMT SYSTEMS
Address: 1461 NEWPORT AVENUE
SAN JOSE, CA 95125
Contact: DAN HERNANDEZ
Telephone #: (408) 292-3266
FAX 298-6591
Date Received:
Turn Around: STANDARD

Project ID: 3810 BROADWAY OAKLAND, CA
Purchase Order #: BA02

Sampler/Company: MATT KAEMPF
Telephone #: (408) 475-8141

Special Instructions/Comments: MAKE 4 POINT COMPOSITE FROM EACH SAMPLE SET OF SB-1, SB-2, SB-3, SB-4, SB-5, SB-6 REPORT RESULTS AS FOLLOWING NOMENCLATURE EXAMPLE: SB-5-COMP (5', 10', 15', 20') OR SB-6-COMP (5', 10', 15', 20')

LAB USE ONLY

Samples arrived chilled and intact:

Yes No

Notes:

9807353

Lab #	Sample ID	Grab/ Composite	Matrix	Date Collected	Time Collected	Pres.	Sample Container	TPHg BTEX	TPHd	Total Lead					
1	SB-1-5'	4 IN 1 COMP	SOIL	7/3/98	1440	NO	ACETATE LINER	X	X	X					
↓	SB-1-10'		↓	↓	1455	↓	↓	↓	↓	↓					
↓	SB-1-15'		↓	↓	1508	↓	↓	↓	↓	↓					
↓	SB-1-20'		↓	↓	1511	↓	↓	↓	↓	↓					
2	SB-2-5'	4 IN 1 COMP	↓	↓	1335	↓	↓	↓	↓	↓					
↓	SB-2-10'		↓	↓	1345	↓	↓	↓	↓	↓					
↓	SB-2-15'		↓	↓	1400	↓	↓	↓	↓	↓					
↓	SB-2-20'		↓	↓	1403	↓	↓	↓	↓	↓					

Relinq. By	Received By	Date	Time
Relinq. By: [signature]	Received By: [signature]	Date 070798	Time 1215
Relinq. By:	Received By	Date	Time
Relinq. By:	Received By	Date	Time

RRM, Inc.

3912 Portola Drive, Suite 8 - Santa Cruz, California - Telephone (408) 475-8141 - Fax (408) 475-8249

Chain of Custody/Analysis Work Order

BILL TO TEXACO

FAX AND SEND RESULTS TO:

Client: TOXICHEM MGMT SYSTEMS
Address: 1461 NEWPORT AVENUE
SAN JOSE, CA 95125
Contact: DAN HERNANDEZ
Telephone #: (408) 292-3266
FAX 298-6591
Date Received:
Turn Around: STANDARD

Project ID: 3810 BROADWAY OAKLAND, CA
Purchase Order #: BA02

Sampler/Company: MATT KAEMPF
Telephone #: (408) 475-8141

Special Instructions/Comments: MAKE 4 POINT COMPOSITE FROM EACH SAMPLE SET OF SB-1, SB-2, SB-3, SB-4, SB-5, SB-6 REPORT RESULTS AS FOLLOWING NOMENCLATURE EXAMPLE: SB-5-COMP (5', 11', 15', 20') OR SB-6-COMP (5', 10', 15', 20')

LAB USE ONLY

Samples arrived chilled and intact:

Yes No

Notes:

(9807353)

Lab #	Sample ID	Grab/ Composite	Matrix	Date Collected	Time Collected	Pres.	Sample Container	TPHg BTEX	TPHd	Total Lead				
3	SB-3-8'	4 IN 1 COMP	SOIL	7/3/98	1226	NO	ACETATE LINER	X	X	X				
↓	SB-3-10'	↓	↓	↓	1231	↓	↓	↓	↓	↓				
↓	SB-3-14'	↓	↓	↓	1238	↓	↓	↓	↓	↓				
↓	SB-3-20'	↓	↓	↓	1255	↓	↓	↓	↓	↓				
4	SB-4-5'	4 IN 1 COMP	↓	↓	1000	↓	↓	↓	↓	↓				
↓	SB-4-9'	↓	↓	↓	1001	↓	↓	↓	↓	↓				
↓	SB-4-12'	↓	↓	↓	1009	↓	↓	↓	↓	↓				
↓	SB-4-20'	↓	↓	↓	1030	↓	↓	↓	↓	↓				

Relinq. By	Received By	Date	Time
Matt Kaempf (signature)	(signature)	070798	1215

RRM, Inc.

3912 Portola Drive, Suite 8 - Santa Cruz, California - Telephone (408) 475-8141 - Fax (408) 475-8249

Chain of Custody/Analysis Work Order

BILL TO TEXACO

FAX AND SEND RESULTS TO:

Client: TOXCHEM MGMT SYSTEMS
Address: 1461 NEWPORT AVENUE
SAN JOSE, CA 95125
Contact: DAN HERNANDEZ
Telephone #: (408) 292-3266
FAX 298-6591
Date Received:
Turn Around: STANDARD

Project ID: 3810 BROADWAY OAKLAND, CA
Purchase Order #: BA02

Sampler/Company: MATT KAEMPF
Telephone #: (408) 475-8141

Special Instructions/Comments: MAKE 4 POINT COMPOSITE FROM EACH SAMPLE SET OF SB-1, SB-2, SB-3, SB-4, SB-5, SB-6 REPORT RESULTS AS FOLLOWING NOMENCLATURE EXAMPLE: SB-5-COMP (5', 11', 15', 20') OR SB-6-COMP (5', 10', 15', 20')

LAB USE ONLY

Samples arrived chilled and intact:
Yes No
Notes:

Sample Information 9807353

Lab #	Sample ID	Grab/ Composite	Matrix	Date Collected	Time Collected	Pres.	Sample Container	TPHg BTEX	TPHd	Total Lead					
5	SB-5-5'	4 IN 1 COMP	SOIL	7/3/98	0820	NO	ACETATE LINER	X	X	X					
↓	SB-5-11'		↓	↓	0840	↓	↓	↓	↓	↓					
↓	SB-5-15'		↓	↓	0903	↓	↓	↓	↓	↓					
↓	SB-5-20'		↓	↓	0930	↓	↓	↓	↓	↓					
6	SB-6-5'	4 IN 1 COMP	↓	↓	1120	↓	↓	↓	↓	↓					
↓	SB-6-10'		↓	↓	1145	↓	↓	↓	↓	↓					
↓	SB-6-15'		↓	↓	1153	↓	↓	↓	↓	↓					
↓	SB-6-20'		↓	↓	1200	↓	↓	↓	↓	↓					

Relinq. By: Matt Kaempf	Received By: [signature]	Date 070798	Time 1215
Relinq. By:	Received By:	Date	Time
Relinq. By:	Received By:	Date	Time

321-003

RRM, Inc.

3912 Portola Drive, Suite 8 - Santa Cruz, California - Telephone (408) 475-8141 - Fax (408) 475-8249

Chain of Custody/Analysis Work Order

Client: BILL: TOXICHEM
Address: 1461 NEWPORT AVENUE
SAN JOSE, CA. 95125
Contact: DAN HERNANDEZ
Telephone #: (408) 292-3266
Date Received:
Turn Around: STANDARD

Project ID: 3810 BROADWAY OAKLAND, CA.
Purchase Order #: BA02

Sampler/Company: KAEMPF/RRM
Telephone #: (408) 475-8141

Special Instructions/Comments: RESULTS AND INVOICE TO TOXICHEM @ 112nd SAMPLE

LAB USE ONLY

Samples arrived chilled and intact:
Yes No
Notes:

Lab #	Sample ID	Grab/ Composite	Matrix	Date Collected	Time Collected	Pres.	Sample Container	TOTAL POROSITY	MOISTURE CONTENT	AIR FILLED POROSITY	TOC				
	SB-1-5'	GRAB	SOIL	7/3/98	1410	NO	ACETATE LINER	X	X	X	X				
	SB-2-5'	↓	↓	↓	1335	↓	↓	X	X	X	X				
	SB-3-5'	↓	↓	↓	1220	↓	↓	X	X	X	X				
	SB-6-5'	↓	↓	↓	1120	↓	↓	X	X	X	X				

Standard charges 1/2 hr. (?) 6.5" samples - extra time for special size. contamination odor in SB-6-5

Relinq By: [signature]	Received By: [signature]	Date 7/7/98	Time 12:30
Relinq By:	Received By:	Date	Time
Relinq By:	Received By:	Date	Time

Dave Cooper
(650) 968-9472

COOPER TESTING LABS

MOISTURE DENSITY - POROSITY DATA SHEET

Job #	324-003
Client	RRM
Project/Location	3810 Broadway
Date	7/13/98

Boring #	SB-1-5	SB-2-5	SB-3-5	SB-6-5	
Depth (ft)			Loose		
Soil Type	yellow brown clayey SAND	brown silty SAND grading clayey	yellow brown silty SAND w/ gravel	olive brown clayey SAND w/ gravel	
Specific Gravity	2.70	2.69	2.66	2.74	
Volume Total cc	180.874	207.697	801.377	205.682	
Volume of Solids	117.789	131.595	175.038	134.222	
Volume of Voids	63.085	76.102	626.339	71.460	
Void Ratio	0.536	0.578	3.578	0.532	
Porosity %	34.9%	36.6%	78.2%	34.7%	
Saturation %	99.8%	82.8%	2.4%	77.7%	
Moisture %	19.8%	17.8%	3.2%	15.1%	
Dry Density (pcf)	109.8	106.4	36.3	111.6	

Remarks

Organic Content
ASTM D2974
[redacted]

Cooper Testing Lab

JOB NO.: 324-003					
CLIENT: RRM			DATE: 07/13/98		
PROJECT 3810 Broadway			BY: DC		
BORING: SAMPLE: DEPTH, ft.:	SB-1-5	SB-2-5	SB-3-5	SB-6-5	
SOIL CLASSIFICATION: (visual)	see porosity				
SOIL, ORGANICS & DISH, gm:	130.19	138.8	151.33	145.87	
SOIL & DISH, gm:	129.63	137.89	150.54	144.48	
DISH, gm:	83.14	79.46	80.93	81.62	
SOIL, gm:	46.49	58.43	69.61	62.86	0
SOIL & ORGANICS, gm:	47.05	59.34	70.4	64.25	0
% ORGANICS:	1.2	1.5	1.1	2.2	ERR

Entech Analytical Labs, Inc.

CA ELAP# 2224

525 Del Rey Avenue, Suite E • Sunnyvale, CA 94086 • (408) 735-1550 • Fax (408) 735-1554

Attn: Matt Kaempf
Remediation Risk Management
3912 Portola Drive, Suite 8
Santa Cruz, CA 95062

Date:	7/13/98
Date Received:	7/6/98
Date Analyzed:	7/6/98
Project #:	3810 Broadway, Oakland
P.O. #:	BA02
Sampled By:	Client

Certified Analytical Report

Vapor Sample Analysis:

Sample ID	Sample Date	Sample Time	Lab #	DF	TPH-Gas	Benzene	Toluene	Ethyl Benzene	Xylene
SB-1	7/3/98	1520	E12698	1	**22**	**0.10**	**0.27**	**ND**	**0.99**
SB-3	7/3/98	1530	E12699	1	**ND**	**ND**	**ND**	**ND**	**ND**
SB-6	7/3/98	1543	E12700	1	**ND**	**ND**	**0.11**	**ND**	**ND**

1. DLR=Dilution Factor x PQL
2. Analysis performed by Entech Analytical Labs, Inc. (CAELAP #2224)

Summary of Methods and Detection Limits:

	TPH-Gas	Benzene	Toluene	Ethylbenzene	Xylenes
EPA Method #	8015M	8020	8020	8020	8020
Units	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
PQL	10 mg/m^3	0.10 mg/m^3	0.10 mg/m^3	0.10 mg/m^3	0.30 mg/m^3

Michael N. Golden, Lab Director

DF=Dilution Factor
DLR=Detection Reporting Limit

PQL=Practical Quantitation Limit
ND=None Detected at or above DLR

Entech Analytical Labs, Inc.

525 Del Rey Avenue, Suite E
Sunnyvale, CA 94086

QUALITY CONTROL RESULTS SUMMARY

METHOD: Gas Chromatography

QC Batch #: GBG2980706
Matrix: Water
Units: ug/L

Date Analyzed: 07/06/98
Quality Control Sample: E12522

PARAMETER	Method #	MB ug/L	SA ug/L	SR ug/L	SP ug/L	SP % R	SPD ug/L	SPD %R	RPD	QC LIMITS RPD	QC LIMITS %R
Benzene	8020	<0.50	40	ND	37	94	39	97	3.2	25	77-111
Toluene	8020	<0.50	40	ND	37	92	38	95	3.4	25	79-110
Ethyl Benzene	8020	<0.50	40	ND	38	95	39	99	3.8	25	79-112
Xylenes	8020	<0.50	120	ND	117	97	123	102	5.3	25	80-113
Gasoline	8015	<50.0	1000	ND	860	86	840	84	2.4	25	61-125

Note: LCS and LCSD results reported for the following Parameters:
Gasoline

Acceptable LCS and LCSD results are reported when matrix interferences cause MS and MSD results to fall outside established QC limits.

Definition of Terms:

na: Not Analyzed in QC batch
MB: Method Blank
SA: Spike Added
SR: Sample Result
RPD(%): Duplicate Analysis - Relative Percent Difference
SP: Spike Result
SP (%R): Spike % Recovery
SPD: Spike Duplicate Result
SPD (%R): Spike % Recovery
NC: Not Calculated

and Recovery Act. No sites on the U.S. EPA RCRIS_CA database were found to be located within a 1 mile radius of the subject site.

4.3. SCVWD File Review

Toxichem requested any available LUST files for the Property and for those sites within a one-quarter mile radius of the Property where underground storage tanks were, or are presently used for fuel storage.

In order to obtain information regarding these properties, files from the SCVWD were examined. No files for the subject site were available. Three sites were identified in the vicinity of the subject site for which LUST files were available. All three sites were closed and no further action was required by the SCVWD. The following information was obtained from this file review. The closure report summaries are presented in Attachment D.

Century Chrysler Plymouth - 4202 Stevens Creek Blvd., San Jose This site was located 0.05 miles to the southeast of the subject site and is the current location of Stevens Creek Toyota. An underground storage tank unauthorized release was reported on February 7, 1995 following the removal of a waste oil tank and a waste anti-freeze tank. Samples were collected beneath the former tanks and analyzed for total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes, and volatile organic compounds (VOCs). Results of the sample analyses were non-detect with the exception of oil and grease range TPH and metals. Oil and grease range TPH were either at or near the detection limit; metals were interpreted to be typical of background levels. As a results of these findings, the Regional Water Quality Control Board issued a letter requiring no further action on May 3, 1995.

Anderson Behel - 4355 Stevens Creek Blvd., Santa Clara This site is located 0.13 mile to the southwest of the subject site. An underground storage tank unauthorized release was reported on January 13, 1990 following the removal of an underground gasoline and waste oil tank. Samples were collected beneath the former tanks and analyzed for total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes, and volatile organic compounds (VOCs). Concentrations of trichloroethane and tetracholoroethene were detected in soils at concentrations of 0.13 and 0.15 parts per billion (ppb), respectively. Oil and grease range TPH were detected at concentrations of 25,000 ppb. Over excavation of the tank pit area was performed to a depth of 21 feet below ground surface. A subsequent soil boring indicated that oil and grease were detected at concentrations of 26,000 below the excavation; however, 5 additional borings indicated that the contamination was localized and was therefore left in place. As a results of these findings, the SCVWD issued a letter requiring no further action on March 4, 1996.

St. Claire Cadillac - 4343 Stevens Creek Blvd., Santa Clara This site is located 0.13 mile to the southwest of the subject site. An underground storage tank

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Entech Analytical Labs, Inc.

525 Del Rey Avenue, Suite E • Sunnyvale, CA 94086 • Telephone (408) 735-1550 (800) 287-1799 • Fax: (408) 735-1554

Chain of Custody/Analysis Work Order

Client: RRM ~ BILL TOXICHEM
Address:
MATT KAEMPFEN
Contact: DAN HERNANDEZ
Telephone #: (408)475-8141 ~ 292-3266
Date Received: 7/6/98
Turn Around:

Project ID: 3810 BROADWAY, OAKLAND
Purchase Order #: BA02

Sampler/Company: KAEMPF
Telephone #: 475-8141

Special Instructions/Comments: ANALYZE BY 1500 ON 7/6/98 AT STANDARD T/A

LAB USE ONLY
Samples arrived chilled and intact: Yes No
Notes:

Sample Information								Requested Analysis							
Lab #	Sample ID	Grab/ Composite	Matrix	Date Collected	Time Collected	Pres.	Sample Container	TPHg/ BTEX							
812698	SB-1	GRAB	SOIL GAS	7/3/98	1520	NO	1L. TEDLAR BAG	X							
812699	SB-3	↓	↓	↓	1530	↓	↓	X							
812700	SB-6	↓	↓	↓	1543	↓	↓	X							

Relinq. By	Received By	Date	Time
[signature]	[signature] 9/1	7/6/98	1025
[signature] 9/1	NTRAW	7/6/98	11:45

Act of 1976 and the Hazardous and Solid Waste Amendments of 1984, the storage and disposal of hazardous materials was essentially uncontrolled. If the drains were utilized for the disposal of these materials onto porous concrete surfaces, a potential exists for soil contamination beneath the drains.

5.4. Hazardous Substance Containers and Unidentified Substance Containers

Based on interviews and visual site inspection, there was no evidence to indicate wells, below ground storage tanks, vent pipes, or fill pipes were located at the site.

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