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Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502-6577

Subject: Feasibility Study and Corrective Action Plan
2855 Mandela Parkway
Oakland, California

To Whom It May Concern:

As a legally authorized representative of BALCO properties, LLC, and on behalf of BALCO properties, LLC, I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document *Feasibility Study and Corrective Action Plan, 2855 Mandela Parkway, Oakland, California*, are true and correct to the best of my knowledge.

Sincerely yours,

Mollie Gilbert
President
BALCO Properties, LLC

FEASIBILITY STUDY AND CORRECTIVE ACTION PLAN 2855 Mandela Parkway Oakland, California

BALCO Properties, LLC
Oakland, California

23 August 2011
Project No. 750254305

Treadwell&Rollo
Environmental & Geotechnical Consultants

Treadwell&Rollo
A LANGAN COMPANY

23 August 2011
Project No. 750254305

Mr. Paresh Khatri
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502-6577

Subject: Feasibility Study and Corrective Action Plan
2855 Mandela Parkway
Oakland, California

Dear Mr. Khatri:

On behalf of BALCO properties, LLC, Treadwell and Rollo, Inc. (Treadwell & Rollo) is pleased to present this Feasibility Study and Corrective Action Plan (FS/CAP) for the property located at 2855 Mandela Parkway in Oakland, California. Preparation of this document was requested by the Alameda County Environmental Health in letters to BALCO properties, dated May 27, 2010 and June 17, 2011.

As requested by Alameda County Environmental Health (ACEH), the FS/CAP includes a summary of soil and groundwater investigations, a detailed description of site lithology, contamination cleanup levels and cleanup goals, and evaluates at least three viable alternatives for remedying or mitigating the actual or potential adverse effects of the petroleum impacts to the site. The FS/CAP also includes a Site Conceptual Model (SCM), which addresses ACEH's request for a "preferential pathways study" in your May 27, 2010 letter. The SCM addresses potential migration pathways and conduits, and also includes a survey of nearby wells, an evaluation of historic maps and photographs from the site, and a survey of nearby utility lines.

If you have any questions regarding this document please call Mr. Christopher Glenn at (510) 874-7074.

Sincerely yours,
TREADWELL & ROLLO, A LANGAN COMPANY

Christopher Glenn, PE, LEED GA
Project Engineer

Patrick Hubbard, PG, CEG
Principal Geologist

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REGISTERED PROFESSIONAL ENGINEER
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STATE OF CALIFORNIA

FEASIBILITY STUDY AND CORRECTIVE ACTION PLAN
2855 Mandela Parkway
Oakland, California

BALCO Properties, LLC
Oakland, California

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FEASIBILITY STUDY AND CORRECTIVE ACTION PLAN (FS/CAP)
2855 Mandela Parkway
Oakland, California

1.0 INTRODUCTION

This report presents the Feasibility Study and Corrective Action Plan (FS/CAP) for environmental remediation of the property located at 2855 Mandela Parkway, Oakland, California (Site) (Figure 1). The Site is impacted with free-phase petroleum product and associated impacts to groundwater. This FS/CAP was prepared in general accordance with Alameda County Environmental Health's (ACEH) letter dated May 27, 2010. In this letter, ACEH requested the preparation of an FS/CAP to evaluate "viable alternatives for remedying or mitigating actual or potential adverse effects" of Site impacts. The ACEH also requested an evaluation of preferential pathways, which is also addressed in this FS/CAP.

2.0 SITE BACKGROUND

2.1 Site Description

The Site is an approximately 4-acre property located at 2855 Mandela Parkway and is bordered by Mandela Parkway and Willow Street to the east, 26th Street to the south, Wood Street to the west, and 32nd Street to the north (Figure 2). The existing building at the Site is a 143,000-square-foot, single-story industrial structure underlain by a reinforced concrete slab. Several areas outside of the building are paved with asphalt and allocated for tenant parking. Space within the building is currently leased to several commercial tenants and is used for various commercial activities.

A waste oil underground storage tank (UST) and a 350-gallon gasoline UST were removed from the Site in 1991. The former gasoline UST apparently leaked, leaving free-phase product in the shallow soil and groundwater beneath the Site (T&R, 2000).

The Site lies in a portion of West Oakland that has long been an industrial area. As reflected by the number of UST and other cleanup sites on Figure 3, these industries have released contamination and impacted soil, groundwater and storm drains (California State Water Resources Control Board, 2011; Applied Marine Sciences, 2002).

2.2 History of Property Use

The building located on the Site was originally constructed in 1941 and operated until approximately 1983 by International Harvester as a truck service and sales facility. In 1982, the property was transferred to Cypress General Partnership and then again in 1983 to Wareham Property Group (Wareham), which leased subdivided space at the property to various tenants.

A waste oil underground storage tank (UST) and a 350-gallon gasoline UST were removed from the Site in 1991 by Wareham. The gasoline tank was reportedly connected to a nearby fuel pump located inside the building. Upon removal, both tanks were noted to have been in a deteriorated condition with numerous holes, and visibly stained soil was observed surrounding the tank. Based on this information, Treadwell and Rollo (T&R) concluded that the former gasoline UST apparently leaked, leaving free-phase product in the shallow soil and groundwater beneath the Site (T&R, 2000).

In 1998, the property was bought by 2855 Mandela Property (including Page Street Properties, LLC). At the time of purchase, a reconnaissance of the property and research of records did not indicate the presence of any tenant business either currently or since 1983 that would have likely operated USTs. Per a 2007 agreement, Balco Properties Ltd LLC became the lead entity for corrective action at the Site.

2.3 Previous Remedial Investigations and Actions

A number of preliminary environmental investigations, including a Phase I and Phase II Site Assessment, were performed at the Site between 1990 and 1998 (HLA, 1990; HLA, 1991; ATEC, 1992; CERES, 1998a, 1998b, and 1998c). These investigations primarily focused in the southeast of the property, near the location of the former tanks. These investigations included collection of soil, groundwater, and soil vapor grab samples. In summary, these investigations searched for other possible sources of petroleum contaminations but resulted in finding no additional sources.

In 1999, T&R performed additional environmental investigations at the Site, including soil and groundwater sampling, product bailing and analysis, and installation of permanent groundwater monitoring wells (T&R, 1999). Based on this investigation, T&R concluded that the lateral extent of free-product was defined and encompassed approximately 15,000 square feet under the building and adjacent outdoor area. Chemical fingerprinting identified the free-product as gasoline with organic lead without methyl tertiary butyl ether (MTBE). T&R concluded that the former 350-gallon gasoline tank was the only source of petroleum impact at the Site.

In 2001, T&R performed a study to evaluate the potential vapor migration into the occupied building space (T&R, 2001). Benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds were not detected in any of ten soil vapor wells, and it was concluded that gasoline vapors, as indicated by BTEX compounds, were not migrating through soil into the building.

In 2007 and 2008, T&R performed groundwater monitoring and product removal at the Site (T&R, 2008). Monitoring indicated a maximum product thickness of 0.45 feet. Recovery of product from recovery wells and trenches using a passive skimming system was performed between October 2007 and June 2008. Approximately 12 gallons of free-product were removed, the majority of which was recovered in the first month of operation. Based upon the low, asymptotic levels of product recovery, the skimming system was shut down in June 2008.

In 2009, T&R performed an additional soil vapor sampling investigation to evaluate the potential for vapor intrusion into the occupied building (T&R, 2009a). The results of the vapor sampling indicated the presence of toluene, xylene, and other volatile organic compounds (VOCs); however, all detected compounds were very low and well below commercial and residential Environmental Screening Levels (ESLs). Also in 2009, T&R continued groundwater monitoring of several monitoring wells located at the Site (T&R, 2009b). Total petroleum hydrocarbons as diesel (TPH-d), benzene, toluene, ethylbenzene, and xylenes were detected in groundwater at maximum concentrations of 73,000 micrograms per Liter (µg/L), 10,000 µg/L, 17,000 µg/L, 6,300 µg/L and 25,000 µg/L, respectively. The maximum concentrations were generally detected at TR-6, located within the building (Figure 2).

3.0 SITE CONCEPTUAL MODEL

T&R has a developed this Site Conceptual Model (SCM) to address the petroleum hydrocarbon impacts at for the Site. The current SCM is based on data available from the references cited. In addition, specific data supporting the SCM are presented in Appendix A. An SCM is an evolving tool to help understand and manage potential contamination risks.

3.1 Hydrogeology

According to historical surveys, the Site is located within the historic margins of San Francisco Bay in an area formerly occupied by tidal flats and marshes. A historic creek and watershed map indicates a slough that passed close to the Site (Appendix A, Figure 7). The slough has not been identified during the subsurface investigations.

At the Site, shallow geologic conditions consist of fill material over the native bay margin deposits. The fill material consists primarily of brown, poorly-graded, fine-grained sand with relatively minor amounts of fines extending to depths ranging from 2 to 8 feet below ground surface (bgs).

The bay margin deposits consist generally of a soft, dark grey clay matrix known locally as Bay Mud, extending to a depth of at least 24 feet (Figure 5). Within the Bay Mud is a complex mixture of other alluvial clays (brown to olive in color), peats, and sand present in relatively thin layers and zones. The Bay Mud at the Site has considerable variability, including varying water content from moist to saturated with a liquid consistency, thin sand layers, and variations in consistency from very soft to stiff. A layer of peat has been sporadically detected within the Bay Mud at the Site; however, the extent and nature of this layer has not been fully defined.

Perched groundwater occurs in fill material on top of the Bay Mud. The perched groundwater was detected in borings and excavations. At the Site, the primary groundwater-bearing unit is composed of discontinuous sand and peat layers in the Bay Mud. The depth to groundwater ranges between 5 to 12 feet bgs and -1.56 to -4.26 feet below mean sea level (msl) elevation (Table 1). Based on the presence of the overlying silts and clays, the shallow groundwater is confined (Figure 5).

3.1.1 Groundwater Flow, Gradient, and Influence

The shallow groundwater flow has a range of magnitudes and directions (Table 1). The results of measurement in May 1999 from temporary piezometers indicated that groundwater flow was to the west-southwest at a gradient of approximately 0.025. However, stabilized water level measurements (corrected for product) at monitoring wells TR-4, -5, and -6 yield a remarkably different result. These results indicate flow to the northeast at a gradient of 0.01 in October 1999 and of 0.005 to the east in September 2008.

Groundwater flow characteristics may vary considerably on a local scale and seasonally due to the highly heterogeneous geology, underground utilities, the Site's low elevation, and proximity to the San Francisco Bay. The wide range of groundwater flow directions and elevations below mean sea level indicates that groundwater may be artificially drained or is under a significant tidal influence. Given the Site's location in the Ettie Street watershed and proximity of several deep storm drains, the groundwater flow is likely influenced by the storm drains and possibly other underground utilities.

3.1.2 Groundwater Use

Shallow groundwater is not used for drinking water supply in the vicinity of the Site and, in general, deeper groundwater is also not used for drinking water supply (Figuers, 1998). T&R conducted a review of potential water supply wells within a radius of approximately one-quarter mile of the Site. The review included well records from the State of California (Department of Water Resources, 2011), Alameda County (Public Works Agency – Water Resources Section, 2011), historical aerial photographs (EDR, 2011a), Sanborn maps (EDR, 2011b), and topographic maps (EDR, 2011c). The wells identified in the review are presented on Figure 6.

No water supply wells were identified within one-quarter mile of the Site. The wells on Figure 6 were largely groundwater monitoring wells with the exception of one cathodic protection well and ten wells at Pacific Supply Company located at 1735 24th Street which were labeled as 19-feet deep extraction wells. A review of the Pacific Supply Geotracker regulatory files indicates the presence of shallow groundwater contamination and a number of well installations (California State Water Resources Control Board, 2011). As a result, these wells are likely associated with monitoring or remediation, and are not water supply wells.

3.2 Contaminants of Potential Concern

3.2.1 Petroleum in Soil and Soil Vapor

The presence of contaminants in soil is variable and relatively low even in wells with substantial light non-aqueous phase liquid (LNAPL) thicknesses. T&R collected Bay Mud soil samples during the construction of these wells, and the following petroleum hydrocarbon concentrations were detected at 6 feet bgs:

- TR-4 - <detection limits with an LNAPL thickness of 2.7 feet in the well;
- TR-6 - TPH-g - 36 milligrams per kilogram (mg/kg), BTEX - 1.3 to 2.9 mg/kg, and MTBE < detection limits with an LNAPL thickness of 7.5 feet in the well; and
- TR-5 - TPH-g - 2,100 mg/kg and BTEX - 24 to 170 mg/kg with an LNAPL thickness of 10.6 feet in well.

In fill material, only non-detectable concentrations were found in the following soil samples:

- SB-25 - <detection limits;
- SB-31 - <detection limits;
- SB-33A - <detection limits - underlying groundwater contained detectable petroleum hydrocarbon concentrations; and
- SB-34 - <detection limits with LNAPL in the underlying Bay Mud.

Soil vapor has been evaluated particularly for the presence of petroleum VOCs that may cause impacts to commercial workers in the buildings on the Site. Benzene and ethylbenzene were not detected, and the toluene and xylene concentrations ranged from 5.7 to 9.1 micrograms per cubic meter (µg/m^3). These concentrations are very low and well below the regulatory criteria for commercial workers (T&R, 2009b).

3.2.2 LNAPL

The area of potential lateral distribution of LNAPL may be approximately 150 feet wide and 250 feet long (Figure 4). These dimensions are based on observed LNAPL and benzene concentrations. Concentrations of benzene are elevated in borings with no LNAPL but located near LNAPL. Based on the overall pattern of results, benzene concentrations above approximately 1,800 µg/L appear to indicate that LNAPL is present in the immediate vicinity.

The LNAPL appears to extend vertically over an approximate seven-foot interval, from 5 to 12 feet bgs (Figure 2). The thickness of product in the wells was approximately 2.7 feet at TR-4, 7.5 feet at TR-5, and 10.6 feet at TR-6 on 4 October 1999. The actual thickness of free-product in the surrounding soil formation was approximately 1 foot at TR-4, 1.6 feet at TR-5, and 2 feet at TR-6 (T&R, 2000).

LNAPL testing provided an estimate of several chemical properties. These properties include LNAPL composition, specific gravity, and flashpoint. The results from these analyses are the following:

- Composition - Chemical analyses of an LNAPL sample indicate that the product is gasoline.
  - Chromatograms match the laboratory gasoline standard and are similar between sampling locations.
  - BTEX compounds are present as is typical of gasoline and predominance of aromatics similar to that of gasoline (Kaplan, Galprin , Lu and Lee, 1997).
  - The PIANO analysis indicates a relative weight percent of petroleum hydrocarbon components.
  - TPH-d was detected but the laboratory noted that these results do not match the diesel standard, and total petroleum hydrocarbons as motor oil (TPH-mo) was not detected.
  - Dynamic viscosity is 0.487 centistokes, similar to that of gasoline.
  - Some lead is present in the LNAPL. Product sample TR-4 contained 360 parts per million of organic lead (tetraethyl and methyltriethyl lead). Tetraethyl lead was detected in the product sample from boring SB-18 at 260 milligrams per liter (mg/L).
- Specific gravity – The average specific gravity was approximately 0.73 of the two samples and is virtually identical to the specific gravity of gasoline
- Flashpoint - LNAPL meets the definition of a flammable substance.

Based on field observations, the mobility of the LNAPL is variable. At some locations, free-product was observed immediately during drilling. Free product was not detected at TR-5 until the day after it was drilled. In contrast, free-product was first observed at well TR-4 after the well was developed and nearly two weeks after installation. Additional information supporting the conclusion that the LNAPL has limited mobility include:

- The limited current LNAPL extent despite a long history of potential historic UST use.
- LNAPL presence in the Bay Mud results in low groundwater flow and limited mobility of the petroleum hydrocarbons.
- The variable hydraulic appears to direct groundwater in opposite east and west directions, limiting the spread of the LNAPL.
- Field observations indicate some low and variable LNAPL rates entering boreholes, wells and trenches.

3.2.3 Petroleum Hydrocarbons Dissolved in Groundwater

Perched groundwater samples were collected at three locations (SB-28, -31, and -33A) from near the fill/Bay Mud interface. All results were below detection limits. Notably, the perched water sample from SB-33 was underlain by groundwater containing detectable concentrations of TPH-g and BTEX.

The shallow groundwater is impacted by TPH-g and BTEX compounds. Results ranged from not detected to the maximum concentrations listed below:

- TPH-g – to 360,000 µg/L
- Benzene - to 40,000 µg/L
- Toluene - to 120,000 µg/L
- Ethylbenzene - to 57,000 µg/L
- Total xylenes - to 240,000 µg/L.

The distributions of these compounds are presented in Appendix A, Figure 11.

Given the nature of LNAPLs to remain above the water table, it is not expected that groundwater impacts exist deeper than the shallow groundwater unit. Nonetheless, deep groundwater has not been characterized at this Site, resulting in a data gap.

3.3 Exposure Pathways

Potential exposure pathways for the petroleum hydrocarbons to reach receptors include the following:

- Construction Excavations - Workers may be exposed via dermal contact and potential inhalation during construction work below 5 feet bgs in the petroleum-impacted area at the Site. The potential exposure would be limited by health and safety planning and implementation during construction projects.

- Water Supply Wells - Liquid and dissolved petroleum from the Site may migrate to and enter drinking water supply wells. This pathway does not appear to be complete because no water supply wells are present within one-quarter mile of the Site. The potential exposure would be limited by the presence of the building and limitations on construction of on-Site water supply wells.

- Indoor Air Inhalation – Commercial workers in the buildings may be exposed to petroleum vapors. This pathway does not appear to be complete because the fill material below the building slab is not impacted by LNAPL and dissolved petroleum, and only a few volatile organic compounds were detected at low concentrations.

- Underground Utilities – Dissolved and vapor petroleum from the Site may move along underground utilities such as storm drains and sanitary sewers and reach potential receptors. Based on current information, this pathway does not appear to be complete because of the following:

    - Low permeability of the Bay Mud and discontinuous sand and peat layers;

    - The primary underground utilities are in the streets and are distant from the petroleum hydrocarbons at the Site, especially relative to other potential sources; and

    - The petroleum hydrocarbons do not extend to the underground utilities in the streets.

Evaluation of this pathway is subject to the data gaps presented in Section 3.6.

3.4 Receptors

Potential receptors of the groundwater contamination are construction workers who may inadvertently encounter contaminated water during subsurface repairs or installation or maintenance of underground utilities. This potential exposure is limited to the petroleum-impacted area and can be mitigated by health and safety planning and limits on utility installation locations.

Other potential receptors are not likely exposed due to incomplete exposure pathways.

3.5 Data Gaps

An SCM is an evolving tool to help understand and manage potential contamination risks, and is improved as key data gaps are addressed. Current key gaps for the Mandela Parkway SCM include the following:

- Monitoring of groundwater elevations and petroleum hydrocarbon concentrations, particularly to evaluate changes over time and check conditions near TR-2;

- Monitoring of petroleum hydrocarbon concentrations in deep groundwater; and

- Evaluating underground utilities directly beneath the building, within the petroleum-impacted area at the Site to check for the potential presence of preferential pathways.

4.0 REMEDIAL ACTION OBJECTIVES

4.1 Risk Management Evaluation

As discussed in the SCM in Sections 3.4 and 3.5, four potential exposure pathways were evaluated with respect to the petroleum impacts at the Site. These four pathways included the following:

- Construction Worker during Excavations;
- Drinking Water Supply Wells;
- Indoor Air Inhalation; and
- Underground Utilities.

Among these pathways, the drinking water supply wells, indoor air inhalation, and underground utilities pathways were considered incomplete. Therefore, risk associated with the Site impacts does not exist at present for these three potential exposure pathways. Potential risk does exist for the construction worker who may inadvertently encounter contaminated soil or water during subsurface repairs or installation or maintenance of underground utilities.

Based on this evaluation, there is a need to mitigate potential risk to construction workers. There is also a need to ensure that the pathways which are incomplete at present, remain either incomplete or mitigated. This mitigation can be addressed either through remediation, containment, and or land use controls.

4.2 Remedial Goals and Objectives

As stated in the "Basin Plan" for this Site, maximum concentrations limits (MCLs) are the presumed cleanup standard for remediation of groundwater impacted with petroleum hydrocarbons. In addition to a remediation goal of meeting the MCLs in groundwater, given the absence of any other pathways for risk associated with the groundwater, we propose an alternative remediation goal of containment of impacted groundwater, LNAPL, and mitigation of potential exposure pathways.

The proposed alternative goal of containment would be evaluated by monitoring of wells placed just outside the impacted area. The Mann-Kendall statistical test will be used to determine whether an increasing trend is present in the concentration data from these wells. To perform this non-parametric test, chronological pairs of data are given scores according to whether the later data point is greater or less than the previous point. An increase in concentration from one data point to the next would receive a score of one, a decrease would receive a negative one, and no change would receive a zero score. These scores are summed over the entire series and the result is compared to a critical value to distinguish the resulting total score from one that would be likely to occur from random fluctuations. Exact critical values are provided for up to ten data points and an approximate critical value can be calculated for larger data sets.

The portion of the alternative cleanup goal related to mitigation of potential exposure pathways would be evaluated through periodic updates of the SCM. The remediation goal and/or alternative remediation goal for groundwater may also be met through remediation, containment, land use controls, or a combination of these.

No remedial goals are presented for impacts to soil vapor, because soil vapor impacts were not detected above commercial or residential ESLs at this Site. Should soil vapor become impacted in the future, it is presumed that ESLs for soil vapor in a commercial land use would be used as the basis for further evaluation of risks.

5.0 FEASIBILITY STUDY OF REMEDIAL ALTERNATIVES

5.1 Screening of Remedial Technologies for LNAPL, Groundwater and Soil Vapor

To begin the remedial alternatives evaluation, a broad range of possible remedial technologies for each media (LNAPL, groundwater, and soil vapor) was screened to determine whether a detailed evaluation was warranted for the remedial technology. The broad range of technologies included technologies typically considered for petroleum-impacted sites, and include technologies which employ physical, chemical, and biological methods for contaminant reduction and/or containment.

The remedial technologies screened included the following, divided by media:

LNAPL Remedial Technologies

- No Action
- Thermal Treatment
- Product Extraction (Active or Passive)
- Biosparging
- In Situ Chemical Oxidation
- Surfactant-Enhanced LNAPL Recovery
- Steam Enhanced LNAPL Recovery
- Excavation
- Physical Barrier for Containment
- Hydraulic Control for Containment

Groundwater Remedial Technologies

- No Action
- Monitored Natural Attenuation
- Groundwater Extraction and Treatment
- Air Sparging
- In Situ Chemical Oxidation
- In Situ Aerobic Bioremediation
- Thermal Treatment
- Aerobic Biobarrier for Containment
- Hydraulic Containment

Soil Vapor Remedial Technologies

- No Action
- Monitored Natural Attenuation
- Bioventing
- Soil Vapor Extraction

5.1.1 Screening of LNAPL Remedial Technologies

The screening of LNAPL remedial technologies is presented in Table 2. As indicated in this table, a number of technologies are eliminated from consideration based on lack of expected effectiveness or technical infeasibility. "Biosparging," "In Situ Chemical Oxidation," and "Steam-Enhanced LNAPL Recovery" are eliminated from consideration because the low permeability of the soil containing the LNAPL is expected to render these technologies ineffective. "Soil Excavation" is eliminated from consideration because of the infeasibility of implementing this technology beneath the existing building.

Upon removing these LNAPL remedial technologies from consideration, "Thermal Treatment" is retained for further evaluation. "Physical Barrier for Containment" is retained for further evaluation as a containment technology. "Product Extraction" and "Surfactant-Enhanced Extraction," are retained for further evaluation, but only if implemented in conjunction with soil fracturing, which has the potential to create sufficient soil permeability to render these technologies effective.

5.1.2 Screening of Groundwater Remedial Technologies

The screening of groundwater remedial technologies is presented in Table 3. As indicated in this table, a number of technologies are eliminated from consideration based on lack of technical effectiveness or technical infeasibility. "Monitored Natural Attenuation" is eliminated due to the unreasonable timeframe for naturally-occurring microbes to remediate the Site. "Groundwater Extraction and Treatment" is eliminated from consideration because the low permeability soil containing the impacted groundwater would result in too low an extraction rate for effective remediation. "Air Sparging" is eliminated from consideration because the low permeability soil would inhibit the injection and movement of atmospheric air.

Upon removing these groundwater remedial technologies from consideration, "Thermal Treatment" is retained for further evaluation. "Aerobic Biobarrier for Containment" is retained for further evaluation as a containment technology. "Chemical Oxidation" and "Aerobic Bioremediation" are retained for further evaluation, but only if implemented in conjunction with soil fracturing, which has the potential to create sufficient soil permeability to render these technologies effective.

5.1.3 Screening of Soil Vapor Remedial Technologies

The screening of soil vapor remedial technologies is presented in Table 4. As indicated in this table, technologies exist which are expected to be effective for remediation of soil vapor. However, as described in previous sections of this document, soil vapor sampling has demonstrated that there are no soil vapor impacts beneath the building slab that are above ESLs at the Site. Therefore, soil vapor remediation will not be considered at this Site. The technology evaluation is included in the event that soil vapor impacts unexpectedly become present in the future.

5.2 Description of Remedial Alternatives

Based on the remedial technology screening presented in Section 5.1, the remedial alternatives presented below were developed for evaluation. Each remedial alternative combines a retained remedial technology for LNAPL and groundwater remediation. The remedial alternatives are as follows:

- Alternative 1: No Action
- Alternative 2: Thermal Treatment (LNAPL and Groundwater)
- Alternative 3: Fracturing of Soils Followed by LNAPL Recovery and Chemical Oxidation of Groundwater
- Alternative 4: Long-Term Containment of LNAPL and Groundwater (With Potential Future Remediation Following Demolition of Building)
- Alternative 5: Peat Zone Remediation

5.2.1 Alternative 1: No Action

Alternative 1 is included for comparison purposes and at the request of the ACEH. Under this alternative, no further action would be performed to remediate or monitor impacts to the Site.

5.2.2 Alternative 2: Thermal Treatment

Alternative 2 is the thermal treatment of LNAPL and impacted groundwater. This alternative was formed based on the screening evaluation showing thermal treatment as a retained technology for both LNAPL and groundwater.

Thermal treatment is a proven remediation technology with demonstrated effectiveness on a wide range of VOCs, including BTEX compounds and TPH. For the purpose of this evaluation, the method of heating is assumed to be thermal conductive heating. Another potential method is electrical resistance heating. With thermal conductive heating, vertical heater borings heat the soil, water, and LNAPL to temperatures at or above the boiling point of water (100°C). The heating of the subsurface vaporizes contaminants and groundwater, while a vacuum applied by a vapor extraction system draws the vapors into off-gas piping for subsequent aboveground treatment.

5.2.3 Alternative 3: Fracturing of Soils Followed by LNAPL Recovery and Chemical Oxidation of Groundwater

Alternative 3 involves hydraulic fracturing of soil within the LNAPL and groundwater-impacted zones to create a region of higher soil permeability, in which remedial technologies that would not be effective in the low permeability soil at this Site would have increased effectiveness. This alternative was formed based on the screening evaluation which retained soil fracturing as an optimization technology. It also combines the LNAPL and groundwater technologies retained for further evaluation when combined with soil fracturing, including Product Extraction and/or Surfactant-Enhanced Recovery for LNAPL and In Situ Chemical Oxidation for groundwater.

Hydraulic fracturing is implemented by pumping a fluid into a well at a rate and pressure high enough to overcome the confining stress and material strength of a soil formation, resulting in the formation of a fracture. A slurry mixture containing sand and a viscous fluid, typically guar gum, is pumped under pressure into the resulting fractures. After fracturing and injection of the sand mixture, the viscous fluid breaks down, leaving fractures filled with permeable sand. This process has been used within the petroleum industry for many years to enhance oil and gas production rates in wells that would otherwise be uneconomical to produce, and it has been used more recently in environmental remediation applications.

Following fracturing, this alternative includes skimming or surfactant-enhanced LNAPL removal. Skimming is the active or passive removal of accumulated LNAPL within a recovery well. Surfactant enhancement is the injection of a surfactant to improve mass recovery of LNAPL by lowering the surface tension of the groundwater and making the LNAPL more miscible in the aqueous phase, both of which allow for improved mass recovery upon extraction.

The alternative also includes chemical oxidation of impacted groundwater. Chemical oxidation is implemented through the injection of a strong oxidizing agent into the subsurface, via injection wells or direct push technology, to react with the contaminant, transforming it into carbon dioxide and water. A typical application of this remedial technology includes two or three injection events. Example oxidants typically used in environmental remediation include hydrogen peroxide, permanganate, activated persulfate, and ozone.

5.2.4 Alternative 4: Long-Term Containment of LNAPL and Groundwater

Alternative 4 combines the retained technologies for containment of both LNAPL and impacted groundwater. For LNAPL, the retained containment technology was the placement of a physical barrier to flow. For groundwater, the retained containment technology was an aerobic biobarrier.

The exact placement and design of the LNAPL and groundwater barriers would depend on the direction and velocity of LNAPL and groundwater flow. For the purpose of this alternative, it is assumed that the direction of flow is in a direction where placement of the containment system is feasible, and that LNAPL and groundwater are migrating at a speed which warrants containment measures.

The LNAPL barrier would be a physical liner, installed by trenching, placed vertically across the water table, thus preventing the migration of LNAPL. The groundwater barrier would not impede water flow, but would utilize wells containing slow-release oxygen material to create a biologically-active zone which would degrade the contaminants in groundwater upon passage though the barrier.

5.2.5 Alternative 5: Peat Zone Remediation

Alternative 5 involves the attempted remediation of LNAPL and impacted groundwater within the "peat-zone," a more permeable zone within the low permeability Bay Mud, in which remedial technologies that were ruled out in the screening evaluation may be more effective. As described in Section 3.1, the existence and extent of this peat-zone is not yet fully defined, and thus this alternative would require additional geological investigation to evaluate. Under this alternative, it is recognized that no action would be taken to remediate LNAPL and groundwater outside the peat-zone, thus remediation would be incomplete. However, it is also recognized that removal of impacts from the highest permeability zone could significantly reduce the rate of LNAPL and groundwater migration and the travel time to a potential receptor. The technologies evaluated are surfactant-enhanced removal for LNAPL and chemical oxidation for groundwater. This alternative was formed based on the recognition of the fact that effective and implementable options for remediation are very limited at this Site, and that removal of a portion of contaminants would be preferable to no remediation at all.

5.3 Evaluation of Remedial Alternatives

A detailed evaluation of each of the five remedial alternatives is provided in Table 5 and summarized in this section.

5.3.1 Evaluation of Alternative 1

The evaluation of Alternative 1 (No Action) indicated that, at present, no environmental or ecological risk would result from this alternative, since there is no complete risk pathway. However, the effectiveness of this alternative is considered low, because there would be no monitoring of, or action to prevent, the potential migration of contaminants into areas where a risk pathway may be present. Although no remediation would occur under this alternative, a low rate of natural attenuation is expected. This alternative is easily implementable and there would be no cost.

5.3.2 Evaluation of Alternative 2

The evaluation of Alternative 2 (Thermal Treatment) indicated that this alternative would have a medium-high expectation to effectively remediate LNAPL and impacted groundwater and soil media. Since the ability to heat the subsurface is not limited by low soil permeability, effective and thorough heating is expected. Contaminants should effectively volatilize, removing them from the subsurface and thereby reducing potential environmental risk, should a risk pathway open in the future. Two side effects of thermal treatment may reduce or negate any improvement in environmental risk due to remediation. First, heating of the soil will dramatically increase vertical permeability of the clay soils, due to drying and cracking of these soils. This potentially opens a pathway to vapor intrusion following the remediation. Second, a sustainability analysis of the alternatives (Appendix B) indicates a very high carbon footprint associated with this alternative due to the high energy use. It is not clear that the environmental benefits of remediation would outweigh the environmental cost of the carbon footprint and the potential to open a risk pathway.

The implementability of Alternative 2 is low-medium, given the extent to which the existing Site use would be disrupted during remediation. This alternative is expected to require over 100 wells to be installed within or outside the building for use as heater points or monitoring points. Extensive trenching beneath the building slab will be required to accommodate vapor extraction piping. Heating of soil beneath the building presents potential safety concerns, especially if business operations continue in the space above; however, a qualified operator would be able to effectively mitigate the safety concern. Remediation operations for 6 to 9 months will also prevent the current tenant from operating within the portion of the building overlaying the remediation area. Although business operations have been performed during thermal treatment at other thermal remediation sites, it is rare and more likely that the tenants in this space would be unable to operate during remediation. The cost of Alternative 2 is very high, due to the intensive use of materials, labor, and energy.

5.3.3 Evaluation of Alternative 3

The evaluation of Alternative 3 (Fracturing of Soils Followed by LNAPL Recovery and Chemical Oxidation of Groundwater) indicated that this alternative would have a medium expectation to remediate LNAPL and impacted soil and groundwater. The effectiveness of remediation under this alternative depends heavily on the extent and quality of soil fracturing that can be achieved. Due to the presence of very low permeability soils, fracturing would need to be extensive to allow for a sufficient extraction rate of LNAPL and/or injection rate of oxidants or oxygen-releasing compounds. Although necessary for effective remediation, soil fracturing also has the potential to increase the vertical permeability of soils beneath the building and to potentially open a pathway for future vapor intrusion. The worst case scenario under this alternative would be incomplete remediation, coupled with an opened pathway for vapor intrusion, thus creating a risk pathway where none exists at present.

The implementabilty of Alternative 3 is low-medium, given the extent to which the existing Site use would be disrupted during remediation. This alternative is expected to require placement of 50 to 100 fracture points. The high pressures used during the fracturing process would, at best, disrupt tenant operations, and at worst, potentially present a concern for the structural integrity of the building. The use of powerful reagents, such as chemical oxidation reagents, also presents a safety concern during remediation. These concerns can be mitigated by a qualified operator and work could potentially be performed on weekends when tenants are not present. Overall, however, this alternative is expected to be very disruptive to operations at the Site. The cost of Alternative 3 is considered high based on the large number of fracture points, volume of remediation reagents, and duration of operation and monitoring.

5.3.4 Evaluation of Alternative 4

The evaluation of Alternative 4 (Long-Term Containment of LNAPL and Groundwater) indicated a high expected effectiveness to contain LNAPL and impacted groundwater. At present, no environmental or ecological risk exists under this alternative, since there is no complete risk pathway at present. The containment actions implemented by this alternative would prevent the migration of contaminants into areas where a risk pathway may be present. No remediation would occur except for along the boundary of the plume, where aerobic biological treatment would be used to contain the groundwater plume. A low rate of natural attenuation is also expected. The implementability of Alternative 4 is medium-high based on the relative ease of installation compared the other alternatives. Trenching, piping, and well installation would be required, but it is expected these can be placed outside the building in a more easily accessible area. If located within the street adjacent to the Site, some disruption to traffic would occur. The cost of Alternative 4 is considered low-medium based on the scope of initial installation and the relatively minor operation and maintenance required.

5.3.5 Evaluation of Alternative 5

The evaluation of Alternative 5 (Limited Chemical Oxidation within Peat Zones) indicates that this alternative would have a low-medium expectation to effectively remediate the Site. The success of the remediation within the "peat-zone" will likely depend on the soil permeability within this zone, which has not been fully characterized. This alternative balances the cost and benefits of remediation by targeting the most easily remediated zone (peat-zone), while performing no action in the difficult areas (clays). Regardless of the short-term effectiveness in removing impacts from the peat-zone, it is possible that the contaminants remaining within the clays would re-impact the soil and groundwater within the peat-zone over time. The implementability of Alternative 5 is medium, based on the relative ease of installation compared to the other remediation alternatives. The same disruption to Site use discussed for Alternative 3 is expected for Alternative 5; however, the extent and duration would be smaller. The cost of Alternative 5 is considered medium, a significant reduction compared to Alternatives 2 and 3.

5.4 Selection of Preferred Remedial Alternative

Based on the evaluation of alternatives presented in Table 5 and discussed in Section 5.3, Alternative 1 (No Action) is not an effective selection for the Site.

Among the three alternatives involving remediation (Alternatives 2, 3, and 5), only Alternative 2 (Thermal Remediation) offers a reasonably high expectation of effective remediation. Alternative 3 (Fracturing of Soils Followed by LNAPL Recovery and Chemical Oxidation of Groundwater) cannot offer a high enough certainty that the extent and quality of fractures will occur and that subsequent remediation will be effective. It is unclear that the peat-zone remediation offered by Alternative 5 (Limited Chemical Oxidation within Peat Zones) offers any short-term risk reduction, given that a risk pathway is not currently present, or any significant long-term risk reduction, given the potential for contaminants left in place to re-impact the peat-zone. Therefore, among the three remediation alternatives, Alternative 2 is the most favorable. As an alternative to remediation under Alternative 2, Alternative 4 (Long-Term Containment of LNAPL and Groundwater) offers a method for the long-term containment and mitigation of environmental risk.

Alternative 2 would remediate the Site, resulting in mass reduction of contaminants and removal of the source of the environmental risk. In is unclear, however, whether the benefits of the intensive remediation approach under Alternative 2 is justified given that no risk pathways exist at present and that Alternative 4 would also effectively prevent any future risk. A number of environmental, social and economic issues are also problematic for Alternative 2. First, this alternative results in the local and global environmental hazards and climate change potential associated with generation of a large quantity of electricity. A remedial sustainability analysis (Appendix B) shows that Alternative 2 would result in a greenhouse gas footprint more than 540 metric tons greater than that of Alternative 4. Second, implementation of Alternative 2 would significantly disrupt the tenant business operations in the existing building, requiring relocation of these businesses for a period of 6 to 9 months. Lastly, the cost of Alternative 2, estimated in the $3-4 million range, is not justified given that the less expensive Alternative 4 exists, which would also mitigate environmental risk. A final benefit of Alternative 4 is that more effective and less expensive remedial alternatives would become available if the contamination were contained until the eventual demolition of the building on the property. For example, after demolition of the building, a technology such as chemical oxidation installed by soil mixing may offer an improved prospect for effective and cost efficient remediation.

For the reasons described above, it is our opinion that Alternative 4 offers the best choice for the Site. Alternative 4 (Long-Term Containment of LNAPL and Groundwater) is proposed as the selected remedial alternative.

6.0 CONCLUSIONS/PROPOSED IMPLEMENTATION

As a result of the evaluation presented in Section 5.0, Alternative 4 (Long-Term Containment of LNAPL and Groundwater) is proposed as the best course of action for this Site. Elements of this alternative include prevention of exposure pathways to human or environmental receptors, prevention of LNAPL and impacted groundwater migration, and continued monitoring. If needed, additional remediation alternatives could be evaluated and implemented following future removal of the building and slab.

A phased-approach to implementation of Alternative 4 is proposed. The following items are recommended for implementation of this alternative:

1) <u>Perform on-site utility survey</u>: A survey of on-site utilities is proposed at the Site to identify potential connections between underground utilities beneath the existing building and significant utilities in the streets. Identification of utilities beneath the building will assist in evaluating whether pathways may exist between the Site impacts and potential receptors that do not appear to exist at present. The survey would be performed through visual inspection and interpolation from visible utilities and utility components and using an underground utility contractor. The utility survey will fill one of the data gaps identified in the SCM in Section 3.6.

2) <u>Confirm extent of LNAPL and impacted groundwater</u>: In order to properly contain the petroleum hydrocarbons, it is necessary to confirm the extent of LNAPL and impacted groundwater. A limited investigation is proposed to perform this task, as outlined on Figure 8. In addition, the collection of one grab groundwater sample at 20-30 feet bgs is proposed to evaluate whether groundwater impacts may extend deeper than currently estimated. This investigation will also fill data gaps identified in the SCM in Section 3.6.

3) <u>Update Building Operation and Maintenance (O&M) Plan</u>: In order to mitigate potential risk to construction workers during excavation work, the O&M Plan for the building should be updated to include health and safety measures where an excavation deeper than 5 feet is performed.

4) <u>Installation of sentry wells to monitor containment</u>: Placement and monitoring of four "sentry wells" is proposed along the edges of the groundwater and LNAPL impacts (Figure 8). These sentry wells will monitor potential changes in the extent of LNAPL and groundwater impacts.

5) <u>Continued groundwater monitoring</u>: As described in Section 3.1.1, historical groundwater elevation measurements at the Site have indicated variation in the direction of groundwater flow. Additional groundwater elevation measurements are proposed to more accurately estimate the direction of groundwater flow. Groundwater elevation measurements would be collected during groundwater monitoring events described below.

   Routine groundwater sampling and analysis is proposed to monitor petroleum hydrocarbon concentrations in groundwater. Monitoring would be performed on a semi-annual basis with a review at the end of year to evaluate attenuation of the contamination and a possible reduction in sampling frequency. Detections of LNAPL and/or groundwater concentrations above the proposed cleanup goals and/or showing an upward concentration trend using the Mann-Kendall statistical test may trigger consideration of additional containment measures. If additional containment measures are needed, these may include those measures described in Section 5.2.4 for Alternative 4.

   In addition, free product removal will be evaluated during groundwater monitoring. A review of previous operations points toward the possibility that skimming may be more effective if performed during portions of the year when higher groundwater elevations reach a more permeable zone within the Bay Mud. It is proposed that this be assessed during groundwater monitoring by determining the volume of free-product present as a function of seasonal variation in groundwater elevation. In addition, free-product may be encountered and removed during well sampling.

6) Monitoring of soil vapor: The existing shallow soil vapor wells (Figure 2) will be monitored on an annual basis. As described in Section 3.4, an exposure pathway to indoor air inhalation is not complete. However, annual monitoring of these wells is proposed to confirm that this potential pathway remains incomplete. Detections of soil vapor concentrations above ESLs in the wells may trigger additional evaluation or mitigation of potential risk.

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TABLES

Table 1
Groundwater Elevations and Gradients
2855 Mandela Parkway
Oakland, California

Wells	Dates	Elevation Range (ft msl)	Gradient Magnitude	Direction	Notes
TR-1,-2,-3	May 1999	-0.35 to 5.74	0.025	W-SW	Temporary wells
TR-4,-5,-6	Oct 1999	-0.40 to -2.96	0.01	NE	Linear well array
TR-5,-6,-10, -11	Sep 2008	-1.56 to 4.20	0.005	E	

TABLE 2.
Screening Evaluation of LNAPL Remediation Technologies
2855 Mandela Parkway
Oakland, California

LNAPL Remedial Technology	Technical Effectiveness	Implementability	Remediation Timeframe	Cost	Result/Ranking
1. No Action	**Low** - No remediation would occur	**High** - No action is easily implementable	**N/A**	**No Cost**	**Retain for Comparison**
2. Thermal Treatment (electrical resistance heating or thermal conductive heating)	**Medium-High** - Ability to heat subsurface is not limited by tight soils, so heating would thoroughly treat soils. - Heating dries out clay and creates permeability for vapor recovery. - Effective for BTEX and most of the diesel range, but may not be effective in removing high boiling point compounds above C16. - If effective, this technology would also treat impacted groundwater during LNAPL remediation	**Low-Medium** - Significant piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab - Safety concerns about applying heat relatively close to the surface of an active building - Volatilized vapors could migrate upward and present an indoor air problem within the building, which would need to be mitigated	**6 to 9 Months**	**High**	**Retain as Remedial Alternative**
3. Product Extraction	**Low** - Previous skimming operations indicate very low LNAPL recovery rate - The rate of extraction would be limited due to the clay formation.	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**More than 10 Years**	**Medium**	**Retain as Remedial Alterative only in Conjunction with Soil Fracturing Optimization Technology**
4. Biosparging	**Low** - Previous skimming operations indicate very low LNAPL recovery rate - The distribution of oxygen for bioremediation would be limited by the tight clay formation. - If effective, this technology would also treat impacted groundwater during LNAPL remediation	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**More than 10 Years**	**Medium**	**Do Not Retain. Technology is not effective.**
5. In Situ Chemical Oxidation	**Low-Medium** - The distribution of chemical oxidant into the impacted areas would be limited by the tight clay formation - Longer-lasting oxidation reagents would be preferred. - Could potentially target peat-zone, if higher permeability exists in this area - If effective, this technology would also treat impacted groundwater during LNAPL remediation	**Low-Medium** - Injection work could be performed on weekends, to minimize disruption to tenants - No permanent piping or equipment required - Potential dangers of surfacing reagent always present when injecting into shallow areas beneath buildings	**1-2 Years**	**Medium-High**	**Do Not Retain. Technology is neither effective nor implementable.**
6. Surfactant-Enhanced LNAPL Recovery	**Low** - Previous skimming operations indicate very low LNAPL recovery rate, which may remain too low for significant removal even with surfactant enhancement - The distribution of surfactant into the impacted areas would be limited by the tight clay formation. - Could potentially target peat-zone, if higher permeability exists in this area	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab, but could be performed using temporary piping and equipment on the weekend to minimize disruption to tenants	**1-2 Years**	**Medium**	**Retain as Remedial Alterative only in Conjunction with Soil Fracturing Optimization Technology**

TABLE 2.
Screening Evaluation of LNAPL Remediation Technologies
2855 Mandela Parkway
Oakland, California

LNAPL Remedial Technology	Technical Effectiveness	Implementability	Remediation Timeframe	Cost	Result/Ranking
7. Steam-Enhanced LNAPL Recovery	**Low** - Previous skimming operations indicate very low LNAPL recovery rate, which may remain too low for significant removal even with steam enhancement - The distribution of steam into the impacted areas would be limited by the tight clay formation.	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**More than 10 Years**	**Medium-High**	**Do Not Retain. Technology is not effective.**
8. Excavation	**High** - Very effective for removal of impacted soils	**Low** - It is unlikely that an excavation at this scale can be safely performed beneath the existing building	**3 Months**	**High**	**Do Not Retain. Technology is not implementable.**
9. Physical Barrier for Long-Term Containment - placement of a physical barrier to LNAPL flow along the downgradient edge of the property to prevent the spread of LNAPL	**High for Containment** **Low for Remediation** - A physical barrier would effectively contain LNAPL, however no remediation of the LNAPL would occur	**Low-Medium** - Some trenching in driveways and streets would be required, potentially disrupting traffic and tenant operations.	**3 Months for Containment; More than 10 Years for Remediation**	**Medium**	**Retain as Remedial Alternative**
9. Hydraulic Control for Long-Term Containment - groundwater extraction to hydraulically control the direction of LNAPL flow	**Medium for Containment** **Low for Remediation** - It is unclear whether a sufficient rate of groundwater extraction could be achieved to contain LNAPL	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**2 Months for Containment; More than 10 Years for Remediation**	**Medium-High**	**Do Not Retain. Technology is less effective than barrier containment technology.**
Potential Optimization Technologies					
10. Soil Fracturing - hydraulic fracturing to create pathways for flow within the clay formation	**Medium** increase to effectiveness - Applicable to all technologies except for excavation and long-term containment	**Medium** - Fracturing may open a pathway for vapor migration into the vapor zone and result in a long-term indoor air problem - Potential structural concerns about fracturing in shallow soils beneath a building - Fracturing work could be performed on weekends, to minimize disruption to tenants	**2 Months**	**Medium** increase to cost	**Retain as Optimization Technology for Remedial Alternatives**
11. In Situ Soil Mixing - mixing of soil and placement of reagent using an excavator equipped with a soil mixing tool	**High** increase to effectiveness - Applicable to injection technologies, such as in in situ chemical oxidation	**Low** - It is impossible to safely remove the building slab to allow access for the soil mixing tool at this scale beneath a building	**2 Months**	**Low to Medium** increase to cost	**Do Not Retain. Technology is not implementable.**

TABLE 3.
Screening Evaluation of Groundwater Remediation Technologies
2855 Mandela Parkway
Oakland, California

Groundwater Remedial Technology	Technical Effectiveness	Implementability	Remediation Timeframe	Cost	Result/Ranking
1. No Action	**Low** - No remediation would occur	**High** - No action is easily implementable	**N/A**	**No Cost**	**Retain for Comparison**
2. Monitored Natural Attenuation	**Low** - GW concentrations will likely rebound unless LNAPL is addressed. - Contaminants present are biodegradable under existing conditions, however contaminant reduction would be very slow.	**High** - Implementable using existing wells	**More than 10 Years**	**Low**	**Do Not Retain. Technology is not effective.**
3. Groundwater Extraction and Treatment	**Low** - GW concentrations will likely rebound unless LNAPL is addressed. - Rate of groundwater extraction would be limited by tight clay formation	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**More than 10 Years**	**Medium-High**	**Do Not Retain. Technology is not effective.**
4. Air Sparging	**Low** - GW concentrations will likely rebound unless LNAPL is addressed. - Requires volatiles to be sparged and transported upward into the vadose zone. This transport would be limited by tight clay formation.	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**More than 10 Years**	**Medium-High**	**Do Not Retain. Technology is not effective.**
5. In Situ Chemical Oxidation	**Low-Medium** - GW concentrations will likely rebound unless LNAPL is addressed. - Several types of oxidants are effective on the petroleum hydrocarbons - Distribution of oxidants into contaminated areas would be limited by tight clay formation.	**Low-Medium** - Injection work could be performed on weekends, to minimize disruption to tenants - No permanent piping or equipment required - Potential dangers of surfacing reagent always present when injecting into shallow areas beneath buildings	**1-2 Years**	**Medium-High**	**Retain as Remedial Alterative only in Conjunction with Soil Fracturing Optimization Technology**
6. In Situ Aerobic Bioremediation	**Medium** - GW concentrations will likely rebound unless LNAPL is addressed. - Aerobic bioremediation is effective for petroleum hydrocarbons -Distribution of oxygen would be limited by tight clay formation - It would be most appropriate to use this technology after the groundwater has been partially treated with a stronger technology	**Medium** - Injection work could be performed on weekends, to minimize disruption to tenants - No permanent piping or equipment required	**3-4 Years**	**Medium**	**Retain as Remedial Alterative only in Conjunction with Soil Fracturing Optimization Technology**

TABLE 3.
Screening Evaluation of Groundwater Remediation Technologies
2855 Mandela Parkway
Oakland, California

Groundwater Remedial Technology	Technical Effectiveness	Implementability	Remediation Timeframe	Cost	Result/Ranking
7. Thermal Treatment	**Medium-High** - GW concentrations will likely rebound unless LNAPL is addressed. - See Table 2 for technical effectiveness evaluation.	**Low-Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab - Safety concerns about applying heat relatively close to the surface of an active building - Volatilized vapors may migrate upward and present an indoor air problem within the building	**6 Months**	**Medium-High**	**Retain as Remedial Alternative**
8. Aerobic Biobarrier for Long-Term Containment - placement of oxygen releasing socks along property boundary to aerobically biodegrade concentrations leaving the site	**High for Containment** **Low for Remediation** - Expected to effectively contain groundwater however very little remediation would occur - Aerobic bioremediation is effective for the diesel range contaminants	**Medium-High** - Would require installation of wells along property boundary for placement of socks. - No permanent equipment or piping required	**1 Month for Containment;** **More than 10 Years for Remediation**	**Low-Medium**	**Retain as Remedial Alternative**
9. Hydraulic Control for Long-Term Containment - groundwater extraction to hydraulically control the GW flow	**Medium for Containment** **Low for Remediation** -It is unclear whether a sufficient rate of groundwater extraction could be achieved to contain groundwater.	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**2 Months for Containment;** **More than 10 Years for Remediation**	**Medium-High**	**Do Not Retain. Technology is less implementable than boundary treatment containment technology.**
Potential Optimization Technologies					
See Table 2. Evaluation of LNAPL Remediation Alternatives					

TABLE 4.
Screening Evaluation of Soil Vapor Remediation Technologies
2855 Mandela Parkway
Oakland, California

Soil Vapor Remedial Technology	Technical Effectiveness	Implementability	Remediation Timeframe	Cost	Result/Ranking
1. No Action	**High** - Due to a lack of soil vapor contaminants, no action would be effective	**High** - No action is easily implementable	**N/A**	**No Cost**	**Retain as Remedial Alternative**
2. Monitored Natural Attenuation	**High** - This technology would effectively remediate soil vapor, however no treatment is required because soil vapor contaminants are not present above risk levels	**High** - A limited number of new wells may be required	**N/A**	**Low**	**Do Not Retain. Reconsider if soil vapor impact presents itself at the site in the future.**
3. Bioventing	**High** - This technology would effectively remediate soil vapor, however no treatment is required because soil vapor contaminants are not present above risk levels	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**N/A**	**Low-Medium**	**Do Not Retain. Reconsider if soil vapor impact presents itself at the site in the future.**
4. Soil Vapor Extraction	**High** - This technology would effectively remediate soil vapor, however no treatment is required because soil vapor contaminants are not present above risk levels	**Medium** - Some piping and equipment is required, which may disrupt tenant operations or require trenching into the building slab	**N/A**	**Medium**	**Do Not Retain. Reconsider if soil vapor impact presents itself at the site in the future.**

TABLE 5.
Evaluation of Remediation Alternatives for All Media
2855 Mandela Parkway
Oakland, California

Site Remedial Alternative	Description	Technical Effectiveness	Implementability	Remediation Timeframe	Cost
1. No Action	No action would be taken to remediate the site. It is likely that groundwater monitoring would continue indefinitely.	**Low** - No remediation would occur - LNAPL would persist; TPH in groundwater would persist and slowly degrade biologically depending on the availability of oxygen - LNAPL and impacted groundwater could potentially spread or migrate - No indoor air concern, since there is no or low detectable concentrations of TPH or BTEX in the upper vadose zone	**High** - No action is easily implementable, although not likely to gain regulatory approval	**Not Applicable**	**No Cost**
2. Thermal Treatment (LNAPL and Groundwater)	A network of heater wells spanning the groundwater and LNAPL depths would be installed on roughly 10-15 foot centers. The heater well, powered by electricity, heats the subsurface to approximately the boiling point of water. Volatilized contaminants travel upward, through permeable zones created from shrinking of clays, into the vadose zone and are captured by a network of soil vapor extraction collection wells. Extracted vapors are cooled and treated above-ground by GAC or similar technology.	**Medium-High** - The only remediation technology that could treat soil, groundwater, and LNAPL by a single technology. - Ability to heat subsurface is not limited by tight soils, so heating would thoroughly treat soils. - Effective for BTEX and most of the diesel range, but may not be effective in treating high boiling point compounds above C16.	**Low-Medium** - Significant piping and equipment is required, which will disrupt tenant operations or require trenching into the building slab. The added cost to keep the space usable by the tenant will likely be similar to the cost of temporarily relocating tenant operations. - Heating presents safety concerns, but a qualified supplier should be able to mitigate any concerns. - Will create permanent permeability in the clay formation, such that if remediation is not successful, contaminants will likely have a pathway to shallow soil vapor under the building that does not exist now. - Regulatory agencies would need to agree to some high boiling point compounds remaining (C16 and above). - Extremely energy intensive (up to 3 million kW-hrs)	**6 to 9 Months**	**Very High**

TABLE 5.
Evaluation of Remediation Alternatives for All Media
2855 Mandela Parkway
Oakland, California

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Site Remedial Alternative	Description	Technical Effectiveness	Implementability	Remediation Timeframe	Cost
3. Fracturing of Soils Followed by LNAPL Recovery and Chemical Oxidation of Groundwater	High pressure is applied to the subsurface to fracture the clay media and to insert a sand mixture into the fractures for the purpose of greatly increasing the permeability of the subsurface. Greater permeability would significantly assist extraction and injection operations. First, skimming would be implemented in the existing wells. If further LNAPL removal is warranted and skimming has reached the limits of effectiveness, surfactant enhanced extraction would be attempted. Surfactant, would be injected into the subsurface, thoroughly mixed to promote solubilization of LNAPL, and then removed. Several injection/extraction events may be required. Second, once LNAPL removal is complete, an oxidant would be injected to abiotically react with contaminants and transform them into carbon dioxide and water. A dilute slow-release hydrogen peroxide reagent is a likely choice for oxidant. Two to three chemical oxidation events may be required. Once groundwater concentrations have decreased, an oxygen-releasing compound would be injected to promote bioremediation of the remaining contaminants. Oxygen is necessary for naturally-occurring bacteria to metabolize the contaminants.	**Medium** - The success of remediation will likely depend largely on the extent and homogeneity of clay fracturing - Areas without sufficient fracturing would not be remediated - If fracturing is extensive, skimming and/or surfactant treatment have a good chance of success at removing LNAPL. - If fracturing is extensive, chemical oxidation and bioremediation have a good chance of success at treating groundwater concentrations	**Low-Medium** - Fracturing will likely create permeable pathways in the clay formation, such that if remediation is not completed and successful, contaminants will likely have a pathway to shallow soil vapor under the building that does not exist now. - Potential structural concerns about fracturing in shallow soils beneath a building - Some piping and equipment is required, which will disrupt tenant operations or require trenching into the building slab - Fracturing and remediation work could potentially be performed on weekends, to minimize disruption to tenants - For chemical oxidation, potential dangers of surfacing reagent always present when injecting into shallow areas beneath buildings	**2 Months for Fracturing** **1-2 Years for Skimming or Surfactant of LNAPL** **3-5 Years for Chemical Oxidation and Aerobic Bioremediation of Groundwater**	**High**

TABLE 5.
Evaluation of Remediation Alternatives for All Media
2855 Mandela Parkway
Oakland, California

Site Remedial Alternative	Description	Technical Effectiveness	Implementability	Remediation Timeframe	Cost
4. Long-Term Containment of LNAPL and Groundwater	A physical barrier would be placed to prevent any further migration of LNAPL. The barrier would likely be a membrane installed by trenching just outside the extent of LNAPL and groundwater impact. A biological barrier to remediate groundwater contaminants would be placed near the property boundary. The biological barrier would likely consist of a row of wells, 5 to 10 feet apart, containing an sock of a slow-release oxygen reagent. The reagent would supply oxygen to the groundwater to stimulate naturally-occurring bacteria to metabolize the contaminants. Because LNAPL and impacted groundwater would remain on site, it is likely that groundwater monitoring would continue indefinitely.	**High for Containment** **Low for Remediation** - LNAPL and TPH would be contained and would not spread or migrate further - LNAPL would persist; TPH in groundwater would persist and slowly degrade biologically depending on the availability of oxygen - No indoor air concern, since there is no or low detectable concentrations of TPH or BTEX in the upper vadose zone	**Medium** - Some trenching, well installation, piping and equipment will be required, which will disrupt tenant operations or require trenching into the building slab - Long-term O&M required	**3 Months for Containment Installation** **Long-term Operation and Monitoring**	**Low-Medium**
5. Peat Zone Remediation	This would result in remediation of the higher permeability "peat zone," while leaving contamination in place within the difficult-to-reach clay zones. Further investigation will be required to determine the feasibility of targeting just the "peat zone." Surfactant enhanced extraction would be attempted for removal of residual LNAPL in the "peat zone." Surfactant would be injected into the subsurface, thoroughly mixed to promote solubilization of LNAPL, and then removed. Several injection/extraction events may be required. Once LNAPL removal is performed an oxidant would be injected to abiotically react with contaminants and transform them into carbon dioxide and water. A dilute slow-release hydrogen peroxide reagent is a likely choice for oxidant. Two to three chemical oxidation events may be required.	**Low-Medium** - The success of remediation will depend on the permeability of the "peat zone," which is not fully defined. - If peat zone can be effectively targeted and is permeable, surfactant treatment would have a good chance of success at removing LNAPL in this area. - If peat zone can be effectively targeted and is permeable, chemical oxidation and bioremediation have a good chance of success at treating groundwater concentrations - Contaminants would remain in place within the clay areas and could potentially re-impact the "peat zone."	**Medium** - Unlike some remedial alternatives, this option would not result in creation of permeable pathways in the clay formation and a future pathway to shallow soil vapor under the building. - Some piping and equipment is required, which will disrupt tenant operations or require trenching into the building slab - Remediation work could potentially be performed on weekends, to minimize disruption to tenants - For chemical oxidation, potential dangers of surfacing reagent always present when injecting into shallow areas beneath buildings	**1-2 Years for Skimming or Surfactant of LNAPL** **1-2 Years for Chemical Oxidation of Groundwater**	**Medium**

Treadwell&Rollo
A LANGAN COMPANY

FIGURES

Base map: The Thomas Guide
Alameda County
2002

0 1/4 1/2 Mile

Approximate scale

2855 MANDELA PARKWAY PROPERTY Oakland, California	**SITE LOCATION MAP**		
Treadwell&Rollo *A LANGAN COMPANY*	Date 07/19/11	Project No. 750254305	Figure 1

\\langan.com\data\OA\data3\750254305\Cadd Data - 750254305\2D Cadd Drafting\Environmental\750254305-N-SP0104.dwg 7/20/11

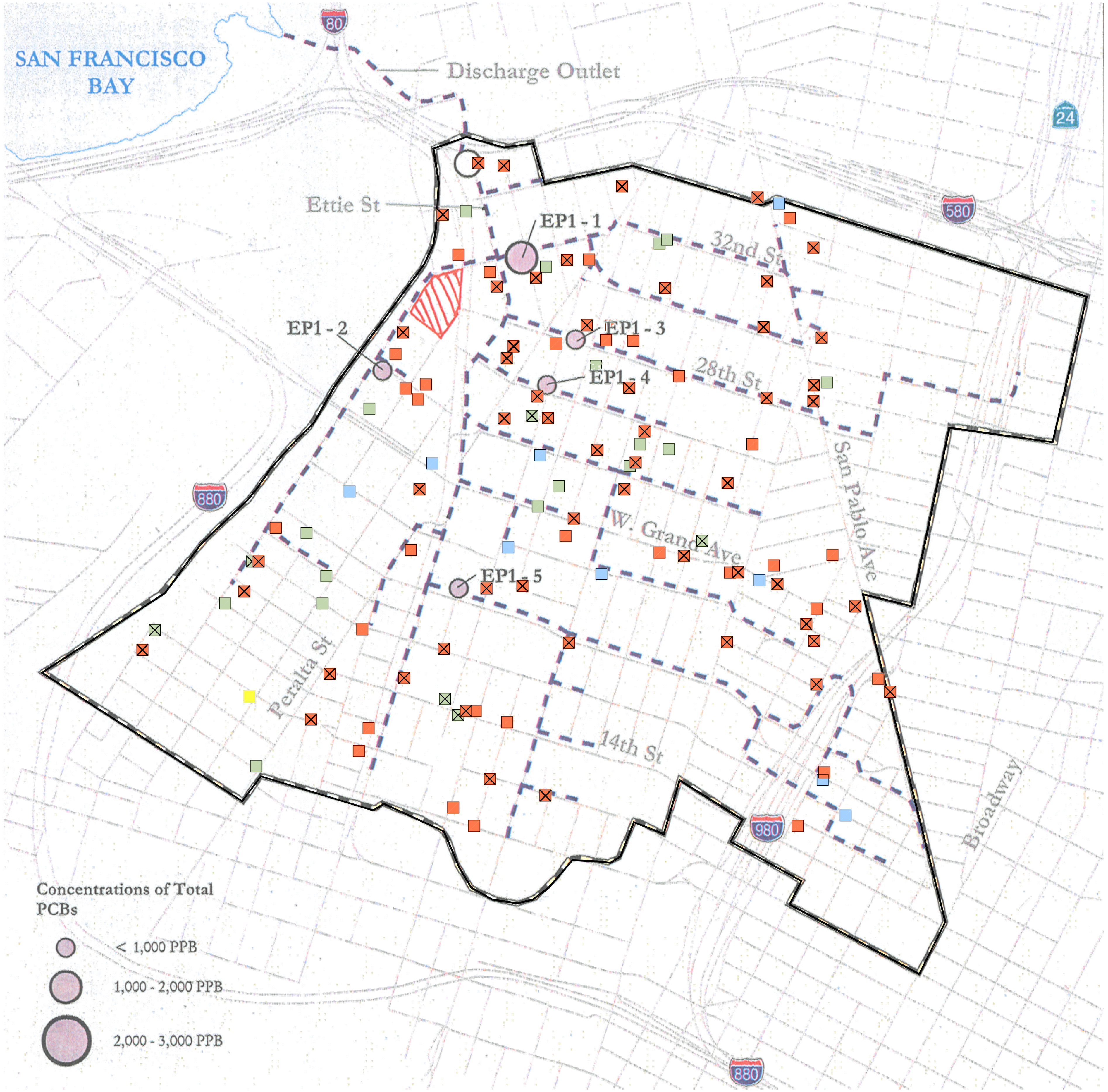
References: Ceres Associates, 1998. Interactive Resources, 1999.

2855 MANDELA PARKWAY PROPERTY
Oakland, California

SITE PLAN

Date 07/20/11 | Project No. 750254305 | Figure 2

Treadwell&Rollo
A LANGAN COMPANY



EXPLANATION

- 2855 Mandela Parkway
- Leaking underground tank (LUST) cleanup site
- Other Cleanup sites
- Military sites
- Permitted underground storage tank (UST) facilities
- Signifies a closed site
- Storm Culvert
- Pump station
- Ettie Street watershed
- Street

Note: All locations are approximate

0 1,200 Feet

Approximate scale

2855 MANDELA PARKWAY PROPERTY
Oakland, California

ETTIE STREET WATERSHED

Date 07/13/11	Project No. 750254305	Figure 3

Treadwell&Rollo
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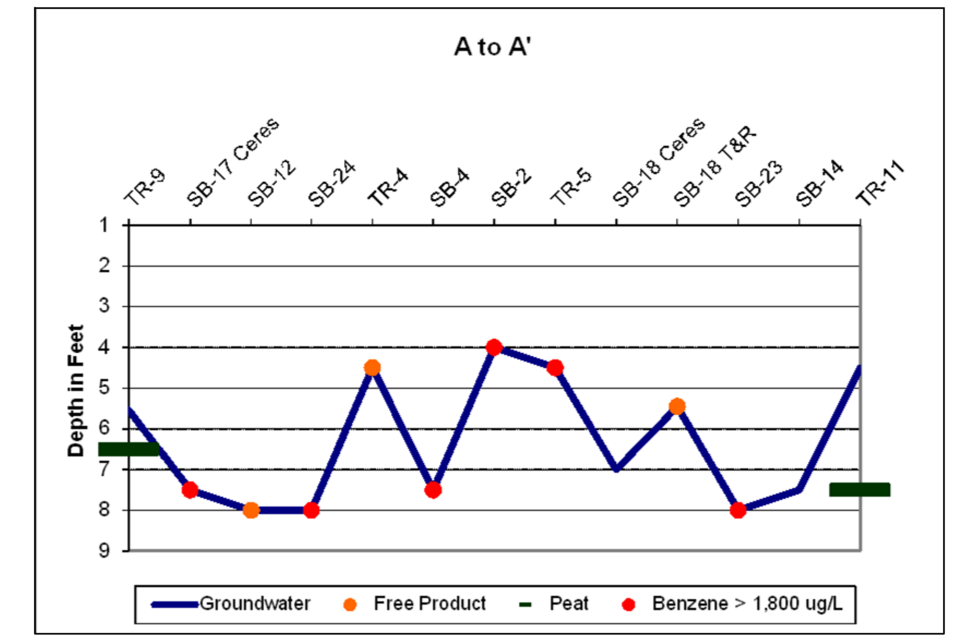
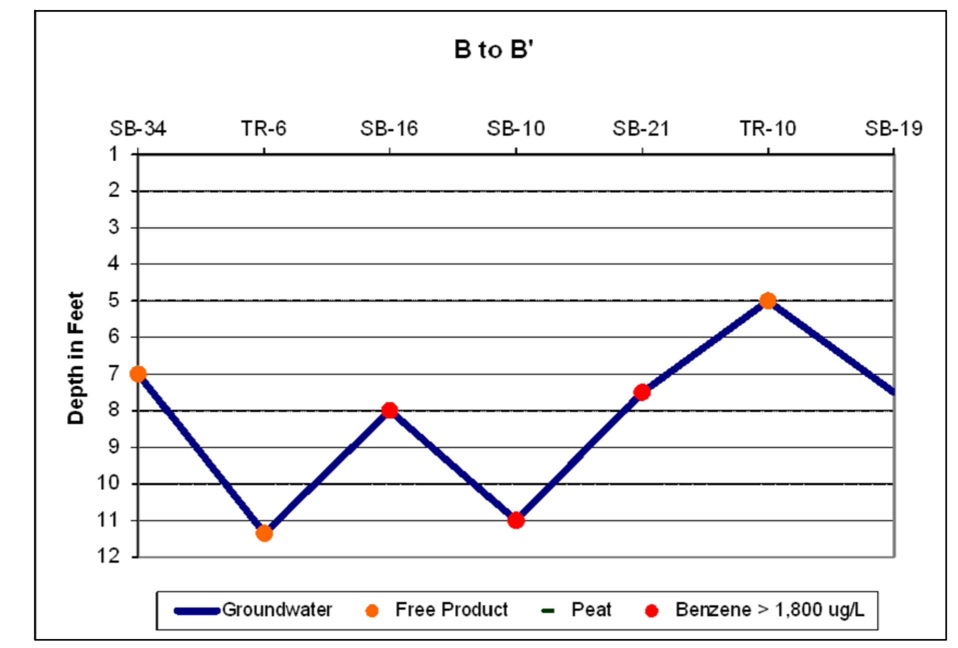
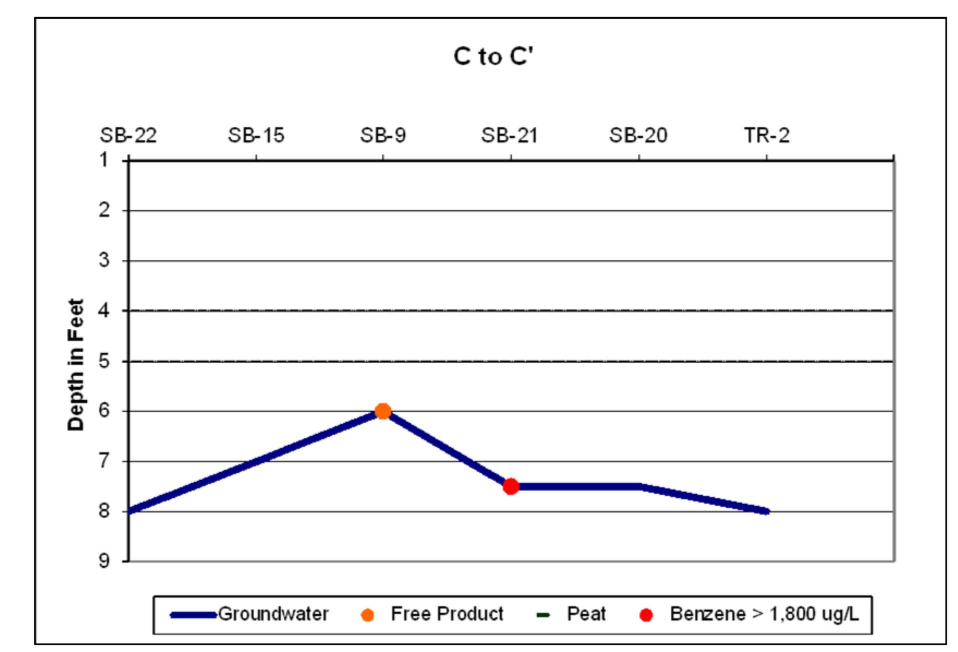
Reference: Base map from a drawing titled "Ettie Street Watershed with Phase I Sampling Sites Shown,", by EIP Associates, dated 09/24/02; UST Sites - http:/geotracker.swrcb.ca.gov.; PCB locations - Applied Marine Sciences, 2002.

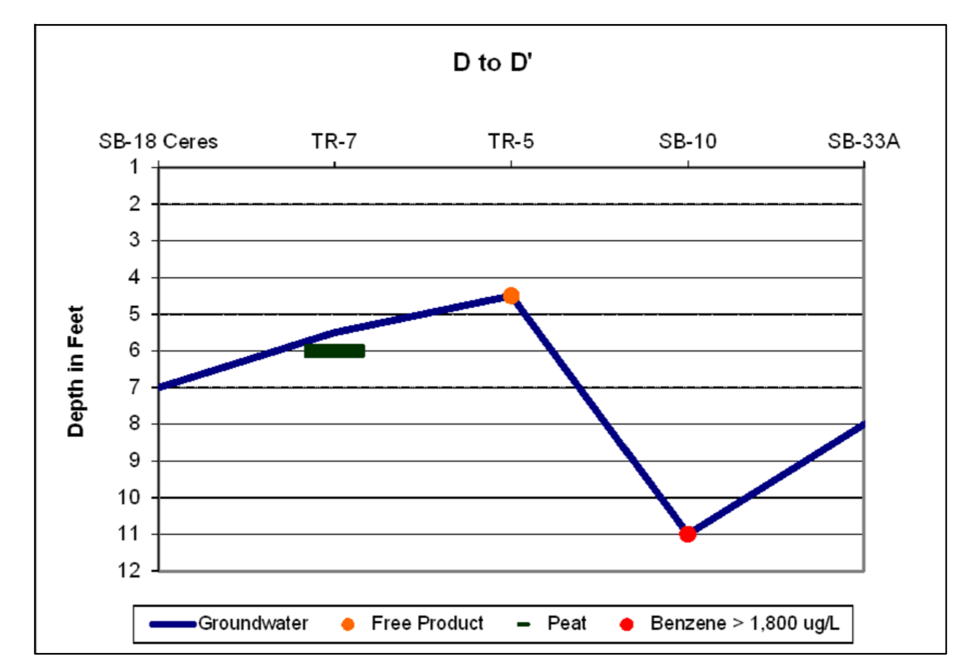
\\langan.com\data\OA\data3\750254305\Cadd Data - 750254305\2D Cadd Drafting\Environmental\750254305-N-SP0101.dwg 7/20/11

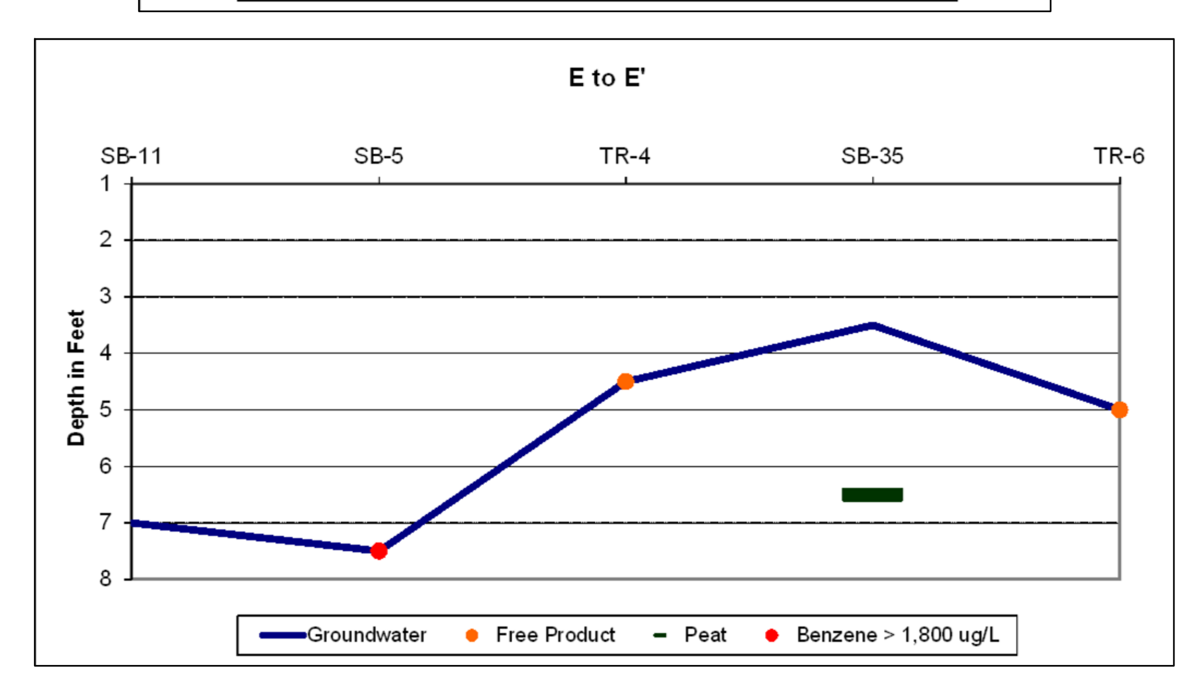
References: Ceres Associates, 1998. Interactive Resources, 1999.











EXPLANATION

- Soil boring (06/92)
- Soil boring (08/98)
- Soil boring (10/98)
- Soil boring (11/98)
- Soil vapor sampling (08/98)
- Soil boring (1999)
- Piezometer (1999)
- Monitoring well (1999)
- Free product extent based on:
  1 - direct observation of product
  2 - benzene > 1,800 µg/L
- A-4 Air sampling location SOMA (11/00)
- G Soil - vapor collection point
- SB-35 Soil boring (2001)
- TR-7 Free product monitoring piezometer (2001)
- Monitoring well (2004)
- Free product recovery system recovery well (2005)
- Sprinkler system excavation (2010)
- Colored symbols = Free Product
- Colored symbols = Benezene > 1,800 µg/L

Note:
Free product may not necessarily be present at all locations within the extent envelope indicated.

2855 MANDELA PARKWAY PROPERTY
Oakland, California

SITE PLAN SHOWING FREE PRODUCT AND BENZENE

Date 07/14/11	Project No. 750254305	Figure 4

Treadwell&Rollo
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LEGEND

▼	Groundwater first encountered	GC =	Clayey gravel
▽	Stabilized groundwater level	SW =	Well-sorted sand
FP =	Free - phase product	SP =	Poorly-sorted sand
(ug/L) =	Micrograms per liter (parts per billion)	CL =	Clay (lean, low plasticity)
	Monitoring well showing screened interval	CH =	Clay (fat, high plasticity)

Notes:
1. The above profile represents a generalized soil cross section interpreted from widely spaced borings. Soil deposits may vary in type, strength, and other important properties between points of exploration.
2. Vertical exaggeration = 2x.

10 Feet
0
0 20 Feet
Approximate Scale

2855 MANDELA PARKWAY PROPERTY
Oakland, California

GENERALIZED GEOLOGIC CROSS SECTION

Date 07/14/11 | Project No. 750254305 | Figure 5

Treadwell&Rollo
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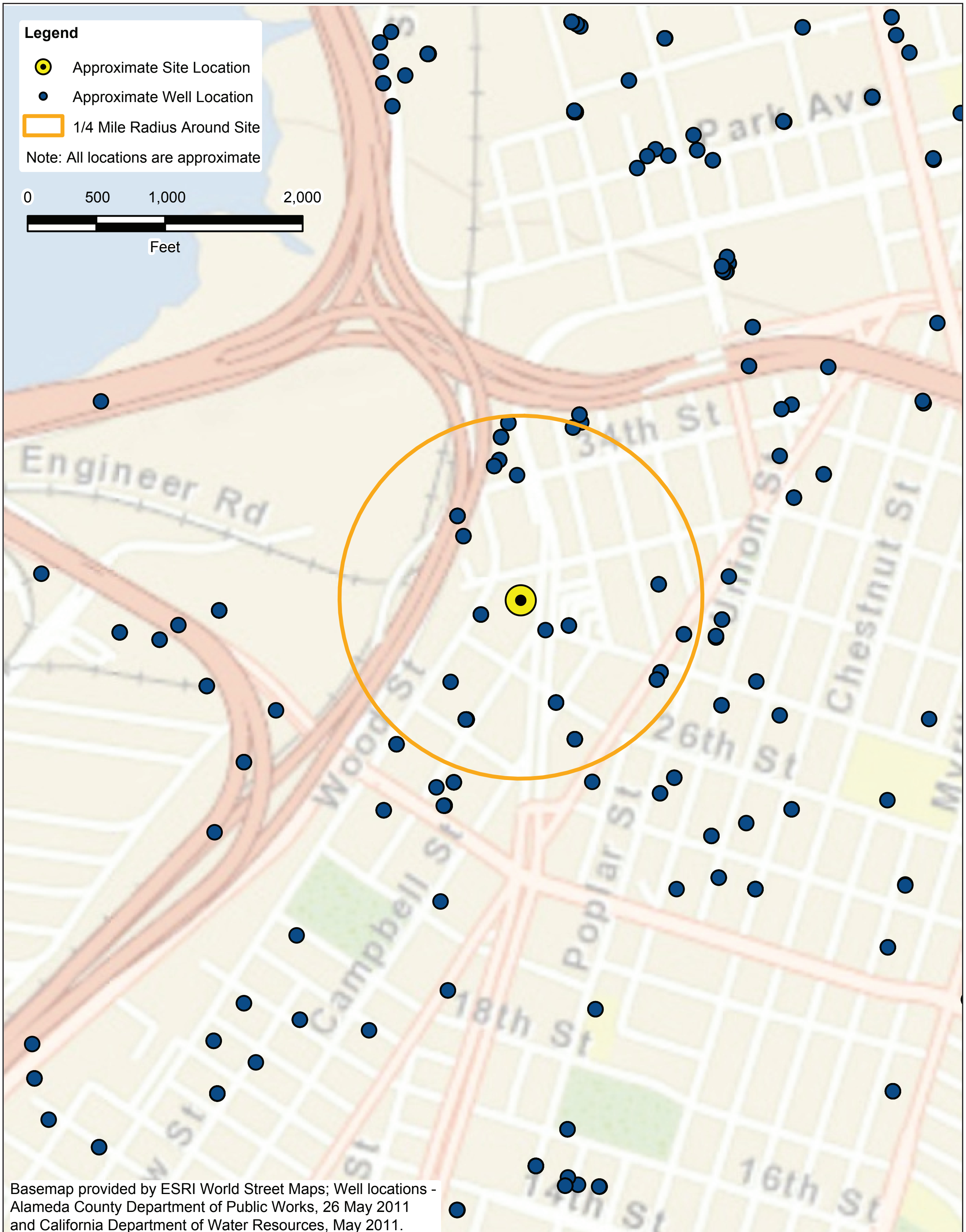
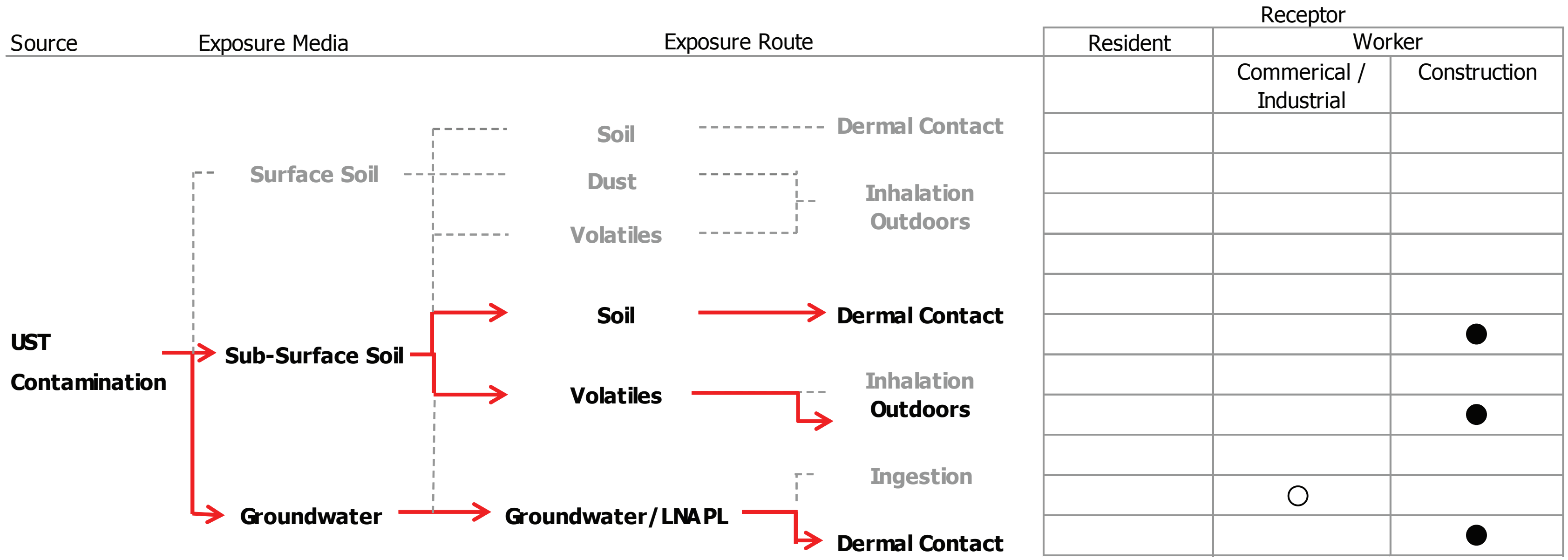
\\langan.com\data\OA\data3\750254305\2D Cadd Drafting\Environmental\750254305-N-XS0101.dwg 7/22/11



2855 MANDELA PARKWAY PROPERTY Oakland, California	WELLS WITHIN 1/4 MILE RADIUS 2855 MANDELA PARKWAY		
Treadwell&Rollo A LANGAN COMPANY	Date 07/14/11	Project No. 750254305	Figure 6



Significant Pathway
Incomplete Pathway
● Potential Exposure - if excavation is conducted below 5 feet bgs without controls and/or health and safety plan
○ Unlikely Exposure - only if wells installed in shallow groundwater and used to supply water

Note:
Where no symbol is shown for a receptor, the pathway is considered incomplete.

2855 MANDELA PARKWAY PROPERTY
Oakland, California

SITE CONCEPTUAL MODEL
POTENTIAL EXPOSURES TO RECEPTORS

Date 07/20/11	Project No. 750254305	Figure 7

Treadwell&Rollo
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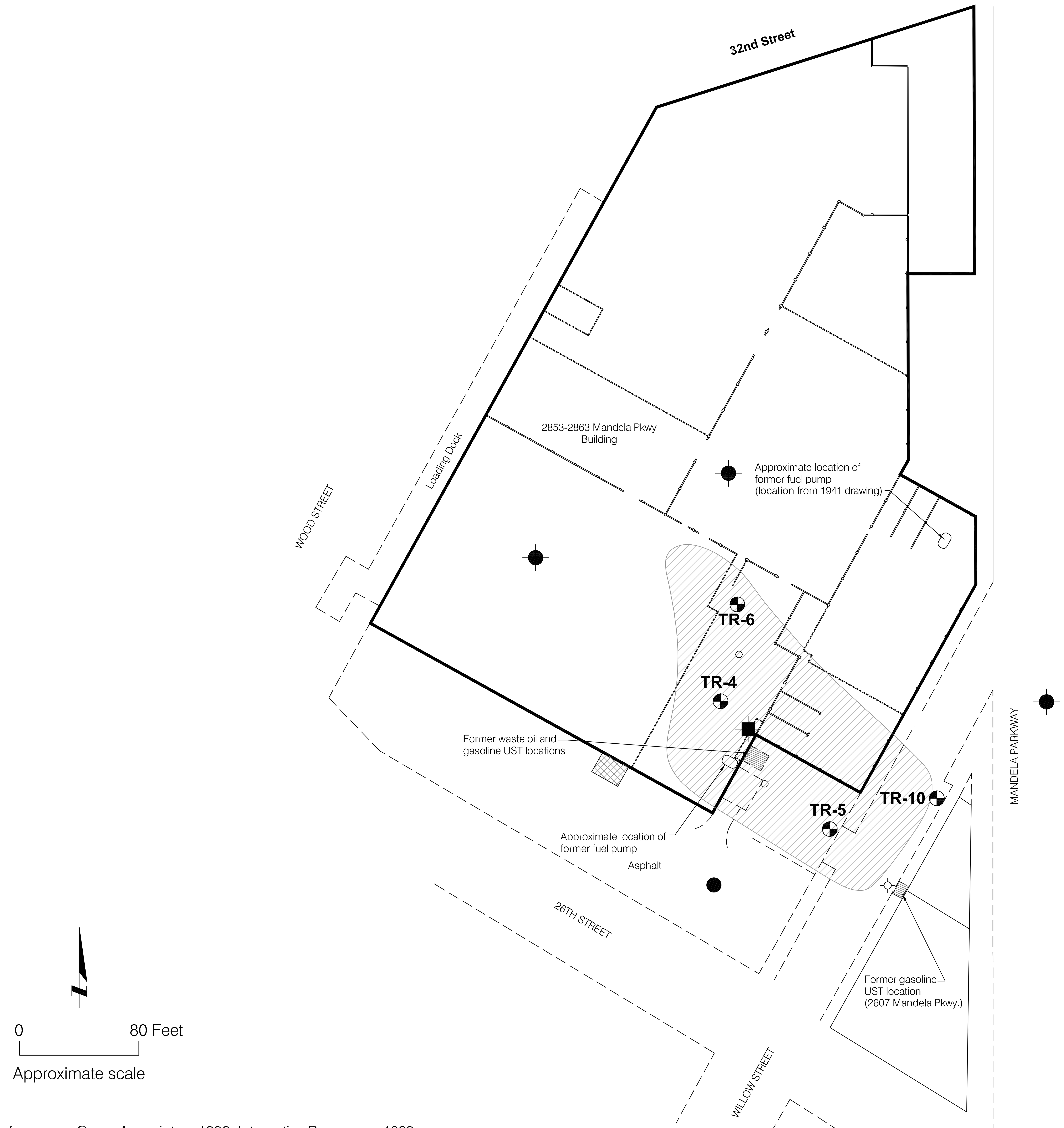

EXPLANATION

- Proposed new monitoring well
- Proposed grab groundwater sample below LNAPL
- Monitoring well (1999)

Note:
Actual locations may be adjusted based on site conditions.

References: Ceres Associates, 1998. Interactive Resources, 1999.

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2855 MANDELA PARKWAY PROPERTY Oakland, California		
PROPOSED REMEDY IMPLEMENTATION PLAN		
Date 07/20/11	Project No. 750254305	Figure 8

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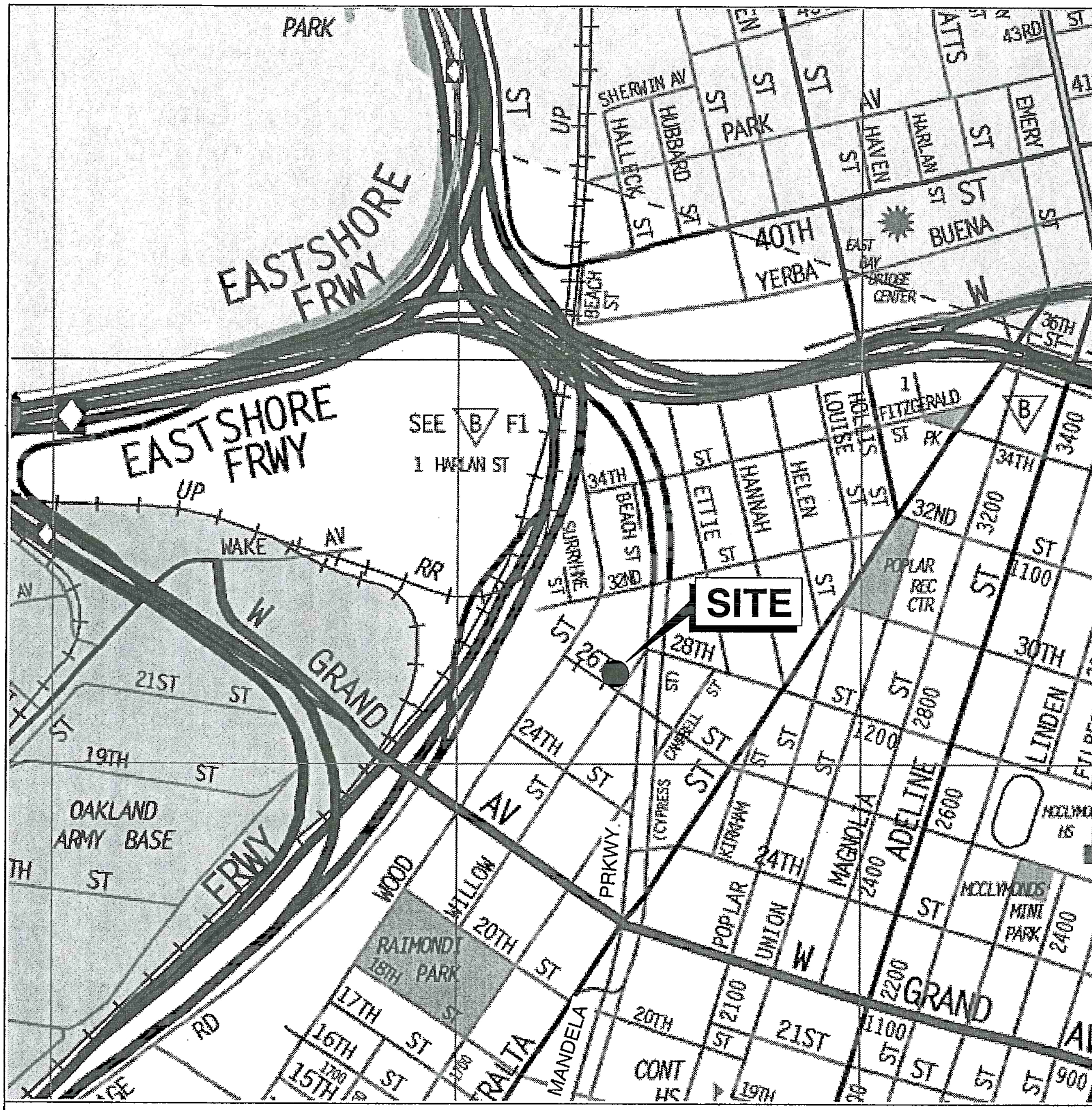
APPENDIX A
Documents Supporting the SCM

Figures from Treadwell & Rollo, 2000



Reference: The Thomas Brothers Maps
Alameda County
1999

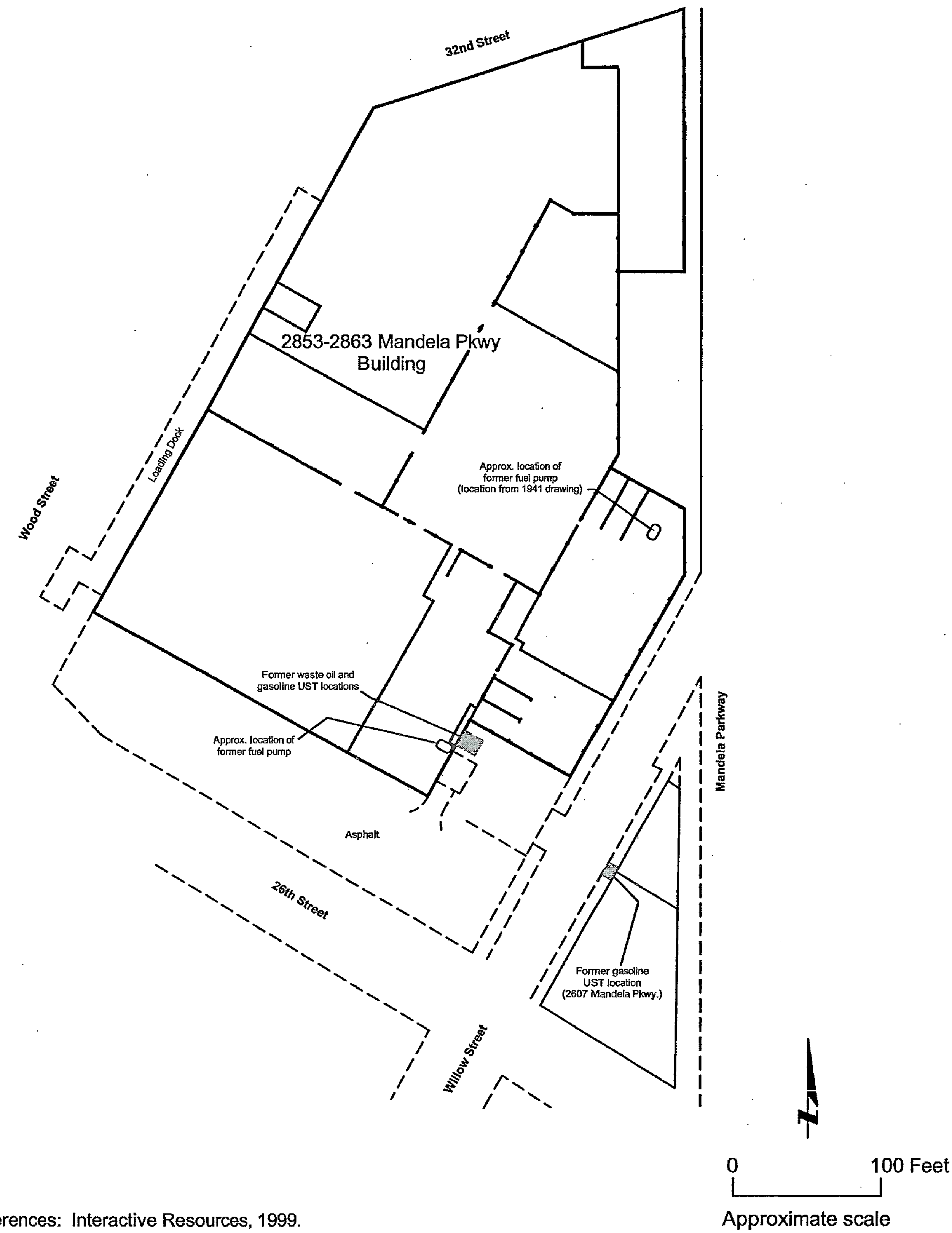
0 1/4 Mile
Approximate scale

2855 MANDELA PARKWAY
Oakland, California

Treadwell&Rollo

SITE LOCATION MAP

Date 5/19/99	Project No. 2543.01	Figure 1



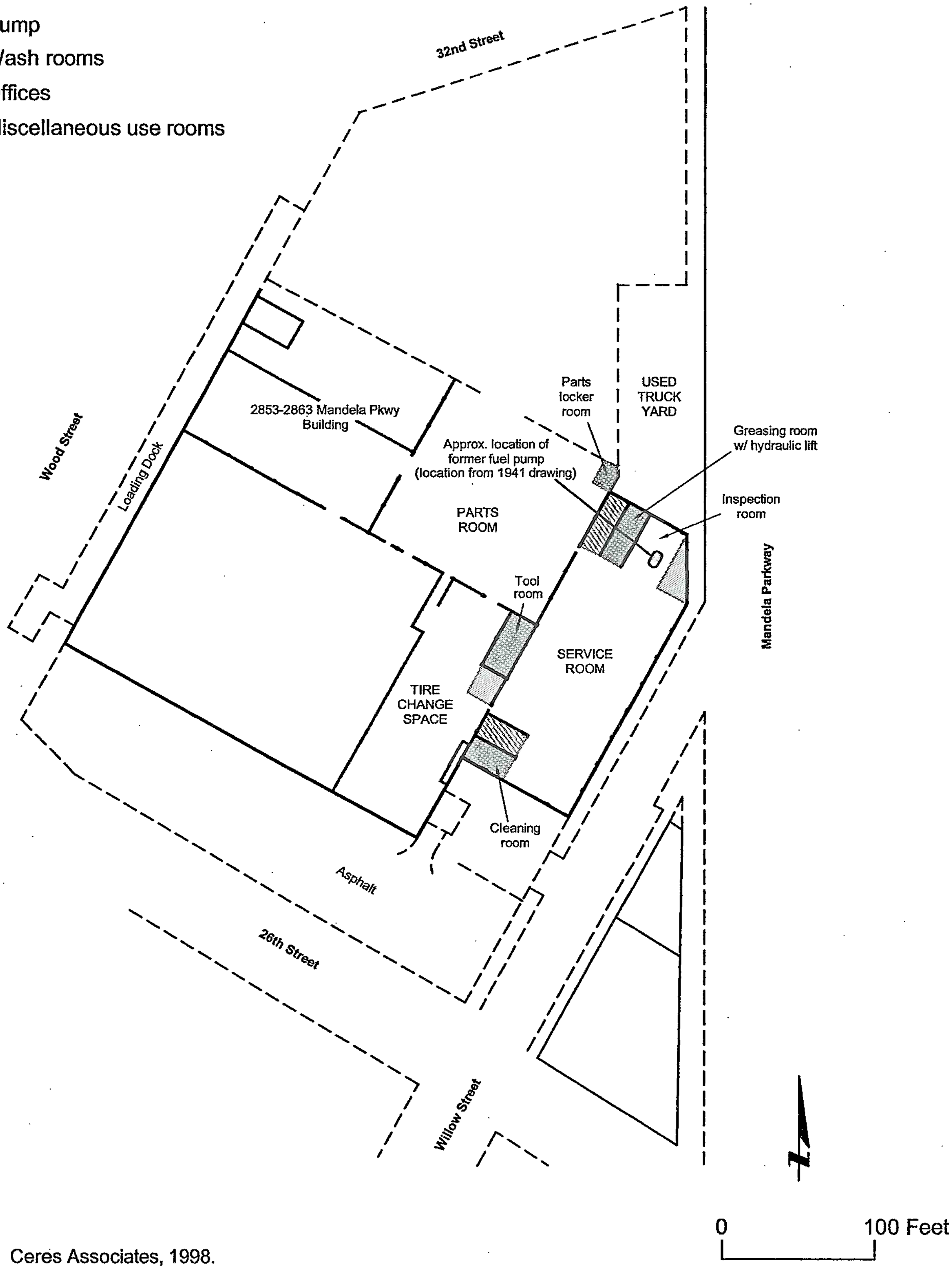
References: Interactive Resources, 1999.

BORINGS1299.DWG

2855 MANDELA PARKWAY PROPERTY Oakland, California	**SITE PLAN**
Treadwell&Rollo	Date 01/20/00 | Project No. 2543.01 | Figure 2

EXPLANATION

- Pump
- Wash rooms
- Offices
- Miscellaneous use rooms



References: Ceres Associates, 1998.
Interactive Resources, 1999.
International Harvester, Drawing No. 5370, 1941

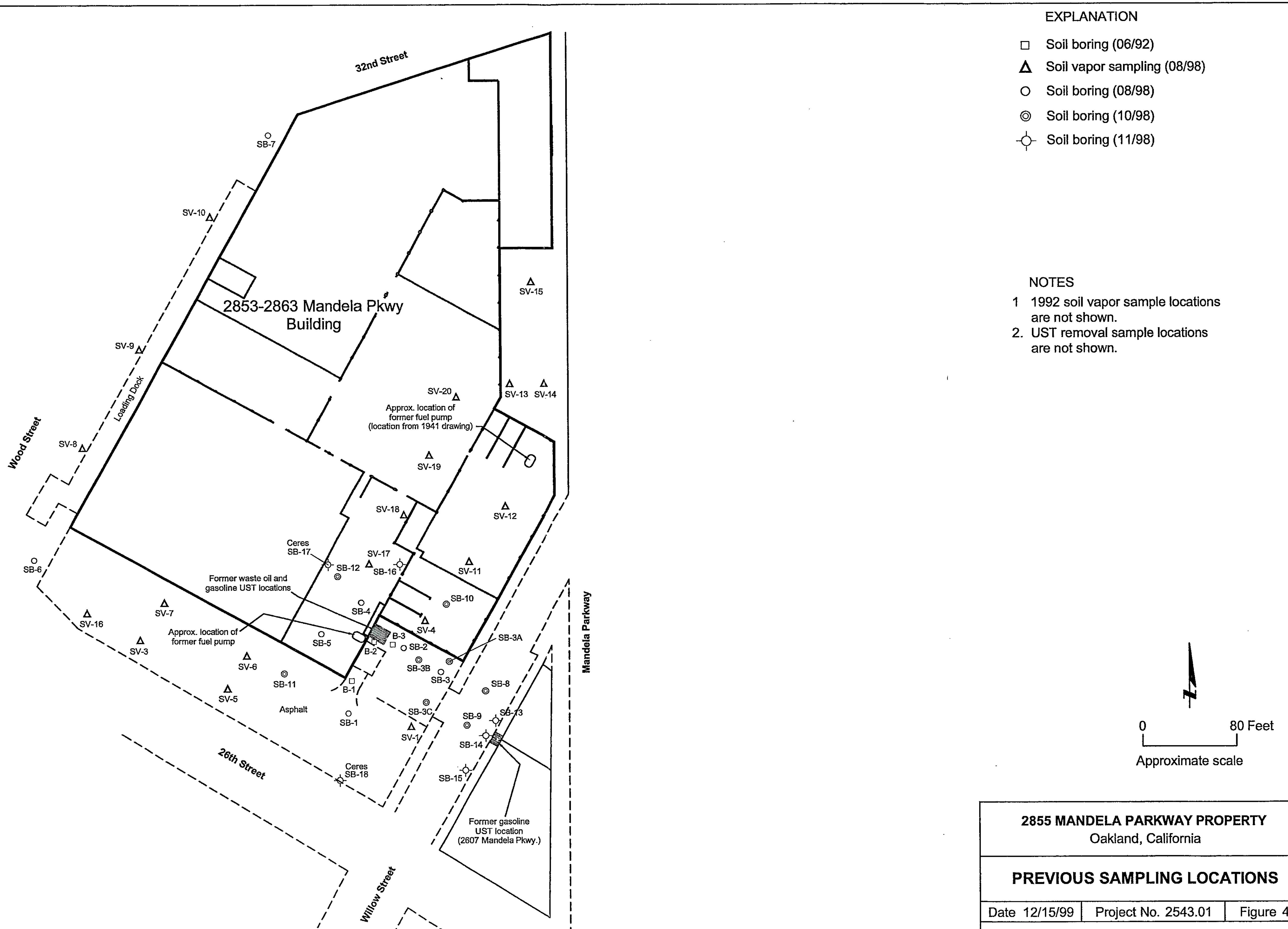
2855 MANDELA PARKWAY PROPERTY
Oakland, California

Treadwell&Rollo

FORMER INTERNATIONAL HARVESTER ACTIVITY AREAS (circa 1941)

Date 01/20/00	Project No. 2543.01	Figure 3

1941BASE.DWG



NOTES

1 1992 soil vapor sample locations are not shown.
2. UST removal sample locations are not shown.

FILE: BORINGS1299.DWG

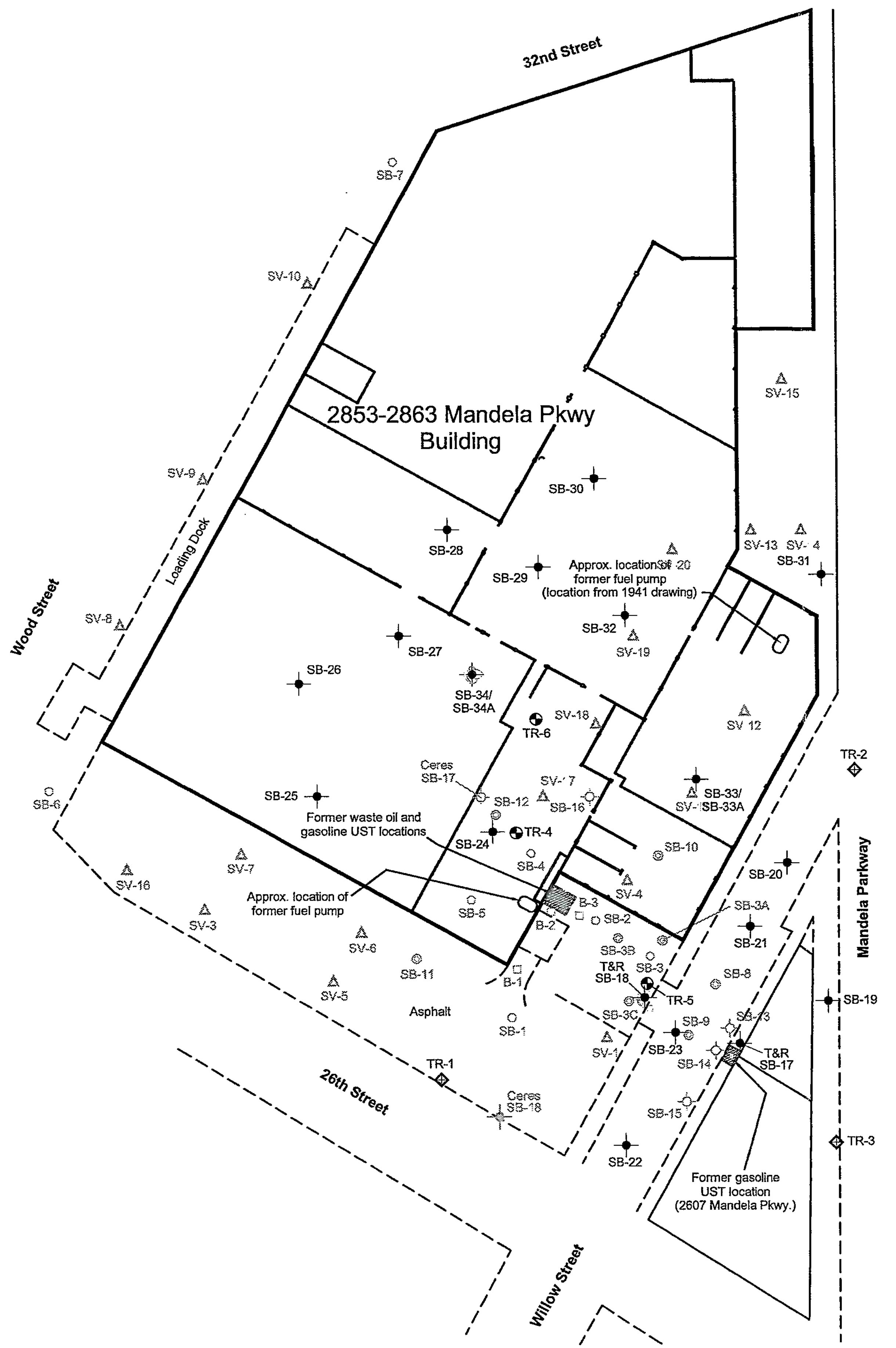
References: Ceres Associates, 1998.
Interactive Resources, 1999.

2855 MANDELA PARKWAY PROPERTY
Oakland, California

PREVIOUS SAMPLING LOCATIONS

Date 12/15/99	Project No. 2543.01	Figure 4

Treadwell&Rollo



EXPLANATION

- Soil boring (06/92)
- Soil vapor sampling (08/98)
- Soil boring (08/98)
- Soil boring (10/98)
- Soil boring (11/98)
- Soil boring (1999)
- Temporary piezometer (1999)
- Monitoring well (1999)

NOTES

1. 1992 soil vapor sample locations are not shown.
2. UST removal sample locations are not shown.

References: Ceres Associates, 1998.
Interactive Resources, 1999.

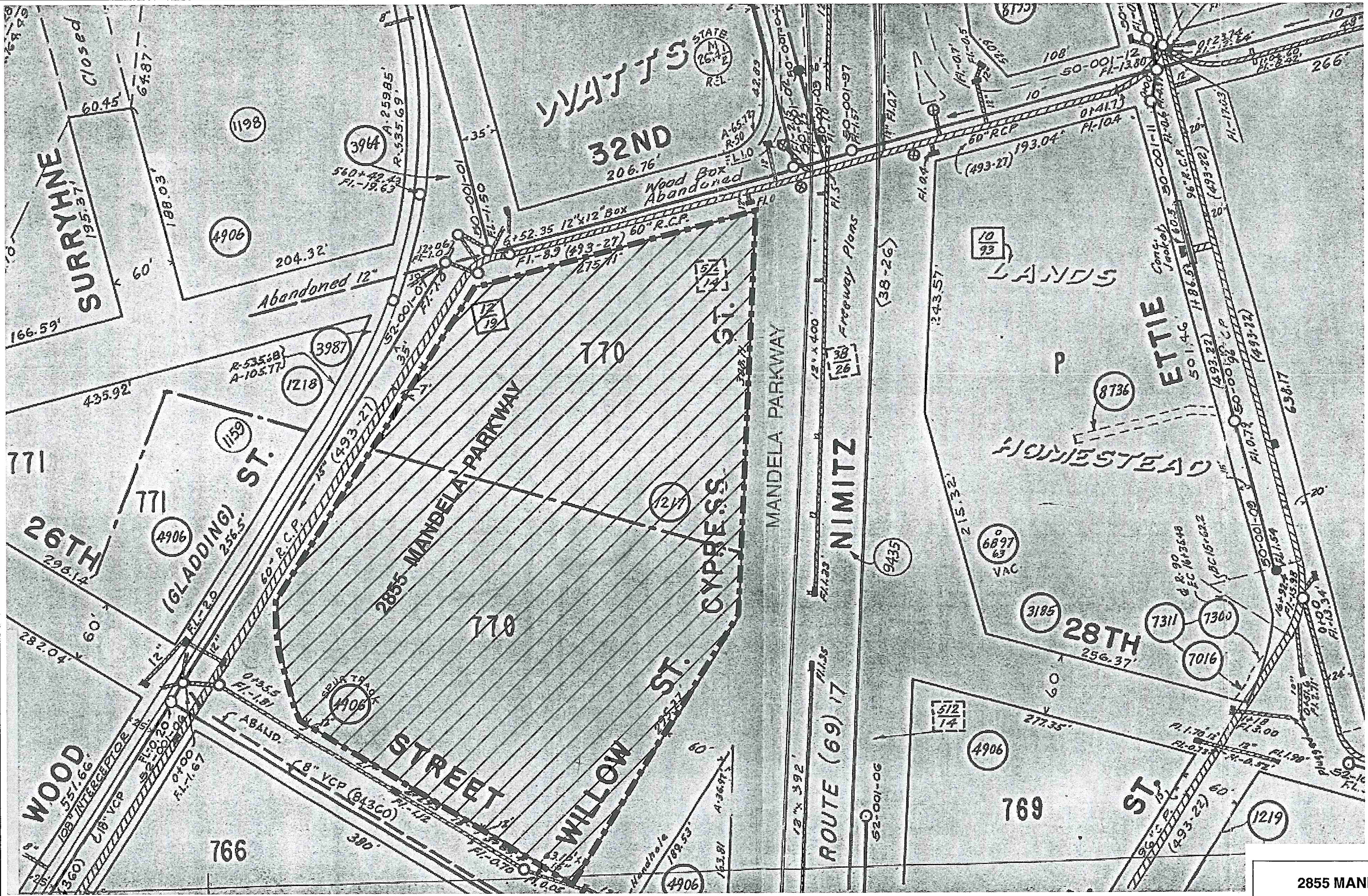
FILE: BORINGS1299.DWG

2855 MANDELA PARKWAY PROPERTY
Oakland, California

SAMPLING LOCATIONS

Date 12/15/99	Project No. 2543.01	Figure 5

Treadwell&Rollo



EXPLANATION

Interceptor sewer

Storm drain

Sanitary sewer

Manhole

FL Flow line elevation in feet, City of Oakland Datum (COOD)

0 ft. COOD = 3 ft. MSL

MSL Mean Sea Level (feet)

0 100 Feet

Approximate scale

Reference:
City of Oakland Sewer Map, Public Works Agency

2855 MANDELA PARKWAY PROPERTY
Oakland, California

SEWER MAP

Date 01/11/00	Project No. 2543.01	Figure 6

Treadwell&Rollo

Reference: Creek & Watershed Map
of Oakland & Berkeley
by Janet M. Sowers, William Lettis & Associates, Inc.
Published by Oakland Museum of California, 1993; revised 1995

EXPLANATION:

Former creeks, buried or drained, and bay shoreline, circa 1850

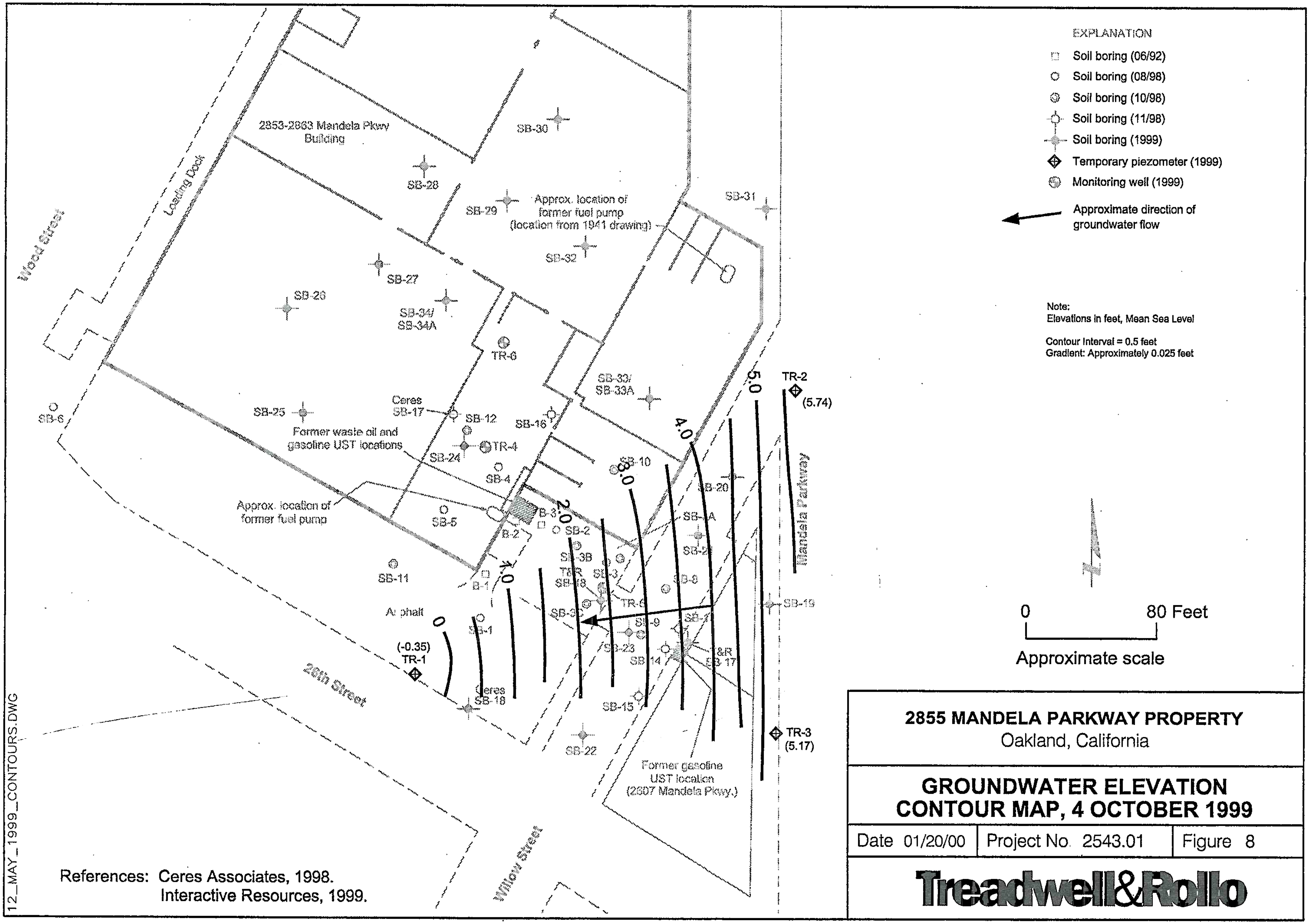
Tidal marsh, circa 1850

N

0 2000 Feet

Approximate scale

2855 MANDELA PARKWAY PROPERTY Oakland, California	**HISTORIC MARSH MAP**
Treadwell&Rollo	Date 01/14/00 | Project No. 2543.01 | Figure 7



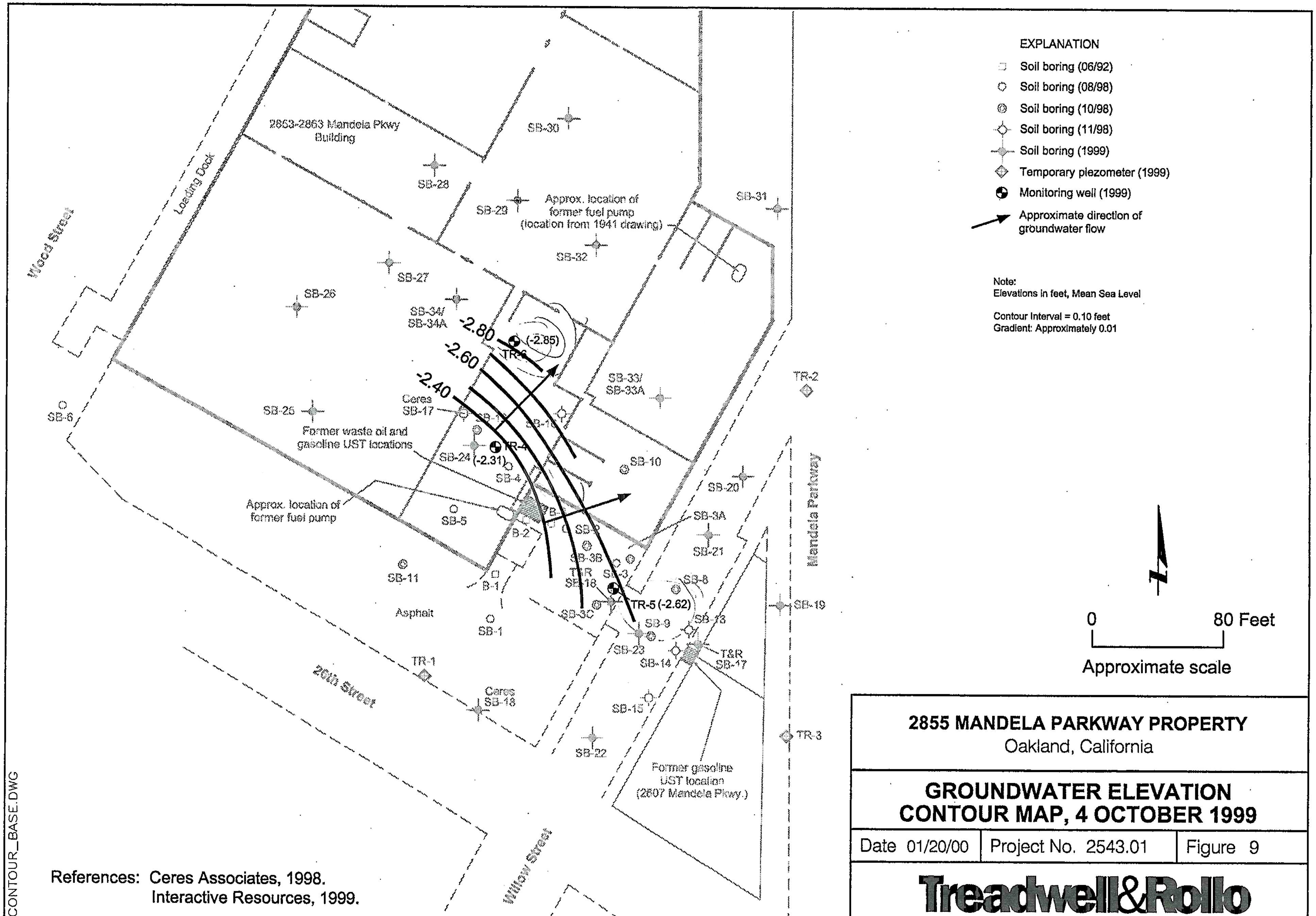
References: Ceres Associates, 1998.
Interactive Resources, 1999.

2855 MANDELA PARKWAY PROPERTY
Oakland, California

GROUNDWATER ELEVATION CONTOUR MAP, 4 OCTOBER 1999

Date 01/20/00	Project No. 2543.01	Figure 8

Treadwell&Rollo



References: Ceres Associates, 1998.
Interactive Resources, 1999.

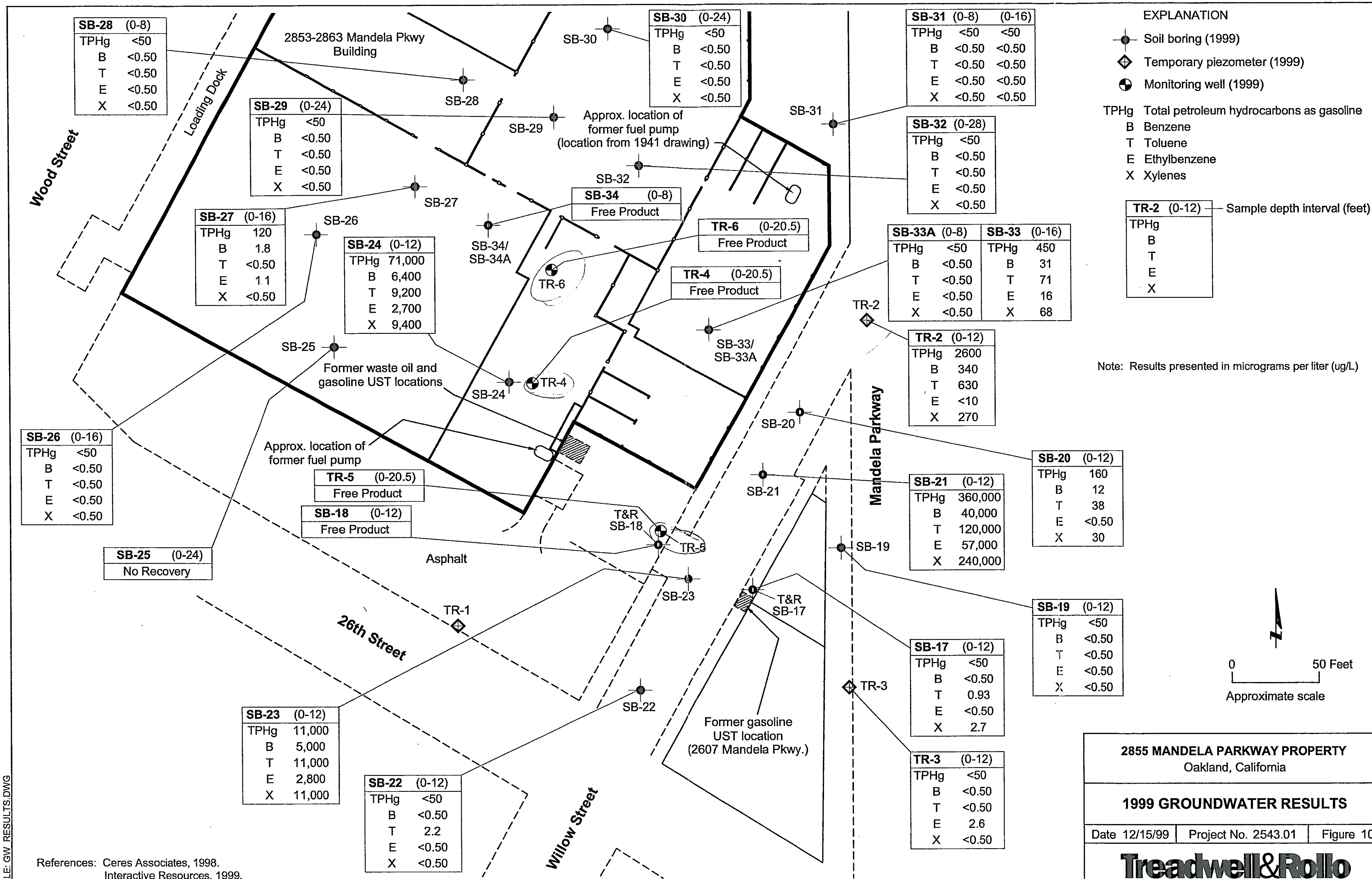
CONTOUR_BASE.DWG

2855 MANDELA PARKWAY PROPERTY
Oakland, California

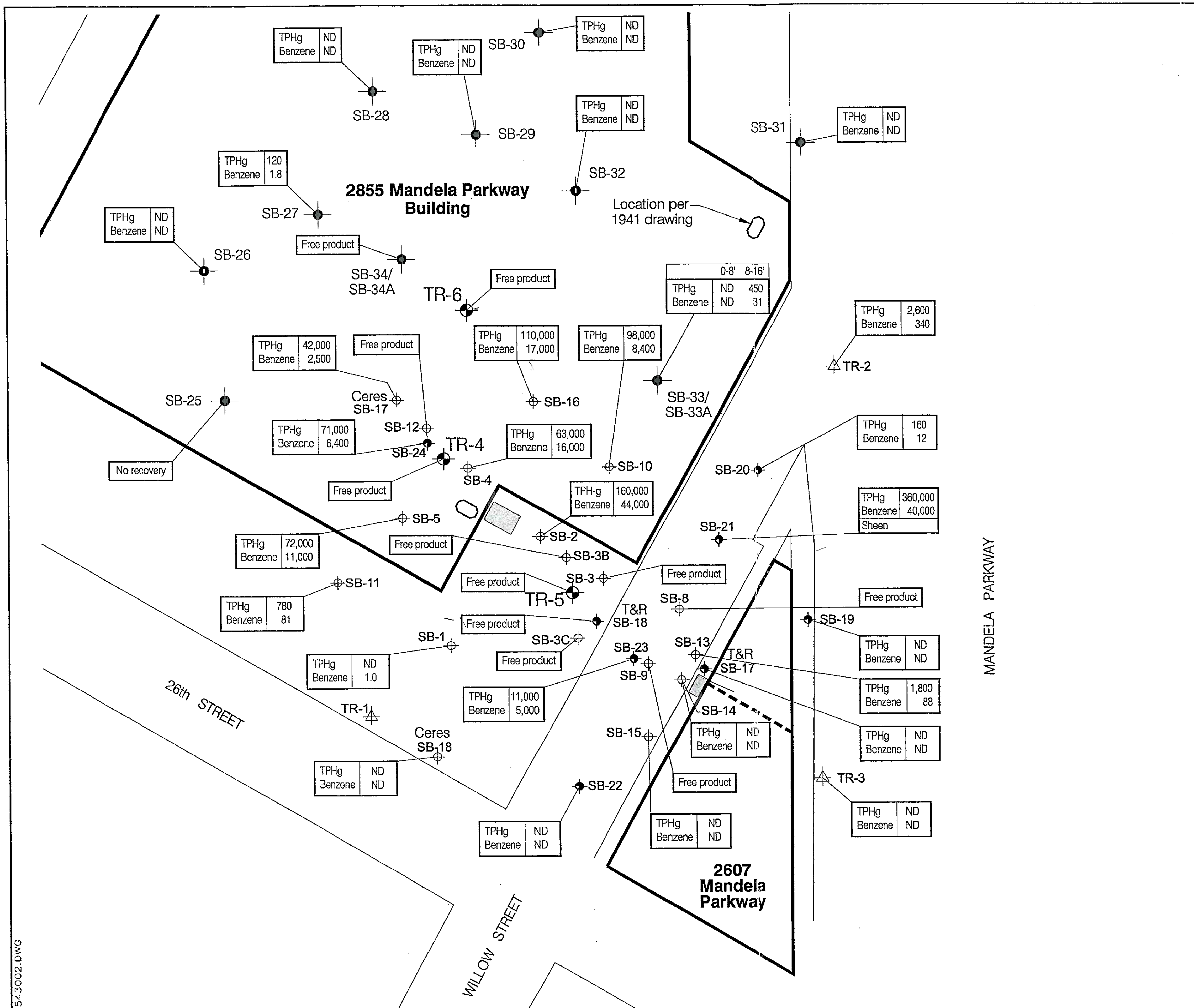
GROUNDWATER ELEVATION CONTOUR MAP, 4 OCTOBER 1999

Date 01/20/00	Project No. 2543.01	Figure 9

Treadwell&Rollo



2853-2863 Mandela Pkwy Building
Wood Street
Loading Dock
Mandela Parkway
26th Street
Willow Street
Asphalt
Approx. location of former fuel pump (location from 1941 drawing)
Approx. location of former fuel pump
Former waste oil and gasoline UST locations
Former gasoline UST location (2607 Mandela Pkwy.)
SB-28 (0-8) TPHg <50 B <0.50 T <0.50 E <0.50 X <0.50
SB-29 (0-24) TPHg <50 B <0.50 T <0.50 E <0.50 X <0.50
SB-30 (0-24) TPHg <50 B <0.50 T <0.50 E <0.50 X <0.50
SB-31 (0-8) (0-16) TPHg <50 <50 B <0.50 <0.50 T <0.50 <0.50 E <0.50 <0.50 X <0.50 <0.50
SB-32 (0-28) TPHg <50 B <0.50 T <0.50 E <0.50 X <0.50
SB-27 (0-16) TPHg 120 B 1.8 T <0.50 E 1.1 X <0.50
SB-24 (0-12) TPHg 71,000 B 6,400 T 9,200 E 2,700 X 9,400
SB-34 (0-8) Free Product
TR-6 (0-20.5) Free Product
TR-4 (0-20.5) Free Product
SB-33A (0-8) TPHg <50 B <0.50 T <0.50 E <0.50 X <0.50
SB-33 (0-16) TPHg 450 B 31 T 71 E 16 X 68
TR-2 (0-12) TPHg 2600 B 340 T 630 E <10 X 270
SB-26 (0-16) TPHg <50 B <0.50 T <0.50 E <0.50 X <0.50
SB-25 (0-24) No Recovery
TR-5 (0-20.5) Free Product
SB-18 (0-12) Free Product
SB-21 (0-12) TPHg 360,000 B 40,000 T 120,000 E 57,000 X 240,000
SB-20 (0-12) TPHg 160 B 12 T 38 E <0.50 X 30
SB-19 (0-12) TPHg <50 B <0.50 T <0.50 E <0.50 X <0.50
SB-17 (0-12) TPHg <50 B <0.50 T 0.93 E <0.50 X 2.7
TR-3 (0-12) TPHg <50 B <0.50 T <0.50 E 2.6 X <0.50
SB-23 (0-12) TPHg 11,000 B 5,000 T 11,000 E 2,800 X 11,000
SB-22 (0-12) TPHg <50 B <0.50 T 2.2 E <0.50 X <0.50
SB-34/ SB-34A
SB-33/ SB-33A
T&R SB-18
T&R SB-17
TR-1
EXPLANATION
Soil boring (1999)
Temporary piezometer (1999)
Monitoring well (1999)
TPHg Total petroleum hydrocarbons as gasoline
B Benzene
T Toluene
E Ethylbenzene
X Xylenes
TR-2 (0-12) Sample depth interval (feet)
Note: Results presented in micrograms per liter (ug/L)
0 50 Feet
Approximate scale
2855 MANDELA PARKWAY PROPERTY
Oakland, California
1999 GROUNDWATER RESULTS
Date 12/15/99
Project No. 2543.01
Figure 10
Treadwell&Rollo
References: Ceres Associates, 1998.
Interactive Resources, 1999.
FILE: GW_RESULTS.DWG

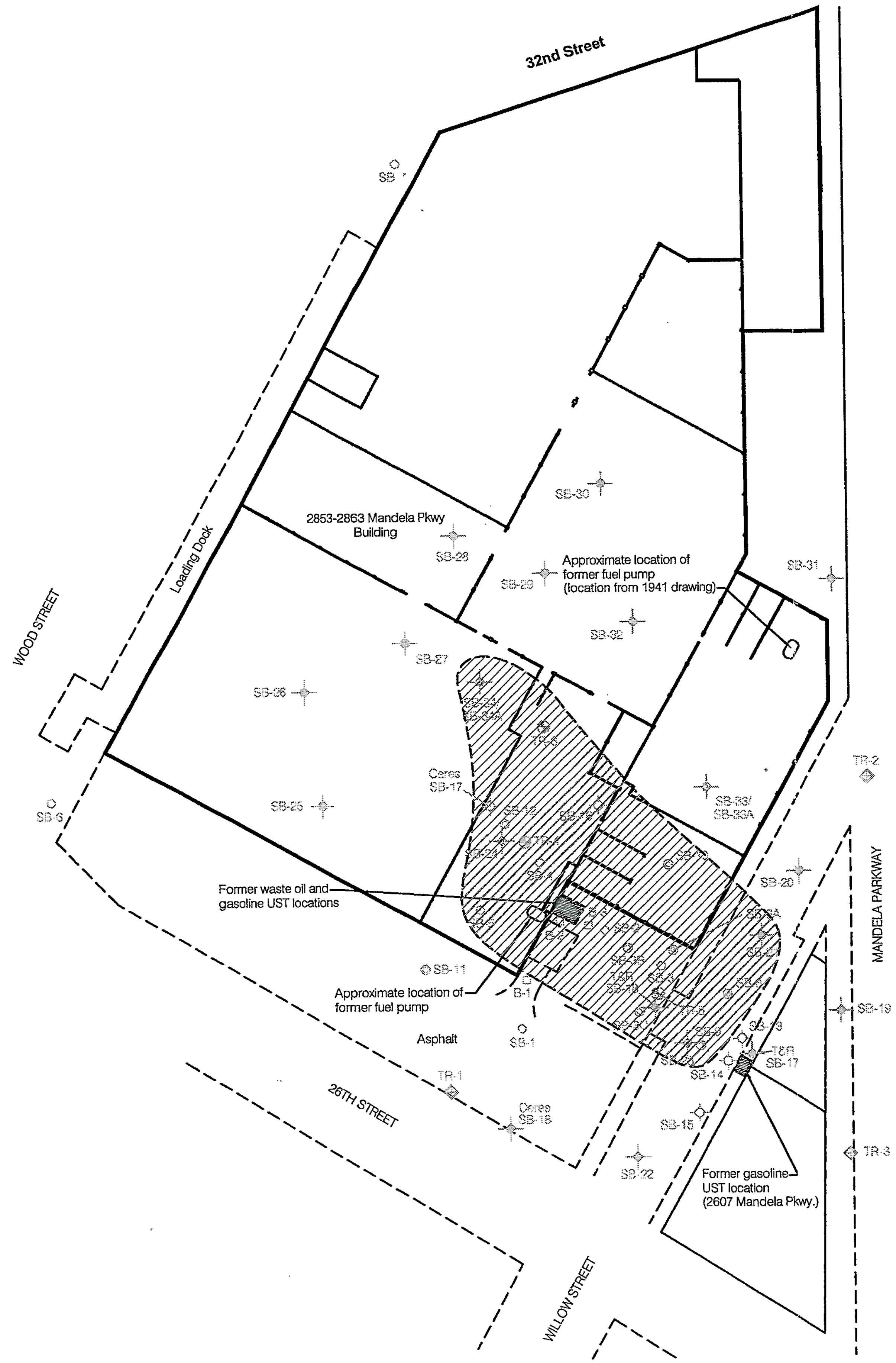


2855 MANDELA PARKWAY PROPERTY
Oakland, California

GROUNDWATER SAMPLING RESULTS
TPHg AND BENZENE

Date 10/8/99 | Project No. 2543.01 | Figure 11

Treadwell&Rollo



EXPLANATION

- Soil boring (06/92)
- Soil boring (08/98)
- Soil boring (10/98)
- Soil boring (11/98)
- Soil boring (1999)
- Piezometer (1999)
- Monitoring well (1999)

Free product extent based on·
1 - direct observation of product
2 - benzene >2000 µg/L

Note:
Free product may not necessarily be present at all locations within the extent envelope indicated.

0 80 Feet
Approximate scale

References: Ceres Associates, 1998.
Interactive Resources, 1999

FILE: APPARENT-EXT-V2.DWG

v2

2855 MANDELA PARKWAY PROPERTY
Oakland, California

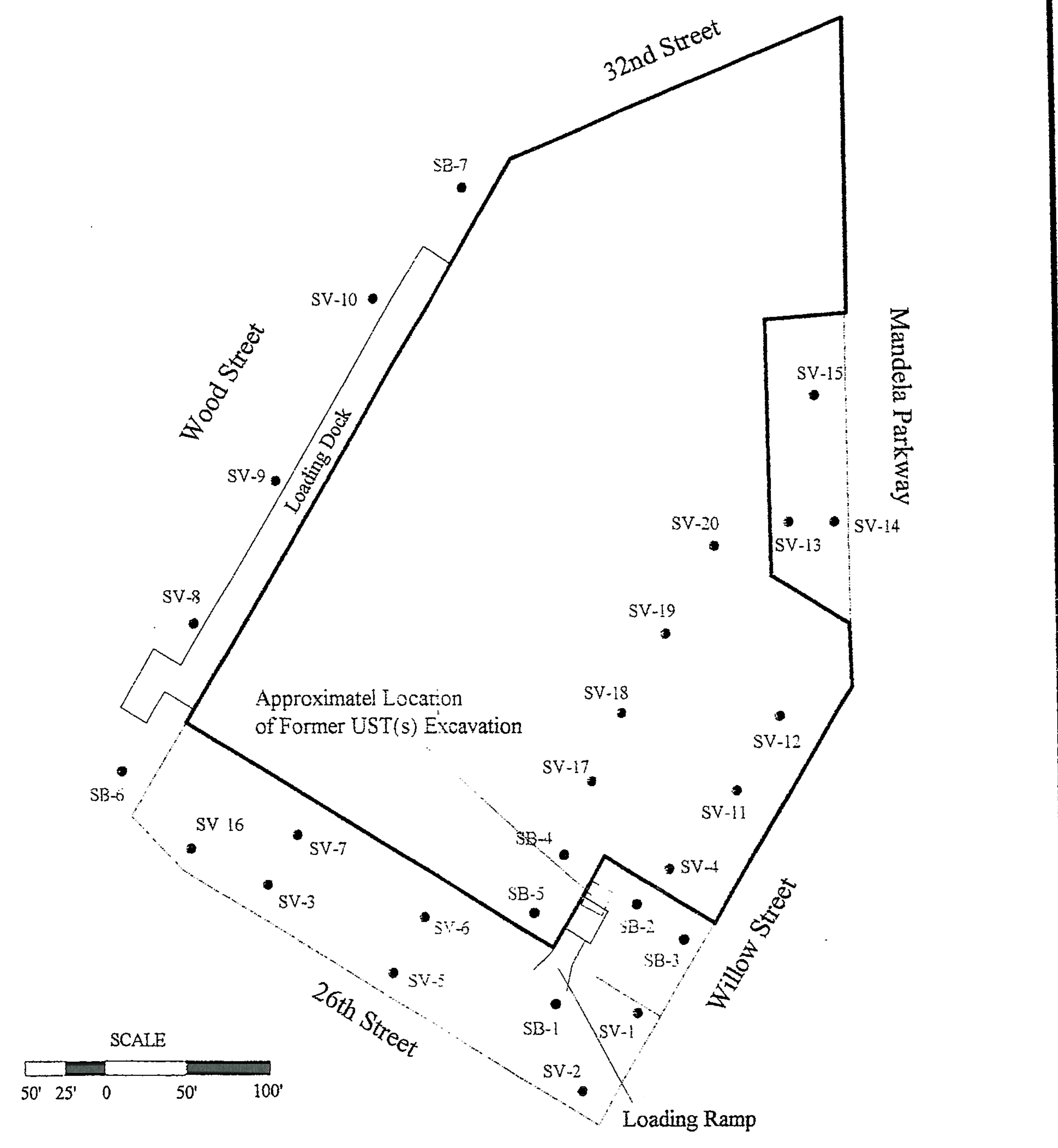
APPARENT EXTENT OF FREE PRODUCT

Date 12/21/99	Project No. 2543.01	Figure 12

Treadwell&Rollo

Treadwell&Rollo
A LANGAN COMPANY

Figures from Appendix A
Treadwell & Rollo, 2000



Commercial Property
2855 Mandela Parkway
Oakland, California

Project CA268-1

CERES Associates

- Soil vapor sample location
- Soil boring sample location
- Property building outline
- Fence

N

FIGURE 2 - SAMPLE LOCATION MAP

TABLE 1
SOIL SAMPLE RESULTS
(TPH-g, BTEX COMPOUNDS AND MTBE)
Page 1 of 2

Sample Location	Sample Depth (feet bgs)	Analytical Laboratory Results (mg/kg or ppm)					
		TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE
SB-1	5	<1.0	<0.005	<0.005	<0.005	<0.005	<0.005
SB-1	10	<1.0	<0.005	<0.005	<0.005	<0.005	<0.005
SB-2	5	**130**	**1.2**	**2.0**	**6.3**	**13**	<0.005
SB-2	11	**52**	**13**	**17**	**2.1**	**8.6**	<0.005
SB-3	5	**68**	**7.2**	**15**	**3.0**	**11**	<0.005
SB-3	10	**99**	**9.1**	**14**	**5.0**	**17**	<0.005
SB-4	5	**21**	**3.1**	**0.49**	**2.9**	**2.9**	<0.005
SB-4	11	**42**	**1.6**	**0.12**	**1.1**	**4.3**	<0.005
SB-4	15	<1.0	**0.019**	<0.005	<0.005	<0.005	<0.005
SB-5	5	**2.7**	**0.56**	**0.011**	**0.46**	**0.041**	<0.005
SB-5	10	**3.4**	**0.040**	**0.76**	**0.13**	**0.59**	<0.005
SB-6	5	<1.0	<0.005	<0.005	<0.005	<0.005	<0.0005
SB-7	5	<1.0	<0.005	<0.005	<0.005	<0.005	<0.005
SB-8	5	**2.6**	**0.92**	**0.010**	**0.026**	**0.063**	<0.05
SB-8	10	**7,400**	**83**	**270**	**110**	**470**	<100
SB-9	5	**1.1**	**0.006**	**0.034**	**0.017**	**0.082**	<0.05
SB-9	10	**49**	**0.31**	**1.7**	**0.84**	**3.5**	<0.30
SB-9	15	**4,700**	**32**	**180**	**80**	**320**	<70
SB-10	5	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
SB-10	10	<1.0	**0.005**	**0.006**	<0.005	**0.017**	<0.05
SB-10	15	**580**	**12**	**29**	**12**	**52**	<10

Bold type indicates compound reported above laboratory detection limit concentration. HVOCs were not reported above their respective detection limit concentrations. Detection limit concentrations are presented on the analytical laboratory data sheets provided in Appendix C.

TABLE 1
SOIL SAMPLE RESULTS
(TPH-g, BTEX COMPOUNDS AND MTBE)
Page 2 of 2

Sample Location	Sample Depth (feet bgs)	Analytical Laboratory Results (mg/kg or ppm)					
		TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE
SB-11	5	**11**	**0.34**	**0.016**	**0.35**	**0.29**	<0.05
SB-11	10	**8.0**	**0.39**	**0.026**	**0.057**	**0.12**	<0.05
SB-11	15	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
SB-12	17	**26**	**0.33**	**1.5**	**0.52**	**2.1**	<0.50
SB-13	10	**94**	**3.2**	**6.1**	**2.6**	**10**	<2.0
SB-13	15	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
SB-14	5	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
SB-14	10	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
SB-15	5	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
SB-15	10	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05
SB-15	15	**1,600**	**22**	**67**	**26**	**93**	<30
SB-16	12	**670**	**12**	**34**	**9.2**	**40**	<5
SB-16	16	**5.6**	**0.60**	**0.62**	**0.14**	**0.57**	<0.05
SB-17	9	**5.9**	**0.017**	**0.12**	**0.074**	**0.33**	<0.05
SB-17	16	**2.9**	**0.33**	**0.36**	**0.064**	**0.25**	<0.05
SB-18	8	<1.0	<0.005	<0.005	<0.005	<0.005	<0.005
SB-18	16	<1.0	<0.005	<0.005	<0.005	<0.005	<0.05

Bold type indicates compound reported above laboratory detection limit concentration. HVOCs were not reported above their respective detection limit concentrations. Detection limit concentrations are presented on the analytical laboratory data sheets provided in Appendix C.

TABLE 2
GRAB GROUNDWATER SAMPLE RESULTS
(TPH-g, BTEX COMPOUNDS AND MTBE)

Sample Location	Sample Depth (feet bgs)	Analytical Laboratory Results (μg/l or ppb)					
		TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE
SB-1	4	<50	**1.0**	**1.0**	<0.5	**1.2**	<0.5
SB-2	4	**160,000**	**44,000**	**38,000**	**5,900**	**24,000**	<50
SB-3	4	No sample. Free product.					
SB-4	7.5	**63,000**	**16,000**	**12,000**	**3,200**	**11,000**	<50
SB-5	7.5	**72,000**	**11,000**	**17,000**	**3,600**	**20,000**	<250
SB-6	8	**63**	**3.1**	**9.0**	**3.3**	**16**	<0.5
SB-7	6.5	<50	**1.1**	**2.1**	**1.9**	**6.4**	<0.5
SB-8	6	No sample. Free product.					
SB-9	6	No sample. Free product.					
SB-10	11	**98,000**	**8,400**	**10,000**	**2,800**	**13,000**	<200
SB-11	7	**780**	**81**	**1.3**	**4.9**	**18**	<1
SB-12	8	No sample. Free product.					
SB-13	7.5	**1,800**	**88**	**100**	**85**	**160**	<80
SB-14	7.5	<50	<0.5	<0.5	<0.5	<0.5	**14**
SB-15	7	<50	<0.5	<0.5	<0.5	<0 5	<5.0
SB-16	8	**110,000**	**17,000**	**24,000**	**2,700**	**11,000**	<1,300
SB-17	7 5	**43,000**	**2,500**	**6,700**	**1,600**	**6,200**	<690
SB-18	7	<50	<0.5	<0.5	**0.67**	<0.5	<5.0

Bold type indicates compound reported above laboratory detection limit concentration. HVOCs were not reported above their respective detection limit concentrations. Detection limit concentrations are presented on the analytical laboratory data sheets provided in Appendix C.

SUBSURFACE SOIL INVESTIGATION
2855 Cypress Street
Oakland, California

A Report Prepared for
Morgan Stanley and Company, Inc.
24222 Avenida de la Carlota, Suite 275
Laguna Hills, California 92653

July 16, 1992

Report Prepared by
ATEC Environmental consultants
8 Pasteur, Suite 150
Irvine, CA 92718

SOIL VAPOR STUDY RESULTS
Chromalloy Facility
Oakland, California

Project #: OTI-060692

Submitted By:

Optimal Technology Inc.

June 21, 1992

Optimal Technology Inc.
Specializing in Soil Gas Surveys

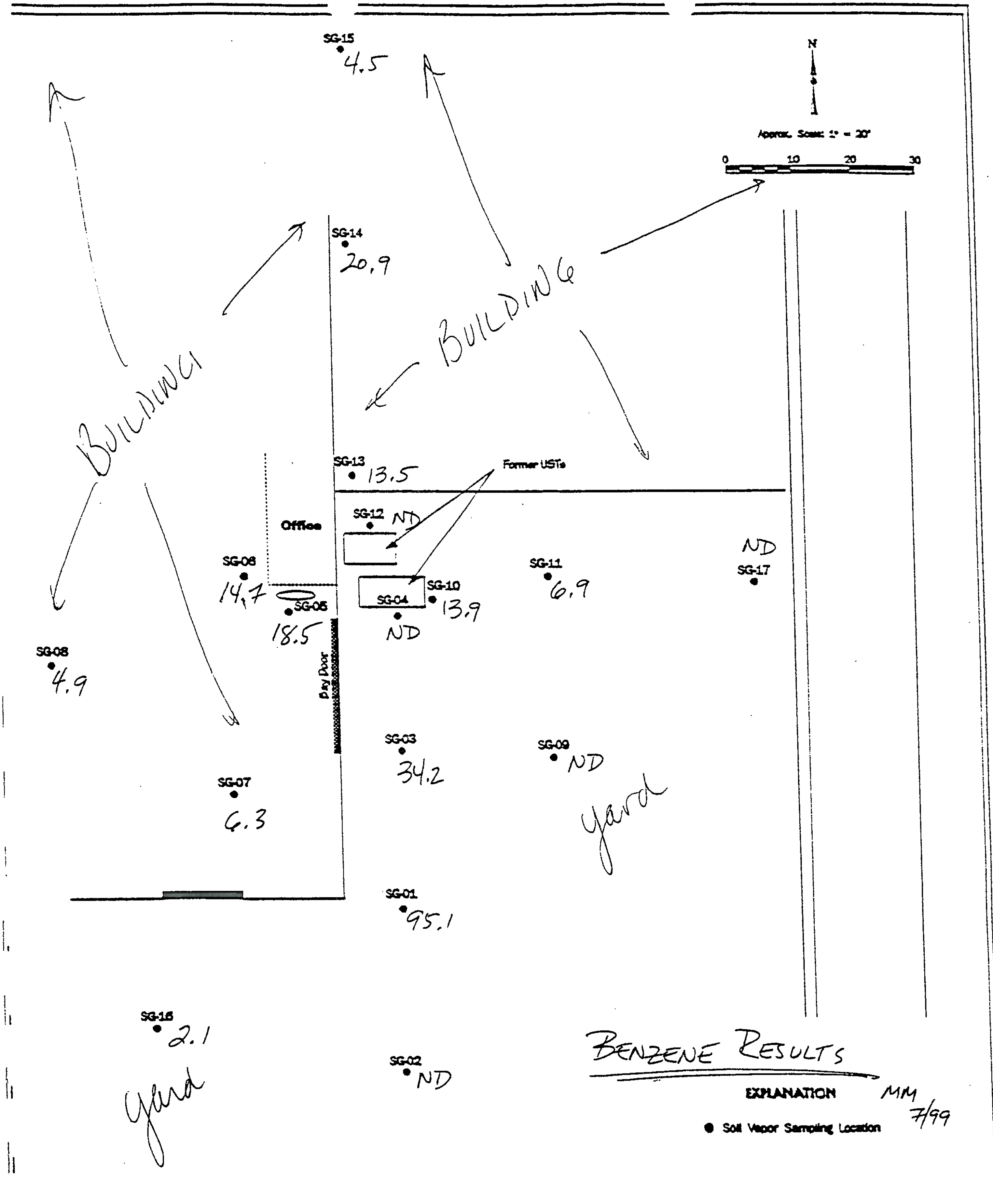
SOIL GAS RESULTS

MPANY: ATEC Environmental
NTACT: Mr. Chris Nevison
DDRESS: 8 Pasteur, Ste # 150
Irvine, CA 92718

PROJECT NAME: Chromalloy
PROJECT NUMBER: OTI-060692
SAMPLE DATES: June 17, 1992
MATRIX TYPE: Air (Soil Vapor)

SAMPLE ID	TVPH (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)
SG-01	763	95.1	49.2	2.1	29.1
SG-02	ND	ND	ND	ND	ND
SG-03	286	34.2	23.8	1.6	19.9
SG-04	ND	ND	ND	ND	ND
SG-05	163	18.5	17.2	1.5	22.8
SG-06	123	14.7	12.6	0.9	14.1
SG-07	53	6.3	4.5	ND	4.1
SG-08	38	4.9	2.9	0.2	1.0
SG-09	ND	ND	ND	ND	ND
SG-10	127	13.9	13.0	1.0	16.9
SG-11	66	6.9	7.4	0.6	13.1
SG-12	ND	ND	ND	ND	ND
SG-13	131	13.5	14.9	1.8	26.3
SG-14	178	20.9	18.1	1.4	19.8
SG-15	50	4.5	5.6	0.6	8.7
SG-16	28	2.1	4.1	0.7	12.7
SG-17	ND	ND	ND	ND	ND

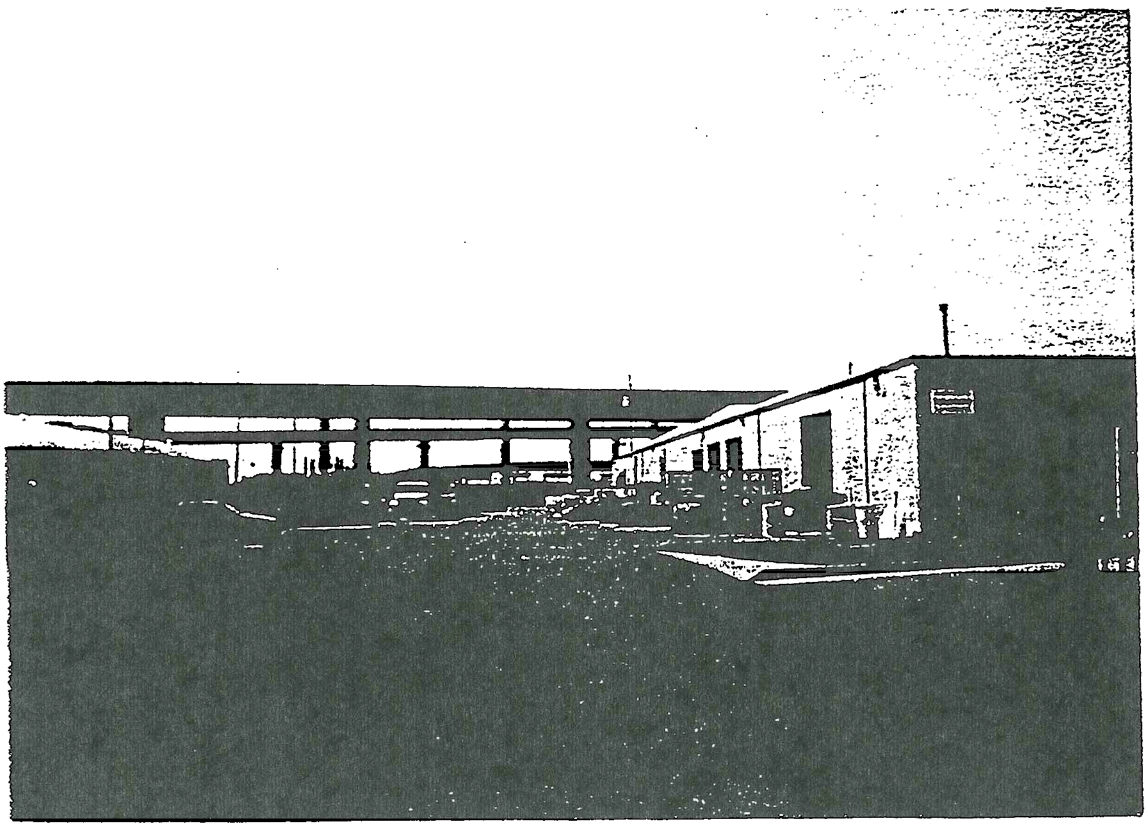
ND = Not Detcted at or above reporting limits of: 0.1 ug/L for Benzene, Toluene, Ethylbenzene, Xylenes
[illegible] for TVPH (as Gasoline)



OPTIMAL TECHNOLOGY INC.	DATE: June 18, 1992	PROJECT NO: [illegible]	APPROVED BY: T.L.T.	FIGURE
6430 Via Real, Suite 6 Carpinteria, CA 93013	COMPANY:	TITLE: BENZENE RESULTS – ug/L Soil Vapor Sampling Locations		1

PHASE II SUBSURFACE INVESTIGATION REPORT

Commercial Property
2853-2863 Mandela Parkway
Oakland, California



CERES Associates

5040 Commercial Circle, Suite F
Concord, California 94520
(925) 825-4466 / Fax (925) 825-4441

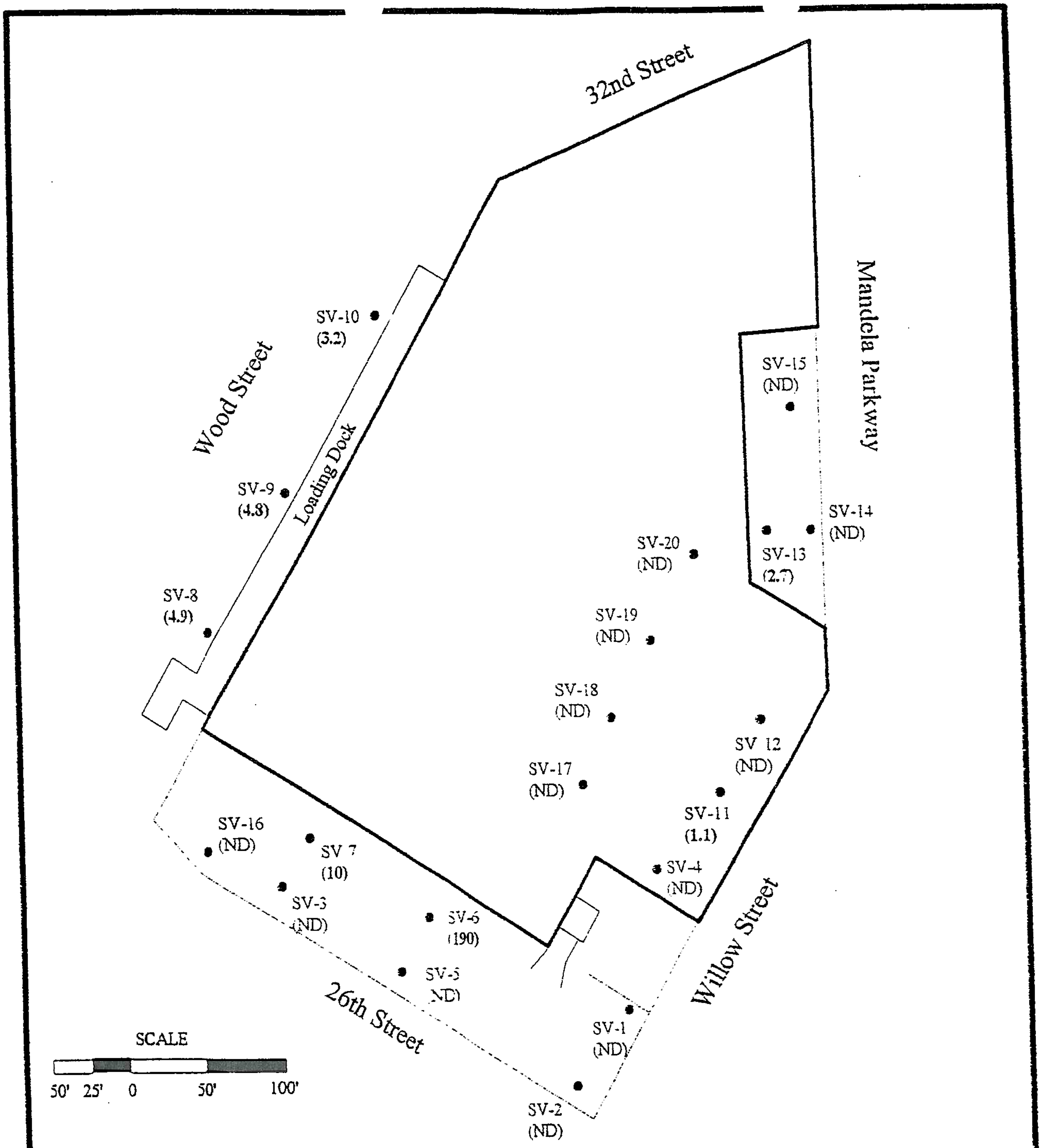
CERES Project CA268-2
September 1, 1998

TABLE 3

SOIL VAPOR SAMPLE RESULTS
(BTEX COMPOUNDS AND MTBE)

Sample Location	Sample Depth (feet bgs)	Analytical Laboratory Results (μg/l)				
		Benzene	Toluene	Ethylbenzene	Xylenes	MTBE
SV-1	3	<1.0	<1.0	<1.0	<1.0	<1.0
SV-2	1	<1.0	<1.0	<1.0	<1.0	<1.0
SV-3	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-4	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-5	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-6	1.5	**190**	**110**	**190**	**75**	<1.0
SV-7	1.5	**10**	**65**	**20**	**15**	<1.0
SV-8	1.5	**4.9**	<1.0	**9.2**	**8.6**	<1.0
SV-9	1.5	**4.8**	<1.0	**7.3**	**5.9**	<1.0
SV-10	1.5	**3.2**	<1.0	**5.4**	**4.5**	<1.0
SV-11	1.5	**1.1**	<1.0	**1.6**	**3.7**	<1.0
SV-12	1.5	<1.0	<1.0	**1.9**	**15**	<1.0
SV-13	1.5	**2.7**	**18**	**6.8**	**6.9**	<1.0
SV-14	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-15	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-16	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-17	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-18	1.5	<1.0	<1.0	<1.0	<1.0	<1.0
SV-19	3	<1.0	<1.0	<1.0	<1.0	<1.0
SV-20	3	<1.0	<1.0	<1.0	<1.0	<1.0

Bold type indicates compound reported above laboratory detection limit concentration.
HVOCs were not reported above their respective detection limit concentrations. Detection limit concentrations are presented on the analytical laboratory data sheets provided in Appendix C.



Commercial Property
2855 Mandela Parkway
Oakland, California

SV-11 (1.1) Soil vapor sample location. Benzene concentration in parts per billion (ppb).

(ND) Not detected above 1.0 ppb.

N

Project CA268-1

CERES Associates

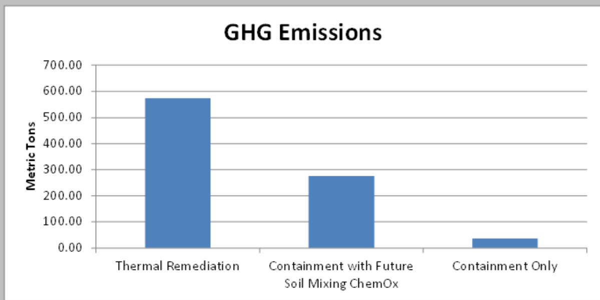
FIGURE 5 - SOIL VAPOR SAMPLE RESULTS (Benzene)

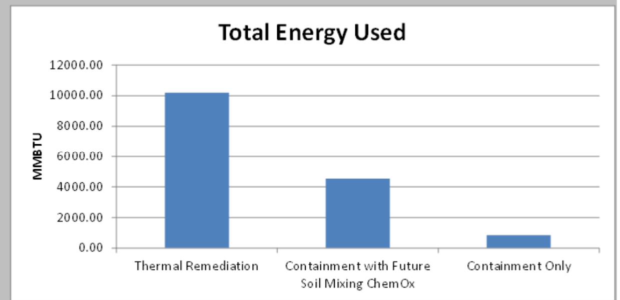
APPENDIX B
Remedial Sustainability Analysis
(Model Results Using Site Wise™ Tool)

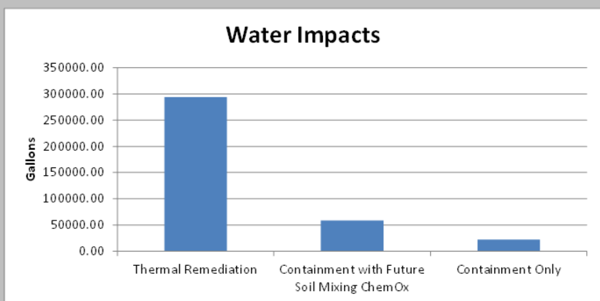
Table B-1
Remedial Sustainability Comparision
2855 Madela Parkway
Oakland, CA

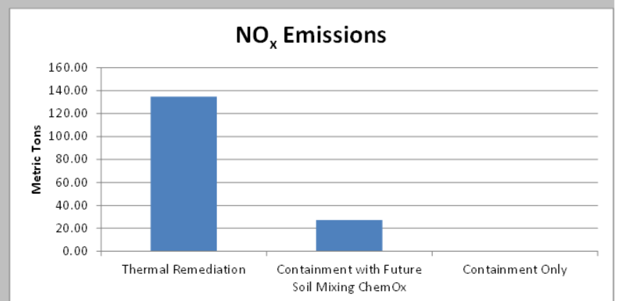
Treadwell&Rollo
A LANGAN COMPANY

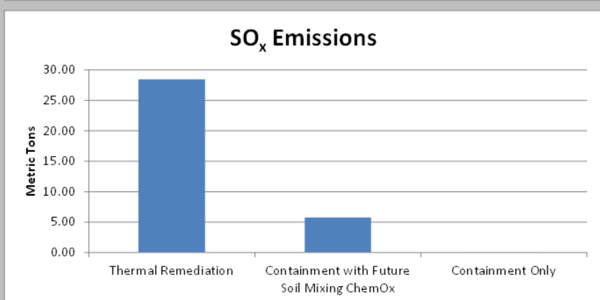
	Remedial Alternatives	GHG Emissions metric ton	Total energy Used MMBTU	Water gallons	NO_x emissions metric ton	SO_x Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Alt. 2	Thermal Remediation	573.57	10181.32	293981.67	134.68	28.47	6.42	0.00	0.02
Alt. 4	Containment with Future Soil	274.25	4534.73	58800.14	27.08	5.76	1.29	0.00	0.01
Alt. 4	Containment Only	37.47	845.18	22000.00	0.08	0.06	0.00	0.00	0.00

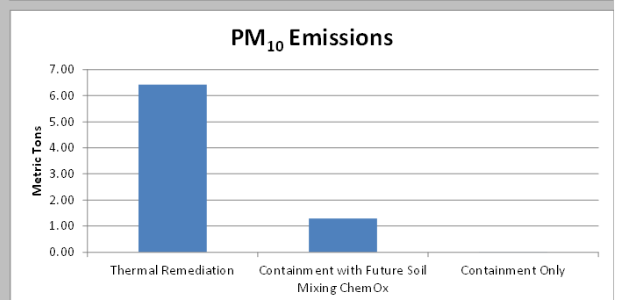


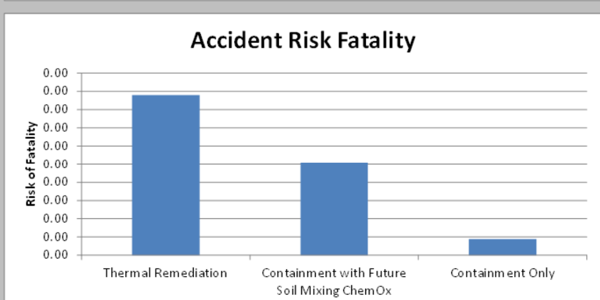


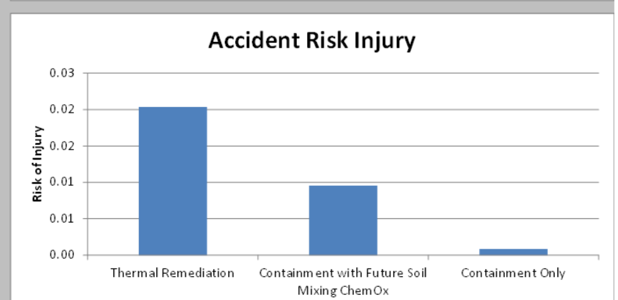










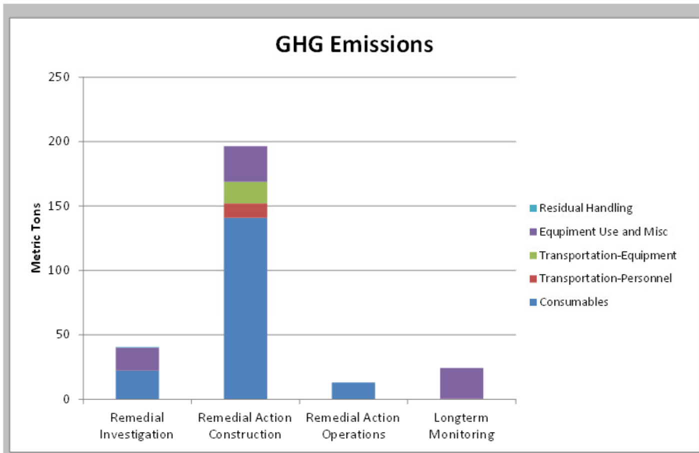


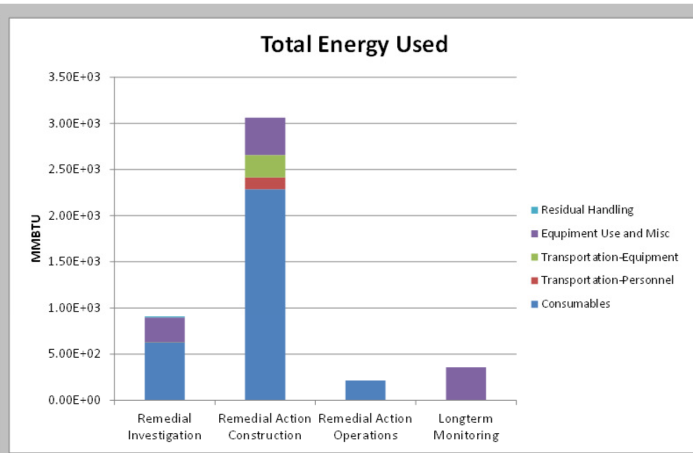
Note: "Thermal Remediation" corresponds to Alternative 2 (Section 5.2). "Containment Only" corresponds to Alternative 4. "Containment with Future Soil Mixing ChemOx" represents Alternative 4 with a hypothetical future remediation effort following demolition of the building.

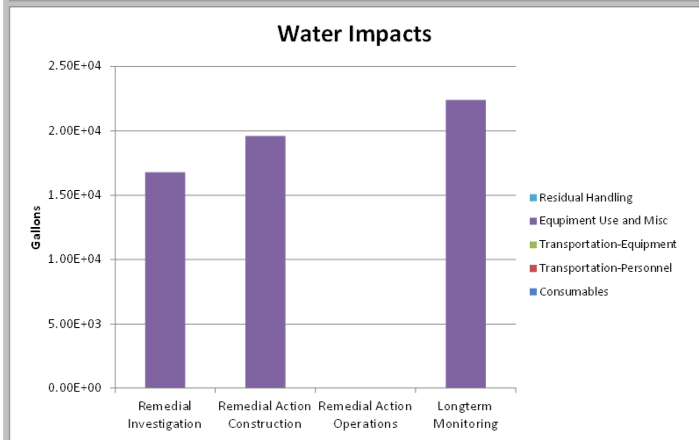
Table B-2
Alt. 2 Thermal Remediation
2855 Madela Parkway
Oakland, CA

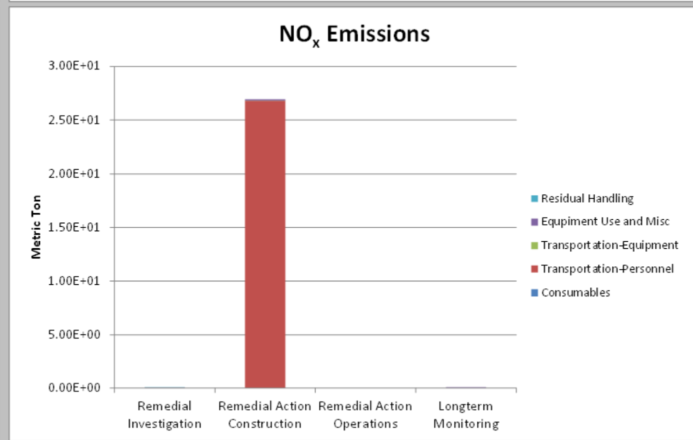
Treadwell&Rollo
A LANGAN COMPANY

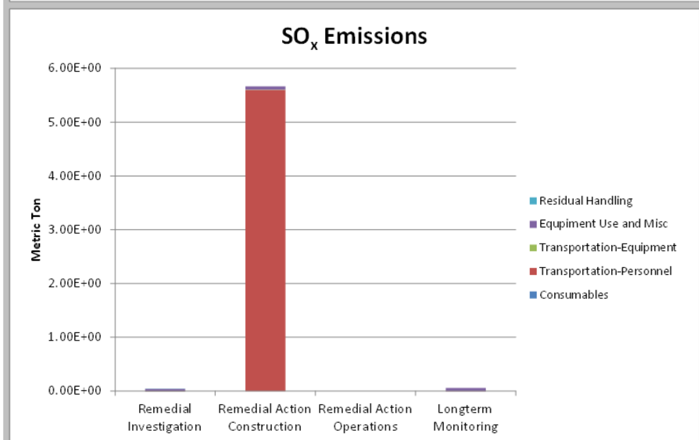
Table B-3
Alt. 4 Containment with Future Soil Mixing ChemOx
2855 Madela Parkway
Oakland, CA

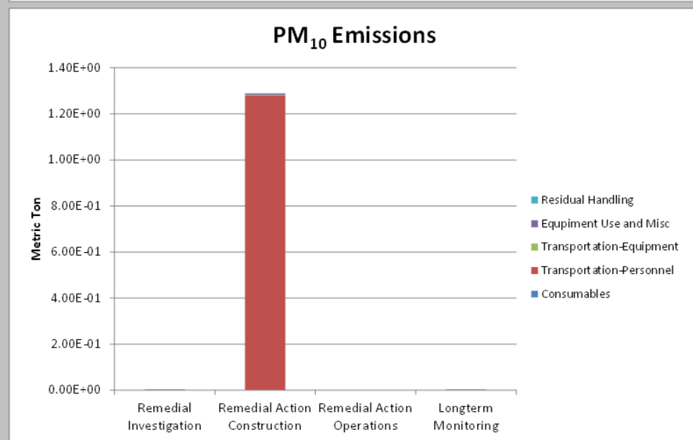


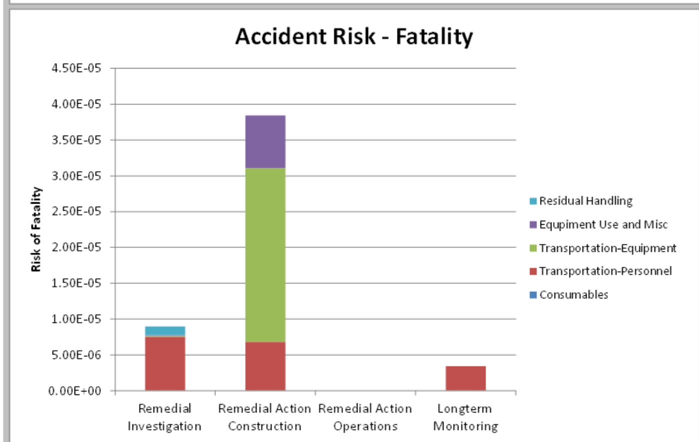












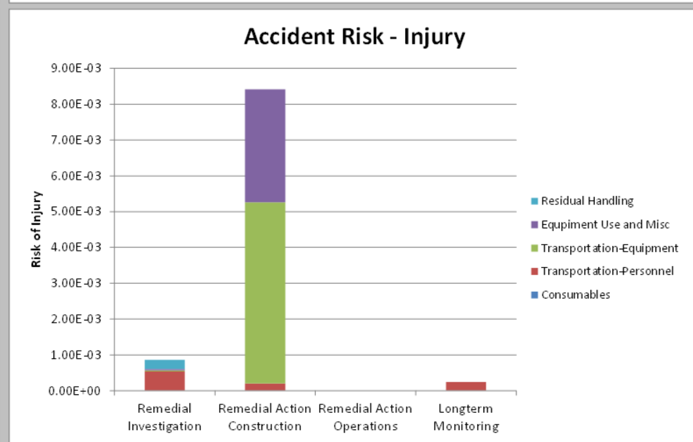


Table B-4
Alt. 4 Containment Only
2855 Mandela Parkway
Oakland, CA