PORT OF OAKLAND

March 15, 2011

Mr. Paresh C. Khatri
Hazardous Materials Specialist
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

RE: RO#0000010 and RO#0000187 (Geotracker Global ID T0600101866 & T0600100892) Feasibility Study/Corrective Action Plan, Port of Oakland's Harbor Facilities Complex Site, 651 Maritime Street, Oakland, CA 2011-03-15

Dear Mr. Khatri:

Please find enclosed the report entitled *Feasibility Study/Corrective Action Plan Port of Oakland's Harbor Facilities Complex Site ("FS/CAP")* dated March 2011, prepared by Malcolm Pirnie, Inc. ("Malcolm Pirnie") on behalf of the Port of Oakland ("Port")[1]. This FS/CAP is submitted in accordance with Alameda County Health Care Services Agency ("ACHCSA") requirements, as specified in ACHCSA letter dated September 2, 2010[2] and Port's response letters dated September 14, 2010[3] and February 17, 2011[4]. This FS/CAP provides: 1) a summary of soil and groundwater

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[1] The Site has been referred to historically as the "Shippers" and "Ringsby" sites, based on the Port tenants that occupied the site at the time of release discoveries. Prior to site redevelopment in 2004, the site was also referred to as 2277 and 2225 Seventh Street. After redevelopment, the Site address became 651 and 555 Maritime Street, although referenced hereafter (including within this Report) as only **651 Maritime Street *(Fuel Leak Case RO0000010).***

[2] Letter from Mr. Paresh C. Khatri (ACHCSA) to Messrs. Jeffrey R. Jones and Jeffrey L. Rubin (Port) regarding *Feasibility Study Evaluation for Fuel Leak Case No. RO0000010 & RO0000187 (Geotracker Global ID T0600101866 & T0600100892), Port of Oakland, 651 Maritime Street, Oakland, CA*, dated September 2, 2010.

[3] Letter from Mr. Jeffrey L. Rubin (Port) to Mr. Paresh Khatri (ACHCSA) regarding *Feasibility Study Evaluation for Port of Oakland's Harbor Facility Complex, 651Maritime Street, Oakland Alameda County Fuel Leak Case Nos. RO0000010 & RO0000187,* dated September 14, 2010.

[4] Letter from Mr. Jeffrey L. Rubin (Port) to Mr. Paresh Khatri (ACHCSA) regarding *Feasibility Study Evaluation for Port of Oakland's Harbor Facility Complex, 651Maritime Street, Oakland Alameda County Fuel Leak Case Nos. RO0000010 & RO0000187,* dated February 17, 2011.

investigations performed at the Site; 2) an assessment of impacts from contaminants of concern; 3) a description of the hydrogeologic regime; 4) proposed remedial goals; 5) alternatives for attainment of cleanup goals; and 6) a recommended preferred alternative that would be protective of human health and the environment and is cost-effective.

We look forward to ACHCSA's review of this document. In the absence of comments from the County within 60 days, the Port will implement the recommended action as specified in this FS/CAP[5]. If you have any questions or comments, please contact Jeff Rubin at (510) 627-1134.

We declare, under penalty of perjury, that the information and/or recommendations contained in the attached report prepared by Malcolm Pirnie are true and correct to the best of our knowledge. Please note that the report is stamped by a Registered Professional Geologist in the State of California.

Sincerely,

Jeffrey R. Jones
Supervisor
Environmental Programs and Planning

Jeffrey L. Rubin, CPSS, REA
Port Associate Environmental Scientist
Environmental Programs and Planning

Enclosure: noted

Cc (w encl.): Donna Drogos (Alameda County Health Care Services Agency)
Leroy Griffin (City of Oakland Fire Services Agency)
James McCarty (Baseline Environmental)
Geotracker

Cc (w/o encl.): Todd Miller (Malcolm Pirnie)
James Strandberg (Malcolm Pirnie)
Yane Nordhav (Baseline Environmental)

[5] Per Code of California Regulations, 23 CCR 2726.

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March 15, 2011

Mr. Jeffrey L. Rubin, CPSS REA
Associate Environmental Scientist
Port of Oakland
530 Water Street
Oakland, California 94607

Subject: Feasibility Study/Corrective Action Plan
Port of Oakland's Harbor Facilities Complex
651 Maritime Street, Oakland, California

Dear Mr. Rubin:

Enclosed is the Feasibility Study / Corrective Action Plan for 651 Maritime Street (formerly 2277 and 2225 Seventh Street), Alameda County Local Oversight Program case number RO0000010. This report has been prepared for submittal to Alameda County Health Care Services Agency (ACHCSA) on behalf of the Port of Oakland (the Port) in accordance with ACHCSA requirements, as specified in their letter dated September 2, 20102 and Port's response letters dated September 14, 2010 and February 17, 2011.

This FS/CAP provides a summary of soil and groundwater investigations performed at the Site, an assessment of impacts from contaminants of concern, a description of the hydrogeologic regime, proposed remedial goals, alternatives for attainment of cleanup goals; and a recommendation for implementing the preferred alternative, which is protective of human health and the environment and is cost-effective.

If you have any questions or comments, please contact me at (510) 735-3014.

Sincerely,

Todd Miller

Todd Miller, CHG
Associate Hydrogeologist

Enclosure

Port of Oakland
530 Water Street • Oakland, CA 94607

Feasibility Study/Corrective Action Plan Port of Oakland's Harbor Facilities Complex Site

651 Maritime Street, Oakland, CA

March 15, 2011

Report Prepared By:

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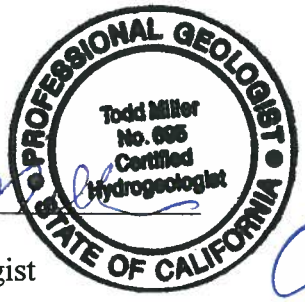
PORT OF OAKLAND'S HARBOR FACILITIES COMPLEX SITE
651 MARITIME STREET, OAKLAND, CA

March 15, 2011

Prepared by:



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1. Introduction

This Feasibility Study/Corrective Action Plan (FS/CAP) was prepared at the request of the Alameda County Health Care Services Agency (ACHCSA), in their letter dated September 2, 2010, to the Port of Oakland (Port) to identify and evaluate alternatives to remediate the Harbor Facility Complex at 651 Maritime Street, Oakland, California. Specifically, the ACHCSA requested that the FS/CAP include:

- A concise background of soil and groundwater investigations;
- An assessment of the residual impacts of the contaminants of concern (COCs);
- Detailed description of site lithology, including soil permeability;
- Cleanup levels and cleanup goals in accordance with San Francisco Bay Regional Water Quality Control Board (Regional Water Board) Water Quality Control Plan (Basin Plan) (Regional Water Board, 2010) and appropriate Environmental Screening Level (ESL) guidance for all COCs and for the appropriate groundwater designation; and
- An appropriate time frame necessary to reach those goals.

2. Site History

The Site encompasses an approximate 13-acre parcel, located between the former Oakland Naval Supply Center and former Oakland Army Base (Figure 2-1). Soil and groundwater impacts beneath the Harbor Facilities Complex are related to two former underground storage tank (UST) sites: 2277 Seventh Street and 2225 Seventh Street. In 2004, the Port redeveloped the two sites. The "Site" consists of the Harbor Facilities Complex (the eastern-most eight acres) and a portion of the Maritime Support Center (the western-most five acres). Previous investigations have indicated that the groundwater beneath the Site is impacted by dissolved petroleum hydrocarbons, primarily in the diesel fuel range, associated aromatic hydrocarbons, and free product. One well also contains dissolved petroleum hydrocarbons in the gasoline range.

The following sections summarize the investigation and remediation activities conducted on-Site. A complete history of the UST removal and investigation activities at the Site is provided in the following documents:

- Soil and Groundwater Site Assessment: Dongary Investments – Oakland, Ramcon Engineering and Environmental Contracting, 1993 (Ramcon, 1993).
- Report of Additional Investigation and Groundwater Monitoring Well Installation and Sampling at 2277 Seventh Street, Oakland, California, Uribe & Associates, 1994 (Uribe, 1994).
- Expanded Environmental Site Assessment, Future Field Support Services Complex, Port of Oakland, Oakland, California, IRIS Environmental, 2002 (IRIS, 2002).
- Additional Site Characterization and Remedial Action Plan, 2225 and 2277 Seventh Street, Oakland, California, Innovative Technical Solutions, Inc., 2002 (ITSI, 2002).
- Phase II Environmental Site Assessment, Future Port Field Support Services Complex, 2225 and 2277 Seventh Street, Port of Oakland, Oakland, California, IRIS/Cambria JV, 2002 (IRIS/CAMBRIA, 2002).

2.1. Site Investigations

Thirteen USTs were removed from the Site between 1990 and 1993. Between 1990 and 1992, nine USTs used to store diesel, gasoline, waste oil, and bulk fuel were removed from the 2225 Seventh Street site. In 1993, four USTs used to store gasoline, waste oil, and motor oil were removed from the 2277 Seventh Street site. Free product was identified in the soil and on the groundwater surface during the UST removal actions at both sites.

Site investigations conducted in 1993 and 1994 included the installation of 46 soil borings (Figure 2-2) and 11 groundwater monitoring wells (wells MW-1 through MW-3 at the 2277 Seventh Street site and wells MW-1 through MW-8 at the 2225 Seventh Street site). A total of 92 soil and 54 groundwater samples were collected between 1993 and 1996 to characterize the two sites. Investigation results identified free product in wells installed in close proximity to the former UST locations. Dissolved phase petroleum constituents (total petroleum hydrocarbons [TPH] as gasoline [TPHg] and as diesel fuel [TPHd] and benzene, toluene, ethylbenzene, and xylenes [BTEX]) were also identified in groundwater monitoring wells near the former USTs.

In 1998, Harding Lawson Associates abandoned well MW-8 to make possible the expansion of the railroad tracks to the north of the Site. Replacement well MW-8A was installed in 2001 (Figure 2-3). In 2002, ITSI abandoned wells MW-1, MW-2 and MW-3 at the former 2225 Seventh Street site, and wells MW-6 and MW-7 at the former 2277 Seventh Street site to facilitate demolition of the on-site buildings and construction of the new Harbor Facilities Complex.

In 2002, prior to redeveloping the property, IRIS conducted additional investigations at the Site to collect data needed to complete a human health risk assessment (HHRA) (IRIS, 2002). The investigations included advancing 32 cone penetrometer test (CPT) borings (Figure 2-4) and 46 soil borings. The CPT tool was outfitted with ultraviolet induced fluorescence to detect the presence of petroleum hydrocarbons. A total of 135 soil and 47 groundwater samples were collected during the two investigations to further define the extent of the dissolved petroleum hydrocarbons and free product impacts. The soil and groundwater samples were also analyzed for the presence of volatile and semi-volatile organic compounds, and metals, to further assess the COCs associated with the Site. Twenty-three soil gas samples were also collected and analyzed for petroleum hydrocarbons, volatile organic compounds, methane and other fixed gases. Analytical results identified petroleum hydrocarbon constituents beneath the Site at concentrations that were generally consistent with past analytical results for soil and groundwater. Other constituents that were analyzed for were either reported to be below laboratory reporting limits or were identified sporadically and at low concentrations and were not considered to be COCs for the Site.

In 2004, the Port completed the redevelopment and the 2225 and 2277 Seventh Street sites to form the Harbor Facilities Complex and a portion of the Maritime Support Center. The Port operates the Harbor Facilities Complex; the Maritime Support Center is currently leased to Shippers Transport Express.

In 2008, four additional groundwater monitoring wells, MW-9 through MW-12 (Figure 2-3) were installed to enhance the existing monitoring well network and to replace wells removed during Site redevelopment. Laboratory results of samples collected from these

additional wells, combined with the historical characterization data, indicate that the extent of the dissolved petroleum hydrocarbons and free product have been delineated. Monitoring data collected since 2008 indicate that the dissolved petroleum hydrocarbons and free product are stable and not migrating. Figure 2-5 illustrates the lateral extent of the dissolved hydrocarbons and free product beneath the Site. Table 2-1 summarizes the groundwater data collected during past groundwater monitoring events.

Figures 2-6 through 2-9 illustrate the TPHd, TPHg, benzene and methyl tert-butyl ether, (MTBE) concentrations over time for those wells where the COCs have been reported above their respective laboratory method reporting limits in at least 10 percent of the groundwater samples analyzed (Table 2-1). In general, the graphs illustrate that COC concentrations beneath the Site are stable and/or decreasing. Additionally, reported concentrations are below their Site-specific remedial goals (see Section 5.3). An exception is well MW-10 where the TPHg and benzene concentrations show an increase with time. Concentrations are currently at (benzene) or below (TPHg) their respective remedial goals. Well MW-10 is in close proximity to, and upgradient of, the free product plume. This is not a downgradient well that would be used as a point of compliance to monitor the migration of the dissolved COCs.

2.2. Remedial Activities

Between 1996 and 2002, the Port used passive and active product skimmers in wells MW-1, MW-2 and MW-3 at the 2277 Seventh Street portion of the Site to recover free product. The product recovery system was shut down in 2003 and removed, pending redevelopment of the Site. The ACHCSA approved the removal of the system with the stipulation that a new recovery system be installed once the redevelopment process was complete.

A new product recovery system was installed in 2004. The new system included nine recovery wells (Figure 2-3), seven of which were outfitted with pneumatically-operated product skimmers. Free product removed from the skimmers is pumped to an aboveground collection tank. In 2006, the ACHCSA approved the use of socks containing Oxygen Release Compound™ in well MW-4 to increase the dissolved oxygen (DO) concentration in groundwater and stimulate aerobic biodegradation of the petroleum hydrocarbons reported in the groundwater at that location. In 2007, the product recovery system was enhanced by adding a low vacuum to the recovery well heads to increase product recovery rates. Air drawn from the recovery wells is treated with granular activated carbon (GAC) and discharged to the atmosphere under a permit from the Bay Area Air Quality Management District.

3. Site Geology and Hydrogeology

Subsurface soils underlying the asphalt and baserock at the Site consist of various types of hydraulically-placed dredge spoils over Bay Mud. Additionally, fill consisting of a heterogeneous inter-layered mix of gravel, sand and silt containing brick, wood fragments and glass was encountered on top of the hydraulically-placed dredge spoils in a few borings advanced at the Site. Figure 3-1 illustrates the locations of generalized geologic cross-sections prepared for the Site by ITSI (2002). Cross-sections are included as Figures 3-2 through 3-4. Bay Mud is generally encountered in Site borings at depths ranging from approximately 8.5 to 11 feet below ground surface (bgs).

Groundwater has typically been encountered between 5 feet bgs and 13 feet bgs in soil borings advanced at the Site. Seepage of groundwater into open soil borings has been reported to be slow. The shallow groundwater surface in the wells has been measured at depths ranging from approximately 5.5 feet bgs to 12 feet bgs.

The nearest surface water body, the Oakland Outer Harbor (part of the San Francisco Bay), is approximately 0.4 miles west-northwest of the Site. Groundwater generally flows to the north-northwest (Figure 3-5) towards the Oakland Outer Harbor. Groundwater gradients beneath the Site vary from approximately 0.001 to 0.025 feet per foot.

4. Assessment of Risks

Risks associated with Site COCs (discussed in Section 5.1) were assessed in a HHRA prepared by Iris Environmental Inc. (IRIS, 2003). A Conceptual Site Model (CSM) has been prepared to assess the chemical migration pathways.

4.1 Conceptual Site Model

A CSM is "a written or pictorial representation of an environmental system and the biological, physical, and chemical processes that determine the transport of contaminants from the sources through environmental media to environmental receptors within the system" (ASTM, 1995). The function of a CSM is to provide a framework for understanding site conditions affecting the transport and ultimate fate of contaminants in the subsurface. This understanding forms the foundation for developing a plan to protect receptors potentially exposed to contaminants resulting in unacceptable health risks and hazards.

Figure 4-1 is a graphical CSM illustrating the analysis of contaminant sources at the Site, affected media, contaminant migration pathways, exposure routes, and potential receptors, with a qualitative assessment of the risk to those receptors based on Site conditions, as presented in Sections 2.0 and 3.0. The known contaminated Site media are soil, soil gas, and groundwater. Additional potentially contaminated media include outdoor air, indoor air, and downgradient surface water bodies. The various source-pathway-receptor scenarios are characterized to be potentially complete or incomplete. An exposure pathway is evaluated to be potentially complete if the following four necessary elements likely exist:

- A source and mechanism of release to the environment;
- An environmental transport medium and possible secondary release mechanism;
- An exposure point (receptor); and
- An exposure route to the receptor.

Pathway-to-receptor scenarios considered to be potentially complete (black symbols on Figure 4-1) represent receptors that warrant development of remedial goals, engineering controls, and/or institutional controls to reduce the risk to an acceptable level. Incomplete exposure pathways (white symbols on Figure 4-1) are not evaluated further.

The following are the potential receptors identified for the Site:

- Commercial workers (present and future full-time Site workers);

- Construction workers (temporary Site construction workers - vertical construction);
- Utility workers (temporary Site construction worker – subsurface improvements); and
- Aquatic biota.

For the Site, the identification of these potential receptors is based on the lateral and vertical extent of the COCs in soil and groundwater. Future land use will be limited to commercial/industrial and sensitive receptors (e.g., hospital, daycare facility, etc.) will be prohibited from using the Site. The Port provided a draft deed restriction to the ACHCSA on April 18, 2007 (Appendix A).

4.1.1. Site Workers

Site commercial/industrial workers represent current or future workers undertaking their normal workday activities at the Site who might experience exposure during normal job activities. The potential exposure pathway for Site workers is exposure to the contaminated vapors. Because the Site is paved, Site workers cannot be exposed to the soil. Contaminants in the form of vapors can potentially migrate into buildings. However, the construction of the Harbor Facilities Complex buildings included installation of a vapor barrier and a negative-pressure sub-slab ventilation system which prevents Site worker exposure to vapors within the building. Therefore, with the implementation of these engineering controls (asphalt cap and vapor barrier), the potential exposure pathways are incomplete. Institutional controls are required to ensure that the engineering controls remain and continue to provide adequate protection.

4.1.2. Construction Workers

Construction workers are hypothetical future workers who might experience exposure to contaminated soil, contaminant vapors, contaminated groundwater, or free product for a brief time during future construction of new Site facilities. Through implementation of proper health and safety procedures, in accordance with Federal and state laws and regulations, construction workers' exposure to contaminants can be mitigated. The Port has prepared and implemented a Risk Management Plan (RMP) (Appendix B) for the Site that includes requiring construction workers to follow appropriate health and safety procedures and protocols. Therefore, with the implementation of the RMP, the potential exposure pathways are incomplete.

4.1.3. Utility Workers

Utility workers are hypothetical future workers who might experience exposure to contaminated soil, contaminated groundwater, contaminant vapors, or free product for a brief time during future construction involving excavation or trenching for utilities or other structures. Through implementation of proper health and safety procedures, in accordance with Federal and state laws and regulations, exposure to utility workers can be mitigated. The Port has prepared and implemented an RMP for the Site that includes

requiring utility workers to follow appropriate health and safety procedures and protocols. Therefore, with the implementation of the RMP, the potential exposure pathways are incomplete.

4.1.4. Aquatic Receptors

Aquatic receptors include benthic organisms as well as pelagic (open water) and demersal (living on or near the bottom) fish. The nearest surface water body is the Oakland Outer Harbor (part of the San Francisco Bay), which is located 0.4 miles west-northwest of the Site. Aquatic receptors are considered potential receptors for Site COCs that migrate through groundwater and are discharged to surface water. Based on the potential for this pathway to be complete, conservative remedial goals should be established to protect this receptor (see Section 5.3). The remedial goals are considered conservative because they are applied to groundwater quality measured in Site wells, which are nearly one-half mile upgradient of the nearest discharge point (Oakland Outer Harbor).

4.1.5. Groundwater as a Resource

The Regional Water Board has recommended that the Oakland Shoreline/Alameda Point Brackish Shallow Groundwater Zone (Zone C), which includes the Site, should be de-designated from municipal supply beneficial use (Regional Water Board, 2010). Shallow groundwater in Bay-front artificial fill, young Bay Mud and the San Antonio Formation/Merritt Sand meets the exemption criteria of the State Water Resources Control Board's (SWRCB's) Sources of Drinking Water Policy because the groundwater cannot reasonably be expected to serve as a public water supply and generally exceeds the 3,000 milligrams per liter total dissolved solids criteria. However, cleanup actions should be protective of ecological receptors and human health (Regional Water Board, 2011). Therefore, with the recommended de-designation of the shallow groundwater as a municipal supply, the drinking water pathway at the Site is considered to be incomplete.

The CSM indicates that with the implementation of the engineering and institutional controls, there are no complete pathways for exposure to commercial workers, construction workers, or utility workers. Groundwater in the Site area is recommended by the Regional Water Board to be de-designated as a municipal resource; therefore, the drinking water pathway is incomplete. The only potentially complete pathway requiring development of remedial goals is the potential discharge of dissolved contaminants from groundwater to the Oakland Outer Harbor.

4.2 Human Health Risk Assessment

IRIS (2003) conducted a HHRA to support the planning and design of the Harbor Facilities Complex buildings to ensure that risks to construction workers and building occupants from Site environmental conditions were identified, evaluated, and properly mitigated.

The HHRA evaluated the risk to three different populations (future on-Site workers [site workers]; on-Site construction workers [construction workers]; and a utility workers from exposure to Site COCs. To be conservative, IRIS identified the COCs as any chemical compound detected at least once in a soil, soil gas or groundwater sample. The COCs included petroleum hydrocarbons in the gasoline, diesel fuel, and motor oil ranges, as well as 17 volatile and 11 semi-volatile organic compounds, nine metals (soil only) and methane (soil gas only).

Risk analysis results indicated that the incremental cancer risk for Site construction workers, Site workers, and utility workers, were $9.21x10^{-6}$, $5.42x10^{-6}$ and $3.83x10^{-6}$. Non-cancer hazard indices for the Site workers and the utility workers were below 1. This assessment indicated that the additional risk to Site workers and utility workers from the COCs were insignificant. The non-cancer hazard index for the Site construction workers was above 1, which required the development and implementation of additional health and safety practices during Site redevelopment, and preparation and implementation of the RMP. With implementation of the RMP, the additional risk to Site construction workers from the COCs is insignificant. The nuisance odor evaluation indicated that the Site workers and utility workers were not expected to experience undesirable odors following the completion of Site redevelopment activities.

5. Feasibility Study/Corrective Action Plan Approach

This FS/CAP identifies and evaluates alternatives to ensure protection of human health, aquatic receptors, and the environment by establishing numeric remedial goals for shallow groundwater and selecting a remedial alternative capable of meeting those goals. The objective of the selected remedial alternative is to ensure that the actual or potential adverse effects of the unauthorized releases are remediated or appropriately mitigated.

5.1. Contaminants of Concern

As presented in Section 2.0, results of the Site investigation activities identified TPHg and TPHd, BTEX, and MTBE as the COCs in soil and groundwater beneath the Site. Results of the risk assessment activities completed in 2003 (see Section 4.0) and the CSM indicate that remediation of the Site would have to be protective of aquatic receptors in the Oakland Outer Harbor, since the pathways for human health concerns are incomplete and the risks are insignificant with implementation of the RMP and the proposed deed restriction.

An assessment of the groundwater monitoring data collected between 1993 and 2010 indicates that the dissolved petroleum hydrocarbons beneath the Site are stable and are not migrating off-Site (see Section 2.1) at concentrations that exceed Site remedial goals (see Section 5.3). Samples collected from downgradient boundary well MW-4 contain low concentrations of benzene. Samples collected from downgradient boundary well MW-8A are non-detect for the Site COCs. A detailed assessment of the dissolved concentration trends was presented in Malcolm Pirnie's 2010 Second Semi-annual Groundwater Monitoring and Remediation System Operation and Maintenance Report (Malcolm Pirnie, 2011).

5.2. Remedial Action Objectives

Remedial actions implemented at the Site are required to comply with applicable portions of Title 23, California Code of Regulations (23 CCR), Division 3, Chapter 16, Sections 2655 and 2725 – 2727; and the Regional Water Board's Basin Plan (Regional Water Board, 2010). Therefore, the selected remedy must:

- Represent a cost effective solution for remediating the Site (23 CCR, Division 3, Chapter 16, Section 2725).
- Adequately protect human health, safety, and the environment (23 CCR, Division 3, Chapter 16, Section 2725).

- Remove product from the subsurface to the extent practicable. Abatement of migration shall be the predominant objective in the design of the product removal system (23 CCR, Division 3, Chapter 16, Section 2655(a) and (c)).
- Achieve Site-specific remedial goals. Goals less stringent than promulgated water quality standards (maximum contaminant levels) may be developed as long as Site-specific COCs do not adversely affect the beneficial use of groundwater or produce taste and odor problems in the basin within which the Site is located (Basin Plan, Section 3.1).

Further guidance in developing the remedial action objectives was obtained from the *Draft Leaking Underground Fuel Tank Guidance Manual* (LUFT Manual) published by the SWRCB in October 2010 (SWRCB, 2010) and various SWRCB resolutions. The draft LUFT Manual recommends selecting a remedial alternative that is technically feasible, specific to site conditions and evaluations, and economically viable. The selected remedial alternative may include actions that address source cleanup, receptor protection, and pathway containment and/or elimination; and should help reduce or manage risks to an acceptable level. The LUFT Manual states that "*For most sites, stable concentrations of dissolved constituents in groundwater indicate that the petroleum is no longer acting as a significant source*."

SWRCB Resolution 09-81 states that allowing for a reasonable time frame for impacted groundwater to reach water quality objectives, even if that time frame is lengthy, is consistent with existing SWRCB Resolutions and Policies. Depending on site-specific conditions, decades to centuries may be a reasonable time frame to reach water quality objectives because of the likelihood that the impacted groundwater will not be used.

Based on the above regulations, resolutions and guidance documents the following remedial action objectives (RAOs) have been selected for the Site:

1. Protect Site, construction, and utility workers from excess risks from COCs in soil, groundwater, soil vapors; and

2. Protect aquatic receptors from excess risks from COCs potentially migrating into the Oakland Outer Harbor.

5.3 Remedial Goals

Remedial goals for the Site are based on protection of aquatic receptors in the Oakland Outer Harbor. No remedial goals are developed for COCs in soil because engineering and institutional controls implemented by the Port (Appendices A and B) will protect potentially exposed populations. The groundwater remedial goals for aromatic hydrocarbons (BTEX and MTBE) are based on the Environmental Screening Levels (ESLs) developed by the Regional Water Board for protection of aquatic receptors in estuarine habitat (Table F-4a). The ESLs for estuarine aquatic habitat do not include values for TPH. Therefore, the remedial goals for TPHd and TPHg are those contained

in Cleanup and Abatement Order 99-045 (Order), dated June 16, 1999 (Regional Water Board, 1999), issued to the San Francisco International Airport (SFO). The Site has subsurface conditions similar to those documented at SFO (fill on top of Bay Mud along the San Francisco Bay Margin). The Order contains remedial goals for TPHg and TPHd in groundwater that are protective of estuarine aquatic organisms.

The Site remedial goals for protection of the estuarine aquatic habitat are:

TPHd – 640 µg/L
TPHg – 3,700 µg/L
Benzene – 46 µg/L
Toluene – 130 µg/L
Ethylbenzene – 43 µg/L
Xylenes – 100 µg/L
MTBE – 1,800 µg/L

Consistent with Site remedial goals for protection of aquatic receptors, the remedial goals will be applied to Site monitoring wells located at or near the downgradient property boundary (i.e. sentinel wells). These wells are MW-4, MW-5 and MW-8A (Figure 3-5).

6. Remedial Alternatives Evaluation

This section describes the methodology used to identify feasible alternative remedies for the Site. This includes screening an initial 18 alternatives to a final seven alternatives that have been evaluated in further detail.

6.1. Preliminary Alternatives Screening

A preliminary screening of the various alternatives applicable to petroleum hydrocarbon remediation was conducted to identify those that are potentially applicable to the Site. Technical implementability was the primary factor used to eliminate alternatives that would likely be ineffective or infeasible at the Site. The results of the preliminary screening step, including an explanation for elimination or retention of each alternative, are summarized in Table 6-1. Alternatives retained for further consideration are those that have the potential to reliably reach the Site-specific RAOs and remedial goals, based on available literature, documentation, and professional experience.

6.2. Retained Alternatives

The preliminary screening step resulted in the identification of the following seven alternatives for further evaluation.

ALTERNATIVE A: No Further Action - Operation of the existing recovery system will be discontinued. Groundwater monitoring activities will cease and on-Site wells will be removed. System components will be removed and underground piping will be closed in-place. Site closure will be obtained without further action. This alternative can be completed within three months of acceptance.

ALTERNATIVE B: Monitored Natural Attenuation with Institutional and Engineering Controls - The existing free-product recovery system will be shut down and a monitored natural attenuation (MNA) program implemented. Groundwater quality will be monitored in wells not containing free product on a semi-annual basis for two years, and annually for three years. Analysis of groundwater samples for natural attenuation parameters will occur every two years (years 1, 3 and 5). Product thickness will be measured quarterly during the first two years of the program to ensure that it is stable and not migrating. Groundwater samples will be collected and analyzed for COCs and MNA parameters and the data evaluated in accordance with ASTM Standard E-1943-98 (reapproved in 2004 and 2010). Downgradient monitoring wells MW-4, MW-5, and MW-8A, would act as sentinel wells. These wells, along with wells MW-2 and MW-9, will be monitored for compliance with the Site remedial goals. If after five years of

monitoring the dissolved contaminants continue to show evidence of stable and/or decreasing concentrations and the free product is not migrating, a finding of no further action will be requested from the ACHCSA. This alternative also includes institutional and engineering controls. Institutional controls include a deed restriction prohibiting use of the Site for sensitive land uses. Engineering controls include construction of a vapor barrier and negative pressure sub-slab ventilation system beneath on-Site buildings and adherence to the RMP during construction activities. Remediation of the dissolved and free product plumes under this alternative may extend to more than 20 years. This alternative can be initiated immediately following acceptance by ACHCSA.

ALTERNATIVE C: Product Removal Using Pneumatic Skimmers - This alternative represents the continuation of the current technology being employed on-Site. Petroleum hydrocarbons are removed from 4-inch-diameter recovery wells installed to 12 feet bgs within the delineated plume area. Recovery wells are equipped with pneumatic skimmer pumps to remove product from the subsurface. The pumps are programmed to operate on a routine basis using an on-Site control system. The recovery wells are plumbed to deliver the recovered product to an on-Site storage tank, which is emptied on an as-needed basis. A low vacuum is applied to the recovery well heads to continuously extract vapors from the subsurface and enhance recovery by reducing the vapor pressure in the interstitial pore spaces, facilitating mobilization of the free product towards the recovery wells. Extracted vapors are treated on-Site before being discharged to the atmosphere, under a Bay Area Air Quality Management District permit. Product level and thickness are measured in the recovery wells on a weekly basis. Groundwater monitoring will be conducted annually until active remediation is complete. The time to complete the remediation of the residual petroleum hydrocarbons using this alternative may be more than 20 years.

ALTERNATIVE D: Mobile High Vacuum Extraction with Institutional and Engineering Controls - A total of 50, 4-inch-diameter extraction wells will be installed to approximately 12 feet bgs on 30-foot centers throughout the remediation area. Free product, groundwater and soil vapors will be removed from each well using a mobile high-vacuum extraction system twice per month. Extracted fluids will be transported off-Site for proper disposal. The final number and spacing of the extraction wells and the removal frequency will be confirmed by conducting pilot tests prior to full-scale implementation of the alternative. Removal frequency will be adjusted throughout the active remediation period depending on results. Product thickness in the remediation wells will be measured prior to each removal event. Groundwater monitoring will be conducted on a semi-annual basis during and for one year following completion of the active remediation. This alternative also includes implementation of institutional and engineering controls, and placement of a deed restriction for sensitive land uses at the Site, as described above. The estimated treatment duration is three years. Construction and startup of this alternative can be completed within six months of acceptance.

ALTERNATIVE E: Multi-phase Extraction with Institutional and Engineering Controls - A total of 50, 4-inch-diameter extraction wells will be installed to approximately 12 feet bgs on 30-foot centers throughout the remediation area. Wells will be connected through a series of manifolds to a blower capable of concurrently extracting free product, groundwater and soil vapors from the wells. Remediation will likely occur in zones comprised of 10 to 20 wells each. Zones will be cycled on and off based on results. Effluent will be separated; the water and vapor streams will be treated on-Site by separate processes using GAC. The recovered product will be sent to an off-site recycling facility. The final number and spacing of the extraction wells will be confirmed by conducting pilot tests prior to full-scale implementation of the alternative. Groundwater monitoring will be conducted on a semi-annual basis during and for one year following completion of the active remediation. This alternative also includes implementation of institutional and engineering controls, and placement of a deed restriction for sensitive land uses at the Site, as described above. The estimated treatment duration is two years. Construction and startup of this alternative can be completed within nine months of acceptance.

ALTERNATIVE F: Thermal In-Situ Treatment: Electrical Resistive Heating - A total of 50 electrodes will be installed to approximately 12 feet bgs on 30-foot centers throughout the remediation area to induce electrical resistive heating of the subsurface soils. A phased electrical current will be applied to the electrodes to heat the soils and elevate the soil temperature to approximately 100C. Increased subsurface temperatures will vaporize low molecular weight petroleum hydrocarbons and will reduce the viscosity of the residual hydrocarbons, thereby increasing its mobility. A multi-phase extraction system consisting of approximately 30 4-inch-diameter wells will be installed throughout the grid array to extract the mobilized petroleum hydrocarbons and soil vapors. Heating the soil will also result in a lowering of the water table in the immediate vicinity of the system exposing more unsaturated (vadose) zone to the extraction wells. Effluent will be separated; the water and vapor streams will be treated on-Site by separate processes using GAC. The recovered product will be sent to an off-site recycling facility. Existing PVC monitoring wells will be removed prior to implementation of this alternative to prevent potential collapsing of well casings due to elevated subsurface temperatures. The optimum number, spacing and orientation of electrodes will be confirmed by conducting a pilot test prior to full-scale implementation of this alternative. Groundwater monitoring will be conducted on a quarterly basis for one year following completion of the active remediation. The estimated treatment duration is one year. Construction and startup of this alternative can be completed within nine months of acceptance.

ALTERNATIVE G: Excavation and Off-site Disposal - Asphalt and concrete surface paving will be removed in the excavation area. An estimated 7,800 cubic yards (cy) of non-impacted soil will be excavated from ground surface to approximately 5 feet below grade (on average), stockpiled on-Site and characterized for re-use as backfill.

Approximately 11,800 cy of petroleum hydrocarbon-impacted soils will be excavated, managed, and transported to a permitted off-site disposal facility. The total depth of excavation is anticipated to be approximately 12 feet bgs, and is based on the depth of the residual petroleum hydrocarbons identified in soil borings during historic Site investigations. Due to the known shallow water table, dewatering will likely be required during excavation activities. Shoring may also be necessary to prevent the excavation walls from collapsing during implementation. The extracted groundwater will be temporarily stored on-Site, treated using GAC, and disposed under a temporary industrial wastewater discharge permit. Recovered product removed during excavation activities will be separated and stored on-Site for proper disposal. Confirmation samples will be collected along the sidewalls and at the base of the excavation prior to backfilling. The excavation will be backfilled with on-Site soils and clean imported fill. Quarterly groundwater monitoring will be conducted for one year following completion of the excavation activities. Four new 2-inch-diameter monitoring wells will be installed inside the excavation area following backfilling to supplement the existing array of monitoring wells. Construction and startup of this alternative can be completed within six months of acceptance.

6.3. Alternatives Evaluation

Malcolm Pirnie has evaluated the seven remedial alternatives based on the criteria specified in the National Oil and Hazardous Substances Pollution Contingency Plan (Title 40, Code of Federal Regulations, Chapter 1, Part 300), in addition to the criteria of sustainability. Malcolm Pirnie's analysis includes a comparative numeric ranking of each of the seven alternatives. The objective of this step is to select the remedial alternative that best meets the required evaluation criteria. Malcolm Pirnie's evaluation and comparative assessment of each remedial alternative is summarized in Table 6-2. Evaluation criteria are further described below.

6.3.1. Reliability and Effectiveness

An assessment of the potential for the remedial alternatives to successfully reduce risk to human health and the environment. Ranking is from 1 (low) to 5 (high).

- Alternatives A and B have low to moderately low rankings, as these alternatives will not effectively reduce the potential risk to the environment. By implementing the institutional and engineering controls, Alternative B will reduce the risk to human health.
- Alternatives C, D, E and F have been given moderate to moderately high rankings as they are expected to be reasonably effective at removing the free product from the subsurface, thereby reducing the risk to human health and the environment.
- Alternative G is expected to effectively remove the adsorbed petroleum hydrocarbons and free product from the subsurface, thereby reducing and/or eliminating impacts to

human health and the environment. This alternative has been assigned the highest ranking.

6.3.2. Reduction of Toxicity, Mobility, and Volume

An assessment of the potential for the remedial alternatives to successfully reduce the volume of the impacted groundwater and free product, chemically or physically alter the petroleum hydrocarbons to reduce the toxicity, and slow or stop its migration. Ranking is from 1 (low) to 5 (high).

- Alternatives A has a low ranking as this alternative will not readily reduce the toxicity or volume of the free product or dissolved petroleum hydrocarbons.
- Alternatives B and C have moderately low rankings. These alternatives are not expected to significantly reduce the toxicity or volume of the free product or dissolved petroleum hydrocarbons.
- Alternatives D and E are expected to be reasonably effective at reducing the volume of the dissolved and free product and, therefore, have been assigned a moderate ranking. Alternatives D and E are expected to increase oxygen in the subsurface, which should increase biodegradation, thereby further reducing toxicity and volume.
- Alternative F is expected to be reasonably effective at removing the free product from the subsurface. This alternative is also expected to break down the long-chain hydrocarbons into shorter chain molecules, increasing the biodegradation rate and further reducing the eco-toxicity of the COCs. This alternative has been assigned a moderately high ranking.
- Alternative G is the only alternative expected to effectively remove the free product and residual petroleum hydrocarbons in the source area, thereby eliminating the toxicity and volume of the COCs in the subsurface. This alternative has been assigned the highest ranking.

6.3.3. Implementability

An assessment of the technical (technology) and administrative (regulatory) feasibility of implementing the remedial alternatives. Ranking is from 1 (low) to 5 (high).

- Alternative A requires no further work at the Site, other than demolition of the existing system and wells, and, therefore, represents the easiest alternative to implement and is expected to have the least impact on Port operations. However, this alternative is not expected to achieve regulatory acceptance and has been given the lowest ranking.
- Alternatives F and G are technically feasible but have been given moderately low rankings as these alternatives are expected to significantly impact Port operations. As the Site is an active facility for maintenance of Port equipment, disruption in work-flow would result in significant impacts to facility operations, as well as other Port activities. Additionally, Alternative G will require disposal of a significant quantity of

soil off-Site and the likely preparation of an Environmental Impact Statement under the California Environmental Quality Act.

- Alternatives B, D and E have moderate to moderately high rankings as they are expected to only moderately impact Port operations. The three alternatives are technically feasible. Collection of groundwater samples is, of course, technically feasible and MNA for dissolved phase petroleum hydrocarbons (Alternative B) is an accepted remedial action by regulatory agencies. Alternative D requires the installation of and routine access to a significant number of wells. Alternative E includes installation of a significant number of wells and above-ground piping, restricting access to the area by Port employees.
- Alternative C has been assigned the highest ranking. Alternative C utilizes the existing on-Site wells. Implementation of this alternative does not impact Port operations.

6.3.4. Duration

The anticipated time, measured in years, required for the remedial alternative to be completed. Time begins when the oversight agency approves the Remedial Action Plan and ends when the State approves a No Further Action request. Ranking is from 1 (long) to 5 (short).

- Alternative C has been assigned the lowest ranking as it is expected to have a duration extending beyond 20 years.
- Alternative B would be implemented for a 5-year period, at which time the data would be evaluated to determine whether the monitoring program should continue or stop. This alternative has been assigned a moderately low ranking.
- Alternatives D, E and F are expected to be completed within three to six years, including confirmation monitoring and closure. Hence, these alternatives have been assigned moderate rankings.
- Alternative G could be completed within one to two years and has, therefore, been assigned a relatively high ranking.
- Alternative A requires no further work at the Site other than demolition of the existing system and, therefore, represents the shortest duration alternative. This alternative has been assigned the highest ranking.

6.3.5. Sustainability

Assessment of the overall impact to the environment and community including, but not limited to, the use of resources to implement the remedial alternatives (e.g., fuel, electricity), emissions to the environment via air or water, and the impact to the use of land/water as beneficial resources. The evaluation of sustainability is consistent with recent regulatory direction and guidance to consider the overall environmental effectiveness of remedial alternatives ("green remediation"). The following evaluation of sustainability is qualitative. A more detailed quantitative evaluation would require

conceptual plans and specifications be developed for each of the seven alternatives. Ranking is from 1 (not sustainable) to 5 (sustainable).

- Alternatives E, F and G are expected to use the most resources and produce the highest amount of greenhouse gases. These alternatives have been assigned low to moderately low rankings. Alternative E will require the use of a significant amount of PVC pipe for both the wells and the distribution manifold. Alternative F is expected to use a significant amount of electrical power, which will significantly increase the Port's greenhouse gas emissions. Alternative G will produce the largest amount of greenhouse gasses by tucking the waste soil to an appropriate disposal facility.
- Alternatives C and D represent moderately sustainable alternatives and have been given moderate rankings. Alternative C will require the use of PVC for the wells and the use of petroleum fuels for and the emission of greenhouse gasses from the large vacuum trucks traveling and from the Site. Alternative D utilizes some PVC pipe for the monitoring wells and manifold piping and uses a moderate amount of electricity to power the on-Site air compressor and blower.
- Alternative B requires that staff use a vehicle and routinely visit the Site to monitor wells and collect subsurface information, thereby generating a small amount of greenhouse gases. Residual petroleum hydrocarbons beneath the Site are not mobile and dissolved COCs do not exceed Site remedial goals at the downgradient property boundary; therefore, the use of off-Site groundwater as a beneficial resource is protected. On-Site groundwater use will be restricted through institutional controls. Hence, this alternative has been assigned a moderately high ranking for sustainability.
- Alternative A requires no further work at the Site other than demolition of the existing system and, therefore, will use the least amount of resources and produce the least amount of greenhouse gases. Residual petroleum hydrocarbons beneath the Site are not mobile and dissolved contaminants do not exceed Site remedial goals at the downgradient property boundary; therefore, the use of off-Site groundwater as a beneficial resource is protected. On-Site groundwater use will be restricted through institutional controls. This alternative has been assigned the highest ranking.

6.3.6. Cost

Costs include both capital (planning, permitting, construction, etc.) as well as long-term (operation, maintenance and monitoring). The estimated costs do not include the approximately $1.4M spent by the Port to date at the Site. To be consistent with the other criteria for evaluation of the alternatives, costs were ranked from 1 (high cost) to 5 (low cost). The estimated costs do not include a Net Present Value evaluation, as the Port funds its environmental programs annually. Detailed costing spreadsheets for each alternative are provided in Appendix C.

- Alternatives C, D, E, F and G are estimated to cost the Port between $2M and $4.2M to implement and, therefore, were assigned low to moderately low rankings.

- Alternative B is expected to cost approximately $290,000 over the next five years. This alternative has been assigned a moderately high ranking.
- Alternative A is estimated to cost less than $50,000, which will be expended within a single fiscal year. This alternative has been assigned the highest ranking.

6.4. Remedial Alternative Ranking

The final numeric ranking of the remedial alternatives is summarized in Table 6-3. Malcolm Pirnie developed an overall numeric score for each alternative based on a weighted ranking of the six criteria described above. The weighted ranking is based on the significance of each criterion to the RAO for the Site, as well as the Port's operational objectives and future anticipated use of the Site. If each criterion were equally important, the weight factor applied to each would be 16.7 percent. The weighting factor has been adjusted up or down to reflect the relative importance of the individual criterion. The weighted rankings applied to each criterion are:

Reliability and Effectiveness – 20%: Assurance that the remedial alternative selected for the Site will be effective at achieving the RAOs.

Reduction of Toxicity, Mobility, and Volume – 10%: Site data indicate that the dissolved phase hydrocarbons and free product are stable and/or decreasing with time. The risk assessment prepared for the Site indicates that the risk to human health from the Site COCs was acceptable prior to resumption of remedial actions in 2004. Hence, reduction of toxicity and mobility represent a less critical criterion.

Implementability – 20%: Assurance that the remedial alternative selected for the Site can be implemented, given the known physical and regulatory constraints.

Duration – 10%: The Port intends to own the property for the foreseeable future. Hence, duration represents a less critical criterion.

Sustainability – 15%: The Port is responsible to the community for minimizing impact to the environment, including generation of regulated wastes and greenhouse gases. Assuring that the remedial alternative selected will help reduce and/or minimize impacts to the environment is important to the Port.

Cost – 25%: As a public agency, the Port is very concerned about its current and future financial obligations. Minimizing obligations that are not directly related to revenue generation is important, as the Port is required to demonstrate efficient and effective management of its financial resources.

6.5. Recommended Remedial Alternative

Based on the weighted rankings summarized in Table 6-3, Malcolm Pirnie recommends implementing Alternative B: Monitored Natural Attenuation with Institutional and Engineering Controls. Further description of the selected alternative and implementation procedures are presented in Section 7.0.

7. Corrective Action Plan

Based on Malcolm Pirnie's evaluation and our discussions with the Port, Alternative B, Monitored Natural Attenuation with Institutional and Engineering Controls, will meet the RAOs and remedial goals in a cost-effective manner. The proposed alternative will monitor the natural attenuation of the COCs in groundwater beneath the Site, and will include the following activities:

1. The free product removal and vapor extraction system will be shut down. The pneumatic pumps will be removed from the wells and stored on-Site. The distribution piping will be purged with air and capped. Remediation equipment will remain in the on-site enclosure throughout the duration of the MNA program.

2. The current semi-annual groundwater monitoring program will be continued through the end of 2015. In addition to collecting samples for analysis of TPHd, TPHg, BTEX and MTBE, groundwater samples will also be analyzed for MNA parameters in 2011, 2013, and 2015. MNA parameters will include:

    - Total dissolved solids by USEPA Method 40 CFR 136/160.1;
    - Major cations (sodium, potassium, calcium and magnesium) by USEPA Method 200.7;
    - Major anions (bicarbonate, carbonate, sulfate, chloride, nitrate, nitrite, and phosphate) by USEPA Method 300.0;
    - Ferrous iron by USEPA Method 6010/6020;
    - Sulfide by USEPA Method E376.2;
    - Methane and carbon dioxide by USEPA Method RSK175;
    - Manganese by USEPA Method SW6010B; and
    - Measuring groundwater samples for ferrous iron in the field using a portable Hach™ Colorimeter.

In addition to the above laboratory analyses, field measurements of DO, oxidation/reduction potential, and pH will be recorded for each sampling location.

3. Free product measurements will be recorded from existing monitoring and product recovery wells on a quarterly basis during 2011 and on a semi-annual basis through 2015.

Investigation-derived waste (including decontamination water and purge water) will be containerized in labeled 55-gallon drums for off-site disposal.

Following the completion of the last semi-annual monitoring event in 2015, a Remedial Action Evaluation Report will be prepared and submitted to the ACHCSA. The Report will provide a detailed analysis of the water quality and MNA monitoring data, evaluate COC concentration trends in groundwater, tabulate free product thickness measurements, and make a recommendation for either continuation of the remedial action or no further action.

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Feasibility Study/Corrective Action Plan
Port of Oakland's Harbor Facilities Complex Site
651 Maritime Street, Oakland, CA

Tables

TABLE 2-1. Groundwater Analytical Results Summary
Feasibility Study / Corrective Action Plan
Harbor Facilities Complex, 651 Maritime Street, Oakland, California

Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-1									
	05/22/00	3,600	41,000	<3,000	100	13 [8]	2.9	2.05	3.2 [8]
	12/08/09	1,400	1,200 [2]	<300	120	2.9	1.8	3	<1.0
	06/17/10	Not sampled due to the presence of free-phase product							
	12/14/10	Not sampled due to the presence of free-phase product							
MW-2									
	05/27/94	87	470	NA	<0.5	<0.5	<0.5	<0.5	NA
	03/29/95	<50	110	1,400	<0.4	<0.3	<0.3	<0.4	NA
	09/06/95	<50	NA	NA	<0.4	<0.3	<0.3	<0.4	NA
	01/08/96	<50	<50	1200	<0.4	<0.3	<0.3	<0.4	NA
	04/04/96	<50	160	320	<0.5	<0.5	<0.5	<1.0	NA
	07/10/96	<50	120	1400	<0.4	<0.3	<0.3	<0.4	NA
	12/03/96	<50	230 [1,2]	<250	<0.5	<0.5	<0.5	<1.0	NA
	03/28/97	<50	714	<250	<0.5	<0.5	<0.5	<1.0	NA
	06/13/97	51	<50	<250	<0.5	<0.5	<0.5	<1.0	NA
	09/18/97	82	<50	<250	0.56	<0.5	<0.5	<1.0	NA
	12/31/97	<50	<47	<280	1.4	<0.5	<0.5	<1.0	NA
	04/13/98	<50	<50	<300	<0.5	<0.5	<0.5	<1.0	NA
	11/06/98	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/19/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	06/24/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/28/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	11/12/99	<50	120 [2,6]	<300	<0.5	<0.5	<0.5	<0.5	6.3 [8,9]
	02/11/00	<50	<50	<300	5.4	<0.5	<0.5	<0.5	<2
	05/22/00	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2
	09/06/00	<50	<50	<300	0.76 [8]	<0.5	<0.5	<0.5	<0.5 [10]
	12/19/00	200 [3,11]	<50	<300	39	1.8	<0.5	2.6	<0.5 [10,12]
	02/21/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	07/10/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	12/05/01	<50	<50	<300	4.4	<0.5	<0.5	<0.5	5.0 [14]
	03/08/02	<50	<50	<500	<0.5	<0.5	<0.5	<0.5	<5.0
	06/13/02	62 [15]	<57	<570	<0.5	<0.5	<0.5	<0.5	<5.0
	09/26/02	69 [2]	<50	<500	1.8	<0.5	<0.5	<0.5	<5.0
	12/12/02	<50	<50	<300	0.98	<0.5	<0.5	<0.5	<2.0
	03/17/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	06/18/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/03/03	<50	<50	<300	3.2	<0.5	<0.5	<0.5	<2.0
	11/26/03	<50	<50	<300	3	<0.5	<0.5	<0.5	<2.0
	03/05/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	06/02/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/03/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	12/16/04	<50	96 [6, 15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/29/05	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	08/10/05	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5

TABLE 2-1. Groundwater Analytical Results Summary
Feasibility Study / Corrective Action Plan
Harbor Facilities Complex, 651 Maritime Street, Oakland, California

Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-2 (cont)	09/29/05	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5
	12/21/05	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	03/24/06	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	07/28/06	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	11/29/06	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/01/07	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	11/14/07	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/05/08	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/18/08	390 [2]	840	<300	1.1	<0.5	0.9	<0.5	<0.5
	03/04/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	04/01/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/17/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/09/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/17/10	<50	220 [2]	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/15/10	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
MW-3									
	Not sampled due to the presence of free-phase product								
MW-4									
	09/11/95	150	<200	500	23	<0.3	<0.3	<0.4	NA
	01/08/96	790	90	400	170	1.2	0.6	0.6	NA
	04/04/96	1,100	180	300	320	1.6	1.1	1.2	NA
	07/10/96	1,200	120	300	470	1.5	0.8	0.8	NA
	12/03/96	990	220 [1,2]	<250	350	3.3	1.3	1.3	NA
	03/28/97	440 [2]	<50	<250	190	1.2	0.64	<1.0	NA
	06/13/97	1,300	92 [5]	<250	500	5.5	3.4	2.8	NA
	09/18/97	1,300	150	<250	550	4.9	2.1	2.00	NA
	12/31/97	73 [1,2,3]	<47	<280	110 [1]	1.0 [1]	<0.5	<1.0	NA
	04/13/98	150 [2,3]	<50	<300	520	2.9	<2.5	<5.0	NA
	11/06/98	<50	<50	<300	250	1.7	<1.0	<1.0	<4
	03/19/99	81	<50	<300	250	<1	1.2	<1.0	<4
Dup.	06/24/99	190	<50	<300	360	1.4	2.2	1.0	24
	09/28/99	750 [3,5]	63 [3,5]	<300	280	1.5	<1.0	<1.0	<4
	11/12/99	330 [3]	840 [2]	<300	740	<2.5	<2.5	<2.5	42 [9]
	02/11/00	200 [2]	<50	<300	58	0.73	<0.5	<0.5	4.4 [8]
	05/22/00	240	<50	<300	500	<2.5	<2.5	<2.5	17
	09/06/00	530 [2,3]	<50	<300	190	0.93	0.6	0.57	<0.5 [10]
	12/19/00	960 [3,11]	70 [5]	<300	420	<2.5	<2.5	<2.5	<0.5 [10,12]
	12/19/00	1,200 [3,11]	<50	<300	440	<2.5	<2.5	<2.5	<0.5 [10,12]
	02/21/01	450 [13]	<50	<300	120	<0.5	<0.5	<0.5	<0.5 [10]
	07/10/01	<250	110 [2,13]	<300	620	2.6	2.9	<2.5	<0.5 [8,10]
	12/05/01	180	<50	<300	61	<0.5	<0.5	<0.5	3.8 [14]
	03/08/02	490 [2]	54 [2]	<500	180	<2.5	<2.5	<2.5	<25
	06/13/02	830 [2]	<50	<500	250	<5.0	<5.0	<5.0	<50
Dup.	06/13/02	820 [2]	<56	<560	240	<5.0	<5.0	<5.0	<50

TABLE 2-1. Groundwater Analytical Results Summary
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Harbor Facilities Complex, 651 Maritime Street, Oakland, California

Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-4 (cont)	09/26/02	390 [2]	57	<500	150	2.1	<1.0	<1.0	<10
Dup.	09/26/02	500 [2]	<50 [16]	<500 [16]	200	1.5	<1.0	<1.0	<10
	12/12/02	580	<50	<300	240	1.4	0.56	<0.5	<2.0
Dup.	12/12/02	2,400	<50	<300	680	5.0	2.3	1.4	<2.0
	03/17/03	130 [15]	<50	<300	320 [17]	<0.5	<0.5	<0.5	<0.5 [10]
Dup.	03/17/03	82 [15]	<50	<300	190	0.64 [17]	0.56	0.53	<0.5 [10]
	06/18/03	360 [11, 15]	<50	<300	150	<0.5	<0.5	<0.5	<2.0
Dup.	06/18/03	330 [11, 15]	<50	<300	140	<0.5	<0.5	<0.5	<2.0
	09/03/03	140 [11, 15]	<50	<300	240	1.3	<0.5	<0.5	<2.0
Dup.	09/03/03	83 [11, 15]	<50	<300	130	0.58 [17]	<0.5	<0.5	<2.0
	11/26/03	160 [15]	68 [15]	<300	320	0.91 [17]	<0.5	0.53	<2.0
Dup.	11/26/03	120 [15]	<50	<300	210	0.66 [17]	<0.5	<0.5	<2.0
	03/05/04	90 [11]	<50	<300	190	1.1	0.55	0.50 [17]	23 [14,17], <0.5 [10]
Dup.	03/05/04	84 [11]	<50	<300	180	0.81	<0.5	<0.5	21 [14,17], <0.5 [10]
	06/02/04	620 [13]	<50	<300	210	0.55 [17]	<0.5	<0.5	<2.0
Dup.	06/02/04	400 [13]	<50	<300	130	<0.5	<0.5	<0.5	<2.0
	09/03/04	780 [13, 15]	<50	<300	<0.5	1.0 [17]	<0.5	0.57	<2.0
Dup.	09/03/04	370 [13, 15]	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	12/16/04	840	<50	<300	290	1.3 [17]	0.69	0.75	<2.0
Dup.	12/16/04	670	<50	<300	230	1.3 [17]	<0.5	<0.5	<2.0
	03/29/05	440 [13]	<50	<300	140	0.57	<0.5	<0.5	<2.0
Dup.	03/29/05	540 [13]	<50	<300	170	0.72	<0.5	<0.5	<2.0
	08/10/05	500 [18]	<50	<250	180	<2.5	<2.5	<2.5	<2.5
	09/29/05	360 [18]	59 [20]	<250	160	<5.0	<5.0	<5.0	<5.0
Dup.	09/29/05	420 [18]	<50	<250	150	<5.0	<5.0	<5.0	<5.0
	12/21/05	110	<50	<300	76	<0.5	<0.5	<0.5	<0.5
Dup.	12/21/05	160	<50	<300	76	<0.5	<0.5	<0.5	<0.5
	03/24/06	420	51	<300	120	0.8	<0.7	<0.7	<0.7
Dup.	03/24/06	440	<50	<300	130	<0.7	<0.7	<0.7	<0.7
	08/04/06	560	92 [2]	<300	160	<1.3	4.3	<1.3	<1.3
Dup.	08/04/06	590	100 [2]	<300	150	<1.3	4.5	<1.3	<1.3
	11/29/06	300	<50	<300	42	<0.7	1.0	<0.7	<0.7
Dup.	11/29/06	300	<50	<300	60	<0.7	<0.7	<0.7	<0.7
	06/01/07	100 [13, 15]	<50	<300	10	<0.5	<0.5	<0.5	<0.5
Dup.	06/01/07	100 [13, 15]	<50	<300	11	<0.5	<0.5	<0.5	<0.5
	11/14/07	54 [15]	<50	<300	2.1	<0.5	<0.5	<0.5	<0.5
Dup.	11/14/07	51 [15]	<50	<300	2.1	<0.5	<0.5	<0.5	<0.5
	06/05/08	67 [15]	<50	<300	14	<0.5	<0.5	<0.5	<0.5
Dup.	06/05/08	91 [15]	<50	<300	15	<0.5	<0.5	<0.5	<0.5
	12/18/08	99 [2]	520	<300	0.5	<0.5	<0.5	<0.5	<0.5
Dup.	12/18/08	88 [2]	850	<300	0.7	<0.5	0.6	<0.5	<0.5
	03/04/09	60 [2]	<50	<300	3.8	<0.5	<0.5	<0.5	<0.5
Dup.	03/04/09	<50	<50	<300	4.4	<0.5	<0.5	<0.5	<0.5

TABLE 2-1. Groundwater Analytical Results Summary
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Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-4 (cont)	04/01/09	<50	<50	<300	7.5	<0.5	<0.5	<0.5	<0.5
Dup.	04/01/09	<50	<50	<300	7.8	<0.5	<0.5	<0.5	<0.5
	06/19/09	69 [2]	<50	<300	15	<0.5	<0.5	<0.5	<0.5
	12/08/09	<50	<50	<300	3.3	<0.5	<0.5	<0.5	<0.5
Dup.	12/08/09	<50	<50	<300	3.5	<0.5	<0.5	<0.5	<0.5
	06/16/10	<50	<50	<300	15	<0.5	<0.5	<0.5	<0.5
Dup.	06/16/10	<50	<50	<300	18	<0.5	<0.5	<0.5	<0.5
	12/14/10	<50	<50	<300	2.2	<0.5	<0.5	<0.5	<0.5
Dup.	12/14/10	<50	<50	<300	2.7	<0.5	<0.5	<0.5	<0.5
MW-5									
	09/11/95	90	<300	2,500	3.3	<0.3	<0.3	<0.4	NA
	04/04/96	<50	180	520	<0.5	<0.5	<0.5	<1.0	NA
	07/10/96	<50	120	1,500	<0.4	<0.3	<0.3	<0.4	NA
	12/03/96	<50	200 [1,2]	<250	<0.5	<0.5	<0.5	<1.0	NA
	03/28/97	<50	<50	<250	<0.5	<0.5	<0.5	<1.0	NA
	06/13/97	<50	<50	<250	<0.5	<0.5	<0.5	<1.0	NA
	09/18/97	<50	<50	<250	<0.5	<0.5	<0.5	<1.0	NA
	12/31/97	<50	<47	<280	<0.5	<0.5	<0.5	<1.0	NA
	04/13/98	<50	<47	<280	<0.5	<0.5	<0.5	<1.0	NA
	11/06/98	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/19/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	06/24/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	3.1
	09/28/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	11/12/99	<50	110 [2,6]	<300	<0.5	<0.5	<0.5	<0.5	5.5 [9]
	02/11/00	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	05/22/00	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/06/00	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	12/19/00	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	02/21/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	07/10/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	12/05/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/08/02	<50	<50	<500	<0.5	<0.5	<0.5	<0.5	<5.0
	06/13/02	<50	<50	<500	<0.5	<0.5	<0.5	<0.5	<5.0
	09/26/02	<50	<50	<500	<0.5	<0.5	<0.5	<0.5	<5.0
	12/12/02	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/17/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5 [10]
	06/18/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/03/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	11/26/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	4.1 [14], <0.5 [10]
	03/05/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	06/02/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/03/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	12/16/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	2.2 [14], <0.5 [10]
	03/29/05	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0

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Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-5 (cont)	08/10/05	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5
Dup.	08/10/05	<50 [19]	<50 [19]	<250	<0.5	<0.5	<0.5	<0.5	<0.5
	09/29/05	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5
	12/21/05	<50	180 [15,22]	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	07/28/06	<50	180	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	11/29/06	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/01/07	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	11/14/07	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/05/08	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/18/08	3,100 [2]	3,600	<300	0.5	<0.5	<0.5	<0.5	1.8
	03/04/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	04/01/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	04/01/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/19/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/08/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/16/10	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/14/10	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
MW-6									
	11/06/98	120	12,000	1,200	19	0.65	1.8	<0.5	<2
	03/19/99	170	3,800	580	21	0.86	1.5	2.9	<2
	06/24/99	120	1,700 [7]	<300 [7]	18	<0.5	1.0	<0.5	54
	09/28/99	130 [3,5]	820	<300	20	0.51	2.2	<0.5	<2
	11/12/99	150	11,000 [2,6]	3,000 [3,6]	27	<0.5	2.2	<0.5	13 [9]
	02/11/00	270 [2]	2,300	<300	23	0.51	2.7	<0.5	5.8
	05/22/00	350	3,000	<300	18	0.51	<0.5	<0.5	7.7
	09/06/00	190	610	<300	26	<0.5	1.7	<0.5	<0.5 [10]
	12/19/00	130 [3,11]	620	<300	24	<0.5	1.6	<0.5	<2
	02/21/01	120 [13]	440	<300	21	<0.5	0.96	<0.5	<2
	07/10/01	120	560	<300	29	<0.5	0.99	<0.5	<2
	12/12/01	53	550	<300	27	<0.5	1.3	<0.5	<2.0
	03/08/02	160 [2]	640 [2]	<500	30	<0.5	<0.5	<0.5	5.0 [14]
	06/13/02	160 [2]	670 [2]	<500	34	<0.5	<0.5	<0.5	<5.0
	09/26/02	230 [2]	1400 [2]	<500	40	0.64	0.8	<0.5	<5.0
	12/12/02	53	110	<300	43	<0.5	<0.5	<0.5	<2.0
	12/18/02	Monitoring well was destroyed							
MW-7									
	09/06/95	<50	<300	800	<0.4	<0.3	<0.3	<0.4	NA
	01/08/96	<50	410	110	<0.4	<0.3	<0.3	<0.4	NA
	04/04/96	<50	530	340	<0.5	<0.5	<0.5	<1.0	NA
	07/10/96	80	840	1,700	<0.4	<0.3	<0.3	<0.4	NA
	12/03/96	<50	280 [1,2]	<250	<0.5	<0.5	<0.5	<1.0	NA
	03/28/97	65 [6]	94 [2]	<250	<0.5	<0.5	<0.5	<1.0	NA
	06/13/97	<50	100	<250	<0.5	<0.5	<0.5	<1.0	NA
	09/18/97	<50	240	<250	<0.5	<0.5	<0.5	<1.0	NA

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Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-7 (cont)	12/31/97	<50	53 [2,3]	<280	<0.5	<0.5	<0.5	<1.0	NA
	04/13/98	<50	<48	<290	<0.5	<0.5	<0.5	<1.0	NA
	11/06/98	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2
	03/19/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	5.3
	06/24/99	73	<50	<300	<0.5	<0.5	<0.5	<0.5	12
	09/28/99	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	14
	11/12/99	<50	600 [2,6]	420 [3]	<0.5	<0.5	<0.5	<0.5	15 [9]
	02/11/00	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	51
	05/22/00	110	53 [2]	<300	<0.5	<0.5	<0.5	<0.5	75
	09/06/00	50 [6]	<50	<300	<0.5	<0.5	<0.5	<0.5	40 [10]
	12/19/00	54 [11]	51 [5]	<300	<0.5	<0.5	<0.5	<0.5	47 [10,12]
	02/21/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	66 [10]
Dup.	02/21/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	60 [10]
	07/10/01	<50	51 [2]	<300	<0.5	<0.5	<0.5	<0.5	76 [10]
Dup.	07/10/01	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	75 [10]
	12/12/01	51	<50	<300	<0.5	<0.5	<0.5	<0.5	98 [14]
Dup.	12/12/01	64	52 [13, 15]	<300	<0.5	<0.5	<0.5	<0.5	96 [14]
	03/08/02	52 [2]	<50	<500	<0.5	<0.5	<0.5	<0.5	24 [14]
	06/13/02	87 [2]	54 [2]	<500	<0.5	<0.5	<0.5	<0.5	51
	09/26/02	83 [2]	84 [2]	<500	<0.5	<0.5	<0.5	<0.5	75 [10]
	12/12/02	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	58 [14]
	12/18/02	Monitoring well was destroyed							
MW-8									
	Not sampled due to the presence of fre-phase product. Destroyed and Replaced by monitoring well MW-8A								
MW-8A									
	12/12/01	68	720 [11,15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/08/02	<50	760 [2]	<570	<0.5	<0.5	<0.5	<0.5	<5.0
Dup.	03/08/02	<50	350 [2]	<580	<0.5	<0.5	<0.5	<0.5	<5.0
	06/13/02	<50	570 [2]	<570	<0.5	<0.5	<0.5	<0.5	<5.0
	09/26/02	<50	410 [2]	<500	<0.5	<0.5	<0.5	<0.5	<5.0
	12/12/02	<50	160 [15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/17/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5 [10]
	06/18/03	<50	74 [15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/03/03	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	3.0 [14]/<0.5 [10]
	11/26/03	<50	94 [15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/05/04	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	06/02/04	<50	67 [15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	09/03/04	<50	86 [15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	12/16/04	<50	160 [6, 15]	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	03/29/05	<50	53	<300	<0.5	<0.5	<0.5	<0.5	<2.0
	08/10/05	<50 [19]	150 [15, 19]	<250	<0.5	<0.5	<0.5	<0.5	<0.5
	09/29/05	<50	66 [21]	<250	<0.5	<0.5	<0.5	<0.5	<0.5
	12/21/05	<50	63 [15,22]	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	03/24/06	<50	71	<300	<0.5	<0.5	<0.5	<0.5	<0.5

TABLE 2-1. Groundwater Analytical Results Summary
Feasibility Study / Corrective Action Plan
Harbor Facilities Complex, 651 Maritime Street, Oakland, California

Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE
MW-8A (cont)	07/28/06	<50	70 [15]	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	11/29/06	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/01/07	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	11/14/07	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/05/08	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/18/08	350 [2]	7,800	2,200 [2]	<0.5	<0.5	<0.5	<0.5	1.3
	03/04/09	<50	51 [2]	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	04/01/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/17/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/08/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/16/10	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/14/10	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
MW-9									
	12/18/08	52 [2]	72	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	03/04/09	290 [2]	310 [2]	<300	44	<0.5	0.6	0.6	<0.5
	04/01/09	210 [2]	210 [2]	<300	36	<0.5	<0.5	<0.5	<0.5
	06/19/09	240 [2]	240 [2]	<300	43	<0.5	<0.5	<0.5	<0.5
	12/08/09	210 [2]	210 [2]	<300	48	<0.5	<0.5	<0.5	<0.5
	06/16/10	160 [2]	160 [2]	<300	49	<0.5	1.0	0.6	<0.5
	12/14/10	170 [2]	130 [2]	<300	34	<0.5	<0.5	0.6	<0.5
MW-10									
	12/18/08	140 [2]	8,000	430 [2]	<0.5	<0.5	<0.5	<0.5	1.0
	03/04/09	96 [2]	110 [2]	<300	11	<0.5	0.5	<0.5	<0.5
	04/01/09	87 [2]	100 [2]	<300	14	<0.5	0.5	<0.5	<0.5
	06/17/09	90 [2]	220 [2]	<300	10	<0.5	1.0	<0.5	<0.5
	12/08/09	120 [2]	240 [2]	<300	26	<0.5	0.8	<0.5	<0.5
	06/16/10	140 [2]	200	<300	46	<0.5	<0.5	<0.5	<0.5
	12/14/10	150 [2]	140 [2]	<300	47	<0.5	<0.5	<0.5	<0.5
MW-11									
	12/18/08	1,900 [2]	15,000	800 [2]	<0.5	<0.5	<0.5	<0.5	5.0
	03/04/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	04/01/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/19/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/09/09	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	06/16/10	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
	12/14/10	<50	<50	<300	<0.5	<0.5	<0.5	<0.5	<0.5
MW-12									
	12/18/08	25,000 [2]	19,000	980 [2]	<0.5	<0.5	<0.5	<0.5	5.1
	03/04/09	150 [2]	550 [2]	<300	<0.5	<0.5	<0.5	<0.5	4.8
	04/01/09	71 [2]	420 [2]	<300	<0.5	<0.5	<0.5	<0.5	5.8
	06/17/09	64 [2]	310 [2]	<300	<0.5	<0.5	<0.5	<0.5	5.7
Dup.	06/17/09	67 [2]	310 [2]	<300	<0.5	<0.5	<0.5	<0.5	5.4
	12/08/09	90 [2]	320 [2]	<300	<0.5	<0.5	<0.5	<0.5	4.7
	06/16/10	94 [2]	300	<300	<0.5	<0.5	<0.5	<0.5	4.8
	12/14/10	100 [2]	510	<300	<0.5	<0.5	<0.5	<0.5	4.0

TABLE 2-1. Groundwater Analytical Results Summary
Feasibility Study / Corrective Action Plan
Harbor Facilities Complex, 651 Maritime Street, Oakland, California

Monitoring Well	Date Sampled	Concentration (µg/L)							
		TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Total Xylenes	MTBE

Notes:
Data prior to December 2005 obtained from *3rd Quarterly Groundwater Monitoring, and Product Recovery Report,* dated 8 November 2005, by Innovative Technical Solutions, Inc.
µg/L = micrograms per liter
Dup. = duplicate sample
NA = not analyzed
TPHg = total petroleum hydrocarbons in gasoline range.
TPHd = total petroleum hydrocarbons in diesel range.
TPHmo = total petroleum hydrocarbons in motor oil range.
MTBE = methyl tert-butyl ether
[1] Analyte found in the associated blank as well as in the sample.
[2] Hydrocarbons present do not match profile of laboratory standard.
[3] Low boiling point/lighter hydrocarbons are present in the sample.
[4] Chromatographic pattern matches known laboratory contaminant.
[5] Hydrocarbons are present in the requested fuel quantification range, but do not resemble pattern of available fuel standard.
[6] High boiling point/heavier hydrocarbons are present in sample.
[7] Sample did not pass laboratory QA/QC and may be biased low.
[8] Presence of this compound confirmed by second column, however, the confirmation concentration differed from the reported result by more than a factor of two.
[9] Trip blank contained MTBE at a concentration of 4.2 mg/L.
[10] MTBE detections confirmed by EPA Test Method 8260; 8260 results displayed.
[11] Sample exhibits unknown single peak or peaks.
[12] EPA Method 8260 confirmation analyzed past holding time.
[13] Lighter hydrocarbons contributed to the quantitation.
[14] MTBE results from EPA Test Method 8021B.
[15] Sample exhibits fuel pattern that does not resemble standard.
[16] Sample extracted out of hold time.
[17] Presence confirmed, but Relative Percent Difference (RPD) between columns exceeds 40%.
[18] Unmodified or weakly modified gasoline is significant.
[19] Liquid sample contains greater than ~1 vol. % sediment.
[20] Gasoline compounds are significant.
[21] Diesel range compounds are significant; no recognizable pattern.
[22] Heavier hydrocarbons contributed to the quantitation.

Table 6-1
Preliminary List of Remedial Alternatives
Feasibility Study / Corrective Action Plan
Harbor Facilities Complex, 651 Maritime Street, Oakland, CA

No.	Remedial Technology	Description	Comments	Selected for further evaluation?
1	No Further Action	Discontinue existing free product removal and groundwater monitoring activities, remove recovery system and wells, and obtain site closure.	Option required to be evaluated under CERCLA.	Yes
2	Containment Zone	Formal de-designation of beneficial use of groundwater beneath the Site. Groundwater monitoring required to ensure stable free product and dissolved plume.	Requires public input and legal change of groundwater beneficial use designation within containment zone. Onerous process that requires issueance of a Cleanup and Abatement Order from the Board	No
3	Monitored Natural Attenuation	Discontinue existing free product removal activities; long-term monitoring of groundwater to ensure that free product and dissolved plume are stable and degradation is occuring.	May achieve remedial goals over time.	Yes
4	Physical Containment	Use of physical barriers, such as sheet piling or concrete slurry, to prevent free product and/or dissolved plume migration.	Free product and dissolved plumes are stable and do not require physical containment.	No
5	Excavation and Off-site Disposal	Excavation and removal of free product together with impacted soil, and hauling of contaminated media off-site for proper disposal; replace with import fill.	Will remove free product source. Depth of excavation will need to extend 5 to 10 feet below water table surface to be effective.	Yes
6	Cut-off Trench	Installation of multiple trenches throughout and downgradient of the free product plume. Backfill trenches with permeable materials. Installation, operation and maintenance of free product removal equipment required.	Free product plume not migrating. Trench installation costs expected to exceed costs for installation of multiple wells. Will result in extraction and treatment of a significant amount of groundwater, increasing operation and maintenance costs.	No
7	Free Product Removal	Installation of hydrophobic sorbents or passive recovery bailers in groundwater wells to collect free product, which is then pumped to an above-ground storage tank for disposal. Requires continual operation and maintenance.	Pneumatic free product recovery pumps are currently used at the Site. Free product removal is being enhanced using a soil vapor extraction system.	Yes
8	Multi-phase Extraction	High vacuum extraction of free product, groundwater and soil vapors through wells placed on a grid across the remediation area. Includes above-ground separation, treatment and disposal of water, oil and vapor.	Requires pilot testing for system design. Installation of wells and an on-site treatment unit. Continuous or cyclic operation of system. Routine operation and maintenance activities.	Yes
9	Mobile High Vacuum Extraction	High vacuum extraction of free product, groundwater and vapors through wells placed on a grid across the remediation area. Extraction occurs intermittently using a mobile vacuum truck. Extracted fluids are disposed directly into the vacuum truck without	Requires pilot testing to determine well spacing and extraction intervals. Routine site visits to extract fluids.	Yes
11	In-situ Thermal Treatment: Steam Injection and Extraction	Use of steam heat in the subsurface to vaporize, dissolve, and mobilize free product, which is then captured through extraction.	Requires pilot testing. On-site steam generation, and seperation treatment and disposal of extracted fluids. Continuous operation of system. Routine operation and maintenance. Available information indicates this technology is not cost-effective in low permeable environments.	No
12	In-situ Thermal Treatment: Electrical Resistive Heating	Use of electrical resistance to mobilize free product for enhanced recovery and promote volatilization of free product with removal through soil vapor extraction.	Requires pilot testing. Installation of eletrodes on a grid basis and extraction wells to remove mobilized fluids and soil vapor. Continuous operation and routine maintenance. Above-ground treatment of vapors and extracted fluids.	Yes
13	Fracturing	Development of preferential horizontal and/or vertical drainage pathways in the subsurface to enhance flow and capture of free product. Fractures are maintained long-term by filling with sand.	Limited extent of fractures can impact effectiveness. Numerous fracture points required across free product footprint. Technology only increases removal rate of free product in close proximity to fracture. Not considered to be a viable alternative for the Site.	No
14	In Situ Chemical Oxidation	Injection of chemical oxidants (peroxide, persulfate, ozone, etc.) into the subsurface to destroy free product.	Presence of free product requires a significant quantity of chemical oxidant to be injected for successful completion of the remedial alternative. This technology is not considered to be a cost-effective solution.	No
15	Air Sparging	Injection of air (or oxygen) into sparge wells placed on a grid basis across the free product footprint. Injected air causes volatilization of lighter fraction hydrocarbons and increases biodegradation rate of the remaining COCs.	Requires pilot testing. Requires installation of above-ground vapor treatment unit. This technology is not expected to be cost-effective for diesel range hydrocarbons. Requires installation and operation of a soil vapor extraction system to remove vapors.	No
16	Surfactant Flushing	Injection of a surfactant into the free product plume and extraction of the free product for above-ground treatment and disposal.	Requires pilot testing to determine optimum surfactant quality and quantity, and well spacing. Requires installation of injection and extraction wells, and above-ground treatment unit. This technology is not expected to be cost-effective based on the low permeability of the Site soils.	No
17	Biostimulation	Injection of nutrients and/or oxygen to stimulate biological degradation of dissolved plumes.	Dissolved plume is currently stable and contained within the Site boundaries. This technology is not effective for free product and is therefore not a viable alternative for the Site.	No
18	Nanotechnology	Injection of nanoscale materials into the subsurface to remediate contaminated soil and groundwater.	Not considered cost-effective in low-permeable soils. This is an unproven technology for free product and not considered to be a viable alternative for the Site.	No

Table 6-2
Alternatives for Remediation of Petroleum Hydrocarbons
Feasibility Study / Corrective Action Plan
Harbor Facilities Complex, 651 Maritime Street, Oakland, CA

Alternative		Reliability/ Effectiveness[a]	TMV Reduction[b]	Implementability[c]	Duration[d]	Sustainability[e]	Relative Cost	Estimated Total Costs
A	No Further Action	1	1	1	5	5	5	$50,000
B	Monitored Natural Attenuation with Institutional and Engineering Controls	2	2	4	2	4	4	$370,000
C	Product Removal Using Pneumatic Skimmers	3	2	5	1	3	2	$2,070,000
D	Mobile High Vacuum Extraction with Institutional and Engineering Controls	4	3	3	3	3	2	$2,260,000
E	Multi-phase Extraction with Institutional and Engineering Controls	4	3	3	3	2	2	$2,040,000
F	Thermal In-situ Treatment: Electrical Resistive Heating	4	4	2	3	1	1	$3,110,000
G	Excavation and Off-site Disposal	5	5	2	4	1	1	$4,180,000

Notes:

Evaluations are based on professional opinions and preliminary cost estimates. Alternatives are ranked from 5 (best performing for the respective criterion) to 1 (worst performing).

NPV = Net Present Value. Calculated using an anuual discount rate of 7%.

[a] Predicted potential for the alternative to address short-term and long-term risks and provide reliable remedial success over time.

[b] Predicted potential for the alternative to reduce toxicity, mobility and/or volume (TMV) of the free product and dissolved COCs.

[c] Technical (technology) and administrative (regulatory) feasibility of implementing the remedial alternative.

[d] Includes time for planning, permitting, approvals, installation, operation and monitoring.

[e] Qualitative comparison of the use of materials and energy, generation of waste, and impact on use of beneficial resources.

Table 6-3
Remedial Alternative Evaluation Summary
Feasibility Study / Corrective Action Plan
Harbor Facilities Complex, 651 Maritime Street, Oakland, CA

Rank[a]	Alternative		Estimated Costs ($)	Weighted Score[b]
1	B	Monitored Natural Attenuation with Institutional and Engineering Controls	370,000	3.20
2	A	No Further Action	50,000	3.00
3	D	Mobile High Vacuum Extraction with Institutional and Engineering Controls	2,260,000	2.95
4	C	Product Removal Using Pneumatic Skimmers	2,070,000	2.85
5	E	Multi-phase Extraction with Institutional and Engineering Controls	2,040,000	2.80
6	G	Excavation and Off-site Disposal	4,180,000	2.70
7	F	Thermal In-situ Treatment: Electrical Resistive Heating	3,110,000	2.30

Notes:

[a] Based on the weighted score. A ranking of 1 represents the most desirable alternative. A ranking of 7 represents the least desirable alternative.

[b] Calculated assuming the following criteria:

Cost - most critical factor to the Port. Assigned a 25% weighting factor.

Reliability/Effectiveness and Implementability - second most critical factors to the Port. Assigned a 20% weighting factor each.

Sustainability - important to the Port. Assigned a 15% weighting factor.

TMV Reduction and Duration - least critical factors to the Port. Assigned a 10% weighting factor for each.

Port of Oakland
Feasibility Study/Corrective Action Plan
Port of Oakland's Harbor Facilities Complex Site
651 Maritime Street, Oakland, CA

Figures

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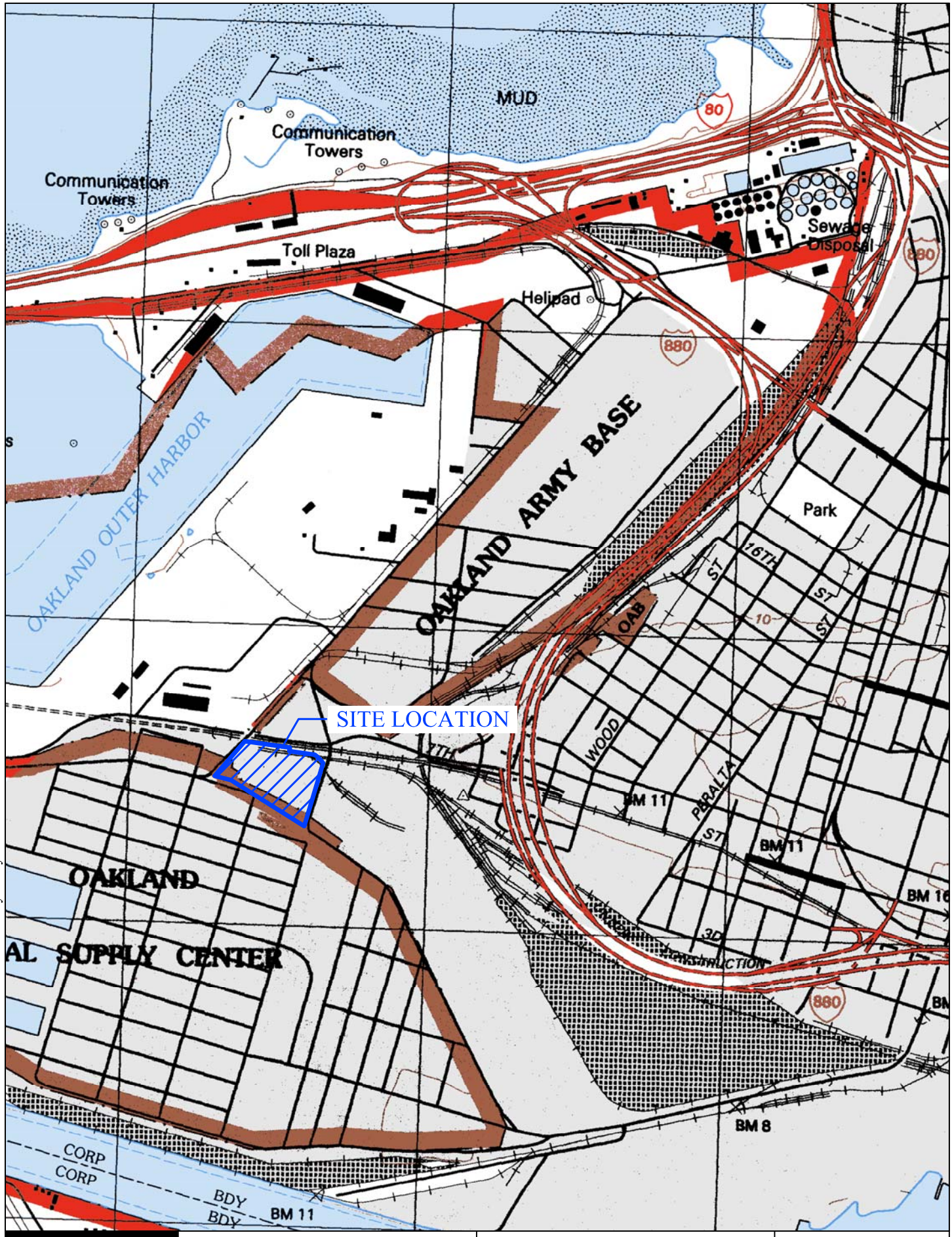

MALCOLM PIRNIE

PORT OF OAKLAND
HARBOR FACILITIES COMPLEX
651 MARITIME STREET, OAKLAND, CA

SITE LOCATION MAP

MALCOLM PIRNIE, INC.
MARCH 2011
FIGURE 2-1

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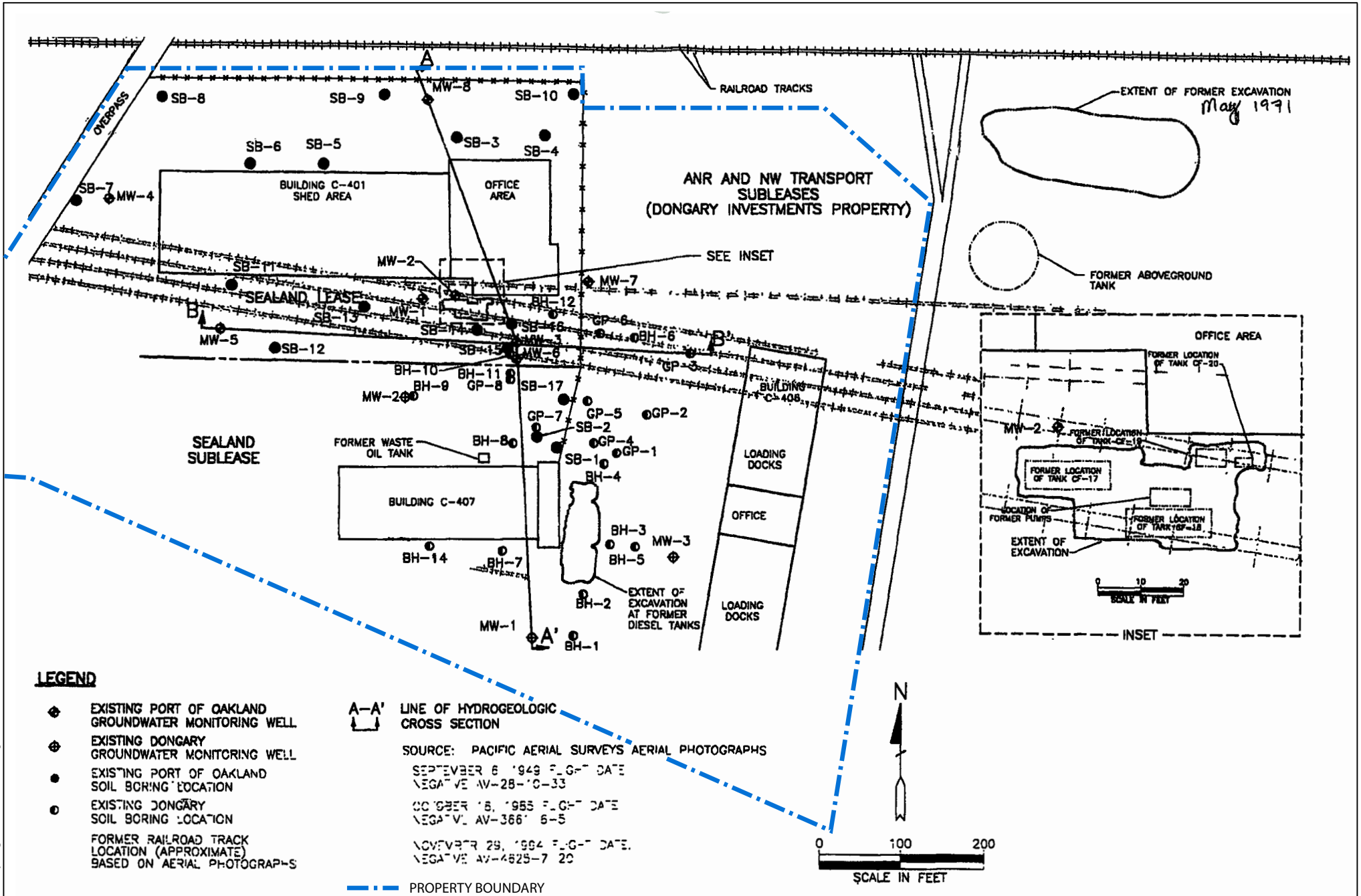


P:\4656\016acad\Feasibility Study\Figure 2-2 - Site Plan.pdf

MALCOLM PIRNIE

PORT OF OAKLAND

HARBOR FACILITIES COMPLEX

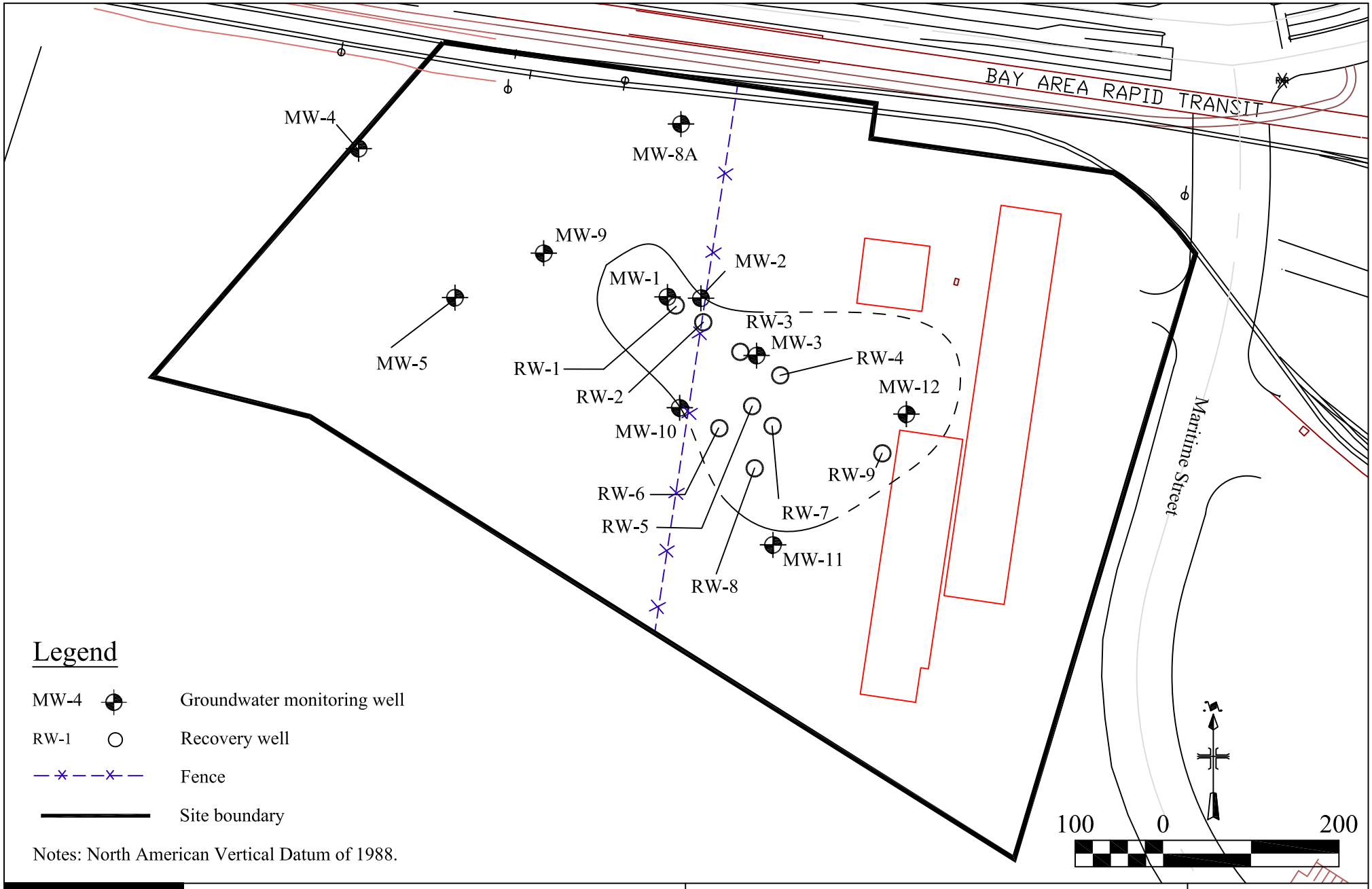
651 MARITIME STREET, OAKLAND, CA

1993/1994 SITE INVESTIGATION AND SAMPLING LOCATIONS

MALCOLM PIRNIE, INC.

MARCH 2011

FIGURE 2-2



MALCOLM PIRNIE

PORT OF OAKLAND
HARBOR FACILITIES COMPLEX
651 MARITIME STREET, OAKLAND, CA

SITE PLAN

MALCOLM PIRNIE, INC.
MARCH 2011
FIGURE 2-3

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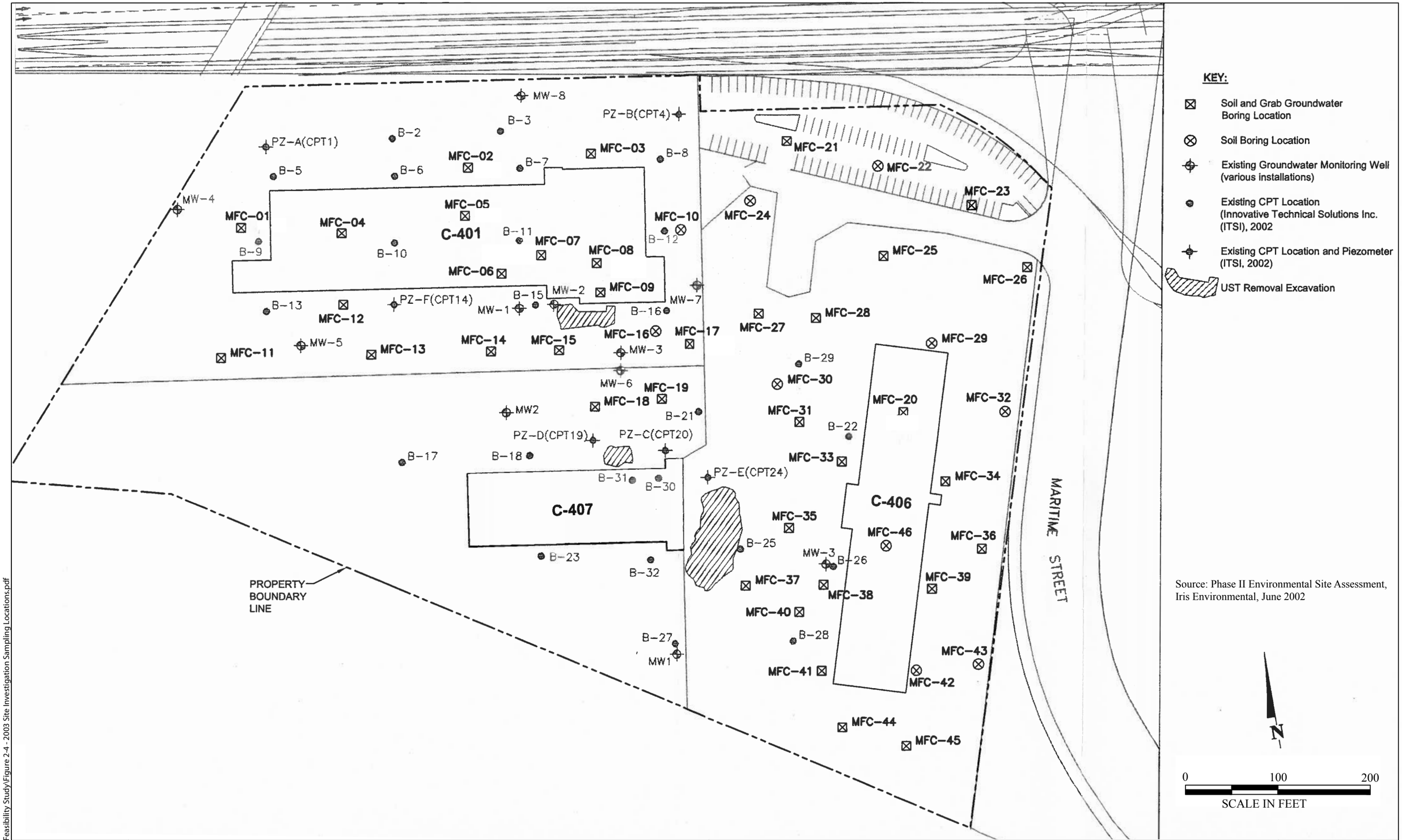

P:\46561016\acad\Feasibility Study\Figure 2-4 - 2003 Site Investigation Sampling Locations.pdf

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HARBOR FACILITIES COMPLEX

651 MARITIME STREET, OAKLAND, CA

2003 SITE INVESTIGATION SAMPLING LOCATIONS

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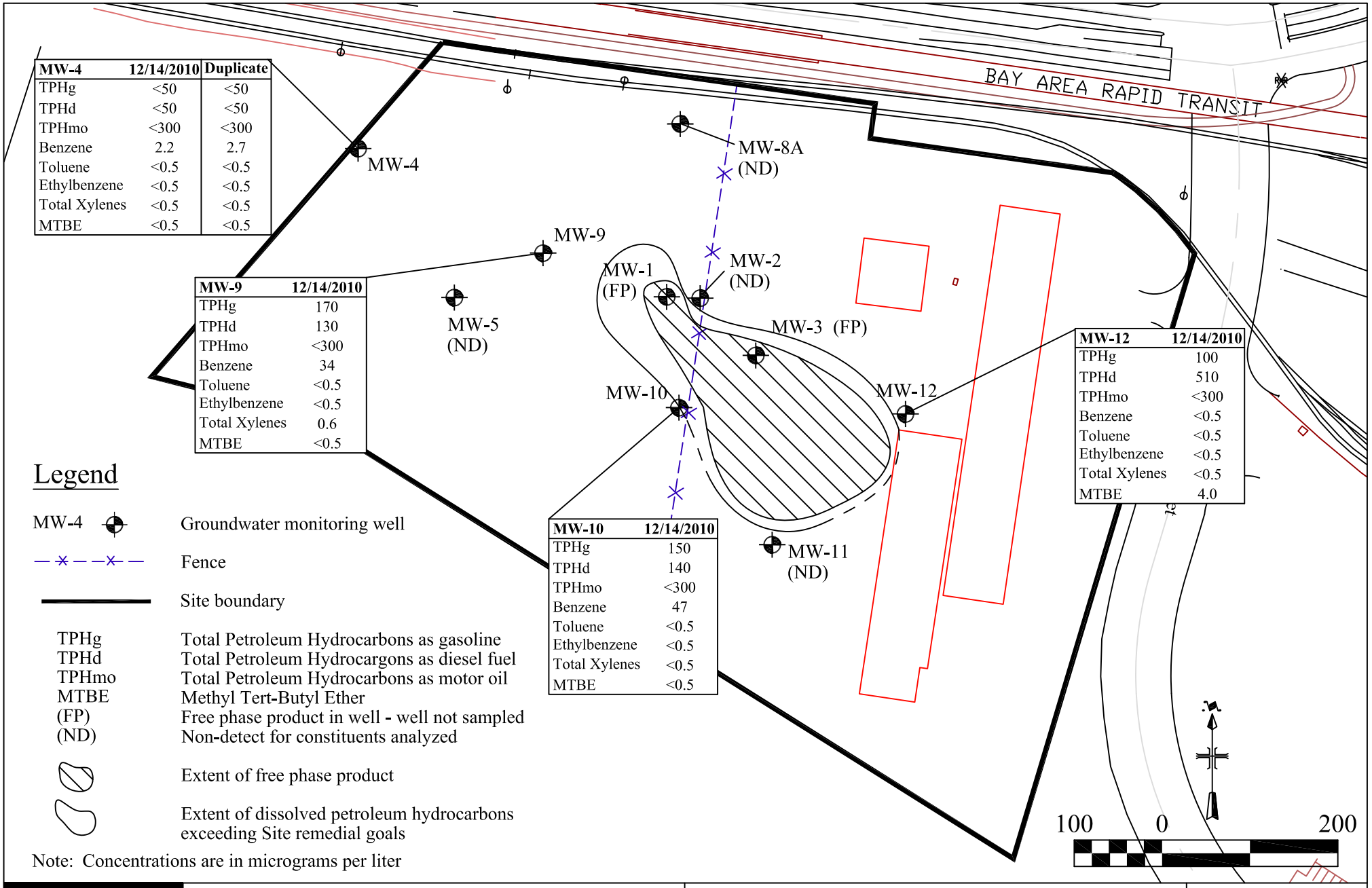
FIGURE 2-4



MW-4	12/14/2010	Duplicate
TPHg	<50	<50
TPHd	<50	<50
TPHmo	<300	<300
Benzene	2.2	2.7
Toluene	<0.5	<0.5
Ethylbenzene	<0.5	<0.5
Total Xylenes	<0.5	<0.5
MTBE	<0.5	<0.5

MW-9	12/14/2010
TPHg	170
TPHd	130
TPHmo	<300
Benzene	34
Toluene	<0.5
Ethylbenzene	<0.5
Total Xylenes	0.6
MTBE	<0.5

MW-12	12/14/2010
TPHg	100
TPHd	510
TPHmo	<300
Benzene	<0.5
Toluene	<0.5
Ethylbenzene	<0.5
Total Xylenes	<0.5
MTBE	4.0

MW-10	12/14/2010
TPHg	150
TPHd	140
TPHmo	<300
Benzene	47
Toluene	<0.5
Ethylbenzene	<0.5
Total Xylenes	<0.5
MTBE	<0.5

Legend

MW-4 — Groundwater monitoring well

Fence

Site boundary

TPHg — Total Petroleum Hydrocarbons as gasoline
TPHd — Total Petroleum Hydrocargons as diesel fuel
TPHmo — Total Petroleum Hydrocarbons as motor oil
MTBE — Methyl Tert-Butyl Ether
(FP) — Free phase product in well - well not sampled
(ND) — Non-detect for constituents analyzed

Extent of free phase product

Extent of dissolved petroleum hydrocarbons exceeding Site remedial goals

Note: Concentrations are in micrograms per liter

MALCOLM PIRNIE

PORT OF OAKLAND
HARBOR FACILITIES COMPLEX
651 MARITIME STREET, OAKLAND, CA

LATERAL EXTENT OF PETROLEUM HYDROCARBONS IN GROUNDWATER

MALCOLM PIRNIE, INC.
MARCH 2011
FIGURE 2-5

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Figure 2-6
TPHd Concentration versus Time in Selected Site Wells

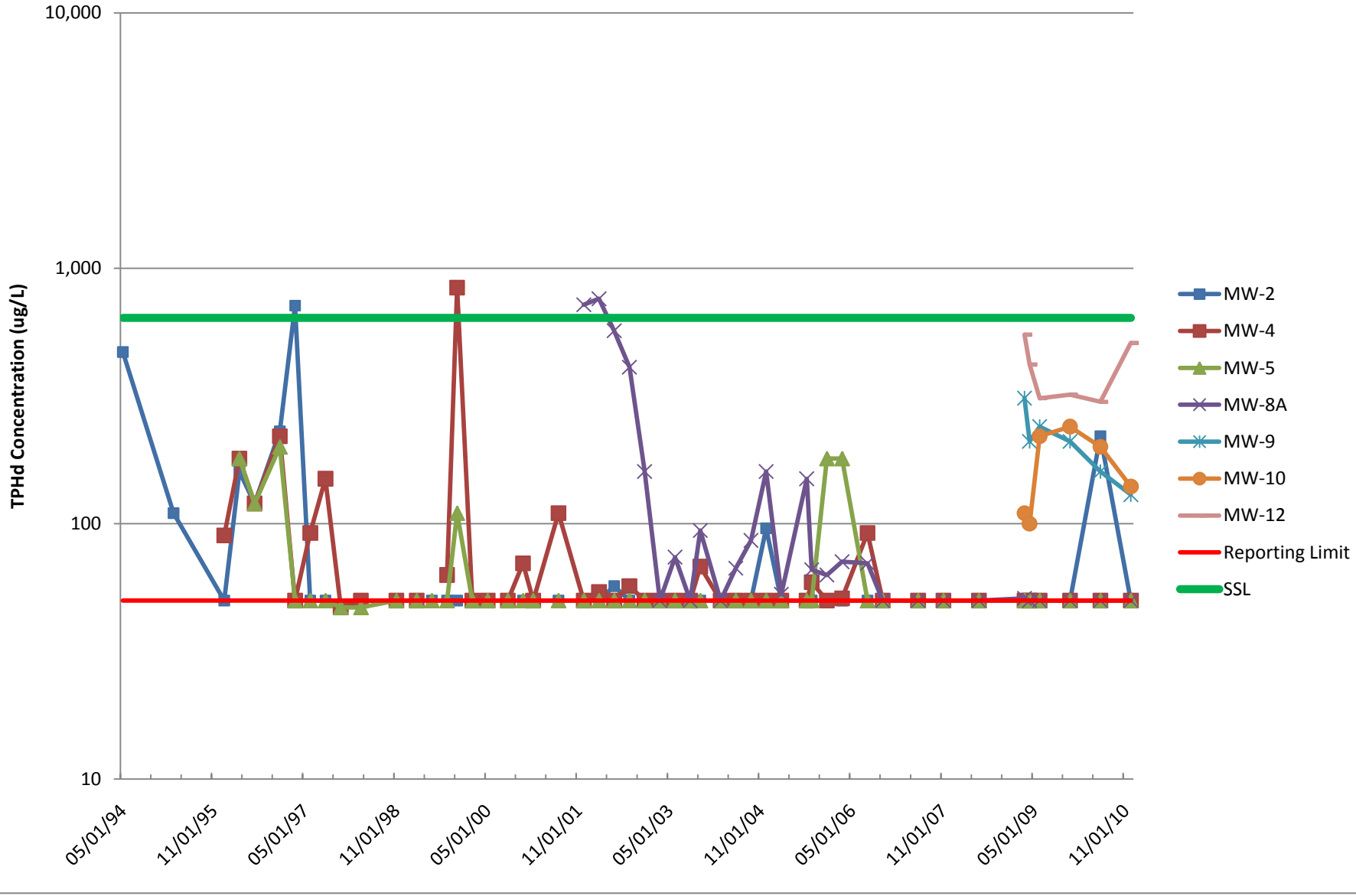


Figure 2-7
TPHg Concentration versus Time in Selected Site Wells

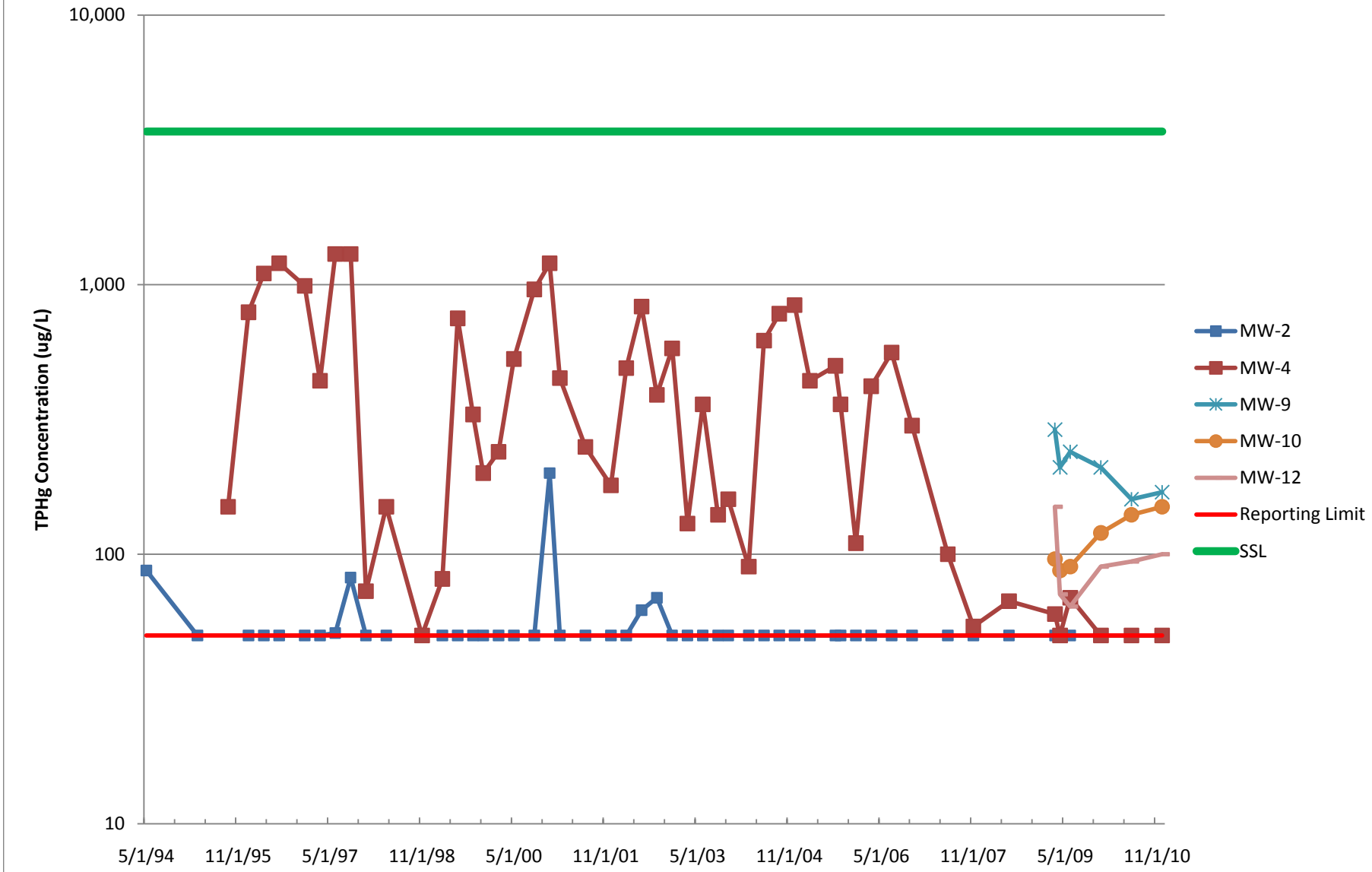
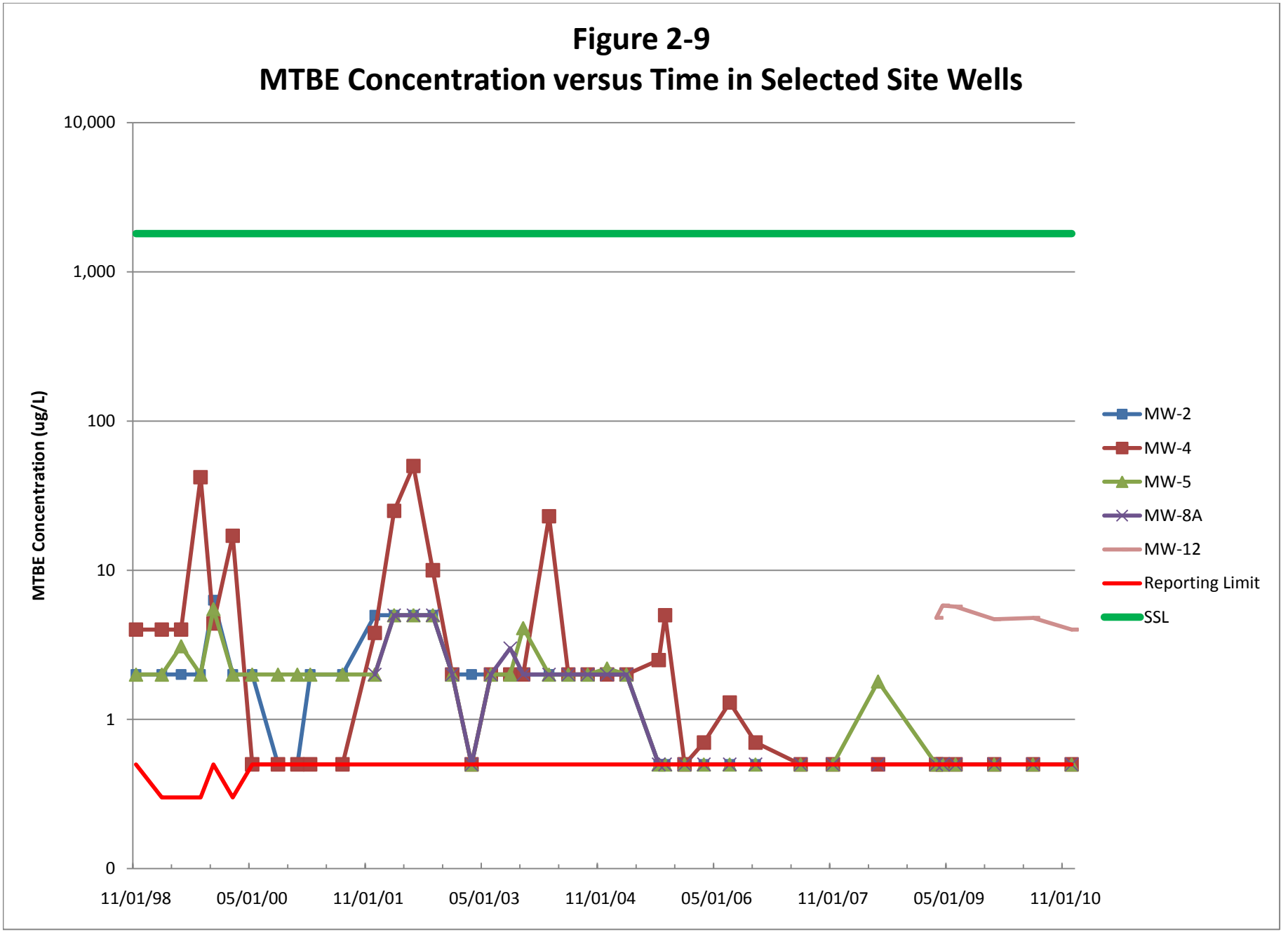


Figure 2-8
Benzene Concentration versus Timei n Selected Site Wells

Figure 2-9
MTBE Concentration versus Time in Selected Site Wells



LEGEND

- C-407 — BUILDING
- PROPERTY BOUNDARY
- CPT-13 — CPT LOCATIONS WITH UVIF PROFILING (ITSI, 2002)
- PZ-F — PIEZOMETER LOCATIONS (ITSI, 2002)
- MW-2 — EXISTING GROUNDWATER MONITORING WELL LOCATIONS
- FORMER LOCATION OF USTs
- MFC-20 — SOIL AND GRAB GROUNDWATER BORING (BY OTHERS, 2002)
- MFC-43 — SOIL BORING (BY OTHERS, 2002)

NOTE:

SURVEYED DATA FOR CPTs, PEIZOMETERS, GROUNDWATER MONITORING WELLS, AND BUILDINGS C-401 AND C-407 PROVIDED BY PLS SURVEYS INC., DRAWING 02-100, 2/27/02

Source: Additional Site Characterization and Remedial Action Plan for 2225 and 2277 Seventh Street, Oakland, California, Innovative Technical Solutions, Inc., May 2002.

0 100 200

SCALE IN FEET

MALCOLM PIRNIE

PORT OF OAKLAND

HARBOR FACILITIES COMPLEX

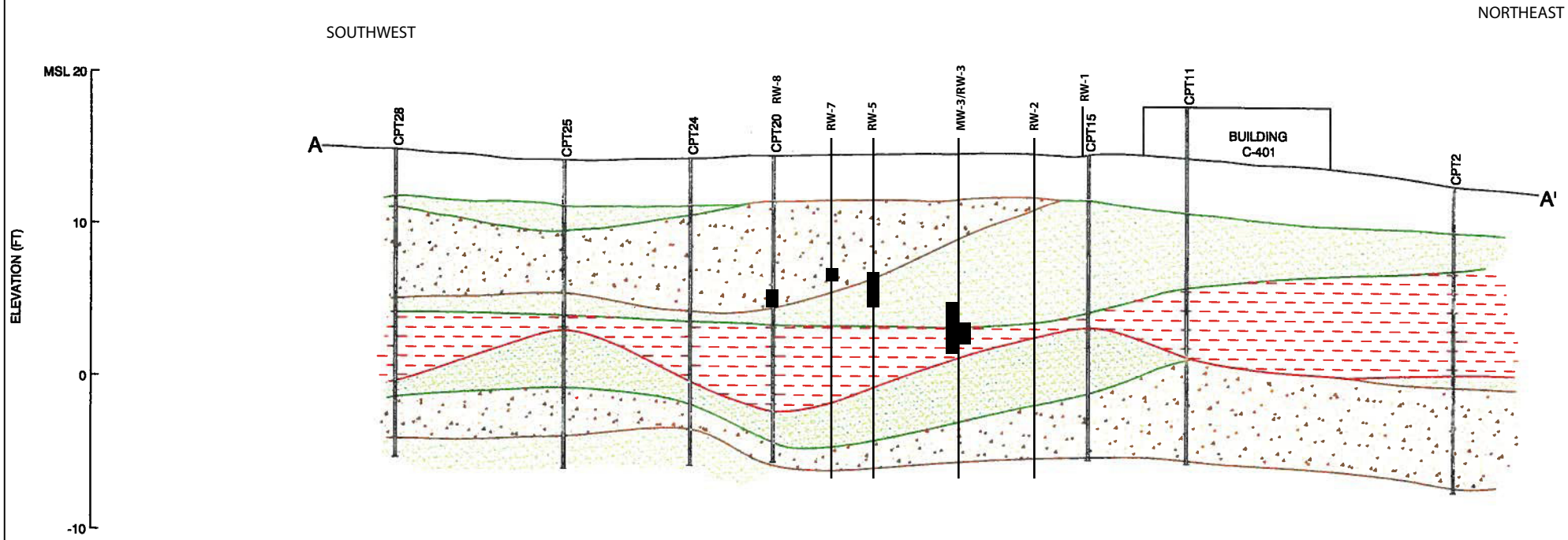
651 MARITIME STREET, OAKLAND, CA

GEOLOGIC CROSS-SECTION LOCATIONS

MALCOLM PIRNIE, INC.

MARCH 2011

FIGURE 3-1



LEGEND

- SECTION NOT INVESTIGATED
- CLAY/SENSITIVE FINES/SILTY CLAY
- SILT/CLAYEY SILT/SANDY SILT
- SAND/SILTY SAND
- FREE PRODUCT IN WELL

VERTICAL SCALE 10 FEET 0

HORIZONTAL SCALE 0 100 FEET

VERTICAL EXAGGERATION = 10X

Source: Additional Site Characterization and Remedial Action Plan for 2225 and 2277 Seventh Street, Oakland, California, Innovative Technical Solutions, Inc., May 2002.

MALCOLM PIRNIE

PORT OF OAKLAND

HARBOR FACILITIES COMPLEX

651 MARITIME STREET, OAKLAND, CA

GEOLOGIC CROSS-SECTION A-A'

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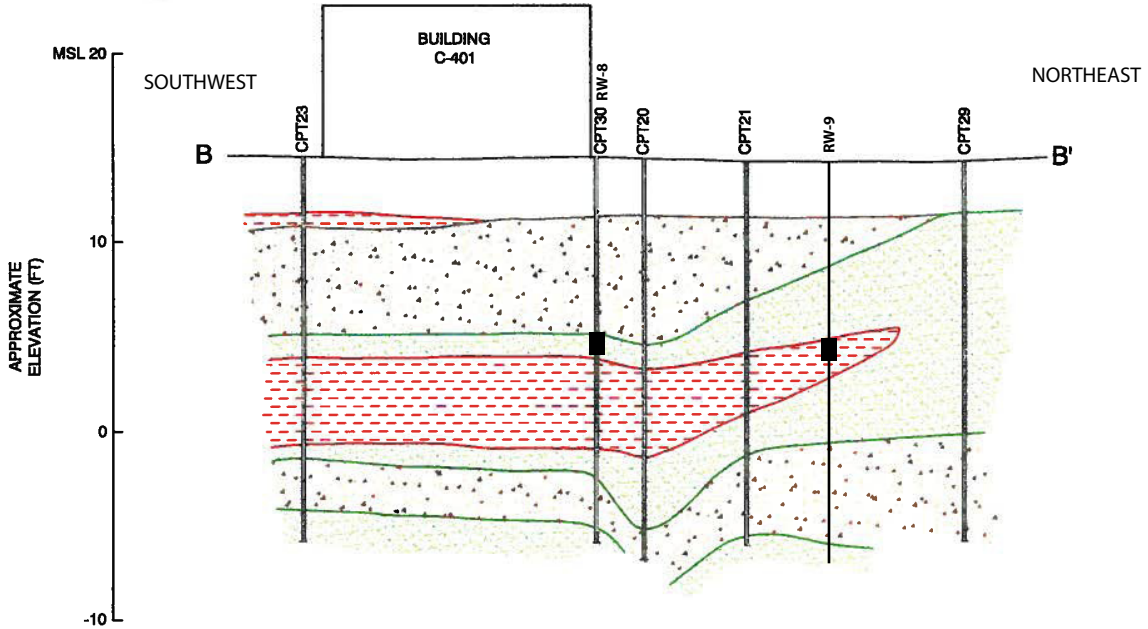
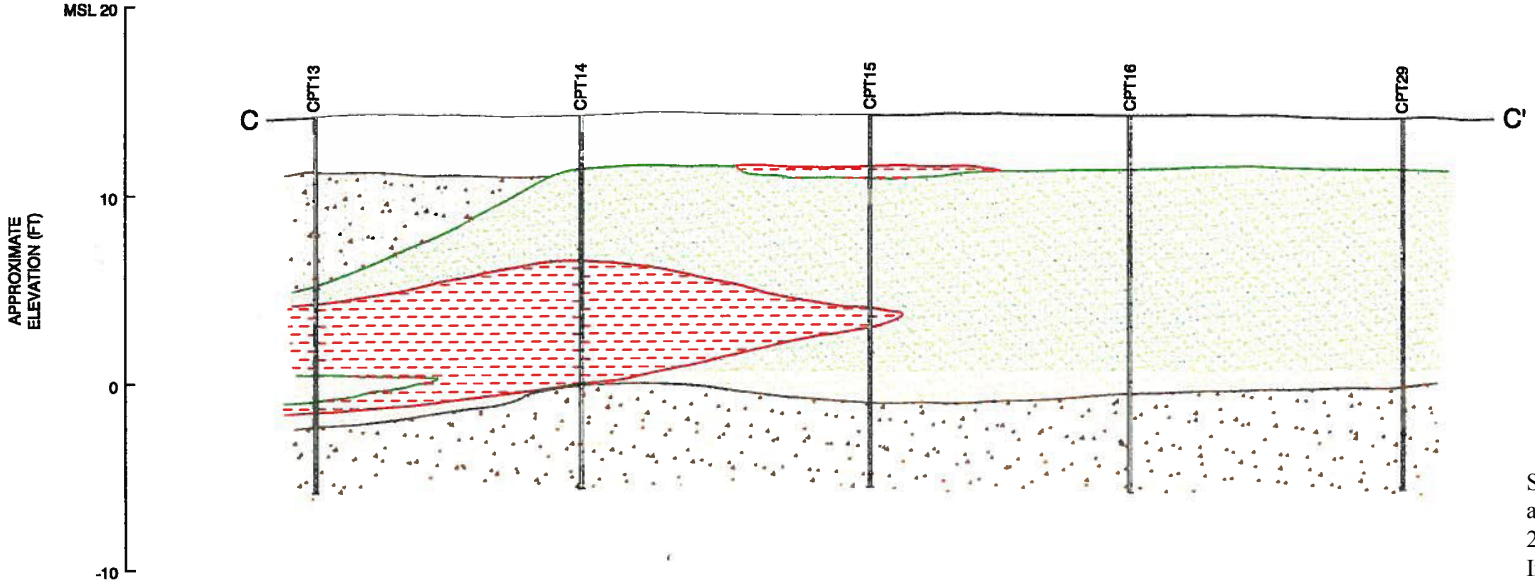
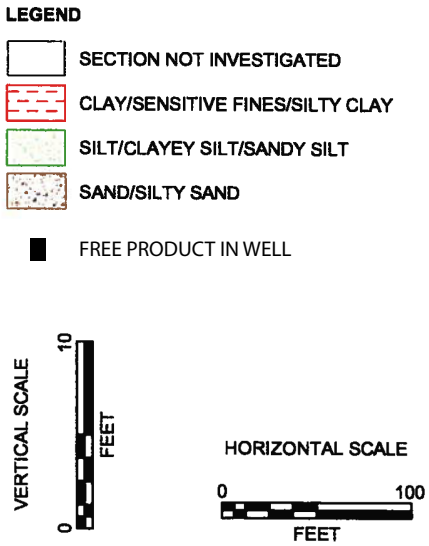
FIGURE 3-2







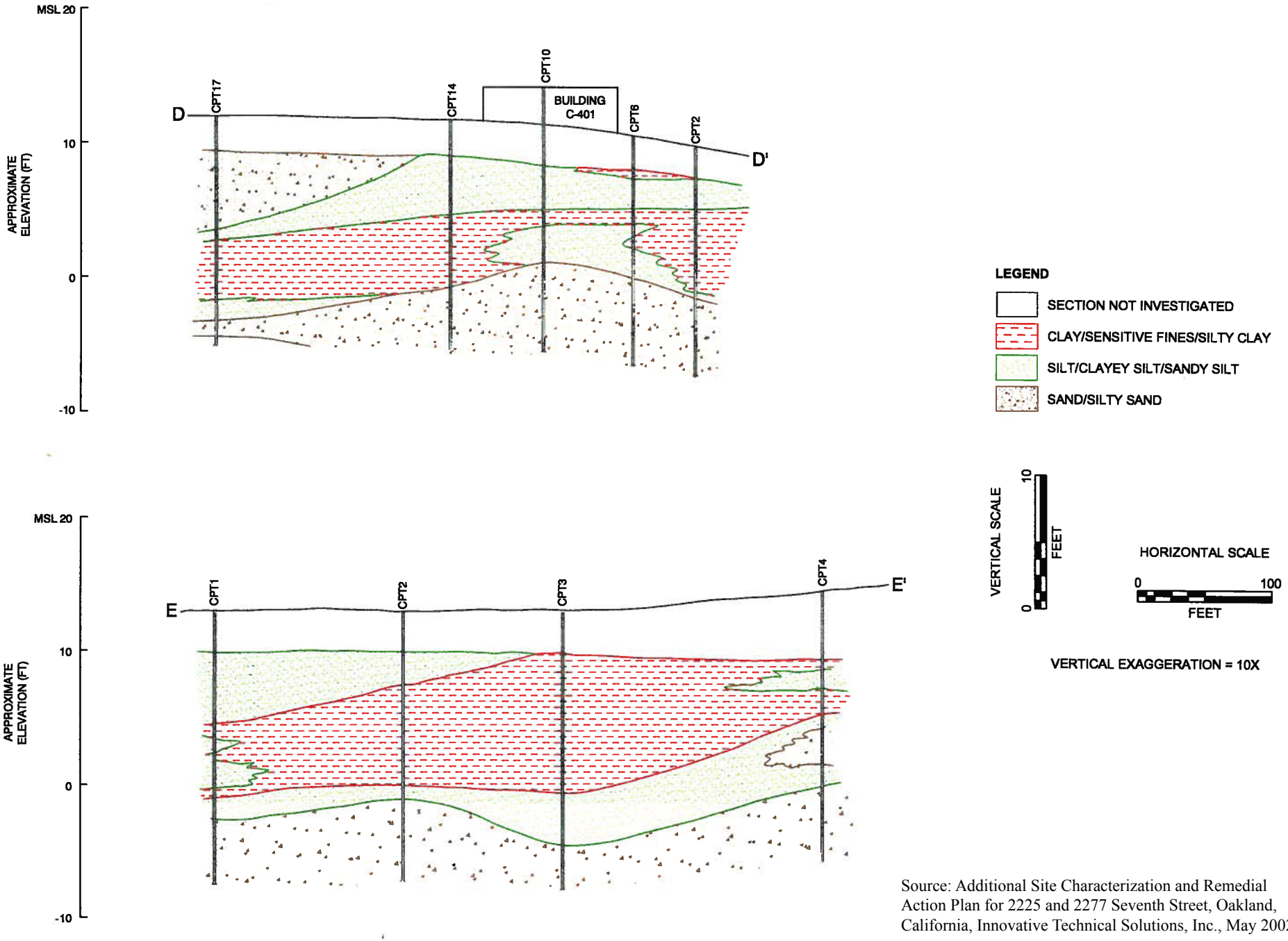
Source: Additional Site Characterization and Remedial Action Plan for 2225 and 2277 Seventh Street, Oakland, California, Innovative Technical Solutions, Inc., May 2002.

MALCOLM PIRNIE

PORT OF OAKLAND
HARBOR FACILITIES COMPLEX
651 MARITIME STREET, OAKLAND, CA

GEOLOGIC CROSS-SECTIONS
B-B' AND C-C'

MALCOLM PIRNIE, INC.
MARCH 2011
FIGURE 3-3



Source: Additional Site Characterization and Remedial Action Plan for 2225 and 2277 Seventh Street, Oakland, California, Innovative Technical Solutions, Inc., May 2002.

MALCOLM PIRNIE

PORT OF OAKLAND

HARBOR FACILITIES COMPLEX

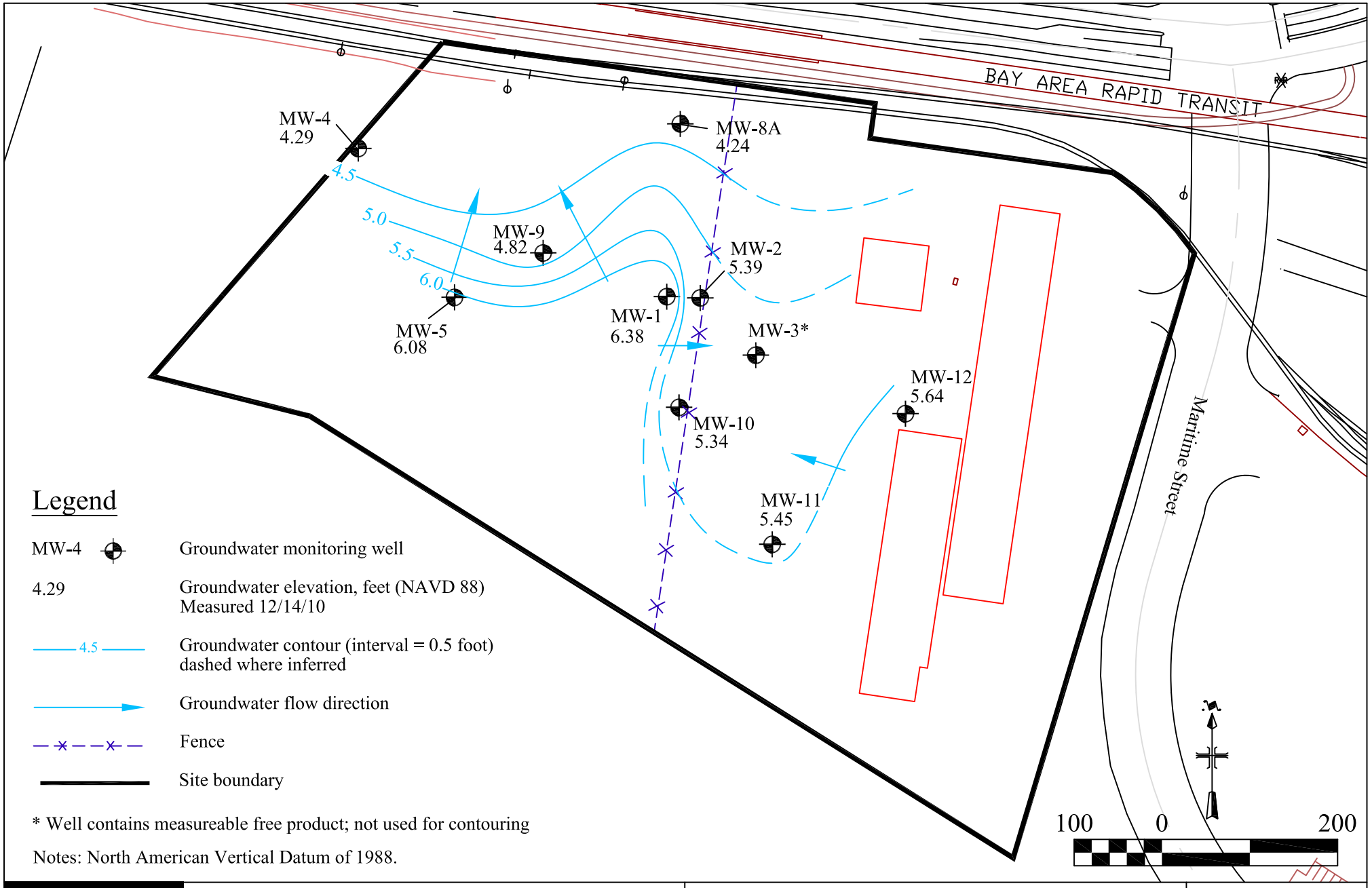
651 MARITIME STREET, OAKLAND, CA

GEOLOGIC CROSS-SECTIONS D-D' AND E-E'

MALCOLM PIRNIE, INC.

MARCH 2011

FIGURE 3-4



Legend

MW-4	Groundwater monitoring well
4.29	Groundwater elevation, feet (NAVD 88) Measured 12/14/10
4.5	Groundwater contour (interval = 0.5 foot) dashed where inferred
	Groundwater flow direction
	Fence
	Site boundary

* Well contains measureable free product; not used for contouring

Notes: North American Vertical Datum of 1988.

MALCOLM PIRNIE

PORT OF OAKLAND

HARBOR FACILITIES COMPLEX
651 MARITIME STREET, OAKLAND, CA

GROUNDWATER ELEVATION
ISOCONTOUR MAP - DECEMBER 2010

MALCOLM PIRNIE, INC.

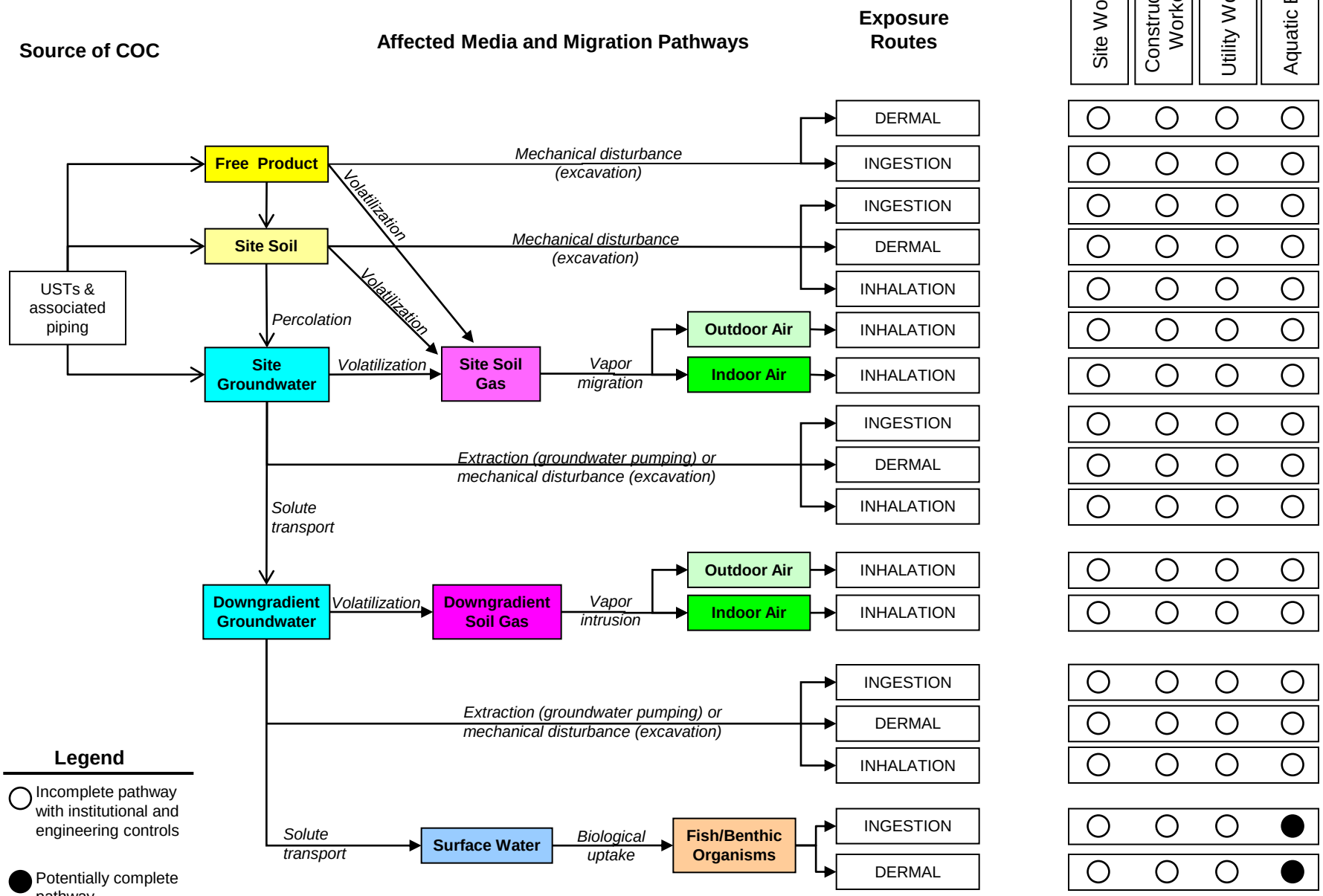
MARCH 2011

FIGURE 3-5

User:Orsi Spec:PIRNIE STANDARD File:P:\4656\016\acad\Feasibility Study\FIGURES.DWG

Figure 4-1. Conceptual Site Model

Feasibility Study / Corrective Action Plan
Port of Oakland's Harbor Facility Complex
651 Maritime Street, Oakland, CA



Port of Oakland
Feasibility Study/Corrective Action Plan
Port of Oakland's Harbor Facilities Complex Site
651 Maritime Street, Oakland, CA

Appendix A
Covenant and Environmental Restriction on Property

MALCOLM PIRNIE

Recording Requested By:

[CURRENT OWNER]

When Recorded, Mail To:
Mee Ling Tung, Director
Alameda County Environmental Health Services
1131 Harbor Bay Parkway
Alameda, California 94502

COVENANT AND ENVIRONMENTAL RESTRICTION ON PROPERTY

The former Shippers Imperial and Ringsby Terminal Sites formerly situated at 2277 7th Street and 2225 7th Street, Oakland, California.

This Covenant and Environmental Restriction on Property (this "Covenant"), dated as of _____, 2007, is entered into by the City of Oakland, a municipal corporation, acting by and through its Board of Port Commissioners (hereinafter "Covenantor" or "Port of Oakland") who is the owner of record of that certain property situated at a location formerly referred to as 2277 7th Street and 2225 7th Street, in the City of Oakland, County of Alameda, State of California, which is more particularly described in Exhibit A attached hereto and incorporated herein by this reference (hereinafter referred to as the "Burdened Property"), for the benefit of the Alameda County Environmental Health Services (the "County"), with reference to the following facts:

A. The Burdened Property and groundwater underlying the property contains hazardous materials.

B. Contamination of the Burdened Property. Soil at the Burdened Property was contaminated by a release, or releases, from underground storage tank(s) ("USTs"). These operations resulted in contamination of soil and groundwater with petroleum hydrocarbons containing volatile organic compounds and semi volatile organic compounds, which constitute hazardous materials as that term is defined in Health & Safety Code Section 25260. Free-phase product in the diesel hydrocarbon range is currently present at the surface of the shallow groundwater. In addition, the natural degradation of the petroleum hydrocarbons has resulted in methane vapors in the subsurface.

C. Remediation of Contamination. The USTs have been removed and impacted soil removed from the Burdened Property. Product recovery is being performed at the Burdened Property to remove the petroleum product from the subsurface. There are currently nine product recovery wells and product-only skimmers are being used to convey the product to an above ground storage tank ("Remedial Action"). The Remedial Action may be modified, subject to approval by the County. In addition, buildings constructed on the Burdened Property have vapor

barriers and passive venting systems below the foundations to mitigate vapor intrusion into the buildings. The surface of the Burdened Property is currently capped with asphalt.

D. Exposure Pathways. The contaminants addressed in this Covenant are present in soil, soil gas, and groundwater on the Burdened Property. Without the mitigation measures which have been performed on the Burdened Property, exposure to these contaminants could take place via in place contact or vapor migration, resulting in dermal contact, inhalation, or ingestion by humans. The risk of public exposure to the contaminants has been substantially lessened by the remediation and controls described herein.

E. Adjacent Land Uses and Population Potentially Affected. The Burdened Property is used for support of Port of Oakland maintenance activities and is adjacent to industrial, transportation-related land uses.

F. Disclosure. Full and voluntary disclosure to the County of the presence of hazardous materials on the Burdened Property has been made and extensive sampling of the Burdened Property has been conducted.

G. Intent. Covenantor desires and intends that in order to benefit the County, and to protect the present and future public health and safety, the Burdened Property shall be used in such a manner as to avoid potential harm to persons or property that may result from hazardous materials that may have been released or deposited on portions of the Burdened Property.

ARTICLE I
GENERAL PROVISIONS

1.1 Provisions to Run with the Land. This Covenant sets forth protective provisions, covenants, conditions and restrictions (collectively referred to as "Restrictions") upon and subject to which the Burdened Property and every portion thereof shall be improved, held, used, occupied, leased, sold, hypothecated, encumbered, and/or conveyed. The restrictions set forth in Article III are reasonably necessary to protect present and future human health and safety or the environment as a result of the presence on the land of hazardous materials. Each and all of the Restrictions shall run with the land, and pass with each and every portion of the Burdened Property, and shall apply to, inure to the benefit of, and bind all Owners and Occupants (as defined in Article II) and successive Owners and Occupants of the Burdened Property, hereof, for the benefit of the County and all Owners and Occupants. Each and all of the Restrictions are imposed upon the entire Burdened Property unless expressly stated as applicable to a specific portion of the Burdened Property. Each and all of the Restrictions run with the land pursuant to section 1471 of the Civil Code. Each and all of the Restrictions are enforceable by the County.

1.2 Incorporation into Deeds and Leases. Covenantor desires and covenants that the Restrictions set out herein shall be incorporated in and attached to each and all future deeds and leases of any portion of the Burdened Property. Recordation of this Covenant shall be deemed binding on all Owners and Occupants, regardless of whether a copy of this Covenant is attached to or incorporated into any future deed or lease concerning the Burdened Property.

1.3 Purpose. It is the purpose of this instrument to convey to the County real property rights, which will run with the land, to facilitate the remediation of past environmental

contamination and to protect human health and the environment by reducing the risk of exposure to residual hazardous materials.

ARTICLE II
DEFINITIONS

2.1 County. "County" shall mean the Alameda County Environmental Health Services and shall include its successor agencies, if any.

2.2 Improvements. "Improvements" shall mean all buildings, roads, driveways, regradings, and paved parking areas, constructed or placed upon any portion of the Burdened Property.

2.3 Occupants. "Occupants" shall mean Owners and those persons entitled by ownership, leasehold, or other legal relationship to the exclusive right to use and/or occupy all or any portion of the Burdened Property.

2.4 Owner or Owners. "Owner" or "Owners" shall mean the Covenantor and/or its successors in interest, who hold title to all or any portion of the Burdened Property.

2.5 Cap. "Cap" means the continuous asphalt or concrete pavement covering the same boundaries as the Burdened Property

2.6 Risk Management Plan. "Risk Management Plan" means a plan to identify measures for managing risks associated with residual contaminants at the Burdened Property.

ARTICLE III
DEVELOPMENT, USE AND CONVEYANCE OF THE BURDENED PROPERTY

3.1 Restrictions on Development and Use. Covenantor promises to restrict the use of the Burdened Property as follows:

(a) No residence for human habitation shall be permitted on the Burdened Property;

(b) No hospitals for humans shall be permitted on the Burdened Property;

(c) No schools for persons under 21 years of age shall be permitted on the Burdened Property; and

(d) No day care centers for children or day care centers for Senior Citizens shall be permitted on the Burdened Property;

3.2 Prohibitive Activities:

(a) Except as otherwise provided by subsections (b) through (h) below, no Owners or Occupants of the Burdened Property, or any portion thereof, shall conduct any excavation work on the Burdened Property in such a way that will disturb contaminated soil or interfere with the integrity of the existing Cap if it will expose contaminated soil. Clean soil, clean fill, base rock the aggregate base, asphalt and concrete that is placed on top of the contaminated soil may be disturbed if the contaminated soil is not disturbed or exposed;

(b) The Burdened Property shall be used and developed in a way that preserves the integrity of the Cap installed on the Burdened Property. Contaminated soil shall not be disturbed without a Risk Management Plan submitted to the County for review and approval;

(c) The Owner shall provide the County written notice at least thirty (30) days prior to any activities which will disturb the Cap and expose the underlying contaminated soils;

(d) Emergency Response Action/Notification: Subsection (c) of this Section 3.2 shall not apply in the event of any emergency or time-sensitive action or occurrence (such as a fire, earthquake, explosion, equipment or utility failure or malfunction) which requires breaching the Cap (hereinafter referred to as "Emergency Event"). However, the Owner shall immediately take all appropriate action to prevent, abate, or minimize any release associated with such Emergency Event and shall immediately notify the County of the Emergency Event. The Owner shall take such appropriate action in accordance with all applicable provisions of this Covenant. Within seven (7) days of the onset of such Emergency Event, Owner shall furnish a report to the County, signed by the Owner, describing the Emergency Event and the measures taken in response thereto. Nothing in this section shall be deemed to limit any other notification requirement to which the Owner may be subject under the Covenant;

(e) The Owner shall inspect and maintain improvements constructed on the Burdened Property as provided in the Risk Management Plan;

(f) The Owner shall notify the County of each of the following: (i) the type, cause, location and date of any damage to the Cap; and (ii) the type and date of repair of such damage. Notification to the County shall be made as provided below within ten (10) working days of both the discovery of any such disturbance and the completion of any repairs;

(g) The Owner shall not extract the groundwater for purposes other than site remediation or construction dewatering;

(h) Owner agrees that the County, and/or any persons acting pursuant to County cleanup orders, shall have reasonable access to the Burdened Property for the purposes of inspection, surveillance, maintenance, or monitoring, as provided for in Division 7 of the Water Code; and

(i) No Owner or Occupant of the Burdened Property shall act in any manner that will aggravate or contribute to the existing environmental conditions of the Burdened Property.

3.3 Enforcement. Failure of an Owner or Occupant to comply with any of the restrictions, as set forth in paragraph 3.2, shall be grounds for the County, by reason of this Covenant, to have the authority to require that the Owner modify or remove any Improvements constructed in violation of that paragraph. Violation of the Covenant shall be grounds for the County to file civil actions against the Owner as provided by law.

3.4 Notice in Agreements. After the date of recordation hereof, all Owners and Occupants shall execute a written instrument which shall accompany all future purchase agreements or leases relating to the Burdened Property. Any such instrument shall contain the following statement:

> The land described herein contains hazardous materials in soils and in the ground water under the property, and is subject to a deed restriction dated as of _____, 2007, and recorded on _____, 2007, in the Official Records of _____ County, California, as Document No. _____, which Covenant and Restriction imposes certain covenants, conditions, and restrictions on usage of the property described herein. This statement is not a declaration that a hazard exists.

ARTICLE IV
VARIANCE AND TERMINATION

4.1 Variance. Any Owner or, with the Owner's consent, any Occupant of the Burdened Property or any portion thereof may apply to the County for a written variance from the provisions of this Covenant.

4.2 Termination. Any Owner or, with the Owner's consent, any Occupant of the Burdened Property or a portion thereof may apply to the County for a termination of the Restrictions as they apply to all or any portion of the Burdened Property.

4.3 Term. Unless terminated in accordance with paragraph 4.2 above, by law or otherwise, this Covenant shall continue in effect until the County approves a termination of the Restrictions.

ARTICLE V
MISCELLANEOUS

5.1 No Dedication Intended. Nothing set forth herein shall be construed to be a gift or dedication, or offer of a gift or dedication, of the Burdened Property or any portion thereof to the general public.

5.2 Notices. Whenever any person gives or serves any notice, demand, or other communication with respect to this Covenant, each such notice, demand, or other

communication shall be in writing and shall be deemed effective (1) when delivered, if personally delivered to the person being served or official of a government agency being served, or (2) three (3) business days after deposit in the mail if mailed by United States mail, postage paid certified, return receipt requested:

If To: "Covenantor"

Director on Engineering
Port of Oakland
530 Water Street
Oakland, CA 94804

With copies to:

Michele Heffes
Deputy Port Attorney
Port of Oakland
530 Water Street
Oakland, CA 94804

And

Christine K. Noma
Wendel Rosen Black & Dean, LLP
1111 Broadway, 24th Floor
Oakland, CA 94607

If To: "County"
Alameda County Environmental
Health Services
Attention: Director
1131 Harbor Bay Parkway
Alameda, California 94502

5.3 Partial Invalidity. If any portion of the Restrictions or terms set forth herein is determined to be invalid for any reason, the remaining portion shall remain in full force and effect as if such portion had not been included herein.

5.4 Article Headings. Headings at the beginning of each numbered article of this Covenant are solely for the convenience of the parties and are not a part of the Covenant.

5.5 Recordation. This instrument shall be executed by the Covenantor and by the Director of Environmental Health Services. This instrument shall be recorded by the Covenantor in the County of Alameda within ten (10) days of the date of execution.

5.6 References. All references to Code sections include successor provisions.

5.7 Construction. Any general rule of construction to the contrary notwithstanding, this instrument shall be liberally construed in favor of the Covenant to effect the purpose of this instrument and the policy and purpose of the Water Code. If any provision of this instrument is found to be ambiguous, an interpretation consistent with the purpose of this instrument that would render the provision valid shall be favored over any interpretation that would render it invalid.

IN WITNESS WHEREOF, the parties execute this Covenant as of the date set forth above.

Covenantor:

CITY OF OAKLAND,
A municipal corporation,
Acting by and through its
Board of Port
Commissioners_____

By Omar Benjamin
Title: Executive Director_____
Date: _____

THIS AGREEMENT SHALL
NOT BE VALID OR EFFECTIVE
FOR ANY PURPOSE UNLESS AND UNTIL
IT IS SIGNED BY THE PORT ATTORNEY

Approved as to form and legality this
_____ day of _____, 2007

_____
Port Attorney

Port Resolution No. _____
PA#_____

Agency: Alameda County
Environmental Health Services

By:_____
Title: Director
Date:_____

STATE OF CALIFORNIA)
)
COUNTY OF _____)

On _____, 20__ before me, the undersigned a Notary Public in and for said state, personally appeared [Covenantor], personally known to me or proved to me on the basis of satisfactory evidence to be the person who executed the within instrument.

WITNESS my hand and official seal.

_____
Notary Public in and for said
County and State

STATE OF CALIFORNIA)
)
COUNTY OF _____)

On _____, 20__ before me, the undersigned a Notary Public in and for said state, personally appeared [DIRECTOR], personally known to me or proved to me on the basis of satisfactory evidence to be the person who executed the within instrument.

WITNESS my hand and official seal.

_____
Notary Public in and for said
County and State

EXHIBIT A

LEGAL DESCRIPTION OF PROPERTY

Exhibit "B"

Original Combined Ringsby/Railway Leases

All that real property in the City of Oakland, County of Alameda, State of California, being that parcel described in that lease between the City of Oakland and Railway Express Agency, Incorporated, recorded on March 26, 1962 in Reel 544, Image 811 (hereafter referred to as the Railway Lease), together with that parcel described in that lease between the City of Oakland and Ringsby Pacific Ltd., a corporation, recorded January 3, 1968 in Reel 2103, Image 117 (hereafter referred to as the Ringsby Lease), Official Records of said County, described as follows:

COMMENCING at Monument No. 8, a standard City of Oakland frame and casting monument on the monument line of 7th Street, west of West Maritime Street, in the Port of Oakland, as said monument is shown on Record of Survey No. 1602, filed in Book 23 of Record of Survey Maps, Page 69, Office of the Recorder of said County; thence, along said monument line, South 81°57'10" East 1311.08 feet to its intersection with the "Agreed Low Tide Line of May 4, 1852" as said tide line is described in Section 3 of Ordinance No. 3197 of the City of Oakland, California, approved November 23, 1910; thence, along said tide line, South 41°00'50" West 65.55 feet to an angle point in said tide line, said angle point being on the southerly line of 7th Street, being also the northern boundary line of that certain expired franchise granted to the Southern Pacific Company by the City of Oakland by Council Ordinance No. 3197; thence, along the southerly line of 7th Street, North 81°57'10" West 19.61 feet to the southeastern line of that 10 foot wide strip of land described in the Grant of Easement from the City of Oakland to the United States of America dated December 5, 1955 and recorded March 28, 1956 in Book 7981 of Official Records of Alameda County, at page 401; thence, along said southeastern line, South 41°00'56" West 60.78 feet to the northwesterly corner of said Railway Lease, said corner being the **POINT OF BEGINNING** for this description; thence, continuing along said southeastern line, and along the westerly line of said Railway Lease, South 41°00'56" West 381.36 feet to the southwesterly corner of said Railway Lease, said corner also being the northwesterly corner of said Ringsby Lease; thence, along the southwesterly line of said Ringsby Lease, South 41°00'56" West 122.62 feet to the southwesterly corner of said Ringsby Lease; thence, along the southwesterly, easterly, and northerly lines of said Ringsby Lease, the following five courses: 1) along the property line common to the Port and the U.S. Navy Supply Center, South 75°50'44" East 184.94 feet; 2) continuing along said common line, South 57°51'32" East 945.86 feet to the southeasterly corner of said Ringsby Lease, said corner being

a point on said tide line; 3) along said tide line, and along the common line between the Port and Southern Pacific Company, North 16°40'16" East 718.80 feet to the northeasterly corner of said Ringsby Lease, said corner being a point that bears South 16°40'16" West 170.79 feet from an angle point in said tide line, said corner also being a point on a non-tangent curve, concave southwesterly, having a radius of 372.21 feet and a central angle of 20°05'13" from which the radius point bears South 54°56'49" West; 4) along said curve to the left, an arc distance of 130.49 feet to the intersection of a line that is parallel with, and 91 feet perpendicularly distant, from said southerly line of 7th Street; 5) along said parallel line, North 81°56'44" West 279.85 feet to an angle point in the northerly line of said Ringsby Lease, said angle point being a point on the easterly line of said Railway Lease; thence, along said easterly line, North 8°03'16" East 40.00 feet to the northeasterly corner of said Railway Lease; thence, along the northerly line of said Railway Lease, North 81°56'44" West 497.15 feet to the **POINT OF BEGINNING**. Contains approximately 602,440 square feet (13.83± acres).

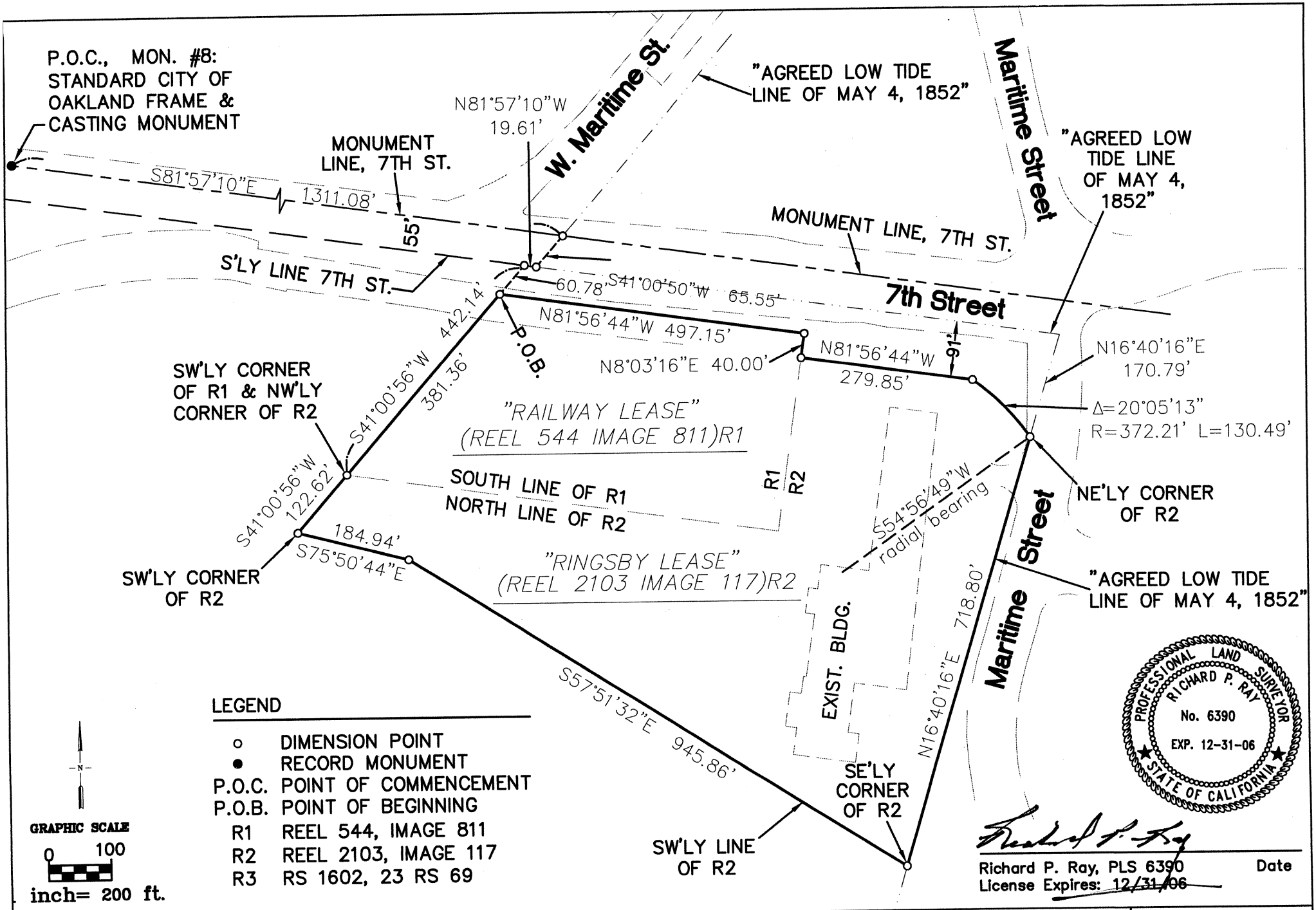
Basis of Bearings. The bearings and distances in this description are based on the California Coordinate System of 1983, Zone 3. Multiple the grid distances contained herein by 1.0000703 to obtain ground distances. See the attached drawing, "Exhibit B", which is hereby made a part of this description.

End of Description

Surveyor's Statement

This description was prepared pursuant to Section 8726 of the Business and Professions Code of the State of California by, or under the supervision of:

Richard P. Ray, PLS 6390
License Expires: 12/31/2006



Richard P. Ray, PLS 6390 Date
License Expires: 12/31/06

PORT OF OAKLAND
530 Water Street
Oakland, California

GEOMATICS GROUP
EXHIBIT"B"
RINGSBY
LEASE

DRAWN BY: R. LEE HIXSON	WORK ORDER NO. TSO/98(M11098.069)
CHECKED BY: RICHARD P. RAY	REVISION: 00
SCALE: 1"=200'	REVISION DATE: DATE
DATE: 6/8/6	CLIENT: PORT OF OAKLAND
SHEET 1 OF 1	
MAP/EXHIBIT LOCATION: FILE	
PROFESSIONAL REVIEW: NAME	

Port of Oakland
Feasibility Study/Corrective Action Plan
Port of Oakland's Harbor Facilities Complex Site
651 Maritime Street, Oakland, CA

Appendix B
Risk Management Plan

4656016 / NCA

MALCOLM PIRNIE

PORT OF OAKLAND

1 March 2009

Mr. Steve Plunkett
Hazardous Materials Specialist
Alameda County Health Care Services Agency
Environmental Health Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Subject: RO#0000010_Risk Management Plan - Port of Oakland, 651 Maritime Street, Oakland, California_2009-03-01

Dear Mr. Plunkett:

Please find enclosed our Risk Management Plan ("RMP") for the Port of Oakland ("Port") Harbor Facilities Complex, located at 651 Maritime Street in Oakland, California. This RMP has been prepared as required by the San Francisco Regional Water Quality Control Board ("Water Board") in a letter from Mr. Roger Brewer of the Water Board to Mr. Barney Chan of Alameda County Health Care Services Agency ("County"), dated 18 December 2002[1]. This RMP will serve as an engineering control tool for managing the site, in conjunction with a deed restriction that the Port submitted to the County for review and comment via e-mail on 12 January 2009.

In response to your letter to the Port dated 30 September 2008[2], we met on-site at the Harbor Facilities Complex (15 October 2008) for a field meeting, along with our consultant, BASELINE Environmental Consulting ("BASELINE"). We discussed facility history and conditions, including seeking County concurrence to manage the site in the future using engineering and institutional controls. The Port has been actively engaged in passive and active free product removal at the site since 1997. We are currently evaluating the efficiency of the on-site product removal system, but do not expect to achieve site closure in the near future. Therefore, the Port proposes to manage the residual subsurface free product at the site using engineering and institutional controls.

The efficiency of the product removal system is currently being undertaken by shutting down the system for progressively longer periods of time and observing the effects of

---

[1] Letter from Mr. Roger Brewer (San Francisco Regional Water Quality Control Board) to Mr. Barney Chan (Alameda County Health Care Services Agency) regarding *Review of Human Health Risk Assessment for Future Port of Oakland Field Support Services Complex, 2225 and 2277 Seventh Street, Oakland, CA*, dated December 18, 2002.

[2] Letter from Mr. Steven Plunkett (County) to Mr. Jeffrey Rubin (Port) regarding *Fuel Leak Case RO0000187 (Global ID# T0600100892), Port of Oakland, 651 Maritime Street, Oakland, CA*, dated September 30, 2008.

free product accumulation; this activity is expected to continue through at least the end of 2009. At the same time, the Port is routinely (about weekly) removing the free product that accumulates in monitoring well MW-3, which is not part of the product removal system. Following this product removal system evaluation (estimated to be at the end of 2009 or first quarter of 2010), we will submit evaluation results to the County, along with recommendations for future continued removal, monitoring of product accumulation, and/or additional actions.

In the aforementioned 30 September 2008 letter, you requested that the Port prepare a Site Conceptual Model ("SCM"), including a discussion of on- and off-site hydrogeology, source areas, contaminant distribution, pathways, and data gaps (referenced under Technical Comment #4). As we discussed during our 10 October 2008 meeting in the field, extensive investigations have been conducted at this site since 1993. The work included a risk evaluation using a Conceptual Site Model ("CSM") by IRIS Environmental ("IRIS") in 2003. The enclosed RMP summarizes the work performed by IRIS and their CSM. The report prepared by IRIS was submitted to the County on 2 July 2003. We trust that the CSM and risk evaluation prepared by IRIS responds to your request in your 30 September 2008 letter to the Port.

We thank you for your guidance on remediation of this site and hope that we will be able to reach an appropriate management option to ensure protection of public health and the environment. We look forward to your comments on this RMP and also receiving any comments that you may have on the previously submitted draft deed restriction. If you have any questions or comments, please contact either of the respective undersigned at (510) 627-1134 or (510) 627-1360.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached report prepared by Baseline are true and correct to the best of my knowledge. Please note that the report is stamped by both a Professional Geologist and Registered Professional Engineer in the State of California.

Sincerely,

Jeffrey L. Rubin, CPSS, REA
Port Associate Environmental Scientist
Environmental Programs and Safety

Jeffrey R. Jones
Supervisor
Environmental Programs and Safety

Enclosure: noted

Cc (w encl.): Michele Heffes

Cc (w/o encl.): James McCarty (BASELINE Environmental)
Yane Nordhav (BASELINE Environmental)

BASELINE

ENVIRONMENTAL CONSULTING

25 February 2009
Y5395-06.00655

Mr. Jeff Rubin
Associate Environmental Scientist
Port of Oakland
530 Water Street
Oakland, California 94607

Subject: Risk Management Plan, Port of Oakland, 651 Maritime Street, Oakland, California

Dear Mr. Rubin:

Enclosed please find a Risk Management Plan ("RMP") for the Port of Oakland's ("Port") properties at 651 and 555 Maritime Street (former 2277 and 2225 Seventh Street sites) for your review and comment. This RMP has been prepared as requested by the San Francisco Regional Water Quality Control Board ("Water Board") in a letter from Roger Brewer of the Water Board to Barney Chan of Alameda County Department of Environmental Health ("ACEH") dated 18 December 2002. The requirement for the preparation of an RMP was also included as a recommendation in the *Final Human Health Risk Assessment for Future Port of Oakland Field Support Services Complex*, prepared by IRIS Environmental and dated 6 May 2003, which was approved by a letter from ACEH to the Port dated 2 July 2003.

Sincerely,

Yane Nordhav
Principal
Prof. Geologist No. 4009

PROFESSIONAL GEOLOGIST
YANE NORDHAV
No. 4009
STATE OF CALIFORNIA

James McCarty
Project Engineer
Prof. Engineer No. C62618

REGISTERED PROFESSIONAL ENGINEER
JAMES G. McCARTY
NO. C 62618
EXP. 6/30/10
CIVIL
STATE OF CALIFORNIA

jgm
Enclosure

cc: Michele Heffes, Esq., Port of Oakland

5900 Hollis Street, Suite D • Emeryville, CA 94608-2008 • (510) 420-8686 • FAX (510) 420-1707
Emeryville Petaluma San Francisco

RISK MANAGEMENT PLAN

Port of Oakland
651 Maritime Street
Oakland, California

FEBRUARY 2009

Prepared for:

PORT OF OAKLAND
OAKLAND, CALIFORNIA

Y5395-06

5900 Hollis Street, Suite D • Emeryville, California 94608 • (510) 420-8686

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Port of Oakland, Oakland, California

1.0 INTRODUCTION

This Risk Management Plan ("RMP") has been prepared by BASELINE Environmental Consulting on behalf of the Port of Oakland ("Port") for two leaking underground storage tank ("LUST") sites, formerly referred to as 2277 Seventh Street and 2225 Seventh Street, respectively, in Oakland, California (Figure 1). These two LUST sites are located adjacent to each other and the properties are owned by the Port. For the purpose of this RMP, the two LUST sites are cumulatively referred to as the "Site" (Figures 2 and 3). The Site has been redeveloped since releases from the former underground fuel storage tanks ("USTs") occurred and is currently being used as the Harbor Facilities Complex ("HFC") at 651 Maritime Street and a portion of the Maritime Support Center ("MSC") at 555 Maritime Street (Figure 4). The Site covers a 13.8-acre area; the eastern 8 acres are 651 Maritime Street and the western 5.8 acres are a portion of 555 Maritime Street. The HFC is comprised of shops, warehouses, and administrative support, (Building C-510); a vehicle washing and fueling facility with an aboveground storage tank; and asphalt paved areas for vehicle parking and equipment and supplies storage for the Port maintenance and construction activities. The MSC is a container storage yard.

The purpose of this RMP is to provide risk management measures to minimize the exposure of future construction and maintenance workers and the general public to residual chemicals in the soil and groundwater at the Site and to control off-site migration, which could impact the environment. The risk management measures consist of both institutional and engineering controls.

2.0 BACKGROUND

From the late 1960s through the early 1990s, the Site contained USTs. Between 1990 and 1992, Dongary Investments (the Port tenant at the time) removed nine USTs, adjacent to Building C-407 (seven diesel USTs and two oil USTs) at 2225 Seventh Street (Figure 3) (IRIS, 2003a). At 2277 Seventh Street, the Port removed four USTs (one waste oil UST, two gasoline USTs, and one oil UST) adjacent to Building C-401 in 1993 (Figure 3) (IRIS, 2003a). Subsurface investigations have indicated that the groundwater underlying the Site contains co-mingled plumes consisting of free-phase petroleum hydrocarbons in the diesel range (Figure 5).

The Alameda County Department of Environmental Health ("ACEH") provides regulatory oversight for the Site under the Local Oversight Program ("LOP"). Because of the historical separation of the two leaseholds, the ACEH LOP formerly managed the Site as two LUST sites, with LOP case numbers for 2277 and 2225 Seventh Street as RO0000010 and RO0000187, respectively. The two sites are now combined as one LUST site with the address of 651 Maritime Street under RO0000010.

At 2225 Seventh Street, the National Environmental Service Company ("NESCO") removed a UST in March 1990 on behalf of Dongary Investments after it failed a tank integrity test in 1989. Ramcon Engineering and Environmental Contracting ("Ramcon") removed the remaining eight USTs in 1992. Soil and groundwater samples collected following the UST removal process indicated the presence of petroleum hydrocarbons in the diesel range and benzene, toluene, ethylbenzene, and xylenes ("BTEX") compounds. In addition, Ramcon observed free product on the groundwater in the excavation areas following UST removal in 1992. In 1993, Ramcon, on behalf of Dongary Investments, installed three groundwater monitoring wells at the 2225 Seventh Street site as part of a soil and groundwater assessment. Quarterly groundwater monitoring began in 1994, as required by ACEH (ACEH, 1994).

In 1993, on behalf of the Port, Uribe and Associates ("Uribe") removed four USTs historically operated as gasoline and waste oil tanks at 2277 Seventh Street (IRIS, 2003a). Uribe collected soil samples from the waste oil UST excavation; analytical results did not indicate the presence of diesel, gasoline, or BTEX above detection limits. However, analytical results of soil samples from the gasoline UST excavation indicated the presence of gasoline, diesel, and BTEX. Additionally, free product was observed on the groundwater in the gasoline UST excavation area.

In 1994, Uribe, on behalf of the Port, installed three groundwater monitoring wells at the 2277 Seventh Street site and in 1995 Alisto Engineering Group, on behalf of the Port, installed five additional monitoring wells (IRIS, 2003a). Quarterly groundwater monitoring was initiated in 1996 in accordance with an approved ACEH workplan. Petroleum hydrocarbons in the gasoline range have been detected in a monitoring well located on the western edge of the 2277 Seventh Street property. In 1998, ACEH requested that groundwater samples be analyzed for methyl tert butyl ether ("MTBE"). Uribe installed, on behalf of the Port, a free-product recovery system in 1997, consisting of one active skimmer pump and two passive skimmer pumps. Operation of the recovery system ceased in 2003 to facilitate redevelopment of the Site.

The HFC and the MSC were constructed on Port property in 2003 and 2006, respectively. In 2002, a Phase I and Phase II environmental site assessment was prepared by IRIS Environmental ("IRIS") for the Port in support of the proposed HFC (IRIS, 2003a). Three monitoring wells located at the 2225 Seventh Street site were abandoned during development of the HFC. A new free-product recovery system was installed by Dillard Construction on behalf of the Port at the Site in 2004, consisting of nine recovery wells, a 250-gallon aboveground storage tank, and associated equipment (Figures 4 and 5). IRIS also prepared a Human Health Risk Assessment ("HHRA") for the Site (IRIS, 2003a) (see detailed discussion in Section 3.0, below). The HHRA concluded that future construction workers could be exposed to residual chemicals in the groundwater and soil. The Water Board, which had been assisting ACEH on the Site, requested that an RMP be developed to protect future construction workers (Water Board, 2002).

In December 2008, ENV America Inc., installed four new groundwater monitoring wells (MW-9, MW-10, MW-11, and MW-12) to replace the wells abandoned during the site redevelopment (Figures 4 and 5). The Port continues to recover free-phase product from the subsurface using the product recovery system and perform groundwater monitoring on a semi-annual basis.

Land uses around the Site are industrial. The Port's Joint Intermodal Transport Railway and the Bay Area Rapid Transit rights-of-way are located along the northern boundary of the Site. Maritime Street is located along the northern boundary, and to the south and west of the Site are other Port properties with Port-related activities. The nearest residential community is more than one-half mile to the southwest.

Soil at the Site generally consists of imported fill material placed over soft clay or "Bay Mud". The upper fill material is either hydraulic fill dredged from San Francisco Bay or a mix of gravel, sand, and silt, often containing debris such as bricks, wood fragments, glass, and slag-like waste (IRIS, 2003a).

Prior to redevelopment of the Site, approximately two feet of clean engineered fill was imported to raise the grade of the Site. The surface of the Site was finished with eight inches of aggregate base-rock and six inches of asphalt concrete. The existing groundwater monitoring wells were raised to match the new grade elevation.

The depth of groundwater below the surface at the Site has ranged from 9.74 to 14.34 feet below ground surface ("bgs") since the site was redeveloped (MSE, 2009). The hydraulic conductivity at the Site may be low as slow recharge of groundwater into temporary wells has been observed (IRIS, 2003a).

3.0 HUMAN HEALTH RISK ASSESSMENT

IRIS prepared a baseline HHRA that focused on potential health risks to construction workers and future users of the Site (IRIS, 2003a). The HHRA evaluated potential exposure to residual chemicals in the soil and groundwater to on-Site construction workers during development of the HFC, on-Site commercial workers, and future on-Site maintenance and construction workers. Protective measures were incorporated into the design of the HFC to limit exposure for commercial users of the HFC, including a passive soil venting system for Building C-510 and an asphalt cap that covers the entire Site. The purpose of this RMP is therefore to provide procedures for protection of future on-Site maintenance and construction workers, since measures have already been developed and implemented for protection of commercial workers on-Site.

The HHRA identified 27 volatile organic compounds ("VOCs"), 11 semi-volatile organic compounds ("SVOCs"), total petroleum hydrocarbons ("TPH"), five metals, and methane as chemicals of potential concern ("COPCs") (Table 1). The complete exposure pathways for future maintenance and construction workersof the Site were identified as: ingestion of COPCs in soil; dermal contact with COPCs in soil; inhalation of vapors from volatilization and dispersion of COPCs in soil, soil gas, and groundwater; and inhalation of airborne particulates resulting from dust emissions and dispersion of COPCs in soil.

The HHRA assumed that the future maintenance and construction workers would be on-Site two days a year for 25 years. Exposure pathways included dermal contact, ingestion, and inhalation of dust and vapors. The inhalation of vapors was modeled by assuming the workers would work in an excavation one meter deep (3.3 feet). The HHRA concluded that the excess cancer risk due to COPCs to on-Site future maintenance and construction workers involved in subsurface

excavations was 3.83×10^{-6}. This is within U.S. Environmental Protection Agency's ("U.S. EPA") acceptable incremental cancer risk range of 1×10^{-4} and 1×10^{-6}. The excess non-cancer health index ("HI") was estimated to be 0.03, well below the target HI of 1.0.[1]

The HHRA also identified methane gas as a potential explosive hazard. The lower explosive limit and upper explosive limit of methane are five percent and 15 percent, respectively. Soil gas samples collected during Site assessment activities by IRIS (2003a) indicated that methane gas was present at concentrations above five percent in the soil gas over the product plume area.

This RMP may need to be revised should further development of the site occur. Measures such as passive soil venting systems or other engineering controls may be necessary in future buildings to provide protection against vapor intrusion into the building.

4.0 RISK MANAGEMENT MEASURES

4.1 Exposure Assessment

Prior to beginning any subsurface work at the Site, an exposure assessment will be preformed by a Certified Industrial Hygienist ("CIH"). Information will be provided by the Port Engineering Department about the proposed work location, dates of work, description of the work, and total depth of excavation, as identified in the Exposure Assessment Form provided in Appendix A. The CIH will review the information provided to determine if there is a potential for worker exposure to Site COPCs. If the work in confined to the upper three feet (three feet or less below the asphalt and baserock), the work may be performed under the Port's *Maritime Environmental Health And Safety Plan For Shallow Excavation For Port Facilities Staff And Port Contractors*. If the work involves excavations deeper than three feet below ground surface, or contact with groundwater, the specific health and safety procedures in this RMP must be followed. The Exposure Assessment Form must be signed and dated by the CIH before subsurface work can proceed.

4.2 Engineering Controls

The purpose of risk management measures is to protect on-Site maintenance and construction workers from exposure to residual COPCs in the soil and groundwater present in the subsurface. Specific engineering controls must be implemented when the work extends greater than three feet bgs. This section describes the requirements for health and safety plans, dust control measures and stockpile management, equipment decontamination, and stormwater pollution control.

4.2.1 Health and Safety Plan

All work that involves subsurface excavations in excess of three feet bgs will be undertaken in accordance with a Site-specific Health and Safety Plan ("HSP"), prepared in accordance with

[1] A non-carcinogenic risk level is measured using a Hazard Index ("HI"). The HI is calculated by summing the hazard quotients for substances that affect the same target organ or organ system (e.g., respiratory system). The hazard quotient is the ratio of potential exposure to the substance and the level at which no adverse health effects are expected. An HI of less than 1 indicates no adverse health effects are expected as a result of exposure and an HI greater than 1 indicates adverse health effects are possible.

Title 8 California Code of Regulations ("CCR") Section 5192 and Title 29 Code of Federal Regulations 1910.120. These sections specifically apply to: 1) clean-up operations or hazardous substance removal work required by a governmental body; 2) corrective actions involving hazardous waste clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 ("RCRA"); 3) voluntary clean-up operations at sites recognized by federal, state, local or other governmental bodies as uncontrolled hazardous waste sites; 4) operations involving hazardous wastes that are conducted at treatment, storage, and disposal ("TSD") facilities; or 5) emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard. However, since subsurface work in excess of three feet bgs would potentially put workers in close proximity to COPCs and may require incidental cleanup of COCPs by excavation and disposal, the Port will require that workers have Hazardous Waste Operations and Emergency Response ("HAZWOPER") training and medical surveillance.

The HSP preparation and implementation is the responsibility of individual contractors engaged by the Port or its lessees; the HSP must be submitted to the Port prior to any excavation greater than three feet bgs in accordance with the Exposure Assessment (Section 4.1). The HSP will include, as a minimum, the following elements:

General Information. This portion of the HSP will include the name of the preparer of the HSP. It shall also include a description of the Site location and the general hazards that are expected to be present that could affect the health and safety of construction and/or maintenance workers, the public, and the environment.

Key Personnel and Responsibilities. The HSP will include the name of the safety officer who will be responsible for implementation of the provisions of the HSP. Furthermore, the HSP shall include the responsibilities of all workers coming into contact with contaminated materials. The HSP shall identify those personnel who should be HAZWOPER trained. All personnel who are in contact with contaminated soil, encountered during breaching of the cap, must be HAZWOPER trained.

Site Information. The HSP will describe the Site history and the COPCs at the Site that are likely to be encountered, based on the Site history as well as the data collected to date.

Hazard Analysis. The HSP will include a listing of all COPCs likely to be encountered at the Site. The COPCs have been identified in the *Final Human Health Risk Assessment and Abbreviated Phase II Environmental Site Assessment Report, Future Port of Oakland Field Support Services Complex, 2225 and 2277 Seventh St., Oakland, California,* prepared by IRIS (2003a) and summarized in Table 1. The HSP will include a description of the symptoms of exposure and regulatory exposure limits for each COPC. The HSP will describe the methods to be undertaken to eliminate exposure hazards (e.g., personal protective equipment) and explosion hazards.

Air Monitoring Approach. The HSP will include an air monitoring strategy that will assist in identifying if construction and/or maintenance workers and the public may be exposed to COPCs above specific action levels. The HSP shall identify the types of air monitoring instruments to be used, calibration of the equipment, monitoring points, and monitoring frequency. The HSP shall

also define action levels above which workers must don personal protective equipment, as well as levels above which work must be stopped or engineering or administrative controls employed to eliminate the exposure of workers or the public to COPCs.

For excavations that meet the definition of confined space,[2] the HSP will also contain provisions for methane monitoring. Monitoring the air in excavations will be performed continuously using a gas meter equipped with an alarm. The alarm will be set to alert workers if the methane concentration reaches two percent by volume. If the methane concentration reaches two percent, engineering controls, such as fans, must be used to maintain the methane concentration below this level. If measurements indicate that the methane level is five percent or more, the work will be stopped until the concentration decreases to below five percent.

Personal Protective Equipment. The HSP will describe the types of personal protective equipment to be donned by workers who come into direct contact with contaminated soil and/or are exposed to dust. The types of appropriate personal protective equipment will be specified by the preparer of the HSP and relate to the specific COPCs that are present at the Site.

Work Zones and Site Security. The HSP will identify the work zones where workers may come into direct contact with contaminated soil. The work zones will be delineated by tape, fencing, and/or definitive access controls. Outside the work zone(s), the support zone will be identified in the HSP. The support zone will be large enough to provide opportunities for decontamination of workers and equipment, including removal of dirt from truck tires prior to exiting the Site.

Decontamination Procedures. The HSP will identify the decontamination procedures to be employed for workers who have come into direct contact with contaminated soil and also decontamination of equipment (including sampling equipment). The HSP will also include provisions for management of clothes that have been in direct contact with COPCs.

Safe Work Practices. The HSP will include a discussion of general safe work practices to be undertaken at the Site. Such safe work practices shall include restrictions of Site access, tailgate meetings, eating and smoking restrictions, personal hygiene, warning signs, and other conditions that would be unique to the Site.

Contingency/Emergency Plans. The HSP will include a description of the procedures to be followed during emergencies. Specifically, the HSP will describe the locations of emergency equipment (including eyewash, first aid kit, and fire extinguisher), and emergency routes to hospital(s), and emergency telephone numbers.

Medical Surveillance. The HSP will include requirements for medical surveillance of those workers who will be involved in activities that involve "cleanup operations" or "hazardous substance removal work," as defined in the California and federal regulations, identified above.

[2] Title 8, CCR, § 5157. A confined space means a space that: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and (3) is not designed for continuous employee occupancy.

4.2.2 Dust Control Measures and Stockpile Management

Construction or maintenance activities that breach the cap and would excavate to a depth greater than three feet bgs may generate visible dust, especially during the dry season. Dust emissions may result from excavation and grading activities, vehicle or equipment movement, wind blowing across the Site or over soil stockpiles, and loading or unloading of soil. Dust control would minimize worker exposure to dust containing COPCs and reduce off-Site migration of both COPCs and nuisance dust. The following dust control measures will be implemented during construction activities:

- Dampen soil by spraying water over soil when performing dust-creating activities;
- Limit the number of soil disturbing activities being performed at one time;
- Minimize drop heights while loading or unloading soil;
- Contaminated soil must be managed and stockpiled separately from other soil generated during construction activities. The contaminated soil must be placed on 10-mil visquene or other impermeable material;
- Cover all soil stockpiles when they are not being added to or removed. This measure will include providing an effective technique of ensuring that the cover is not blown off the stockpile by the wind (e.g., sand bags, tires);
- Sweep paved roadways on-Site and off-Site near exit routes daily, or more frequently, if necessary; and
- Cease soil-disturbing activities when wind speed exceeds 25 miles per hour.

Additional dust control measures may be required if air monitoring or observation indicates that dust emissions from the Site exceed levels defined in the HSP or exceed the legally permissible discharge limits, if any, established by state or local requirements.

4.2.3 Decontamination of Equipment and Vehicles

Construction equipment and vehicles used during the breach of the cap that would excavate to a depth greater than three feet bgs may have deposits of soil containing COPCs adhering to surfaces, particularly on the wheels and wheel wells. Vehicles will be inspected and soil deposits removed prior to the equipment or vehicles leaving the Site. Soil removed from vehicles will be placed in stockpiles with other excavated material.

4.2.4 Stormwater Pollution Controls

Stormwater runoff from the Site during a breach of the cap may contain sediments due to exposure of surface soils, excavations, and the modification of established drainage patterns. Construction sites one acre or larger are required to manage stormwater in accordance with California's National Pollutant Discharge Elimination System ("NPDES") General Construction Permit. The Port must file a Notice of Intent ("NOI") with the California State Water Resources Control Board and have a Storm Water Pollution Prevention Plan ("SWPPP"). The General Construction Permit requires construction contractors to implement best management practices ("BMPs") designed to reduce sediments in stormwater runoff to the extent possible.

If proposed construction involving the breaching of the cap is less than one acre in size, the Port is not required to file an NOI or prepare a SWPPP; however, an Erosion and Sediment Control

Plan will still be prepared and implemented to ensure control of stormwater runoff from the area where the cap is breached. The plan must be prepared by the Port (or its lessee or the contractor). It shall be kept on file at the Port's Environmental Programs and Planning Division and will be made available to the ACEH at their request.

BMPs shall be based on the September 2004 California Stormwater Association, *Stormwater Best Management Practice Handbook*, construction, and updates, such as the following:

- The use of silt fences around the perimeter of the Site to impede off-Site migration of sediment;
- Sediment basin or traps where sediments can settle out of stormwater runoff;
- Gravel bag berms to control stormwater flow directions;
- Sandbag or straw bale barriers around storm drain inlets to prevent sediments from entering the storm drain system; and
- Covering stockpiles with plastic sheeting and ensuring that stockpiles do not accumulate water.

In addition to erosion and sediment control, hazardous materials releases, such as any spills of oil, petroleum fuels, or hydraulic fluids shall be considered. The SWPPP and/or Erosion and Sediment Control Plan must contain procedures for responding to hazardous materials releases, such as use of absorbent material and proper management of the resultant waste.

5.0 SOIL CHARACTERIZATION

Future construction and/or maintenance activities at the Site may include excavation and stockpiling of subsurface soils. Excavated soil may consist of shallow fill or potentially contaminated soil from below the shallow fill. The soil from below the shallow fill may be visibly contaminated.[3] Excavated soil may either be reused under the pavement cap within the excavations or characterized for off-Site disposal. Excavated soil designated for on-Site reuse must be characterized in accordance with *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*, Chapter 9, dated 1986, as updated ("SW-846"). Excavated soil designated for off-Site disposal may be characterized in accordance with SW-846 or landfill-specific criteria. Soil sampling frequency for excavated material to be reused shall be in accordance with the guidelines presented on Table 2. The frequency of samples collected for off-Site disposal shall be in accordance with specific landfill requirements.

The soil samples collected for reuse or off-Site disposal shall be analyzed by a California-licensed analytical laboratory for the following chemicals:

- Total extractable petroleum hydrocarbons ("TEPH") as diesel/motor oil with silica gel cleanup in accordance with EPA Method 8015 modified;
- TPH as gasoline in accordance with EPA Method 8015 modified;
- VOCs in accordance with EPA Method 8260B;
- SVOCs in accordance with EPA Method 8270C;

[3] Visibly contaminated soil is soil that shows evidence of TPH impact.

- Title 22 metals in accordance with EPA Methods 6010B and 7471A; and
- Hexavalent chromium in accordance with EPA Method 7196.

5.1 Waste Classification

The first step in classification of the visibly contaminated soils for reuse or off-Site disposal is to determine whether the soil is a California or federal hazardous waste. Soils that are a California or federal hazardous waste cannot be reused on-Site and must be disposed of at a permitted landfill.

The analytical results of the soil samples will be compared against the Total Threshold Limit Concentration ("TTLC") (Title 22, CCR).[4] Total chemical concentrations that exceed the TTLC are designated as California hazardous waste. Analytical results shall also be compared to the Soluble Threshold Limit Concentration ("STLC"); soluble concentrations exceeding the STLCs are characterized as a California hazardous waste. The theoretical maximum soluble concentration in a sample using the Waste Extraction Test ("WET") is ten percent of the total concentration because the test performed by the laboratory uses a ten-fold dilution of the sample during the extraction process. Therefore, soil samples in which the total metals results exceed ten times the STLC must also be analyzed for soluble concentrations using the WET. Soil containing chemicals exceeding the STLC are also classified as a California hazardous waste.

If the sample results exceed the STLC and are twenty percent of the RCRA threshold limit, the samples shall also be analyzed for soluble content using the Toxicity Characteristic Leaching Procedure ("TCLP"). These results will be compared against RCRA hazardous waste thresholds (Title 40, CFR). Soil containing chemicals exceeding the RCRA hazardous waste thresholds are designated RCRA hazardous waste. Any soil classified as a California or RCRA hazardous waste will be disposed of off-Site at a permitted facility.

If the visibly contaminated soil is not a California or RCRA hazardous waste and will be reused on-Site, it will be screened against appropriate ESL values;[5] shallow fill[6] placed on the Site during recent Site redevelopment can be segregated and reused without sampling. The applicable ESLs for the Site are for the commercial land use where groundwater is not a current or potential source of drinking water. The ESL values for arsenic has been adjusted to the Portwide background levels of 16.4 milligram per kilogram ("mg/kg") for fill and 5.6 mg/kg for native ("Bay Mud") materials, as developed by BASELINE Environmental Consulting (BASELINE, 2008) (Table 3).

For chemical constituents that exceed the respective ESL value, a 95% UCL (one-tailed) of the data will be calculated based on the U.S. EPA Guidance (2002). The 95% UCL shall be compared to the applicable ESL values, as modified, in Table 3. If the 95% UCL is below the ESLs, then the material can be reused on-Site.

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[4] The analytical results may be evaluated by calculating the one-tailed 90 percent upper confidence level (90% UCL) of the sample mean in accordance with U.S. EPA Guidance (EPA, 2002).

[5] Table B of the Water Board document *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater* (February 2005), as modified in Table 3 of this RMP.

[6] Top two feet.

6.0 GROUNDWATER AND STORMWATER

Subsurface construction work may require the dewatering of excavation or trenches. Groundwater or stormwater may be disposed of in one of three ways:

- Discharge to the storm drain system under an NPDES permit;
- Discharge to the East Bay Municipal Utility District's ("EBMUD") sanitary sewer system under a permit from EBMUD; or
- Off-haul to a permitted recycling facility.

Samples of groundwater or stormwater that is discharged under an NPDES permit or an EBMUD permit will be analyzed, as required, by the conditions of the permit. Samples of groundwater or stormwater that is off-hauled to a permitted recycling facility shall be analyzed for the following:

- TEPH as diesel/motor oil with silica gel cleanup in accordance with EPA Method 8015 modified;
- TPH as gasoline in accordance with EPA Method 8015 modified;
- VOCs in accordance with EPA Method 8260B;
- SVOCs in accordance with EPA Method 8270C; and
- Title 22 metals in accordance with EPA Methods 6010B and 7471A.

Groundwater or stormwater hauled off-Site must be transported in accordance with federal, state, and local regulations under appropriate waste manifests and disposed of or recycled at a permitted facility.

7.0 INSTITUTIONAL CONTROLS

A Covenant to Restrict Use of Property ("CRUP") will be executed by the Port and filed with ACEH. The CRUP will restrict Site uses such that no residential or sensitive land uses are allowed on-Site. The Port (and any future Site owners) would have the responsibility for administering the CRUP.

8.0 REFERENCES

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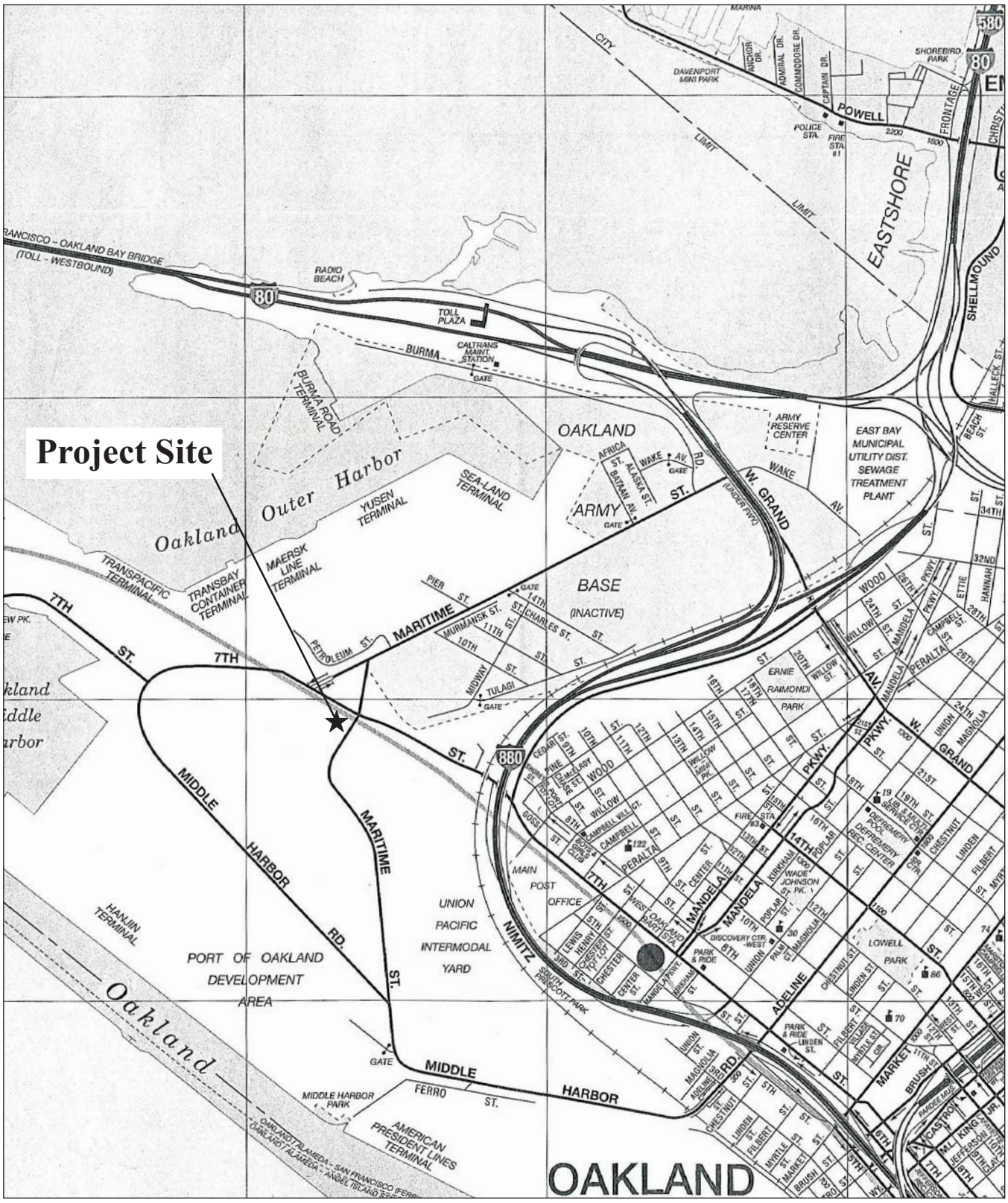
_____, 1986, Test Methods for Evaluation Solid Waste, Physical/Chemical Methods, SW-846, as updated.

FIGURES

REGIONAL LOCATION

Figure 1



651 Maritime Street
Port of Oakland
Oakland, California

0 2000 Feet

BASELINE

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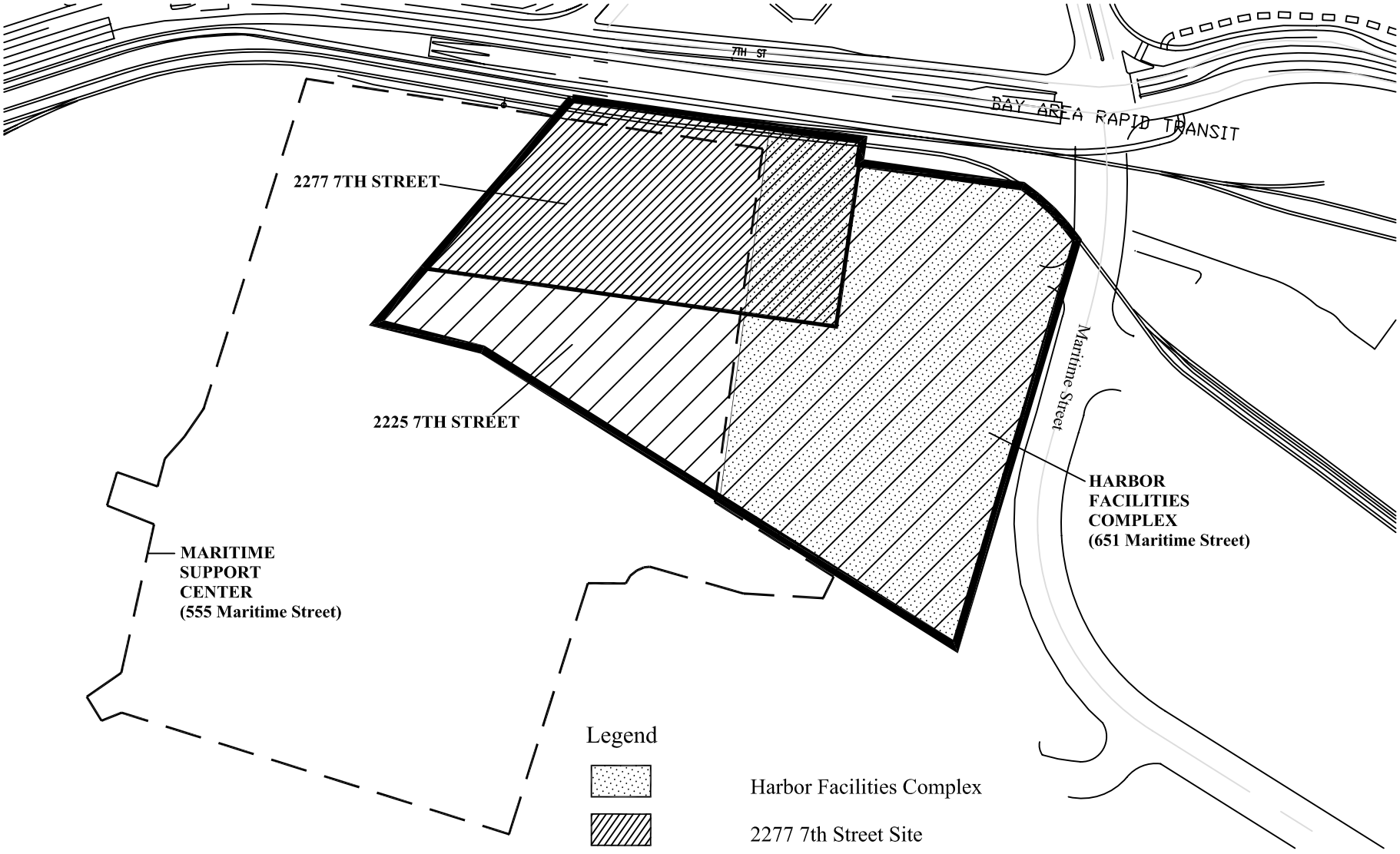
SITE BOUNDARIES

Figure 2



651 Maritime Street
Port of Oakland
Oakland, California

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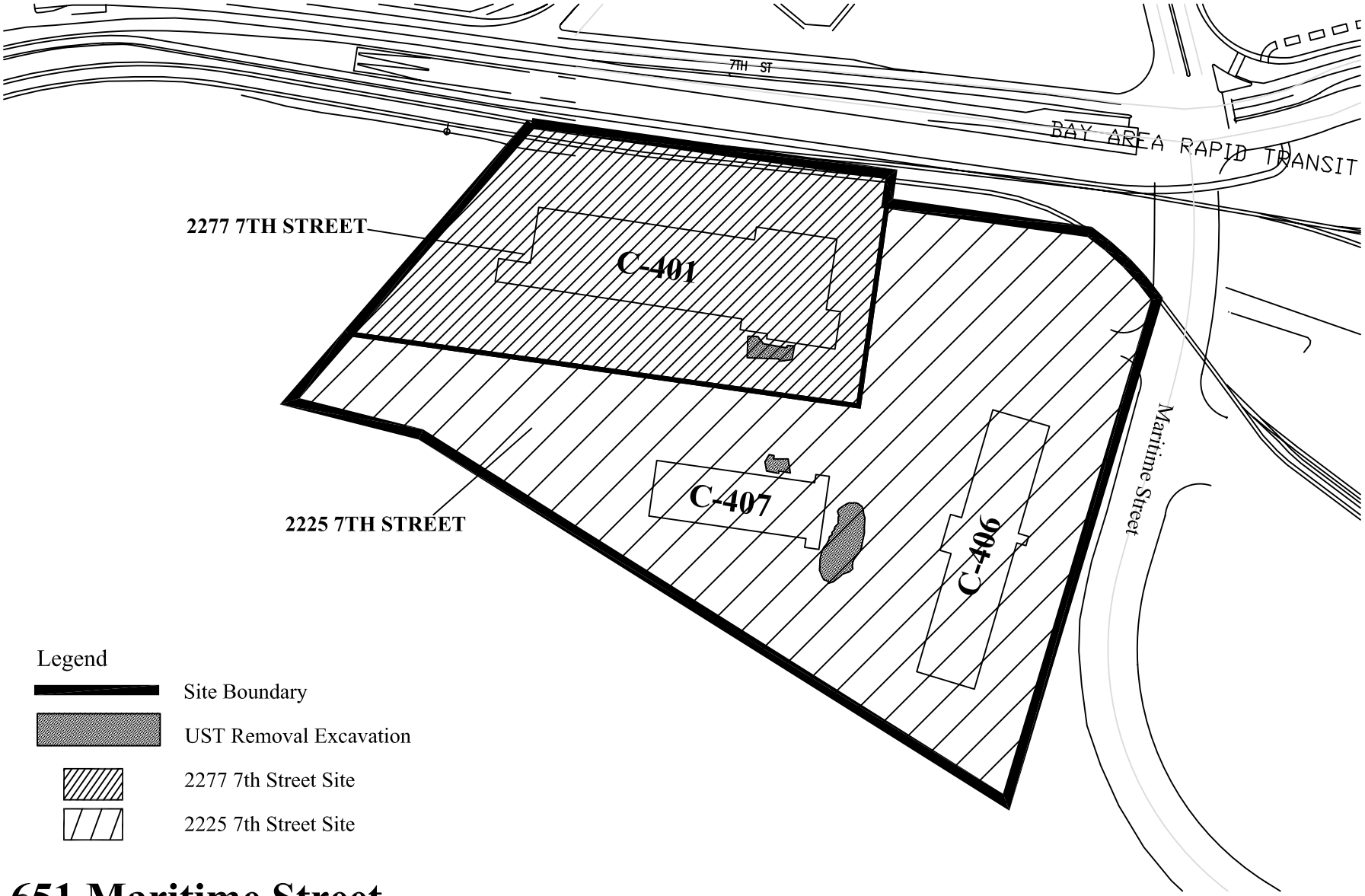
UST REMOVAL EXCAVATION SITES

Figure 3



651 Maritime Street
Port of Oakland
Oakland, California

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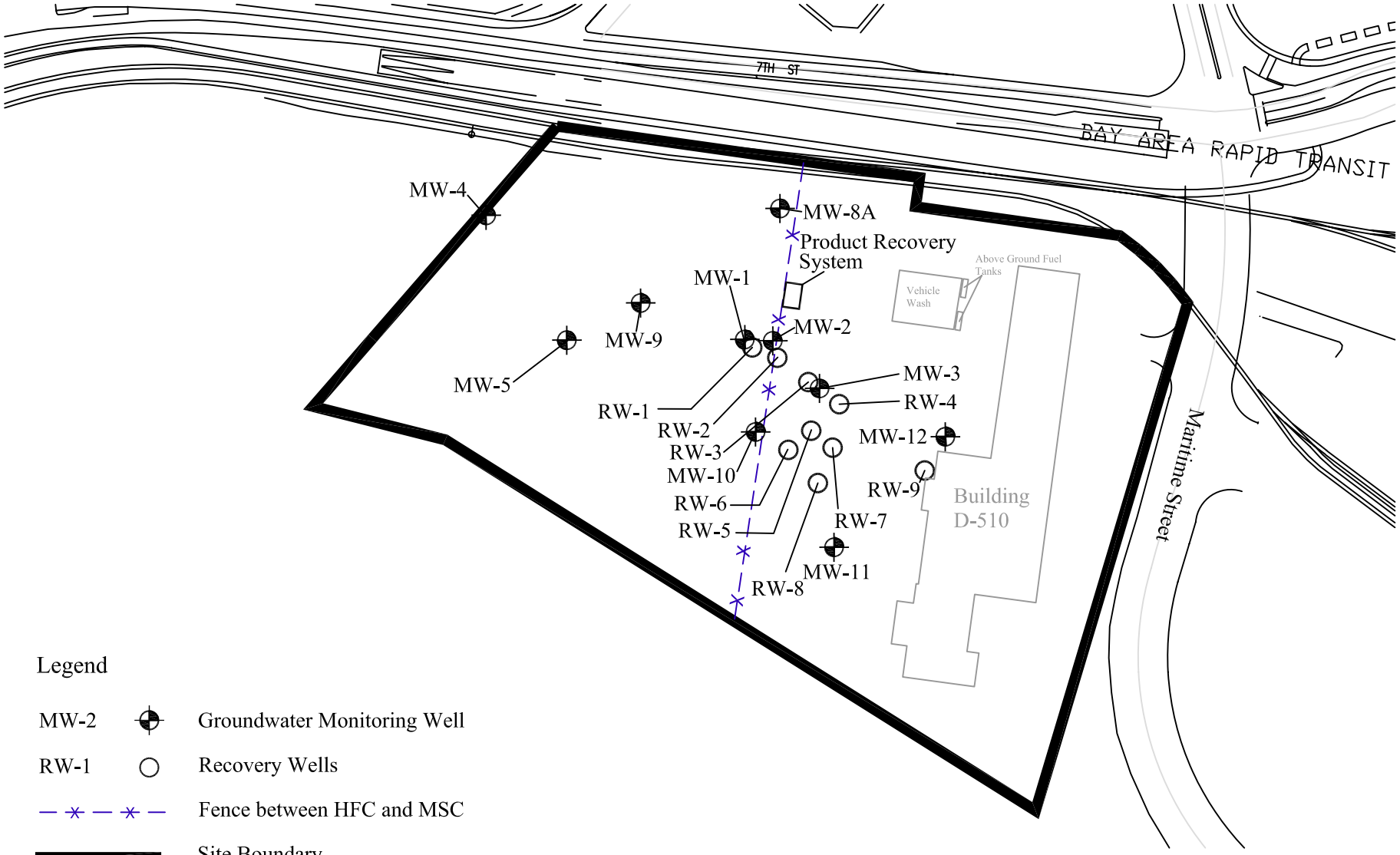
SITE PLAN

Figure 4



651 Maritime Street
Port of Oakland
Oakland, California

0 200 Feet

BASELINE

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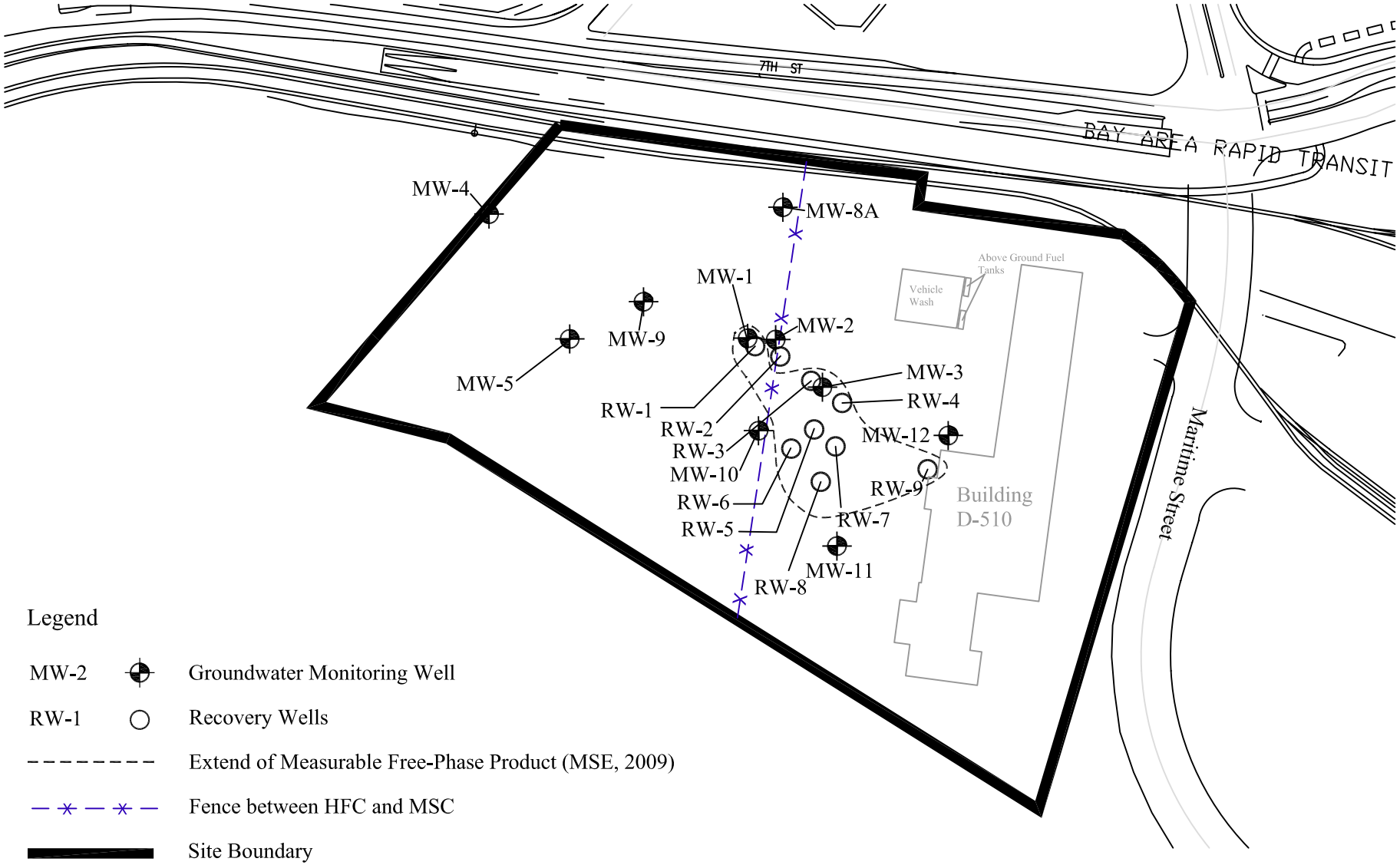
LIMITS OF FREE-PHASE PRODUCT

Figure 5



651 Maritime Street
Port of Oakland
Oakland, California

BASELINE

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TABLES

Table 1: **Chemicals of Potential Concern**
651 Maritime Street
Risk Management Plan
Port of Oakland, Oakland, California

Volatile Organic Compounds	Media
1,1-dichloroethene	Soil/groundwater
1,1-dichloroethane	Groundwater
1,2,4-trimethylbenzene	Soil/groundwater/soil gas
1,2-dichloroethane	Groundwater
1,2-dichloropropane	Groundwater
1,3,5-trimethylbenzene	Soil/groundwater
Acetone	Soil
Benzene	Soil/groundwater/soil gas
Chlorobenzene	Soil
Chloroethane	Groundwater
cis-dichloroethene	Groundwater/soil gas
trans-dichloroethene	Groundwater
di-isopropyl ether (DIPE)	Groundwater
Ethylbenzene	Soil/groundwater/soil gas
Isopropylbenzene	Soil/groundwater/soil gas
Methyl tert-butyl ether (MTBE)	Soil/groundwater/soil gas
Naphthalene	Soil/groundwater
n-butylbenzene	Soil/groundwater
n-propylbenzene	Soil/groundwater/soil gas
sec-butylbenzene	Soil/groundwater/soil gas
Tetrachloroethene	Soil/groundwater
Toluene	Soil/groundwater/soil gas
Trichloroethene	Soil/groundwater/soil gas
Trichlorofluoromethane	Soil gas
Trichlorotrifluoroethane	Soil gas
Vinyl chloride	Groundwater/soil gas
Xylene(s)	Soil/groundwater/soil gas
Total Petroleum Hydrocarbons	
Diesel	Soil/groundwater
Gasoline	Soil/groundwater/soil gas
Motor oil	Soil/groundwater
Semi-volatile Organic Compounds	
2-methylnaphthalene	Soil/groundwater
Acenaphthene	Soil
Anthracene	Soil
Benzo(a)anthracene	Soil
Chrysene	Soil
Dibenzofuran	Soil/groundwater
Fluoranthene	Soil
Fluorene	Soil/groundwater
Naphthalene	Soil/groundwater
Phenanthrene	Soil/groundwater
Pyrene	Soil
Metals	
Arsenic	Soil
Cadmium	Soil
Copper	Soil
Lead	Soil
Zinc	Soil
Other	
Methane	Soil gas

Source: Iris, 2003b.

Table 2: **Frequency of Soil Sampling**
651 Maritime Street
Risk Management Plan
Port of Oakland, California

Volume of Excavated Soils	Number of Samples
Up to 1,000 cubic yards	1 discrete sample per 250 cubic yards, with a minimum of 4 samples.
Between 1,000 and 5,000 cubic yards	4 samples for first 1,000 cubic yards, plus 1 discrete sample per additional 500 cubic yards
Greater than 5,000 cubic yards	12 samples for first 5,000 cubic yards, plus 1 discrete sample per additional 1,000 cubic yards.

Source: DTSC, 2001.

Table 3: **Environmental Screening Levels**
651 Maritime Street Risk Management Plan
Port of Oakland, Oakland, California

CHEMICAL PARAMETER	ESLs for Shallow Soils[1] (mg/kg)
Acenaphthene	19
Acenaphthylene	13
Acetone	0.50
Aldrin	0.13
Anthracene	2.8
Antimony	40
Arsenic	16.4 (fill)/5.6 (native) [2]
Barium	1,500
Benzene	0.27
Benzo(a)anthracene	1.3
Benzo(a)pyrene	0.13
Benzo(b)fluoranthene	1.3
Benzo(g,h,i)perylene	27
Benzo(k)fluoranthene	1.3
Beryllium	8.0
Biphenyl,1,1-	6.5
Bis(2-chloroethyl)ether	0.16
Bis(2-chloroisopropyl)ether	0.077
Bis(2-ethylhexyl)phthalate	120
Boron	2.0
Bromodichloromethane	1.3
Bromoform	24
Bromomethane	2.3
Cadmium	7.4
Carbon tetrachloride	0.044
Chlordane	1.7
Chloroaniline, p-	0.053
Chlorobenzene	1.5
Chloroethane	0.85
Chloroform	1.5
Chloromethane	6.4
Chlorophenol, 2-	0.12
Chromium III	750
Chromium VI	8.0
Chrysene	23
Cobalt	80
Copper	230
Cyanide (free)	0.0036
Dibenzo(a,h)anthtracene	0.21
Dibromochloromethane	14
Dibromo-3-chloropropane, 1,2-	0.0045
Dibromoethane, 1,2-	0.044
Dichlorobenzene, 1,2-	1.6
Dichlorobenzene, 1,3-	7.4

Table 3: **Environmental Screening Levels**
651 Maritime Street Risk Management Plan
Port of Oakland, Oakland, California

CHEMICAL PARAMETER	ESLs for Shallow Soils[1] (mg/kg)
Dichlorobenzene, 1,4-	1.8
Dichlorobenzidine, 3,3-	2.6
Dichlorodiphenyldichloroethane (DDD)	10
Dichlorodiphenyldichloroethylene (DDE)	4.0
Dichlorodiphenyltrichloroethane (DDT)	4.0
Dichloroethane, 1,1-	1.9
Dichloroethane, 1,2-	0.48
Dichloroethylene, 1,1-	4.3
Dichloroethylene, cis 1,2-	18.0
Dichloroethylene, trans 1,2-	34.0
Dichlorophenol, 2,4-	3.0
Dichloropropane, 1,2-	1.0
Dichloropropene, 1,3-	0.36
Dieldrin	0.0023
Diethylphthalate	0.035
Dimethylphenol, 2,4-	0.74
Dimethylphthalate	0.035
Dinitrophenol, 2,4-	0.042
Dinitrotoluene, 2,4-	0.86
Dioxane, 1,4	30
Dioxin (2,3,7,8-TCDD)	0.000018
Endosulfan	0.0046
Endrin	0.00065
Ethylbenzene	4.7
Fluoranthene	40
Fluorene	8.9
Heptachlor	0.013
Heptachlor epoxide	0.014
Hexachlorobenzene	1.3
Hexachlorobutadiene	4.6
Hexachlorocyclohexane (gamma) lindane	0.0068
Hexachloroethane	41
Indeno(1,2,3-cd)pyrene	2.1
Lead	750
Mercury	10
Methoxychlor	19
Methyl ethyl ketone	13
Methyl isobutyl ketone	3.9
Methyl mercury	12
Methyl tert butyl ether	8.4
Methylene chloride	17.0
Methylnaphthalene (Total 1- & 2-)	0.25
Molybdenum	40
Naphthalene	2.8

Table 3: **Environmental Screening Levels**
651 Maritime Street Risk Management Plan
Port of Oakland, Oakland, California

CHEMICAL PARAMETER	ESLs for Shallow Soils[1] (mg/kg)
Nickel	150
Pentachlorophenol	5.0
Perchlorate	140
Phenanthrene	11
Phenol	3.9
Polychlorinated biphenyls (PCBs)	0.74
Pyrene	85
Selenium	10
Silver	40
Styrene	15
Tert-butyl alcohol	110
Tetrachloroethane, 1,1,1,2-	4.5
Tetrachloroethane, 1,1,2,2-	0.60
Tetrachloroethylene	0.95
Thallium	16
Toluene	9.3
Toxaphene	0.00042
TPH (gasolines)	180
TPH (middle distillates)	180
TPH (residual fuels)	2,500
Trichlorobenzene, 1,2,4-	7.6
Trichloroethane, 1,1,1-	7.8
Trichloroethane, 1,1,2-	1.1
Trichloroethylene	4.1
Trichlorophenol, 2,4,5-	0.18
Trichlorophenol, 2,4,6-	10
Vanadium	200
Vinyl chloride	0.047
Xylenes	11
Zinc	600

Notes:
ESLs = Environmental Screening Levels (RWQCB, 2008 and LBNL, 2002).
mg/kg = milligram per kilogram.
mg/L = microgram per liter.
ESLs listed in this table may change over time; future updates to the ESLs must be researched before using the values listed in this table.

[1] Source: SF Regional Water Quaity Control Board, 2008, *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater* , Table B-2, May.

[2] BASELINE, 2008, Evaluation of 95th Percentile Background Arsenic Concentrations for the Port of Oakland, California, 10 December.

APPENDIX A

Exposure Assessment Form

EXPOSURE ASSESSMENT FORM

TASK ORDER NO.: _____ **DATES OF WORK:** _____

LOCATION OF WORK:
(attach a site plan) _____

DESCRIPTION OF WORK: _____

DEPTH OF EXCAVATIONS:
(below ground surface) _____

EXPOSURE ASSESSMENT

Workers will not be exposed to site contaminants.	☐	Yes [1]
Workers may be exposed to site contaminants.	☐	Yes [2]

[1] Use Port's standard construction health and safety procedures.

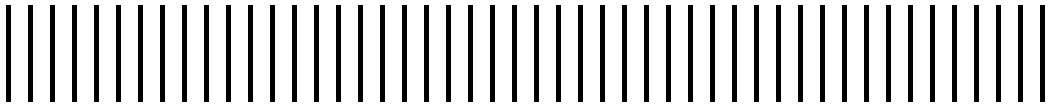
[2] Follow the procedures in the Risk Management Plan for 651 and 555 Maritime Street.

_____ _____

Sign (Certified Industrial Hygienist) Date

Port of Oakland
Feasibility Study/Corrective Action Plan
Port of Oakland's Harbor Facilities Complex Site
651 Maritime Street, Oakland, CA

Appendix C
Detailed Cost Estimate Spreadsheet



4656016 / NCA

MALCOLM PIRNIE

ALTERNATIVE B
MONITORED NATURAL ATTENUATION

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Development of Land Use Covenants	1	Event	$20,000	$20,000	
Regulatory Negotiations	1	Event	$50,000	$50,000	
MNA Work Plan	1	Event	$20,000	$20,000	
Site Management Plan	0	Event	$20,000	$0	
O&M Plan / H&S Plan	1	Event	$10,000	$10,000	Existing H&S Plan is appropriate for long-term monitorin
Additional GW Monitoring and Extraction Wells	0	Well	$5,000	$0	
CAPITAL COST CONTINGENCY	5%	% of Total		$5,000	
PROJECT MANAGEMENT (PM)	5%	% of Total		$5,250	
TECHNICAL SUPPORT (TS)	10%	% of Total		$10,500	
TOTAL CMI COSTS				**$120,750**	

ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
OPERATION AND MAINTENANCE	0	Event			
Sampling and Reporting (Labor)			$60,000	$0	
Field Engineering (Labor)			$20,000	$0	
Office Engineering			$0	$0	
Engineering QC			$0	$0	
Well/infiltration gallery rehab			$0	$0	
Equipment and Supplies			$50,000	$0	
Utility Fees			$20,000	$0	
Disposal fees			$10,000	$0	
Laboratory Analysis			$0	$0	
ANNUAL O&M COST CONTINGENCY	5%	% of Total		$0	
PROJECT MANAGEMENT (PM)	5%	% of Total		$0	
TECHNICAL SUPPORT (TS)	10%	% of Total		$0	
TOTAL ANNUAL O&M COSTS				**$0**	

ALTERNATIVE B
MONITORED NATURAL ATTENUATION

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

GROUNDWATER MONITORING AND REPORTING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Semi-annual Monitoring and Reporting	2	Annual	$32,000	$64,000	wells sampled semi-annually for 2 years for TPHd, TPHg, BTEX, MTBE.
Annual Monitoirng and Reporting	3	Annual	$16,000	$48,000	wells sampled annually for 3 years for TPHd, TPHg, BTEX, MTBE.
Free Product Monitoring	2	Annual	$9,600	$19,200	quarterly for 2 years
MNA parameters	3	Event	$6,000	$18,000	wells sampled once every 2 years for MNA parameters
Post-closure Monitoring and Reporting	0	Annual	$0	$0	
MONITORING COST CONTINGENCY	5%	% of Total		$7,460	
PROJECT MANAGEMENT (PM)	5%	% of Total		$7,833	
TECHNICAL SUPPORT (TS)	10%	% of Total		$15,666	
TOTAL GROUNDWATER MONITORING AND REPORTING COSTS				**$180,159**	

PERIODIC COSTS (Every 5 Years)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
MAINTENANCE	0	Event			
General (Permitting, clearances, etc.)			$10,000	$0	
Well Rehabilitation			$10,000	$0	
Equipment Replacement			$0	$0	
Groundwater flow modeling			$0	$0	
Five-Year Review Report			$10,000	$0	
PERIODIC COST CONTINGENCY	5%	% of Total		$0	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$0	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$0	
TOTAL PERIODIC COSTS (Every 5 Years)				**$0**	

CLOSURE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration	1	Event	$50,000	$50,000	Destruction of Site wells
Closure Report	1	LS	$10,000	$10,000	Well destruction and closure report
CLOSURE COST CONTINGENCY	5%	% of Total		$3,000	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$3,150	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$0	
TOTAL CLOSURE COSTS				**$66,150**	

TOTAL COST ESTIMATE **$367,059**

ALTERNATIVE C
FREE PRODUCT REMOVAL

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Development of Land Use Covenants	0	Event		$0	
Regulatory Negotiations	0	Event		$0	
Remedial Investigation/Confirmation Samples	0	Event		$0	
System Design & Specifications	0	Event		$0	Design Specs for bid process and permitting.
Construction Work Plan/Plans and Specs	0	Event		$0	
O&M Plan / H&S Plan	0	Event		$0	
Installl Product Recovery Wells	0	Well		$0	10 4-inch wells to 12 feet bgs
Piping Installation	0	linear ft. pipe		$0	below ground single-walled PVC pipe
Treatment/Operation System & Compound	0	System		$0	
Startup	0	event		$0	
CAPITAL COST CONTINGENCY	5%	% of Total		$0	
PROJECT MANAGEMENT (PM)	5%	% of Total		$0	
TECHNICAL SUPPORT (TS)	10%	% of Total		$0	
TOTAL CMI COSTS				**$0**	

ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
OPERATION AND MAINTENANCE	20	Event			20-year cost projection
Sampling and Reporting (Labor)			$0	$0	
Field Engineering (Labor)			$30,000	$600,000	
Office Engineering			$10,000	$200,000	
Engineering QC			$5,000	$100,000	
Well/infiltration gallery rehab			$0	$0	
Equipment and Supplies			$5,000	$100,000	
Utility Fees			$10,000	$200,000	
Disposal fees			$2,000	$40,000	
Laboratory Analysis			$0	$0	
ANNUAL O&M COST CONTINGENCY	5%	% of Total	$3,100.00	$62,000	
PROJECT MANAGEMENT (PM)	5%	% of Total	$3,255.00	$65,100	
TECHNICAL SUPPORT (TS)	10%	% of Total	$6,510.00	$130,200	
TOTAL ANNUAL O&M COSTS			**$74,865**	**$1,497,300**	

ALTERNATIVE C
FREE PRODUCT REMOVAL

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

GROUNDWATER MONITORING AND REPORTING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Semi-annual Monitoring and Reporting	0	Event	$16,000	$0	
Annual Monitoring and Reporting	20	Event	$16,000	$320,000	wells sampled annually for 20 years for TPHd, TPHg, BTEX, MTBE.
Post-closure Monitoring and Reporting	1	Event	$16,000	$16,000	
MONITORING COST CONTINGENCY	5%	% of Total		$16,800	
PROJECT MANAGEMENT (PM)	5%	% of Total		$17,640	
TECHNICAL SUPPORT (TS)	10%	% of Total		$35,280	
TOTAL GROUNDWATER MONITORING AND REPORTING COSTS				**$405,720**	

PERIODIC COSTS (Every 5 Years)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
MAINTENANCE	3	Event			Periodic maintenance events at 5, 10 and 15 years
General (Permitting, clearances, etc.)			$0	$0	
Well Rehabilitation			$10,000	$30,000	
Equipment Replacement			$10,000	$30,000	
Groundwater flow modeling			$0	$0	
Five-Year Review Report			$10,000	$30,000	
PERIODIC COST CONTINGENCY	5%	% of Total	$1,500	$4,500	
PROJECT MANAGEMENT (PM)	5%	%'AGE	$1,575	$4,725	
TECHNICAL SUPPORT (TS)	0%	%'AGE	$0	$0	
TOTAL PERIODIC COSTS (Every 5 Years)			**$33,075**	**$99,225**	

CLOSURE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration	1	Event	$50,000	$50,000	Destruction of monitoring wells
Closure Report	1	LS	$10,000	$10,000	Well destruction report
CLOSURE COST CONTINGENCY	5%	% of Total		$3,000	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$3,150	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$0	
TOTAL CLOSURE COSTS				**$66,150**	

TOTAL COST ESTIMATE $2,068,395

ALTERNATIVE D
MOBILE HIGH VACUUM EXTRACTION

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Development of Land Use Covenants	1	Event	$20,000	$20,000	
Regulatory Negotiations	1	Event	$50,000	$50,000	
Remedial Investigation	0	Event	$100,000	$0	
System Design & Specifications	1	Event	$10,000	$10,000	Develop specification necessary to hire subcontractor for HiVac
Construction Work Plan/Plans and Specs	1	Event	$10,000	$10,000	
O&M Plan / H&S Plan	1	Event	$10,000	$10,000	O&M plan for HiVac unit, treatment and dipsosal plans for extracted fluid
Additional Extraction Wells	50	Well	$3,000	$150,000	50 4-inch wells to 12 ft
Piping Installation	0	linear ft. pipe		$0	
Conduct Pilot Test	1	Event	$30,000	$30,000	install and test 5 wells and prepare report; workplan and permitting included
Disposal of Extracted Fluids	2500	gallon	$2	$5,000	Purged Volume during Pilot Tes
CAPITAL COST CONTINGENCY	5%	% of Total		$14,250	
PROJECT MANAGEMENT (PM)	5%	% of Total		$14,963	
TECHNICAL SUPPORT (TS)	10%	% of Total		$29,925	
TOTAL CMI COSTS				**$344,138**	

ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
OPERATION AND MAINTENANCE	78	Event			26 events per year for 3 years
HiVac Subcontractor			$7,500	$585,000	
Field Engineering (Labor)			$5,000	$390,000	5 days per event, 10 hours per day, 10 wells per day
Office Engineering			$0	$0	
Engineering QC			$0	$0	
Well/infiltration gallery rehab			$0	$0	
Equipment and Supplies			$0	$0	
Utility Fees			$0	$0	
Disposal fees			$5,000	$390,000	disposal of 5,000 gallons of extracted fluid per event
Laboratory Analysis			$0	$0	
ANNUAL O&M COST CONTINGENCY	5%	% of Total	$875	$68,250	
PROJECT MANAGEMENT (PM)	5%	% of Total	$919	$71,663	
TECHNICAL SUPPORT (TS)	10%	% of Total	$1,838	$143,325	
TOTAL ANNUAL O&M COSTS			**$549,413**	**$1,648,238**	

ALTERNATIVE D
MOBILE HIGH VACUUM EXTRACTION

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

GROUNDWATER MONITORING AND REPORTING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Semi-Annual Monitoring and Reporting	6	Event	$16,000	$96,000	Semi-annual for 4 years (3 years operation pluse on additional year)
Annual Monitoring and Reporting	0	Event	$16,000	$0	
Post-closure Monitoring and Reporting	1	Event	$16,000	$16,000	
MONITORING COST CONTINGENCY	5%	% of Total	$2,400	$5,600	
PROJECT MANAGEMENT (PM)	5%	% of Total	$2,520	$5,880	
TECHNICAL SUPPORT (TS)	10%	% of Total	$5,040	$11,760	
TOTAL GROUNDWATER MONITORING AND REPORTING COSTS				**$135,240**	

PERIODIC COSTS (Every 5 Years)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
MAINTENANCE	0	Event			
General (Permitting, clearances, etc.)			$0	$0	
Well Rehabilitation			$10,000	$0	
Equipment Replacement			$0	$0	
Groundwater flow modeling			$0	$0	
Five-Year Review Report			$10,000	$0	
PERIODIC COST CONTINGENCY	5%	% of Total		$0	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$0	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$0	
TOTAL PERIODIC COSTS (Every 5 Years)				**$0**	

CLOSURE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration	1	Event	$108,000	$108,000	Destruction of 50 extraction and 14 monitoring wells
Closure Report	1	LS	$10,000	$10,000	Well destruction and closure report
CLOSURE COST CONTINGENCY	5%	% of Total		$5,900	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$6,195	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$0	
TOTAL CLOSURE COSTS				**$130,095**	

TOTAL COST ESTIMATE $2,257,710

ALTERNATIVE E
MULTI-PHASE EXTRACTION

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Development of Land Use Covenants	1	Event	$20,000	$20,000	
Regulatory Negotiations	1	Event	$50,000	$50,000	
Remedial Investigation	0	Event	$100,000	$0	
System Design & Specifications	1	Event	$50,000	$50,000	Design Specs for bid process and permitting.
Construction Work Plan/Plans and Specs	1	Event	$40,000	$60,000	includes application for NPDES permit
O&M Plan / H&S Plan	1	Event	$10,000	$10,000	
Additional GW Monitoring and Extraction Wells	50	Well	$3,000	$150,000	50 4-inch wells to 12 ft
Piping Installation	5000	linear ft. pipe	$7	$35,000	abovground single-walled PVC pipe
Effluent Treatment System	1	System	$250,000	$250,000	Permitting, connstruction and reporting
Conduct Pilot Test	1	Event	$30,000	$30,000	install and test 5 wells and prepare report; workplan and permitting included
System Startup	1	Event	$50,000	$50,000	14 -day to 30-day startup period reqired by permitting agencies
Disposal of Extracted groundwater	2500	gallon	$2.00	$5,000	disposal of treated effluent during pilot test
CAPITAL COST CONTINGENCY	5%	% of Total		$35,500	
PROJECT MANAGEMENT (PM)	5%	% of Total		$37,275	
TECHNICAL SUPPORT (TS)	10%	% of Total		$74,550	
TOTAL CMI COSTS				**$857,325**	

ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
OPERATION AND MAINTENANCE	2	Annual			
Sampling and Reporting (Labor)			$0	$0	
Field Engineering (Labor)			$104,000	$208,000	20 hours per week ($100/hr) for 2 year
Office Engineering			$40,000	$80,000	8 hrs per week
Engineering QC			$10,000	$20,000	
Well/infiltration gallery rehab			$0	$0	
Equipment and Supplies			$5,000	$10,000	
Utility Fees			$50,000	$100,000	Estimate - actual value unknown
Disposal fees			$100,000	$200,000	
Laboratory Analysis			$50,000	$100,000	
ANNUAL O&M COST CONTINGENCY	5%	% of Total		$35,900	
PROJECT MANAGEMENT (PM)	5%	% of Total		$37,695	
TECHNICAL SUPPORT (TS)	10%	% of Total		$75,390	
TOTAL ANNUAL O&M COSTS			**$359,000**	**$866,985**	

ALTERNATIVE E
MULTI-PHASE EXTRACTION

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

GROUNDWATER MONITORING AND REPORTING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Semi-Annual Monitoring and Reporting	6	Event	$16,000	$96,000	Semi-annual monitoring for 3 yrs
Annual Monitoring and Reporting	0	Event	$16,000	$0	
Post-closure Monitoring and Reporting	1	Event	$16,000	$16,000	
MONITORING COST CONTINGENCY	5%	% of Total		$5,600	
PROJECT MANAGEMENT (PM)	5%	% of Total		$5,880	
TECHNICAL SUPPORT (TS)	10%	% of Total		$11,760	
TOTAL GROUNDWATER MONITORING AND REPORTING COSTS				**$135,240**	

PERIODIC COSTS (Every 5 Years)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
MAINTENANCE	0	Event			
General (Permitting, clearances, etc.)			$0	$0	
Well Rehabilitation			$10,000	$0	
Equipment Replacement			$0	$0	
Groundwater flow modeling			$0	$0	
Five-Year Review Report			$10,000	$0	
PERIODIC COST CONTINGENCY	5%	% of Total	$1,000	$0	
PROJECT MANAGEMENT (PM)	5%	%'AGE	$1,050	$0	
TECHNICAL SUPPORT (TS)	0%	%'AGE	$0	$0	
TOTAL PERIODIC COSTS (Every 5 Years)				**$0**	

CLOSURE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration	1	Event	$150,000	$150,000	Destruction of extraction and monitoring wells and treatment system
Closure Report	1	LS	$10,000	$10,000	Well destruction and closure report
CLOSURE COST CONTINGENCY	5%	% of Total		$8,000	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$8,400	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$0	
TOTAL CLOSURE COSTS				**$176,400**	

TOTAL COST ESTIMATE $2,035,950

ALTENRATIVE F
THERMAL ELECRICAL RESISTIVE HEATING

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST		TOTAL	NOTES
Development of Land Use Covenants	0	Event	$20,000	$	-	
Regulatory Negotiations	1	Event	$50,000	$	50,000	
Remedial Investigation	0	Event	$100,000	$	-	
System Design & Specifications	1	Event	$50,000	$	50,000	
Construction Work Plan/Plans and Specs	1	Event	$40,000	$	40,000	
O&M Plan / H&S Plan	1	Event	$10,000	$	10,000	
Remove PVC GW Monitoring Wells	12	Well	$2,500	$	30,000	
Piping Installation	0	linear ft. pipe	$25	$	-	
Groundwater Treatment System (GAC)	0	System	$750,000	$	-	
Thermal In-situ Treatment	16,400	Ton	$110	$	1,804,000	consruction cost estimate based on literature and previous cost estimate provided to Malcolm Pirnie by subcontractors for similar work. 1 cy = 1.4 tons
Conduct Pilot Test	1	Event	$30,000	$	30,000	
System Startup	0	Event	$50,000	$	-	
CAPITAL COST CONTINGENCY	5%	% of Total		$	100,700	
PROJECT MANAGEMENT (PM)	5%	% of Total		$	105,735	
TECHNICAL SUPPORT (TS)	10%	% of Total		$	211,470	
TOTAL CMI COSTS				**$**	**2,431,905**	

ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST		TOTAL	NOTES
OPERATION AND MAINTENANCE	1	Annual				Annual
Sampling and Reporting (Labor)			$0	$	-	
Field Engineering (Labor)			$65,000	$	65,000	10 hours per week for 12 months
Office Engineering			$15,000	$	15,000	
Engineering QC			$10,000	$	10,000	
Well/infiltration gallery rehab			$0	$	-	
Equipment and Supplies			$50,000	$	50,000	
Utility Fees			$200,000	$	200,000	unknown - estimated
Disposal fees			$10,000	$	10,000	unknown - estimated
Laboratory Analysis			$0	$	-	
ANNUAL O&M COST CONTINGENCY	5%	% of Total		$	17,500	
PROJECT MANAGEMENT (PM)	5%	% of Total		$	18,375	
TECHNICAL SUPPORT (TS)	10%	% of Total		$	36,750	
TOTAL ANNUAL O&M COSTS			**$350,000**	**$**	**422,625**	

ALTENRATIVE F
THERMAL ELECRICAL RESISTIVE HEATING

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

GROUNDWATER MONITORING AND REPORTING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Quarterly Monitoring and Reporting	4	Quarterly	$16,000	$ 64,000	
Semi-annual Monitoring and Reporting	0	Annual	$16,000	$ -	
Annual Monitoring and Reporting	0	Annual	$16,000	$ -	
Post-closure Monitoring and Reporting	0	Annual	$16,000	$ -	
MONITORING COST CONTINGENCY	5%	% of Total		$ 3,200	
PROJECT MANAGEMENT (PM)	5%	% of Total		$ 3,360	
TECHNICAL SUPPORT (TS)	10%	% of Total		$ 6,720	
TOTAL GROUNDWATER MONITORING AND REPORTING COSTS				**$ 77,280**	

PERIODIC COSTS (Every 5 Years)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
MAINTENANCE	0	Event			
General (Permitting, clearances, etc.)			$0	$ -	
Well Rehabilitation			$10,000	$ -	
Equipment Replacement			$0	$ -	
Groundwater flow modeling			$0	$ -	
Five-Year Review Report			$10,000	$ -	
PERIODIC COST CONTINGENCY	5%	% of Total	$1,000	$ -	
PROJECT MANAGEMENT (PM)	5%	%'AGE	$1,050	$ -	
TECHNICAL SUPPORT (TS)	0%	%'AGE	$0	$ -	
TOTAL PERIODIC COSTS (Every 5 Years)				**$ -**	

CLOSURE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration	1	Event	$150,000	$ 150,000	Destruction of 10 existing wells (pre-treatment) and 6 new wells (post-treatment), and ERH system
Closure Report	1	LS	$10,000	$ 10,000	Well destruction and closure report
CLOSURE COST CONTINGENCY	5%	% of Total		$ 8,000	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$ 8,400	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$ -	
TOTAL CLOSURE COSTS				**$ 176,400**	

TOTAL COST ESTIMATE $ 3,108,210

ALTERNATIVE G
EXCAVATION AND DISPOSAL

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST		TOTAL	NOTES
Development of Land Use Covenants	0	Event	$20,000	$	-	
Regulatory Negotiations	1	Event	$10,000	$	10,000	
Remedial Investigation/Confirmation Samples	0	Event	$100,000	$	-	
System Design & Specifications	1	Event	$30,000	$	30,000	Design Specs for bid process and permitting.
Construction Work Plan/Plans and Specs	1	Event	$20,000	$	20,000	
O&M Plan / H&S Plan	1	Event	$10,000	$	10,000	
Piping Installation	0	linear ft. pipe	$7	$	-	
Effluent Treatment System	0	System	$250,000	$	-	
Conduct Pilot Test	0	Event	$30,000	$	-	
Disposal of Extracted groundwater	1,000,000	gallon	$0.10	$	100,000	disposal of water to sanitary sewer (include on-site treatment) under EBMUD permit
Excavate and Stockpile Non-impacted Soil	12,000	tons	$7	$	84,000	1 cy = 1.4 tons (approximately)
Excavate and Stockpile Impacted Soil	16,400	tons	$9	$	147,600	
Transportation and Disposal of Impacted Soil	16,400	tons	$60.00	$	984,000	
Import Clean Fill	16,400	tons	$32.00	$	524,800	
Backfill & Compact	28,400	tons	$10.00	$	284,000	
Excavation oversight	120	days	$2,500	$	300,000	
Confirmation Sample Analysis	100	per sample	$150	$	15,000	samples analyzed on 24-hr TAT
Shoring	16,800	sq.ft.	$50.00	$	840,000	(perimeter x depth to 20 ft bgs)
CAPITAL COST CONTINGENCY	5%	% of Total		$	167,470	
PROJECT MANAGEMENT (PM)	5%	% of Total		$	175,844	
TECHNICAL SUPPORT (TS)	10%	% of Total		$	351,687	
TOTAL CMI COSTS				**$**	**4,044,401**	

ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST		TOTAL	NOTES
OPERATION AND MAINTENANCE	0	Event				
Sampling and Reporting (Labor)			$0	$	-	
Field Engineering (Labor)			$0	$	-	
Office Engineering			$0	$	-	
Engineering QC			$0	$	-	
Well/infiltration gallery rehab			$0	$	-	
Equipment and Supplies			$0	$	-	
Utility Fees			$0	$	-	
Disposal fees			$0	$	-	
Laboratory Analysis			$20,000	$	-	Confirmation Samples (24-hr TAT)
ANNUAL O&M COST CONTINGENCY	5%	% of Total		$	-	
PROJECT MANAGEMENT (PM)	5%	% of Total		$	-	
TECHNICAL SUPPORT (TS)	10%	% of Total		$	-	
TOTAL ANNUAL O&M COSTS			**$20,000**	**$**	**-**	

ALTERNATIVE G
EXCAVATION AND DISPOSAL

Site: Harbor Facilities Complex, Port of Oakland

Location: 651 Maritime Stree, Oakland, CA

Phase: Remediation

Base Year: 2011

Date: March 15, 2011

GROUNDWATER MONITORING AND REPORTING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Install New Wells	4	per well	$5,000	$ 20,000	Install new wells inside excavation area
Quarterly Monitoring and Reporting	4	Annual	$16,000	$ 64,000	wells sampled quarterly for one year for TPHd, TPHg, BTEX and MTBE
Semi-annual Monitoring and Reporting	0	Annual	$32,000	$ -	
Annual Monitoring and Reporting	0	Annual	$16,000	$ -	
Post-closure Monitoring and Reporting	0	Annual	$16,000	$ -	
MONITORING COST CONTINGENCY	5%	% of Total		$ 3,200	
PROJECT MANAGEMENT (PM)	5%	% of Total		$ 3,360	
TECHNICAL SUPPORT (TS)	10%	% of Total		$ 6,720	
TOTAL GROUNDWATER MONITORING AND REPORTING COSTS				**$ 77,280**	

PERIODIC COSTS (Every 5 Years)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
MAINTENANCE	0	Event			
General (Permitting, clearances, etc.)			$0	$ -	
Well Rehabilitation			$10,000	$ -	
Equipment Replacement			$0	$ -	
Groundwater flow modeling			$0	$ -	
Five-Year Review Report			$10,000	$ -	
PERIODIC COST CONTINGENCY	5%	% of Total		$ -	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$ -	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$ -	
TOTAL PERIODIC COSTS (Every 5 Years)				**$ -**	

CLOSURE COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration	1	Event	$35,000	$ 35,000	Destruction of 13 monitoring wells
Closure Report	1	LS	$20,000	$ 20,000	Excavation Completion and Well Destruction Reports
CLOSURE COST CONTINGENCY	5%	% of Total		$ 2,750	
PROJECT MANAGEMENT (PM)	5%	%'AGE		$ 2,888	
TECHNICAL SUPPORT (TS)	0%	%'AGE		$ -	
TOTAL CLOSURE COSTS				**$ 60,638**	

TOTAL COST ESTIMATE $ 4,182,318