Alameda-Contra Costa Transit District

R0402

July 20, 2004

Ms. eva chu
Alameda County Health Division
Division of Environmental Protection
Department of Environmental Health
1131 Harbor Bay Parkway, Second Floor
Alameda, CA 94502

Dear Ms. chu:

Subject: Quarterly Groundwater Monitoring Report – May 2004 Sampling and Technology Screening Report, June 2004
AC Transit, 1177 47th Street, Emeryville

AC Transit hereby submits the enclosed Quarterly Groundwater Monitoring and Technology Screening Reports for the AC Transit facility located at 1177 47th Street in Emeryville. These reports were prepared by our consultant, Cameron-Cole, LLC, and contain the results of the May 2004 sampling event and the results of a screening of preliminary remedial action alternatives and data needs for the site.

The quarterly groundwater monitoring included collecting groundwater samples from three on-site monitoring wells (MW-11, MW-12 and MW-13). A groundwater sample was not collected from MW-13 due to the presence of an 11.04-inch free phase hydrocarbon layer. These samples were analyzed for total petroleum hydrocarbons (TPH) using modified EPA Method 8015 and benzene, toluene, ethylbenzene, and xylenes (BTEX), and methyl tert-butyl ether (MTBE) using EPA Method 8021B. No analytes were detected in samples collected from MW-11. TPH as degraded diesel and degraded gasoline was detected in MW-12 at concentrations of 190 ppb and 620 ppb, respectively. MTBE was detected in MW-12 at 5.6 ppb.

The technology screening report presents bioslurping as the recommended potential immediate corrective action until a full remedial action alternative is developed. Additional data is needed in order to make a determination as to the overall effectiveness of a bioslurping system. Three remedial action objectives (RAO) were listed in the report: (1) recover and treat free product, (2) control migration of dissolved constituents, and (3) reduce constituent concentrations to below applicable water quality objectives. The report also describes the steps that need to be taken to address data gaps so that a feasibility study can be performed and a final remedial action alternative selected. Groundwater sampling downgradient of the site will be conducted to properly characterize the extent that affected groundwater may have migrated beyond the AC Transit property line.

A workplan for additional site characterization activities and engineering evaluation of remedial action alternatives for this site will be developed for your review and approval. If you have any questions or comments regarding this next step or on the enclosed reports, please call me at (510) 577-8869.

Sincerely,

Suzanne Patton

Suzanne Patton, P.E.
Environmental Engineer
enclosures

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TECHNOLOGY SCREENING REPORT
FOR THE AC TRANSIT FACILITY LOCATED
AT 1177 47th STREET, EMERYVILLE, CALIFORNIA

June 2004

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INTRODUCTION

This report presents and screens remediation technologies to address groundwater impacts at the AC Transit Facility located at 1177 47th Street, Emeryville, California (Site). The report summarizes site conditions and objectives for treating observed impacts. Based on these conditions and objectives, technologies are screened for probable effectiveness and implementability. The criteria indicate that bioslurping using air pressure to introduce air to the subsurface and extract free product and groundwater is the most probable technology for achieving the immediate objectives at the site.

Bioslurping is not considered to be a final remedy. This report represents the first step in developing a full remediation alternative at the site. Based on this technology screening, a path forward is developed. The steps in this path include:

1) Collection of critical data to allow full evaluation of a limited number of alternatives;
2) Documentation of alternatives analysis through a limited Feasibility Study (FS);
3) Installation of a selected interim measure based on short term objectives
4) Additional data collection and selection of a final remedy; and
5) Proceeding to site closure.

This report concludes by detailing the current data gaps and briefly describing these next steps for moving toward site closure.

SITE CONDITIONS

The site is a maintenance yard for AC Transit vehicles. As a result of site activities, documented spills and leaks from underground storage, petroleum based compounds have been noted dissolved within groundwater underlying the site and as free phase product overlying the groundwater table. Quarterly groundwater monitoring is currently conducted under the oversight of the Alameda County Health Agency (ACHA). Figure 1 shows the site layout and location of monitor wells. During these monitoring events, groundwater samples have been analyzed for the presence of total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes (BTEX) and methyl-tertbutyl-ether (MTBE). TPH representative of gasoline, diesel, stoddard solvents and hydraulic oil have been detected in monitor wells. BTEX and MTBE have also been detected at low concentrations in select wells.

A potentiometric map is shown in Figure 2 based on water level readings recorded in November 2003. In general, groundwater flows to the west across the site. . However, the groundwater gradient becomes steeper and shifts to a northwesterly direction near the western property boundary in the vicinity of MW-12 and MW-13. The Site is underlain by fill followed by a silty clay to depths of three to six feet below ground surface (bgs), where a thin clayey to silty sand layer is commonly encountered. The first sand layer is slightly moist at depths less than six feet bgs and very moist to saturated below six feet bgs. This sand layer is underlain by silty clay to depths of 14 to 16 feet bgs. Very moist to saturated conditions are encountered below the silty clay layer at depths of 16 to 28 feet bgs in more transmissive clayey sand to silty gravel layers.

PRELIMINARY REMEDIAL ACTION OBJECTIVES

Based on the surface and subsurface characteristics of the site, the chemical and physical nature of the petroleum compounds detected and the extent of the known impacted area, the following remedial action objectives (RAO) have been identified:

- **Recover or treat free product.** Free product was observed in Soil Boring SB-4 and, since September 2002, in monitor well MW-13, which are both located near the western edge of the site. Free product could potentially serve as a continuing source of dissolved constituents. Therefore, one objective is to reduce or eliminate free product present in the subsurface.
- **Control dissolved plume migration.** Dissolved TPH has been observed across the entire site. Low concentrations of dissolved BTEX and MTBE have also been observed in select wells, particularly MW-6. However, the extent of migration of the dissolved

plume off-site is currently unknown. Therefore, this RAO is to prevent any additional migration of dissolved constituents off-site and to control migration of constituents that have already traveled off-site.

- **Reduce constituent concentrations to below applicable water quality objectives (WQO).** This RAO refers to treatment or extraction of groundwater to reach closure standards. The specific WQOs of the site will depend on potential site use, potential receptors and current groundwater standards and is beyond the scope of this report.

TECHNOLOGY SCREENING

To address the presence of dissolved and free phase constituents, technologies were screened for effectiveness in achieving these RAOs and for implementability at the site. The results of the technology screening are described in this section and summarized in Table 1. This technology screening is not a complete feasibility study and does not describe a preferred remediation alternative (combination of technologies and approaches for closure). However, based on this screening, those technologies that are most likely to achieve the RAOs were determined.

Monitored Natural Attenuation

Monitored Natural Attenuation (MNA) refers to allowing natural processes to reduce the concentrations of contaminants in the sub-surface. The main process in MNA is biodegradation (primarily aerobic). MNA requires a sampling program to demonstrate that degradation processes are occurring. Typically, monitoring of MNA involves measurements of the target compounds and electron acceptors.

In general, petroleum constituents are considered to be amenable to natural attenuation processes. However, MNA data has not been analyzed to assess this potential at the site. Although MNA is cost-effective as a remedial technology, it does not prevent migration of dissolved constituents or actively treat the source of those constituents. Natural attenuation processes are limited by the rate at which constituents will dissolve from the free product into the aqueous phase. Therefore, MNA can potentially require very long time periods in order to achieve RAOs.

Groundwater Extraction via Wells or Trench

Groundwater extraction, or pump-and treat technologies refers to the pumping of groundwater out of the subsurface through extraction wells or a trench comprised of permeable material. Extracted groundwater is typically treated and then discharged. The wells or trench are typically placed to achieve hydraulic control of the identified constituent plume.

Groundwater extraction is a well-tested method for controlling plume migration and accelerating time periods to closure. However, extraction of groundwater does not result in enhanced collection or treatment of free product. Therefore, the source of the dissolved constituents can remain an issue for very long time periods. To be effective, groundwater extraction must ensure that the entire dissolved plume is captured by the extraction system. Therefore, groundwater capture models are frequently required and the systems can become less effective in regions of complex groundwater flow.

Vacuum Enhanced Recovery

Vacuum-enhanced recovery (VER) utilizes separate systems within a single well for extraction of air and free product. As a result of the applied vacuum, the groundwater table remains static and free product recovery rates can be optimized. The application of vacuum also introduces air into the impacted zone to stimulate in-situ aerobic biodegradation.

VER has two significant advantages for the site in addition to introducing air for biodegradation. First, the system involves enhanced free product recovery. The recovery of product will serve to reduce the source of the dissolved plume and shorten remediation times. Second, the VER system can be adjusted to extract significant quantities of groundwater. This extraction can allow control over the dissolved plume and prevent any additional off-site migration.

Bioslurping

Bioslurping refers to the utilization of vacuum pressure applied near the interface of free product and groundwater. The result is the extraction of air, free product and groundwater in a mixed stream. Bioslurping is similar to VER except the gaseous, water and free-phases are all extracted through a single pipe (stinger) placed down-well. Bioslurping can also be adjusted to emphasize groundwater or air extraction based on the depth of the stinger. However, due to the fact that bioslurping relies on air pressure to extract liquids rather than a submerged pump, the capacity to extract groundwater is more limited than VER. This reduced capacity is offset by a more simple, easier to maintain and more cost-effective system. As with VER, the vacuum action also introduces air into the impacted area to stimulate in-situ aerobic biodegradation of petroleum compounds.

Oxygen Releasing Compounds

Oxygen Releasing Compound (ORC) is a chemical oxalate formulation that slowly releases oxygen when moist. The released oxygen serves to stimulate aerobic biodegradation of compounds such as petroleum hydrocarbon. ORC can be placed in wells in either a grid or as a barrier. As a barrier, the released oxygen travels advectively to stimulate biodegradation downgradient of the injection wells.

ORC has the advantage of being a relatively low cost, passive treatment option with no associated piping or ex-situ treatment system. This passive system can potentially treat the off-site dissolved plume without placement of off-site wells. However, ORC has limited effectiveness on free product because biodegradation processes typically occur only in the aqueous phase. Therefore, closure using ORC without free product removal would require long time periods. Due to the long time period required for treatment, multiple re-applications of the ORC would be required. In addition, because free product is present on the downgradient edge of the site, prevention of off-site migration using ORC would require placement of the barrier off-site. Finally, the effectiveness of ORC in treating groundwater is dependent on the ability to reach all impacted regions. Heterogeneities in soil or due to the presence of free product can reduce this ability.

In-Situ Chemical Oxidation

In-Situ Chemical Oxidation (ISCO) refers to the introduction of a chemical oxidant (e.g. Fentons Reagent) into groundwater to oxidize target compounds. Oxidant is typically introduced as a liquid or gas into groundwater in a grid arrangement to treat the entire plume area. When effective, ISCO has the advantage of being a rapid remediation technology for relatively low cost.

ISCO is typically used for readily oxidizable compounds such as chlorinated solvents. Very strong oxidants such as Fenton's Reagent or persulfate can oxidize some petroleum compounds under environmental conditions (particularly aromatics such as BTEX). However, saturated alkanes can be recalcitrant to ISCO technologies. In addition, ISCO is less effective in treating free product because it has difficulty penetrating into the non-aqueous phase to react with petroleum compounds. Based on the range of petroleum hydrocarbons measured and the presence of free product, it is estimated that ISCO would have limited effectiveness at the site.

DATA GAPS

Additional data is required to allow a complete evaluation of remedial alternatives. The primary data gaps are described in this section. These data gaps are not specific to a given technology.

Delineation of Dissolved Plume and Free Product

In order to determine the impacted area, volume of free product and remedial priorities, the extent of impact needs to be delineated. Currently, no monitor wells are placed downgradient of the site. Given the observed dissolved concentrations and the presence of free product at the downgradient edge of the site, there is compelling reason to believe that the dissolved plume has moved some distance off-site. Collection of additional grab groundwater samples followed by installation of monitor wells (all located downgradient of the site) will provide additional definition of the extent of migration.

Off-Site Groundwater Map

As described earlier, groundwater flows generally to the west across the site and shifts to the northwest and achieves a steeper gradient near the downgradient edge of the site. In order to control plume migration using any extraction system, the flow direction and gradient through the entire downgradient plume must be determined. This data should be obtained using permanent monitor wells to allow analysis of temporal variation.

Treatment System Functionality

There are currently several oil-water separators on-site which are used to treat vehicle maintenance wastewater prior to discharge to the POTW. As a cost reducing measure, one of the existing separators could be used to treat extracted free product and groundwater to POTW dischargeable limits. This application depends on the current piping system and separator capacity for flow as well as the current permit limits and requirements from the POTW. In order to evaluate this potential, a review of the system and permit should be conducted.

Engineering Site Review

The implementation of a remedial technology requires knowledge of the site infrastructure, environment and conditions. Therefore, an engineering site review is required prior to a complete evaluation or technology implementation. The engineering site review involves a site visit by Cameron-Cole engineers to evaluate power sources, piping alternatives, infrastructure barriers (such as traffic patterns, use patterns, overhead obstructions, underground utilities, treatment system locations, buildings) surface gradients, safety issues, etc. For a small site, the engineering site review requires one day for the walk through and an additional day for documentation.

Specific Remedial Action Objectives

The preferred remedial alternative will depend on the specific objectives at the site. Objectives will be set by the potential site use (e.g. property transfer) and regulatory guidance (e.g. implementing interim measures). Based on the criteria from the regulator and property owner, specific objectives regarding time frame (e.g. active and short-term vs. passive and long-term) and remedial priorities (e.g. control of plume migration and recovery of free product) can be determined. These remedial action objectives would be documented in the feasibility study and used to determine a final course of action (remedial alternative).

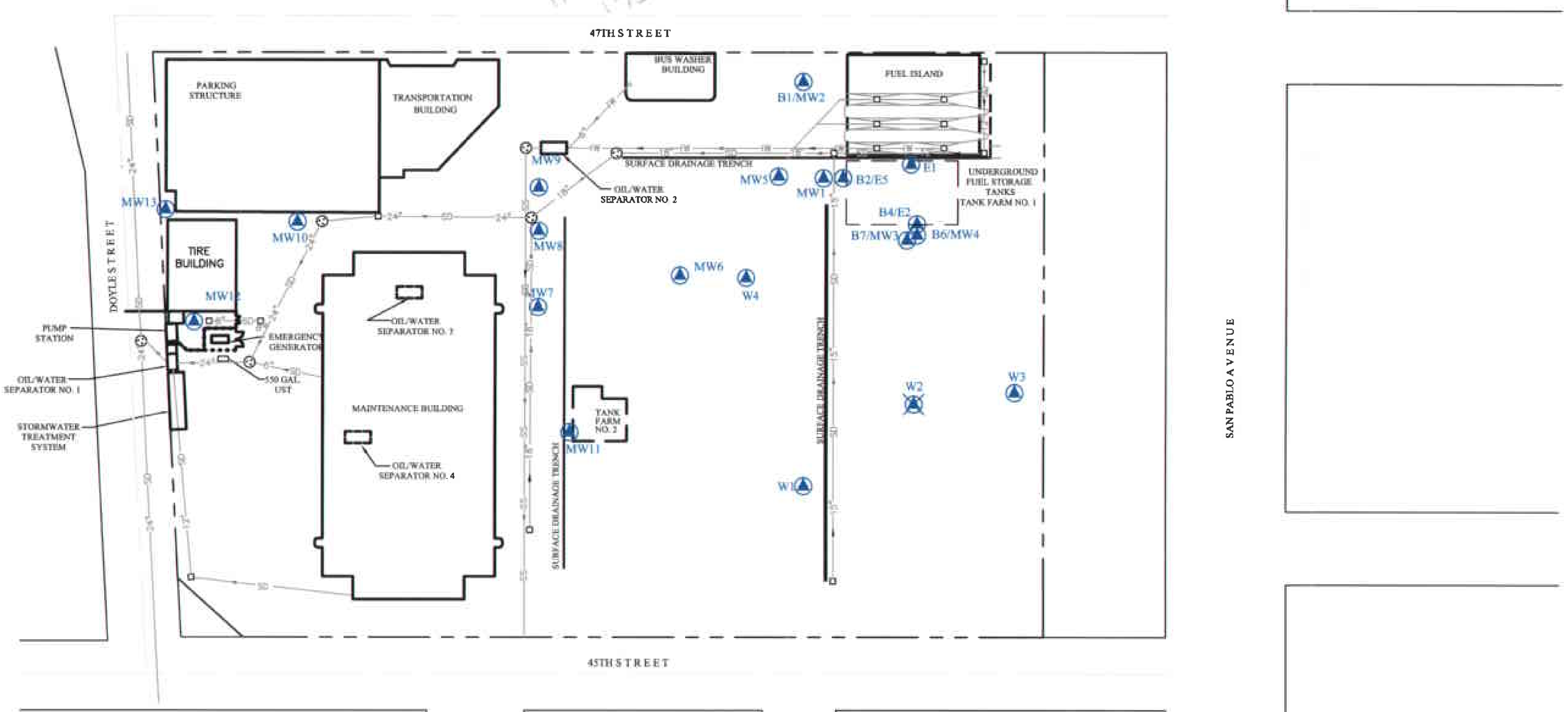
CONCLUSIONS AND PROJECTED WORK

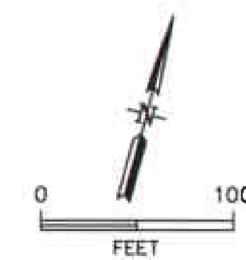
Bioslurping presents the most likely technology to accomplish the stated preliminary remedial action objectives (recover free product, control plume migration and reduce constituent concentrations). The bioslurping technology has the ability to recover free product and introduce air for enhanced biodegradation. Limited groundwater extraction can help to reduce off-site migration of dissolved constituents. The simplicity of the technology and the lower amount of piping and pumps required compared to VER makes this a more attractive system for implementation in an area with demanding infrastructure obstructions (limited space and significant traffic patterns).

Additional data is required to make a final determination as to the potential effectiveness of a bioslurping system. In addition, a final remedial alternative may require additional components such as in-situ reactive technologies for treatment of residual petroleum or more active groundwater extraction to control the downgradient plume. Therefore, it is recommended that bioslurping be considered as a potential interim measures technology while additional data is collected.

It is recommended that additional data be collected in the near future to fill all of the identified data gaps. Plume delineation and groundwater mapping will require installation of additional monitor wells. An engineering survey can be completed quickly and in conjunction with these installations. A review of the treatment system functionality and identification of specific RAOs can be conducted by AC Transit in coordination with Cameron-Cole and the ACHA.

Moving forward, it is recommended that a feasibility study be conducted based on this additional data. The feasibility study can identify an appropriate interim measure as well as a final preferred remedy. This FS serves as the template for planning and installing effective remediation systems.





LEGEND

⊙	MANHOLE
□	CATCH BASIN
▲	MONITORING WELL
⊠	ABANDONED MONITORING WELL
—SD—	STORM DRAIN PIPELINE
—SS—	SANITARY SEWER PIPELINE
—IW—	INDUSTRIAL WASTE PIPELINE
—■—■—	CHAIN LINK FENCE

	BY	DATE
DRAWN	WRB	10/25/02
CHECKED		
APPROVED		
APPROVED		
APPROVED		

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EMERYVILLE FACILITY - OAKLAND, CALIFORNIA

FIGURE 1

AC TRANSIT - MONITORING WELL LOCATION MAP

SCALE: 1" = 100'

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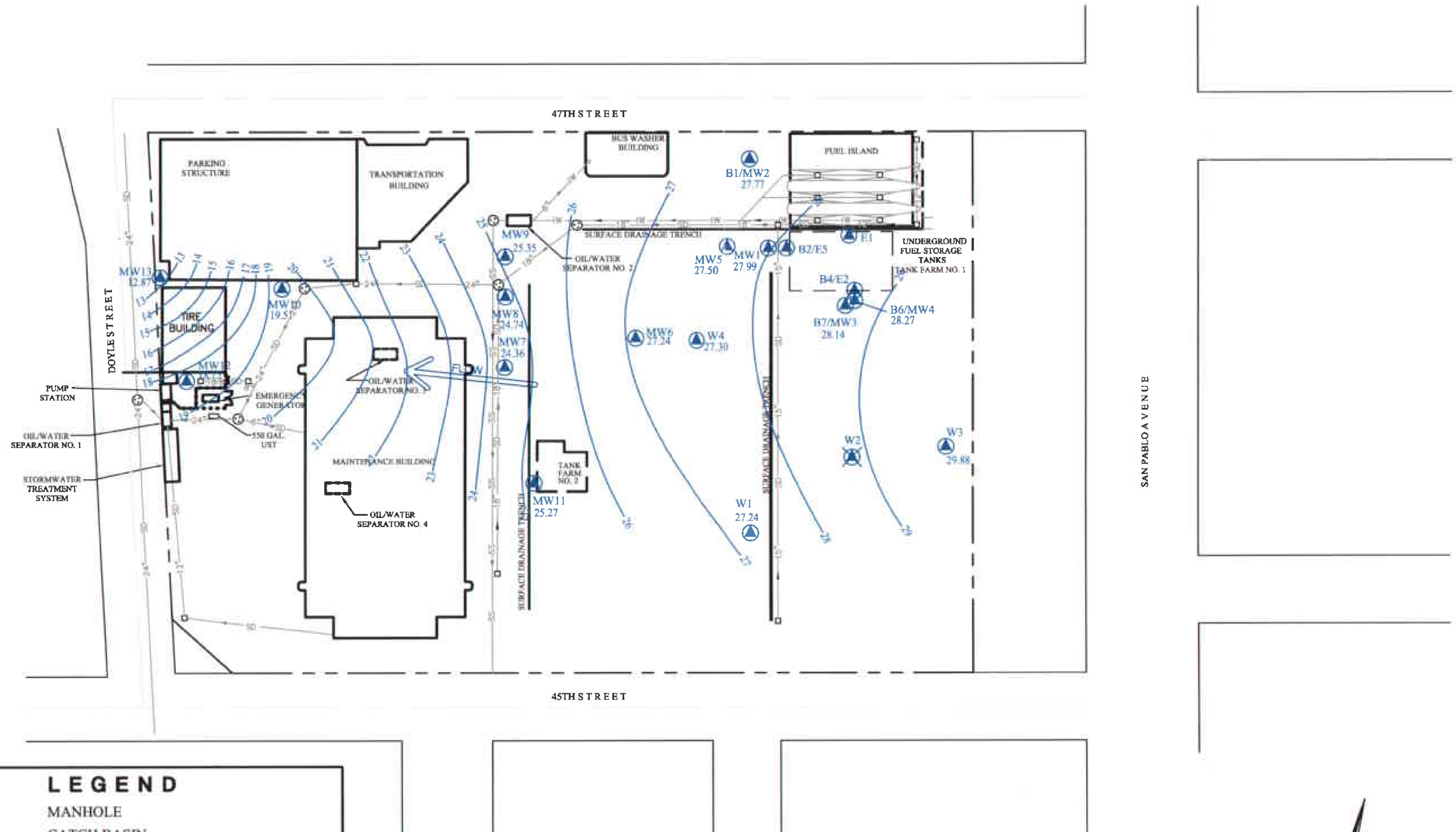

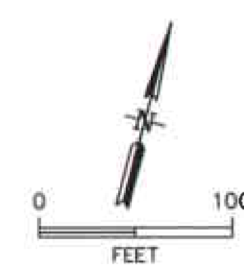

LEGEND

	MANHOLE
	CATCH BASIN
	MONITORING WELL
	ABANDONED MONITORING WELL
27.19	POTENTIOMETRIC SURFACE ELEVATION
*28.86	NOT USED IN CONTOURING
	POTENTIOMETRIC SURFACE CONTOUR
SD	STORM DRAIN PIPELINE
SS	SANITARY SEWER PIPELINE
IW	INDUSTRIAL WASTE PIPELINE
	CHAIN LINK FENCE

FIGURE 2

	BY	DATE
DRAWN	WRB	12/9/03
CHECKED		
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CAMERON-COLE

EMERYVILLE FACILITY - OAKLAND, CALIFORNIA

AC TRANSIT - POTENTIOMETRIC SURFACE MAP
NOVEMBER 20, 2003

SCALE: 1" = 100'

DWG. NO.: 2015-16

AC Transit, Emeryville
6/9/2004

Table 1. Remedial Technology Screening

Technology Type	Capital		Operation and Maintenance		Criteria	
	ROM Costs ($)	Components	ROM Costs per Year ($)	Monitoring Type	Effectiveness in the treatment of contaminants and control of plume migration.	Implementability of technology at site.
Monitored Natural Attenuation	5,000-10,000	• Additional monitor wells • Work Plan	10,000-25,000	Quarterly groundwater monitoring.	• No free product or groundwater treatment can result in very long time-frame to closure. • Highly cost-effective. • No source treatment can allow continued increase in impacted area. • Conditions appear to be conducive to natural attenuation of dissolved constituents.	• Requires placement of additional monitoring wells • Easily implementable
Groundwater Extraction via Wells	75,000-125,000	• Additional monitor wells • Groundwater capture model • Extraction wells, piping, pumps • Work Plan and Installation Report	10,000-25,000	Monthly system inspection and quarterly groundwater monitoring.	• Allows control of plume and free product migration to prevent down-gradient impacts. • No source zone treatment can result in very long time-frame to closure. • Complex groundwater flow increases complexity.	• Requires placement of additional monitoring wells and extraction wells to capture groundwater across entire plume. • Medium difficulty of implementation due to presence of structures over downgradient plume and placement of conveyance trenches.
Groundwater Extraction via Trench	100,000-175,000	• Additional monitor wells • Groundwater capture model • Trench, pipes, pumps • Work Plan and Installation Report	10,000-25,000	Monthly system inspection and quarterly groundwater monitoring.	• Allows control of plume and free product migration to prevent down-gradient impacts. • No source zone treatment can result in very long time-frame to closure. • Complex groundwater flow increases complexity.	• Requires placement of additional monitoring wells and extraction trench to capture groundwater across entire plume. • High difficulty of implementation due to presence of structures and utilities in areas of potential trench placement and placement of conveyance trenches.
Vacuum Enhanced Recovery	125,000-200,000	• Additional monitor wells • Extraction wells, pipes, pumps, blowers, well assemblies • Work Plan and Installation Report	25,000-50,000	Monthly system inspection and quarterly groundwater monitoring.	• Free product recovery and source zone treatment reduces time to closure and plume migration. • Can stimulate in-situ aerobic biodegradation of petroleum compounds. • Can be designed to include groundwater recovery for control of dissolved plume migration.	• Requires placement of additional monitoring wells and extraction wells to treat entire plume area. • Medium difficulty of implementation due to presence of structures over downgradient plume and placement of conveyance trenches.
Bioslurping	100,000-175,000	• Additional monitor wells • Extraction wells, piping, pumps, well assemblies • Groundwater Capture Model potential • Work Plan and Installation Report	20,000-40,000	Monthly system inspection and quarterly groundwater monitoring.	• Free product recovery and source zone treatment reduces time to closure and plume migration. • Can stimulate in-situ aerobic biodegradation of petroleum compounds. • Can be designed to include groundwater recovery for control of dissolved plume migration.	• Requires placement of additional monitoring wells and extraction wells to treat entire plume area. • Medium difficulty of implementation due to presence of structures over downgradient plume and placement of conveyance trenches.

AC Transit, Emeryville
6/9/2004

Table 1. Remedial Technology Screening

Technology Type	Capital		Operation and Maintenance		Criteria	
	ROM Costs ($)	Components	ROM Costs per Year ($)	Monitoring Type	Effectiveness in the treatment of contaminants and control of plume migration.	Implementability of technology at site.
Biosparging	75,000-150,000	• Additional monitor wells • Injection wells, blowers, piping, well assemblies • Work Plan and Installation Report	10,000-25,000	Monthly system inspection and quarterly groundwater monitoring.	• No groundwater capture or free product recovery can result in continued plume migration and very long time frame to closure. • Effectiveness can be reduced by sub-surface heterogeneities by requiring smaller well spacing. • No treatment of extraction stream is required.	• Requires placement of additional monitoring wells and extraction wells to treat entire plume area. • Medium difficulty of implementation due to presence of structures over downgradient plume.
Oxygen Releasing Compounds	50,000-100,000	• Additional monitor wells • Injection wells, chemical • Work Plan and Installation Report	10,000-25,000	Monthly system inspection and quarterly groundwater monitoring.	• Relatively low cost per injection. • No groundwater capture or free product recovery can result in continued plume migration and very long time frame to closure. • Effectiveness can be reduced by sub-surface heterogeneities by requiring smaller well spacing. • Multiple applications most likely required.	• Requires placement of additional monitoring wells and extraction wells to treat entire plume area. • Medium difficulty of implementation due to presence of structures over downgradient plume.
In-Situ Chemical Oxidation	100,000-150,000	• Additional monitor wells • Injection wells, pipes, well assemblies, pumps, chemical • Work Plan and Installation Report	10,000-25,000	Monthly system inspection and quarterly groundwater monitoring.	• Unknown effectiveness of chemical oxidants on constituents within free product phase. • Multiple applications most likely required. • No groundwater control (and potential for pushing free product) can result in continued plume migration and expansion. • Effectiveness can be reduced by sub-surface heterogeneities by requiring smaller well spacing.	• Requires placement of additional monitoring wells and extraction wells to treat entire plume area. • Medium difficulty of implementation due to presence of structures over downgradient plume.