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PES Environmental, Inc.
Engineering & Environmental Services

FAX TRANSMITTAL

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Number of pages including cover sheet 13

To:Kevin Graves
RWQCB
(510) 286-1380

Subject:Proposed Passive In-situ Bioremediation Pilot Study Work Plan and Monitoring Revisions
Emery Bay Plaza
1650 65th Street
Emeryville, California

From: **PES Environmental, Inc.**
Baywood Center
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Sent By: Andy Briefer
PES PROJECT: 131.0100.005

☐ Urgent ☐ For your review ☐ Reply ASAP x Please Comment

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PES Environmental, Inc.
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HAZMAT
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December 21, 1993 STID 4352

131.01.005

Alameda County Department of Environmental Health
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, California 94621

Attention: Ms. Susan Hugo

WORKPLAN
PASSIVE IN-SITU BIOREMEDIATION
PILOT STUDY
EMERY BAY PLAZA
1650 65TH STREET PROPERTY
EMERYVILLE, CALIFORNIA

Dear Ms. Hugo:

PES Environmental, Inc. (PES) presents this workplan on behalf of Emery Bay Plaza for a one-year passive in-situ bioremediation pilot study at the subject site (Plate 1). The objective of the pilot study is to assess the appropriateness of passive in-situ bioremediation techniques for remediating petroleum hydrocarbons in soils within the zone of water-level fluctuation and in groundwater beneath the site. This workplan presents: (1) a brief introduction; (2) a summary of the engineering evaluation of groundwater remedial alternatives; (3) a proposed scope of work for the recommended alternative; and (4) a schedule for the proposed scope of work.

1.0 INTRODUCTION

Since October, 1989, investigations to define the extent of hydrocarbons in soil and groundwater have been undertaken in onsite areas. Plate 2 presents the locations of monitoring wells at the site. The extent of petroleum hydrocarbon-affected groundwater originating from the former onsite underground gasoline storage tank has been defined and remedial actions for hydrocarbon-affected groundwater began with the operation of a groundwater extraction and treatment system in December, 1990. This workplan focuses on a pilot program to evaluate the effectiveness of passive in-situ bioremediation of groundwater affected by gasoline hydrocarbons originating from the former onsite UST.

2.0 EVALUATION OF GROUNDWATER REMEDIATION ALTERNATIVES

PES, in response to a request by Emery Bay Plaza has performed an evaluation of groundwater remedial alternatives for the subject site. The study was conducted to evaluate whether alternative remedial measures for groundwater could meet Emery Bay Plaza's needs and current regulatory requirements. The evaluation consisted of a review of demonstrated approaches for remediation of hydrocarbon-affected groundwater within the known site-specific conditions and newly revised regulatory requirements. The alternatives that were reviewed include: (1) continued operation of the existing groundwater pump and treatment system; (2) active in-situ bioremediation of groundwater; (3) passive in-situ bioremediation of groundwater; and (4) regulatory compliance monitoring. The results of the evaluation are presented below.

2.1 Continued Groundwater Extraction and Treatment

The existing groundwater extraction and treatment system has been operating since December 1990, with PES operating the system since December 1991. Groundwater is pumped from a single extraction well through an activated carbon treatment system and discharged to the sanitary sewer. Groundwater extraction appears to be effective in preventing further migration of hydrocarbon-affected groundwater. However, due to the low solubility of petroleum hydrocarbons in groundwater and the low groundwater extraction rate, the rate at which petroleum hydrocarbons are removed from the subsurface is slow.

Under the current operating conditions and cleanup objectives, groundwater extraction and treatment would be required for an indefinite period of time. Emery Bay Plaza would prefer to obtain regulatory closure of the site to increase potential uses of the property and to reduce current and future liability.

2.2 Active In-Situ Bioremediation

This alternative involves introduction of oxygen and nutrients into the subsurface to biologically degrade hydrocarbon in groundwater. Groundwater extraction and treatment is performed concurrently to maintain hydraulic control of the hydrocarbons and injected nutrients. Nutrient injection and groundwater extraction are usually accomplished with a system of wells or trenches.

Although a relatively new technology, this approach has been successfully applied at sites in the San Francisco Bay Area. However, the technique is not well suited for the subject site because: (1) site soils have a low permeability which will likely prevent the degree of hydraulic control normally required to successfully apply this technique; and (2) costs are prohibitive.

2.3 Passive In-situ Bioremediation

Passive in-situ bioremediation is a technique that uses naturally occurring hydrocarbon-utilizing microbes to degrade petroleum hydrocarbons in soil and groundwater. Bioremediation involves stimulating the native soil bacteria through the addition of oxygen and nutrients (possible including nitrogen and phosphorus) to the affected zone which results in the accelerated degradation of petroleum hydrocarbons in the soil and groundwater by these microbes. This method has several advantages in that it destroys the hydrocarbons and, because the process occurs in-situ, it is not as limited as groundwater extraction by the low solubility of the hydrocarbons in groundwater.

Bioremediation has been previously approved by the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) and implemented at similar sites in the Bay Area. For example, Geomatrix Consultants implemented bioremediation programs at gasoline-contaminated sites in both Capitola and Concord, California. Another successful example of in-situ bioremediation of petroleum hydrocarbon contamination from underground storage tanks occurred at Pacific Renaissance Plaza Redevelopment site in downtown Oakland, California. This application of in-situ bioremediation was designed to treat petroleum hydrocarbon-affected soil in the zone of the water-level fluctuation using a system of injection and extraction wells and infiltration basins to circulate oxygen- and nutrient-enriched water through the hydrocarbon-affected zone.

PES believes the Emery Bay Plaza site is amenable to biological treatment methods. PES has noted extensive growth of bacteria in the extraction well and associated piping has occurred, where the hydrocarbon-affected water and bacteria obtain oxygen from contact with air. Additionally, PES is familiar with and worked on other similar sites in the Bay Area where in-situ bioremediation has been used (shallow groundwater and low permeability soils).

2.4 Alternative Points of Compliance Monitoring

Recent revisions to the RWQCB's Water Quality Control Plan (also known as the Basin Plan) allow for alternative approaches to remediation of petroleum hydrocarbon-affected groundwater. Specifically, if it can be demonstrated that a groundwater hydrocarbon plume has not migrated offsite and is not continuing to migrate, then long term monitoring of the groundwater may be acceptable in lieu of an active remediation program. The source of the contamination must be removed or isolated. Furthermore, it must be demonstrated that no cost-effective remedial alternatives exist and an evaluation of risks must be performed. A plan must be submitted and approved that manages risks which remain as a result of this approach.

After reviewing the results of the evaluation of alternatives presented above, we recommend a one year passive in-situ bioremediation pilot program. If successful, the program can be

extended until cleanup objectives are met. PES believes that the program, if effective, would result in significant reduction of the petroleum hydrocarbons in the subsurface, significantly reduce the duration of remediation and lead towards regulatory closure of the site.

During the pilot program, the operation of the groundwater extraction and treatment system, including routine system monitoring and reporting will be discontinued. Groundwater monitoring and reporting will continue as described below.

3.0 SCOPE OF WORK

3.1 Approach

The rate of bioremediation of hydrocarbons in soils and groundwater is limited by the supply of available oxygen and possibly by nutrients such as nitrogen and phosphorus. The most efficient method for delivering oxygen and nutrients to the groundwater is by adding a nutrient- and hydrogen peroxide-enriched water (hereinafter referred to as enriched water) directly into groundwater.

Enriched water will consist of concentrated hydrogen peroxide and nutrients mixed with dechlorinated potable water. Enriched water will be introduced on a periodic basis and will be integrated with the quarterly groundwater monitoring program. Monitoring for dissolved oxygen, hydraulic effects of adding enriched water and degradation of hydrocarbons in the water will be performed.

The periodic introduction of enriched water provides several advantages over other techniques for supplying oxygen to groundwater. Enriched water carries more oxygen than oxygen-saturated water and the use of concentrated hydrogen peroxide can prevent biofouling in wells. Periodic addition of enriched water does not require installation of a permanent distribution system and does not preclude the subsequent use of other remedial actions should they be required.

The following section describes the scope of work proposed to implement a one year pilot program intended to stimulate the natural biodegradation of petroleum hydrocarbons by indigenous microorganisms and to monitor the progress of the remediation. The pilot program includes the following four tasks:

3.2 Task 1 - Install and Develop an Upgradient Monitoring Well

PES will design, permit and observe the installation of a monitoring well upgradient of the former onsite underground tank. The well will be installed to allow an evaluation of "background" groundwater quality as well as provide an upgradient nutrient introduction point.

The well will be installed in a boring drilled to approximately 20 feet below ground surface by using hollow-stem auger drilling equipment. Soil samples will be collected for lithologic logging and possible chemical analyses. A 2-inch diameter well casing with approximately 15 feet of slotted well screen will be installed in the boring and the screened interval will be located to intersect the groundwater surface. The annulus between the casing and the borehole wall will be packed with Number 3 size clean sand to approximately one foot above the screen. Two feet of bentonite will be placed above the sand to seal the annulus and the well will be grouted to ground surface with neat cement. The well will be completed at ground surface with a flush-mounted, water-tight traffic-rated cover and a locking well cap.

The well will be developed to remove fines from the well bore and sort the sandpack to allow for collection of representative groundwater samples free of excessive sediment. Well development will consist of alternately surging and bailing the well until the water is reasonably clear and free of sediment.

3.3 Task 2 - Quarterly Groundwater Monitoring

Quarterly groundwater monitoring at the site will continue in accordance with the current quarterly groundwater monitoring program. Water levels in all the wells will be measured before quarterly groundwater sampling events and converted to water-level elevations to evaluate groundwater gradient. Water-level measurements will be obtained using an electric water-level sounder.

Prior to sampling each well, a minimum of three well volumes will be purged using a clean stainless steel bailer, bladder pump, or teflon bailer. During purging, the discharge water will be monitored for pH, temperature, and electrical conductivity. Once the water quality parameters have stabilized, groundwater samples will be collected using a teflon bailer. Well development water and purge water will be stored onsite in 55-gallon drums for later disposal.

The seven existing and new upgradient wells will be purged and sampled quarterly and samples submitted to a California-certified analytical laboratory under chain-of-custody procedures for laboratory analyses for Total Petroleum Hydrocarbons quantified as gasoline (TPH-g) by EPA Test Method 5030/8015-modified and benzene, toluene, ethylbenzene and total xylenes by EPA Test Method 8020.

In addition to the existing groundwater monitoring, PES will monitor parameters related to the progress of the pilot program. To monitor the progress of the pilot program and effectiveness of nutrient delivery, the concentration of dissolved oxygen will be measured in all the wells prior to and following each nutrient delivery event. Dissolved oxygen is an indirect indicator of hydrocarbon concentration. In areas of high hydrocarbon concentration, dissolved oxygen is consumed by the native bacteria and residual dissolved oxygen concentrations are expected to be low. Conversely, effective nutrient addition will be demonstrated by elevated concentrations of dissolved oxygen in the monitoring wells.

3.4 Task 3 - Nutrient Introduction

A mixture of clean water, hydrogen peroxide (an oxygen source) and a blend of micronutrients will be prepared and introduced on a quarterly basis into three wells, EW-1, MW-2 and the new upgradient monitoring well. This nutrient amendment will be delivered to the areas of highest hydrocarbon concentration to stimulate natural biodegradation of the hydrocarbons.

The in-situ bioremediation system will consist of a drum of 35% concentrated hydrogen peroxide and a metering pump to deliver a controlled amount of hydrogen peroxide to a mixing tank where it will be combined with dechlorinated potable water and small quantities of nitrogen and phosphorus nutrients. A centrifugal pump, globe valve and flow meter will be attached to the mixing tank to allow periodic controlled addition of enriched water at a constant rate into EW-1, MW-2 and the new upgradient monitoring well. Plate 3 presents a schematic of the in-situ bioremediation system.

The nutrient amendment will be mixed at a concentration to maximize oxygen delivery and prevent accumulation of biomass in the immediate vicinity of the well while reducing the potential for precipitation of inorganic carbonates. It is currently anticipated that a volume of approximately 300-400 gallons per quarter will be introduced into the wells at a concentration of approximately 1.3% hydrogen peroxide. This delivery program is intended to result in a concentration of hydrogen peroxide which will inhibit biological activity in the tank excavation area to prevent plugging of the aquifer by biomass. Higher concentrations of hydrogen peroxide in the tank excavation may result in precipitation of carbonates and plugging of the aquifer. Application rates and concentrations may be adjusted as necessary to minimize mounding of the groundwater and aquifer plugging and to maximize oxygen delivery.

3.5 Task 4 - Performance Evaluation and Reporting

PES will evaluate the progress of the pilot program quarterly and adjust the nutrient delivery and monitoring programs as necessary to maximize biodegradation of hydrocarbons and reduce the potential for plugging the aquifer.

Once laboratory results for chemical analyses have been obtained from the groundwater sample, a report will be prepared summarizing the bioremediation activities performed and the findings of the quarterly monitoring. The report will include water-level measurements, a brief description of sampling procedures, a summary of chemical analysis results, water-level elevation contour map and a brief evaluation and interpretation of results. Data from the pilot program will be incorporated into the quarterly groundwater monitoring reports. Copies of laboratory reports and chain-of-custody forms will be included.

At the end of the one year pilot program, PES will review and summarize the results and assess whether the program is effective in remediating hydrocarbon-affected groundwater contamination at the site. Recommendations will be developed for future remedial actions at the site, which may include continuation of the passive bioremediation program (if it proves successful), or a different appropriate remedial response, such as alternative compliance point monitoring.

4.0 SCHEDULE

Upon approval of this workplan by the Alameda County Department of Environmental Health, PES will coordinate the pilot program to begin immediately following the next quarterly groundwater monitoring event. Nutrient applications will be scheduled to follow within several days of each quarterly groundwater monitoring event to maximize the opportunity for transport of the enriched water and biological degradation of hydrocarbons and to preclude interference with quarterly groundwater monitoring.

We trust this information meets your needs and respectfully request your timely review. If you have any questions or require additional information, please contact either of the undersigned.

Yours very truly,

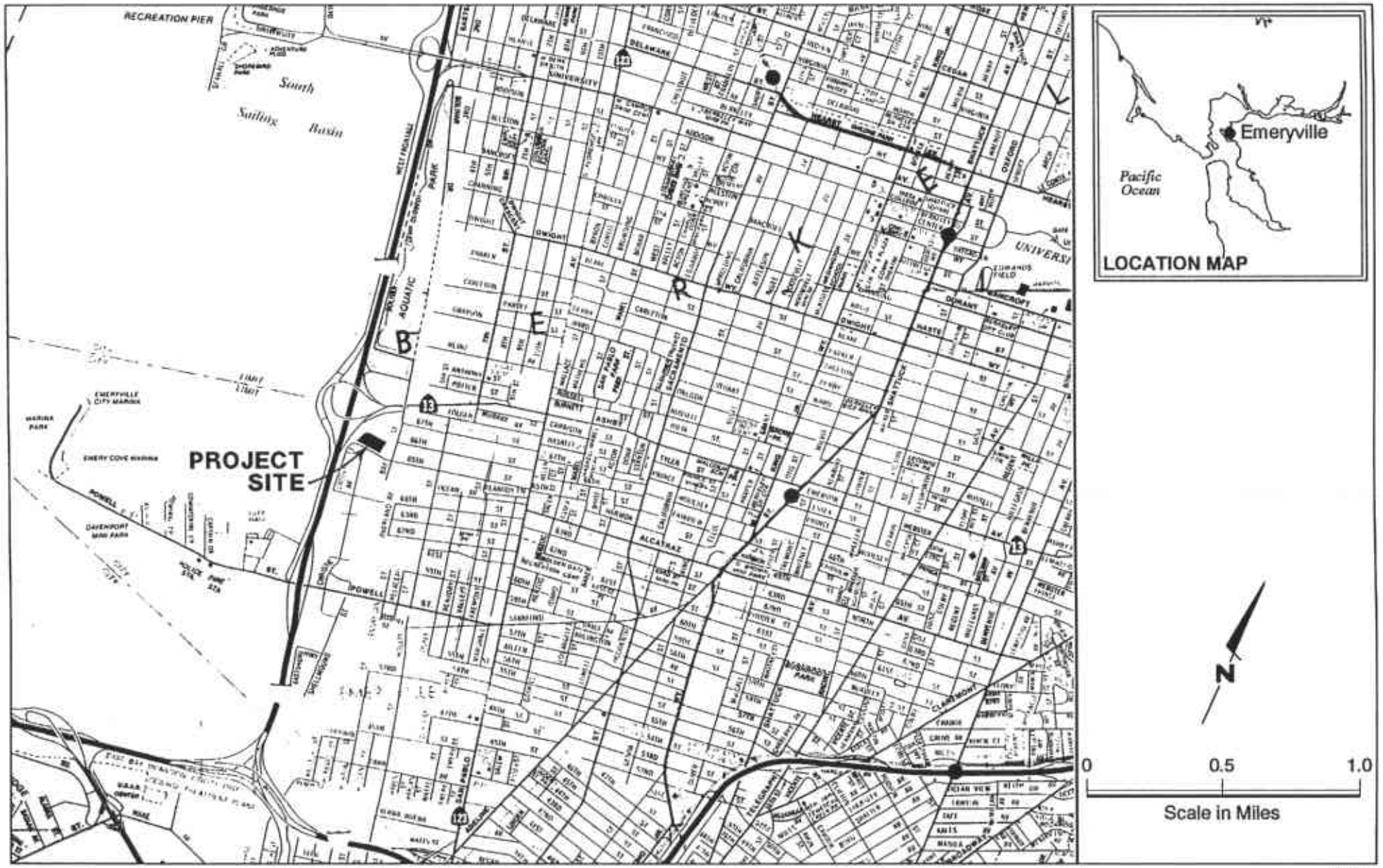
PES ENVIRONMENTAL, INC.

Andrew A. Briefer, P.E.
Senior Engineer

Robert S. Creps, P.E.
Associate Engineer

Attachments: Plate 1 Site Location Map
Plate 2 Well Location Map
Plate 3 In-Situ Bioremediation Schematic Diagram

cc: Rich Hiett RWQCB - San Francisco Bay Region
Tom Gram Emery Bay Plaza
Matt Dulka Hanson, Bridgett, Marcus, Vlahos & Rudy



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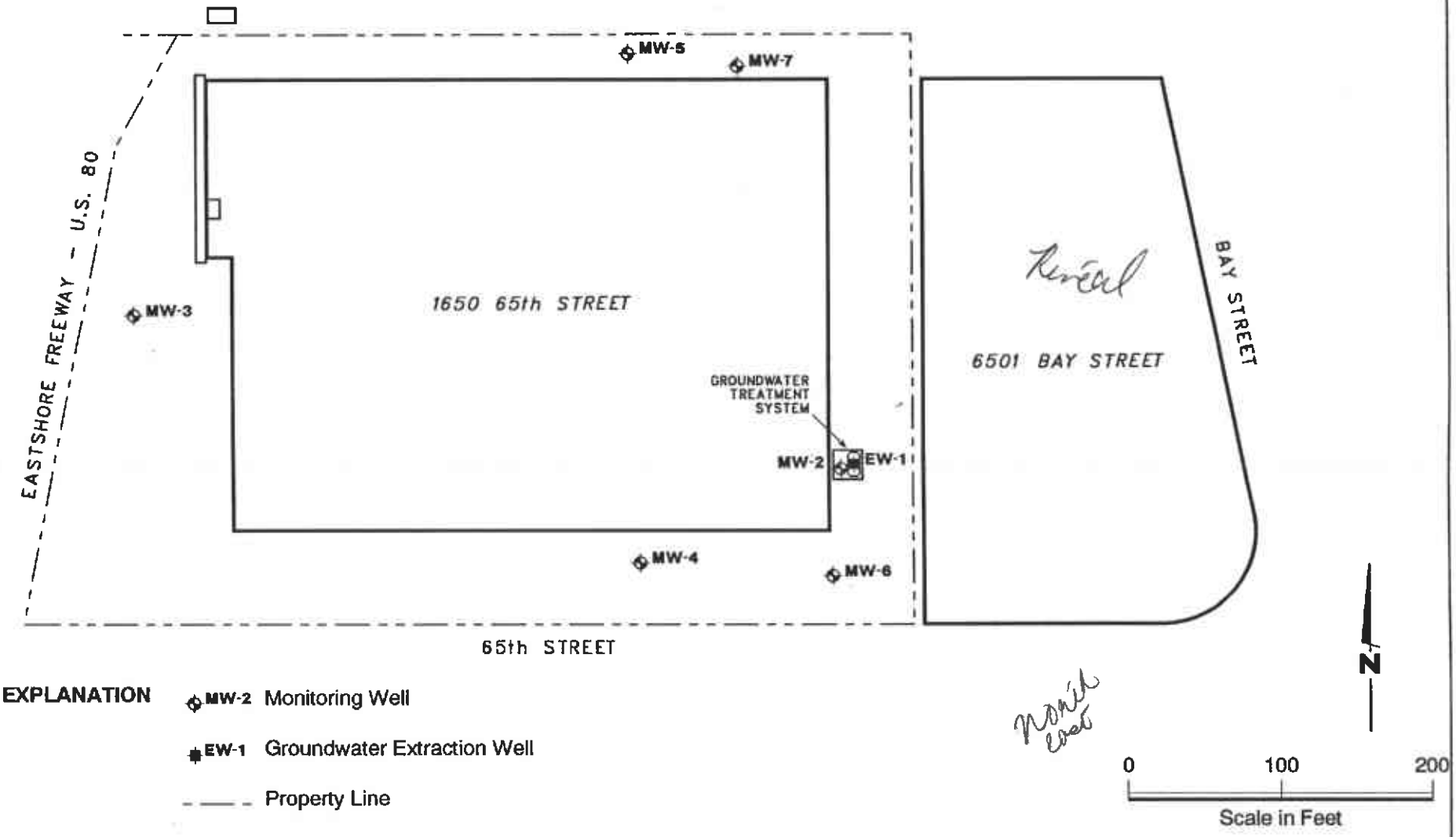
Site Location Map
1650 65th Street
Emeryville, California

PLATE
1

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE	REVISED DATE
131.01.003		12/93		



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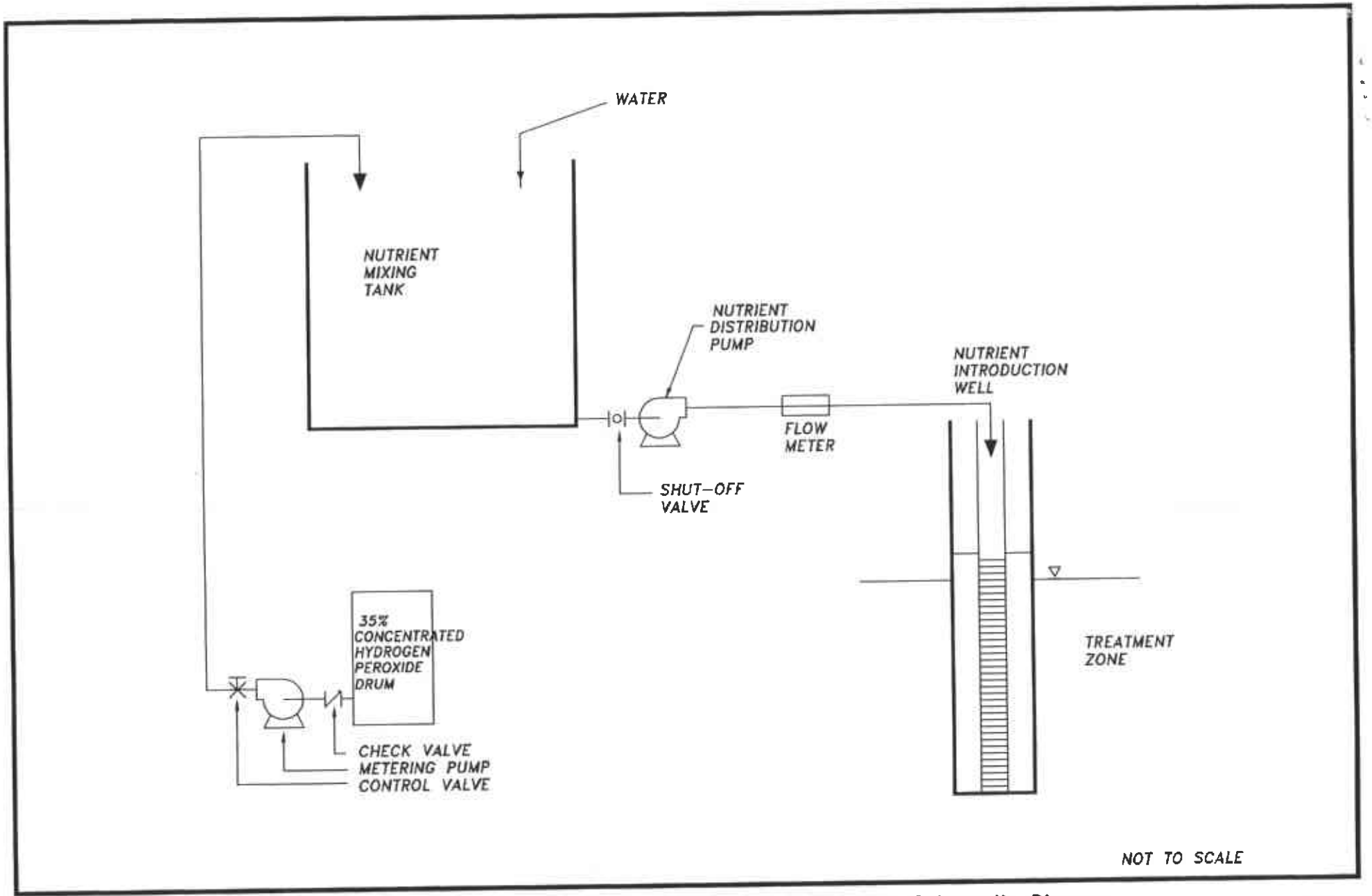
Well Location Map
1650 65th Street
Emeryville, California

PLATE
2

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE	REVISED DATE
131.01.003		12/93		



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In-Situ Bioremediation Schematic Diagram
Emery Bay Plaza
1650 65th Street
Emeryville, California

PLATE
3

JOB NUMBER	DWG NUMBER/DRAWN BY	DATE	REVISED DATE	REVISED DATE
131.01.00.005	131SCHEM/SH	12/93		