STELLAR ENVIRONMENTAL SOLUTIONS, INC.
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TRANSMITTAL MEMORANDUM	
TO: ALAMEDA COUNTY HEALTH CARE SERVICES AGENCY DEPT. OF ENVIRONMENTAL HEALTH HAZARDOUS MATERIALS DIVISION 1131 HARBOR BAY PKWY, SUITE 250 ALAMEDA, CA 94502	DATE: NOVEMBER 10, 2004
ATTENTION: MS. DONNA DROGOS	FILE: SES-2004-02
SUBJECT: REDWOOD REGIONAL PARK FUEL LEAK SITE	
WE ARE SENDING: ☒ HEREWITH	☐ UNDER SEPARATE COVER
☒ VIA MAIL	☐ VIA
THE FOLLOWING: BIOVENTING PILOT TEST RESULTS REPORT FOR REDWOOD REGIONAL PARK SERVICE YARD SITE – OAKLAND, CALIFORNIA (DATED OCTOBER 29, 2004)	
☐ AS REQUESTED	☐ FOR YOUR APPROVAL
☐ FOR REVIEW	☒ FOR YOUR USE
☐ FOR SIGNATURE	☐ FOR YOUR FILES
COPIES TO: N. FUJITA (EBRPD) (3 COPIES) C. WILCOX (CA FISH & GAME) R. BREWER (REGIONAL BOARD)	BY: Bruce Rucker BHR

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GEOSCIENCE & ENGINEERING CONSULTING

October 29, 2004

Ms. Donna L. Drogos, P.E.
Supervising Hazadous materials Specialist
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Subject: Bioventing Pilot Test Results Report
Redwood Regional Park Service Yard Site – Oakland, California

Dear Ms. Drogos:

Attached is the referenced Stellar Environmental Solutions, Inc. (SES) report for the former underground fuel storage tank site at the Redwood Regional Park Service Yard, located at 7867 Redwood Road, Oakland, California. This project is being conducted for the East Bay Regional Park District and follows previous site investigation and remediation activities (conducted since 1993). The key regulatory agencies for this investigation are the Alameda County Department of Environmental Health (Alameda County Health), the Regional Water Quality Control Board, and the California Department of Fish and Game.

This report summarizes the results from implementation of a bioventing pilot test at the site. Based on the favorable findings, we recommend proceeding with full-scale bioventing system installation and implementation. If you have any questions regarding this report, please contact Mr. Neal Fujita of the East Bay Regional Park District, or contact us directly at (510) 644-3123.

Sincerely,

Bruce M. Rucker, R.G., R.E.A.
Project Manager

Michael B. Phelps, P.E.,
Principal Engineer

Richard S. Makdisi, R.G., R.E.A.
Principal Geochemist

cc: Carl Wilcox, California Department of Fish and Game
Roger Brewer, California Regional Water Quality Control Board
Neal Fujita, East Bay Regional Park District

BIOVENTING PILOT TEST RESULTS REPORT

REDWOOD REGIONAL PARK
SERVICE YARD
OAKLAND, CALIFORNIA

Prepared for:

EAST BAY REGIONAL PARK DISTRICT
P.O. BOX 5381
OAKLAND, CALIFORNIA 94605

Prepared by:

STELLAR ENVIRONMENTAL SOLUTIONS
2198 SIXTH STREET
BERKELEY, CALIFORNIA 94710

October 29, 2004

Project No. 2004-02

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1.0 PROJECT DESCRIPTION AND SITE HISTORY

PROJECT DESCRIPTION

The subject property is the East Bay Regional Park District (EBRPD) Redwood Regional Park Service Yard located at 7867 Redwood Road in Oakland, Alameda County, California. The site has undergone site investigations and remediation since 1993 to address subsurface contamination caused by leakage from one or both of two former underground fuel storage tanks (UFSTs) that contained gasoline and diesel fuel. The Alameda County Department of Environmental Health (Alameda County Health) has provided regulatory oversight of the investigation since its inception. Other regulatory agencies with historical involvement in site review include the Regional Water Quality Control Board (RWQCB) and the California Department of Fish and Game (CDFG).

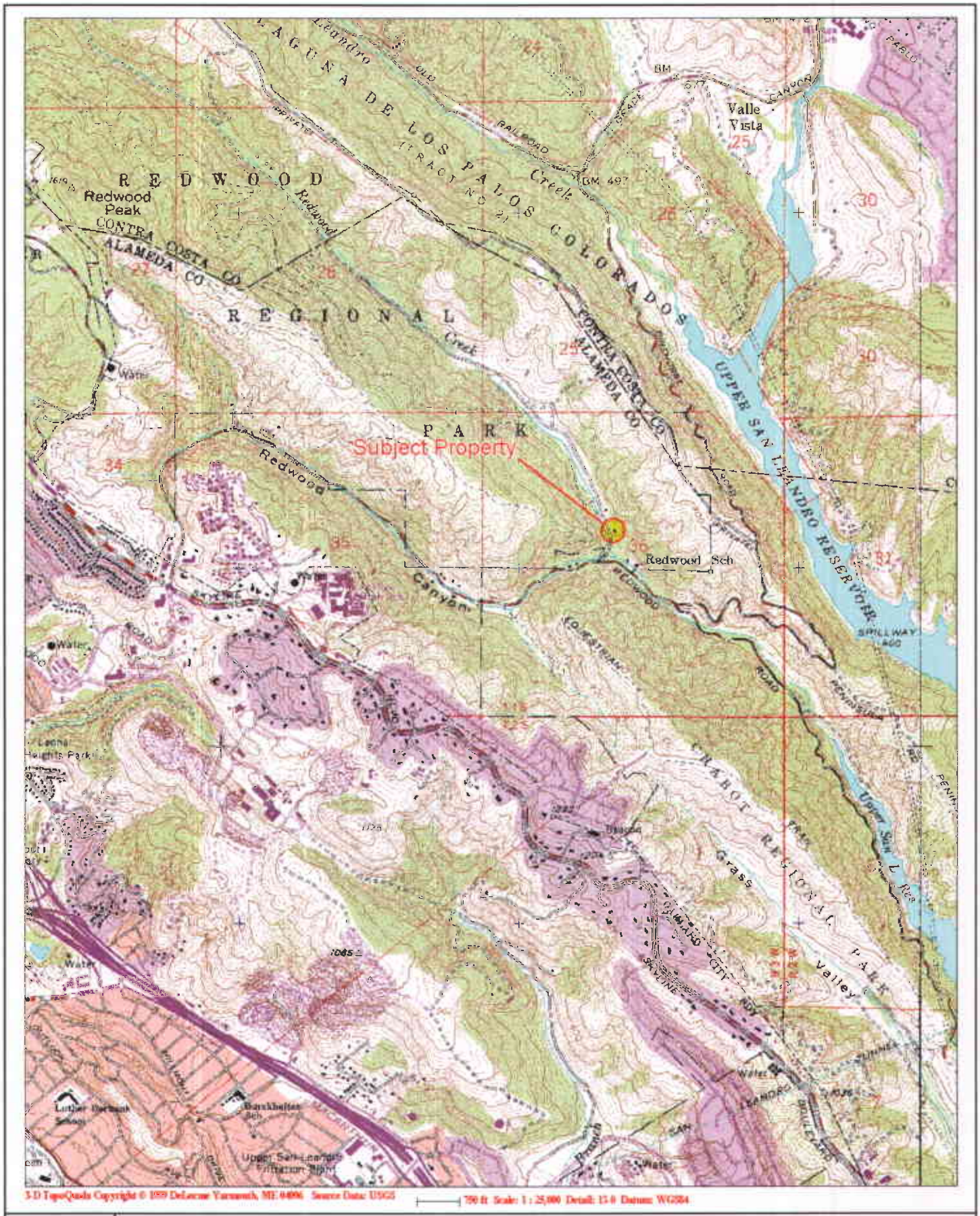
This report discusses the implementation of a bioventing pilot test at the site. Bioventing was selected as an appropriate corrective action to mitigate residual petroleum contamination based on site conditions and residual contaminant distribution. The bioventing pilot test activities were conducted in September/October 2004 and included: installation of one vent well (VW) and three vapor monitoring points (VMPs); laboratory analysis of soil and soil vapor samples; an oxygen influence/soil permeability test; and a respiration test. A detailed description of these activities is included in Sections 2.0 and 3.0.

Data collected during the pilot test are used herein to assess the feasibility of the bioventing technology and to develop design criteria for full-scale remediation. Important design parameters measured during the pilot test included: system radius of influence, air permeability of the soil, and contaminant mass removal rates. These results are presented and discussed in Section 4.0. A proposed full-scale design based on the results is provided in Section 5.0.

SITE DESCRIPTION

Figure 1 shows the location of the project site. A site plan is shown on Figure 2.

The site slopes to the west, from an elevation of approximately 564 feet above mean sea level (amsl) at the eastern edge of the service yard to approximately 545 feet amsl at Redwood Creek,



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SITE LOCATION ON U.S.G.S. TOPOGRAPHIC MAP

Redwood Reg. Park Service Yard Oakland, CA	By: MJC	APRIL 2004
	Figure 1	

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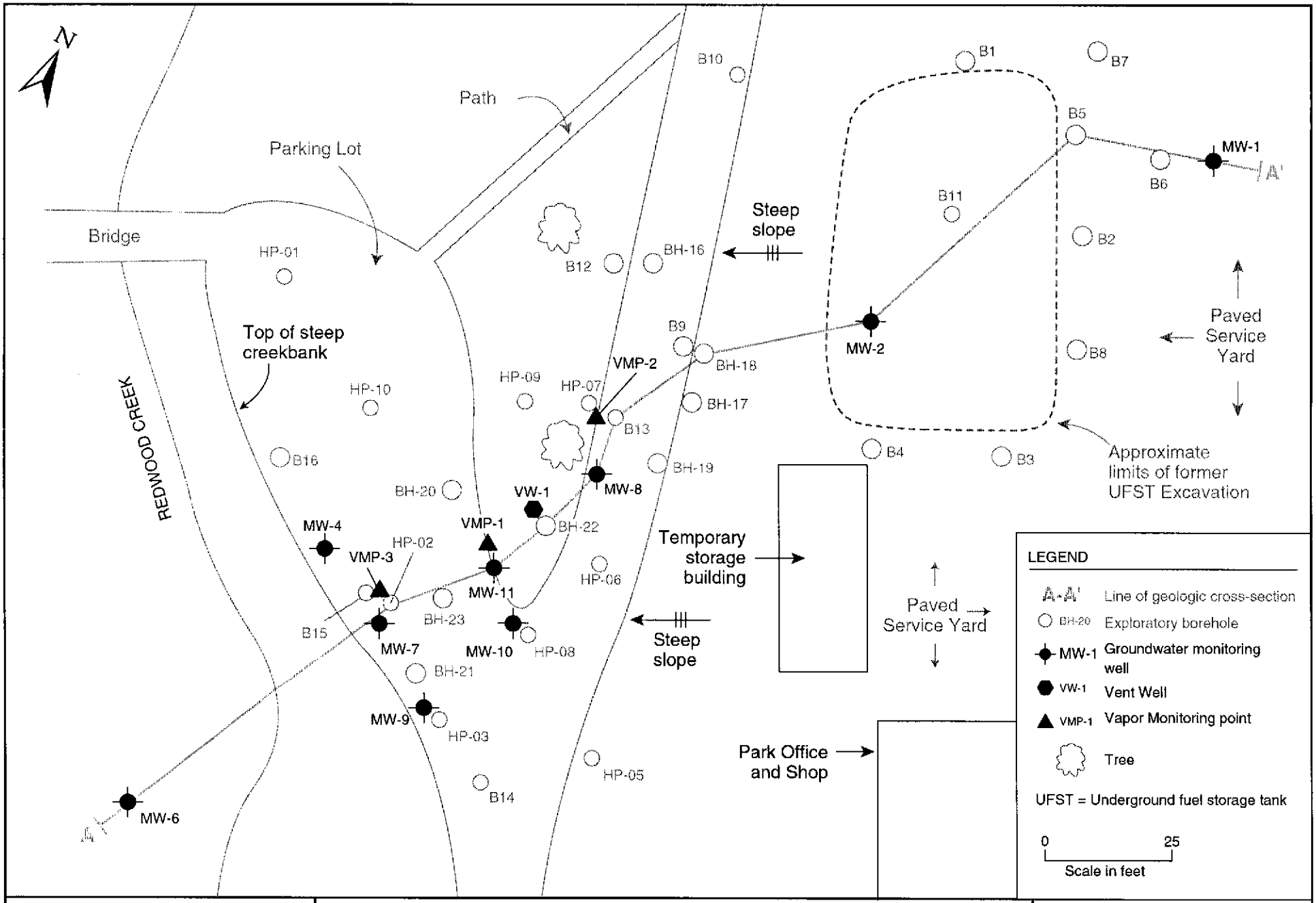

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SITE PLAN AND WELL LOCATIONS
Redwood Regional Park Service Yard, Oakland, CA

Figure 2

by: MJC | OCTOBER 2004

2004-02-16

which defines the approximate western edge of the project site with regard to this investigation. From east to west, the study area consists of:

- Flat, paved EBRPD service yard with several permanent and temporary buildings/sheds (former UFST excavation area);
- Steep slope (approximately 45 degrees) between the western edge of the service yard and the park entrance road (immediately west of MW-2);
- Hummocky terrain with low vegetation (between MW-8 and MW-11), including a large EBRPD-designated sycamore tree (adjacent to MW-8 and VMP-2);
- Flat, unpaved parking lot (between MW-11 and MW-7); and
- Steep slope (approximately 45 degrees) to Redwood Creek (immediately west of MW-4, MW-7, and MW-9).

The park entrance road was repaved in October 2004. All but one of the existing and proposed wells are outside the roadway; MW-8 is located approximately 2 feet inside the roadway. As of October 2004 (completion of bioventing pilot test), two 2-inch-diameter PVC air distribution pipes run approximately 6 inches beneath the road base adjacent to a stormwater culvert, immediately to the north of the work area. These pipes were installed during roadway improvements so it would not be necessary to disturb the pavement during installation of the full-scale bioventing system.

SITE HISTORY AND CONTAMINATION

Contaminant corrective actions and investigations have been conducted at the site since 1993. General phases of work previously included:

- Removal of UFSTs and contaminated soil;
- Installation and quarterly groundwater monitoring of groundwater monitoring wells;
- Several phases of remedial investigation-oriented exploratory borehole drilling and sampling;
- A correction action feasibility study;
- Two phases of ORC™ injection; and
- An evaluation of bioventing feasibility as a corrective action.

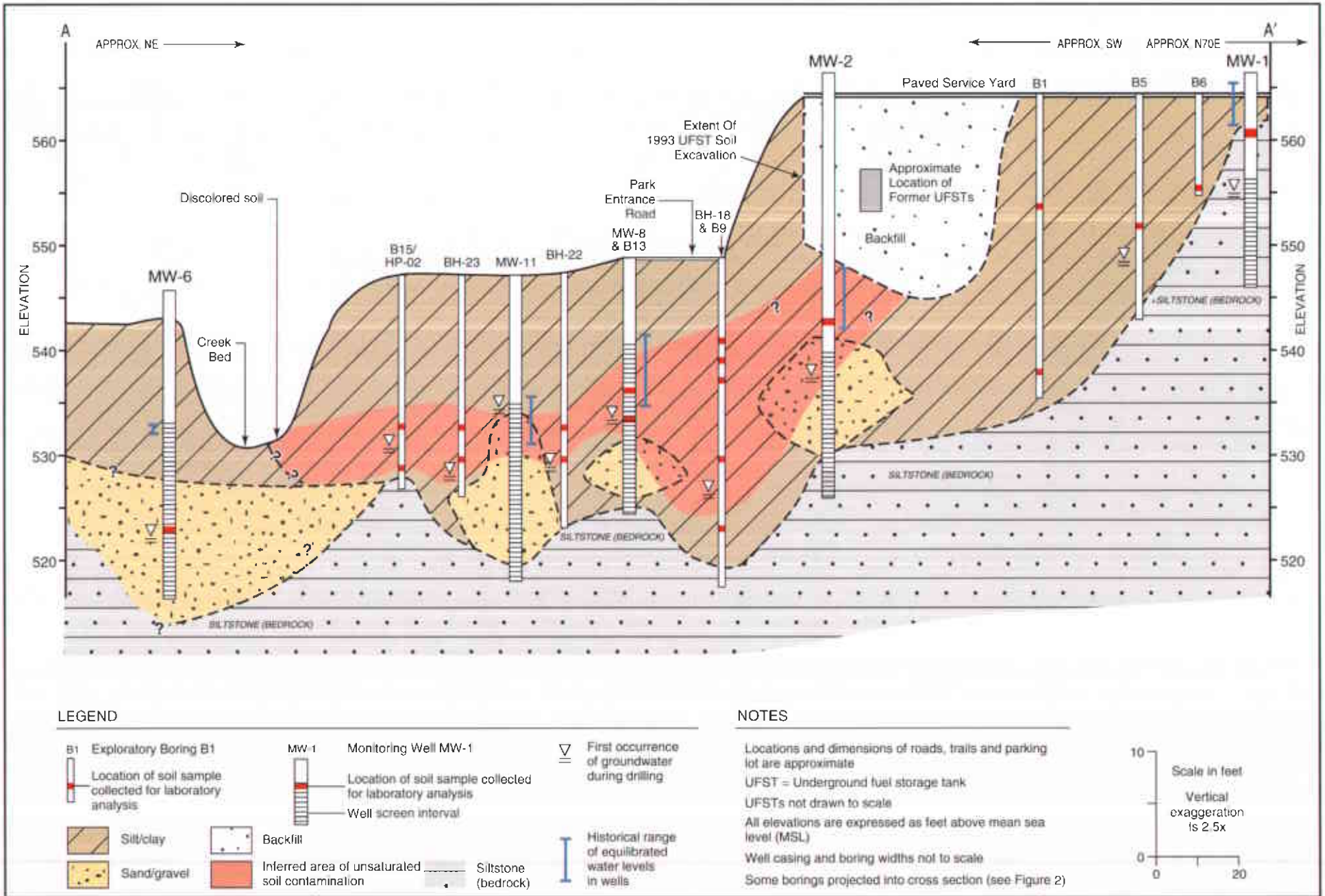
As discussed in detail in previous SES reports (SES, 2004a; SES, 2004b), the available data support the following conclusions:

- Site chemicals of concern include total petroleum hydrocarbons (TPH)—specifically gasoline and diesel; benzene, toluene, ethylbenzene, and xylenes (BTEX); and methyl *tertiary*-butyl ether (MTBE).
- The saturated zone overlies laterally-extensive bedrock, which limits downward migration of groundwater contamination.
- The unsaturated zone varies in thickness due to seasonal water level fluctuations of several feet.
- Residual soil contaminant mass in the unsaturated zone is acting as a long-term source of groundwater contamination; the maximum thickness of the residual soil contamination (during lowest water level periods) is approximately 10 feet.
- Previous ORC™ injection programs resulted in permanent reductions at the peripheral plume margins, but was followed by rebound to pre-injection conditions within the central portions of the plume, corroborating the conceptual model that remaining unsaturated zone soil contamination is continuing to impact groundwater.
- Site conditions are favorable for bioventing as a corrective action to reduce unsaturated zone soil contamination, especially in the near-source area that is inaccessible to other methods due to the hilly topography.

SITE GEOLOGY AND HYDROGEOLOGY

Figure 3 is a geologic cross-section (A-A') along the longitudinal axis of the plume. Shallow soil stratigraphy consists of a surficial 3- to 10-foot-thick clayey silt unit underlain by a 5- to 15-foot-thick silty clay unit. In the majority of boreholes, a 5- to 10-foot-thick clayey coarse-grained sand and clayey gravel unit that laterally grades to a clay or silty clay was encountered. This unit overlies a weathered siltstone at the base of the observed soil profile. The top of this bedrock varies in elevation by several feet in the area of contamination, and likely is a fundamental control on local groundwater flow (on the order of several feet). The soils beneath Redwood Creek appear to be a thin clayey unit with large cobbles in the creek bed, underlain by sandy and gravelly soils to an unknown depth. Soils in the vicinity of MW-1 are inferred to be landslide debris (loose matrix of poorly-sorted material and steep groundwater gradient).

Groundwater at the site occurs under unconfined and semi-confined conditions, generally within the clayey, silty, sand-gravel zone. The top of this zone varies between approximately 12 and 19 feet below ground surface (bgs), and the bottom of the water-bearing zone (approximately 25 to 28 feet bgs) corresponds to the top of the siltstone bedrock unit. Seasonal fluctuations in groundwater depth create a capillary fringe of several feet which is saturated in the rainy period (late fall through early spring) and unsaturated during the remainder of the year. The thickness of



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Cross Section A-A'
Redwood Regional Park Service Yard, Oakland, CA

Figure 3

by: MJC | OCTOBER 2004

2004-02-15

the saturated zone plus the capillary fringe varies between approximately 10 and 15 feet in the area of contamination. Local perched water zones have been observed well above the top of the capillary fringe, generally in the rainy high-water conditions in the winter and spring.

SITE CONCEPTUAL MODEL AND CONTAMINANT MASS ESTIMATE

A large mass of residual TPH contamination in the unsaturated zone overlies the contaminant plume, primarily in the area between the former UFSTs and the park entrance roadway, with the contaminated zone thinning toward Redwood Creek. Seasonal desorption of contamination in this unsaturated zone occurs during the rainy season and during high-water periods, acting as a long-term source of dissolved contamination. Previous ORC™ injection programs, which resulted in permanent reductions at the peripheral plume margins but were followed by rebound (to pre-injection conditions) within the central portions of the plume, indicate that site conditions support aerobic biodegradation; however, biodegradation is limited by oxygen deficiency in the unsaturated zone.

Based on this conceptual model and using conservative assumptions for equilibrium partitioning, contaminant geometry, soil moisture, and previous laboratory analytical results for TPH in soil, estimates of TPH mass in soil were calculated. Residual TPH in vadose zone soil is estimated at 1,400 to 7,000 pounds (100 to 600 gallons of gasoline), compared to a mass of TPH in groundwater estimated at 1 to 10 pounds (0.1 to 1.0 gallon of gasoline).

REGULATORY STATUS

The lead regulatory agency for the site investigation and remediation is Alameda County Health, with oversight provided by the RWQCB. The CDFG is also involved with regard to water quality impacts to Redwood Creek. All workplans and reports are submitted to these agencies. Following several SES technical submittals and a meeting with Alameda County Health, Alameda County Health approved implementing the bioventing pilot test.

2.0 PILOT TEST WELL INSTALLATIONS

This section discusses the installation of pilot test wells, associated soil sampling and analysis methods, and water level measurements in the pilot test wells.

PILOT TEST WELL INSTALLATION AND CONSTRUCTION

Rationale for Well Location and Construction

Bioventing typically has an effective radius of influence between 10 and 50 feet, depending on soil type. A single vent well (VW-1) was installed in the central portion of the contaminated area, and three VMPs (VMP-1, VMP-2, and VMP-3) were installed at distances of approximately 10, 20, and 35 feet from the vent well to allow for an evaluation of the radius of influence due to air injection at VW-1. Figure 2 shows the locations of the pilot test wells.

VW-1 is screened from 6 to 16 feet bgs, which incorporates the majority of the thickness of the residual soil contamination zone, but is not so shallow as to allow short-circuiting to the atmosphere. The shallowest depth of first occurrence of groundwater in the vicinity of the vent well, measured in previous boreholes, was approximately 18 feet bgs; therefore, the bottom of the vent well screen was terminated above this depth to minimize the potential that the vent well would flood (reducing the effective vertical length of injected air).

Two "nested" casings/screens were installed in each of the three VMP boreholes (total of six VMP screens available for monitoring). The VMP screened intervals in each borehole corresponded to the top of unsaturated zone soil contamination at each location (at approximately 10 to 12 feet bgs), and to the bottom of the vent well screened interval (at approximately 14 to 16 feet bgs). Therefore, all VMP screens are at depths coincident with the vent well screened interval and provide two separate monitoring depths.

Well Installation Activities

The wells were installed on June 1 and 2, 2004 by HEW Drilling (East Palo Alto, CA) under direct supervision of Bruce Rucker, the SES California Registered Geologist. Prior to installation, well installation permits were obtained from Alameda County Public Works Agency (ACPWA). The well permits are contained in Appendix A.

Well boreholes were drilled with approximately 8-inch-diameter truck-mounted, hollow-stem augers. Flush-threaded PVC casing and screen was used, with no organic solvents or glues. Bentonite seals (chips emplaced downhole followed by hydration) were placed in the annular space between the well screens and filter packs to isolate the monitoring intervals. Well installation and construction details are provided in the following subsections.

Waste soil from the drilling was placed in labeled, 55-gallon steel drums temporarily stored onsite. This waste soil will be profiled and disposed of offsite when it is known that no more waste soil will be generated (i.e., after the full-scale system is installed). Waste water from equipment decontamination was placed in the onsite poly tank that is used to store groundwater well purge water. That water will continue to be stored and periodically transported offsite for proper disposal when the tank is full.

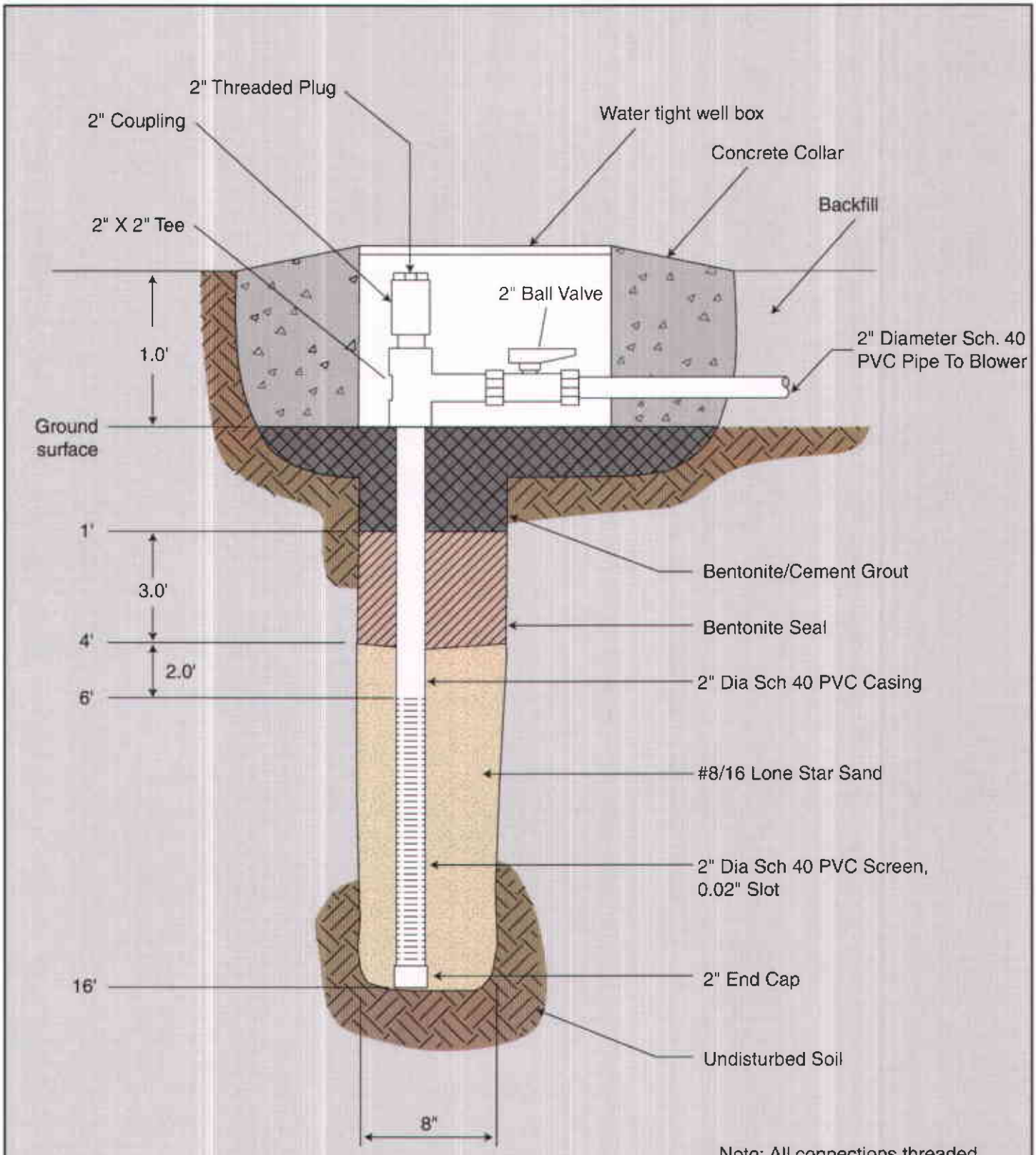
Vent Well Installation and Construction

Figure 4 shows the as-built construction detail for VW-1. The total depth of the VW-1 borehole was 16 feet bgs. VW-1 was constructed of 2.0-inch inner diameter (ID), Schedule 40 PVC casing and screened from 6 to 16 feet bgs (0.020-inch slot size). Annular filter pack material was placed across and 2 feet above the well screen. Annular filter pack material was #8/16 sand. A 3-foot-thick layer of hydrated bentonite pellets was then placed above the filter pack, followed by a bentonite/cement grout annular pollution seal to surface. A metal well box was installed at the surface to protect the well, with a cut opening in the north side for eventual air distribution piping.

Vapor Monitoring Well Installation and Construction

Figure 5 shows the as-built construction details for the three VMPs. The total depth of the VMP boreholes was 16 feet bgs. Two isolated, nested screened intervals were installed in each VMP; each screened interval was constructed with a 1.5-foot-long, 1.0-inch ID Schedule 80 PVC slotted well screen (0.020-inch slot size). In all three VMPs, the upper screened interval was from 10 to 11.5 feet bgs. In VMP-1 and VMP-2, the lower screened interval was from 14 to 15.5 feet bgs, and in VMP-3 the lower screened interval was from 12.5 to 14 feet bgs. Riser casing (from top of screened interval to surface) was 0.5-inch ID Schedule 80 PVC. The two nested casings in each VMP are contained in a common well box.

Annular filter pack of #8/16 sand was placed across and 0.5 feet above and below each well screen. A bentonite seal (2 to 3 feet thick) was placed between each filter pack to isolate the individual well screens/filter packs within the borehole. Above the shallowest filter pack, a cement grout annular pollution seal was installed to ground surface. Surface completions were



AS-BUILT VENT WELL CONSTRUCTION DETAILS FOR VW-1

Redwood Regional Park Oakland, CA	By: MJC	OCTOBER 2004	★ Stellar Environmental Solutions, Inc. Geoscience & Engineering Consulting
	Figure 4		

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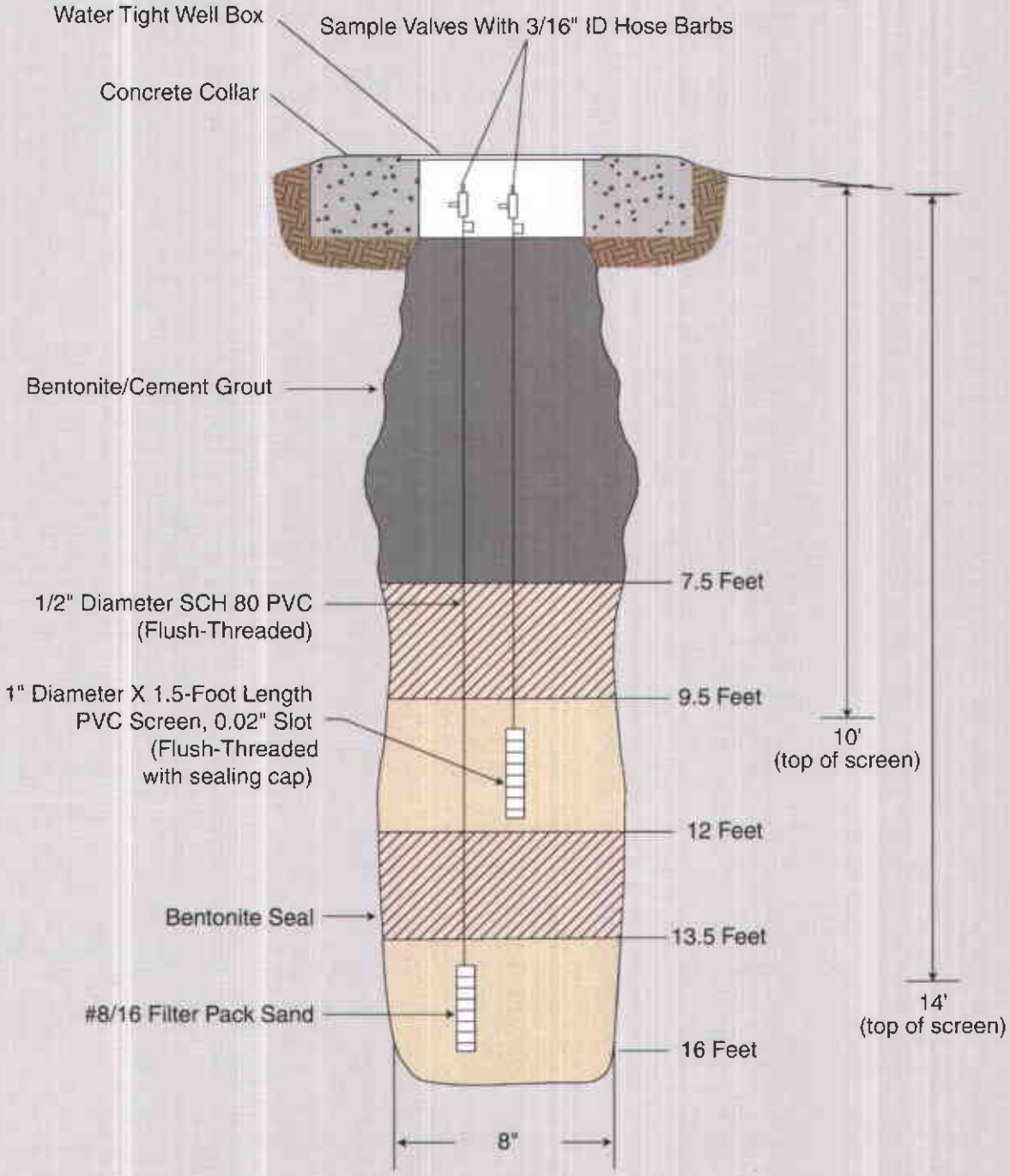

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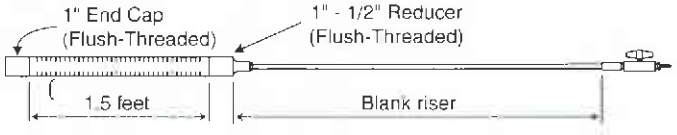


VMP SCREEN DETAIL
Not To Scale

AS-BUILT VAPOR MONITORING POINT CONSTRUCTION DETAILS

Redwood Regional Park Oakland, CA	By: MJC	OCTOBER 2004	★ Stellar Environmental Solutions, Inc. Geoscience & Engineering Consulting
	Figure 5		

2004-02-05

traffic-rated, Christy-type well boxes. Individual valves were installed on each VMP casing at the ground surface for purging and sampling.

Each nested VMP screened interval was assigned a unique name, corresponding to the top of the 1.5-foot-long screened interval (e.g., VMP1-10 refers to the screened interval between 10 and 11.5 feet in VMP-1).

In accordance with ACPWA requirements, SES completed and submitted to ACPWA Well Completion Forms for all seven wells, including one form for each of the six nested VMP casings and one for VW-1. Copies of the Well Completion Forms are included in Appendix A.

SOIL SAMPLING AND ANALYSIS

Two soil samples were collected for laboratory analysis from each of the four well boreholes. Soil sampling depths in the VMPs generally corresponded to the screened intervals (10.5 and 15 feet bgs); in VW-1, soil samples were collected at 10 and 15.5 feet bgs, within the screened interval of 6 to 16 feet bgs. Soil samples were collected in a 2-inch-diameter, 1.5-foot-long barrel sampler, fitted with three pre-cleaned, 2-inch OD by 6-inch-long, thin-walled brass sleeves. Laboratory analytical services were provided by Curtis & Tompkins, Ltd. (Berkeley, CA), a California ELAP-certified lab for all site analytical methods.

The soil samples were analyzed for site contaminants to be used to establish baseline contaminant concentrations prior to bioventing activities. Selected soil samples were also analyzed for physical and chemical parameters to support calculations of soil air permeability (moisture content) and for indicators that affect bioventing-induced contaminant degradation (moisture content, alkalinity, phosphorous, and nitrogen). Soil sampling results are presented and discussed in Section 4.0.

POST-INSTALLATION FINDINGS

Following well installation, water levels were measured to confirm if the screened intervals were saturated or dry. Saturated conditions (i.e., flooded screen) would indicate that air injected during the bioventing pilot test would not transmit through the saturated soil at and below that depth, and would also preclude collecting baseline soil vapor samples. Table 1 summarizes the water level measurements.

Measurements conducted subsequent to well installation in mid-June 2004 confirmed that approximately 6 feet of the vent well screen and all three VMP upper screened intervals (10 to 11.5 feet bgs) were exposed to unsaturated conditions. However, water was present in the three

Table 1
Pilot Test Well Water Level Measurements
Redwood Regional Park Service Yard, Oakland, California

	Well ID						
	VW-1	VMP-1		VMP-2		VMP-3	
Screen Depth:	6-16	10-11.5	14-15.5	10-11.5	14-15.5	10-11.5	12.5-14
Date	**Water Level (in feet below TOC)**						
06/17/2004	12.50	dry	10.80	dry	12.70	dry	10.80
07/06/2004	12.40	dry	11.10	dry	12.90	dry	11.00
07/19/2004	12.02	dry	11.31	dry	13.30	dry	11.26
08/02/2004	12.25	dry	11.45	dry	13.72	dry	11.37
08/15/2004	12.43	dry	11.76	dry	14.00	dry	11.68
08/20/2004	12.57	dry	11.92	dry	14.18	dry	11.84
09/06/2004	12.93	dry	12.33	dry	14.60	dry	12.18
09/14/2004	13.14	dry	12.62	dry	14.70	dry	12.10
10/28/2004	13.70	dry	12.10	dry	14.20	dry	11.99
Maximum estimated exposed screen length (feet) *	7.5	1.5	(1.4)	1.5	0.7	1.5	(0.4)
Average drop in water level (feet/month)	0.32	—	0.66	—	0.78	—	0.48

* Value in parentheses is a negative value (groundwater level above top of screen; screen was therefore not exposed).

lower screened intervals of the VMPs. Each VMP screened interval was purged dry (with a peristaltic pump), and water levels recovered by the next measurement to near pre-purging levels, indicating that the water present in the lower screened intervals was groundwater and not added or residual water from well construction activities. The deeper VMP screened intervals either intersected the water table, or at least act as low-pressure zones allowing groundwater to rise into the deeper screens by capillary action.

As discussed in Section 1.0, equilibrated water levels in wells seasonally fluctuate up to several feet and reach a minimum in early to late fall. Thus, it was determined that it would be appropriate to postpone the scheduled pilot test, and conduct continued water level measurements in pilot test wells over time (through the dry season) to confirm if water levels would continue to drop and expose additional screen in the lower VMP screened intervals.

Water level measurements were subsequently conducted in pilot test wells and nearby groundwater monitoring wells approximately every 2 weeks. As shown in Table 1, water levels continued to decrease over time; by mid-September, the deeper screen in VMP-2 was exposed, while the deeper screened intervals in VMP-1 and VMP-3 were unlikely to be exposed prior to the potential beginning of the rainy season. Therefore, the pilot test was initiated beginning on September 15, 2004. By late October 2004 (following two precipitation events), water levels in the three VMPs had begun to rise, although the water level in VW-1 was at its lowest level.

3.0 PILOT TEST EQUIPMENT AND SAMPLING ACTIVITIES

This section discusses the equipment specifications and soil vapor sampling and analysis methods used to conduct the bioventing pilot test. Photos of the equipment and setup are provided in Appendix C.

PILOT TEST EQUIPMENT SPECIFICATIONS

Blower System

For ease of setup and operation, the aboveground portion of the pilot test equipment consisted of a rented, pre-packaged blower system (Environmental Instruments, Concord, CA) and contained the following components:

- 1.5-hp Rotron Model 454 vacuum blower (127 standard cubic feet per minute [scfm] maximum free air flow, 65 inches water [" H_2O] maximum pressure);
- 208-230 volt starter;
- outlet pressure gauge (0" to 100" H_2O range);
- outlet air bleed valve (for controlling air flow); and
- quick connect/disconnect camlock fittings.

This blower system was selected based on the pilot test design specifications; namely, achieving a potential 40-foot radius of influence and a 40-scfm flow rate under induced pressure conditions. As part of the system mobilization and setup, this pre-packaged system was connected to VW-1 with a flexible PVC hose and a Fernco™ coupling and 2-inch piping. One sampling port was installed between VW-1 and the blower for measuring air flow to the vent well and injected air temperature. During pilot test operations, air flow was measured using a thermal anemometer (TSI model 8345), and induced pressure at the VMPs was measured using Dwyer magnehelic gauges (0" to 1" H_2O range). The system flow rate was maintained at approximately 40 scfm for the first 144 hours of the test, followed by the 21-hour downtime, and was increased to approximately 80 to 87 scfm for the remaining 120 hours.

Electric Power

Because electrical power is not available near the vent well at the site, a rented, trailer-mounted, diesel-powered 15-kilowatt generator (Multiquip Model DCA-15SPX3 [Hertz Equipment, Berkeley, CA]) was mobilized to the site for the pilot test. This generator was selected for its quiet operation in the site's park setting, and was sized for efficient operation and low maintenance requirements under 24-hour duty.

Test Duration

The test was conducted over a 285-hour period, with a 21-hour downtime period starting at 144 hours after the test began (due to a blower failure). The downtime did not significantly affect the overall pilot test data.

SOIL VAPOR SAMPLING AND ANALYSIS

Soil vapor sampling was used to establish baseline conditions for future evaluation of the impact of bioventing on residual soil contamination. Soil vapor samples were collected using a sample collection system consisting of a small, portable vacuum pump, Tygon® tubing, and a vacuum chamber (Downey and Hall, 1994). The vacuum pump was used to purge the well and tubing. The purge times for each of the VMP depths was approximately 3 minutes, and the purge time for VW-1 was approximately 7 minutes; these purge times were based on well construction and the flow rate of the pump to ensure that a representative sample was collected.

Once the well was purged, soil vapor samples were collected in Tedlar® bags within the vacuum chamber for field analysis. Soil vapor samples were collected for laboratory analysis subsequent to purging and field screening by attaching an evacuated Summa® canister directly to the well. A leak check was performed prior to sampling to ensure that no ambient air could leak into the sampling system and to verify that the canister had not leaked prior to its use.

Prior to blower operation, a total of five soil vapor samples (one from VW-1, one from each of the three shallow VMP screens, and one from the deep screen at VMP-2) were collected for both field and laboratory analysis. All soil vapor samples were analyzed in the field using portable meters (GasTech Model GT-408) for oxygen/carbon dioxide and a photoionization detector (PID) (*Mini*-RAE Plus Classic) for organic compounds. Meters were calibrated on a daily basis and/or according to manufacturer's specifications.

All samples collected for laboratory analysis were analyzed for BTEX, MTBE, and total volatile hydrocarbons as gasoline (TVHg) using EPA Method TO-3. Laboratory analytical services were provided by Air Toxics, Ltd. (Folsom, CA). Sample results are discussed in Section 4.0, and certified analytical results and chain-of-custody forms are provided in Appendix B.

4.0 SAMPLING RESULTS AND SYSTEM PERFORMANCE EVALUATION

SOIL SAMPLING RESULTS

Soil analytical results are presented in Table 2 (contaminants) and Table 3 (physio-chemical parameters). Certified analytical results and chain-of-custody forms were provided in the Q2 2004 Monitoring Report (SES, 2004). Sampling and analytical procedures are described in Section 2.0.

Of the four soil samples collected in the upper screened intervals (10 feet bgs), elevated concentrations were present only in the 10.5-foot-deep sample at VMP-2. The presence of shallow soil contamination at this location was expected based on previous findings that indicate a substantial mass of residual unsaturated zone soil contamination immediately downgradient of the former UFSTs. Elevated fuel contaminant concentrations were detected in all the lower screened interval soil samples, although contaminant concentrations were an order of magnitude lower at VW-1 than at the three VMPs.

Table 2
Soil Sampling Results – Contaminants, June 2004
Redwood Regional Park Service Yard, Oakland, California [a]

Location	Depth (feet)	TVHg	TEHd	Benzene	Toluene	Ethyl Benzene	Xylenes	MTBE
VW-1	10	*< 0.98*	1.1	*< 0.0049*	*< 0.0049*	*< 0.0049*	*< 0.0098*	*< 0.020*
	15.5	38	1.5	*< 0.025*	*< 0.025*	0.26	0.13	*< 0.10*
VMP-1	10.5	*< 1.0*	*< 1.0*	< 0.0052	< 0.0052	< 0.0052	< 0.0104	< 0.021
	14.5	2,100	42	*< 0.5*	*< 0.5*	15	4.0	< 2.0
VMP-2	10.5	3,500	1,000	1.4	*< 1.3*	42	197	< 5.0
	14.5	3,200	650	8.0	*< 0.5*	40	77	*< 2.0*
VMP-3	10.5	*< 1.1*	1.2	*< 0.0055*	*< 0.0055*	*< 0.0055*	*< 0.011*	*< 0.022*
	15	1,400	470	*< 0.5*	*< 0.5*	8.9	5.3	*< 2.0*

[a] All concentrations in mg/kg.

Table 3
Soil Sampling Results – Physio-Chemical Parameters, June 2004
Redwood Regional Park Service Yard, Oakland, California

Location	Depth (feet)	Moisture Content (% by weight)	Total Alkalinity, as $CaCO_3$ (mg/kg)	Total Kjeldahl Nitrogen (mg/kg)	Total Phosphorous (mg/kg)
VW-1	15.5	19%	640	150	39
VMP-1	14.5	20%	370	420	51
VMP-2	10.5	18%	410	320	13

Table 3 presents soil sampling results for soil moisture, total alkalinity, total Kjeldahl nitrogen, and total phosphorous. The results indicate that soils are moist (between 72 and 80 percent saturated using an assumed total porosity of 0.40), but contain sufficient air-filled porosity (between 0.08 and 0.11 out of an assumed total porosity of 0.40) for bioventing to be an effective technology (USACE, 1995). These soil moistures are near the upper range, but within bioventing feasibility criteria range of 40 and 85 percent of saturation (SES, 2004b). Alkalinity, nitrogen, and phosphorus concentrations are within the range typical of other sites where bioventing has been effective, and indicate that soils contain sufficient buffering capacity and nutrients for effective biological activity. These results indicate that aerobic biodegradation is likely to be an important hydrocarbon removal mechanism when sufficient oxygen is brought into the contaminated zone through bioventing operations.

SOIL VAPOR SAMPLING RESULTS

Fuel Hydrocarbons

Table 4 summarizes baseline soil vapor sample analytical results for TVHg and BTEX, and field results for ionizable compounds measured with a PID at VW-1 and the four exposed screen intervals at the VMPs. TVHg concentrations ranged from 0.39 to 11,000 parts per million by volume (ppmv) and total BTEX concentrations ranged from 0.0049 to 871 ppmv. Maximum concentrations for all hydrocarbon compounds were measured at VMP-2, which is also the location where the maximum soil concentrations were measured (Table 2). There was relatively good correlation between PID field readings and TVHg laboratory measurements, with higher PID readings associated with higher TVH readings.

Table 4
Baseline Soil Vapor Sampling Results, June 2004
Redwood Regional Park Service Yard, Oakland, California [a]

Location	Depth (feet)	TVHg	Benzene	Toluene	Ethyl Benzene	Xylenes	O_2 (%)	CO_2 (%)	PID
VW-1	6-16	0.39	0.0049	*< 0.0022*	*< 0.0022*	*< 0.0022*	10.8	9.6	5.6
VMP-1	10-11.5	78	1.2	0.063	< 0.0060	0.18	1.9	16.8	67
VMP-2	10-11.5	11,000	200	41	110	520	0.0	17.6	> 4,000
	14-15.5	7,100 [b]	47 [b]	18 [b]	7.1 [b]	69 [b]	17.1 [c]	1.4 [b]	3,300 [b]
VMP-3	10-11.5	350	6.9	1.4	1.2	0.33	4.0	12.6	372

Notes:

[a] All concentrations in ppmv unless otherwise indicated.

[b] Results may be biased low due to ambient air leakage.

[c] Results may be biased high due to ambient air leakage.

For the deeper screened interval in VMP-2, vapor sampling was hindered by significant vacuum pressure created on the well during purging and sampling. Therefore, hydrocarbon sampling results for this location may be biased low due to dilution by ambient air drawn through fittings of the sampling apparatus.

Oxygen/Carbon Dioxide

During baseline sampling, oxygen concentrations were significantly depleted and carbon dioxide concentrations were significantly elevated (as compared to ambient conditions) in all monitored points, with the exception of the deep screen at VMP-2. As discussed above, results for this location are likely biased high for oxygen and low for carbon dioxide due to dilution by ambient air drawn through fittings of the sampling apparatus.

Oxygen concentrations below background concentration (usually 18 to 21 percent), and carbon dioxide concentrations above background (usually 0.05 percent) indicate that petroleum hydrocarbon contamination has induced native microbiological activity in soils. However, aerobic microbial activity is substantially limited below approximately 5 percent oxygen. Baseline sampling at most locations were below this threshold level.

SYSTEM PERFORMANCE EVALUATION

Measures used to evaluate system performance included an air permeability test, an estimate of the radius of influence due to air injection, and comparison of mass removal rates due to

biodegradation with the initial contaminant mass estimates. These evaluations are discussed in the following subsections.

Air Permeability Test

The objective of the air permeability (AP) test is to determine the site-specific soil air permeability and the effective radius of influence (i.e., the extent of the subsurface which can be affected by air injection). During the pilot test, air pressure at the centrally-located vent well induced a pressure response at the three VMPs. Because air was injected at a relatively constant flow rate, the pressure response measured at the VMPs can be used to calculate the soil air permeability and radius of influence using the modified field drawdown method (Johnson et al., 1990). This method allows for both a dynamic and a steady-state calculation. Because of the soil lithology at the project site (primarily silty clay), the dynamic response occurred too quickly for a reasonable estimate of soil air permeability; therefore, the steady-state method was used.

Two AP tests were conducted between September 21 and 22, 2004. During the first test, air was injected at VW-1 at a constant rate of approximately 40 scfm with an average pressure at the wellhead of 22.5" H_2O. During the second test, the flow rate was raised to 80 scfm with an average pressure at the wellhead of 16" H_2O . The steady-state pressure response for each of the shallow VMP depths plotted with distance for the second AP test is shown on Figure 6. Significant pressure response was noted at VMP-1 with relatively smaller responses measured at both VMP-2 and VMP-3. Similar results were obtained during the first AP test at the lower flow rate.

As shown on Figure 6, using these results and the steady-state calculation method of Johnson et al. (1990), the soil air permeability was approximately 75 darcys. This value is somewhat higher than expected for the silty clay lithology at the site, likely a result of some sand fraction within the soil matrix and/or secondary permeability. It is nearly 3 orders of magnitude higher than the minimum bioventing feasibility criteria of 0.1 darcy (USEPA, 1995). Longer-term increases in permeability could be expected as extended air injection operations open up new air flow pathways and reduce soil moisture. Therefore, the site soils are sufficiently permeable to air for bioventing to be an effective remedial technology.

Radius of Influence

The depth and radius of pressure and oxygen influence in the subsurface resulting from air extraction at the vent well is the primary design parameter for bioventing systems. The pilot test data determine the volume of soil that can be influenced at a given flow rate and vent well screen configuration. Long-term changes in soil vapor concentrations with distance and depth are also used to confirm the radius of influence estimate calculated from pressure response data alone.

Figure 6: Air Permeability/Radius of Influence Estimate
Redwood Regional Park, Oakland, California

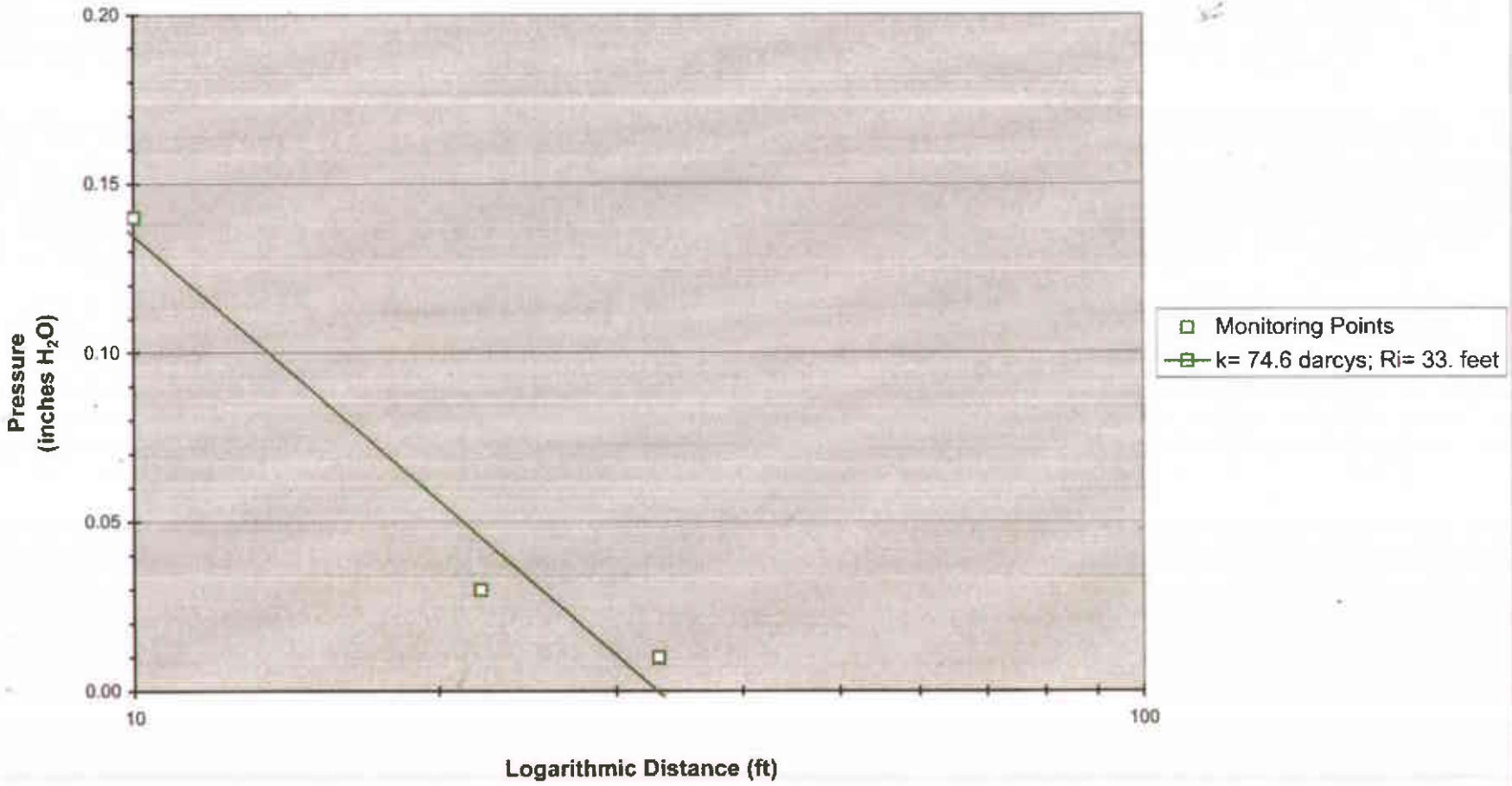
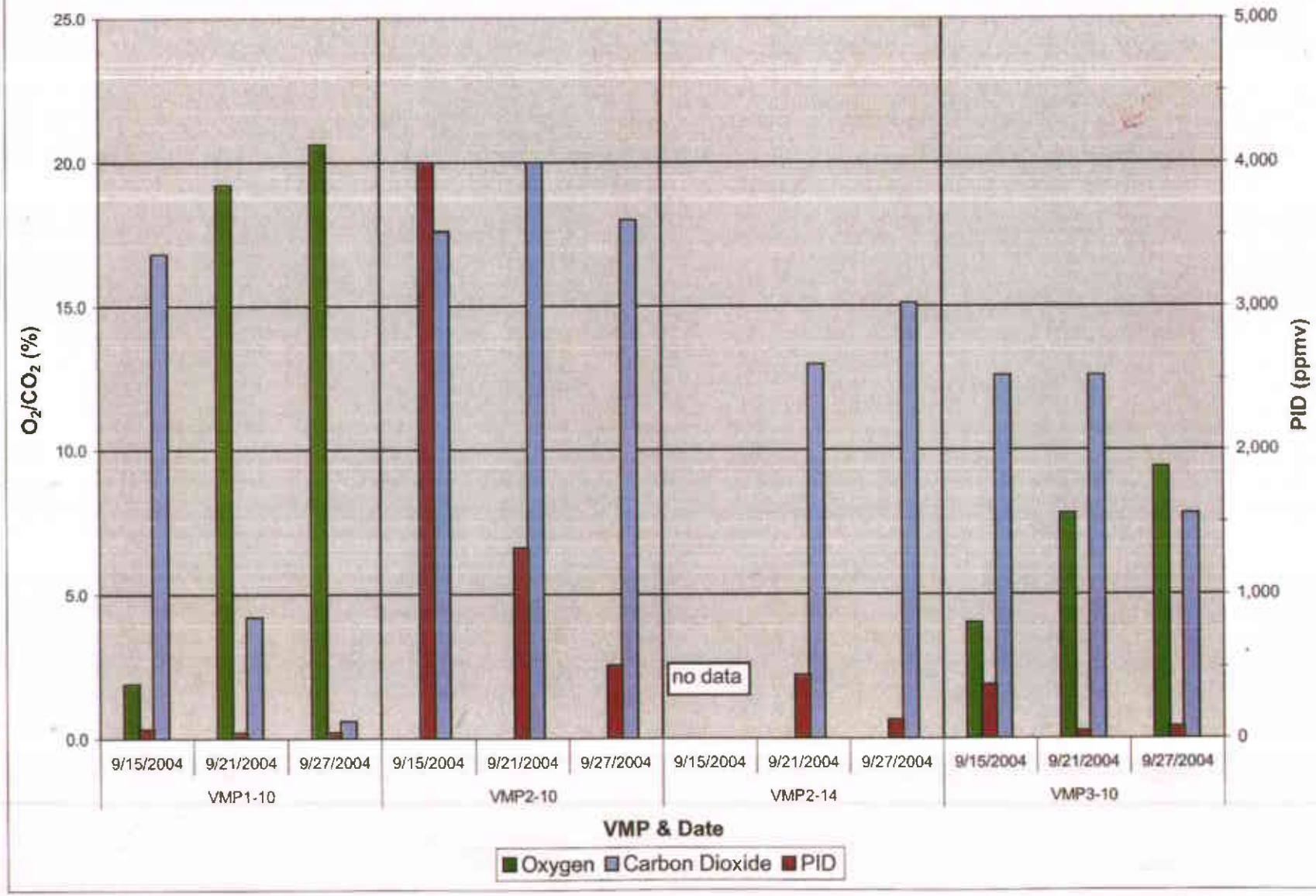


Figure 7: Baseline Concentrations vs. Concentrations During Injection at VMPs
Redwood Regional Park, Oakland, California



The pressure and oxygen response was measured during the two AP tests, which were conducted at flow rates of 40 scfm and 80 scfm between September 15 and 21 and between September 21 and 27, respectively. Oxygen, carbon dioxide, and PID responses during the two test at the VMPs with exposed screens are shown on Figure 7. Both VMP1-10 and VMP3-10 showed significant increases in oxygen concentration, decreases in carbon dioxide concentrations, and decreases in PID measurements during the two tests, with the most significant changes noted during initial injection at the lower flow rate (40 scfm). These results are an indication that the radius of oxygen influence from air injection at 40 scfm is approximately 30 feet—the distance between VW-1 and VMP-3, consistent with the measurements from pressure data alone (33 feet) (see Figure 6).

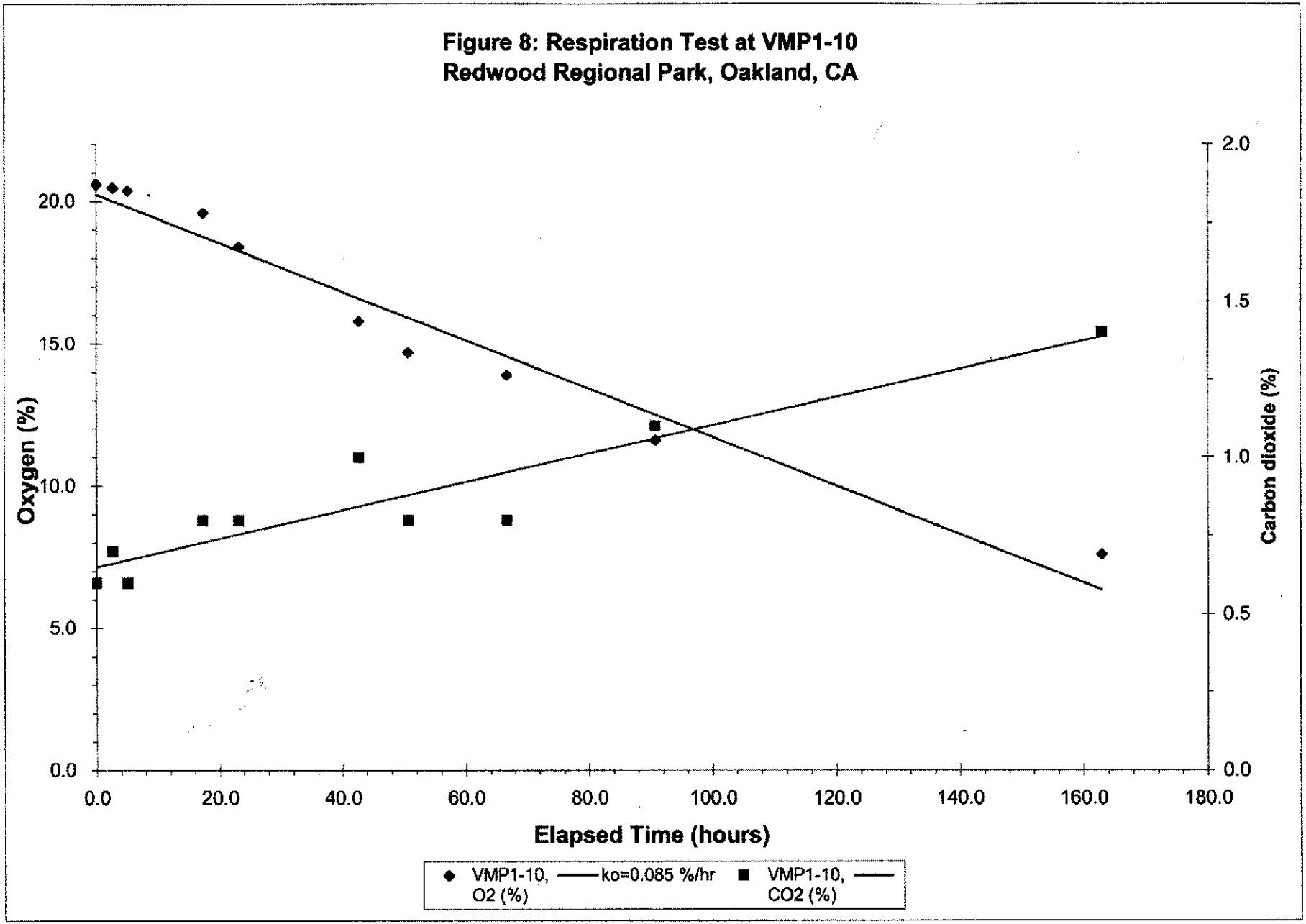
Notably, no expected increases in oxygen concentration were measured during either test at either screened interval at VMP-2, even though VMP-2 is located 20 feet from VW-1 and within the measured radius of influence. The probable explanation for this observation is that the large sycamore tree root structure is acting as a hindrance to air flow (around both it and VMP-2). The root structure was either providing a preferential vertical flow pathway to the ground surface, and/or oxygen was rapidly depleted within the air by microorganisms in this more contaminated area prior to reaching the VMP. Either of the latter two explanations would be consistent with observed increases in carbon dioxide and decreased PID measurements, which were noted as shown on Figure 7. These changes at VMP-2 indicate that, although oxygen concentrations did not increase, air movement was occurring and longer-term oxygen increases could be expected. Regardless, any full-scale bioventing system design would be required to incorporate the effect of the tree on air flow pathways. Provision for this effect is incorporated into the design presented in Section 5.0.

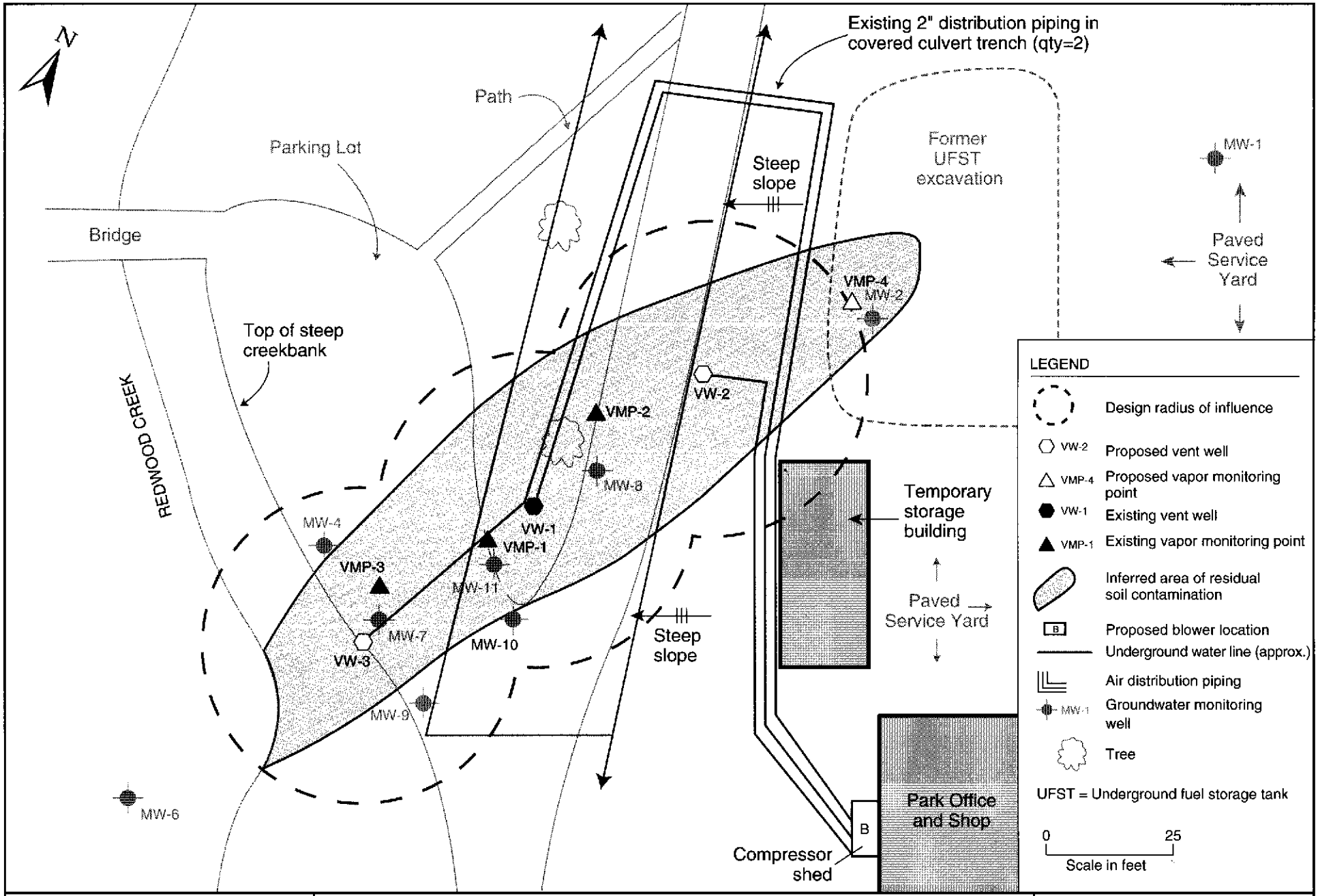
In Situ Respiration Test and Contaminant Mass Removal Rates

An in situ respiration (ISR) test was conducted between September 27 and October 4, 2004, immediately following the radius-of-influence test. The ISR test consisted of shutting down the blower and monitoring over time the decreases in oxygen concentration and increases in carbon dioxide concentration at those locations with significant increases in oxygen at the end of the radius-of-influence test (VW-1, VMP1-10, and VMP3-10). The response at VMP1-10 is shown on Figure 8.

Following procedures described in the U.S. Environmental Protection Agency (USEPA) bioventing protocol document (USEPA, 1995), biodegradation rates were calculated from the site-specific oxygen utilization rates, measured soil moisture contents (Table 3), and calculated

Figure 8: Respiration Test at VMP1-10
Redwood Regional Park, Oakland, CA





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PROPOSED FULL-SCALE BIOVENTING SYSTEM DESIGN
Redwood Regional Park Service Yard, Oakland, CA

Figure 9

by: MJC | OCTOBER 2004

2004-02-17

air-filled porosity (described previously in this section). Calculated site-specific biodegradation rates ranged from 50 to 311 milligrams of TPH per kilogram of soil per year at VW-1 and VMP1-10, respectively. These biodegradation rates indicate that fuel residuals remain in the vadose zone soils, and are significant enough to indicate that continued long-term injection of air is warranted and would be cost-effective for reducing residual soil contamination. A decrease in these biodegradation rates over time during subsequent ISR testing would be an indicator of contaminant removal and is expected as the contaminant levels in the soil drop due to continued biodegradation.

5.0 PROPOSED FULL-SCALE DESIGN

The purpose of the expanded full-scale bioventing system is to provide oxygen and stimulate aerobic biodegradation of the remaining soil contamination present at the site. Based on the previous site investigation studies, two additional air injection VWs, along with the existing VW (VW-1), should be capable of providing oxygen to the majority of the contaminated soil area, including those with the highest levels of residual fuel contamination.

OBJECTIVES

Following its implementation, the primary objectives of the full-scale bioventing system will be to:

- Optimize the system air flow rates to fully influence the contaminated area;
- Monitor the system to ensure continuous operation;
- Reduce the existing contamination levels to acceptable regulatory cleanup criteria; and
- Provide the most cost-effective remediation alternative for this site, while eliminating unnecessary impacts to site operations.

SYSTEM DESIGN

Well Location and Construction

The proposed upgrade to the existing bioventing system will incorporate the addition of two new VWs and one new VMP. The additional VWs, to be designated VW-2 and VW-3, will be located north and south of VW-1, along the primary axis of the groundwater flow direction and area of residual soil contamination (Figure 9). The new VMP, to be designated VMP-4, will be placed up on the hill overlooking the site in the area of the former UFST excavation and used to monitor oxygen influence from air injection at VW-2 in the former source area soils. Construction details for the proposed VWs and VMP will be similar to those for the existing VW-1 and VMPs (as described in Section 2.0 and shown on Figures 4 and 5), except that screen lengths and depths will be as identified in Table 5.

Table 5
Well Construction Details – Full-Scale Bioventing System
Redwood Regional Park Service Yard, Oakland, California

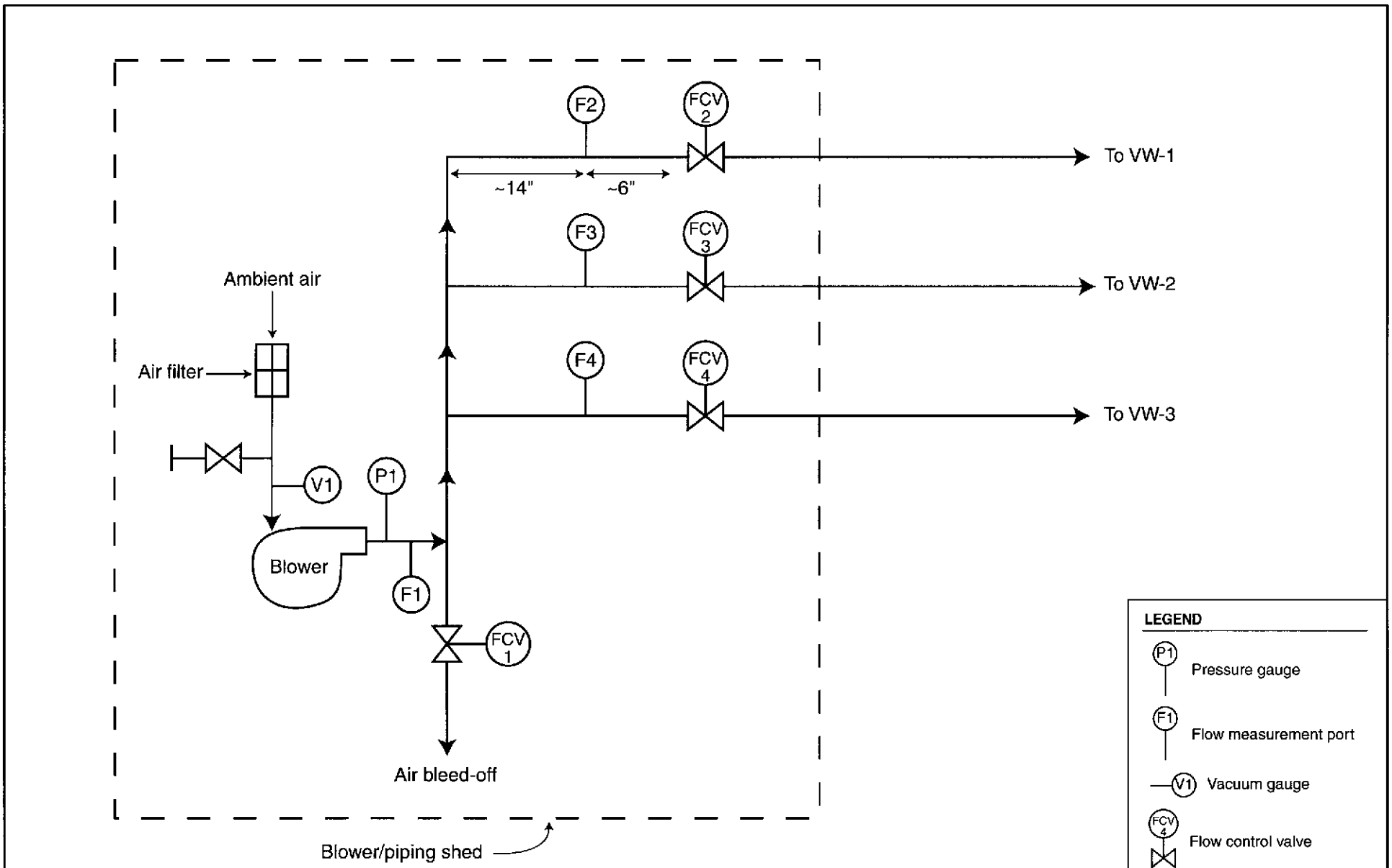
Location	Total Depth (feet bgs)	Screened Interval (feet bgs)
VW-2	18	8 to 18
VW-3	18	8 to 18
VMP-4	22	15.5 to 17.0
		20.5 to 22.0

Distribution Piping and Instrumentation

Air supply piping that will be used as the conduit for the injected air to flow from the blower to the VWs will be constructed of solid 2-inch ID, Schedule 80 PVC. The two new VWs and the existing VW will be manifolded to a new air blower, using below-grade or above-grade piping as required by site conditions. The proposed blower and distribution piping locations are shown on Figure 9.

Separate flow control valves and flow measurement ports will be installed for each VW header piping within the blower enclosure/shed to adjust individual air flows to each VW. A process and instrumentation diagram is provided on Figure 10.

Based on data collected during the bioventing pilot test, a minimum injection rate of 40 scfm at each VW should be sufficient to supply oxygen to the contaminated soils within the influence of the three VWs, and to sustain in situ fuel biodegradation. The radius of influence around each VW is expected to be at least 30 feet, based on data collected during the bioventing pilot test (Figure 6). While the design radius of influence of 30 feet around VW-2, as shown on Figure 9, does not appear to include the area beneath the former UFST excavation, the overlying excavation backfill material should act as a preferential pathway and extend the actual area of influence under field conditions. Therefore, the proposed design should encompass all of the remaining areas of residual fuel contamination. System monitoring at the four VMPs will be used to confirm that air injection at the three VWs is influencing the oxygen concentrations within the soils impacted by remaining fuel residuals.



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BIOVENTING PROCESS FLOW AND INSTRUMENTATION DIAGRAM
Redwood Regional Park Service Yard, Oakland, CA

Figure 10

by: MJC | OCTOBER 2004

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Table 6
Well Construction Details – Full-Scale Bioventing System
Redwood Regional Park Service Yard, Oakland, California

Specification	Value
Blower model	Rotron 505M (or equivalent)
Blower type	Regenerative
Horsepower (hp)	2.0 hp
Voltage (V)	208-230V or 104-115V (with fused disconnect)
Phase, frequency	Single, 60 Hz
Full-load (starting) amps (A)	56A at 230V 112A at 115V
Max. operating amps (A)	11A at 230V 22A at 115V
Max. free air flow	160 scfm
Max. operating pressure	62 in. H_2O
Air flow at 20 in. H_2O	140 scfm

Blower and Electrical System

Based on the design air flow rate of 40 scfm for each of three VWs and the injection pressure of approximately 16" H_2O measured during the pilot test, the blower and electrical power requirements are as listed in Table 6.

A fused disconnect will be provided at the power source connection within the Park Office building. In addition, a non-fused disconnect (shut-off switch) will be provided at the location of the blower, to be located within the existing compressor shed behind the Park Office. All electrical connections will be made by a qualified, licensed electrical contractor.

SYSTEM OPERATION AND MAINTENANCE

System Start-Up

At start-up of the full-scale system, it will be necessary to optimize the air injection rate and to ensure proper operation of the blower system. Flow rate optimization is accomplished by gradually increasing the flow rate to each vent well until all VMPs reach a minimum oxygen concentration of approximately 10 percent, expected to be approximately 40 scfm per vent well based on the pilot test results. The blower, flow rates, and oxygen concentrations in the VMPs will be checked at least bi-weekly during the first month of operation to ensure that the required

flow rates are achieved and that oxygen concentrations increase in the VMPs as a result of air injection.

Blower Maintenance

Bioventing systems have minimal ongoing operations and maintenance (O&M) requirements. Regenerative blowers are virtually maintenance-free. The only recurring O&M required on these units is a monthly check of the air filter, which is generally replaced when a vacuum difference of 10 to 15 inches of water is reached across the inlet filter. The time period between filter changes is dependent on site conditions, but typically is required every 3 to 6 months.

System Monitoring and Reporting Requirements

Monitoring of the bioventing system will include monthly system checks of the blower operation, including well flow rates, outlet pressure, inlet vacuum, and the need for air filter replacement. Additionally, system performance monitoring will include a comprehensive annual system check to ensure that oxygen continues to reach all VMPs in the contaminated soils and to perform an ISR test at the VMPs to ensure that biodegradation is continuing at acceptable levels. Additional details on ISR testing are found in Section 4.0.

Confirmation of the contaminant removal rates is predicted from the data collected during the ISR tests, quantitative estimates of the long-term biodegradation rates, and decreases in soil vapor concentrations. Oxygen-utilization data from the ISR tests are used to estimate biodegradation rates and to evaluate the progress of contaminant removal and system effectiveness. Typically, as the fuel residuals in the soil are depleted, the respiration activity of the indigenous microorganisms is reduced and slower oxygen-utilization rates result.

Once oxygen-utilization rates in previously contaminated areas approach the values in uncontaminated soil (typically, a negligible decrease over a 72-hour period), confirmatory soil vapor sampling and analysis can be conducted as part of site closure approval. The use of oxygen-utilization rates and soil vapor sampling results as screening indicators decreases the likelihood of premature and expensive soil sampling events. Soil vapor sampling and analyses methods are discussed in Section 3.0.

A summary of system installation, start-up, and monitoring requirements, including quantities and frequency, is provided in Table 7.

Table 7
Summary of Full-Scale Bioventing System Requirements
Redwood Regional Park Service Yard, Oakland, California

Item	Quantity/Frequency	Description, Notes and Related Scope Items
Vent Well Installation	2	2-inch PVC, 18 feet total depth, fixed connection to air distribution piping; drilling permit (see Figures 4 and 9 for details)
Vapor Monitoring Point Installation	1	1.0-inch PVC screens (quantity=2), 0.5-inch PVC riser casing, 18 feet total depth, drilling permit (see Figures 5 and 9 for details)
Soil Disposal	Once; 5 drums	Profile and dispose of five 55-gallon drums of non-hazardous, petroleum-contaminated soil
Electrical Service	1	To be provided by others (see Table 6 for specifications)
Blower	1	(see Table 6 for specifications)
Air Distribution Piping (aboveground portion)	~ 400 lineal feet (all piping east of the roadway)	2-inch Schedule 80 PVC, separate lines to each VW; glued couplings (see Figure 9)
Air Distribution Piping (belowground portion)	~ 200 lineal feet (all piping west of the roadway)	2-inch Schedule 80 PVC, separate lines to each VW; glued couplings; 1-foot-deep trench (common trench where appropriate) (see Figure 9)
Process Instrumentation (see Figure 10 for details)	1	Air pressure gauge (outlet)
	1	Vacuum gauge (inlet)
	4	Flow measurement ports
	4	Flow control valves
	1	Vacuum relief valve
	1	Intake air filter
System Startup	Bi-weekly during first month	Blower vacuum and pressure measurements; air flow rate optimization/measurements; oxygen and pressure measurements at VMPs
System O&M	Monthly	System inspection (blower operation, flow rates, outlet pressure, inlet vacuum)
	Quarterly	Air filter change (or as needed)
Respiration Testing and Soil Vapor Sampling	Annually	Blower shutdown; oxygen measurements at VMPs for ~72 hours; laboratory analysis of soil vapor for TVH/BTEX (at end of test)
Reporting		
Full-Scale System Installation & Startup	Once	Documentation of well installations, system installation, and system startup
Progress Reports	Quarterly	Summary of system O&M measurements
Summary Reports	Annually	Summary of quarterly measurements; discussion of respiration test and soil vapor sampling results

6.0 SUMMARY, CONCLUSIONS, AND PROPOSED ACTIONS

This section presents the conclusions and recommendations from the bioventing pilot test conducted by SES at Redwood Regional Park Service yard located at 7867 Redwood Road in Oakland, Alameda County, California.

SUMMARY AND CONCLUSIONS

- The bioventing pilot test activities were conducted between June and October 2004, and included installation of one air injection vent well, installation of three vadose zone VMPs, laboratory analysis of soil and soil vapor samples, and installation and operation of the bioventing pilot test system components for approximately 2 weeks. Data collected during the pilot test were used to assess the feasibility and cost of additional remediation of the remaining soil contamination and to develop design criteria for full-scale bioventing operations.
- The bioventing technology was successfully operated at the site, and permeability testing indicated that soil air permeability was approximately 75 darcys, sufficient for bioventing to be an effective technology and significantly greater than the minimum design criteria.
- During the 2 weeks of operations, the pressure, oxygen influence, and soil vapor sampling measurements collected at the three VMPs showed a radius of influence of approximately 30 feet, greater than the minimum design criteria needed for cost-effective operations.
- Seasonal variations in water levels will have a concomitant effect on the thickness of the contaminated soil zone that will be affected by bioventing, with the lower zone subject to little or no effect in the wet periods. Continuous operation of the system through the dry, low-water periods will, however, have an effect on the lower zone for at least part of the year.

PROPOSED ACTIONS

EBRPD proposes to implement the following actions to address regulatory concerns:

- Present this report to the interested regulatory agencies.
- Install a full-scale bioventing system at the site, to include two additional VWs and one additional VMP, which treats the remaining areas of residual soil contamination.

- Operate and maintain the full-scale bioventing system until in situ respiration testing data (i.e., oxygen utilization rates) and soil vapor sampling data at the VMPs indicate that residual soil contamination has been significantly reduced and biodegradation is no longer oxygen limited.
- Report on bioventing system progress within the existing quarterly program of creek and groundwater sampling and reporting for contaminants of concern.

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ALAMEDA COUNTY PUBLIC WORKS AGENCY

WATER RESOURCES SECTION
399 ELMHURST ST. HAYWARD CA. 94544-1395
PHONE (510) 670-6633 James Yoo
FAX (510) 782-1939
APPLICANTS: PLEASE ATTACH A SITE MAP FOR ALL DRILLING PERMIT APPLICATIONS
DESTRUCTION OF WELLS OVER 45 FEET REQUIRES A SEPARATE PERMIT APPLICATION

DRILLING PERMIT APPLICATION

FOR OFFICE USE
PERMIT NUMBER W04-0592
WELL NUMBER
APN

FOR APPLICANT TO COMPLETE

CATION OF PROJECT: Redwood Regional Park
9867 East Shore Road
OAKLAND CA

IENT
me EBRPD - Neil Fujita
dress PO Box 5381 Phone 510-544-3215
y OAKLAND CA Zip 94605

'PLICANT
me STELLAR ENVIRONMENTAL SOLUTIONS
Fax 510/644-3859
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y Berkeley CA Zip 94710

PE OF PROJECT
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Municipal
Industrial
Replacement Domestic
Irrigation
Other

RILLING METHOD:
Mud Rotary
Cable
Air Rotary
Other
Auger

RILLER'S NAME HEW DRILLING
RILLER'S LICENSE NO. C-57 # 604987

'ELL PROJECTS
Drill Hole Diameter 8 in. Maximum
Casing Diameter 2 in. Depth 20 ft.
Surface Seal Depth 1 ft. Owner's Well Number VW-1

'EOTECHNICAL PROJECTS
Number of Borings
Hole Diameter in. Maximum
Depth ft.

TARTING DATE June 1, 2004
OMPLETION DATE June 2, 2004

PERMIT CONDITIONS
Circled Permit Requirements Apply

A. GENERAL
1. A permit application should be submitted so as to arrive at the ACPWA office five days prior to proposed starting date.
2. Submit to ACPWA within 60 days after completion of permitted original Department of Water Resources-Well Completion Report.
3. Permit is void if project not begun within 90 days of approval date

B. WATER SUPPLY WELLS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic and irrigation wells unless a lesser depth is specially approved.

C. GROUNDWATER MONITORING WELLS INCLUDING PIEZOMETERS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth for monitoring wells is the maximum depth practicable or 20 feet.

D. GEOTECHNICAL
Backfill bore hole by tremie with cement grout or cement grout/sand mixture. Upper two-three feet replaced in kind or with compacted cuttings.

E. CATHODIC
Fill hole above zone with concrete placed by tremie.

F. WELL DESTRUCTION
Send a map of work site. A separate permit is required for wells deeper than 45 feet.

G. SPECIAL CONDITIONS - MW#2

NOTE: One application must be submitted for each well or well destruction. Multiple borings on one application are acceptable for geotechnical and contamination investigations.

APPROVED DATE 5-20-04

hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE B. M. Rucker DATE 5-20-04

LEASE PRINT NAME Bruce Rucker

Rev.9-18-02

ALAMEDA COUNTY PUBLIC WORKS AGENCY

WATER RESOURCES SECTION
399 ELMHURST ST. HAYWARD CA. 94544-1395
PHONE (510) 670-6633 James Yoo
FAX (510) 782-1939
APPLICANTS: PLEASE ATTACH A SITE MAP FOR ALL DRILLING PERMIT APPLICATIONS
DESTRUCTION OF WELLS OVER 45 FEET REQUIRES A SEPARATE PERMIT APPLICATION

DRILLING PERMIT APPLICATION

FOR APPLICANT TO COMPLETE

CATION OF PROJECT Redwood Regional Park
7867 Redwood Road
OAKLAND CA

LIENT
ame EBRPD - Neil Fujii
ddress P.O. Box 5381 Phone 510-569-3515
ity OAKLAND CA Zip 94605

PPLICANT
ame STELLAR ENVIRONMENTAL SOLUTIONS Fax 510/644-3859
ddress 2198 6th St #201 Phone 510/644-3123
ity BERKELEY CA Zip 94710

YPE OF PROJECT
(Well Construction) Geotechnical Investigation
Cathodic Protection • General •
Water Supply • (Contamination) •
Monitoring • Well Destruction •

ROPOSED WATER SUPPLY WELL USE
New Domestic • Replacement Domestic •
Municipal • Irrigation •
Industrial • Other •

RILLING METHOD:
Mud Rotary • Air Rotary • (Auger) •
Cable • Other •

RILLER'S NAME HEW DRILLING

RILLER'S LICENSE NO. C-57 # 604987

ELL PROJECTS
Drill Hole Diameter 8 in. Maximum
Casing Diameter 1/2 in. Depth 20 ft.
Surface Seal Depth 1 ft. Owner's Well Number VMP-1

EOTECHNICAL PROJECTS
Number of Borings Maximum
Hole Diameter in. Depth ft.

TARTING DATE June 1, 2004

OMPLETION DATE June 2, 2004

FOR OFFICE USE
PERMIT NUMBER W04-0553
WELL NUMBER
APN

PERMIT CONDITIONS
Circled Permit Requirements Apply

A. GENERAL
1. A permit application should be submitted so as to arrive at the ACPWA office five days prior to proposed starting date.
2. Submit to ACPWA within 60 days after completion of permitted original Department of Water Resources-Well Completion Report.
3. Permit is void if project not begun within 90 days of approval date.

B. WATER SUPPLY WELLS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic and irrigation wells unless a lesser depth is specially approved.

C. GROUNDWATER MONITORING WELLS INCLUDING PIEZOMETERS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth for monitoring wells is the maximum depth practicable or 20 feet.

D. GEOTECHNICAL
Backfill bore hole by tremie with cement grout or cement grout/sand mixture. Upper two-three feet replaced in kind or with compacted cuttings.

E. CATHODIC
Fill hole anode zone with concrete placed by tremie.

F. WELL DESTRUCTION
Send a map of work site. A separate permit is required for wells deeper than 45 feet.

G. SPECIAL CONDITIONS MW#2

NOTE: One application must be submitted for each well or well destruction. Multiple borings on one application are acceptable for geotechnical and contamination investigations.

APPROVED DATE 5-20-04

hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE B. M. Rucker DATE 5-20-04

PLEASE PRINT NAME Bruce Rucker

Rev.9-18-02

ALAMEDA COUNTY PUBLIC WORKS AGENCY

WATER RESOURCES SECTION
399 ELMHURST ST. HAYWARD CA. 94544-1395
PHONE (510) 670-6633 James Yoo
FAX (510) 782-1939
APPLICANTS: PLEASE ATTACH A SITE MAP FOR ALL DRILLING PERMIT APPLICATIONS
DESTRUCTION OF WELLS OVER 45 FEET REQUIRES A SEPARATE PERMIT APPLICATION

DRILLING PERMIT APPLICATION

FOR OFFICE USE
PERMIT NUMBER W04-0594
WELL NUMBER
APN

FOR APPLICANT TO COMPLETE

CATION OF PROJECT Redwood Regional Park
7867 Redwood ROAD
OAKLAND CA

IENT
me EBRPD - Neil Fujita
dress PO Box 5381 Phone 510-544-3213
y OAKLAND CA Zip 94605

PLICANT
me STELLAR ENVIRONMENTAL SOLUTIONS Fax 510/644-3859
dress 2198 6th St #201 Phone 510/644-3123
ty Berkeley CA Zip 94710

YPE OF PROJECT
Well Construction
Cathodic Protection
Water Supply
Monitoring
Geotechnical Investigation
General
Contamination
Well Destruction

ROPOSED WATER SUPPLY WELL USE
New Domestic
Municipal
Industrial
Replacement Domestic
Irrigation
Other

RILLING METHOD:
Mud Rotary
Cable
Air Rotary
Other
Auger

RILLER'S NAME HEW DRILLING
RILLER'S LICENSE NO. C-57 # 604587

VELL PROJECTS
Drill Hole Diameter 8 in. Maximum
Casing Diameter 4" in. Depth 20 ft.
Surface Seal Depth 1 ft. Owner's Well Number VMP-2

GEOTECHNICAL PROJECTS
Number of Borings
Hole Diameter in. Maximum
Depth ft.

TARTING DATE June 1, 2004
COMPLETION DATE June 2, 2004

PERMIT CONDITIONS
Circled Permit Requirements Apply

A. GENERAL
1. A permit application should be submitted so as to arrive at the ACPWA office five days prior to proposed starting date.
2. Submit to ACPWA within 60 days after completion of permitted original Department of Water Resources-Well Completion Report.
3. Permit is void if project not begun within 90 days of approval date

B. WATER SUPPLY WELLS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic and irrigation wells unless a lesser depth is specially approved.

C. GROUNDWATER MONITORING WELLS INCLUDING PIEZOMETERS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
2. Minimum seal depth for monitoring wells is the maximum depth practicable or 20 feet.

D. GEOTECHNICAL
Backfill bore hole by tremie with cement grout or cement grout/sand mixture. Upper two-three feet replaced in kind or with compacted cuttings.

E. CATHODIC
Fill hole anode zone with concrete placed by tremie.

F. WELL DESTRUCTION
Send a map of work site. A separate permit is required for wells deeper than 45 feet.

G. SPECIAL CONDITIONS MW#2

NOTE: One application must be submitted for each well or well destruction. Multiple borings on one application are acceptable for geotechnical and contamination investigations.

APPROVED DATE 5-27-04

I hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE B. M. Rucker DATE 5-20-04

PLEASE PRINT NAME Bruce Rucker

Rev.9-18-02

ALAMEDA COUNTY PUBLIC WORKS AGENCY

WATER RESOURCES SECTION
399 ELMHURST ST. HAYWARD CA. 94544-1395
PHONE (510) 670-6633 James Yoo
FAX (510) 782-1939
APPLICANTS: PLEASE ATTACH A SITE MAP FOR ALL DRILLING PERMIT APPLICATIONS
DESTRUCTION OF WELLS OVER 45 FEET REQUIRES A SEPARATE PERMIT APPLICATION

DRILLING PERMIT APPLICATION

FOR OFFICE USE
PERMIT NUMBER W04-0595
WELL NUMBER
APN

FOR APPLICANT TO COMPLETE

CATION OF PROJECT (Redwood) Regional Park
7867 Redwood Road
OAKLAND CA

IENT
me EBRPD - Neal Fujita
dress P.O. Box 5381 Phone 510-635-3813
y OAKLAND CA Zip 94605

PLICANT
me STELLAR ENVIRONMENTAL SOLUTIONS Fax 510/644-3859
dress 2198 6th St #201 Phone 510/644-3123
y Berkeley CA Zip 94710

PE OF PROJECT
Well Construction
Cathodic Protection
Water Supply
Monitoring
Geotechnical Investigation
General
Contamination
Well Destruction

OPOSED WATER SUPPLY WELL USE
New Domestic
Municipal
Industrial
Replacement Domestic
Irrigation
Other

RILLING METHOD:
Mud Rotary
Cable
Air Rotary
Other
Auger

RILLER'S NAME HEW DRILLING

RILLER'S LICENSE NO. C-57 # 604987

ELL PROJECTS
Drill Hole Diameter 8 in. Maximum
Casing Diameter 1/2 in. Depth 20 ft.
Surface Seal Depth 1 ft. Owner's Well Number VMP3

EOTECHNICAL PROJECTS
Number of Borings
Hole Diameter in. Maximum
Depth ft.

TARTING DATE June 2, 2004

OMPLETION DATE June 2, 2004

PERMIT CONDITIONS
Circled Permit Requirements Apply

A. GENERAL
1. A permit application should be submitted so as to arrive at the ACPWA office five days prior to proposed starting date.
2. Submit to ACPWA within 60 days after completion of permitted original Department of Water Resources Well Completion Report
3. Permit is void if project not begun within 90 days of approval date

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1. Minimum surface seal thickness is two inches of cement grout placed by tremie.
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D. GEOTECHNICAL
Backfill bore hole by tremie with cement grout or cement grout/sand mixture. Upper two-three feet replaced in kind or with compacted cuttings.

E. CATHODIC
Fill hole anode zone with concrete placed by tremie.

F. WELL DESTRUCTION
Send a map of work site. A separate permit is required for wells deeper than 45 feet.

G. SPECIAL CONDITIONS MW#2

NOTE: One application must be submitted for each well or well destruction. Multiple borings on one application are acceptable for geotechnical and contamination investigations.

APPROVED DATE 5-21-04

I hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE B. M. Fuller DATE 5-20-04

PLEASE PRINT NAME BRUCE RUCKER

Rev.9-18-02

ALAMEDA COUNTY PUBLIC WORKS AGENCY
WATER RESOURCES SECTION
399 ELMHURST ST. HAYWARD, CA. 94544-1395
PHONE (510) 670-6633 James Yoo FAX (510) 782-1939

PERMIT NO. W04-0592-0595

WATER RESOURCES SECTION
GROUNDWATER PROTECTION ORDINANCE
MW#2-GENERAL CONDITIONS: Vapor and Extraction wells

1) Prior to any drilling activities shall be the applicants responsibilities to contact and coordinate a Underground Service Alert (USA), obtain encroachment permit(s), excavation permit(s) or any other permits or agreements required for that Federal, State, County or to the City and follow all City or County Ordinances. No work shall begin until all the permits and requirements have been approved or obtained.

2) The minimum surface seal thickness two inches of cement grout placed by tremie.

3) All vapor wells shall have a minimum surface cement seal depth of five (5) feet or the maximum depth practicable or twenty (20) feet. All extraction wells shall have a minimum surface seal depth of two (2) feet or the maximum depth practicable or twenty (20) feet.

4) Wells shall have a Christy box or similar structure with a locking cap or cover. Well(s) shall be kept locked at all times. Well(s) that become damaged by traffic or construction shall be repaired in a timely manner or destroyed immediately (through permit process). No well(s) shall be left in a manner to act as a conduit at any time.

5) Permitte, permittee's, contractors, consultants or agents shall be responsible to assure that all material or waters generated during drilling, boring destruction, and/or other activities associated with this Permit will be safely handled, properly managed, and disposed of according to all applicable federal, state, and local statues regulating such. In no case shall these materials and/or waters be allowed to enter, or potentially enter, on-or off site storm sewers, dry wells, or waterways or be allowed to move off the property where wok is being completed.

6) No changes in construction procedures or well type shall change, as described on this permit application. This permit may be voided if it contains incorrect information.

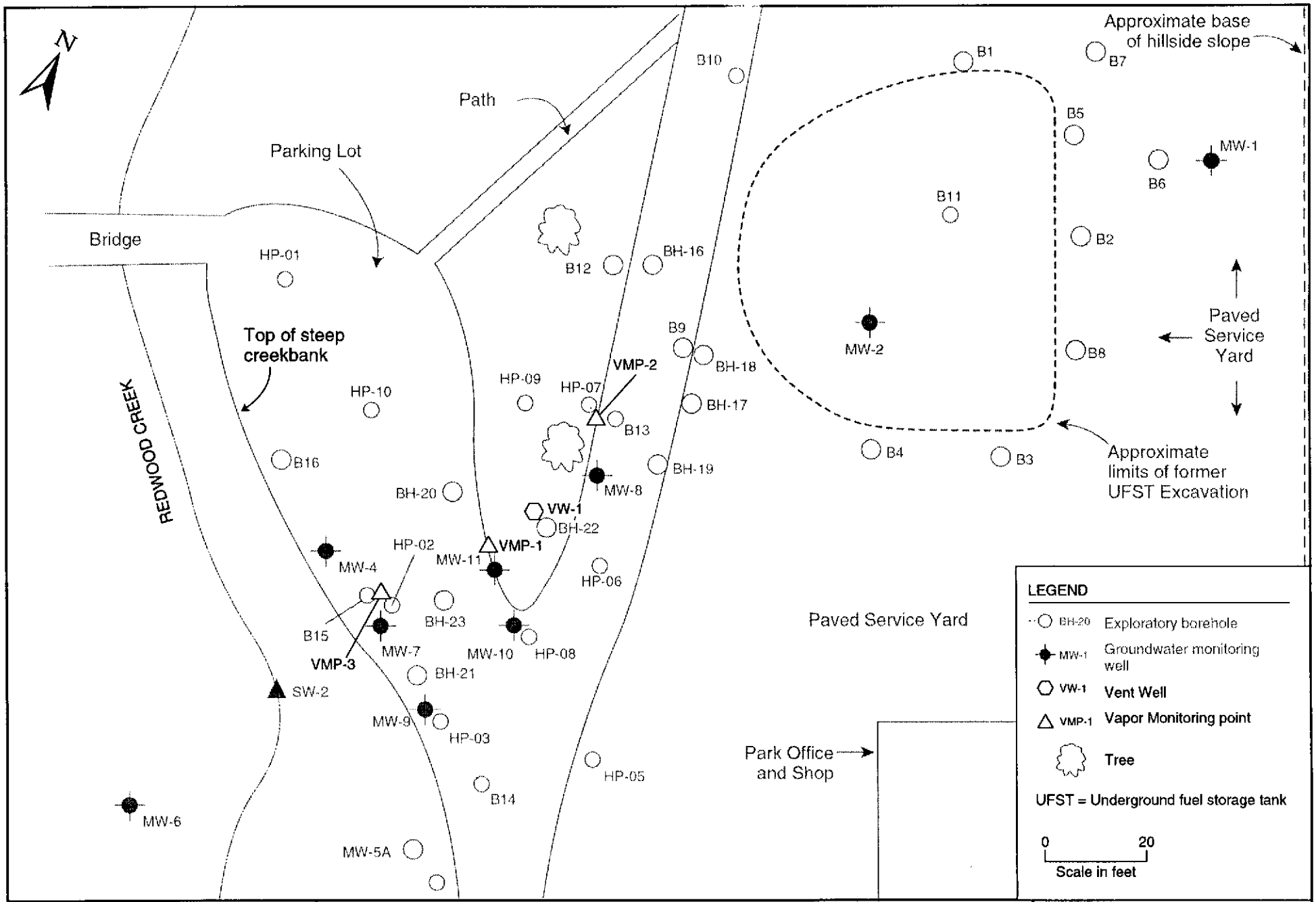
7) Drilling Permit(s) can be voided/ canceled only in writing. It is the applicants responsibilities to notify Alameda County Public Works Agency, Water Resources Section in writing for an extension or to cancel the drilling permit application. No drilling permit application(s) shall be extended beyond ninety (90) days from the original start date. **Permit is valid from June 1 to June 2, 2004.** Applicants may not cancel a drilling permit application after the completion date of the permit issued has passed.

8) Compliance with the above well-sealing specifications shall not exempt the well-sealing contractor from complying with appropriate State reporting-requirements related to well destruction (Sections 13750 through 13755 (Division 7, Chapter 10, Article 3) of the California Water Code). **Contractor must complete State DWR Form 188 and mail original to the Alameda County Public Works Agency, Water Resources Section, within 60 days. Including: permit number and site map.**

9) Permittee shall assume entire responsibility for all activities and uses under this permit and shall indemnify, defend and save the Alameda County Public Works Agency, its officers, agents, and employees free and harmless from any and all expense, cost, liability in connection with or resulting from the exercise of this Permit including, but not limited to, properly damage, personal injury and wrongful death.

STELLAR ENVIRONMENTAL SOLUTIONS, INC.
2198 SIXTH STREET, BERKELEY, CA 94710
TEL: 510.644.3123 ★ FAX: 510.644.3859

TRANSMITTAL MEMORANDUM	
TO: ALAMEDA COUNTY PUBLIC WORKS AGENCY 399 ELMHURST STREET HAYWARD, CA 94544-1395	**DATE:** JUNE 10, 2004
ATTENTION: WATER RESOURCES SECTION	FILE: SES-2004-02
SUBJECT: **REDWOOD REGIONAL PARK SERVICE YARD** 7867 REDWOOD ROAD OAKLAND, CA	
WE ARE SENDING: ☒ HEREWITH	☐ UNDER SEPARATE COVER
☒ VIA MAIL	☐ VIA
THE FOLLOWING: (7) DWR WELL COMPLETION REPORTS (ORIGINAL FORMS) FOR WELLS VW-1, VMP-1-10', VMP-1-14', VMP-2-10', VMP-2-14', VMP-3-10' & VMP-3-14' WITH WELL SCHEMATICS AND LOCATION MAP	
☐ AS REQUESTED	☐ FOR YOUR APPROVAL
☐ FOR REVIEW	☒ FOR YOUR USE
☐ FOR SIGNATURE	☐ FOR YOUR FILES
COPIES TO:	**BY:** Bruce Rucker BNR
REMARKS: PER JAMES YOO'S INSTRUCTIONS, WE HAVE ENCLOSED THE "ORIGINAL" DWR FORMS, AND WE UNDERSTAND THAT ACPWA WILL FORWARD A COPY OF THE PACKAGE TO DWR, AS NECESSARY.	



Stellar Environmental Solutions, Inc.
Geoscience & Engineering Consulting

BIOVENTING PILOT TEST WELL LOCATIONS
Redwood Regional Park Service Yard, Oakland, CA

Figure 1

by: MJC | APRIL 2004

2003-02-43

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 0409378

Work Order Summary

CLIENT:	Mr. Joe Dinan Stellar Environmental 2198 6th Street Suite 201 Berkely, CA 94710	**BILL TO:**	Mr. Joe Dinan Stellar Environmental 2198 6th Street Suite 201 Berkely, CA 94710
PHONE:	510-644-3123	**P.O. #**	
FAX:		**PROJECT #**	2004-03 Redwood
DATE RECEIVED:	09/20/2004	**CONTACT:**	Taryn Badal
DATE COMPLETED:	10/01/2004		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
01A	VW-1	Modified TO-3	2.5 "Hg
02A	VMP-1-Shallow	Modified TO-3	3.0 "Hg
03A	VMP-2-Shallow	Modified TO-3	5.0 "Hg
04A	VMP-2-Deep	Modified TO-3	8.0 "Hg
05A	VMP-3-Shallow	Modified TO-3	5.5 "Hg
06A	Lab Blank	Modified TO-3	NA
07A	LCS	Modified TO-3	NA
07B	LCS	Modified TO-3	NA

CERTIFIED BY: Linda J. Truman DATE: 10/01/04

Laboratory Director

Certfication numbers: AR DEQ - 03-084-0, CA NELAP - 02110CA, LA NELAP/LELAP- AI 30763, NJ NELAP - CA004
NY NELAP - 11291, UT NELAP - 9166389892
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 07/01/04, Expiration date: 06/30/05
Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
Modified TO-3 (Gas range)
Stellar Environmental
Workorder# 0409378

Five 1 Liter Summa Canister samples were received on September 20, 2004. The laboratory performed analysis for volatile organic compounds in air via modified EPA Method TO-3 using gas chromatography with photo ionization and flame ionization detection. The method involves concentrating up to 200 mL of sample. The concentrated aliquot is then dry purged to remove water vapor prior to entering the chromatographic system. The TPH (Gasoline Range) results are calculated using the response factor of Gasoline and correspond to the range of hydrocarbons from C5 to C10. A molecular weight of 100 is used to convert the TPH (Gasoline Range) ppmv result to ug/L. See the data sheets for the reporting limits for each compound.

Method modifications taken to run these samples include:

Requirement	*TO-3*	*ATL Modifications*
Daily Calibration Standard Frequency	Prior to sample analysis and every 4 - 6 hrs	Prior to sample analysis and after the analytical batch </= 20 samples
Initial Calibration Calculation	4-point calibration using a linear regression model	5-point calibration using average Response Factor
Initial Calibration Frequency	Weekly	When daily calibration standard recovery is outside 75 - 125 %, or upon significant changes to procedure or instrumentation
Moisture Control	Nafion system	Sorbent system
Minimum Detection Limit (MDL)	Calculated using the equation DL = A+3.3S, where A is intercept of calibration line and S is the standard deviation of at least 3 reps of low level standard	40 CFR Pt. 136 App. B
Preparation of Standards	Levels achieved through dilution of gas mixture	Levels achieved through loading various volumes of the gas mixture

Receiving Notes

There were no receiving discrepancies.

Analytical Notes

The detection of Ethyl Benzene and m,p-Xylenes may have been masked in sample VMP-1-Shallow due to complex hydrocarbon interference.

The detection of m,p-Xylenes may have been masked in sample VMP-3-Shallow due to complex hydrocarbon interference.

Definition of Data Qualifying Flags

Seven qualifiers may have been used on the data analysis sheets and indicate as follows:

B - Compound present in laboratory blank greater than reporting limit.

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the detection limit.

M - Reported value may be biased due to apparent matrix interferences.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

AIR TOXICS LTD.

SAMPLE NAME: VW-1

ID#: 0409378-01A

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092218**	**Date of Collection: 9/15/04**	
Dil. Factor:	**2.20**	**Date of Analysis: 9/22/04 06:17 PM**	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.0022	0.0071	0.0049	0.016
Toluene	0.0022	0.0084	Not Detected	Not Detected
Ethyl Benzene	0.0022	0.0097	Not Detected	Not Detected
Total Xylenes	0.0022	0.0097	Not Detected	Not Detected
TPH (Gasoline Range)	0.055	0.23	0.39	1.6

Container Type: 1 Liter Summa Canister

Surrogates	%Recovery	Method Limits
Fluorobenzene (FID)	89	75-150
Fluorobenzene (PID)	107	75-125

AIR TOXICS LTD.

SAMPLE NAME: VMP-1-Shallow

ID#: 0409378-02A

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092219**	**Date of Collection: 9/15/04**	
Dil. Factor:	**5.97**	**Date of Analysis: 9/22/04 06:51 PM**	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.0060	0.019	1.2	3.8
Toluene	0.0060	0.023	0.063	0.24
Ethyl Benzene	0.0060	0.026	Not Detected	Not Detected
Total Xylenes	0.0060	0.026	0.18 M	0.80 M
TPH (Gasoline Range)	0.15	0.62	78	320

M = Reported value may be biased due to apparent matrix interferences.

Container Type: 1 Liter Summa Canister

Surrogates	%Recovery	Method Limits
Fluorobenzene (FID)	94	75-150
Fluorobenzene (PID)	109	75-125

AIR TOXICS LTD.

SAMPLE NAME: VMP-2-Shallow

ID#: 0409378-03A

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092223**	**Date of Collection: 9/15/04**	
Dil. Factor:	**2420**	**Date of Analysis: 9/22/04 09:33 PM**	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	2.4	7.8	200 M	640 M
Toluene	2.4	9.3	41	160
Ethyl Benzene	2.4	11	110	490
Total Xylenes	2.4	11	520	2300
TPH (Gasoline Range)	60	250	11000	44000

M = Reported value may be biased due to apparent matrix interferences.
Q = Exceeds Quality Control limits, due to matrix effects. Matrix effects confirmed by re-analysis.

Container Type: 1 Liter Summa Canister

Surrogates	%Recovery	Method Limits
Fluorobenzene (FID)	184 Q	75-150
Fluorobenzene (PID)	192 Q	75-125

AIR TOXICS LTD.

SAMPLE NAME: VMP-2-Deep

ID#: 0409378-04A

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092221**	**Date of Collection:**	**9/15/04**
Dil. Factor:	**649**	**Date of Analysis:**	**9/22/04 08:07 PM**

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.65	2.1	47 M	150 M
Toluene	0.65	2.5	18	67
Ethyl Benzene	0.65	2.9	7.1	31
Total Xylenes	0.65	2.9	69	310
TPH (Gasoline Range)	16	67	7100	30000

M = Reported value may be biased due to apparent matrix interferences.
Q = Exceeds Quality Control limits, possibly due to matrix effects.
Container Type: 1 Liter Summa Canister

Surrogates	%Recovery	Method Limits
Fluorobenzene (FID)	263 Q	75-150
Fluorobenzene (PID)	258 Q	75-125

AIR TOXICS LTD.

SAMPLE NAME: VMP-3-Shallow

ID#: 0409378-05A

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092220**	**Date of Collection:**	**9/15/04**
Dil. Factor:	**44.9**	**Date of Analysis:**	**9/22/04 07:30 PM**

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.045	0.14	6.9	22
Toluene	0.045	0.17	1.4	5.2
Ethyl Benzene	0.045	0.20	1.2	5.1
Total Xylenes	0.045	0.20	0.33 M	1.4 M
TPH (Gasoline Range)	1.1	4.7	350	1400

M = Reported value may be biased due to apparent matrix interferences.
Q = Exceeds Quality Control limits, possibly due to matrix effects.
Container Type: 1 Liter Summa Canister

Surrogates	%Recovery	Method Limits
Fluorobenzene (FID)	126	75-150
Fluorobenzene (PID)	133 Q	75-125

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 0409378-06A

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092213**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 9/22/04 02:30 PM**	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.0010	0.0032	Not Detected	Not Detected
Toluene	0.0010	0.0038	Not Detected	Not Detected
Ethyl Benzene	0.0010	0.0044	Not Detected	Not Detected
Total Xylenes	0.0010	0.0044	Not Detected	Not Detected
TPH (Gasoline Range)	0.025	0.10	Not Detected	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
Fluorobenzene (FID)	90	75-150
Fluorobenzene (PID)	106	75-125

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0409378-07A

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092202b**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 9/22/04 07:17 AM**	

Compound	%Recovery
Benzene	122
Toluene	100
Ethyl Benzene	101
Total Xylenes	112

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
Fluorobenzene (PID)	108	75-125

AIR TOXICS LTD.

SAMPLE NAME: LCS

ID#: 0409378-07B

MODIFIED EPA METHOD TO-3 GC/PID/FID

File Name:	**6092225**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 9/22/04 10:41 PM**	

Compound	%Recovery
TPH (Gasoline Range)	108

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
Fluorobenzene (FID)	115	75-150

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CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action, of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
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(916) 985-1000 FAX (916) 985-1020

Contact Person Joe Dinan
Company Stellar Environmental Solutions Email jdinan@stellar-env.com
Address 2095 Sixth St #201 City Berkeley State CA Zip 94710
Phone 510/644-3123 Fax 510/644-3859

Collected by: (Signature)

Project Info:
P.O. # 2004-03
Project # 2004-03
Project Name Redwood

Turn Around Time:
[X] Normal
[ ] Rush
specify

Lab Use Only
Pressurized by: Jm
Date: 9/21/04
Pressurization Gas: (N) He

Lab I.D.	Field Sample I.D. (Location)	Date	Time	Analyses Requested	Canister Pressure/Vacuum Initial	Final	Receipt	Final (psig)
01A	VW-1	9/15/04	1510	TO-3	(29)	-10	2.5"Hg	15psi
02A	VMP-1-Shallow	9/15/04	1345	TO-3	(29)	-4	3.0"Hg	
03A	VMP-2 Shallow	9/15/04	1525	TO-3	(29)	-4	5.0"Hg	
04A	VMP-2-Deep	9/15/04	1550	TO-3	(29)	-11	8.0"Hg	
05A	VMP-3-Shallow	9/15/04	1255	TO-3	(29)	-5	5.5"Hg	↓

Relinquished by: (signature)	Date/Time	Received by: (signature)	Date/Time
Joseph Dinan	9/16/04	[illegible]	9/20/04 907
Relinquished by: (signature)	Date/Time	Received by: (signature)	Date/Time
Relinquished by: (signature)	Date/Time	Received by: (signature)	Date/Time

Notes:

Lab Use Only	Shipper Name	Air Bill #	Temp (°C)	Condition	Custody Seals Intact?	Work Order #
	Fedex	843084838210	-	good	Yes No (None)	0409378

Form 1265 rev.10

Subject: Drilling vapor monitoring point VMP-2.	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: June 1, 2004	Project No.: SES 2004-02
Photographer: Bruce Rucker	Photo No.: 01

Subject: Typical VMP slotted screen and riser pipe coupling.	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: June 1, 2004	Project No.: SES 2004-02
Photographer: Bruce Rucker	Photo No.: 02

Subject: Drilling vent well VW-1.	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: June 2, 2004	Project No.: SES 2004-02
Photographer: Bruce Rucker	Photo No.: 03

Subject: Drilling vapor monitoring point VMP-3.	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: June 1, 2004	Project No.: SES 2004-02
Photographer: Bruce Rucker	Photo No.: 04

Subject: Drilling vapor monitoring point VMP-1.	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: June 1, 2004	Project No.: SES 2004-02
Photographer: Bruce Rucker	Photo No.: 05

Subject: Bioventing system consisting of generator and blower (fenced enclosure) with piping connected to vent well VW-1 (at left).	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: September 16, 2004	Project No.: SES 2004-02
Photographer: Joe Dinan	Photo No.: 06

Subject: View of air sampling apparatus and vacuum pump at well VMP-3.	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: September 17, 2004	Project No.: SES 2004-02
Photographer: Joe Dinan	Photo No.: 07

Subject: O_2/CO_2 Meter and PID neter used in conducting field measurements. The PID is reading an air sample in the Tedlar bag.	
Site: Redwood Regional Park Service Yard, Oakland, Alameda County, California	
Date Taken: September 17, 2004	Project No.: SES 2004-02
Photographer: Joe Dinan	Photo No.: 08