UNDERGROUND STORAGE TANK SITE 22187
GROUNDWATER AND BIOSPARGING MONITORING REPORT
APRIL 2005

MARINE CORPS BASE
CAMP PENDLETON, CALIFORNIA

Prepared For

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15 JULY 2005

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LIST OF ACRONYMS AND ABBREVIATIONS

BS	biosparging
BSMP	biosparging monitoring point
BTEX	benzene, toluene, ethylbenzene, and total xylenes
BV	bioventing
CO_2	carbon dioxide
cm/s	centimeters per second
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
Fe(II)	ferrous iron
Fe(III)	ferric iron
gpm	gallons per minute
HDPE	high density polyethylene
LCS/LCSD	laboratory control standards/laboratory control standards duplicate
LEL	lower explosive level
LUFT	leaking underground fuel tank
MCB	Marine Corps Base
MCL	maximum contaminant level
mg/L	milligrams per liter
MS/MSD	matrix spike/matrix spike duplicate
MTBE	methyl tert-butyl ether
MW	monitoring well
NFESC	Naval Facilities Engineering Service Center
O&M	operation and maintenance
O_2	oxygen
ORP	oxygen reduction potential
QA	quality assurance
QC	quality control
RPD	relative percent differences
RWQCB	Regional Water Quality Control Board
SAM	Site Assessment and Mitigation
SVOC	semi-volatile organic compounds
SWDIV	Southwest Division Naval Facilities Engineering Command
TBA	tertiary butyl alcohol
TPH-D	total petroleum hydrocarbons as diesel
TPH-M	total petroleum hydrocarbons as motor oil
TVH	total volatile hydrocarbons
UST	underground storage tank
µg/L	micrograms per liter

SECTION 1

INTRODUCTION

This groundwater and biosparging (BS) system monitoring report was prepared for underground storage tank (UST) Site 22187, located at Marine Corps Base (MCB) Camp Pendleton, California. Parsons prepared the report for the United States Navy.

The groundwater sampling work conducted at the site, as well as the associated reporting activities, are performed for the U.S. Navy, Naval Facilities Engineering Service Center (NFESC) on behalf of the Naval Facilities Engineering Command, Southwest Division (SWDIV) under contract number N47408-98-C-7500. The report is prepared in accordance with direction from the U.S. Navy and with recommendations from the San Diego Regional Water Quality Control Board (RWQCB). In addition, the groundwater sampling is performed in accordance with the County of San Diego *Site Assessment and Mitigation (SAM) Manual* (County of San Diego, 2002).

This introduction (Section 1) contains project and site background information, including the BS/bioventing (BV) system. Section 2 contains sampling and analysis protocol and procedures. Section 3 summarizes sampling results. Section 4 contains conclusions and recommendations. Section 5 contains references cited. Appendix A provides historical groundwater elevation and analytical data. Appendix B contains groundwater sampling sheets and waste manifest forms. Appendix C contains laboratory analytical results from the latest sampling event. Appendix D contains RWQCB meeting minutes.

1.1 SCOPE OF WORK

Groundwater monitoring is a component of the scope of work from the U.S. Navy for the assessment and remediation of hydrocarbon-impacted soil and groundwater at the Building 22187 boiler plant. This monitoring includes measurements of groundwater levels and the collection and analysis of groundwater samples. In addition, this report discusses the impact on groundwater concentrations from the BS/BV system that commenced operation in April 2001.

The groundwater samples are analyzed for total petroleum hydrocarbons as diesel (TPH-D) during each monitoring event. Analysis for total petroleum hydrocarbons as motor oil (TPH-M) was discontinued in July 1999 because detected concentrations were at trace levels consistently below TPH-D concentrations. Samples collected this monitoring event were also tested for the presence of semi-volatile organic compounds (SVOC), in accordance with a request by the RWQCB. Also with RWQCB concurrence, analysis for benzene, toluene, ethylbenzene, and total xylenes (BTEX) and methyl tert-butyl ether (MTBE) was discontinued after 2004 because detected concentrations consistently were below cleanup goals. To meet updated requirements of the RWQCB, samples collected in October 2000 were also tested for the presence of other oxygenates and the degradation product tertiary butyl alcohol (TBA); none were detected and analysis for these compounds has been discontinued.

1.2 SITE BACKGROUND

MCB Camp Pendleton is located on the coast of northern San Diego County, California, and covers approximately 125,000 acres (Figure 1-1). Site 22187 is located in Area 22, in the southeast portion of MCB Camp Pendleton (Figure 1-2). The Santa Margarita River is located several thousand feet to the west of the site. Building 22187 is an active boiler plant. Two former fuel steel USTs (7,000-gallons and 30,000-gallons, respectively) removed in 1992 were located approximately 20 feet from the northwest corner of the boiler plant. Figure 1-3 presents a detailed site layout.

1.3 PREVIOUS INVESTIGATIONS

In 1986, the two Site 22187 USTs failed an integrity test conducted by AAA Testing (IT Corp., 1993). More recent investigations identified petroleum hydrocarbons in both the soil and groundwater at the site. BTEX compounds also were detected in the groundwater. Benzene was found in the groundwater at concentrations greater than the State of California's maximum contaminant level (MCL) for drinking water of 1 microgram per liter (µg/L). Although free product initially was not observed at the site, it was present in MW22187-10 during the Fourth Quarter 1997 monitoring event. Results of previous groundwater monitoring are presented in Appendix A.

1.4 GEOLOGY AND HYDROGEOLOGY

Quaternary alluvial deposits of the Santa Margarita River underlie the site. The loose- to medium-dense silty sands and discontinuous clay layers in the subsurface are interpreted to be floodplain deposits and locally artificial fill. A laterally significant 1-foot to 5-foot-thick clay zone that is laterally continuous beneath the site thickens and deepens to the east and pinches out to the west and north. Figure 1-4 presents a geologic cross-section that also illustrates the historical minimum and maximum groundwater levels and approximate extent of soil contamination in October 1997 and November 2000. The cross-section location is shown on Figure 1-3.

Site 22187 lies within the Chappo subunit of the Ysidora Hydrologic Area of the Santa Margarita Hydrologic Unit. Groundwater at the site is interpreted to flow toward the southwest, toward the adjacent and low-lying marshy area. Groundwater generally occurs beneath the laterally continuous clay zone. Falling head slug tests conducted in two of the monitoring wells (MWs) indicated that the hydraulic conductivity at the site ranges from 3.3 x 10^{-3} centimeters per second (cm/s) to 1.8 x 10^{-4} cm/s (IT Corp., 1993). This would be consistent with the relatively fast recovery of the wells observed during groundwater sampling. The groundwater gradient at the site typically has been calculated between 0.002 and 0.006 south to west.

1.5 CLEANUP GOALS

The groundwater cleanup goals are identified in Table 3-2 and correspond to drinking water MCLs for BTEX compounds and MTBE and secondary MCL's for TPH-D. Cleanup goals were developed for soils based on a dual standard of leachable concentrations and soil concentrations. Cleanup goals were detailed in the *Final Remediation Work Plan for Underground Storage Tank Site 22187* (Parsons, 2000a) and modified for MTBE in groundwater according to the response to RWQCB comments (Parsons, 2000b).

1.6 BIOSPARGING/BIOVENTING SYSTEM

A BS/BV system was installed at Site 22187 in accordance with the Remediation Work Plan (Parsons, 2000a), as approved by the RWQCB in a meeting on July 20, 2000. Eleven BS wells (BSW22187-1 through BSW22187-11) and two nested BS monitoring points (BSMPs) (BSMP22187-1 and BSMP22187-2) were installed. In addition, one BV well (BVW22187-1) was located adjacent to BSW22187-2. A letter report containing installation and startup results was submitted to the RWQCB on August 8, 2001 (Parsons, 2001a). The report identified that the BV blower was not needed, and recommended that only the BS blower be operated. The RWQCB responded with comments on April 30, 2002 (California RWQCB, 2002). A response dated June 3, 2002, was submitted to the RWQCB.

During a meeting with the RWQCB on February 10, 2005, it was agreed to continue BS system operation until a further reduction in oxygen utilization is observed. At that time, the BS system will be shutdown for one year to see if TPH concentrations stabilize (see Appendix D).

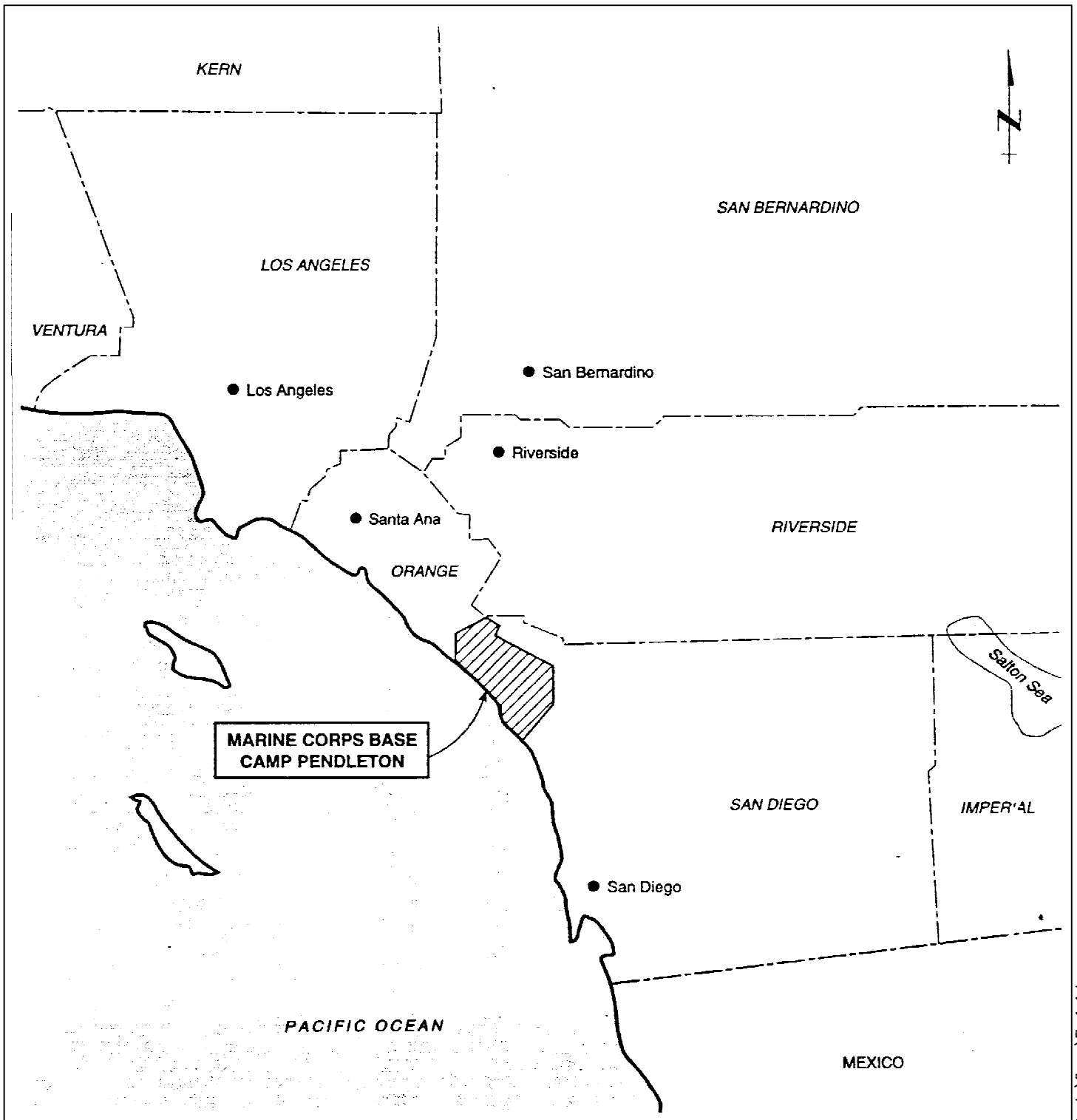

FIGURE 1-1

LOCATION OF MCB CAMP PENDLETON

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

Source:
USGS, California Index to Topograpic and Other Map Coverage Southern California, South Half (OHM, 1997).

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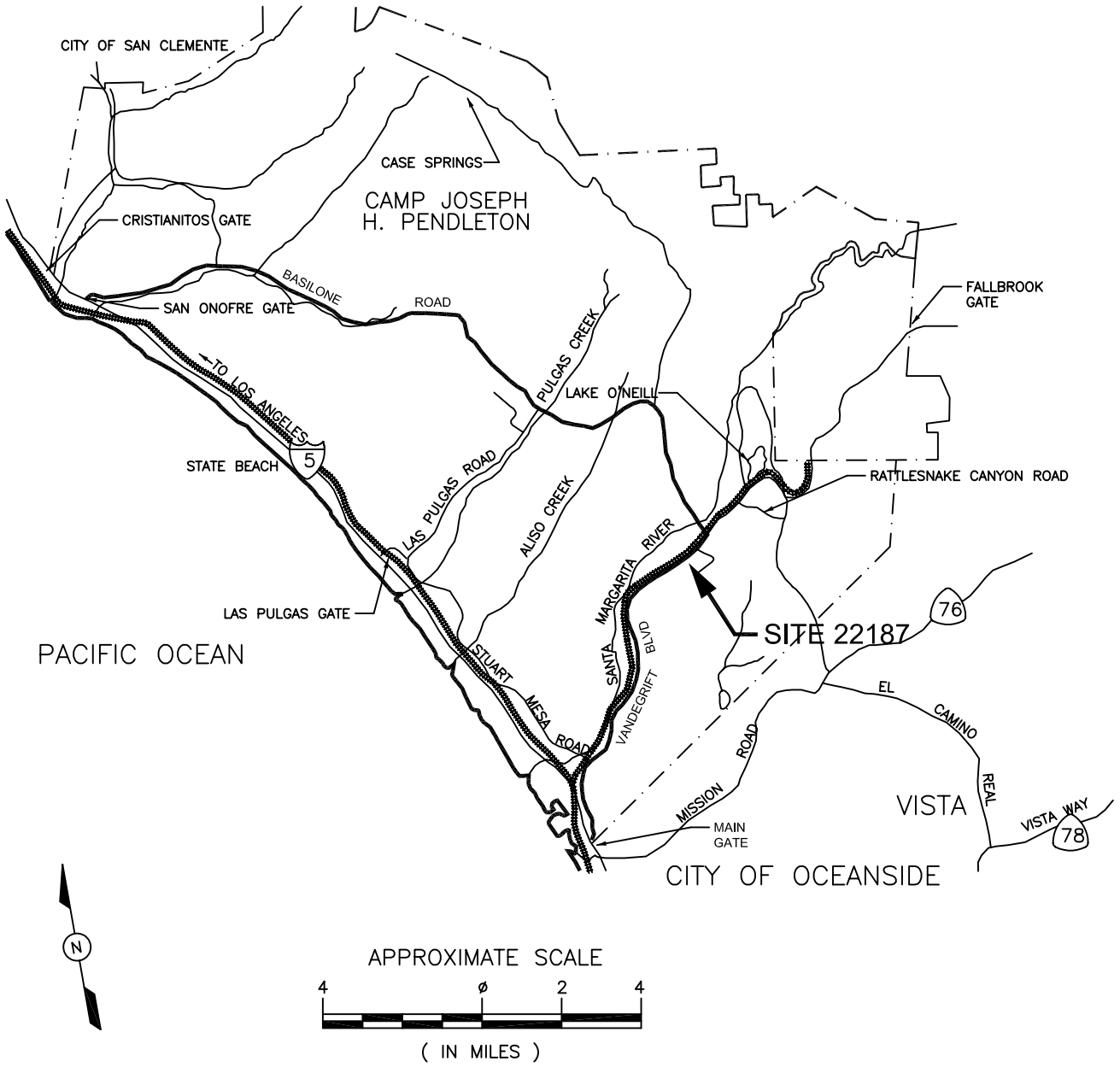

Roads & Highways
Creeks & Streams
MCB Camp Pendleton Boundary

Source: Metcalf & Eddy

FIGURE 1-2

SITE 22187 LOCATION

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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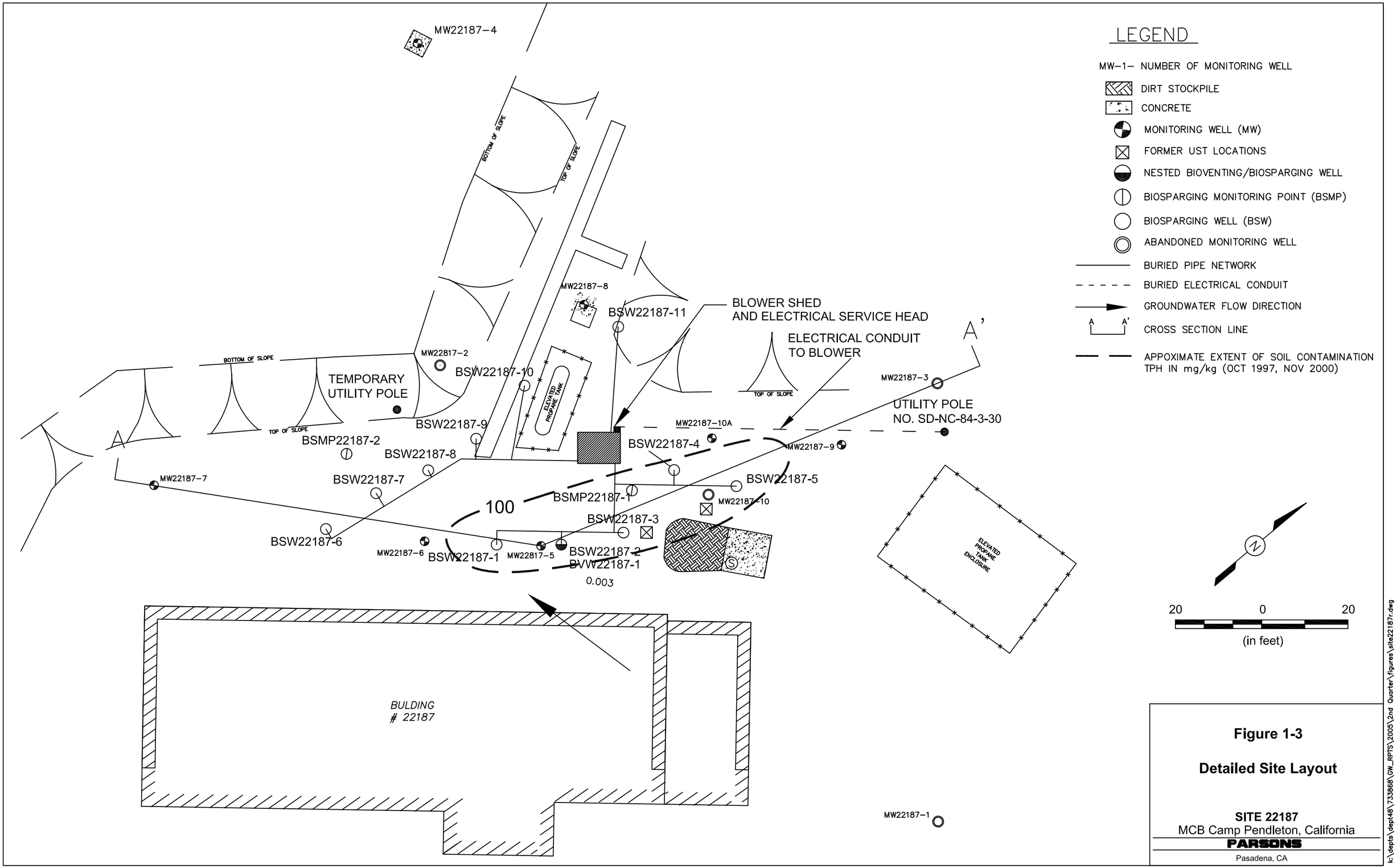

Figure 1-3

Detailed Site Layout

SITE 22187
MCB Camp Pendleton, California
PARSONS
Pasadena, CA

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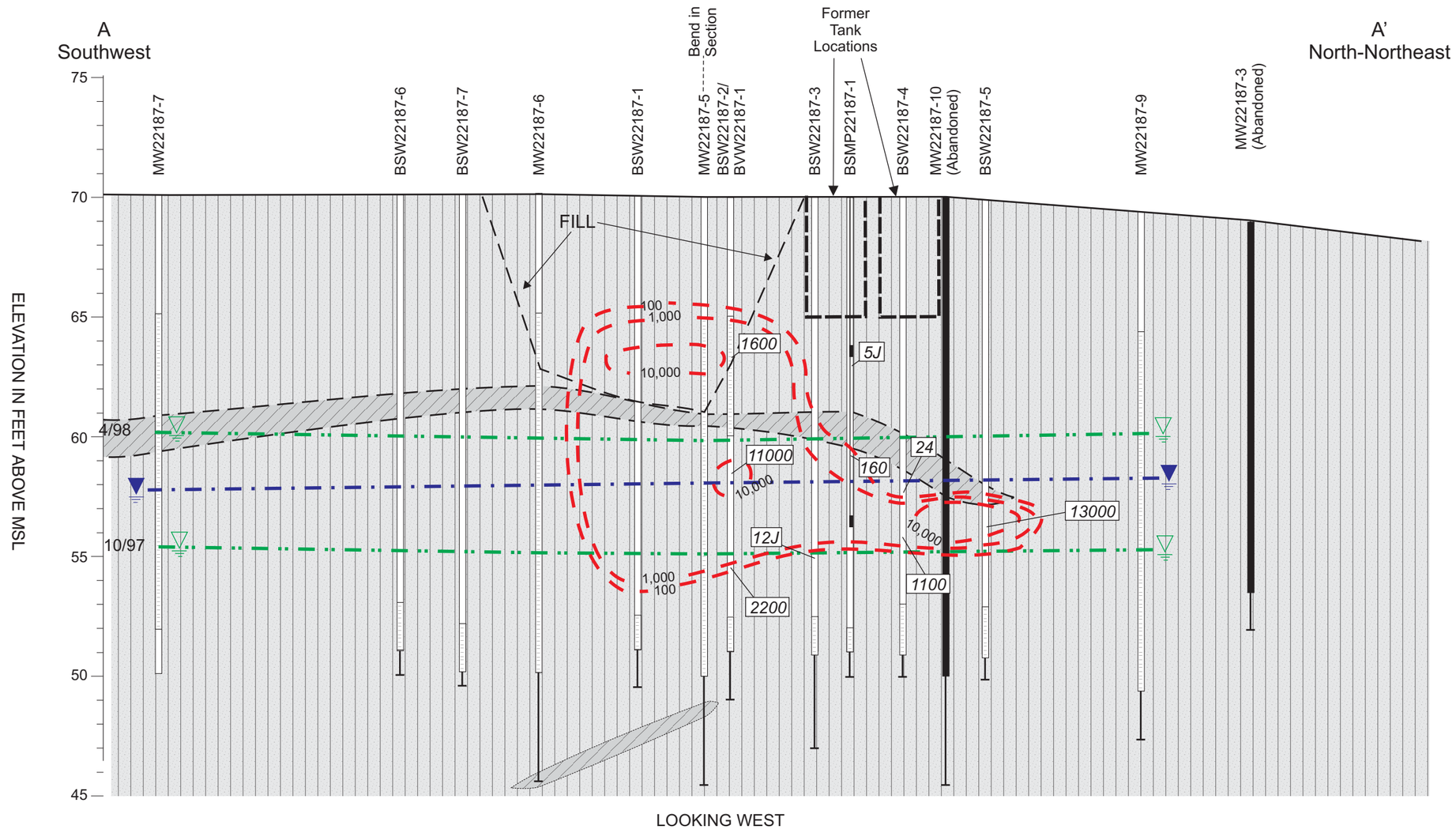

LEGEND

- Sandy Silt/Silty Sand
- Clay
- Geologic Contact (Dashed Where Inferred)
- Current Groundwater Level (4/2002)
- Historic Maximum/Minimum Groundwater Level (Date Measured)
- Approximate Extent of Soil Contamination TPH in mg/kg (JUL 1997, NOV 2000)
- 2200 — TPH-D in soil, mg/kg (NOV 2000)

20 10 0 20
HORIZONTAL SCALE (feet)

5 0 5
VERTICAL SCALE (feet)

Figure 1-4

Geologic Cross Section A-A' and Estimated Extent of Soil Contamination

Site 22187
MCB Camp Pendleton, CA

PARSONS
Pasadena, CA

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SECTION 2

FIELD ACTIVITIES AND PROCEDURES

This section describes the field activities conducted during this monitoring event and the procedures used to conduct these activities. The activities described include (1) measurement of groundwater levels, (2) collection of groundwater samples for chemical analyses, (3) collecting quality assurance/quality control groundwater samples, (4) BS system operation and maintenance (O&M), and (5) measurement of soil gas concentrations for monitoring the BS performance within the vadose zone. Also included is a discussion on the management of investigation-derived waste.

2.1 GROUNDWATER LEVEL MEASUREMENTS

On April 14, 2005, prior to the collection of groundwater samples, groundwater levels were measured in seven MWs (MW22187-4 through MW22187-10A) at the site. The static depth to groundwater from the top of each well casing was measured to the nearest 0.01 foot using an electric water level probe. The depth to groundwater was converted to groundwater elevation using the surveyed top-of-casing elevation for each well.

2.2 GROUNDWATER PURGING AND SAMPLING

Five of the seven MWs (MW22187-5 through MW22187-8 and MW22187-10A) were purged and sampled on April 14, 2005. Background well MW22187-9 and downgradient MW22187-4 were not sampled this event, in accordance with the groundwater monitoring schedule contained in the *Remediation Work Plan* (Parsons, 2000a).

Prior to the collection of a groundwater sample, each well was purged using a Grundfos® Redi-Flo II® pump with high density polyethylene (HDPE)-type tubing, set at a flow rate of approximately 2 gallons per minute (gpm). For purging, the volume of water contained within the well casing at the time of purging was calculated, and at least three times the calculated volume was removed from the well. Water quality parameters (pH, temperature, specific conductivity, and turbidity) were measured at regular intervals using a direct-reading meter. Dissolved oxygen (DO) concentrations and the oxygen reduction potential (ORP) were measured using a YSI Model 6820 instrument with a flow-through cell. The well was considered sufficiently purged when consecutive measurements of pH, temperature, and specific conductivity varied by less than 10 percent, and a minimum of three well casing volumes were removed. If the MW was evacuated to a dry state during purging, the MW was allowed to recharge, and the sample was collected as soon as sufficient water was present in the MW to obtain the necessary sample quantity.

Samples to be analyzed for volatile compounds were collected by lowering a new disposable polyethylene bailer into each well and carefully pouring the water down the inner walls of the sample bottle to minimize aeration of the sample.

The groundwater samples were analyzed for the following specific compounds:

- TPH-D using U.S. Environmental Protection Agency (EPA) Method 8015 Modified;

- SVOC using EPA Method 8270C; and
- Geochemical parameters including sulfate and nitrate using EPA Method 300.0; ferrous iron (Fe[II]) using EPA Method 3500DFE; alkalinity using EPA Method 310.1; and methane using RSK175.

Types of containers and volumes collected are noted on the groundwater sampling data sheets (Appendix B).

2.3 QUALITY ASSURANCE AND QUALITY CONTROL

Groundwater samples were collected and preserved in accordance with both EPA and California Leaking Underground Fuel Tank (LUFT) protocols. The samples were delivered under a chain-of-custody in a cooler with ice to a state-certified laboratory.

Three types of quality-control (QC) samples were used to assess the adequacy of sampling, decontamination, and transportation procedures. Multiple sites are sampled during a given monitoring event; therefore, QC samples are collected appropriate to the defined need of the monitoring event, but not necessarily collected at every designated site.

- A trip blank sample was transported with each cooler and analyzed by Method 8260B. The trip blanks were used to determine whether cross-contamination of volatile organic compounds occurred during transportation to the laboratory.
- An equipment blank sample was collected during the monitoring event by running distilled water into and over the decontaminated pump. This sample was analyzed by Methods 8015M and 8260B to verify that the sampling equipment was free of organic contaminants.
- Field duplicate samples were collected at the rate of one for every ten primary samples and sent to the laboratory "blind."

2.4 BIOSPARGING SYSTEM OPERATION AND MAINTENANCE

As recommended in the letter report on the BS/BV system installation and startup results (Parsons, 2001a), only the BS was operated. BS O&M was performed in accordance with the O&M Manual (Parsons, 2001b). System operation inspections were performed at least monthly and summarized in the monthly remediation system reports. In February 2002, the operation began on a cycled on/off schedule in order to reduce electrical consumption while maintaining elevated oxygen concentrations. Cycling between wells commenced in June 2002 to optimize oxygenation of groundwater. Based on the monitoring results, BSW22187-1 through BSW22187-5 and BSW22187-9 only have been cycled since August 2002 to focus on the former source area that is actively utilizing the oxygen.

System tarp and filters were replaced during March 2005. Otherwise, no maintenance of the system has been required.

Explosion hazard monitoring for vapors in underground utility areas was conducted on March 31, 2005. Underground utility areas at the site were monitored using a lower explosive level (LEL) meter to confirm no vapor migration.

2.5 SOIL GAS SAMPLING

Soil gas sampling from selected MWs began in March 2001 prior to startup of the BS, and has been performed periodically as needed to evaluate the effect of BS on the vadose zone. The most recent soil gas monitoring occurred in April 2004. Soil gas samples are collected in a Tedlar bag using a vacuum pump. Soil gas concentrations of oxygen (O_2) and carbon dioxide (CO_2) are measured using either a Gastech GT408 meter or a Landfill Gas Analyzer GA-90, which is able to measure CO_2 concentrations above 5%. Total volatile hydrocarbons (TVH) are periodically measured using a MiniRae PID.

2.6 WASTE MANAGEMENT

During monitoring activities, groundwater was purged into a truck-mounted polyethylene tank and then transported to Crosby and Overton for treatment and disposal under a nonhazardous-waste manifest. A copy of the manifest is presented in Appendix B.

SECTION 3

RESULTS

This section presents the results of field activities conducted at the site, including groundwater level measurements and laboratory analyses of groundwater samples collected during this monitoring event. All work was conducted in accordance with the Site 22187 *Remediation Work Plan* (Parsons, 2000a), the sampling plan updated in the installation and startup letter report (Parsons, 2001a), and the *O&M Manual* (Parsons, 2001b).

3.1 GROUNDWATER ELEVATIONS

Due to heavy winter rains, groundwater elevations increased in all of the wells on site in comparison to the previous monitoring event. The average increase was 2.31 feet, with a maximum increase of 2.49 feet in well MW22187-9. Table 3-1 presents a summary of groundwater elevations measured since July 1998. Groundwater level fluctuations at the site generally reflect seasonal changes, showing an increase during the wet months of winter and spring and a decrease during the dry months of summer and fall. Figure 3-1 shows a hydrograph of the groundwater elevation data collected to date. Historical groundwater elevations are provided in Appendix A.

The hydraulic gradient calculated for this site was 0.004 west. This is consistent with previous events. The hydraulic gradient and flow direction are illustrated on Figure 3-2.

3.2 ANALYTICAL RESULTS

A summary of petroleum hydrocarbon concentrations detected in site groundwater since July 1998 is presented in Tables 3-2. Historical data are provided in Appendix A.

3.2.1 Data Quality Assessment

Five primary samples were collected during this monitoring event. All samples were analyzed for diesel (modified method 8015) and one sample (MW22187-5) was analyzed for SVOCs (method 8270C). Diesel was detected in the equipment blank EB-01-0405 (0.014 milligrams per liter [mg/L]) and non-detect in the method blank; however, the presence and concentration of this compound in the associated blank does not impact site data. Diesel Surrogate recoveries were acceptable for all site and associated QC samples. Diesel laboratory control standards/laboratory control standards duplicate (LCS/LCSD) results demonstrate acceptable method precision and accuracy. Diesel matrix spike/matrix spike duplicate (MS/MSD) results were low; however, primary sample concentration exceeds for times the spike concentration and data qualification is not required. SVOC target compounds were not detected in the method blank. SVOC surrogate recoveries were acceptable for all site and associated QC samples. SVOC LCS/LCSD results demonstrate acceptable method precision and accuracy. Collected samples were properly preserved and shipped in two coolers to the laboratory which were received at temperatures of 3.8^{o}C and 4.1 ^{o}C. Based on the review of the laboratory reports and quality assurance (QA)/QC analyses, the data was deemed acceptable and usable as reported. Laboratory reports are provided in Appendix C.

3.2.2 Groundwater Contaminants

TPH-D was detected at or above the cleanup goal of 0.1 mg/L in all five of the MWs sampled this event. These TPH-D concentrations are generally within the range of historical concentrations, except at MW22187-8 where there was an increase from 0.79 mg/L in October 2004 to 6.5 mg/L this event. BS operation has focused on this portion of the site, and may be contributing to the release of residual contamination from the saturated zone from this portion of the site. TPH-D concentrations are likely to decrease as biodegradation processes proceed. Figure 3-3 shows the concentration trends of TPH-D versus groundwater elevation in selected site wells over time.

A sample from one well (MW22187-5) was analyzed for the presence of SVOCs and none were detected.

Figure 3-5 shows the locations and results of samples collected and analyzed during this monitoring event. Historical plume extents are shown on Figure A-1 in Appendix A.

3.2.3 Geochemical Indicators

Biodegradation causes measurable changes in groundwater chemistry. Specifically, concentrations of petroleum hydrocarbons, DO, nitrate, Fe(II), sulfate, and methane in groundwater change both temporally and spatially as biodegradation proceeds. Petroleum hydrocarbons readily serve as electron donors in both aerobic and anaerobic biodegradation processes. Electron acceptors include (in order of decreasing preference) DO, nitrate, ferric iron (Fe[III]), sulfate, and CO_2. Electron acceptors and donors are depleted during biodegradation processes. Byproducts of biodegradation include CO_2, water, nitrogen gas, Fe(II), hydrogen sulfide, and methane. Alkalinity also increases as CO_2 is produced.

One purpose of BS is to inject oxygen to increase groundwater DO concentrations and hence facilitate removal of petroleum hydrocarbons through aerobic biodegradation processes, which tend to proceed more quickly than anaerobic processes. DO is utilized for aerobic degradation of dissolved-phase petroleum hydrocarbons, and is most effective when DO concentration are maintained above 2 milligram per liter (mg/L) (USEPA, 2004). DO data collected since startup of the BS/BV system is listed in Table 3-3. During this reporting period, the BS system was operating approximately four months. During operation, DO concentrations generally remained below 2 mg/L in the four wells monitored. After 2 weeks following system shutoff, during respiration monitoring, two wells and two BSMPs indicated DO concentrations above 2 mg/L, ranging from 2.44 mg/L (at BSMP-2-18.5) to 4.49 mg/L (at MW22187-5). The inability of the BS system to maintain elevated DO during operation indicates that the BS system has limited effectiveness in oxygenating groundwater at the site.

Additional geochemical data collected during the April 2005 groundwater monitoring event are summarized in Table 3-4. This data was collected to evaluate the progress of anaerobic biodegradation processes. The following geochemical evaluation is primarily based on the most recently collected data (April 2005) as representative of current conditions.

During groundwater purging, field measurements of DO ranged between 0.42 mg/L and 3.46 mg/L, with the lowest concentrations detected in the samples collected from MW22187-6, MW22187-7, and MW22187-10A. The highest DO concentration was observed in the downgradient well (MW22187–8). Those portions of the plume with the lowest DO

concentrations are most likely representative of the portions of the plume experiencing anaerobic biodegradation processes.

ORP, is a measure of the relative tendency of a solution to accept or transfer electrons. The ORP of a groundwater system depends on (and may in turn control) which electron acceptors are being reduced by microorganisms during BTEX oxidation. Low ORP measured in the areas of contamination provide a general indication that biodegradation is occurring. ORP measured in the field during groundwater purging ranged from 154.9 millivolts (mV) to -80.1 mV, with the lowest values measured in MW22187-5 and MW22187-6, the wells in the middle of the plume.

Nitrate concentrations ranged from 1.6 mg/L to 9.3 mg/L. The depletion of nitrate throughout most of the site suggests that nitrate has been used as an electron donor and that denitrification has occurred.

Sulfate concentrations at the site ranged from 240 mg/L to 630 mg/L. The lowest sulfate concentrations were detected in the samples collected from wells MW22187-6 and MW22187-7, whereas the highest sulfate concentration was detected in the sample collected from well MW22187-8. This relationship may indicate in which portions of the plume that anaerobic biodegradation of petroleum hydrocarbons is proceeding through the microbially mediated process of sulfate reduction.

When Fe(III) is used as an electron acceptor during anaerobic biodegradation of organic carbon, it is reduced to Fe(II), which is soluble in water. Higher Fe(II) concentrations inside the contaminant plume versus background Fe(II) concentrations can be used as an indicator that anaerobic degradation of organic carbon has occurred or is occurring via Fe(III) reduction. Fe(II) concentrations ranged from non-detect (<0.05 mg/L) to 0.2 mg/L. The concentrations measured during this monitoring event are uniformly low and do not suggest that iron reduction is occurring.

Methane can be a strong indicator of biodegradation. The preferred biodegradation pathways discussed above produce acetate as an intermediate product and CO_2 as a final product of TPH-D and BTEX degradation. When oxygen and other electron acceptor levels are depleted, methanogenic bacteria begin to convert CO_2 to methane. Because methane is not present in fuel, the presence of methane above background concentrations in fuel-contaminated groundwater is indicative of microbial degradation of fuel hydrocarbons. Thus, an elevated methane concentration is an excellent indicator of microbial degradation. At Site 22187, detected methane concentrations ranged from non-detect (<3 µg/L) to 29 µg/L. These results are substantially lower then past results in 1997 through 1999. Methane was not elevated within the plume, indicating that methanogenesis is not occurring.

In summary, the geochemical data collected during this monitoring event present only weak evidence of anaerobic biodegradation in portions of the plume. These portions of the plume are somewhat depleted in concentrations of electron acceptors including DO, nitrate, and sulfate and indicate a slightly reducing redox potential, but concentrations of metabolic byproducts such as Fe(II) and methane are not elevated. It is likely that the active BS operation is currently counteracting the widespread formation of anaerobic biodegradation conditions.

3.3 EXPLOSION HAZARD MONITORING

The well boxes, sewer manholes, and storm drain at the site were monitored for potential explosion hazards. On March 31, 2005, a LEL meter was used at the sewer manholes and the measurements were 0.0%. Therefore, there is no explosion hazard present at the site.

3.4 SOIL GAS DATA

Soil gas monitoring data collected from the vadose zone of the BSMPs is summarized in Table 3-5. Historically, the O_2 concentrations became elevated (near saturated oxygen conditions) in the monitoring locations during system operation and during respiration testing (once the BS is turned off and during the off cycle mode), oxygen levels decreased. Carbon dioxide concentrations generally decreased while atmospheric air was being introduced to the subsurface, and increased during respiration testing after the blower was cycled off.

Oxygen utilization rates are determined from oxygen data obtained during in situ respiration testing. The rates are calculated as the zero order relationship between percent oxygen and time. Typically, a rapid linear decrease in oxygen is observed, followed by a lag period once oxygen concentrations drop below approximately 5% (Leeson and Hinchee, 1997).

Figure 3-6 illustrates oxygen utilization versus time, as measured in BSMP-1-6.5 during respiration test periods in 2001 through 2005. Respiration rates have generally continued to decrease during this time period. Through 2003, the oxygen utilization rates at Site 22187 remained at or above 2%/day in BSMP-1-6.5, located nearest the former UST location. During 2004, the oxygen utilization rate has decreased to between 0.8%/day and 1.2%/day. In March through mid-April, 2005, the oxygen utilization rate further decreased to 0.6%/day. These measurements indicate that residual contamination has been reduced and that the BS system may be nearing the end of its ability to remove residual vadose zone contamination near the former source area.

Table 3-1
Summary of Groundwater Elevation Data at Site 22187
MCB Camp Pendleton, California

Well	Date	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Depth to Product (feet)	Product Thickness (feet)	GW Elevation (feet above MSL)
MW-4	7/22/1998	63.50	5.49	ND	0	58.01
MW-4	10/21/1998		6.62	ND	0	56.88
MW-4	1/25/1999		5.25	ND	0	58.25
MW-4	5/10/1999		4.98	ND	0	58.52
MW-4	7/19/1999		5.68	ND	0	57.82
MW-4	10/5/1999		6.78	ND	0	56.72
MW-4	1/25/2000		7.88	ND	0	55.62
MW-4	4/3/2000		6.57	ND	0	56.93
MW-4	7/23/2000		6.62	ND	0	56.88
MW-4	10/16/2000		7.71	ND	0	55.79
MW-4	2/7/2001		6.46	ND	0	57.04
MW-4	4/27/2001		4.80	ND	0	58.70
MW-4	10/11/2001		6.47	ND	0	57.03
MW-4	4/26/2002		5.59	ND	0	57.91
MW-4	10/15/2002		7.57	ND	0	55.93
MW-4	4/17/2003		3.95	ND	0	59.55
MW-4	10/16/2003		5.67	ND	0	57.83
MW-4	10/25/2004		5.67	ND	0	57.83
MW-4	**4/14/2005**		**3.60**	**ND**	**0**	**59.90**
MW-5	7/21/1998	70.15	11.91	ND	0	58.24
MW-5	10/21/1998		13.11	ND	0	57.04
MW-5	1/25/1999		12.12	ND	0	58.03
MW-5	5/10/1999		11.49	ND	0	58.66
MW-5	7/19/1999		12.13	ND	0	58.02
MW-5	10/5/1999		13.21	ND	0	56.94
MW-5	1/25/2000		14.38	ND	0	55.77
MW-5	4/3/2000		13.12	ND	0	57.03
MW-5	7/23/2000		13.18	ND	0	56.97
MW-5	10/16/2000		14.21	ND	0	55.94
MW-5	2/7/2001		13.12	ND	0	57.03
MW-5	4/27/2001		11.30	ND	0	58.85
MW-5	10/11/2001		13.01	ND	0	57.14
MW-5	4/26/2002		12.10	ND	0	58.05
MW-5	10/15/2002		14.02	ND	0	56.13
MW-5	4/17/2003		10.46	ND	0	59.69
MW-5	10/16/2003		12.24	ND	0	57.91
MW-5	4/1/2004		10.99	ND	0	59.16
MW-5	10/25/2004		12.27	ND	0	57.88
MW-5	**4/14/2005**		**9.84**	**ND**	**0**	**60.31**

Table 3-1
Summary of Groundwater Elevation Data at Site 22187
MCB Camp Pendleton, California

Well	Date	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Depth to Product (feet)	Product Thickness (feet)	GW Elevation (feet above MSL)
MW-6	7/21/1998	70.45	11.91	ND	0	58.54
MW-6	10/21/1998		13.45	ND	0	57.00
MW-6	1/25/1999		12.00	ND	0	58.45
MW-6	5/10/1999		11.86	ND	0	58.59
MW-6	7/19/1999		12.49	ND	0	57.96
MW-6	10/5/1999		13.58	ND	0	56.87
MW-6	1/25/2000		14.71	ND	0	55.74
MW-6	4/3/2000		13.42	ND	0	57.03
MW-6	7/23/2000		13.50	ND	0	56.95
MW-6	10/16/2000		14.57	ND	0	55.88
MW-6	2/7/2001		13.43	ND	0	57.02
MW-6	4/27/2001		11.60	ND	0	58.85
MW-6	10/11/2001		13.35	ND	0	57.10
MW-6	4/26/2002		12.46	ND	0	57.99
MW-6	10/15/2002		14.37	ND	0	56.08
MW-6	4/17/2003		10.82	ND	0	59.63
MW-6	10/16/2003		12.60	ND	0	57.85
MW-6	4/1/2004		11.30	ND	0	59.15
MW-6	10/25/2004		12.62	ND	0	57.83
MW-6	**4/14/2005**		**10.27**	**ND**	**0**	**60.18**
MW-7	7/22/1998	70.11	12.02	ND	0	58.09
MW-7	10/21/1998		13.22	ND	0	56.89
MW-7	1/25/1999		11.85	ND	0	58.26
MW-7	5/10/1999		11.62	ND	0	58.49
MW-7	7/19/1999		12.27	ND	0	57.84
MW-7	10/5/1999		13.35	ND	0	56.76
MW-7	1/25/2000		14.40	ND	0	55.71
MW-7	4/3/2000		13.18	ND	0	56.93
MW-7	7/23/2000		13.32	ND	0	56.79
MW-7	10/16/2000		14.34	ND	0	55.77
MW-7	2/7/2001		13.13	ND	0	56.98
MW-7	4/27/2001		11.41	ND	0	58.70
MW-7	10/11/2001		13.14	ND	0	56.97
MW-7	4/26/2002		12.26	ND	0	57.85
MW-7	10/15/2002		14.51	ND	0	55.60
MW-7	4/17/2003		10.65	ND	0	59.46
MW-7	10/16/2003		12.38	ND	0	57.73
MW-7	4/1/2004		11.15	ND	0	58.96
MW-7	10/25/2004		12.38	ND	0	57.73
MW-7	**4/14/2005**		**10.15**	**ND**	**0**	**59.96**

Table 3-1
Summary of Groundwater Elevation Data at Site 22187
MCB Camp Pendleton, California

Well	Date	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Depth to Product (feet)	Product Thickness (feet)	GW Elevation (feet above MSL)
MW-8	7/22/1998	72.09	13.86	ND	0	58.23
MW-8	10/21/1998		15.50	ND	0	56.59
MW-8	1/25/1999		13.65	ND	0	58.44
MW-8	5/10/1999		14.42	ND	0	57.67
MW-8	7/19/1999		14.05	ND	0	58.04
MW-8	10/5/1999		15.18	ND	0	56.91
MW-8	1/25/2000		16.32	ND	0	55.77
MW-8	4/3/2000		15.07	ND	0	57.02
MW-8	7/23/2000		15.07	ND	0	57.02
MW-8	10/16/2000		16.14	ND	0	55.95
MW-8	2/7/2001		15.04	ND	0	57.05
MW-8	4/27/2001		13.23	ND	0	58.86
MW-8	10/11/2001		14.89	ND	0	57.20
MW-8	4/26/2002		14.08	ND	0	58.01
MW-8	10/15/2002		15.94	ND	0	56.15
MW-8	4/17/2003		12.37	ND	0	59.72
MW-8	10/16/2003		14.13	ND	0	57.96
MW-8	4/1/2004		12.87	ND	0	59.22
MW-8	10/25/2004		14.15	ND	0	57.94
MW-8	**4/14/2005**		**11.90**	**ND**	**0**	**60.19**
MW-9	4/16/1997	69.78	10.63	ND	0	59.15
MW-9	6/11/1997		11.57	ND	0	58.21
MW-9	10/28/1997		14.56	ND	0	55.22
MW-9	2/6/1998		13.24	ND	0	56.54
MW-9	4/6/1998		9.75	ND	0	60.03
MW-9	7/21/1998	69.78	11.40	ND	0	58.38
MW-9	10/21/1998		12.65	ND	0	57.13
MW-9	1/25/1999		11.10	ND	0	58.68
MW-9	5/10/1999		10.98	ND	0	58.80
MW-9	7/19/1999		11.59	ND	0	58.19
MW-9	10/5/1999		12.71	ND	0	57.07
MW-9	1/25/2000		13.93	ND	0	55.85
MW-9	4/3/2000		12.68	ND	0	57.10
MW-9	7/23/2000		12.67	ND	0	57.11
MW-9	10/16/2000		13.71	ND	0	56.07
MW-9	2/7/2001		12.62	ND	0	57.16
MW-9	4/27/2001		10.77	ND	0	59.01
MW-9	10/11/2001		12.48	ND	0	57.30
MW-9	4/26/2002		11.61	ND	0	58.17
MW-9	10/15/2002		13.45	ND	0	56.33
MW-9	4/17/2003		9.90	ND	0	59.88
MW-9	10/16/2003		11.57	ND	0	58.21
MW-9	10/25/2004		11.74	ND	0	58.04
MW-9	**4/14/2005**		**9.25**	**ND**	**0**	**60.53**

Table 3-1
Summary of Groundwater Elevation Data at Site 22187
MCB Camp Pendleton, California

Well	Date	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Depth to Product (feet)	Product Thickness (feet)	GW Elevation (feet above MSL)
MW-10A	7/21/1998	69.58	11.31	ND	0	58.27
MW-10A	10/21/1998		12.45	ND	0	57.13
MW-10A	1/25/1999		11.25	ND	0	58.33
MW-10A	5/10/1999		10.88	ND	0	58.70
MW-10A	7/19/1999		11.53	ND	0	58.05
MW-10A	10/5/1999		12.63	ND	0	56.95
MW-10A	1/25/2000		13.80	ND	0	55.78
MW-10A	4/3/2000		12.51	ND	0	57.07
MW-10A	7/23/2000		12.58	ND	0	57.00
MW-10A	10/16/2000		13.63	ND	0	55.95
MW-10A	2/7/2001		12.51	ND	0	57.07
MW-10A	4/27/2001		10.63	ND	0	58.95
MW-10A	10/11/2001		12.38	ND	0	57.20
MW-10A	4/26/2002		11.47	ND	0	58.11
MW-10A	10/15/2002		13.39	ND	0	56.19
MW-10A	4/17/2003		9.80	ND	0	59.78
MW-10A	10/16/2003		11.62	ND	0	57.96
MW-10A	4/1/2004		10.37	ND	0	59.21
MW-10A	10/25/2004		11.63	ND	0	57.95
MW-10A	**4/14/2005**		**9.25**	**ND**	**0**	**60.33**

NA = Not available

ND = Not detected

Bold indicates results from the most recent sampling event.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 22187
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-4	22187-MW4-603	7/22/1998	< 0.04	< 0.5	< 0.08	< 0.5	0.04 J	NA
MW-4	MW22187-4-0199	1/28/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-4	MW22187-4-0599	5/10/1999	< 0.5	< 0.5	< 0.5	< 0.5	0.8 J1	2 J1
MW-4	MW22187-4-1099	10/6/1999	< 0.1	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-4	MW22187-4-1000	10/19/2000	0.2 J1	< 1	< 1	< 1	< 2	< 5
MW-4	MW22187-04-1001	10/15/2001	< 0.07	< 1	< 1	< 1	< 2	< 5
MW-4	MW22187-4	4/30/2002	< 0.05	< 1	< 1	< 1	< 2	< 5
MW-4	MW22187-4-1002	10/15/2002	< 0.009	< 1	9.1	< 1	< 2	< 5
MW-4	MW22187-4-1003	10/16/2003	< 0.096	< 1	< 1	< 1	< 2	< 5
MW-4	MW22187-4-1004	10/25/2004	< 0.096	< 1	< 1	< 1	< 2	< 5
MW-5	22187-MW5-604	7/21/1998	1.3	2.8	< 0.1 J	15.2 J	< 0.9	NA
MW-5	MW22187-5-0199	1/28/1999	3.2	5.8	< 0.5	8.2	< 1.5	21
MW-5	MW22187-5-0599	5/10/1999	1.9	2.6	< 0.5	3.7	2.5 J1	5
MW-5	MW22187-5-1099	10/6/1999	1.3	0.8	< 0.5	< 0.5	< 1.5	2.7 J1
MW-5	MW22187-5-0400	4/6/2000	1.4	4.2	< 1	< 1	< 2	5 J1
MW-5	MW22187-5-1000	10/19/2000	0.6	1 J1	< 1	< 1	< 2	< 2
MW-5	MW22187-5-0401	4/30/2001	1.3	0.9 J1	< 1	< 1	< 2	2 J1
MW-5	MW22187-5-1001	10/15/2001	0.42	1	< 1	< 1	< 2	6
MW-5 d	MW22187-99-1001	10/15/2001	0.47	< 1	< 1	< 1	< 2	< 5
MW-5	MW22187-5	4/29/2002	1.6	1	< 1	< 1	< 2	4 J1
MW-5 d	MW22187-99	4/29/2002	1.5	1 J1	< 1	< 1	< 2	4 J1
MW-5	MW22187-MW5-1002	10/15/2002	< 0.1	< 5	110	< 5	2 J1	< 25
MW-5 d	MW22187-99-1002	10/15/2002	< 0.16	0.3	79	0.5	3.5	0.4
MW-5	MW22187-5-0403	4/18/2003	0.21	< 1	< 1	< 1	< 2	< 5
MW-5	MW22187-5-1003	10/16/2003	0.35	< 1	< 1	< 1	< 2	< 5
MW-5	MW22187-5-0404	4/1/2004	0.42	< 1	< 1	< 1	< 2	< 5
MW-5	MW22187-5-1004	10/25/2004	0.53	< 1	< 1	< 1	< 2	< 5
MW-5	MW22187-5-0405	4/14/2005	0.56	NA	NA	NA	NA	NA

J Estimated Value
J1 Result is less than the PQL but greater than the MDL
PQL Project quantitation limit
MDL Method detection limit

mg/L milligram per liter
µg/L microgram per liter
NA not analyzed
NS not sampled

MTBE methyl tert-butyl ether
EB Equipment blank
TB Trip blank
d Field duplicate sample

[1]BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
TPH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

Notes: Samples analyzed after 1999 were analyzed for BTEX using method SW8260B instead of method SW8021
All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling event. All results were non-detect.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 22187
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-6	22187-MW6-605	7/21/1998	0.9	0.4 J1	< 0.2 J	0.9 J	< 0.7	NA
MW-6	MW22187-6-0199	1/28/1999	1.3	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-6	MW22187-6-0599	5/10/1999	1.4	1.3	< 0.5	1.4	1.3 J1	9
MW-6	MW22187-6-1099	10/6/1999	0.69	< 0.5	< 0.5	< 0.5	< 1.5	5
MW-6 d	MW22187-99-1099	10/6/1999	0.99	< 0.5	< 0.5	< 0.5	< 1.5	4 J1
MW-6	MW22187-6-0400	4/6/2000	0.7	< 1	< 1	< 1	< 2	3 J1
MW-6	MW22187-6-1000	10/19/2000	0.8	< 1	< 1	< 1	< 2	3 J1
MW-6 d	MW22187-99-1000	10/19/2000	0.9	< 1	< 1	< 1	< 2	< 2
MW-6	MW22187-6-0401	4/30/2001	0.8	< 1	< 1	< 1	< 2	2 J1
MW-6	MW22187-6-1001	10/15/2001	0.38	< 1	< 1	< 1	< 2	0.6 J1
MW-6	MW22187-6	4/29/2002	1.8	7.7	< 1	15	< 2	5
MW-6	MW22187-6-1002	10/15/2002	< 0.1	< 1	14	< 1	< 2	2
MW-6	MW22187-6-0403	4/18/2003	0.65	< 1	< 1	< 1	< 2	0.45 J1
MW-6	MW22187-6-1003	10/16/2003	0.26	< 1	< 1	< 1	< 2	0.32 J1
MW-6	MW22187-6-0404	4/1/2004	0.34	< 1	< 1	< 1	< 2	< 5
MW-6	MW22187-6-1004	10/25/2004	0.38	< 1	< 1	< 1	< 2	< 5
MW-6 d	MW22187-99-1004	10/25/2004	0.51	< 1	0.61 J1	< 1	< 2	< 5
MW-6	MW22187-6-0405	4/14/2005	0.23	NA	NA	NA	NA	NA

J	Estimated Value	mg/L	milligram per liter	MTBE	methyl tert-butyl ether
J1	Result is less than the PQL but greater than the MDL	µg/L	microgram per liter	EB	Equipment blank
PQL	Project quantitation limit	NA	not analyzed	TB	Trip blank
MDL	Method detection limit	NS	not sampled	d	Field duplicate sample

[1]BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
TPH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

Notes: Samples analyzed after 1999 were analyzed for BTEX using method SW8260B instead of method SW8021
All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling event. All results were non-detect.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 22187
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-7	22187-MW7-606	7/22/1998	< 0.1	< 0.5	< 0.08	< 0.5	0.02 J	NA
MW-7	MW22187-7-0199	1/28/1999	0.7	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-7	MW22187-7-0599	5/10/1999	0.5	< 0.5	< 0.5	< 0.5	< 1.5	5
MW-7	MW22187-7-0799	7/20/1999	2	< 0.5	< 0.5	< 0.5	< 1.5	< 12
MW-7	MW22187-7-1099	10/6/1999	1.4	< 0.5	< 0.5	< 0.5	< 1.5	5.9
MW-7	MW22187-7	1/26/2000	1.1	< 1	< 1	< 1	< 2	3 J1
MW-7	MW22187-7-0400	4/4/2000	0.8	< 1	< 1	< 1	< 2	2 J1
MW-7	MW22187-7-0700	7/24/2000	0.7	< 1	< 1	< 1	< 2	4 J1
MW-7 d	MW22187-99-0700	7/24/2000	0.7	< 1	< 1	< 1	< 2	5
MW-7	MW22187-7-1000	10/18/2000	0.8	< 1	< 1	< 1	< 2	4 J1
MW-7	22187-7-0201	2/8/2001	0.5	< 1	< 1	< 1	< 2	3 J1
MW-7	MW22187-7-0401	4/30/2001	0.4 J1	< 1	< 1	< 1	< 2	1 J1
MW-7	MW22187-7-1001	10/15/2001	0.36	< 1	< 1	< 1	< 2	0.7 J1
MW-7	MW22187-7	4/29/2002	0.43	< 1	< 1	< 1	< 2	3 J1
MW-7	MW22187-7-1002	10/15/2002	< 0.1	< 1	43	< 1	0.8 J1	3
MW-7	MW22187-7-0403	4/18/2003	0.21	< 1	< 1	< 1	< 2	0.45 J1
MW-7	MW22187-7-1003	10/16/2003	0.35	< 1	< 1	< 1	< 2	0.79 J1
MW-7	MW22187-7-0404	4/1/2004	0.49	< 1	< 1	< 1	< 2	0.57 J1
MW-7	MW22187-7-1004	10/25/2004	0.72	< 1	< 1	< 1	< 2	1.2 J1
MW-7	MW22187-7-0405	4/14/2005	0.1	NA	NA	NA	NA	NA

J	Estimated Value	mg/L	milligram per liter	MTBE	methyl tert-butyl ether
J1	Result is less than the PQL but greater than the MDL	µg/L	microgram per liter	EB	Equipment blank
PQL	Project quantitation limit	NA	not analyzed	TB	Trip blank
MDL	Method detection limit	NS	not sampled	d	Field duplicate sample

[1]BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
TPH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

Notes: Samples analyzed after 1999 were analyzed for BTEX using method SW8260B instead of method SW8021
All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling event. All results were non-detect.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 22187
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-8	22187-MW8-607	7/22/1998	0.2 J1	< 5	< 5	< 5	0.02 J	NA
MW-8	MW22187-8-0199	1/28/1999	0.6	< 0.5	< 0.5	< 0.5	< 1.5	32
MW-8	MW22187-8-0599	5/10/1999	0.5 J1	< 0.5	< 0.5	< 0.5	< 1.5	24
MW-8	MW22187-8-1099	10/5/1999	0.55	< 0.5	< 0.5	< 0.5	< 1.5	16
MW-8	MW22187-8-0400	4/4/2000	< 0.5	< 1	< 1	< 1	< 2	< 5
MW-8	MW22187-8-1000	10/19/2000	0.5 J	< 1	< 1	< 1	< 2	4 J1
MW-8	MW22187-8-0401	5/1/2001	0.4 J1	< 1	< 1	< 1	< 2	3 J1
MW-8	MW22187-8-1001	10/15/2001	0.36	< 1	< 1	< 1	< 2	1 J1
MW-8	MW22187-8	4/30/2002	0.28	< 1	< 1	< 1	< 2	0.6 J1
MW-8	MW22187-8-1002	10/15/2002	< 0.1	< 1	53	< 1	1.4 J1	1
MW-8	MW22187-8-0403	4/18/2003	0.57	< 1	< 1	< 1	< 2	< 5
MW-8	MW22187-8-1003	10/16/2003	0.67	< 1	< 1	< 1	< 2	< 5
MW-8 d	MW22187-99-1003	10/16/2003	0.33	< 1	< 1	< 1	< 2	0.39 J1
MW-8	MW22187-8-0404	4/1/2004	1.3	< 1	< 1	< 1	< 2	< 5
MW-8	MW22187-8-1004	10/25/2004	0.79	< 1	< 1	< 1	< 2	< 5
MW-8	MW22187-8-0405	4/14/2005	6.5	NA	NA	NA	NA	NA
MW-9	22187-MW9-608	7/21/1998	< 0.05	< 0.5	< 0.5 J	< 0.5 J	0.04 J1	NA
MW-9	MW22187-9-0199	1/28/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-9	MW22187-9-0599	5/10/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	6
MW-9	MW22187-9-1099	10/5/1999	0.1	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-9	MW22187-9-1000	10/18/2000	0.06 J1	< 1	< 1	< 1	< 2	< 1
MW-9	MW22187-9-1001	10/12/2001	< 0.1	< 1	< 1	< 1	< 2	< 5
MW-9	MW22187-9	4/26/2002	0.35	< 1	< 1	< 1	< 2	0.6 J1
MW-9	MW22187-9-1002	10/15/2002	< 0.1	< 1	16	< 1	< 2	0.6
MW-9	MW22187-9-1003	10/16/2003	< 0.096	< 1	< 1	< 1	< 2	< 5
MW-9	MW22187-9-1004	10/25/2004	0.026 J1	< 1	0.47 J1	< 1	< 2	< 5

J	Estimated Value	mg/L	milligram per liter	MTBE	methyl tert-butyl ether
J1	Result is less than the PQL but greater than the MDL	µg/L	microgram per liter	EB	Equipment blank
PQL	Project quantitation limit	NA	not analyzed	TB	Trip blank
MDL	Method detection limit	NS	not sampled	d	Field duplicate sample

[1]BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
TPH-D groundwater cleanup goals correspond to drinking water secondary MCLs.

Notes: Samples analyzed after 1999 were analyzed for BTEX using method SW8260B instead of method SW8021
All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling event. All results were non-detect.

Table 3-2
Summary of Petroleum Hydrocarbons in Groundwater at Site 22187
MCB Camp Pendleton, California

Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
MW-10A	22187-MW10A-609	7/21/1998	0.3 J1	< 0.5	< 0.5 J	< 0.5 J	0.04 J1	NA
MW-10A	MW22187-10A-0199	1/28/1999	0.2 J1	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-10A	MW22187-10A-0599	5/10/1999	0.3 J1	< 0.5	< 0.5	< 0.5	< 1.5	4 J1
MW-10A	MW22187-10A-1099	10/5/1999	0.55	< 0.5	< 0.5	< 0.5	< 1.5	< 5
MW-10A	MW22187-10A-0400	4/4/2000	0.2 J1	< 1	< 1	< 1	< 2	< 5
MW-10A	MW22187-10A-1000	10/18/2000	0.5	< 1	< 1	< 1	< 2	< 0.6
MW-10A	MW22187-10A-0401	4/30/2001	< 0.2	< 1	< 1	< 1	< 2	< 5
MW-10A	MW22187-10A-1001	10/15/2001	< 0.08	< 1	< 1	< 1	< 2	0.8 J1
MW-10A	MW22187-10A	4/26/2002	< 0.096	< 1	< 1	< 1	< 2	0.4 J1
MW-10A	MW22187-10A-1002	10/15/2002	< 0.1	< 1	15	< 1	< 2	0.5
MW-10A	MW22187-10A-0403	4/18/2003	0.15	< 1	< 1	< 1	< 2	< 5
MW-10A	MW22187-10A-1003	10/16/2003	0.069 J1	< 1	< 1	< 1	< 2	0.35 J1
MW-10A	MW22187-10A-0404	4/1/2004	0.1	< 1	< 1	< 1	< 2	< 5
MW-10A	MW22187-10A-1004	10/25/2004	0.11	< 1	< 1	< 1	< 2	0.36 J1
MW-10A	MW22187-10A-0405	4/14/2005	0.27	NA	NA	NA	NA	NA

J	Estimated Value	mg/L	milligram per liter	MTBE	methyl tert-butyl ether
J1	Result is less than the PQL but greater than the MDL	µg/L	microgram per liter	EB	Equipment blank
PQL	Project quantitation limit	NA	not analyzed	TB	Trip blank
MDL	Method detection limit	NS	not sampled	d	Field duplicate sample

[1]BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
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Clean Up Goals [1]			0.1	1	150	680	1750	13
EB	EB-01-0599	5/10/1999	0.04 J1	< 0.5	0.1 J1	1	1.1 J1	1 J1
EB	EB-01-0799	7/20/1999	< 0.5	< 0.5	< 0.5	< 0.5	< 1.5	4 J1
EB	EB-01-1099	10/6/1999	0.02 J1	< 0.5	< 0.5	< 0.5	< 1.5	< 5
EB	EB01-0700	7/25/2000	0.08 J1	< 0.5	< 0.5	< 0.5	< 1.5	NA
EB	EB-02-0799	7/26/2000	NA	< 1	< 1	< 1	< 2	< 5
EB	EB-03-1000	10/18/2000	< 0.5	< 1	< 1	< 1	< 2	< 5
EB	EB-04-1000	10/19/2000	< 0.5	< 1	< 1	< 1	< 2	0.5 J1
EB	EB-01-0201	2/8/2001	< 0.5	< 1	< 1	< 1	< 2	< 5
EB	EB-05-0401	4/30/2001	0.04 J1	< 0.5	< 0.5	1.6	2.4	< 5
EB	EB-03-1001	10/12/2001	0.1	0.2 J1	0.6	1.1	1	NA
EB	EB-04-1001	10/15/2001	0.05 J1	< 1	< 1	< 1	< 2	< 5
EB	QCEB	4/29/2002	0.01 J1	< 1	< 1	< 1	< 2	0.5 J1
EB	QCEB	4/30/2002	0.04 J1	< 1	< 1	< 1	< 2	< 5
EB	QCEB-02-1002	10/15/2002	NA	< 1	< 1	< 1	< 2	< 5
EB	QCEB01-1002	10/16/2002	0.2	NA	NA	NA	NA	NA
EB	QCEB-01-0403	4/22/2003	< 0.096	< 1	0.42 J1	< 1	0.86 J1	< 5
EB	EB-01-1003	10/16/2003	< 0.096	< 1	< 1	< 1	< 2	< 5
EB	EB-01-0404	4/1/2004	< 0.096	< 1	< 1	< 1	< 2	< 5
EB	EB-01-1004	10/25/2004	< 0.096	< 1	< 1	< 1	< 2	< 5
EB	EB-01-0405	4/11/2005	0.014 J1	< 1	< 1	< 1	< 2	< 5

J	Estimated Value	mg/L	milligram per liter	MTBE	methyl tert-butyl ether
J1	Result is less than the PQL but greater than the MDL	µg/L	microgram per liter	EB	Equipment blank
PQL	Project quantitation limit	NA	not analyzed	TB	Trip blank
MDL	Method detection limit	NS	not sampled	d	Field duplicate sample

[1]BTEX and MTBE groundwater cleanup goals correspond to drinking water maximum contaminant levels (MCLs).
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All samples were analyzed for tert-butyl alcohol, ethyl tert-butyl ether, diisopropyl ether and tert-amyl methyl ether during the October 2000 sampling event. All results were non-detect.

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Well	Sample ID	Date	TPH-D (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
Clean Up Goals [1]			0.1	1	150	680	1750	13
TB	TB-01-0599	5/10/1999	NA	< 0.5	< 0.5	< 0.5	< 1.5	< 5
TB	TRIP BLANK	7/20/1999	NA	< 0.5	< 0.5	< 0.5	< 1.5	< 5
TB	TB-02-1099	10/5/1999	NA	< 0.5	0.6	< 0.5	< 1.5	< 5
TB	TB-03-1099	10/6/1999	NA	< 0.5	< 0.5	< 0.5	< 1.5	< 5
TB	TRIP BLANK	1/26/2000	NA	< 1	< 1	< 1	< 2	< 5
TB	TRIP BLANK-1	4/4/2000	NA	< 1	< 1	< 1	< 2	< 5
TB	TB-02-1000	10/18/2000	NA	< 1	< 1	< 1	< 2	< 5
TB	TB-03-1000	10/19/2000	NA	< 1	< 1	< 1	< 2	< 5
TB	TB-01-0201	2/8/2001	NA	< 1	< 1	< 1	< 2	< 5
TB	TB-04-0401	4/30/2001	NA	< 1	< 1	< 1	< 2	< 5
TB	TB-03-1001	10/12/2001	NA	0.2 J1	0.8	1.1	2	NA
TB	TB-04-1001	10/15/2001	NA	< 1	< 1	< 1	< 2	< 5
TB	QCTB	4/26/2002	NA	< 1	< 1	< 1	< 2	< 5
TB	QCTB	4/29/2002	NA	< 1	0.3 J1	< 1	< 2	< 5
TB	QCTB	4/30/2002	NA	< 1	< 1	< 1	< 2	< 5
TB	QCTB-01-1002	10/15/2002	NA	< 1	< 1	< 1	< 2	< 5
TB	QCTB-03-0403	4/18/2003	NA	< 1	< 1	< 1	< 2	< 5
TB	QCTB-05-0404	4/1/2004	NA	< 1	< 1	< 1	< 3	< 5
TB	TB05-1004	10/25/2004	NA	< 1	< 1	< 1	< 2	< 5

J	Estimated Value	mg/L	milligram per liter	MTBE	methyl tert-butyl ether
J1	Result is less than the PQL but greater than the MDL	µg/L	microgram per liter	EB	Equipment blank
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Table 3-3
Biosparging Dissolved Oxygen Data for Site 22187
MCB Camp Pendleton, California

Monitoring Location	BSMP-1-18.5 Distance to BSW-3: 10 ft		BSMP-2-18.5 Distance to BSW-7: 11.5 ft		MW-5 Distance to BSW-2: 4.5 ft		MW-6 Distance to BSW-1: 17 ft		MW-7 Distance to BSW-6: 41 ft		MW-8 Distance to BSW-11: 9.5 ft		MW-9 Distance to BSW-10: 26 ft		MW-10A Distance to BSW-5: 7 ft	
DATE	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)
Baseline monitoring																
04/04/01	0959	4.53	1001	0.91	0951	0.09	0946	0.10	0947	0.10	0921	0.11	0915	0.16	0918	0.13
BV system startup: 04/04/01 11:35																
BS system startup: 04/09/01 09:45																
04/09/01	1015	3.67	1026	1.26	1018	1.45	1033	0.16	-	-	1030	0.27	-	-	1039	0.10
04/09/01	1127	1.73	1125	1.44	1135	1.45	1138	0.11	-	-	1142	0.28	-	-	-	-
04/09/01	1348	3.56	1339	1.80	1330	1.03	1333	0.11	1345	0.09	1352	0.51	1407	0.10	1403	0.08
04/10/01	1516	2.81	1512	0.81	1507	0.09	1502	0.10	1435	0.16	1453	0.11	1444	0.16	1448	0.13
04/11/01	1050	2.60	1055	0.74	1040	0.08	1035	0.08	1030	0.11	1023	0.16	1013	0.15	1018	0.11
04/16/01	1208	2.79	1156	2.57	1150	0.07	1126	0.09	1124	0.15	1134	0.08	1141	0.07	1138	0.07
04/20/01	-	-	1138	1.27	1130	0.07	1133	0.07	1135	0.08	1140	0.07	1145	0.05	1143	0.06
System Shut-Off/Respiration Testing: 04/20/01 12:35																
04/20/01	1344	1.15	1340	1.73	1337	0.16	1338	0.11	1339	0.11	1341	0.10	1343	0.06	1342	0.11
04/20/01	1531	0.23	1541	1.57	1523	0.10	1529	0.08	1530	0.11	1527	0.06	1525	0.10	1523	0.11
04/23/01	0804	0.008	0800	2.61	0755	0.07	0756	0.07	0758	0.09	0802	0.22	0807	0.19	0805	0.34
04/30/01	1220	0.12	1242	2.71	1230	0.07	1234	0.06	1237	0.09	1218	0.09	1206	0.18	1214	0.12
07/11/01	1150	0.19	1220	2.73	1148	0.13	1205	0.13	1207	0.12	1230	0.14	1203	0.26	1201	0.19
System Startup: 07/11/01																
09/25/01	1251	0.26	1300	2.26	1245	0.18	-	-	-	-	-	-	-	-	-	-
System shutdown prior to groundwater sampling event: 09/25/01 13:28																
10/02/01	1203	0.15	1210	0.6	1155	0.14	-	-	-	-	-	-	-	-	-	-
10/15/01	-	-	-	-	1339	0.47	1116	0.46	1020	0.66	1225	2.09	1350	0.51	1312	0.53
System shutdown prior to groundwater sampling event: 04/12/02 07:25																
04/29/02	-	-	-	-	1025	0.00	0951	1.47	0856	3.29	1059	5.28	1402	3.67	1441	0.65
System Restarted BSWs 1-5, 9: 06/24/02 12:45																
07/02/02	1338	0.81	1322	2.62	-	-	-	-	-	-	-	-	-	-	-	-
System pulsed BSWs 6 - 11: 07/02/02 13:45																
07/11/02	1026	0.46	1030	1.62	-	-	-	-	-	-	-	-	-	-	-	-
System pulsed: 07/11/02 through 9/17/02																
System shutdown prior to groundwater sampling event: 09/17/02 10:55																
09/17/02	1115	1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10/15/02	0845	3.37	0930	3.75	-	-	-	-	-	-	-	-	-	-	-	-
10/25/02	0805	1.09	0813	1.96	-	-	-	-	-	-	-	-	-	-	-	-
System restarted BSWs 1-5, 9: 10/25/02 08:20																
10/31/02	1235	0.55	1242	1.16	-	-	-	-	-	-	-	-	-	-	-	-
02/06/03	0837	0.83	0846	4.12	0856	1.12	0850	0.65	-	-	-	-	-	-	0910	2.72
System cycled off: 02/06/03 09:40																
02/07/03	0922	1.65	0931	4.42	0943	1.26	0935	1.4	-	-	-	-	-	-	0949	1.58

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Biosparging Dissolved Oxygen Data for Site 22187
MCB Camp Pendleton, California

Monitoring Location	BSMP-1-18.5 Distance to BSW-3: 10 ft		BSMP-2-18.5 Distance to BSW-7: 11.5 ft		MW-5 Distance to BSW-2: 4.5 ft		MW-6 Distance to BSW-1: 17 ft		MW-7 Distance to BSW-6: 41 ft		MW-8 Distance to BSW-11: 9.5 ft		MW-9 Distance to BSW-10: 26 ft		MW-10A Distance to BSW-5: 7 ft	
DATE	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)	Time	DO (mg/L)
02/10/03	0817	0.87	0758	3.98	0810	0.81	0805	1.06	-	-	-	-	-	-	0827	1.4
System cycled on BSWs 1-5, 9: 2/17/03 12:30																
System shutdown prior to groundwater sampling event: 04/01/03 08:41																
04/17/03	-	-	-	-	1335	2.88	1307	1.86	1221	1.38	1132	5.07	-	-	1243	3.3
04/17/03	-	-	-	-	1335	0.45	1314	0.19	1227	0.21	1148	1.75	-	-	1250	0.33
System cycled on BSWs 1-5, 9: 4/23/03 07:40																
07/15/03	1554	0.36	-	-	1554	0.24	1554	0.27	-	-	-	-	-	-	1554	0.21
System shutdown prior to groundwater sampling event: 09/22/03 14:21																
10/16/03	-	-	-	-	1518	1.4	1423	0.08	1316	0.28	22.04	0.22	1222	0.44	1350	0.12
System cycled on BSWs 1-5, 9: 11/06/03 12:30																
System shutdown prior to groundwater sampling event: 03/19/04 0900																
04/01/04	-	-	-	-	1504	2.07	1426	0.27	1355	0.2	1340	0.21	-	-	1304	0.67
System cycled on BSWs 1-5, 9: 04/16/04 0710																
System shutdown prior to groundwater sampling event: 09/21/04																
09/21/04	-	0.26	-	-	-	0.64	-	0.28	-	-	-	-	-	-	-	0.35
09/22/04	-	0.39	-	-	-	0.67	-	0.50	-	-	-	-	-	-	-	0.54
10/02/04	-	0.16	-	-	-	0.12	-	0.09	-	-	-	-	-	-	-	0.18
10/25/04	-	-	-	-	1232	1.4	1142	0.77	1113	1.2	1047	1.56	945	1.22	1023	0.89
System cycled on BSWs 1-5, 9: 11/10/04																
02/02/05	-	0.56	-	-	-	0.96	-	1.03	-	-	-	-	-	0.59	-	1.14
03/17/05	-	3.35	-	-	-	0.87	-	0.60	-	-	-	-	-	0.64	-	0.82
System shut down with RWQCB approval: 03/17/05																
03/22/05	1115	4.01	-	-	-	0.85	-	0.88	-	-	-	-	-	0.51	-	0.39
03/31/05	0810	3.58	0810	2.44	0810	4.49	0810	2.82	-	-	-	-	-	-	0810	1.38

ft = feet
mg/L = milligrams per liter
DO = dissolved oxygen
NM = not measured

Table 3-4
Summary of Groundwater Geochemical Data at Site 22187
MCB Camp Pendleton, California

Well	Date	DO (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Fe (II) (mg/L)	CH4 (µg/L)	ORP (mV)	CO2 (ppm)	Alkalinity (mg/L)
MW4	6/12/1997	NA	<4	906	NA	NA	NA	NA	1420
MW4	10/28/1997	7.4	<3.2	959	ND	<3	75	NA	1430
MW4	2/6/1998	5.21	<3.2	866	ND	<3	148	NA	1380
MW4	4/6/1998	10.93	<3.2	1060	ND	4.76	136	NA	1430
MW4	7/22/1998	0.48	20J1	1500	0.15	<3	98.8	27	1700
MW4	1/28/1999	1.1	<40	2100	0.05	<3	NA	41	880
MW5	6/11/1997	NA	<0.8	256	NA	NA	NA	NA	567
MW5	10/28/1997	2	<0.8	257	2.4	547	-75	NA	675
MW5	2/6/1998	0.64	<1	230	ND	570	110	NA	611
MW5	4/6/1998	2.98	<0.5	151	2.2	1170	-101	NA	892
MW5	7/21/1998	0.14	<4	140	1.31	740	-96.7	28	700
MW5	1/28/1999	0.35	<4	130	1.97	1700	NA	36	960
MW5	**4/14/2005**	**1.47[1]**	**4.2 J1**	**360**	**0.061**	**5.8**	**-76.6[1]**	**NA**	**520**
MW6	6/11/1997	NA	<0.8	246	NA	NA	NA	NA	713
MW6	10/28/1997	4.2	<0.8	223	1.6	39	-50	NA	853
MW6	2/6/1998	0.88	<1	210	2	370	-22	NA	799
MW6	4/6/1998	3.27	<0.8	190	1.2	8.75	-60	NA	662
MW6	7/21/1998	0.2	<4	200	1.31	110	-32.5	39	780
MW6	1/28/1999	0.41	<4	250	1.27	560	NA	38	1040
MW6	**4/14/2005**	**0.31[1]**	**9.3**	**240**	**< 0.05**	**29**	**-80.1[1]**	**NA**	**520**
MW7	6/12/1997	NA	<0.8	256	NA	NA	NA	NA	691
MW7	10/28/1997	2.6	<0.8	245	ND	76.1	85	NA	861
MW7	2/6/1998	1.68	<1.0	230	ND	52	170	NA	844
MW7	4/6/1998	1.56	<0.8	276	ND	31	177	NA	773
MW7	7/22/1998	0.02	3 J1	260	0.02	<3	98.5	30	800
MW7	1/28/1999	0.42	<4	390	0.0	3J1	NA	41	880
MW7	**4/14/2005**	**0.66[1]**	**1.6 J1**	**250**	**0.2**	**< 3**	**74[1]**	**NA**	**250**
MW8	6/12/1997	NA	<2.0	513	NA	NA	NA	NA	699
MW8	10/28/1997	4.45	<1.6	451	0.3	575	15	NA	733
MW8	2/6/1998	3.12	<1.6	401	ND	690	155	NA	768
MW8	4/6/1998	8.85	<1.0	385	ND	33	96	NA	781
MW8	7/22/1998	0.37	3 J1	390	0.38	190	102	36	900
MW8	1/28/1999	0.5	<8	460	0.10	56	NA	16	880
MW8	**4/14/2005**	**3.46[1]**	**7.8**	**630**	**0.17**	**8.1**	**106.7[1]**	**NA**	**190**
MW9	6/11/1997	NA	<0.8	242	NA	NA	NA	NA	558
MW9	10/28/1997	2.7	<0.8	253	ND	106	35	NA	626
MW9	2/6/1998	1.49	<1.0	340	ND	370	-106	NA	710
MW9	4/6/1998	3.47	<1.6	350	ND	178	-163	NA	666
MW9	7/21/1998	0.03	<4	210	0.04	64	87.6	30	620
MW9	1/28/1999	0.40	<2	300	0.00	200	NA	29	800
MW10	6/11/1997	NA	<0.4	186	NA	NA	NA	NA	973
MW10	2/6/1998	NA	0.2	52	NA	3100	NA	NA	906
MW10	4/6/1998	NA	NA	NA	NA	NA	NA	NA	NA
MW10	-	Well abandoned after 4/6/98 and replaced by MW10A.							
MW10A	7/21/1998	0.53	3 J1	330	0.35	39	92.3	15	840
MW10A	1/28/1999	0.2	<4	320	0.30	49	NA	27	880
MW10A	**4/14/2005**	**0.42[1]**	**3.3 J1**	**410**	**0.18**	**< 3**	**154.9[1]**	**NA**	**550**

DO	Dissolved Oxygen	ppm	Parts per million by volume
Fe (II)	Ferrous iron	mg/L	milligrams per liter
CH4	Methane	µg/L	micrograms per liter
ORP	Oxidation-reduction potential	mV	millivolts
CO2	Carbon dioxide	NA	Not available
J	Estimated value	MDL	method detection limit
J1	Result is less than the CRDL but greater than the MDL		
CRDL	contract required detection limit		

Bold indicates results from the most recent sampling event.

[1] Field measurement obtained during purging

Table 3-5
Biosparging/Bioventing Soil Gas Data for Site 22187
MCB Camp Pendleton, California

Monitoring Location	BSMP-1-6.5 20.5 ft from BVW-1; 10 ft from BSW-3				BSMP-2-7 11.5 ft from BSW-7				MW-5 4.5 ft from BVW-1/BSW-2				MW-6 16 ft from BSW-1			
DATE	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)
Baseline monitoring																
04/04/01	1031	<1	13.0	128.6	Unable to obtain sample				1111	10.5	4.4	59.1	-	-	-	-
BV system startup: 04/04/01 11:35																
04/04/01	1247	<1	12.7	22.1	-	-	-	-	1240	8.4	5.6	67.9	-	-	-	-
04/04/01	1347	<1	12.2	26.0	-	-	-	-	1342	9.4	5.0	79.5	-	-	-	-
04/04/01	1443	<1	10.8	27.8	-	-	-	-	1437	10.1	4.1	88.1	-	-	-	-
04/06/01	1038	<1	12.7	37.2	-	-	-	-	1040	11.5	3.9	117.7	-	-	-	-
04/09/01	0806	<1	12.2	21.9	-	-	-	-	0804	14.2	2.6	87.2	-	-	-	-
BV system shut-off: 04/09/01 08:38																
BS system startup: 04/09/01 09:45																
04/09/01	1052	<1	12.4	24.0	-	-	-	-	1104	19.9	1.6	313.4	-	-	-	-
04/09/01	1331	2.2	11.8	16.1	-	-	-	-	1342	20.2	0.8	354.1	-	-	-	-
04/10/01	0856	18.7	2.5	64.9	-	-	-	-	0857	20.5	0.3	405.2	-	-	-	-
04/11/01	1104	19.8	1.5	102.1	-	-	-	-	1037	20.9	0.2	303.1	-	-	-	-
04/16/01	1218	20.3	0.6	7.4	-	-	-	-	1150	20.9	0.1	177.9	-	-	-	-
04/20/01	1145	20.6	0.6	2.6	-	-	-	-	1130	20.9	0.4	352.0	-	-	-	-
BS system shut down/respiration testing: 04/20/01 12:35																
04/20/01	1340	20.5	0.8	6.5	-	-	-	-	1337	20.6	0.4	222.0	-	-	-	-
04/20/01	1524	20.5	0.8	7.6	-	-	-	-	1523	19.7	0.4	189.8	-	-	-	-
04/23/01	0859	12.6	1.2	4.4	-	-	-	-	0855	13.9	0.6	61.3	-	-	-	-
04/30/01	1303	1.7	3.6	7.2	-	-	-	-	-	-	-	-	-	-	-	-
07/11/01	1315	<1	<1	7.5	-	-	-	-	1326	14.5	2.6	59.9	-	-	-	-
System startup: 07/11/01																
09/25/01	1247	16.8	3.5	220	-	-	-	-	1240	20.9	0.4	140	-	-	-	-
System shutdown prior to groundwater sampling event: 09/25/01 13:28																
10/02/01	1255	0.7	7.8	140	-	-	-	-	1245	20.9	0.1	0	-	-	-	-
System restarted: 10/31/01 10:45																
System cycled off: 02/15/02 12:50																
02/26/02	0815	15.6	1.2	-	-	-	-	-	0809	19.5	0.25	1.2	-	-	-	-
System restarted: 02/26/02 08:20																
System cycled off: 03/8/02 06:57																
System restarted: 03/19/02 16:18																

Table 3-5
Biosparging/Bioventing Soil Gas Data for Site 22187
MCB Camp Pendleton, California

Monitoring Location	BSMP-1-6.5 20.5 ft from BVW-1; 10 ft from BSW-3				BSMP-2-7 11.5 ft from BSW-7				MW-5 4.5 ft from BVW-1/BSW-2				MW-6 16 ft from BSW-1			
DATE	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)
System cycled off: 03/28/02 10:30																
03/28/02	1040	20.7	0.4	0.0	-	-	-	-	1045	20.9	0.0	0.0	-	-	-	-
04/04/02	1021	2.1	3.8	0.0	-	-	-	-	1045	20.9	0.1	0	-	-	-	-
System restarted: 04/04/02 10:25																
System shutdown prior to groundwater sampling event: 04/12/02 07:25																
04/22/02	1318	<1	6.8	-	-	-	-	-	1314	17.2	0.8	-	-	-	-	-
05/02/02	-	-	-	-	-	-	-	-	955	18.7	0.35	-	-	-	-	-
System restarted: 05/02/02																
System cycled off: 05/16/02 11:25																
05/22/02	0805	5.4	2.8	0.0	-	-	-	-	-	-	-	-	-	-	-	-
System restarted: 05/22/02 8:08																
System cycled off: 05/30/02 11:31																
05/30/02	1142	18.7	0.9	>10K	-	-	-	-	-	-	-	-	-	-	-	-
06/24/02	1215	0.7	9.6	0.0	-	-	-	-	-	-	-	-	-	-	-	-
System pulsed BSWs 1-5, 9: 06/24/02 12:45																
07/02/02	1338	19.8	0.9	0.0	-	-	-	-	-	-	-	-	-	-	-	-
System pulsed BSWs 6 - 11: 07/02/02 13:45																
07/11/02	1045	7.5	9.5	0.0	-	-	-	-	-	-	-	-	-	-	-	-
System pulsed BSWs 1-5, 9: 07/11/02 10:55																
07/26/02	0850	19.9	1.1	0.0	-	-	-	-	-	-	-	-	-	-	-	-
System pulsed BSWs 6 - 11: 07/26/02 09:00																
08/02/02	1145	2.2	>20	-	-	-	-	-	-	-	-	-	-	-	-	-
System pulsed BSWs 1-5, 9: 08/02/02 11:55																
08/16/02	0852	19.2	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-
System cycled off: 08/16/02 08:58																
System cycled on BSWs 1-5, 9: 08/22/02 07:00																
System cycled off: 09/17/02 10:55																
09/17/02	1115	17.2	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/02	1035	1.6	5.7	-	-	-	-	-	-	-	-	-	-	-	-	-
10/15/02	0845	0.3	>5	-	-	-	-	-	-	-	-	-	-	-	-	-
10/25/02	0805	0.6	10.8	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3-5
Biosparging/Bioventing Soil Gas Data for Site 22187
MCB Camp Pendleton, California

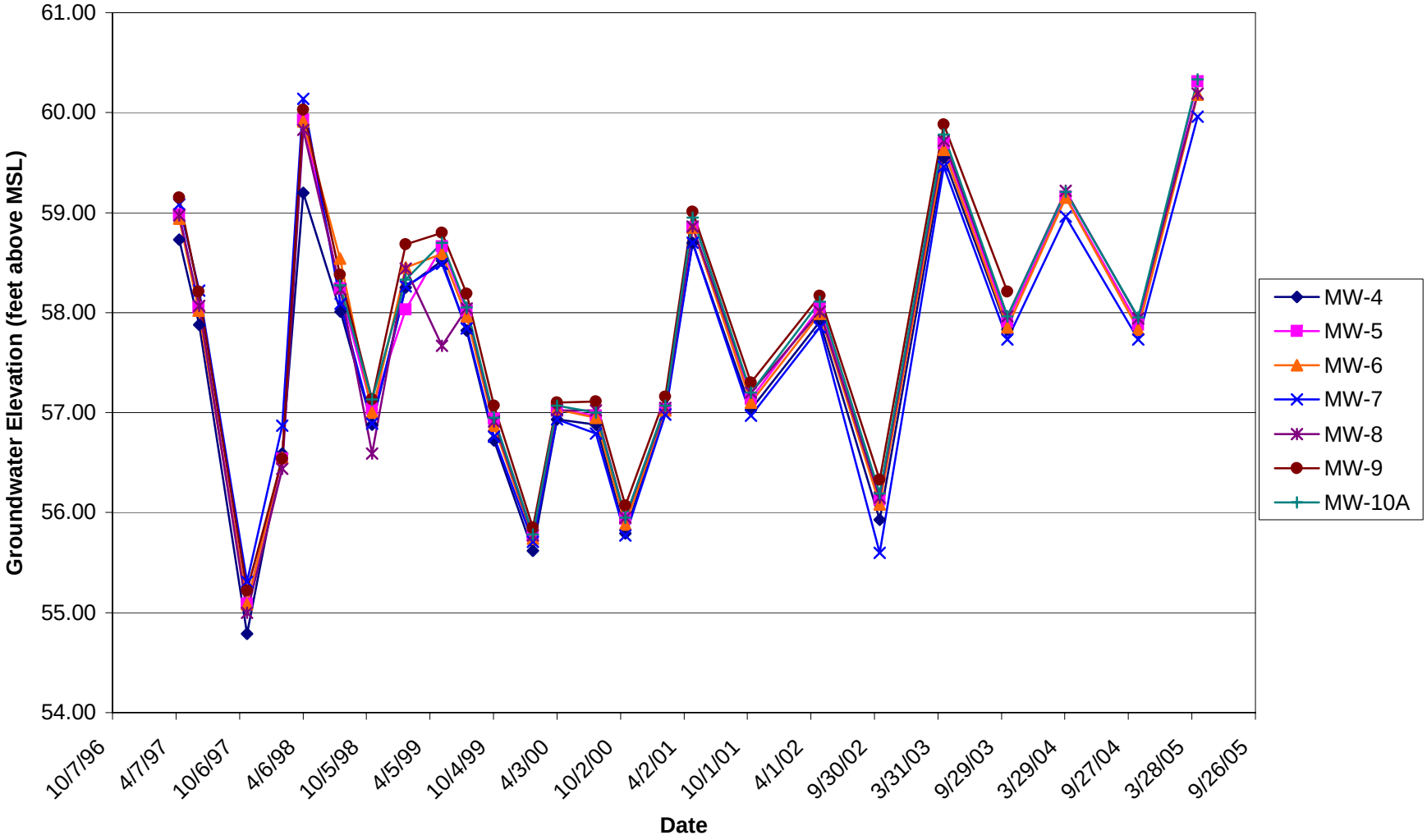
Monitoring Location	BSMP-1-6.5 20.5 ft from BVW-1; 10 ft from BSW-3				BSMP-2-7 11.5 ft from BSW-7				MW-5 4.5 ft from BVW-1/BSW-2				MW-6 16 ft from BSW-1			
DATE	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)	Time	O_2 (%)	CO_2 (%)	TVH (ppmv)
System cycled on BSWs 1-5, 9: 10/25/02 08:20																
10/31/02	1235	19.1	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-
11/15/02	0810	20.6	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
02/06/03	0902	18.4	0.4	0.0	907	15.5	0.6	0.0	0915	19.0	0.0	16.5	0911	19.0	0.0	0.0
System shutdown for respiration test: 02/06/03 09:20																
02/07/03	1001	18.8	0.3	0.0	936	16.4	0.6	2.1	0951	20.5	0.0	2.1	0945	20.9	0.0	0.0
02/10/03	0823	12.1	1.0	1.3	800	17.7	0.6	0.6	0818	19.1	0.0	13.2	0811	21.0	0.0	0.1
02/14/03	0856	3.2	2.5	4.9	0833	17.6	0.5	0	0848	20.1	0.0	3.5	0843	19.4	0.0	0.5
System cycled on BSWs 1-5, 9: 2/17/03 12:30																
System shutdown prior to groundwater sampling event: 04/01/03 08:41																
System cycled on BSWs 1-5, 9: 4/23/03 07:40																
09/22/03	1340	20.9	0	0.3	1406	21	0.2	0.9	-	-	-	-	-	-	-	-
System shutdown prior to groundwater sampling event: 09/22/03 14:21																
09/24/03	1200	16.9	0.3	212	1212	21.1	0.3	0.4	-	-	-	-	-	-	-	-
09/29/03	0940	6.1	2.2	1.6	0952	20.9	0.3	2.3	-	-	-	-	-	-	-	-
10/06/03	1036	2.8	3.7	33.4	1047	20.5	0.6	7.4	-	-	-	-	-	-	-	-
System cycled on BSWs 1-5, 9: 11/06/03 12:30																
03/19/04	-	20.8	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-
System shutdown prior to groundwater sampling event: 03/19/04 0900																
03/22/04	-	20.4	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/04	-	17.1	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-
04/16/04	-	3.0	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-
System cycled on BSWs 1-5, 9: 04/16/04 0710																
System shutdown prior to groundwater sampling event: 09/21/04 0900																
09/21/04	-	19.3	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/04	-	19.4	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-
10/02/04	-	6.4	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-
System cycled on BSWs 1-5, 9, 11: 11/10/04																
System shut down with RWQCB approval: 03/17/05																
03/31/05	0810	12.7	0.8	0.6	0810	21.5	0.1	0.5	810	17.7	0.3	0.7	0810	20.8	0.3	0.2
04/18/05	1140	2.5	2.6	0.0	1140	14.4	0.5	0.0	1140	17.5	0.8	0.0	1140	21.2	0.2	0.0

ft = feet
% = percent
ppmv = parts per million by volume

in H_2O = inches of water
O_2 = oxygen
CO_2 = carbon dioxide

TVH = total volatile hydrocarbons
Press = pressure
NM = not measured

Figure 3-1
Site 22187 Hydrograph



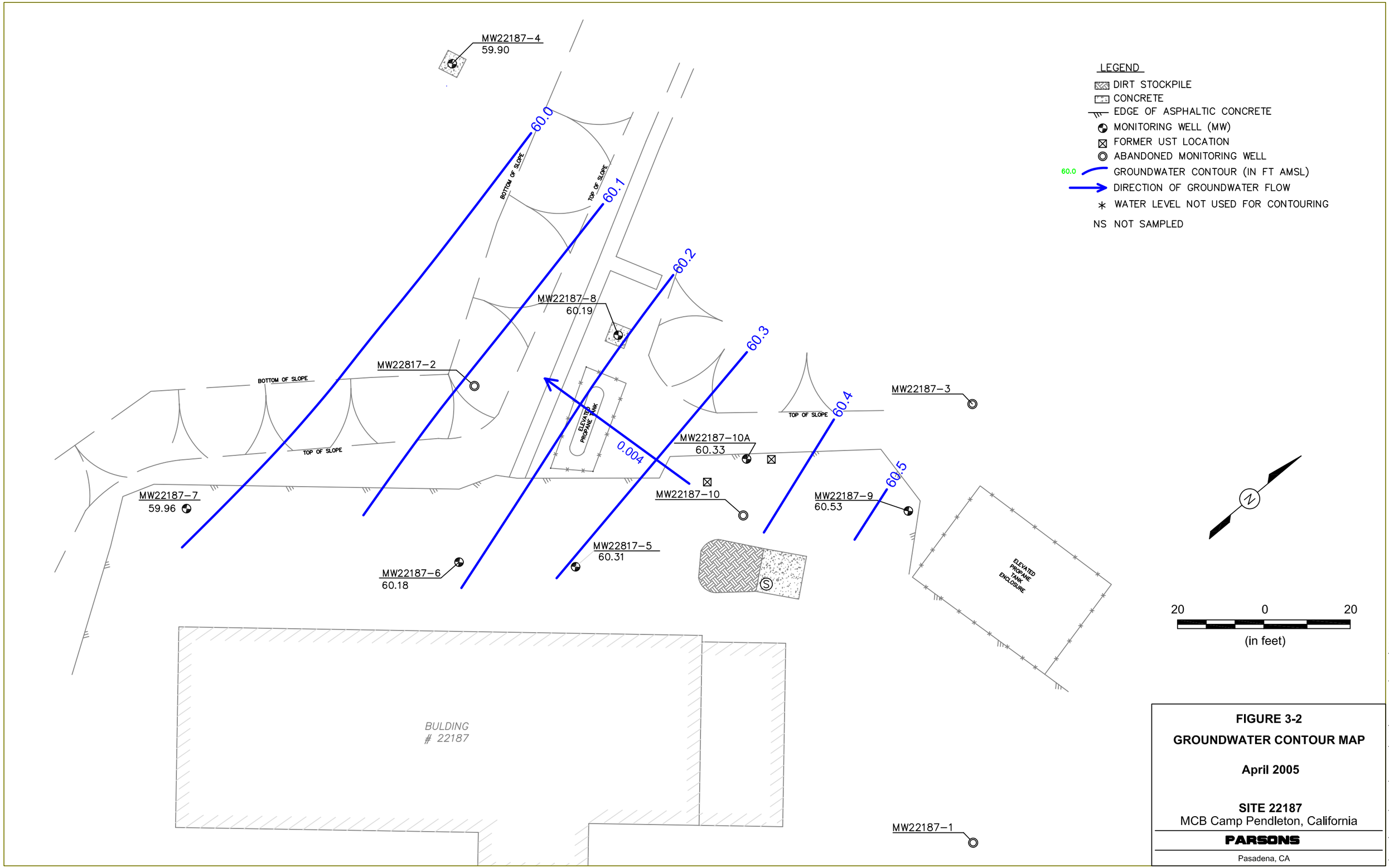


FIGURE 3-2

GROUNDWATER CONTOUR MAP

April 2005

SITE 22187
MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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Figure 3-3
TPH-D Concentration vs Groundwater Elevation for Selected Well at Site 22187

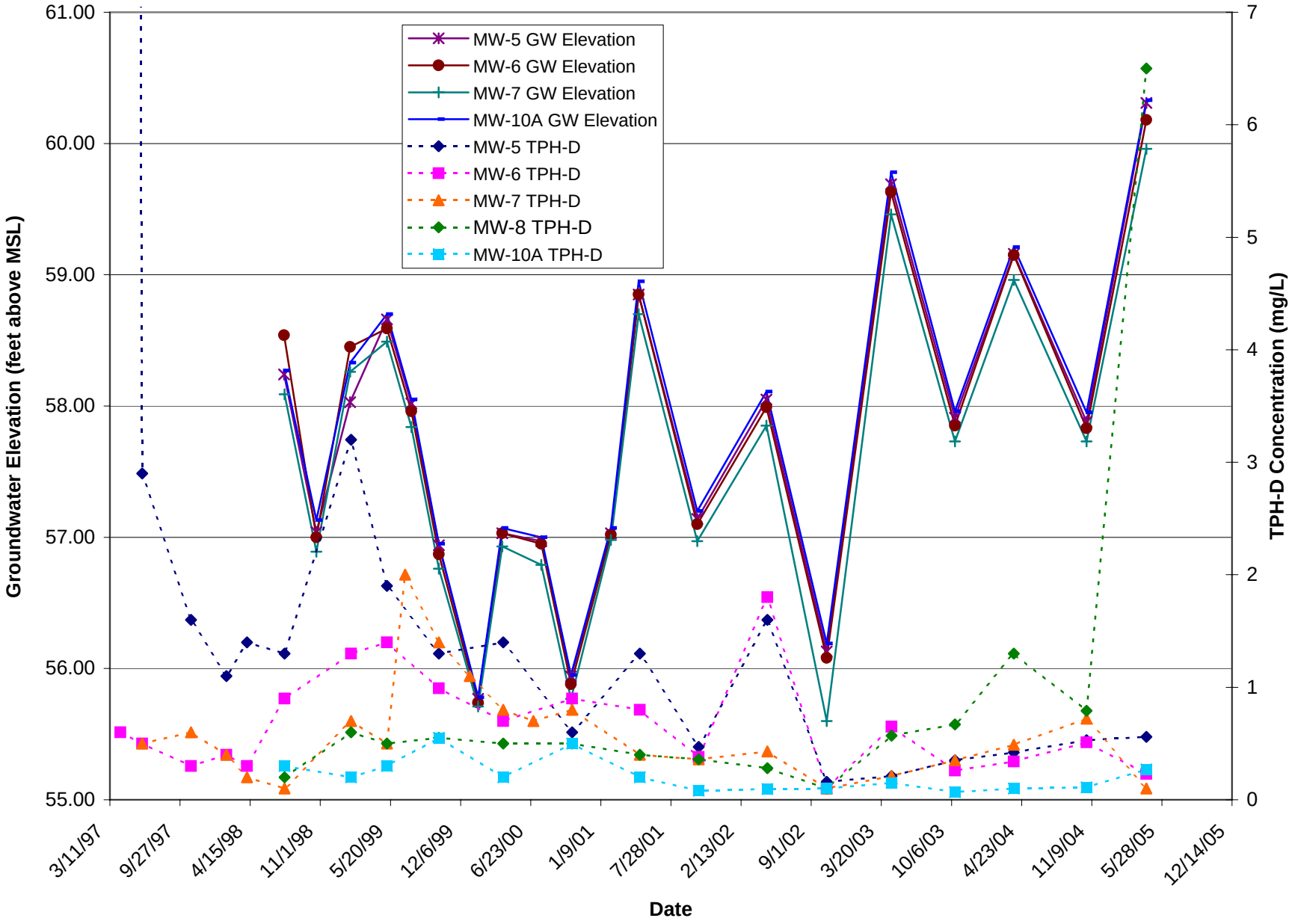
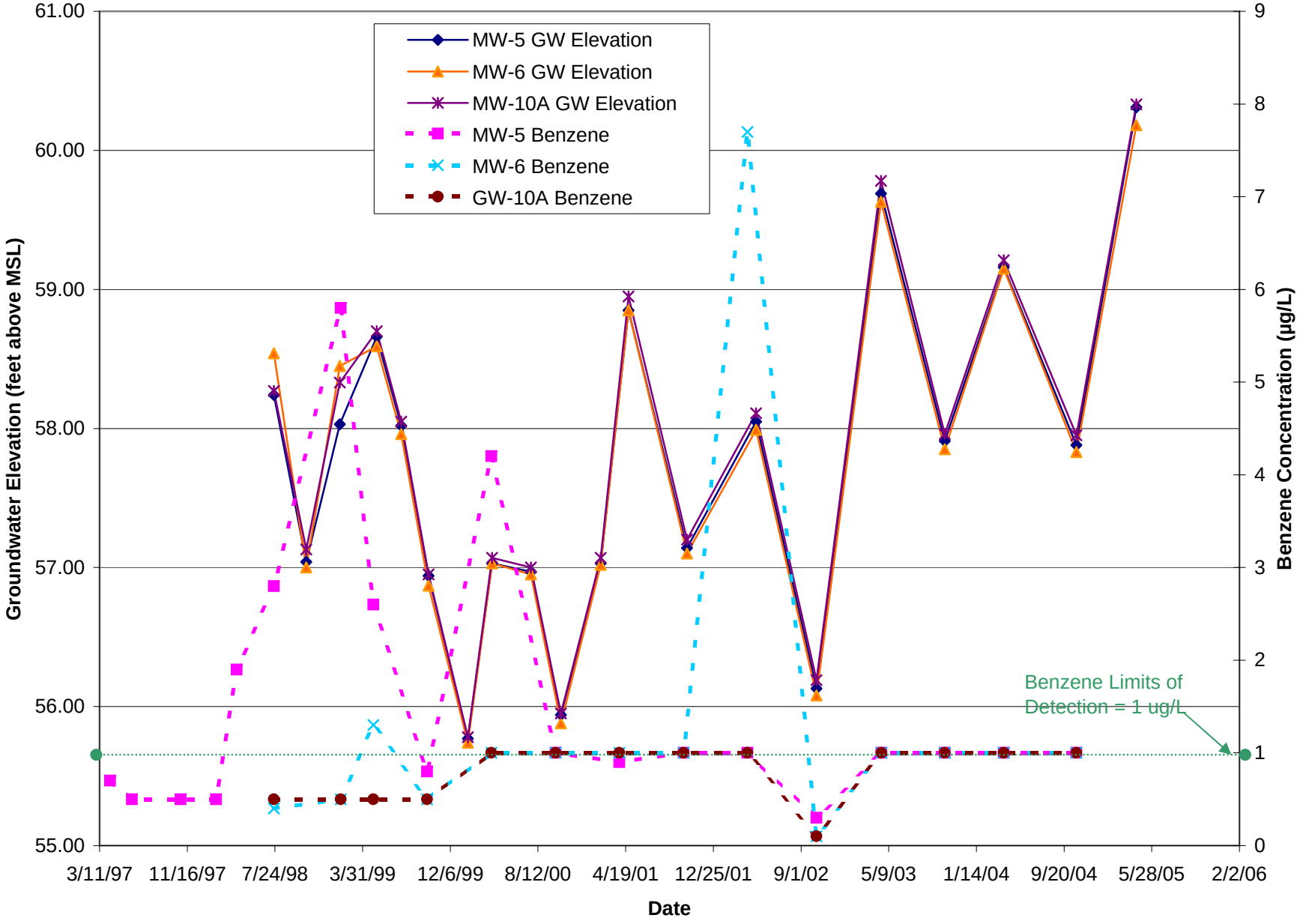


Figure 3-4

Benzene Concentration verses Groundwater Elevation for Selected Wells at Site 22187



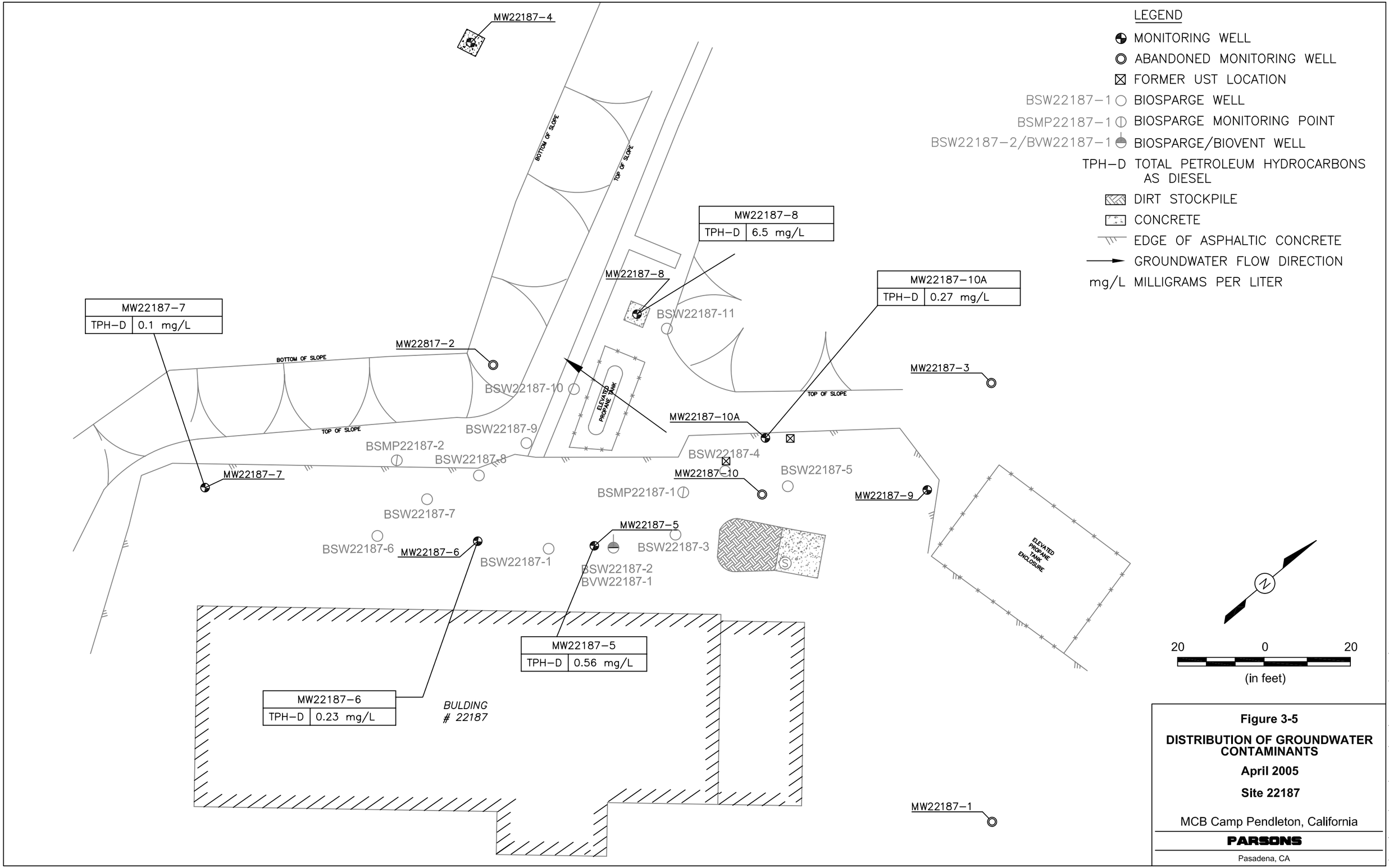


Figure 3-5

DISTRIBUTION OF GROUNDWATER CONTAMINANTS

April 2005

Site 22187

MCB Camp Pendleton, California

PARSONS

Pasadena, CA

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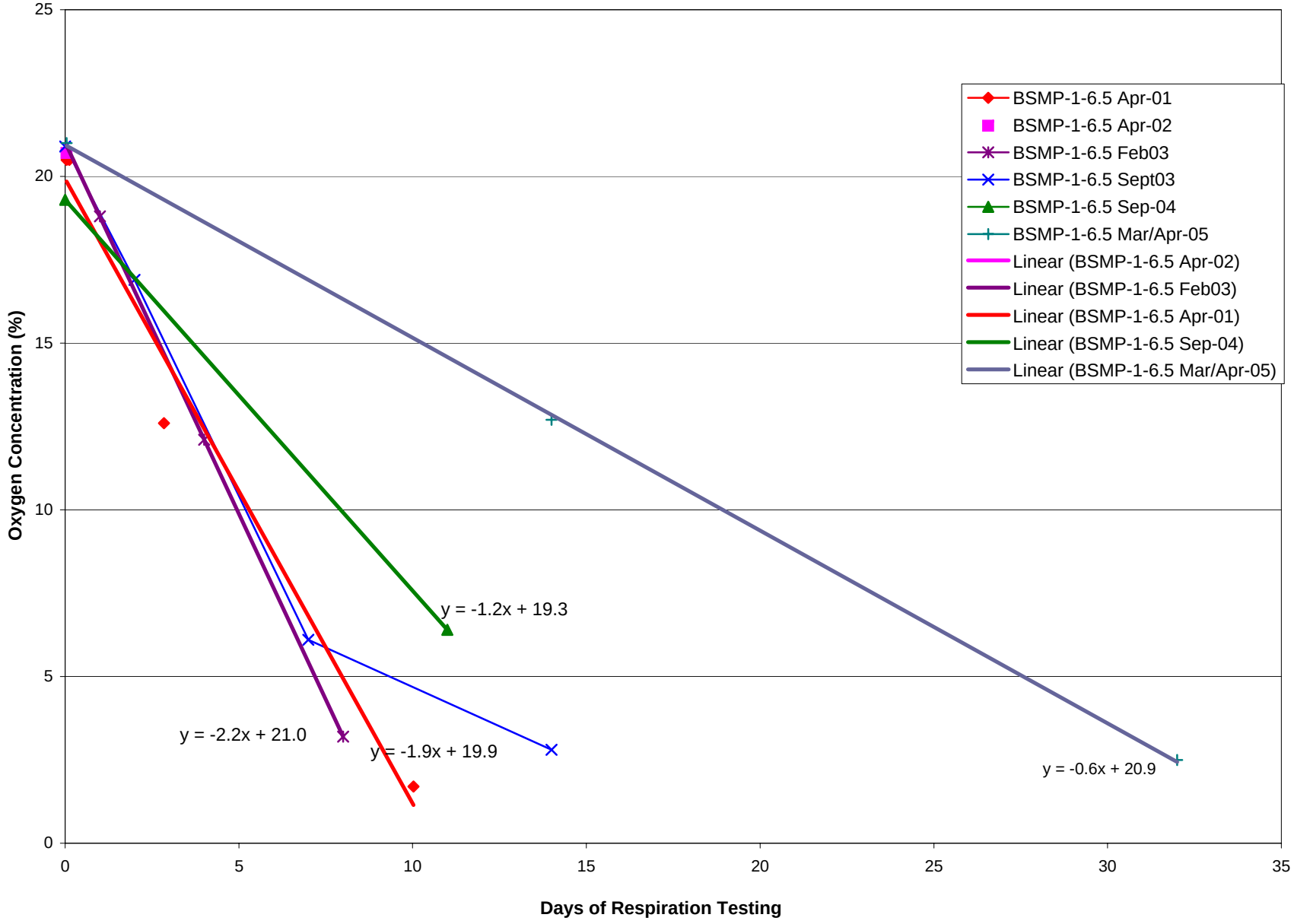
Figure 3-6
Oxygen Utilization at Site 22187



SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

The following section presents conclusions, recommendations and the project schedule for Site 22187.

4.1 CONCLUSIONS

The following summarizes the results for the April 2005 groundwater monitoring event and BS operation at Site 22187.

1) The hydraulic gradient calculated for this site was 0.004 west. This is consistent with previous events.
2) TPH-D was again detected in five MWs between the secondary MCL cleanup goal of 0.1 mg/L. While most measured TPH-D concentrations were within the range of historical concentrations, MW22187-8 increased from 0.79 mg/L in October 2004 to 6.5 mg/L this event.
3) BTEX and MTBE were not analyzed this event because the cleanup goals have been met for these compounds in all MWs.
4) During recent monitoring, DO concentrations were only occasionally observed above 2 mg/L. Due to physical subsurface limitations and non-uniform air distribution, the biosparging has had limited success in increasing DO concentrations.
5) The geochemical data collected during this monitoring event present only weak evidence of anaerobic biodegradation within portions of the plume. It is likely that the active BS operation is currently counteracting the widespread formation of anaerobic biodegradation conditions.
6) Oxygen utilization rates measured at Site 22187 further decreased to 0.6%/day. These measurements indicate that residual contamination has been reduced and that the BS system may be nearing the end of its ability to remove residual vadose zone contamination near the former source area.

4.2 RECOMMENDATIONS

Based on the above conclusions and monitoring data, the following are recommendations for Site 22187:

1) Discontinue operation of the BS blower and allow natural anaerobic biodegradation processes to resume at the site.
2) Perform one additional year of semiannual groundwater monitoring to insure that rebound in TPH-D concentrations does not occur and that the TPH-D plume is stable. Include analysis of geochemical parameters (e.g., sulfate, iron, methane, alkalinity) in one of these events to further evaluate anaerobic biodegradation.

3) After the rebound period, evaluate the potential for no further action based on the fact that primary MCLs have been met and achieving the secondary MCL for TPH-D may be impractical at the site.

4) If rebound is observed, continue annual groundwater monitoring each winter/spring (e.g., April).

5) If the primary MCLs continue to be met and TPH-D concentrations are not migrating, request no further action.

SECTION 5

REFERENCES

California Regional Water Quality Control Board (RWQCB), San Diego Region, 2002, "Letter Report on the Pilot Biosparging and Bioventing Remediation System Installation & Startup Results for Site 22187, Marine Corps Base Camp Pendleton." Letter dated April 30.

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Leeson, Andrea, and R. E. Hinchee, 1997. *Soil Bioventing: Principles and Practice*. Lewis Publishers, Boca Raton, FL.

Parsons, 2000a, *Final Remediation Work Plan for Underground Storage Tank Site 22187, MCB Camp Pendleton, California*, January 17.

Parsons, 2000b, *Response to Comments, Final Remediation Work Plans for Sites 1121, 1131, 2404, 2296, 22187, 43302, 53435, and H-49 at Marine Corps Base Camp Pendleton, California; Comments from Regional Water Quality Control Board Dated 16 May 2000*, June 28.

Parsons, 2001a, *Letter Report on the Biosparging Remediation System Installation and Startup Results for Site 22187, Marine Corps Base Camp Pendleton, California*, August 8.

Parsons, 2001b, *Operation & Maintenance (O&M) Manual for Bioventing and Biosparging Systems; Remediation Project: Underground Storage Tank Sites 1121, 2296, 22187, 43302, 53435, and H-49, Marine Corps Base, Camp Pendleton, California*, July 3.

United States Environmental Projection Agency (USEPA), 2004, *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites*, 410-R-04-002, May 1995, updated May 2004.

APPENDIX A

HISTORICAL DATA

Table A-1
Historical Groundwater Elevations, Site 22187, MCB Camp Pendleton

WELL	DATE	Well Head Elevation (feet above MSL)	Depth to Water (feet)	Depth to Product (feet)	Product Thickness (feet)	Corrected GW Elevation (feet above MSL)
MW1	4/16/97	68.72	10.92	ND	0.00	57.80
MW2			— Abandoned —			
MW3			— Abandoned —			
MW4	4/16/97	63.50	4.77	ND	0.00	58.73
MW4	6/12/97		5.62	ND	0.00	57.88
MW4	10/28/97		8.71	ND	0.00	54.79
MW4	2/6/98		6.91	ND	0.00	56.59
MW4	4/6/98		4.30	ND	0.00	59.20
MW5	4/16/97	70.15	11.17	ND	0.00	58.98
MW5	6/11/97		12.10	ND	0.00	58.05
MW5	10/28/97		15.06	ND	0.00	55.09
MW5	2/6/98		13.61	ND	0.00	56.54
MW5	4/6/98		10.22	ND	0.00	59.93
MW6	4/16/97	70.45	11.51	ND	0.00	58.94
MW6	6/11/97		12.43	ND	0.00	58.02
MW6	10/28/97		15.37	ND	0.00	55.08
MW6	2/6/98		13.90	ND	0.00	56.55
MW6	4/6/98		10.54	ND	0.00	59.91
MW7	4/17/97	70.11	11.37	ND	0.00	58.74
MW7	6/12/97		12.23	ND	0.00	57.88
MW7	10/28/97		15.14	ND	0.00	54.97
MW7	2/6/98		13.58	ND	0.00	56.53
MW7	4/6/98		10.31	ND	0.00	59.80
MW8	4/16/97	72.09	13.12	ND	0.00	58.97
MW8	6/12/97		14.02	ND	0.00	58.07
MW8	10/28/97		17.09	ND	0.00	55.00
MW8	2/6/98		15.65	ND	0.00	56.44
MW8	4/6/98		12.26	ND	0.00	59.83
MW9	4/16/97	69.78	10.63	ND	0.00	59.15
MW9	6/11/97		11.57	ND	0.00	58.21
MW9	10/28/97		14.56	ND	0.00	55.22
MW9	2/6/98		13.24	ND	0.00	56.54
MW9	4/6/98		9.75	ND	0.00	60.03
MW10	4/16/97	69.74	10.31	ND	0.00	59.43
MW10	6/11/97		11.60	ND	0.00	58.14
MW10	10/28/97		[1]	[1]	[1]	[1]
MW10	2/6/98		[1]	[1]	[1]	[1]
MW10	4/6/98		[1]	[1]	[1]	[1]

Explanation:
[1] *MW10 contained free product and was not measured*
ND = Not detected

Table A-2

Historical Hydrocarbons in Groundwater, Site 22187, MCB Camp Pendleton

	CONSTITUENT:		TPH-D	TPH-M	Benzene	Toluene	Ethylbenzene	Xylenes
		METHOD:	M8015 LUFT	M8015 LUFT	EPA-8020	EPA-8020	EPA-8020	EPA-8020
		UNITS:	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L
WELL	SAMPLE	DATE						
B4	114	4/14/97	9	<3	<0.5	<0.5	<0.5	<1.5
B5	126	4/14/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW1	172	4/18/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	360	6/12/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	455	10/28/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	537	2/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	538	2/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW4	588	4/6/98	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW5	096	4/10/97	63	NA	0.7	<0.5	14.5	4.1
MW5	345	6/11/97	2.9	0.7	<0.5	<0.5	1.0	<1.5
MW5	452	10/28/97	1.6	<0.5	<0.5	<0.5	<0.5	<1.5
MW5	533	2/6/98	1.1	<0.5	<0.5	<0.5	<0.5	<1.5
MW5	585	4/6/98	1.4	<0.5	1.9	<0.5	2.4	<1.5
MW6	098	4/11/97	0.6	NA	<0.5	<0.5	<0.5	<1.5
MW6	344	6/11/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW6	451	10/28/97	0.3 J	<0.5	<0.5	<0.5	<0.5	<1.5
MW6	532	2/6/98	0.4 J	<0.5	<0.5	<0.5	<0.5	<1.5
MW6	584	4/6/98	0.3 J	<0.5	<0.5	<0.5	<0.5	<1.5
MW7	353	6/12/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW7	450	10/28/97	0.6	<0.5	<0.5	<0.5	<0.5	<1.5
MW7	531	2/6/98	0.4 J	<0.5	<0.5	<0.5	<0.5	<1.5
MW7	583	4/6/98	0.2 J	<0.5	<0.5	<0.5	<0.5	<1.5
MW8	127	4/14/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW8	354	6/12/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW8	454	10/28/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW8	455	2/6/98	0.2 J	0.2 J	<0.5	<0.5	<0.5	<1.5
MW8	587	4/6/98	0.2 J	<0.5	<0.5	<0.5	<0.5	<1.5
MW9	170	4/17/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW9	347	6/11/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW9 (dupe)	348	6/11/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW9	453	10/28/97	<0.5	<0.5	<0.5	<0.5	<0.5	<1.5
MW9	534	2/6/98	0.1 J	<0.5	<0.5	<0.5	<0.5	<1.5
MW9	586	4/6/98	0.2 J	<0.5	<0.5	<0.5	<0.5	0.7 J
MW10 (B3-099)		4/11/97	810	NA	<0.5	<0.5	<0.5	<1.5
MW10	346	6/11/97	5.8	2.0	1.8	1.9	2.4	4.1
MW10	539	2/6/98	8	<5	4.4	8.6	10.3	7.8
MW10		4/6/98	*	*	*	*	*	*

Explanation:

J = Estimated value
**MW10 contained free product*
M8015E = Modified Method 8015 - Extractables
mg/L = milligrams per liter
NA = Not analyzed
TPH-D = Total Petroleum Hydrocarbons as Diesel
TPH-M = Total Petroleum Hydrocarbons as Motor Oil
µg/L = micrograms per liter

Table A-3
Free Product Analysis, Site 22187, MCB Camp Pendleton

CONSTITUENT:		TPH-D	TPH-M	Benzene	Toluene	Ethylbenzene	Xylenes
METHOD:		M8015 LUFT	M8015 LUFT	EPA-8020	EPA-8020	EPA-8020	EPA-8020
	UNITS:	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L
SAMPLE	DATE						
MW10-505	11/3/97	226,000	79,100	<2,500	<2,500	1,900 J	4,700 J

Explanation:
J = Estimated value
M8015E = Modified Method 8015 - Extractables
mg/L = milligrams per liter
TPH-D = Total Petroleum Hydrocarbons as Diesel
TPH-M = Total Petroleum Hydrocarbons as Motor Oil
µg/L = micrograms per liter

Table A-4

Historical Bioremediation Activity Indicators (Lab Measurements), Silte 22187, MCB Camp Pendleton

	CONSTITUENT:		Alk	Ammonia	Nitrate	Nitrite	TKN	Phos	Sulfate	Sulfide	Total Iron	Ferrous Iron	Methane	Dissolved Oxygen	Redox
		METHOD:	310.1	350.2	300.0	300.0	351.3	300.0	300.0	Hach	7380	Hach	GC/FID	Meter	Meter
		UNITS:	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mV
WELL	SAMPLE	DATE													
MW4	360	6/12/97	1420	NA	<4	<5	1.2	<10	906	NA	14.0	NA	NA	NA	NA
MW4	455	10/28/97	1430	NA	<3.2	6.81	1.5	<8	959	NA	<0.1	NA	<3	NA	NA
MW4	531	2/6/98	1380	NA	<3.2	<4	NA	<8	866	ND	0.403	ND	<3	5.21	148
MW4	588	4/6/98	1430	NA	<3.2	<4	NA	<8	1060	NA	0.0230 J	NA	4.76	NA	NA
MW5	345	6/11/97	567	0.2	<0.8	<1	1.3	<2	256	NA	11.0	NA	NA	NA	NA
MW5	452	10/28/97	675	NA	<0.8	<0.1	1.5	<2	257	NA	<0.1	NA	547	NA	NA
MW5	533	2/6/98	611	NA	<1	<1.3	NA	<2.5	230	ND	4.56	ND	570	0.64	110
MW5	585	4/6/98	892	NA	<0.5	<0.63	NA	<1.3	151	NA	2.14	NA	1170	NA	NA
MW6	344	6/11/97	713	0.3	<0.8	<1	2.0	<2	246	NA	13.3	NA	NA	NA	NA
MW6	451	10/28/97	853	NA	<0.8	<1	1.5	<2	223	NA	<0.1	NA	39	NA	NA
MW6	532	2/6/98	799	NA	<1	<1.3	NA	<2.5	210	ND	3.14	2.0	370	0.88	-22
MW6	584	4/6/98	662	NA	<0.8	<1	NA	<2	190	NA	1.7	NA	8.75	NA	NA
MW7	353	6/12/97	691	NA	<0.8	<0.1	1.2	<2	256	NA	22.4	NA	NA	NA	NA
MW7	450	10/28/97	861	NA	<0.8	<1	1.4	<2	245	NA	<0.1	NA	76.1	NA	NA
MW7	531	2/6/98	844	NA	<1	<1.3	NA	<2.5	230	ND	0.013 J	ND	52	1.68	170
MW7	583	4/6/98	773	NA	<0.8	<1	NA	<2	276	NA	0.0433 J	NA	31.0	NA	NA
MW8	354	6/12/97	699	NA	<2	<2.5	1.2	<5	513	NA	32.7	NA	NA	NA	NA
MW8	454	10/28/97	733	NA	<1.6	<2	2.1	<4	451	NA	<0.1	NA	575	NA	NA
MW8	536	2/6/98	768	NA	<1.6	<2	NA	<4	401	ND	2.85	ND	690	3.12	155
MW8	587	4/6/98	781	NA	<1	<1.3	NA	<2.5	385	NA	109	NA	33.0	NA	NA
MW9	347	6/11/97	558	0.2	<0.8	<1	0.92	<2	242	NA	0.0424	NA	NA	NA	NA
MW9	348	6/11/97	569	0.3	<0.8	<1	0.80	<2	223	NA	49.7	NA	NA	NA	NA
MW9	453	10/28/97	626	NA	<0.8	<1	0.4	<2	253	NA	<0.1	NA	106	NA	NA
MW9	534	2/6/98	710	NA	<1	<1.3	NA	<2.5	340	ND	<0.05	ND	370	1.49	-106
MW9	586	4/6/98	666	NA	<1.6	<2	NA	<4	350	NA	0.0437 J	NA	178	NA	NA
MW10	346	6/11/97	973	1.2	<0.4	<0.5	3.0	<1	186	NA	9.0	NA	NA	NA	NA
MW10	539	2/6/98	906	NA	0.2	<0.2	NA	0.7	52	NA	0.925	NA	3100	NA	NA
MW10		4/6/98	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]

Explanation:

[1] MW10 contained free product and was not sampled
Alk = Alkalinity
GC/FID = Gas Chromatograph/Flame Ionization Detector
J = Estimated value
mg/L = milligrams per liter
mV = millivolts
NA = Not Analyzed
TKN = Total Kjeldahl Nitrogen
Phos = Phosphorus
µg/L = micrograms per liter

Table A-5

Historical Bioremediation Activity Indicators (Field Measurements), Site 22187

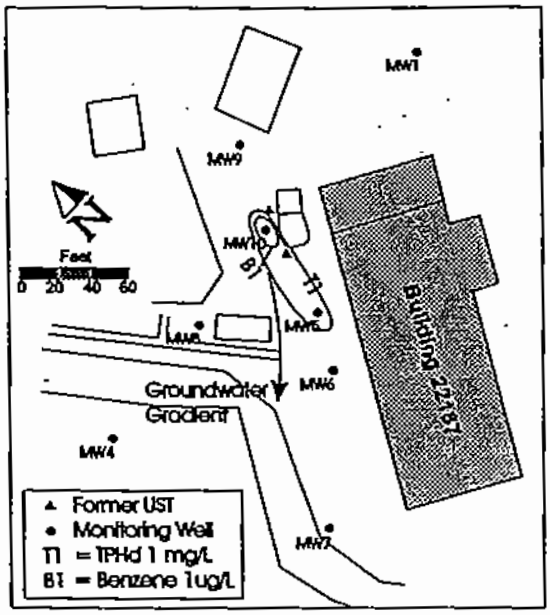
MCB Camp Pendleton

	CONSTITUENT:	Dissolved O2	Redox (Orion)	Redox (Orp)	Ferrous Iron	Sulfide
	UNITS:	mg/L	mV	mV	mg/L	mg/L
WELL	DATE					
MW4	10/28/97	7.40	98.3	75	ND	ND
MW4	2/6/98	5.21	NA	148	ND	ND
MW4	4/6/98	10.93	NA	136	ND	ND
MW5	10/28/97	2.00	-87	-75	2.40	ND
MW5	2/6/98	0.64	NA	110	ND	ND
MW5	4/6/98	2.98	NA	-101	2.2	ND
MW6	10/28/97	4.20	-63	-50	1.60	ND
MW6	2/6/98	0.88	NA	-22	2.0	ND
MW6	4/6/98	3.27	NA	-60	1.2	ND
MW7	10/28/97	2.60	134.7	85	ND	ND
MW7	2/6/98	1.68	NA	170	ND	ND
MW7	4/6/98	1.56	NA	177	ND	ND
MW8	10/28/97	4.45	3	15	0.30	ND
MW8	2/6/98	3.12	NA	155	ND	ND
MW8	4/6/98	8.85	NA	96	ND	ND
MW9	10/28/97	2.70	61.5	35	ND	ND
MW9	2/6/98	1.49	NA	-106	ND	ND
MW9	4/6/98	3.47	NA	-163	ND	ND
MW10	10/28/97	[1]	[1]	[1]	[1]	[1]
MW10	2/6/98	[1]	[1]	[1]	[1]	[1]
MW10	4/6/98	[1]	[1]	[1]	[1]	[1]

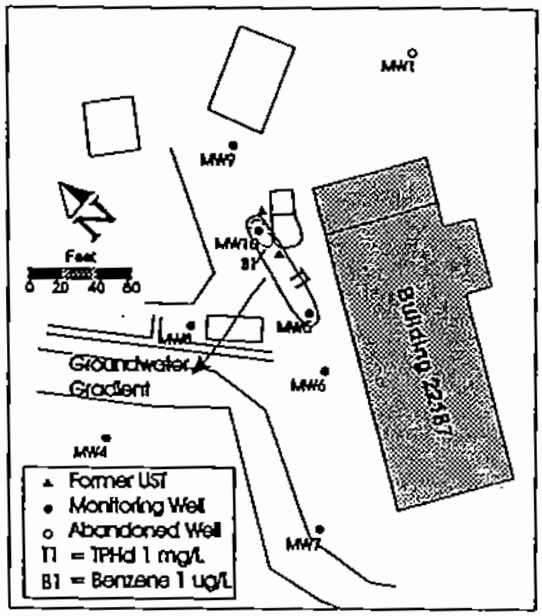
Explanation:

[1] *MW10 contained free product and was not sampled*
mg/L = milligrams per liter
mV = millivolts
NA = Not analyzed
ND = Not detected

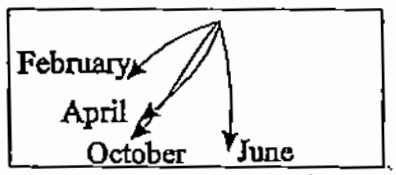
Figure A-1 Historical Groundwater Gradient and Contaminant Distribution at Site 22187.



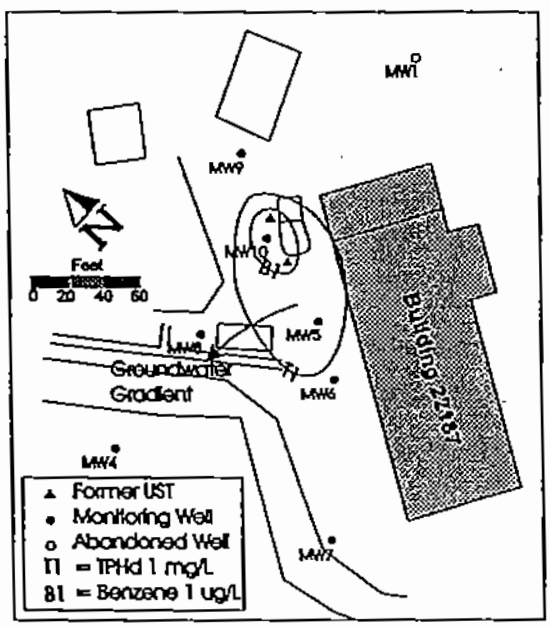
June 1997



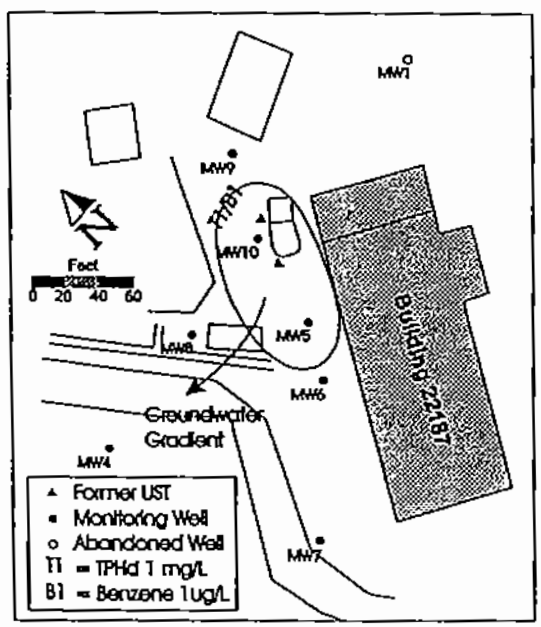
October 1997



Interpreted Groundwater Flow Direction



February 1998



April 1998

APPENDIX B

GROUNDWATER SAMPLING SHEETS

AND WASTE MANIFESTS

WELL GAUGING DATA

Project # 050411-CD1 Date 4/14/05 Client Parsons @ Camp Pendleton

Site AREA 22 Site 22187

Well ID	Well Size (in.)	Sheen / Odor	Depth to Immiscible Liquid (ft.)	Thickness of Immiscible Liquid (ft.)	Volume of Immiscibles Removed (ml)	Depth to water (ft.)	Depth to well bottom (ft.)	Survey Point: TOB or TOC	
MW 22187-4	4					3.60	17.35	TOC	
MW 22187-5	4	odor				9.84	19.86		
MW 22187-6	4	odor				10.27	19.65		
MW 22187-7	4					10.15	19.80		
MW 22187-8	4					11.90	21.94		
MW 22187-9	4					9.25	19.71		
MW 22187-10	4					9.25	20.17		

WELL MONITORING DATA SHEET

Project #: 050411-CD1	Client: Parsons @ Camp Pendleton BAA
Sampler: CD	Start Date: 4/14/05
Well I.D.: MW22187-5-	Well Diameter: 2 3 (4) 6 8 ___
Total Well Depth: 19.86	Depth to Water Pre: 9.84 Post: 10.65
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump Peristaltic Pump Bladder Pump 11.84
Sampling Method: Dedicated Tubing (Disposable Bailer) Other ___
Flow Rate: 2 GPM Pump Depth: 19'

6.5 (Gals.) X 3 = 19.5 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
1317	Start	Purge						Color
1319	21.74	7.43	2873	427	1.45	-63.4	4	
1321	21.79	7.39	2887	37	1.42	-67.9	8	
1323	21.85	7.38	2900	10	1.46	-71.0	12	
1325	21.90	7.36	2911	7	1.48	-75.6	16	
1327	21.91	7.36	2914	4	1.47	-76.6	19.5	

Did well dewater? Yes (No) Amount actually evacuated: 19.5

Sampling Time: 1335 Sampling Date: 4/14/05 Depth to Water: 10.65

Sample I.D.: MW22187-5-0405 Laboratory: APCL

Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See SOW, (PNAs)

Equipment Blank I.D.: @ Time Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 050411-001	Client: Parsons @ Camp Pendleton BAA
Sampler: TD	Start Date: 4/14/05
Well I.D.: MW 22187-6	Well Diameter: 2 3 (4) 6 8 ___
Total Well Depth: 19.65	Depth to Water Pre: 10.27 Post: 11.15
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	Flow Cell Type: YSI 550

Purge Method: 2" Grundfos Pump Peristaltic Pump Bladder Pump 12.14
Sampling Method: Dedicated Tubing (Disposable Bailer) Other ___
Flow Rate: 2 GPM Pump Depth: 18.5'

6.1 (Gals.) X 3 = 18.3
Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
1252	Start	Purge						
1254	21.88	7.41	2839	21	0.53	-62.9	4	odor
1255	21.95	7.38	2873	17	0.46	-73.2	6	
1256	22.00	7.36	2882	14	0.37	-76.9	8	
1258	22.00	7.37	2886	13	0.29	-76.2	12	
1259	22.05	7.37	2909	10	0.30	-79.9	16	
1301	22.04	7.37	2905	7	0.31	-80.1	18.5	

Did well dewater? Yes (No) Amount actually evacuated: 18.5
Sampling Time: 1306 Sampling Date: 4/14/05 Depth to Water: 11.15
Sample I.D.: MW22187-6-0405 Laboratory: APCL
Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See SOW
Equipment Blank I.D.: @ Time Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 050411-001	Client: Parsons @ Camp Pendleton BAA
Sampler: CD	Start Date: 4/14/05
Well I.D.: MW 22187-7-0405	Well Diameter: 2 3 4 6 8 ___
Total Well Depth: 19.80	Depth to Water Pre: 10.15 Post: 13.97
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump Peristaltic Pump Bladder Pump 12.08
Sampling Method: Dedicated Tubing Disposable Bailer Other ___

Flow Rate: 2 GPM Pump Depth: 19.0'

6.3 (Gals.) X 3 = 18.9
Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
1217	Start Purge							
1219	21.47	7.53	1973	20	2.27	65.9	4	
1220	21.40	7.56	1985	10	1.68	70.2	6	
1221	21.35	7.58	1997	7	1.21	73.5	8	
1223	21.45	7.59	2064	6	0.68	74.5	12	
1225	21.59	7.59	2097	4	0.66	74.2	16	
1227	21.62	7.58	2103	4	0.66	74.0	19	

Did well dewater? Yes No Amount actually evacuated: 19

Sampling Time: 1234 Sampling Date: 4/14/05 Depth to Water: 12.05

Sample I.D.: MW 22187-7-0405 Laboratory: APCL

Analyzed for: TPH-G BTEX MTBE TPH-D Other: See SOW

Equipment Blank I.D.: @ Time Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 050411-001	Client: Parsons @ Camp Pendleton BAA
Sampler: CD	Start Date: 4/14/05
Well I.D.: MW22187-8	Well Diameter: 2 3 (4) 6 8 ____
Total Well Depth: 21.94	Depth to Water Pre: 11.90 Post: 20.15
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: (PVC) Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump Peristaltic Pump Bladder Pump
Sampling Method: Dedicated Tubing (Disposable Bailer) Other_____
Flow Rate: 2 GPM Pump Depth: 20'

6.5 (Gals.) X 3 = 19.5 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
1154	Start	Purge	—	—	—	—		
1156	20.04	7.79	2757	690	6.11	46	4	
1158	19.08	7.63	2810	643	4.73	101.9	8	
1200	19.28	7.54	2779	130	3.46	106.7	12	Well dewatered

Did well dewater? (Yes) No Amount actually evacuated: 12
Sampling Time: 1347 Sampling Date: 4/14/05 Depth to Water: 11.90
Sample I.D.: MW22187-8-0405 Laboratory: APCL
Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See SOW
Equipment Blank I.D.: @ Time Duplicate I.D.:

WELL MONITORING DATA SHEET

Project #: 050411-001	Client: Parsons @ Camp Pendleton BAA
Sampler: [illegible]	Start Date: 4/14/05
Well I.D.: MW22187-10A	Well Diameter: 2 3 (4) 6 8 ___
Total Well Depth: 20.17	Depth to Water Pre: 9.25 Post: 10.36
Depth to Free Product:	Thickness of Free Product (feet):
Referenced to: PVC Grade	Flow Cell Type: YSI 556

Purge Method: 2" Grundfos Pump Peristaltic Pump Bladder Pump 11.43

Sampling Method: Dedicated Tubing (Disposable Bailer) Other ___

Flow Rate: 2 GPM Pump Depth: 19

7.1 (Gals.) X 3 = 21.3 Gals.

Well Diameter	Multiplier	Well Diameter	Multiplier
1"	0.04	4"	0.65
2"	0.16	6"	1.47
3"	0.37	Other	radius² * 0.163

Time	Temp. (°C or °F)	pH	Cond. (mS or µS)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Water Removed (gals. or mL)	Observations
740	Start Purge							
742	20.71	7.32	3373	47	1.11	151.4	4	
744	20.72	7.32	3363	17	1.16	152.4	8	
746	20.79	7.33	3354	28	0.89	153.4	12	
748	20.82	7.34	3323	31	0.40	155.1	16	
752	20.84	7.34	3310	27	0.42	1550	20	
753	20.83	7.34	3292	36	0.42	154.9	21.5	

Did well dewater? Yes (No) Amount actually evacuated: 21.5

Sampling Time: 759 Sampling Date: 4/14/05 Depth to Water: 10.36

Sample I.D.: MW22187-10A-0405 Laboratory: APCL

Analyzed for: TPH-G BTEX MTBE (TPH-D) Other: See SOW

Equipment Blank I.D.: @ Time Duplicate I.D.:

BLAINE
TECH SERVICES, INC

[redacted]

1580 ROGERS AVENUE
SE, CALIFORNIA 95112-1105
FAX (408) 573-7771
PHONE (408) 573-0555

CONDUCT ANALYSIS TO DETECT

LAB APCL COC 1 of 1

Parsons (626) 440-4000 Fax: (626) 440-6200
C. Zicker
100 W Walnut Ave.
Pasadena CA 91124

CHAIN OF CUSTODY

CLIENT Parsons

SITE Camp Pendleton Area 22 - Site 22187

Global ID T0607302907

Job# 933868 PO# 06000

Disposal by APCL
QC requirement AFCEE

SAMPLE I.D	DATE	TIME	MATRIX AQ = H2O	#	Preservation	Type	TPH-D 8015	BTEX & MTBE (8260B)	Sulfate, Nitrate, Ferrous Iron, Alkalinity 300	Methane RSK175	PNAs (8270C)			ADD'L INFORMATION	STATUS	CONDITION	LAB SAMPLE #
MW22187-5-0405	4/14/05	1335	AQ	6	NO HCL	A,V,P	X		X	X	X						
MW22187-6-0405		1306		5			X		X	X							
MW22187-7-0405		1234					X		X	X							
MW22187-8-0405		1347					X		X	X							
MW22187-10-0405		759					X		X	X							
TB-04-0405	4/14/05	700	AQ	2	HCL	✓		X	~~X~~	~~X~~	0						

SAMPLING COMPLETED DATE 4/14/05 TIME 1500

SAMPLING PERFORMED BY Chris Davis

RESULTS NEEDED NO LATER THAN Standard TAT

RELEASED BY	TIME	RECEIVED BY	DATE	TIME
Chris Davis	1515	[signature]	4/14/05	1515
[signature]	1735	[signature]	4/14/05	1735

SHIPPED VIA

TIME SENT

COOLER #

NON-HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. CA2170023533
Manifest Document No. 17384
2. Page 1 of 1

3. Generator's Name and Mailing Address
United States Marine Corps - XC/S Environmental Security
P.O. Box 555008
Camp Pendleton CA 92055
Att: Chuck Davine
CA 17384
4. Generator's Phone (760) 725-5617

5. Transporter 1 Company Name
ECOLOGY CONTROL INDUSTRIES
6. US EPA ID Number CAD982030173
A. Transporter's Phone 310 320-2565

7. Transporter 2 Company Name
8. US EPA ID Number
B. Transporter's Phone

9. Designated Facility Name and Site Address
CROSBY & OVERTON
1630 W. 17TH STREET
LONG BEACH CA 90813
10. US EPA ID Number CAD028409019
C. Facility's Phone 562 432-5445

11. Waste Shipping Name and Description	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol
a. Non Hazardous Waste, Liquid (Groundwater)	001	TT	1000	G
b.				
c.				
d.				

D. Additional Descriptions for Materials Listed Above
(L) Profile# 00627

E. Handling Codes for Wastes Listed Above
15

15. Special Handling Instructions and Additional Information
24 Hour Emergency # 1-800-321-5479
ECI Job #5069 PO# 733868

16. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Printed/Typed Name: Margo Williams
Signature: Margo Williams
Month 04 Day 18 Year 05

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: Gordo Costichi
Signature: [signature]
Month 04 Day 18 Year 05

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name
Signature
Month Day Year

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of waste materials covered by this manifest except as noted in Item 19.

Printed/Typed Name: JOE SIMONE
Signature: [signature]
Month 04 Day 18 Year 05

GENERATOR
TRANSPORTER
FACILITY

ORIGINAL - RETURN TO GENERATOR

ECI ///
Ecology Control Industries
A FULL SERVICE ENVIRONMENTAL COMPANY

04210552

TRANSPORTATION SERVICE ORDER

SERVICE ORDER # 288324 5069

DATE: 04/18/05

CUSTOMER

Name: PARSONS ENGINEERING Job Location: CAMP PENDLETON OCEAN SIDE

Address (BILLING): City: Zip:

Ordered by: Company: P.O. #:

DRIVER

Name (PRINT): Rodolfo Castillo Signed: Rodolfo Castillo

Truck #: 27008 Trailer #: Size/Type: V Truck

SERVICES

Services performed: Report to CAMP PENDLETON IN OCEAN SIDE CA for WORK AS Directed, pump out a total of 1000 Gallons of Ground water from monitor well load up and transport to Corey Overton in Long Beach CA complete job return to ECI Terrace yard

TIME

MANIFEST #: DISPOSAL #:

# # # #

#Loads: Qty:

BBL: Gal: Tons: Yards:

Start: 0500 AM PM Stop: 1300 AM PM

MEALS: Start: — AM PM Stop: — AM PM

Other Time: Add/Deduct

Gross Time: 8 Hrs.

Less: — Hrs.

Total: 8 Hrs.

SITE

Time In: Time In: Time In: Stop Miles:

Start Miles:

Time Out: Time Out: Time Out: Miles Driven:

DESCRIPTION

	QTY.	U.O.M.	RATE	EXT.		QTY.	U.O.M.	RATE	EXT.
Vacuum Truck	8		65	520.00	Disposal				270.00
End Dump					Washout				
Roll-off					Roper Pump				
Flat Bed					Bin Liner				
Tank Mover					Surcharge				
Driver Relief									
Subsistence									

ENTERED APR 27 2005 PAYROLL

Authorized & Approved by: PARSONS Title: GEOLOGIST

TOTAL CHARGES: $ 790.00

If invoice is not paid within 30 days, interest shall commence accruing at 1.5% per month. Should suit be commenced to collect any portion of this invoice, Ecology Control Industries shall be entitled to any costs deemed reasonable by the court, including attorney fees.

Original: Accounting Yellow: Accounting Pink: Customer Gold: Driver TSO-1

APPENDIX C

LABORATORY REPORTS

MANIFESTS

Applied P & CH Laboratories
13760 Magnolia Ave., Chino, CA 91710
Tel: (909) 590-1828 Fax: (909) 590-1498

APCL Analytical Report

Submitted to:
Parsons Engineering Science
Attention: Cindy Zicker
100 W. Walnut Street
Pasadena CA 91124
Tel: (626)585-6000 Fax: (626)440-6200

Service ID #: 801-052314
Collected by: CD
Collected on: 04/14/05

Received: 04/14/05
Extracted: 04/18-20/05
Tested: 04/14-27/05
Reported: 05/04/05

Sample Description: Water from Site 22187.
Project Description: 933868 Camp Pendleton Area 22.

Analysis of Water Samples

Component Analyzed	Method	Unit	PQL	MDL	Analysis Result MW22187-5-0405 05-02314-1	MW22187-6-0405 05-02314-2
ALKALINITY	310.1	mg/L	2	0.93	520	520
IRON (II)	SM3500DFE-	mg/L	0.05	0.012	0.061	<0.05
Dilution Factor					100	50
NITRATE AS N	300.0	mg/L	0.06	0.020	4.2J	9.3
SULFATE	300.0	mg/L	0.5	0.16	360	240
Dilution Factor					0.96	0.96
DIESEL	M8015E	mg/L	0.1	0.013	0.56	0.23
Dilution Factor					1	1
METHANE	RSK175	µg/L	3	0.55	5.8	29
ETHANE	RSK175	µg/L	3	1.6	<3	<3
ETHENE	RSK175	µg/L	3	0.56	<3	<3

Component Analyzed	Method	Unit	PQL	MDL	Analysis Result MW22187-7-0405 05-02314-3	MW22187-8-0405 05-02314-4	MW22187-10A-0405 05-02314-5
ALKALINITY	310.1	mg/L	2	0.93	360	190	550
IRON (II)	SM3500DFE-	mg/L	0.05	0.012	0.17	0.17	0.18
Dilution Factor					40	100	100
NITRATE AS N	300.0	mg/L	0.06	0.020	1.6J	7.8	3.3J
SULFATE	300.0	mg/L	0.5	0.16	250	630	410
Dilution Factor					0.96	0.96	0.96
DIESEL	M8015E	mg/L	0.1	0.013	0.10	6.5	0.27
Dilution Factor					1	1	1
METHANE	RSK175	µg/L	3	0.55	<3	8.1	<3
ETHANE	RSK175	µg/L	3	1.6	<3	<3	<3
ETHENE	RSK175	µg/L	3	0.56	<3	<3	<3

Applied P & CH Laboratories
13760 Magnolia Ave., Chino, CA 91710
Tel: (909) 590-1828 Fax: (909) 590-1498

APCL Analytical Report

Component Analyzed	Method	Unit	PQL	MDL	Analysis Result MW22187-5-0405 05-02314-1
SEMI-VOC					
Dilution Factor					1
ACENAPHTHENE	SW8270C	µg/L	10	1.5	< 10
ACENAPHTHYLENE	SW8270C	µg/L	10	1.6	< 10
ANTHRACENE	SW8270C	µg/L	10	1.5	< 10
BENZ(A)ANTHRACENE	SW8270C	µg/L	10	1.5	< 10
BENZO(A)PYRENE	SW8270C	µg/L	10	1.2	< 10
BENZO(B)FLUORANTHENE	SW8270C	µg/L	10	1.9	< 10
BENZO(G,H,I)PERYLENE	SW8270C	µg/L	10	1.2	< 10
BENZO(K)FLUORANTHENE	SW8270C	µg/L	10	1.5	< 10
CHRYSENE	SW8270C	µg/L	10	1.4	< 10
DIBENZ(A,H)ANTHRACENE	SW8270C	µg/L	10	1.2	< 10
FLUORANTHENE	SW8270C	µg/L	10	1.6	< 10
FLUORENE	SW8270C	µg/L	10	2.0	< 10
INDENO(1,2,3-CD)PYRENE	SW8270C	µg/L	10	1.1	< 10
2-METHYLNAPHTHALENE	SW8270C	µg/L	10	2.0	< 10
NAPHTHALENE	SW8270C	µg/L	10	2.0	< 10
PHENANTHRENE	SW8270C	µg/L	10	1.7	< 10
PYRENE	SW8270C	µg/L	10	0.68	< 10

PQL: Practical Quantitation Limit. MDL: Method Detection Limit. CRDL: Contract Required Detection Limit

N.D.: Not Detected or less than the practical quantitation limit. "-": Analysis is not required.

J: Reported between PQL and MDL.

Listed Dilution Factors (DF) are relative to the method default DF. All unlisted DFs are 1.0

Respectfully submitted,

Dominic Lau
Laboratory Director
Applied P & CH Laboratories

BLAINE
TECH SERVICES, INC.

1680 ROGERS AVENUE
SAN JOSE, CALIFORNIA 95112-1105
FAX (408) 573-7771
PHONE (408) 573-0555

CONDUCT ANALYSIS TO DETECT

LAB APCL COC 1 of 1

Parsons (626) 440-4000 Fax: (626) 440-6200
C. Zicker
100 W Walnut Ave.
Pasadena CA 91124

CHAIN OF CUSTODY

CLIENT Parsons

SITE Camp Pendleton Area 22 - Site 22187

Global ID T0607302907

job# 933868 PO# 06000

Disposal by APCL
QC requirement : AFCEE

SAMPLE I.D.	DATE	TIME	MATRIX AQ = H2O	#	Preservation	Type	TPH-D 8015	BTEX & MTBE (8260B)	Sulfate, Nitrate, Ferrous Iron, Alkalinity 300	Methane RSK175	PNAs (8270C)				ADD'L INFORMATION	STATUS	CONDITION	LAB SAMPLE #
MW22187-5-0405	4/14/05	1335	AQ	6	NO / HCL	A,V,P	X		X	X	X							
MW22187-6-0405		1306		5			X		X	X								
MW22187-7-0405		1234					X		X	X								
MW22187-8-0405		1347					X		X	X								
MW22187-10A-0405		759					X		X	X								
TB-04-0405	4/14/05	700	AQ	2	HCL	V		X	~~X~~	~~X~~								

2314

SAMPLING COMPLETED	DATE	TIME	SAMPLING PERFORMED BY	RESULTS NEEDED NO LATER THAN
	4/14/05	1500	Chris Davis	Standard TAT

RELEASED BY	TIME	RECEIVED BY	DATE	TIME
Chris Davis	1515	[signature]	4-14-05	1515
[signature]	1735	[signature]	4/14/05	1735

SHIPPED VIA	TIME SENT	COOLER #

Applied P & CH Laboratories
13760 Magnolia Ave., Chino CA 91710
Tel: (909) 590-1828 Fax: (909) 590-1498

Sample Receiving Checklist

APCL ServiceID: 2314 **Client Name/Project:** Parsons

1. Sample Arrival

Date/Time Received 4/14/05 1735 Date/Time Opened 4/14/05 1735 By (name): Jason N.

Custody Transfer: ☐ Client ☐ Golden State ☐ UPS ☐ US Mail ☐ FedEx ☒ APCL Empl: _____

2. Chain-of-Custody (CoC)

☒ With Samples? ☐ Faxed? ☒ Client has Copy? ☒ Signed, dated? By: _____
☒ Project ID? ☒ Analyses Clear? ☐ Hold Samples? #on Hold _____ # Received _____
☐ CoC/Docs Zip-Locked under lid? ☐ Compos.#: _ ☒ #Samples OK? _____
☒ Sampled By : CD

3. Shipping Container/Cooler

☒ Cooler Used? # of 2 Cooled by: ☒ Ice ☐ Blue Ice ☐ Dry Ice ☐ None
Temp °C 3.8 4.1 _____ _____ _____ _____
(Cooler temperature measured from temp blank if present, otherwise measured from the cooler).
Cooler Custody Seal? ☐ Absent ☐ Intact ☐ Tampered?

4. Sample Preservation

☐ **pH <2** ☐ pH >12
If Not, pH = _____ Preserved by: ☐ Client ☐ APCL ☐ Third Party _____

5. Holding-time Requirements

☐ pH 24hr ☐ BACT 6/24hr ☐ Cr^{VI} 24hr ☒ NO_3^- 48hr ☐ BOD 48hr
☐ Cl_2 ASAP ☐ Turbidity 48hr ☐ DO ASAP ☒ Fe(II) ASAP
☐ HT Expired? ☐ Client notified?

6. Sample Container Condition

☒ Intact? ☐ Broken? ☐ Anomalies Documented?
Type: ☒ plastic ☒ glass ☐ Tube: brass/SS ☐ Tedlar Bag
☒ Quantity OK? ☐ Leaking? ☒ Appropriate for specific method?
☒ Caps tight? ☐ Air Bubbles? ☒ Adequate Volume?
Labels: ☒ Unique ID? ☒ Date/Time ☒ Label and ink intact?

7. Turn Around Time

☒ RUSH TAT: _____ ☐ Std (7-10 days) ☐ Not Marked

8. Sample Matrix

☐ Drinking H_2O ☒ Other Liq ☐ Soil ☐ Wipe ☐ Polymer ☐ Air ☐ Other: _____
☐ Ground H_2O ☐ Sludge ☐ Filter ☐ Oil/Petro ☐ Paint ☐ W. Water ☐ Extract ☐ Unknown

9. Pre-Login Check List Completed & OK?

☒ ALL OK? (if not, see SOP C-11) ☐ Client Contact? (Name:_____)Date/Time:_____

Received/Checked by: [signature] Printed: 14 Apr 2005 7:19 a.m.

*HT: Samples must be analyzed for results to reflect total concentrations. Results generated outside required of holding times are considered minimal values and may be used to define waste as hazardous but not as non-hazardous.

DocumentFile: [real.textfiles]smpscl.tex.

Applied P & CH Laboratories

Organic Analysis Results for Method SW8270C

Client Name:	Parsons Engineering Science	Project No:	933868	Collection Date:	04/20/2005
Project ID:	Camp Pendleton Area 22	Service ID:	52314	Collected by:	
		Lab Sample ID:	05G1855-MB-01	Received Date:	04/20/2005
Sample ID:	05G1855-MB-01	Sample Matrix	Water	Moisture %:	--
Sample Type:	Method Blank	Prep. Method:	3510	Instrument ID:	GC/MS: Y
Anal. Method:	SW8270C	Prep. Date:	04/20/05	Anal. Date:	04/26/05
Batch No:	05G1855	Prep. No:	1 of 1	Anal. Time:	12:03
Data File Name:	G1855K01	Sample Amount:	1000 mL	Dilution Factor:	1
Extract Vol.	1.0 mL				

#	Component Name	CAS No	Unit	RL	Result	Qualifier
1	ACENAPHTHENE	83-32-9	µg/L	10	< 10	U
2	ACENAPHTHYLENE	208-96-8	µg/L	10	< 10	U
3	ANTHRACENE	120-12-7	µg/L	10	< 10	U
4	BENZ(A)ANTHRACENE	56-55-3	µg/L	10	< 10	U
5	BENZO(A)PYRENE	50-32-8	µg/L	10	< 10	U
6	BENZO(B)FLUORANTHENE	205-99-2	µg/L	10	< 10	U
7	BENZO(G,H,I)PERYLENE	191-24-2	µg/L	10	< 10	U
8	BENZO(K)FLUORANTHENE	207-08-9	µg/L	10	< 10	U
9	CHRYSENE	218-01-9	µg/L	10	< 10	U
10	DIBENZ(A,H)ANTHRACENE	53-70-3	µg/L	10	< 10	U
11	FLUORANTHENE	206-44-0	µg/L	10	< 10	U
12	FLUORENE	86-73-7	µg/L	10	< 10	U
13	INDENO(1,2,3-CD)PYRENE	193-39-5	µg/L	10	< 10	U
14	2-METHYLNAPHTHALENE	91-57-6	µg/L	10	< 10	U
15	NAPHTHALENE	91-20-3	µg/L	10	< 10	U
16	PHENANTHRENE	85-01-8	µg/L	10	< 10	U
17	PYRENE	129-00-0	µg/L	10	< 10	U

Surrogates			Control Limit, %	Surro. Rec.%
1	2-FLUOROBIPHENYL	321-60-8	40-129	92
2	2-FLUOROPHENOL	367-12-4	20-119	48
3	NITROBENZENE-D5	4165-60-0	40-128	69
4	PHENOL-D5	4165-62-2	10-110	26
5	TERPHENYL-D14	1718-51-0	40-134	71
6	2,4,6-TRIBROMOPHENOL	118-79-6	20-129	93
# of out-of-control				0

Internal Standard			Control Limit, %	IS Rec.%
1	ACENAPHTHENE-D10	15067-26-2	50-200	75
2	CHRYSENE-D12	1719-03-5	50-200	151
3	1,4-DICHLOROBENZENE-D4	3855-82-1	50-200	110
4	NAPHTHALENE-D8	1146-65-2	50-200	109
5	PERYLENE-D12	1520-96-3	50-200	87
6	PHENANTHRENE-D10	1517-22-2	50-200	108
# of out-of-control				0

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Qualifier: U - Not Detected or less than MDL/IDL
F - Positively identified, but Less than RL
M - A matrix effect was present
T - TIC by GC/MS
E - Exceed calibration range
B - Analyte is detected in the associated method blank
J - Positively identified, the quantitaion is estimated
R - unusable due to deficiencies

FORM-2C

Applied P & CH Laboratories

Surrogate Recovery Summary for Method SW8270C

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	052314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05G1855		

#	Client Sample No	Lab Sample ID	S1 %	S1 #	S2 %	S2 #	S3 %	S3 #	S4 %	S4 #	S5 %	S5 #	S6 %	S6 #	TOT OUT
1	05G1855-LCS-01	05G1855-LCS-01	54		41		55		29		61		79		0
2	05G1855-LSD-01	05G1855-LSD-01	51		42		55		29		59		77		0
3	05G1855-MB-01	05G1855-MB-01	92		48		69		26		71		93		0
4	MW22187-5-0405	05-2314-1	91		47		81		28		72		120		0
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															

	QC Control Limit
S1 = 2-FLUOROBIPHENYL	40-129
S2 = 2-FLUOROPHENOL	20-119
S3 = NITROBENZENE-D5	40-128
S4 = PHENOL-D5	10-110
S5 = TERPHENYL-D14	40-134
S6 = 2,4,6-TRIBROMOPHENOL	20-129

Column to be used to flag recovery values:

* – Values outside of contract required QC Limits D – Surrogate diluted out I – Matrix Interference

FORM-3C

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method SW8270C

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05G1855		
LCS Filename:	G1855L01	Date Analyzed:	042605	Time Analyzed:	10:46
LCSD Filename:	G1855J01	Date Analyzed:	042605	Time Analyzed:	11:25

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
ACENAPHTHENE	µg/L	50	0	39.5	79	40-112
4-CHLORO-3-METHYLPHENOL	µg/L	100	0	82.4	82	41-105
2-CHLOROPHENOL	µg/L	100	0	60.6	61	44-102
1,4-DICHLOROBENZENE	µg/L	50	0	33.0	66	40-106
2,4-DINITROTOLUENE	µg/L	50	0	46.5	93	40-117
4-NITROPHENOL	µg/L	500	0	121	24	18-144
N-NITROSODI-N-PROPYLAMINE	µg/L	50	0	28.5	57	45-113
PENTACHLOROPHENOL	µg/L	500	0	379	76	27-138
PHENOL	µg/L	100	0	33.4	33	32-102
PYRENE	µg/L	50	0	37.1	74	40-119
1,2,4-TRICHLOROBENZENE	µg/L	50	0	41.0	82	40-108
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
ACENAPHTHENE	µg/L	50	40.1	80	1	39	40-112
4-CHLORO-3-METHYLPHENOL	µg/L	100	84.4	84	2	36	41-105
2-CHLOROPHENOL	µg/L	100	59.5	60	2	36	44-102
1,4-DICHLOROBENZENE	µg/L	50	32.8	66	0	37	40-106
2,4-DINITROTOLUENE	µg/L	50	46.0	92	1	40	40-117
4-NITROPHENOL	µg/L	500	114	23	4	65	18-144
N-NITROSODI-N-PROPYLAMINE	µg/L	50	27.9	56	2	39	45-113
PENTACHLOROPHENOL	µg/L	500	398	80	5	61	27-138
PHENOL	µg/L	100	33.9	34	3	36	32-102
PYRENE	µg/L	50	36.1	72	3	38	40-119
1,2,4-TRICHLOROBENZENE	µg/L	50	41.3	83	1	35	40-108
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

FORM-4B

Applied P & CH Laboratories

Method Blank Summary for Method SW8270C

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Analysis Date:	04/26/05
		Sample Matrix:	Water	Analysis Time:	12:03
Sample ID:	**05G1855-MB-01**	Batch No:	05G1855	Instrument ID:	GC/MS: Y
Lab Sample ID:	05G1855-MB-01	Data File Name:	G1855K01	GC Column:	DB-5.625
				Column ID:	0.25 mm

This Method Blank applies to the following samples and QC samples:

#	Client Sample No	Lab Sample ID	Sample Type	Data Filename	Analysis Date	Analysis Time
1		05G1855LCS01	Lab Control Spike	G1855L01	04/26/05	10:46
2		05G1855LSD01	Lab Control Spike Duplicate	G1855J01	04/26/05	11:25
3	MW22187-5-0405	05-2314-1	Field Sample	2314-01A	04/27/05	18:47
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
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22						
23						
24						
25						

Applied P & CH Laboratories

Organic Analysis Results for Method M8015E

Client Name:	Parsons Engineering Science	Project No:	933868	Collection Date:	04/18/2005
Project ID:	Camp Pendleton Area 22	Service ID:	52314	Collected by:	
		Lab Sample ID:	05G1832-MB-01	Received Date:	04/18/2005
Sample ID:	**05G1832-MB-01**	Sample Matrix	Water	Moisture %:	–
Sample Type:	Method Blank	Prep. Method:	3510	Instrument ID:	GC: W
Anal. Method:	M8015E	Prep. Date:	04/18/05	Anal. Date:	04/21/05
Batch No:	05G1832	Prep. No:	1 of 1	Anal. Time:	12:08
Data File Name:	1832G.K01	Sample Amount:	1000 mL	Dilution Factor:	1
Extract Vol.	1.0 mL				

#	Component Name	CAS No	Unit	RL	Result	Qualifier
1	DIESEL	11-84-7	mg/L	0.1	<0.1	U

Surrogates			Control Limit, %	Surro. Rec.%
1	OCTACOSANE, C28	630-02-4	57-139	82
# of out-of-control				0

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Qualifier: U - Not Detected or less than MDL/IDL
F - Positively identified, but Less than RL
M - A matrix effect was present
T - TIC by GC/MS
E - Exceed calibration range
B - Analyte is detected in the associated method blank
J - Positively identified, the quantitaion is estimated
R - unusable due to deficiencies

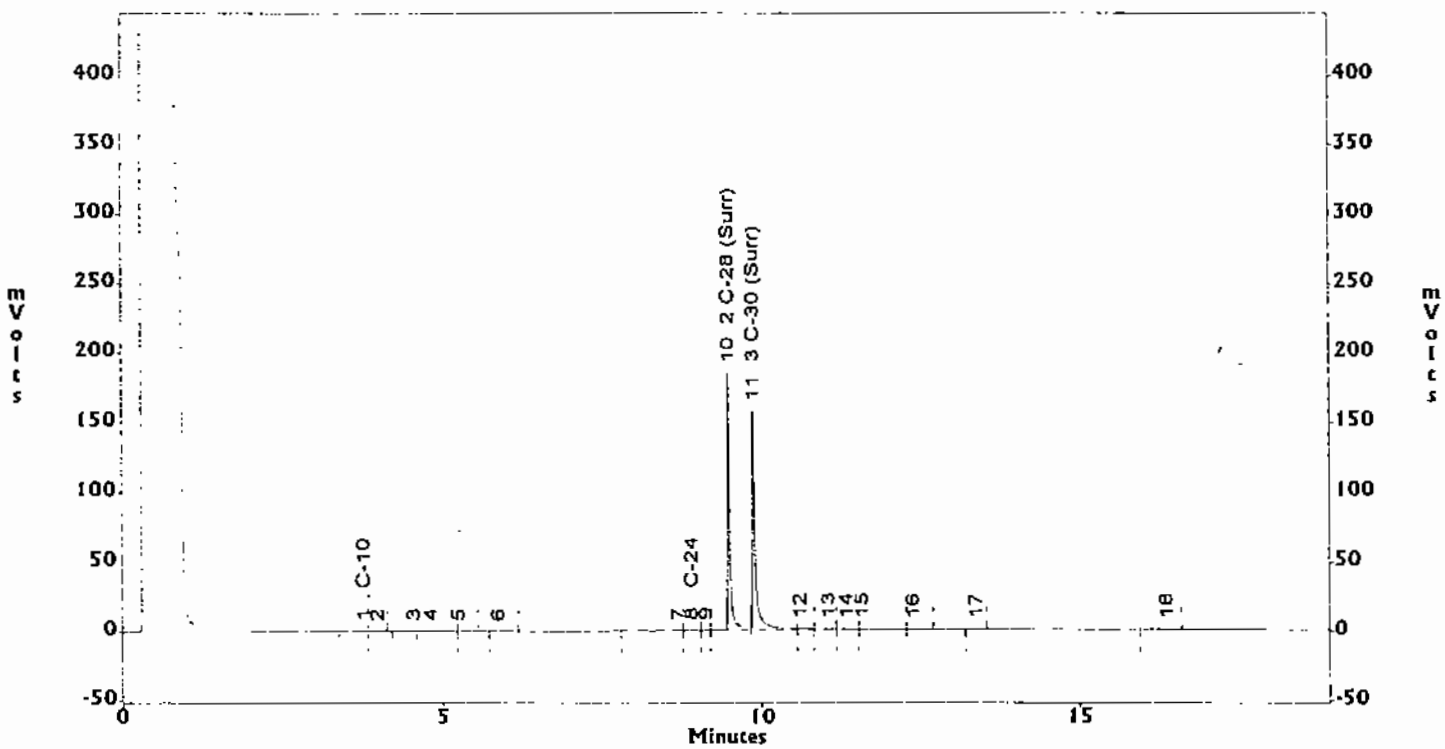
Applied P & Ch Lab
Total Extractable Petroleum Hydrocarbon Analysis by GC-FID
Instrument ID: GC-W, Column: DB-1 (0.32mm x 15m x 0.25 um), Jul

File : c:\data\0504\ds12w\05g1832\1832g.k01
Method : c:\ezchrom\methods\ds12-056.w00
Sample ID : mb f=0.001
Vial : 1
Volume : 2
Acquired : Apr 21, 2005 12:08:32
Printed : Apr 21, 2005 12:49:46
User : Linda Liang
File Desc. : Continue

Channel A Results

Name	Time	Area	AVE RF	Conc (ppm)
C-10	3.77	3420	0.000	0.000
C-16	6.63	0	0.000	0.000
C-22	8.32	0	0.000	0.000
C-24	8.90	2938	0.000	0.000
2 C-28 (Surr)	9.48	439111	10757.817	40.818
3 C-30 (Surr)	9.88	509368	10638.618	47.879
C-36	12.12	0	0.000	0.000
1 Diesel c10-c24		25025	12992.507	1.926
4 Motor oil c24-c36		75701	5674.990	13.339
5 JP5 c8-c16		22292	12037.801	1.852

c:\data\0504\ds12w\05g1832\1832g.k01 -- Channel A



FORM-2C

Applied P & CH Laboratories

Surrogate Recovery Summary for Method M8015E

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		SDG Number:	052314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05G1832		

#	Client Sample No	Lab Sample ID	S1 % #	TOT OUT
1	05G1832-LCS-01	05G1832-LCS-01	110	0
2	05G1832-LSD-01	05G1832-LSD-01	110	0
3	MW43302-6-0405MS	05-2282-4MS	95	0
4	MW43302-6-0405MSD	05-2282-4MSD	96	0
5	05G1832-MB-01	05G1832-MB-01	82	0
6	MW22187-5-0405	05-2314-1	86	0
7	MW22187-6-0405	05-2314-2	86	0
8	MW22187-7-0405	05-2314-3	102	0
9	MW22187-8-0405	05-2314-4	95	0
10	MW22187-10A-0405	05-2314-5	105	0
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

S1 = N-OCTACOSANE

QC Control Limit
57-139

Column to be used to flag recovery values:

* - Values outside of contract required QC Limits D - Surrogate diluted out I - Matrix Interference

FORM-3C

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method M8015E

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05G1832		
LCS Filename:	1832G.L01	Date Analyzed:	042105	Time Analyzed:	10:27
LCSD Filename:	1832G.J01	Date Analyzed:	042105	Time Analyzed:	10:52

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
DIESEL	mg/L	1	0	0.967	97	56-129
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
DIESEL	mg/L	1	0.954	95	2	49	56-129
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

FORM-3C

Applied P & CH Laboratories

Matrix Spike/Matrix Spike Duplicate Recovery for Method M8015E

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05G1832		
MS Filename:	1832G.M01	Date Analyzed:	042105	Time Analyzed:	11:17
MSD Filename:	1832G.N01	Date Analyzed:	042105	Time Analyzed:	11:43
MS Sample No:	MW43302-6-0405	Sample Lab ID:	05-2282-4		

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration MS	MS Rec% #	QC Limit, % REC
DIESEL	mg/L	0.962	5.1	5.47	38 *	41-138
# of Out-of-control					1	

Spiked Components	Unit	Spike Added	MSD Concentration	MSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
DIESEL	mg/L	0.962	5.27	18 *	4	49	41-138
# of Out-of-control				1	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

Applied P & CH Laboratories

Organic Analysis Results for Method RSK175

Client Name:	Parsons Engineering Science	Project No:	933868	Collection Date:	04/20/2005
Project ID:	Camp Pendleton Area 22	Service ID:	52314	Collected by:	
		Lab Sample ID:	05G1854-MB-01	Received Date:	04/20/2005
Sample ID:	**05G1854-MB-01**	Sample Matrix	Water	Moisture %:	–
Sample Type:	Method Blank	Prep. Method:	-	Instrument ID:	GC: K
Anal. Method:	RSK175	Prep. Date:	-	Anal. Date:	04/20/05
Batch No:	05G1854	Prep. No:	–	Anal. Time:	14:13
Data File Name:	1854G.K01	Sample Amount:	33 mL	Dilution Factor:	1
Extract Vol.	-				

#	Component Name	CAS No	Unit	RL	Result	Qualifier
1	METHANE	74-82-8	μg/L	3	<3	U
2	ETHANE	74-84-0	μg/L	3	<3	U
3	ETHENE	74-85-1	μg/L	3	<3	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Qualifier: U - Not Detected or less than MDL/IDL
F - Positively identified, but Less than RL
M - A matrix effect was present
T - TIC by GC/MS
E - Exceed calibration range
B - Analyte is detected in the associated method blank
J - Positively identified, the quantitaion is estimated
R - unusable due to deficiencies

FORM-3C

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method RSK175

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05G1854		
LCS Filename:	1854G.L01	Date Analyzed:	042005	Time Analyzed:	13:51
LCSD Filename:	1854G.J01	Date Analyzed:	042005	Time Analyzed:	13:54

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
METHANE	µg/L	19.8	0	17.8	90	65-122
ETHANE	µg/L	37.3	0	29.3	79	66-124
ETHENE	µg/L	34.8	0	32.5	93	65-122
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
METHANE	µg/L	19.8	17.4	88	2	34	65-122
ETHANE	µg/L	37.3	28.6	77	3	25	66-124
ETHENE	µg/L	34.8	31.8	91	2	22	65-122
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* - Values outside of contract required QC Limits D - Spiked components diluted out

Comments: _____

FORM-3C

Applied P & CH Laboratories

Matrix Spike/Matrix Spike Duplicate Recovery for Method RSK175

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05G1854		
MS Filename:	1854G.M01	Date Analyzed:	042005	Time Analyzed:	15:16
MSD Filename:	1854G.N01	Date Analyzed:	042005	Time Analyzed:	15:19
MS Sample No:	**MW22187-10A-0405**	Sample Lab ID:	05-2314-5		

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration MS	MS Rec% #	QC Limit, % REC
METHANE	µg/L	19.8	0	16.9	85	65-132
ETHANE	µg/L	37.3	0	27.6	74	69-118
ETHENE	µg/L	34.8	0	30.9	89	72-112
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	MSD Concentration	MSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
METHANE	µg/L	19.8	16.7	84	1	34	65-132
ETHANE	µg/L	37.3	27.6	74	0	25	69-118
ETHENE	µg/L	34.8	30.7	88	1	22	72-112
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

Applied P & CH Laboratories

Wet Analysis Results for Method 310.1

Client Name:	Parsons Engineering Science	Project No:	933868	Anal. Method	310.1
Project ID:	Camp Pendleton Area 22	Service ID:	52314	Collected by:	CD

Component Name: Alkalinity
CAS No: 10-09-3

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2314-1	MW22187-5-0405	Water	04/14/05	04/14/05	04/18/05	05W2105	mg/L	2	520	
05-2314-2	MW22187-6-0405	Water	04/14/05	04/14/05	04/18/05	05W2105	mg/L	2	520	
05-2314-3	MW22187-7-0405	Water	04/14/05	04/14/05	04/18/05	05W2105	mg/L	2	360	
05-2314-4	MW22187-8-0405	Water	04/14/05	04/14/05	04/18/05	05W2105	mg/L	2	190	
05-2314-5	MW22187-10A-0405	Water	04/14/05	04/14/05	04/18/05	05W2105	mg/L	2	550	
05W2105-MB-01	05W2105-MB-01	Water	04/18/05	04/18/05	04/18/05	05W2105	mg/L	2	<2	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.
Qualifier: U - Not Detected or less than MDL
F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

Applied P & CH Laboratories

Wet Analysis Results for Method SM3500DFE-

Client Name:	Parsons Engineering Science	Project No:	933868	Anal. Method	SM3500DFE-
Project ID:	Camp Pendleton Area 22	Service ID:	52314	Collected by:	CD

Component Name: Iron (II)
CAS No:

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2314-1	MW22187-5-0405	Water	04/14/05	04/14/05	04/14/05	05W2055	mg/L	0.05	0.061	
05-2314-2	MW22187-6-0405	Water	04/14/05	04/14/05	04/14/05	05W2055	mg/L	0.05	<0.05	U
05-2314-3	MW22187-7-0405	Water	04/14/05	04/14/05	04/14/05	05W2055	mg/L	0.05	0.17	
05-2314-4	MW22187-8-0405	Water	04/14/05	04/14/05	04/14/05	05W2055	mg/L	0.05	0.17	
05-2314-5	MW22187-10A-0405	Water	04/14/05	04/14/05	04/14/05	05W2055	mg/L	0.05	0.18	
05W2055-MB-01	05W2055-MB-01	Water	04/14/05	04/14/05	04/14/05	05W2055	mg/L	0.05	<0.05	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.
Qualifier: U - Not Detected or less than MDL
F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

Applied P & CH Laboratories

Wet Analysis Results for Method 300.0

Client Name:	Parsons Engineering Science	Project No:	933868	Anal. Method	300.0
Project ID:	Camp Pendleton Area 22	Service ID:	52314	Collected by:	CD

Component Name: Nitrate as N
CAS No: 14797-55-8

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2314-1	MW22187-5-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	6	4.2	F
05-2314-2	MW22187-6-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	3	9.3	
05-2314-3	MW22187-7-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	2.4	1.6	F
05-2314-4	MW22187-8-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	6	7.8	
05-2314-5	MW22187-10A-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	6	3.3	F
05W2074-MB-01	05W2074-MB-01	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	0.06	<0.06	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.
Qualifier: U - Not Detected or less than MDL
F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

Applied P & CH Laboratories

Wet Analysis Results for Method 300.0

Client Name:	Parsons Engineering Science	Project No:	933868	Anal. Method	300.0
Project ID:	Camp Pendleton Area 22	Service ID:	52314	Collected by:	CD

Component Name: Sulfate

CAS No: 14808-79-8

Lab ID	Sample ID	Matrix	Coll. Date	Rcv Date	Anal. Date	Batch	Unit	RL	Result	Q
05-2314-1	MW22187-5-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	50	360	
05-2314-2	MW22187-6-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	25	240	
05-2314-3	MW22187-7-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	20	250	
05-2314-4	MW22187-8-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	50	630	
05-2314-5	MW22187-10A-0405	Water	04/14/05	04/14/05	04/15/05	05W2074	mg/L	50	410	
05W2074-MB-01	05W2074-MB-01	Water	04/15/05	04/15/05	04/15/05	05W2074	mg/L	0.5	<0.5	U

Not Detected is shown as PQL, with dilution and moisture corrected if applicable.

Note: Q - Qualifier.

Qualifier: U - Not Detected or less than MDL

F - Less than RL (PQL, EQL or CRDL), but greater than MDL.

FORM-3

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method 310.1

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05W2105		
LCS Filename:	-	Date Analyzed:	041805	Time Analyzed:	13:26
LCSD Filename:	-	Date Analyzed:	041805	Time Analyzed:	13:26

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
ALKALINITY	mg/L	100	0	101	101	90-110
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
ALKALINITY	mg/L	100	102	102	1	10	90-110
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

FORM-3

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method 300.0

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05W2074		
LCS Filename:	-	Date Analyzed:	041505	Time Analyzed:	10:03
LCSD Filename:	-	Date Analyzed:	041505	Time Analyzed:	10:15

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
NITRATE AS N	mg/L	1.5	0	1.49	99	86-110
SULFATE	mg/L	15	0	14.6	97	82-110
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
NITRATE AS N	mg/L	1.5	1.50	100	1	13	86-110
SULFATE	mg/L	15	14.6	97	0	17	82-110
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

FORM-3

Applied P & CH Laboratories

Matrix Spike/Matrix Spike Duplicate Recovery for Method 300.0

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05W2074		
MS Filename:	-	Date Analyzed:	041505	Time Analyzed:	14:25
MSD Filename:	-	Date Analyzed:	041505	Time Analyzed:	14:38
MS Sample No:	U8-133	Sample Lab ID:	05-2316-2		

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration MS	MS Rec% #	QC Limit, % REC
NITRATE AS N	mg/L	37.5	19	57.2	102	86-112
SULFATE	mg/L	375	30	403	99	83-116
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	MSD Concentration	MSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
NITRATE AS N	mg/L	37.5	51.2	86	17 *	13	86-112
SULFATE	mg/L	375	341	83	18 *	17	83-116
# of Out-of-control				0	2		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

FORM-3

Applied P & CH Laboratories

Lab Control Spike/Lab Control Spike Duplicate Recovery for Method SM3500DFE-

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05W2055		
LCS Filename:	-	Date Analyzed:	041405	Time Analyzed:	18:43
LCSD Filename:	-	Date Analyzed:	041405	Time Analyzed:	18:43

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration LCS	LCS Rec% #	QC Limit, % REC
IRON (II)	mg/L	0.5	0	0.518	104	80-120
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	LCSD Concentration	LCSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
IRON (II)	mg/L	0.5	0.522	104	0	25	80-120
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

FORM-3

Applied P & CH Laboratories

Matrix Spike/Matrix Spike Duplicate Recovery for Method SM3500DFE-

Client Name:	Parsons Engineering Science	Contract No:		Lab Code:	APCL
Case No:		SAS No:		Service ID:	52314
Project ID:	Camp Pendleton Area 22	Project No:	933868	Sample Matrix:	Water
		Batch No:	05W2055		
MS Filename:	-	Date Analyzed:	041405	Time Analyzed:	18:43
MSD Filename:	-	Date Analyzed:	041405	Time Analyzed:	18:43
MS Sample No:	MW1121-11-0405	Sample Lab ID:	05-2313-1		

Spiked Components	Unit	Spike Added	Concentration Unspiked	Concentration MS	MS Rec% #	QC Limit, % REC
IRON (II)	mg/L	0.5	0.50	0.904	81	75-125
# of Out-of-control					0	

Spiked Components	Unit	Spike Added	MSD Concentration	MSD Rec% #	RPD% #	QC Limit, % RPD	QC Limit, % REC
IRON (II)	mg/L	0.5	0.908	82	1	25	75-125
# of Out-of-control				0	0		

Column to be used to flag recovery and RPD values:

* – Values outside of contract required QC Limits D – Spiked components diluted out

Comments: _____

Wet Chemistry QC Report B
Duplicate Results

Matrix: Water

APCL Service ID: 05-2314

Analysis	Batch ID	Analysis Date	Sample Name	Unit	Result	Duplicate Result	RPD %	RPD Control limit
Alkalinity	05W2105	04/18/2005	05-2276-09	mg/L	229.0	227.6	1	20

Note: N/A = Not applicable; NR: Not requested; NC= Not Calculated; ND: Not detected.

APPENDIX D

MEETING MINUTES

PARSONS
100 W Walnut St, Pasadena, CA 91124 (626) 440-4000 Fax (626) 440-6200

Meeting Notes

Subject:	**Meeting Notes regarding Project Update Meeting for 8 UST Sites, MCB Camp Pendleton**		
Location:	AC/S ES Office Bldg. 22165, Library Conference Room		
Date:	2/10/2005	Time:	9:00 AM
Project:	UST Sites, Camp Pendleton	Facilitator &	C. Silver, Parsons
Project No.:	733868.01000	Recorded By:	

Attendees Name/Company

Bipin Patel	SWDIV	Laurie Walsh	RWQCB
Chet Storrs	MCB Camp Pendleton AC/S	Cannon Silver	Parsons

Item	Meeting Notes	Action
1.	Parsons gave an overview of site locations, contaminants, cleanup goals, and remediation history.	None.
2.	Discussed EPA Guidance for evaluation of biosparging effectiveness. Discussed recent guidance to maintain DO above 2 mg/L, and efforts to optimize system operation to achieve higher DO. Parsons professional judgment is that sparging pure oxygen would not significantly improve performance. Discussed success in observing oxygen utilization at the sites.	Parsons to use 2 mg/L as DO goal, and to continue to try optimizing system operation to reach this concentration.
3.	Chet clarified that entire Base is within a beneficial use aquifer, but that comparing sites to the EPA guidance on low-risk soil and groundwater sites can be useful as an evaluation of remedial progress. He noted that other sites on Base have been closed even with groundwater monitoring results above MCLs.	Noted.
4.	Discussed Site 22187. Noted that oxygen utilization remains at ~1%/day, suggesting that continued biosparging may be useful in removing residual biodegradable petroleum hydrocarbons within the vadose zone.	Biosparging will continue at Site 22187 until a further reduction in oxygen utilization is observed. Parsons to use multiple lines of evidence to evaluate system performance, including accepted models such as Bioscreen™. Post remediation monitoring will include one year of groundwater monitoring and soil confirmation sampling.
5.	Discussed whether analysis for benzene and MTBE may be discontinued at Site 22187. Benzene has not been detected above cleanup	Laurie to ask others at the RWQCB.

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	goals since April 2002, and MTBE remains well below cleanup goals.	
6.	Discussed Site 2296, including the Response to Comments. Soil borings installed in February 2003 indicated that leachable TPH remained under the street, and remediation during 2004 focused on this area. 2004 soil gas monitoring oxygen utilization rates are now zero, indicating that residual vadose zone soil contamination has now been removed. Benzene MCL has been met, and dissolved-phase TPHd concentrations in MW2296-5 are decreasing.	Parsons to discontinue biosparging system operation. One-year of groundwater monitoring will include April and October 2005 events. After one year, the System Performance Review Report will be submitted, possibly with recommendations for no further action.
7.	Discussed delivery of QA/QC data to RWQCB.	Parsons to send CD with 2nd Quarter 2004 QA/QC data to Camp Pendleton, who will then forward to RWQCB.
8.	The site number reference system was discussed.	Parsons to update numbers on Response to Comments.
9.	Discussed Site 1121. Benzene concentrations are asymptotic in MW1121-8, and non-detect in MW-10A. TPHd continues to fluctuate in MW1121-8 and MW-10A, possibly as a result of BS system operation. Laurie noted that closure may be argued based on the distance to the nearest Base drinking water well (9,300 feet from neighboring Site 1131), that TPHd has only a taste and odor threshold, and that biodegradation is occurring.	Parsons to shutdown biosparging system for one year to see if TPHd concentrations stabilize, perform soil confirmation sampling to document percent reduction, and then present the case for site closure.
10.	Discussed Site 1131. Cleanup goals for benzene have been met. TPHd concentrations continue to fluctuate in MW1131-1, due to submerged residual pockets of petroleum hydrocarbons within the weathered grandiolite. Overall plume is stable. Downgradient well MW1131-8 remains near cleanup goals.	Similar to Site 1121, Parsons to shutdown biosparging system for one year to see if TPHd concentrations stabilize, perform soil confirmation sampling to document percent reduction, and then present the case for site closure.
11.	Discussed Site 43302. TPHd concentrations have increased as groundwater elevations have decreased. Benzene concentrations have continued to decrease. Oxygen utilization continues at ~0.5%/day.	Biosparging will continue at Site 43302 until a further reduction in oxygen utilization is observed. Continue to work on reaching MCL for benzene.
12.	Discussed Site 53435. No benzene at the site. Discussed how increasing TPHd concentrations may be related to the decreasing groundwater elevations or to BS system operation. Suggested turning off the system for 3 months to evaluate	Parsons to turn off the system for 3 months to evaluate whether TPH concentrations stabilize. The 4th Quarter 2004 System and Groundwater Monitoring Report will be revised to

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	impact on GW concentrations. Soil gas sampling indicates that residual biodegradable petroleum compounds remain in the subsurface. Discussed elevated TPH measured in downgradient MW53435-8. Discussed whether there were two sources and plumes present, based on 1997 soil boring data. Mentioned that the site has a high groundwater velocity. Laurie mentioned that the proximity to the San Onofre Creek is a concern.	include a further evaluation of contamination sources, plume extent, and trends.
Site visits were conducted to 22187, 2296, 1121, 1131, 43302, and 53435. The site visits were concluded at approximately 14:00.		
cc: All participants Martha Araujo, NFESC File		