Versar INC.

GROUNDWATER MONITORING REPORT - OCTOBER 19, 1994
PACIFIC DRY DOCK YARD I
OAKLAND, CALIFORNIA

Prepared for:

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Versar Project No. 2722-017

January 6, 1995

PROJECT SUMMARY

On October 19, 1994, Versar, Inc. (Versar) conducted the sixth round of groundwater monitoring and sampling at the Pacific Dry Dock Yard I located at 1441 Embarcadero in Oakland, California.

Groundwater monitoring is being conducted from two of the five monitoring wells as part of the site investigation activities. Each sampling event includes: (1) measurement of groundwater levels from all five monitoring wells; (2) collection and analysis of groundwater samples for total petroleum hydrocarbons as gasoline, total petroleum hydrocarbons as diesel, benzene, toluene, ethylbenzene, and xylenes from monitoring wells MW-1 and MW-3; (3) calculation of the hydraulic gradient; and (4) production of a report summarizing the results of the sampling event. Mr. Vernon P. Elarth, Geologist, prepared this report under the guidance of Mr. Lawrence Kleinecke, Senior Geohydrologist.

The following conclusions summarize the findings of Versar's investigation:

- On October 19, 1994, the calculated groundwater gradient was 0.007 feet/foot to the northeast. The data used to calculate this gradient were collected during an incoming tide.
- Total petroleum hydrocarbons as diesel were detected in a sample collected from groundwater monitoring well MW1.
- No other petroleum hydrocarbon analytes were detected in samples collected from monitoring wells MW1 and MW3.

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1.0 INTRODUCTION

Versar, Inc. (Versar) has been retained by Crowley Marine Services, Inc. (Crowley) to conduct environmental investigations, including a program of groundwater monitoring, at Pacific Dry Dock Yard I (PDDI), located at 1441 Embarcadero in Oakland, California (the site). This groundwater monitoring report describes the procedures and findings of the sixth round of monitoring and groundwater sampling, which was conducted on October 19, 1994. This investigation is being conducted in accordance with the policies of the San Francisco Bay Regional Water Quality Control Board and the Alameda County Health Care Services Agency.

The site occupies approximately two acres and is bounded by the Embarcadero to the north, the Oakland Inner Harbor to the south, an undeveloped lot to the east, and a boat repair yard to the west. PDDI has been unoccupied since January 1994 and there is currently no activity at the site.

Currently, a machine shop with covered storage occupies the south-central section and a sheet metal bulkhead abuts the southern edge of the site. Four aboveground diesel storage tanks occupy the southwest corner of the site. Other structures, including an office building, a machine shed, an aboveground waste oil tank, and assorted sheds and storage buildings were demolished recently and removed. Figures 1 and 2 show the site location and site layout, respectively.

During the second, third, and fourth rounds of groundwater sampling, additional filtered duplicate groundwater samples were collected from monitoring wells MW1 and MW3. These additional samples were filtered in the field using a 0.45 micrometer filter and submitted for laboratory analysis of TPH-D. Laboratory analytical results of the filtered duplicate samples generally indicated a lower concentration of TPH-D compared to the unfiltered samples. These results indicate that the concentrations of TPH-D detected in unfiltered samples are higher due to contaminant adsorbtion to soil particles in the groundwater samples.

Concentrations of total dissolved solids (TDS) in the groundwater samples collected from the site regularly exceed 3,000 milligrams per liter, the baseline above which the water quality control plan published by the Regional Water Quality Control Board - San Francisco Bay Region considers water not suitable for beneficial uses. The groundwater elevation is consistently higher at the west end of the site. Saline or brackish water recharge appears to be occurring near the west end of the site.

1.1 Site Geology and Geohydrology

The site is located in the Coast Ranges geomorphic province between the Hayward Fault (to the east) and the San Andreas Fault (to the west). The underlying bedrock consists of Mesozoic volcanic and metavolcanic rocks similar to those found throughout the Coast Ranges. Overlying the bedrock are Quaternary marine and nonmarine alluvial sediments consisting of clays and silts.

The site is nearly level at an elevation ranging from five to ten feet above lower low-tide datum (National Geodetic Vertical Datum of 1929). Versar's investigation has characterized the shallow soils beneath the site as sand, silt, and clay fill material extending from the surface to the bay muds. The fill material contains wood and brick fragments. The bay muds consist of silty clays, clays with shell fragments, and thin layers of sands or gravels. These layers are often saturated with groundwater.

During the October 19, 1994 sampling event, depth to groundwater was measured at between 5.00 and 7.00 feet below ground surface (bgs) during an incoming tide. Calculations indicate a groundwater gradient of 0.007 feet per foot (ft/ft) to the northeast. The impact of tidal fluctuations on gradient calculations has not yet been determined. Figure 3 shows the groundwater contours and flow direction calculated from the sixth sampling round. A hydrograph of the groundwater elevations in the monitoring wells from all five groundwater monitoring events is included as Figure 4. The groundwater contours and flow direction calculated from previous sampling events are depicted in Appendix A.

1.2 Site History

Since 1935, PDDI has been used as a dry dock facility. In the past, while repairing and refurbishing seagoing vessels, Crowley used products containing regulated materials and generated various regulated and nonregulated wastes. These products and waste materials include waste sand-blasting materials, oil-based paints, solvents, acids, caustic agents, waste oils, and motor fuels.

During December 1989 and January 1990, Versar conducted a site assessment of PDDI. The site assessment (Versar, 1990) identified an underground storage tank (UST) reported to contain unleaded gasoline. The UST was reportedly out of service.

In September 1991, Versar supervised the removal of the UST (Versar, 1991). Soil and groundwater samples collected from the excavation following the removal were found to contain total petroleum hydrocarbons as gasoline (TPH-G); total petroleum hydrocarbons as diesel (TPH-D); total oil and grease (TOG); benzene, toluene, ethylbenzene, and xylenes (BTEX); and organic lead.

During October 1991 and January 1992, Versar collected a series of soil and groundwater samples from PDDI (Versar, May 1992). The results of this investigation identified four areas of soil containing identifiable concentrations of TPH-G, TPH-D, TOG, and BTEX.

On June 23 and 24, 1993, five 2-inch-diameter groundwater monitoring wells were installed to a depth of 13 to 14 feet bgs at PDDI (Versar, November 7, 1993). During drilling activities, soil samples collected from boreholes MW1, MW2, and MW4 were submitted for laboratory analysis and concentrations of TPH-D, BTEX, and TOG were identified. Analysis of soil samples collected from borehole MW3 identified concentrations of TPH-D and toluene. The sample collected from borehole MW5 contained only toluene.

Metals were detected in two soil samples (MW1-5.5 and MW3-5.5). Metals detected were arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc. However, none of the detected metals exceeded their respective regulatory limits.

On June 25, 1993, each monitoring well was developed by removing a minimum of five well volumes of groundwater, or until dry. On July 1, 1993, each well was purged and sampled. This sampling event represented the first of a series of monitoring and sampling events. The groundwater samples were analyzed for TPH-D, TPH-G, TOG, and BTEX. Additionally, the groundwater sample collected from MW3 was analyzed for semivolatile organic compounds and volatile organic compounds.

The second round of groundwater monitoring and sampling at PDDI was conducted on October 14, 1993. The samples were analyzed for TPH-D, TPH-G, BTEX, TDS, and salinity. On December 8, 1993, a peristaltic pump and groundwater sampling filter were used to collect duplicate samples from monitoring wells MW1 and MW3. The analytical results of filtered groundwater samples collected from these wells showed up to a tenfold decrease in the concentration of TPH-D when compared to unfiltered samples. These results indicate that some of the TPH-D contamination detected previously in monitoring wells MW1 and MW3 was due to the adsorption of TPH-D to soil particles.

The third round of monitoring and sampling at PDDI was performed on January 17 and 18, 1994. The groundwater samples were again analyzed for TPH-D, TPH-G, BTEX, TDS, and salinity. Petroleum hydrocarbon constituents were detected in monitoring wells MW1 and MW3.

The fourth round of monitoring and sampling at PDDI was performed on March 30, 1994. The groundwater samples were analyzed for TPH-D, TPH-G, BTEX, TDS, and salinity. Petroleum hydrocarbon constituents were detected in monitoring well MW1. In addition, toluene was detected in the other four monitoring wells.

The fifth round of monitoring and sampling at PDDI was performed on July 15, 1994. The groundwater samples were analyzed for TPH-D, TPH-G, BTEX, TDS, and salinity. Petroleum hydrocarbon constituents were detected in monitoring well MW1. In addition, toluene was detected in the other four monitoring wells. However, due to the extremely low concentrations of analytes, when detected, in monitoring wells MW2, MW4, and MW5, it was decided that only MW1 and MW3 will be sampled in the sixth groundwater monitoring event as agreed by Alameda County Department of Health Services (ACHS).

1.3 Groundwater Monitoring Program

The primary purpose of this program is to maintain regularly scheduled groundwater monitoring at the PDDI site. The general objectives of this sixth sampling event were to:

- measure groundwater levels in monitoring wells MW1, MW2, MW3, MW4, and MW5 and determine the local hydraulic gradient;
- purge and collect groundwater samples from monitoring wells MW1, and MW3;
- submit the groundwater samples to a certified laboratory for analysis for TPH-G, TPH-D, and BTEX; and
- prepare this groundwater monitoring report.

2.0 SAMPLING ACTIVITIES

The sixth round of groundwater monitoring and sampling at PDDI was conducted on October 19, 1994. The investigation included measurement of the groundwater levels in the five monitoring wells and the collection of groundwater samples from monitoring wells MW1 and MW3.

Before any groundwater sampling was conducted, Versar measured the depth to groundwater in each monitoring well. Groundwater was present at depths of 6.67 feet bgs (MW1), 5.72 feet bgs (MW2), 5.00 feet bgs (MW3), 6.89 feet bgs (MW4), and 7.00 feet bgs (MW5). These depths were converted to elevations using data from a previous survey and were used to calculate the hydraulic gradient. The gradient on October 19, 1994, was 0.007 ft/ft in a northeasterly direction, as shown in Figure 3. The groundwater level data for previous sampling events are listed in Table 1.

After groundwater levels were measured, the monitoring wells were purged following Versar's standard procedures, outlined in Appendix B. Data collected during purging included (1) the initial depth to groundwater; (2) pH; (3) temperature; (4) conductivity; and (5) observations of sheen, odor, free product, and turbidity. Details of the purging were recorded and are included as Appendix C.

Versar collected groundwater samples from each monitoring well using a single use bailer. The samples for TPH-G and BTEX were placed in precleaned, 40-milliliter glass vials preserved with hydrochloric acid. Groundwater samples to be analyzed for TPH-D were placed in precleaned, 1-liter glass amber containers. Sampling containers were labeled with the date collected and a unique sample identification and stored at approximately 4° C in an insulated cooler. All monitoring well groundwater samples were submitted for analysis to Trace Analysis Laboratory, Inc., (Trace) a California-certified laboratory (Certification No. 1199). Trace prepared the samples following U.S. Environmental Protection Agency (EPA) protocols and were accompanied by Versar's chain-of-custody record. The results of the laboratory analysis are presented in Section 3.0, "Laboratory Analytical Results".

3.0 LABORATORY ANALYTICAL RESULTS

During this sampling event, Versar collected two groundwater samples for laboratory analysis for TPH-G, TPH-D, and BTEX. Analysis for TPH-G and TPH-D was performed following the California Department of Health Services method. Analysis for BTEX was performed following the modified EPA Method 8020. Analytical results of groundwater samples are summarized in Figure 5. A copy of the laboratory analytical report and chain-of-custody record from the sampling event is included as Appendix D.

Trace reported that the groundwater samples collected on October 19, 1994, from monitoring wells MW1 and MW3 did not contain TPH-G or BTEX at or above the method reporting limits. The groundwater sample from MW1 contained 830 micrograms per liter of TPH-D; the groundwater sample from MW3 did not contain TPH-D at or above the method reporting limit. The laboratory analytical results indicate the matrix spike recovery and relative percent difference (RPD) are within acceptable ranges.

Laboratory analytical results for groundwater samples from October 19, 1994, are summarized in Table 2. Results of laboratory analysis for TPH-D in the filtered duplicate samples from MW1 and MW3 from previous sampling events are summarized in Table 3. The historical trend of chemical data is summarized in Table 4.

4.0 FUTURE ACTIVITIES

This is the sixth round of the sampling activities for the two monitoring wells MW1 and MW3 at the PDDI site. Because petroleum hydrocarbon contamination has been identified in groundwater samples collected during the first six sampling events, additional groundwater monitoring will be conducted. The next sampling event is scheduled for January 1995.

5.0 REFERENCES

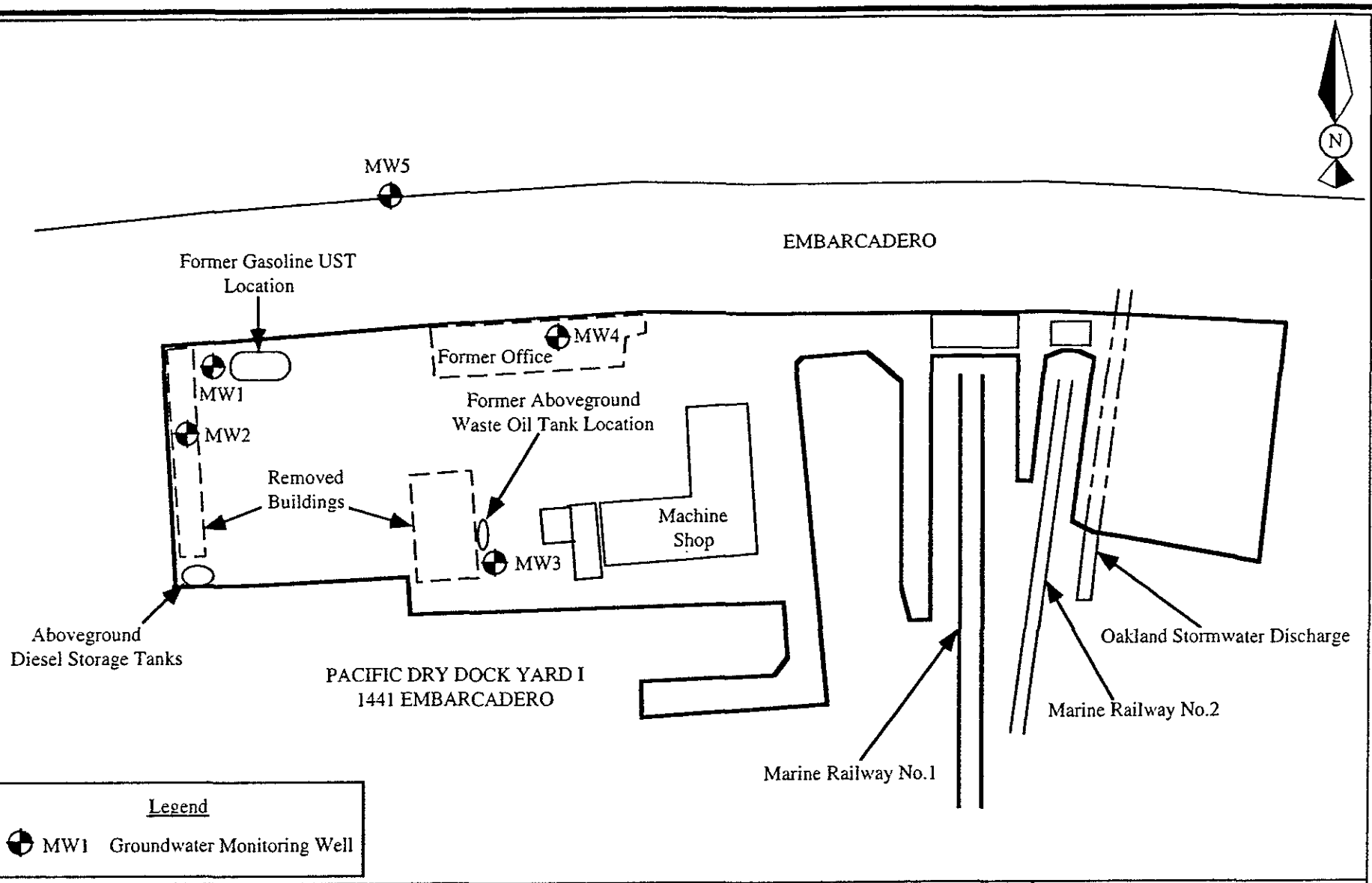
Versar, Inc. Fair Oaks, California. 1990, Site Assessment Report for the Pacific Dry Dock and Repair Yards I and II, Oakland, California.

Versar, Inc. Fair Oaks, California. October 1991, Tank Removal, Pacific Dry Dock and Repair Yard I, Western Section, Oakland, California.

Versar, Inc. Fair Oaks, California. May 1992, Preliminary Investigation and Evaluation Report (PIER), Pacific Dry Dock and Repair Yard I, Western Section, Oakland, California.

Versar, Inc. Fair Oaks, California. November 7, 1993, Well Installation, Pacific Dry Dock and Repair Yard I, Western Section, Oakland, California.

Scale (miles) 0 0.25 0.50	Site Location	Figure 1
Project No. 2722-017	Pacific Dry Dock Yard I Oakland, California	Versar, Inc.



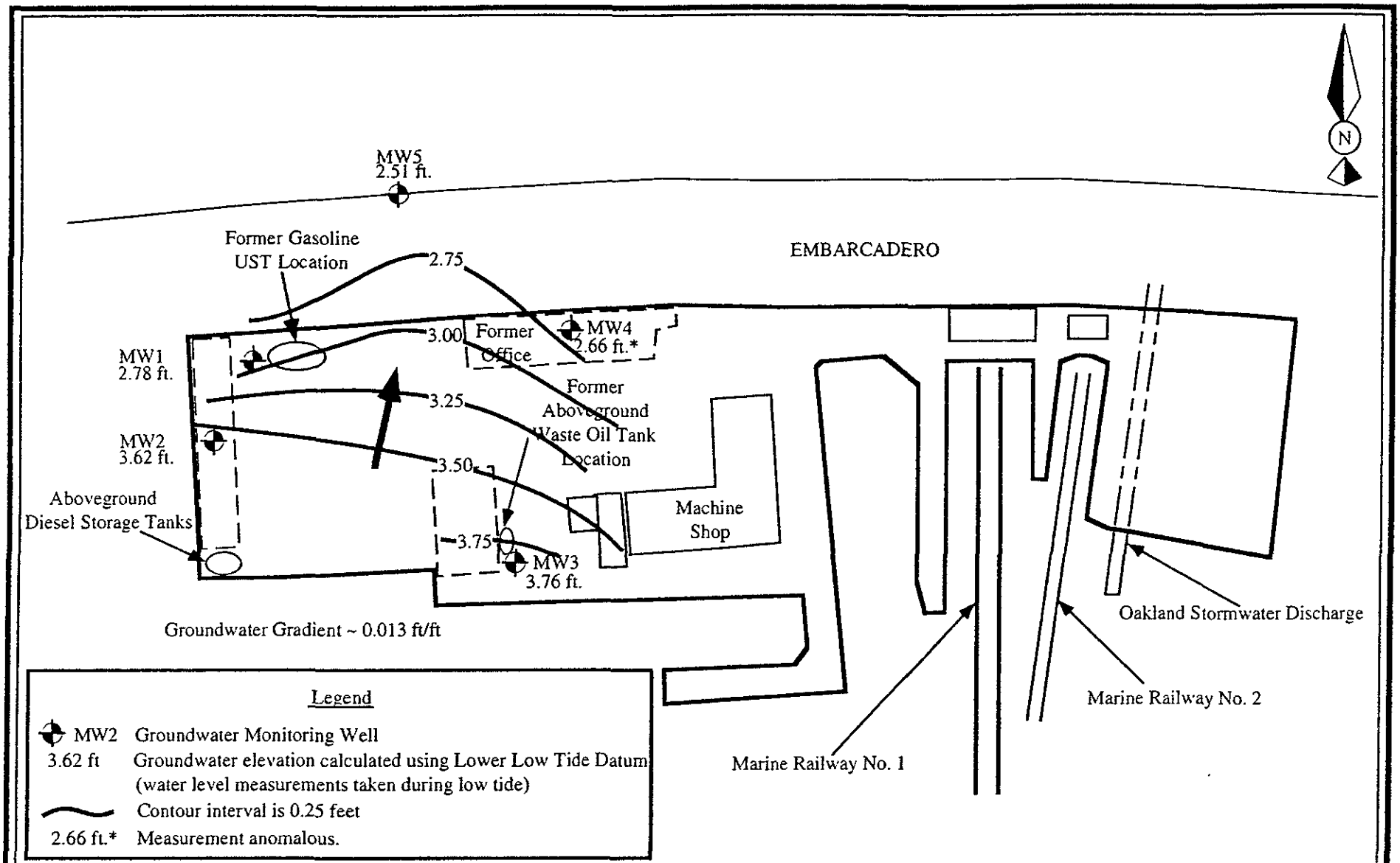
Site Layout

Pacific Dry Dock Yard I
Oakland, California

Figure 2

Project No. 2722-017

Versar, Inc.



Scale (feet)

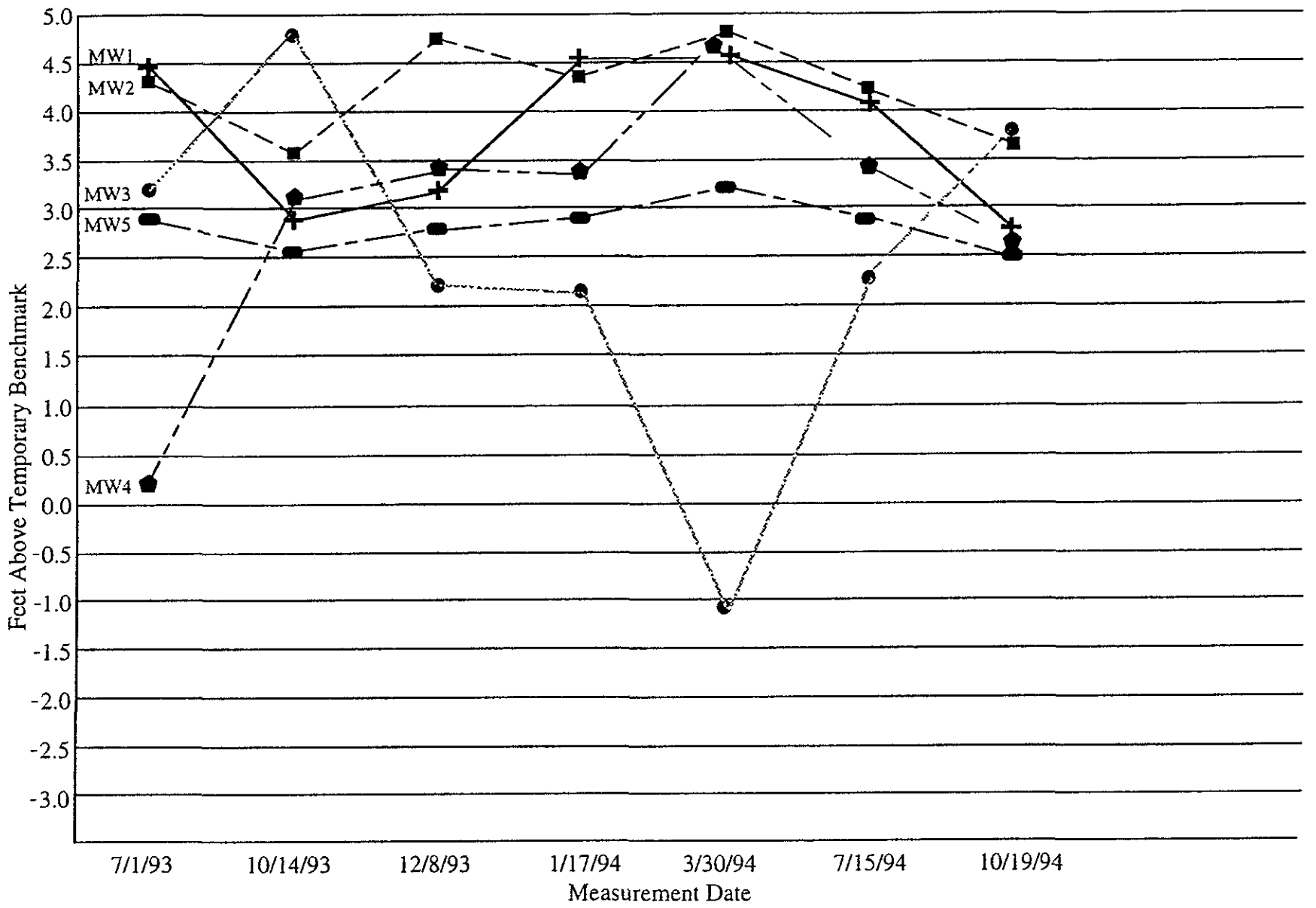
0 50 100

Project No. 2722-017

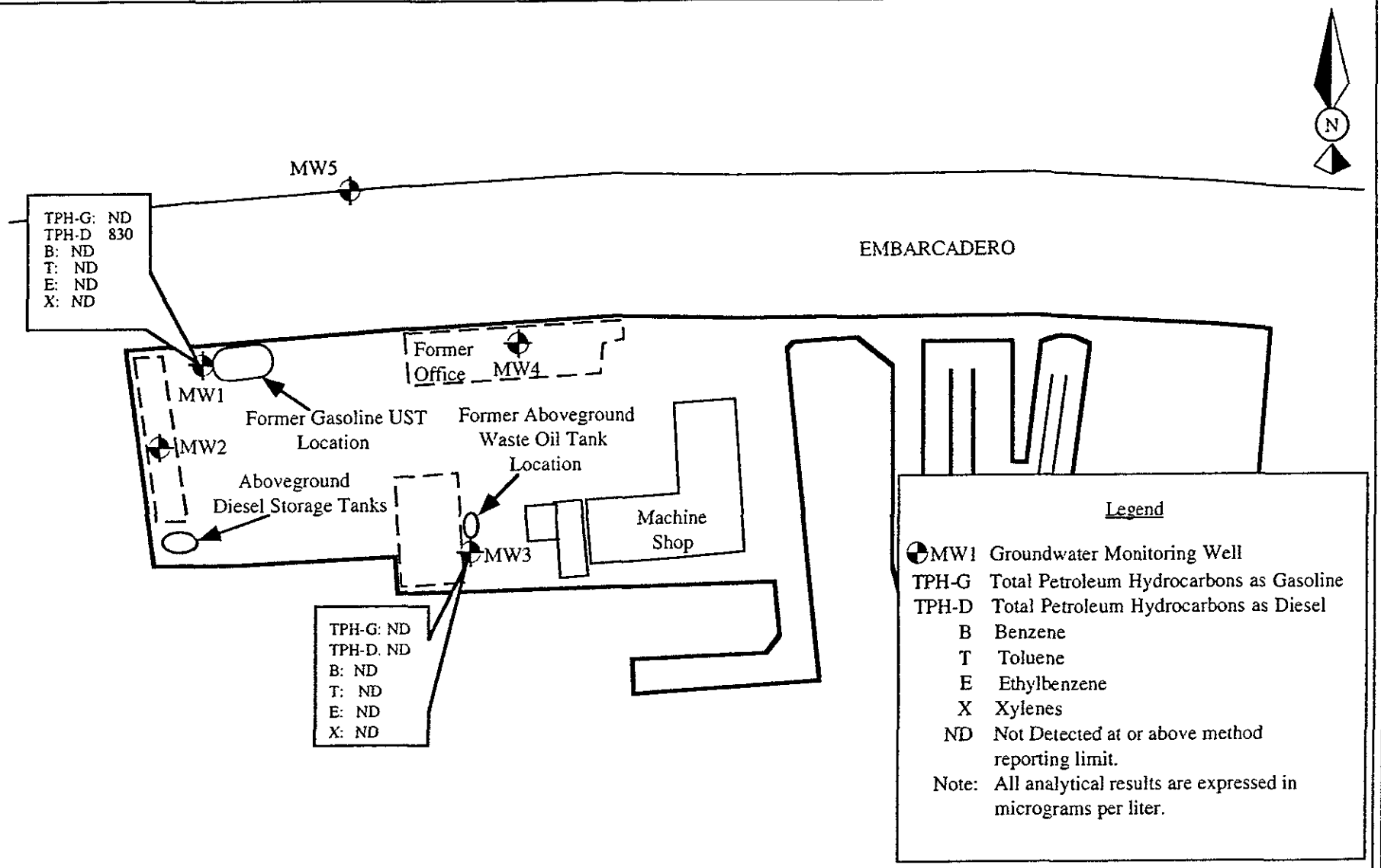
Calculated Groundwater Gradient
October 19, 1994
Pacific Dry Dock Yard I
Oakland, California

Figure 3

Versar, Inc.



Not to Scale	Groundwater Measurements July 1, 1993 through October 19, 1994	Figure 4
Project No. 2722-017	Pacific Dry Dock Yard I Oakland, California	Versar, Inc.



Scale (feet)
0 50 100

Project No. 2722-017

Laboratory Analytical Results for Groundwater
Samples Collected on October 19, 1994
Pacific Dry Dock Yard I
Oakland, California

Figure 5

Versar, Inc.

TABLE 1

GROUNDWATER MONITORING REPORT
MONITORING WELL GROUNDWATER LEVELS

October 19, 1994

Pacific Dry Dock Yard I
Oakland, California

	MW1	MW2	MW3	MW4	MW5	Hydraulic Gradient (feet/foot)
Reference Casing Elevation (feet)	9.45	9.34	8.76	9.55	9.51	
July 1, 1993						
Depth to Groundwater (High Tide)[1]	5.01	4.94	5.54	9.33	6.56	
Groundwater Elevation	4.44	4.40	3.22	1.22	2.95	0.017 ft/ft to the east
October 14, 1993						
Depth to Groundwater (High Tide)[1]	6.54	5.74	3.98	6.45	6.92	
Groundwater Elevation	2.91	3.60	4.78	3.10	2.59	0.013 ft/ft to the north
December 8, 1993						
Depth to Groundwater (Low Tide)[2]	6.28	4.55	6.50	6.02	6.71	
Groundwater Elevation	3.17	4.79	2.26	3.53	2.80	0.016 ft/ft to the east
January 17, 1994						
Depth to Groundwater (High Tide)[1]	4.93	4.90	6.60	6.05	6.60	
Groundwater Elevation	4.52	4.44	2.16	3.50	2.91	0.013 ft/ft to the southeast
March 30, 1994						
Depth to Groundwater (Low Tide)[2]	4.87	4.51	9.81	4.91	6.35	
Groundwater Elevation	4.58	4.83	-1.05	4.65	3.16	0.030 ft/ft to the southeast

[1] Depth-to-groundwater measurements were taken during high tide and are expressed in feet below top of casing.
[2] Depth-to-groundwater measurements were taken during low tide and are expressed in feet below top of casing.
[3] Depth-to-groundwater measurements were taken on an outgoing tide and are expressed in feet below top of casing.

GROUNDWATER MONITORING REPORT
MONITORING WELL GROUNDWATER LEVELS

October 19, 1994

Pacific Dry Dock Yard I
Oakland, California

	MW1	MW2	MW3	MW4	MW5	Hydraulic Gradient (feet/foot)
July 15, 1994						
Depth to Groundwater (Outgoing Tide)[3]	5.31	5.16	8.76	9.55	9.51	
Groundwater Elevation	4.14	4.18	1.81	3.49	2.95	0.013 ft/ft to the southeast
October 19, 1994						
Depth to Groundwater (Incoming Tide)[4]	6.67	5.72	5.00	6.89	7.00	
Groundwater Elevation	2.78	3.62	3.76	2.66	2.51	0.007 ft/ft to the northeast

[1] Depth-to-groundwater measurements were taken during high tide and are expressed in feet below top of casing.
[2] Depth-to-groundwater measurements were taken during low tide and are expressed in feet below top of casing.
[3] Depth-to-groundwater measurements were taken on an outgoing tide and are expressed in feet below top of casing.
[4] Depth-to-groundwater measurements were taken on an incoming tide and are expressed in feet below top of casing.

TABLE 2

GROUNDWATER MONITORING REPORT
LABORATORY ANALYTICAL RESULTS FOR GROUNDWATER

October 19, 1994

Pacific Dry Dock Yard I
Oakland, California

Groundwater Monitoring Well	Sample Date	TPH-G (µg/L)[1]	TPH-D (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	TDS (µg/L)	Salinity
MW1	10/19/94	ND	830	ND	ND	ND	ND	NA	NA
MW3	10/19/94	ND	ND	ND	ND	ND	ND	NA	NA

[1] µg/L = micrograms per liter
[2] ND = Not Detected at or above method reporting limits.
[3] NA = Not Analyzed

TABLE 3

GROUNDWATER MONITORING REPORT
LABORATORY ANALYTICAL RESULTS FOR TPH-D IN FILTERED DUPLICATE SAMPLES
FROM MONITORING WELLS MW1 AND MW3

October 19, 1994

Pacific Dry Dock Yard I
Oakland, California

Groundwater Monitoring Well	Sample Date	Total Petroleum Hydrocarbons as Diesel (µg/L)[1]
MW1	10/14/93	63
	1/18/94	60
	3/30/94	110
MW1 (Filtered Duplicate)	12/8/93	57
	1/18/94	150
	3/30/94	ND[2]
MW3	10/14/93	840
	1/18/94	64
	3/30/94	ND
MW3 (Filtered Duplicate)	12/8/93	89
	1/18/94	91
	3/30/94	ND

[1] µg/L = micrograms per liter
[2] ND = Not Detected at or above method reporting limits.

TABLE 4

GROUNDWATER SAMPLING AND ANALYSIS PROGRAM
HISTORICAL TREND OF CHEMICAL DATA FOR GROUNDWATER

October 19, 1994

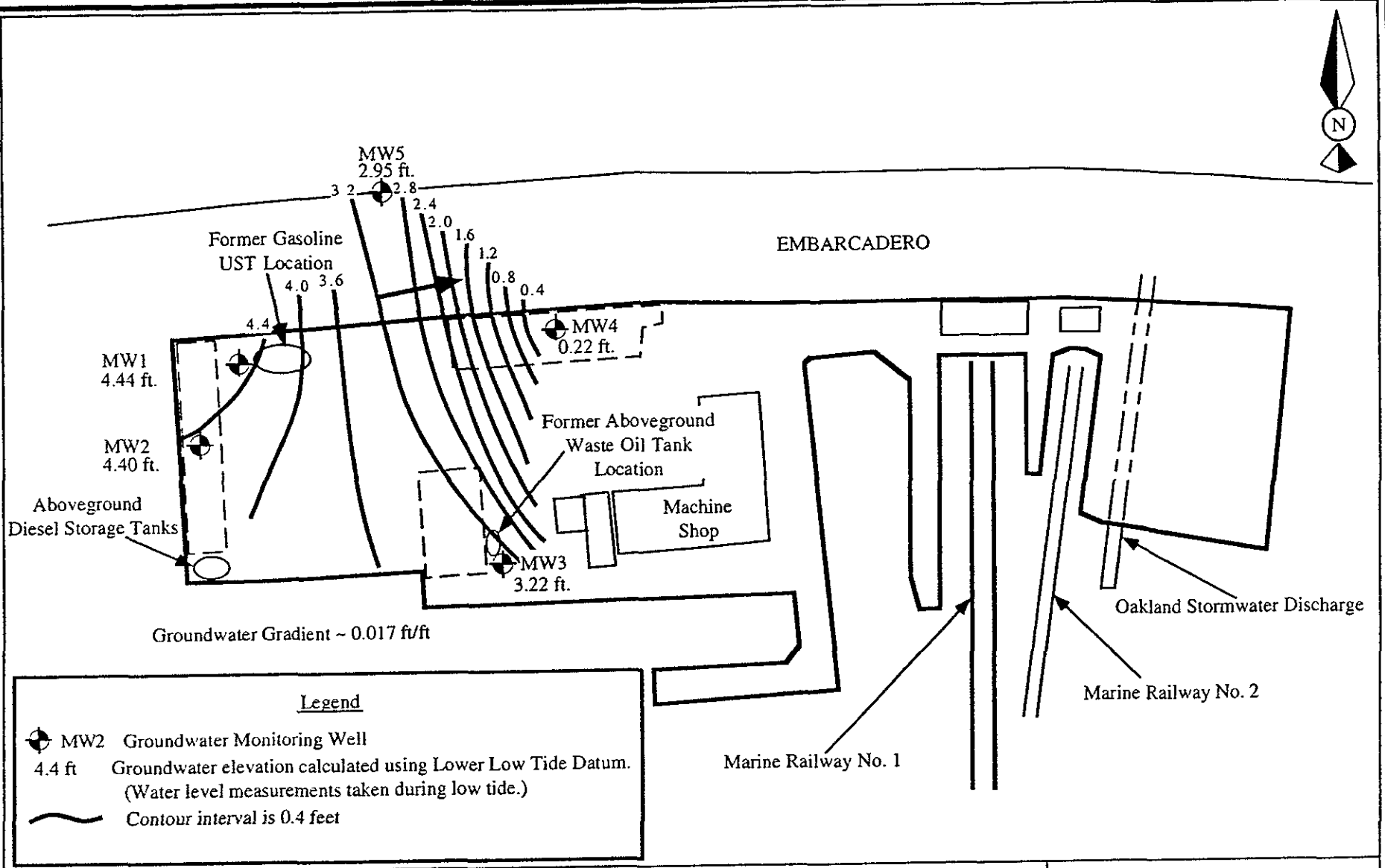
Pacific Dry Dock Yard I
Oakland, California

Groundwater Monitoring Well	Sample Date	TPH-G (µg/L)[1]	TPH-D (µg/L)	Total Oil and Grease (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	TDS (µg/L)	Salinity
MW1	7/1/93	ND[2]	ND	ND	ND	ND	ND	ND	NA[3]	NA
	1014/93	ND	63	NA	ND	ND	ND	ND	8,800,000	8.7
	1/18/94	ND	60	NA	NA	1.0	1.4	1.5	1,200,000	1.0
	3/30/94	ND	110	NA	2.5	1.7	0.56	1.9	NA	0 97
	7/15/94	ND	60	ND	ND	ND	ND	ND	NA	NA
	10/19/94	ND	830	NA	ND	ND	ND	ND	NA	NA
MW2	7/1/93	ND	ND	ND	ND	ND	ND	ND	NA	NA
	10/14/93	ND	ND	NA	ND	ND	ND	ND	12,000,000	11
	1/18/94	ND	ND	NA	ND	ND	ND	ND	570,000	0.46
	3/30/94	ND	ND	ND	ND	2.2	ND	ND	NA	0.29
	7/15/94	ND	ND	ND	ND	ND	ND	ND	NA	NA
MW3	7/1/93	ND	ND	ND	ND	ND	ND	ND	NA	NA
	10/14/93	ND	840	NA	ND	ND	ND	ND	31,000,000	29
	1/18/94	ND	64	NA	ND	ND	ND	ND	28,000,000	27
	3/30/94	ND	ND	NA	ND	0.90	ND	ND	NA	21
	7/15/94	ND	ND	ND	ND	ND	ND	ND	NA	NA
	10/19/94	ND	ND	NA	ND	ND	ND	ND	NA	NA
MW4	7/1/93	ND	ND	ND	ND	ND	ND	ND	NA	NA
	10/14/93	ND	ND	NA	ND	ND	ND	ND	3,600,000	3.4
	1/18/94	ND	ND	NA	ND	ND	ND	ND	3,100,000	2.6
	3/30/94	ND	ND	NA	ND	1.5	ND	1.5	NA	0.1
	7/15/94	ND	ND	ND	ND	ND	ND	ND	NA	NA
MW5	7/1/93	ND	ND	ND	ND	ND	ND	ND	NA	NA
	10/14/93	ND	ND	NA	ND	ND	ND	ND	2,000,000	2.0
	1/18/94	ND	ND	NA	ND	ND	ND	ND	2,200,000	2.1
	3/30/94	ND	ND	ND	ND	0.87	ND	ND	NA	1.6
	7/15/94	ND	ND	ND	ND	ND	ND	ND	NA	NA

[1] µg/L = micrograms per liter
[2] ND = Not Detected at or above method reporting limits
[3] NA = Not Analyzed

APPENDIX A

Groundwater Contour Maps from Previous Groundwater Monitoring Events



Scale (feet)

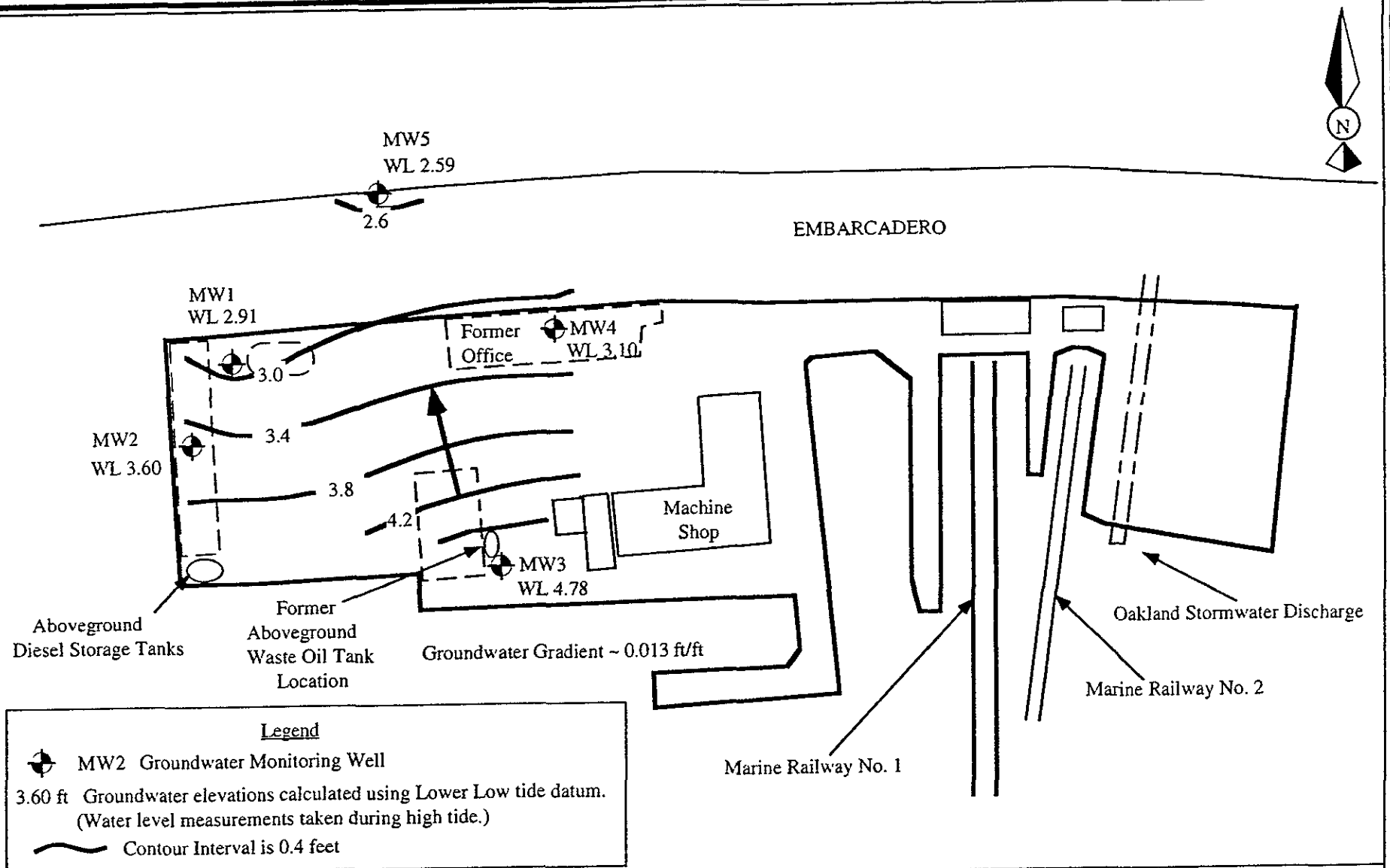
0 50 100

Project No. 2722-017

Calculated Groundwater Gradient
July 1, 1993
Pacific Dry Dock Yard I
Oakland, California

Figure 1

Versar, Inc.



Scale (feet)

0 50 100

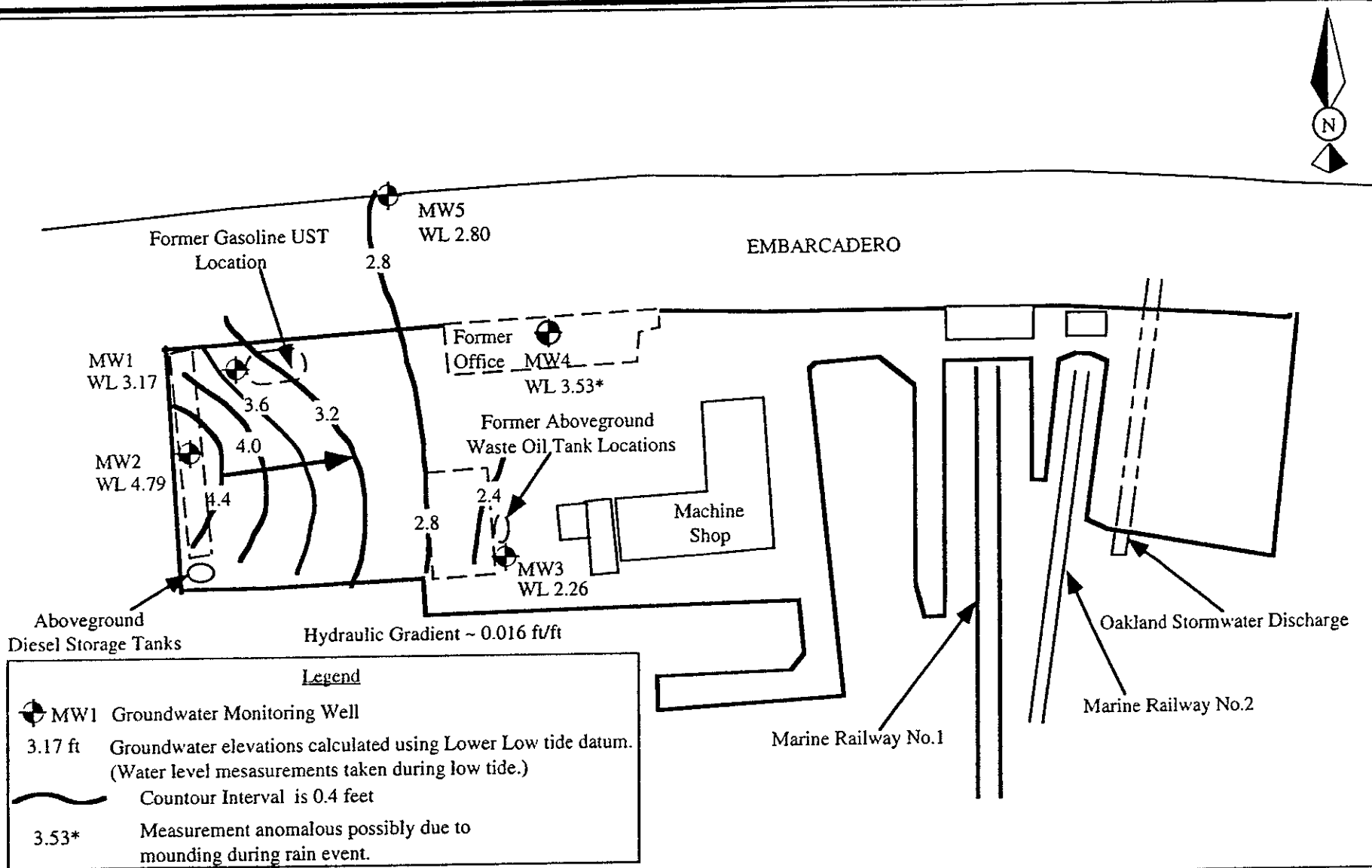
Project No. 2722-017

Calculated Groundwater Gradient
October 14, 1993

Pacific Dry Dock Yard I
Oakland, California

Figure 2

Versar, Inc.



Scale (feet)

0 50 100

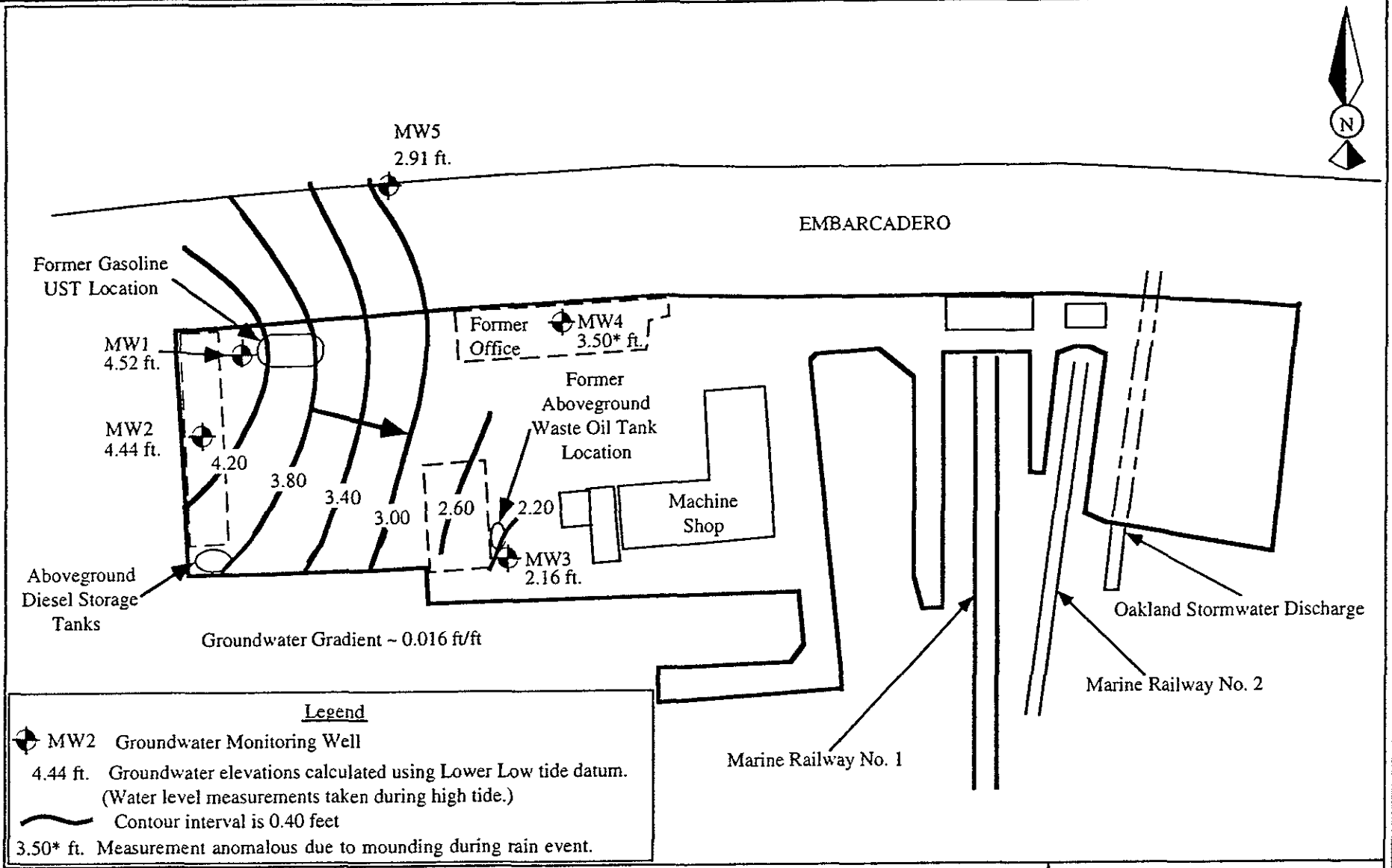
Project No. 2722-017

Calculated Groundwater Gradient
December 8, 1993

Pacific Dry Dock Yard I
Oakland, California

Figure 3

Versar, Inc.



Legend

MW2 Groundwater Monitoring Well

4.44 ft. Groundwater elevations calculated using Lower Low tide datum. (Water level measurements taken during high tide.)

Contour interval is 0.40 feet

3.50* ft. Measurement anomalous due to mounding during rain event.

Scale (feet)

0 50 100

Project No. 2722-017

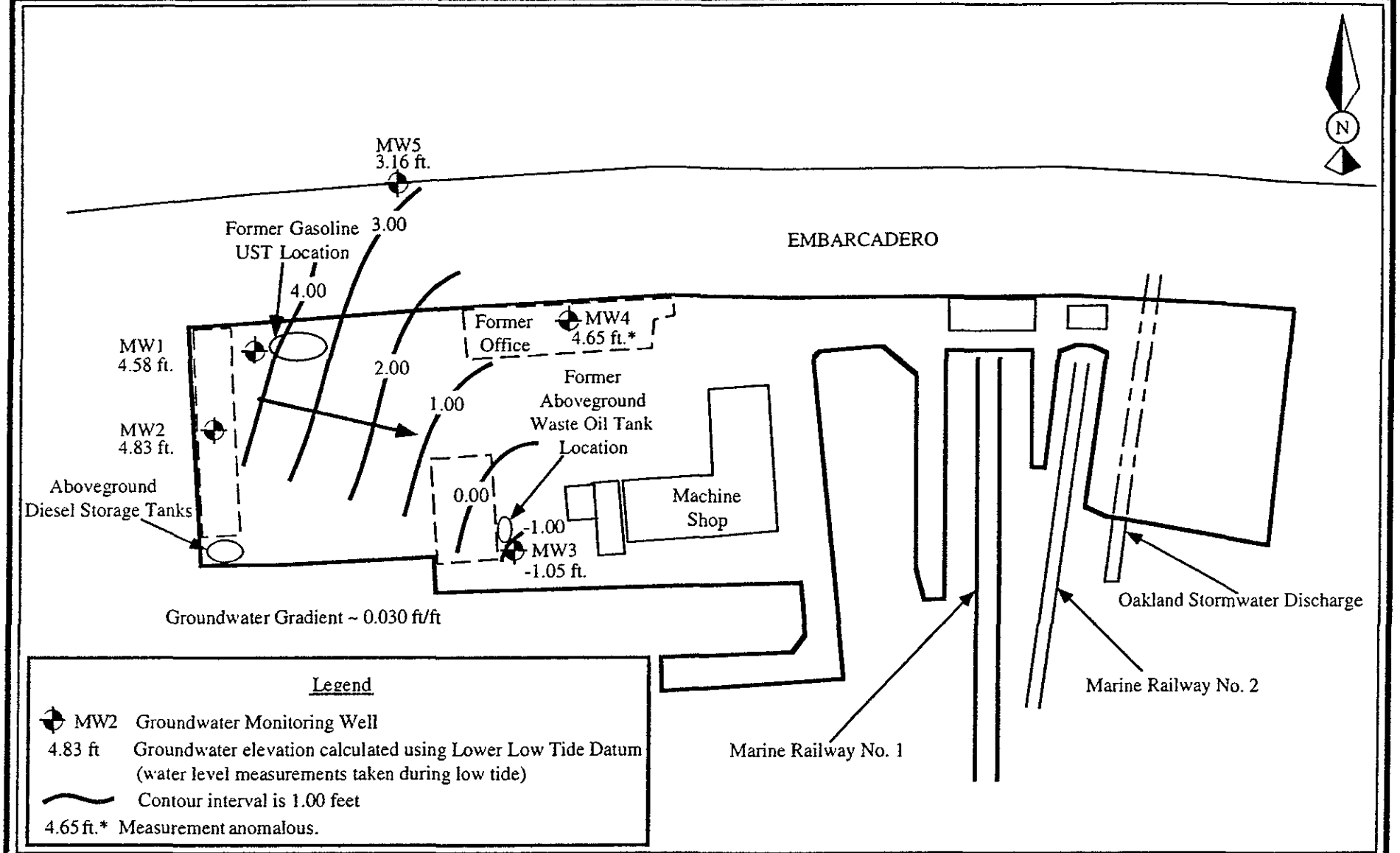
Calculated Groundwater Gradient
January 17, 1994

Pacific Dry Dock Yard I

Oakland, California

Figure 4

Versar, Inc.

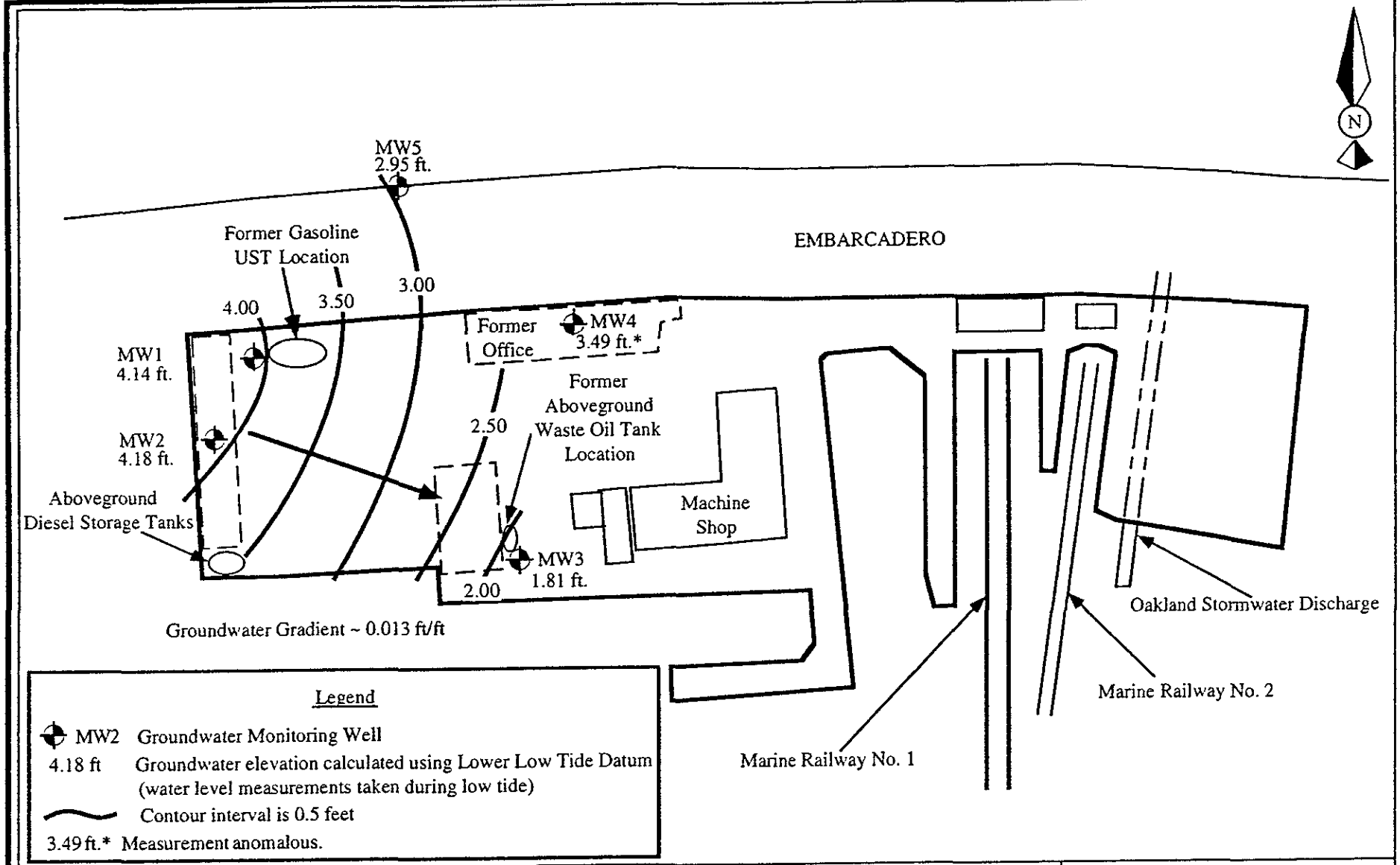


Calculated Groundwater Gradient
March 30, 1994
Pacific Dry Dock Yard I
Oakland, California

Figure 5

Project No. 2722-017

Versar, Inc.



Project No. 2722-017

Calculated Groundwater Gradient
July 15, 1994
Pacific Dry Dock Yard I
Oakland, California

Figure 6

Versar, Inc.

APPENDIX B

Groundwater Monitoring and Sampling Procedures

1.0 SAMPLING AND DECONTAMINATION PROCEDURES

The decontamination procedures for non-dedicated field equipment and well development/purging equipment are given below. These procedures are followed during all field activities.

1. Non-dedicated well development, purging, and sampling equipment is carefully pre-cleaned prior to each use, as follows:

   a. Carefully brush off any loose foreign debris with a soft bristle brush.

   b. Rinse the equipment thoroughly in clean water.

   c. Wash the equipment in a non-phosphate detergent bath.

   d. Rinse thoroughly in clean water.

   e. Rinse with pesticide-grade hexane (if deemed necessary).

   f. Rinse thoroughly with deionized water.

   g. Air dry in a dust-free environment.

   h. Store in sterile plastic bags or other suitable cover until use.

2. Clean disposable gloves are worn by all field personnel when handling decontaminated equipment.

2.0 COLLECTION OF SAMPLES

2.1 Groundwater Sampling

Groundwater samples were collected for laboratory analysis using the procedures given below.

1. Open the well and measure the organic vapor concentration with a flame ionization detector (FID) or photoionization dectector (PID).

2. Measure the water levels (if any) in the well using a decontaminated measuring device. All measurements must be made to the nearest 0.01 foot, and measured relative to the top of the casing. Record the depth of the water in the field notebook.

3. Inspect the disposal bailer to ensure that the bottom valve assembly is working correctly.

4. Begin purging the well by inserting a bailer into the PVC monitoring well casing and carefully lower it into the well. Take care to avoid agitating and aerating the fluid column in the well.

5. Slowly withdraw the bailer and transfer the water samples to a sampling containers.

6. Measure the temperature, pH, conductivity, and turbidity. Record these and all subsequent measurements in the field notebook.

7. Continue purging the well (a minimum of three well volumes) until the temperature, pH, conductivity, and turbidity have stabilized, or the well is dry.

8. When the water has recovered to 80 percent of the original level, carefully lower a new disposable bailer into the well and recover groundwater samples.

9. Fill the appropriate sample containers by releasing water from the bailer via the bottom emptying device with a minimum of agitation. The most volatile parameters are collected first, proceeding to the least volatile parameters.

10. Place the purge water in a DOT-approved 55-gallon drums.

3.0 ANALYSIS OF SAMPLES

Samples are submitted to a California state-certified laboratory for analysis.

4.0 SAMPLE HANDLING

4.1 Sample Containers, Preservation, and Holding Times

All samples are collected, placed in containers, preserved, and analyzed within the time constraints with applicable local, provincial, and federal procedures. All sample containers are precleaned in accordance with prescribed EPA methods. A non-adhesive tape is placed

around all sample container lids to prevent leaks and to prevent unauthorized tampering with individual samples following collection and prior to the time of analysis.

4.2 Sample Tracking and Management

All samples are tracked using a standard chain-of-custody form. The chain of custody record includes the following information:

1. Sample number
2. Signature of collector
3. Date and time of collection
4. Sample collection location
5. Sample type
6. Signature of persons involved in the chain-of-possession
7. Inclusive dates of possession
8. Analytical parameters
9. Pertinent field observations

The custody record is completed using waterproof ink. Corrections are made by drawing a line through, initialing the error, and then entering the correct information.

Custody of the samples begins at the time of sample collection and are maintained by the sampling team supervisor until samples are relinquished for shipment to the laboratory, or until samples are hand-delivered to the designated laboratory sample custodian. Partial sample sets being accumulated for hand-delivery to the laboratory are stored in coolers with chain-of-custody records affixed.

Each sample shipment is accompanied by a chain-of-custody record identifying its contents. The original record accompanies the shipment and the copy is retained by the sampling team leader. The original (the top copy) is enclosed in a plastic zip-lock bag and secured to the inside of the cooler lid with tape.

APPENDIX C

Monitoring Well Purge Table Sheets

MONITORING WELL PURGE TABLE

Project Number: 2722-017	**Site Name:** Crowley Yard 1
Well Number: MW1	**Date(s) Purged:** 10/19/94
OVA - Ambient: 0 ppm	**Purge Method:** Disposable bailer
OVA - Vault: 0 ppm	**Purge Rate:** 0.33 gallons/min
OVA - Casing: 0 ppm	**Date & Time Sampled:** 10/19/94 (1430)
Water Level - Initial: 6.67 feet	**Purged & Sampled By:** V. Elarth
Water Level - Final: 12.60 feet	**Sampling Method:** Disposable bailer
Well Depth: 14.26 feet	**Free Product:** None
Well Diameter: 2 inches	**Sheen:** None
Well Casing Volume: 3.71 gallons	**Odor:** Moderate hydrocarbon

Time	Purge Water Removed (gallons)	Temperature (degrees Fahrenheit)	pH	Electrical Conductivity (umhos/cm)	Turbidity
1221	0.25	69.3	6.13	2,830	Clear
1223	0.75	71.5	5.77	2,300	Clear
1224	1.0	71.8	5.58	2,500	Clear
1225	1.5	71.5	4.68	5,380	Clear
1226	2.0	70.9	5.64	6,080	Clear
1228	2.5	70.4	5.82	6,810	Clear
1230	3.0	70.1	5.93	7,400	Clear
1232	3.5	68.7	6.19	6,660	Moderate
1430	Sample	68.1	6.53	6,970	Clear

Field Notes: 80% = 8.10' = Half bailers at 3.0 gallons. After removing 3.6 gallons only 1/4' of water in well

MONITORING WELL PURGE TABLE

Project Number: 2722-017	**Site Name:** Crowley Yard I
Well Number: MW3	**Date(s) Purged:** 10/19/94
OVA - Ambient: 0 ppm	**Purge Method:** Disposable bailer
OVA - Vault: 0 ppm	**Purge Rate:** 0.33 gallons/min
OVA - Casing: 0 ppm	**Date & Time Sampled:** 10/19/94 (1250)
Water Level - Initial: 5.0 feet	**Purged & Sampled By:** V. Elarth
Water Level - Final: 4.48 feet	**Sampling Method:** Disposable bailer
Well Depth: 14.94 feet	**Free Product:** None
Well Diameter: 2 inches	**Sheen:** None
Well Casing Volume: 4.86 gallons	**Odor:** None

Time	Purge Water Removed (gallons)	Temperature (degrees Fahrenheit)	pH	Electrical Conductivity (umhos/cm)	Turbidity
1152	0.25	67.6	5.22	12,860	Clear
1155	1.00	67.5	5.10	15,140	Clear
1156	1.50	67.5	5.13	15,090	Clear
1158	2.00	67.1	5.22	15,240	Clear
1159	2.5	66.9	5.33	14,730	Clear
1201	3.0	67.0	5.38	15,170	Clear
1202	3.5	67.2	5.44	15,520	Clear
1204	4.0	67.1	5.48	14,570	Clear
1205	4.5	67.1	5.57	15,733	Clear
1207	5.0	67.0	5.60	15,120	Clear
1250	Sample	65.1	6.34	12,400	Clear

Field Notes: 80% = 6.99

APPENDIX D

Laboratory Analytical Results and Chain-of-Custody Records for
Groundwater Samples Collected During October 19, 1994
Sixth Groundwater Sampling Event

Trace Analysis Laboratory, Inc.
5423 Investment Boulevard, #8 • Hayward, California 94545
Telephone (510) 783-6960
Facsimile (510) 783-1512

October 26, 1994

Mr. Lawrence Kleinecke
Versar, Inc.
5330 Primrose Drive, Suite 228
Fair Oaks, California 95628

Dear Mr. Kleinecke:

Trace Analysis Laboratory received two water samples on October 19, 1994 for your Project No. 2722-017, Crowley Yard I (our custody log number 4863).

These samples were analyzed for Total Petroleum Hydrocarbons as Diesel, Gasoline, Benzene, Toluene, Ethylbenzene, and Xylenes. Our analytical report, the completed chain of custody form, and our analytical methodologies are enclosed for your review.

Trace Analysis Laboratory is certified under the California Environmental Laboratory Accreditation Program. Our certification number is 1199.

If you should have any questions or require additional information, please call me.

Sincerely yours,

For Scott T. Ferriman
Project Specialist

Enclosures

Trace Analysis Laboratory, Inc.
3423 Investment Boulevard, #8 • Hayward, California 94545
Telephone (510) 783-6960
Facsimile (510) 783-1512

LOG NUMBER: 4863
DATE SAMPLED: 10/19/94
DATE RECEIVED: 10/19/94
DATE EXTRACTED: 10/24/94
DATE ANALYZED: 10/26/94
DATE REPORTED: 10/26/94

CUSTOMER: Versar, Inc.

REQUESTER: Lawrence Kleinecke

PROJECT: No. 2722-017, Crowley Yard I

Sample Type: Water

Method and Constituent:	Units	MW-1 Concentration	MW-1 Reporting Limit	MW-3 Concentration	MW-3 Reporting Limit	Method Blank Concentration	Method Blank Reporting Limit
DHS Method:							
Total Petroleum Hydrocarbons as Diesel	ug/l	830	50	ND	50	ND	50

QC Summary:

% Recovery: 93
% RPD: 6.4

Concentrations reported as ND were not detected at or above the reporting limit. Sample MW-1 contains compounds eluting later than the diesel standard.

TAL Trace Analysis Laboratory, Inc.

LOG NUMBER: 4863
DATE SAMPLED: 10/19/94
DATE RECEIVED: 10/19/94
DATE ANALYZED: 10/21/94
DATE REPORTED: 10/26/94

Sample Type: Water

Method and Constituent:	Units	MW-1 Concentration	MW-1 Reporting Limit	MW-3 Concentration	MW-3 Reporting Limit	Method Blank Concentration	Method Blank Reporting Limit
DHS Method:							
Total Petroleum Hydrocarbons as Gasoline	ug/l	ND	50	ND	50	ND	50
Modified EPA Method 8020 for:							
Benzene	ug/l	ND	0.50	ND	0.50	ND	0.50
Toluene	ug/l	ND	0.50	ND	0.50	ND	0.50
Ethylbenzene	ug/l	ND	0.50	ND	0.50	ND	0.50
Xylenes	ug/l	ND	1.5	ND	1.5	ND	1.5

QC Summary:

% Recovery: 120
% RPD: 4.1

Concentrations reported as ND were not detected at or above the reporting limit.

Louis W. DuPuis
Quality Assurance/Quality Control Manager

KEMRON INC. 4505

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME
2722-017	Crowley - Yard I

SAMPLERS: (Signature) V P Elarth (Printed) V P Elarth

PARAMETERS: NO. OF CONTAINERS; TPHG/BTEX; TPH-D

INDUSTRIAL HYGIENE SAMPLE: Y / N

FIELD SAMPLE NUMBER	DATE 1994	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	TPHG/BTEX	TPH-D	REMARKS
mw-3	10/19	1250		X	mw-3	5	X	X	WATER
mw-1	↓	14:30		X	mw-1	4	X	X	↓

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
V P Elarth	10/19/94 1455				
(Printed) V P Elarth		(Printed)	(Printed)		(Printed)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature) Scott T. Ferriman	Date / Time 10/19/94 1455	Remarks	
(Printed)		(Printed) Scott T. Ferriman			

Distribution: Original Plus One Accompanies Shipment (white and yellow); Copy to Coordinator Field Files (pink).

4 L, water, 2 L each, 3 VOAs and 2 VOAs HCl, white. Tray 2. 5-Day