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Results of Ground Water Sampling

December 1994

Former Unocal Service Station 5905

Bothell, Washington

January 19, 1996

For

Unocal ERS - Western Region

1659		DEPARTMENT OF ECOLOGY	
		NWRO/TCP TANK UNIT	
INTERIM CLEANUP REPORT		<input checked="" type="checkbox"/>	
SITE CHARACTERIZATION		<input type="checkbox"/>	
FINAL CLEANUP REPORT		<input type="checkbox"/>	
OTHER _____		<input type="checkbox"/>	
AFFECTED MEDIA: SOIL		<input checked="" type="checkbox"/>	
OTHER _____ GW		<input checked="" type="checkbox"/>	
INSPECTOR (INIT.) <u>WMM</u>		DATE <u>12-10-96</u>	

January 19, 1996

Unocal ERS - Western Region
P.O. Box 76
Seattle, Washington 98111

Attention: Mr. Leigh Carlson

Results of Ground Water Sampling
December 1994
Former Unocal Service Station 5905
Bothell, Washington
File No. 9161-183-04

INTRODUCTION

This letter summarizes the results of our December 1994 ground water monitoring and sampling at former Unocal Service Station 5905. The site is located at 18015 Bothell Way Northeast in Bothell, Washington. The Ecology (Washington State Department of Ecology) UST (underground storage tank) site identification number for Service Station 5905 is 008485. The LUST (leaking UST) incident number for the site is 1659. The property currently is owned by Mr. Lowell Haynes. All Unocal facilities were removed from the site in 1991 and 1992; extensive excavation of petroleum-contaminated soil occurred during this time interval. A new service station facility was constructed at the site in 1993 by parties other than Unocal. The general layout of the site, with approximate monitoring well locations and former and current facilities, is shown in Figure 1.

SCOPE

GeoEngineers' scope of services completed during this reporting period is summarized below.

1. Measure the depths to ground water in the existing monitoring wells.
2. Measure combustible vapor concentrations in the monitoring well casings.

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Telephone (206) 861-6000
Fax (206) 861-6050

3. Obtain ground water samples from the existing monitoring wells for laboratory testing of the following: BETX (benzene, ethylbenzene, toluene and xylenes) by EPA Method 8020, gasoline-range hydrocarbons by Ecology Method WTPH-G, and diesel- and heavy oil-range hydrocarbons by Ecology Method WTPH-D extended.
4. Obtain a sample from the purge and decontamination water generated during ground water sampling and submit the sample for analytical testing of BETX, and fats, oil and grease by EPA Method 413.2 for disposal characterization.

DECEMBER 1994 SAMPLING EVENT

GROUND WATER ELEVATIONS

A representative of GeoEngineers measured the depths to ground water in MW-5 and MW-9 through MW-11 on December 29, 1994. The depths to ground water and ground water elevations measured from March 1992 through the current reporting period are presented in Table 1. Ground water elevations, inferred ground water contours and inferred ground water flow directions based on the December 1994 measurements are shown in Figure 2. Field procedures are described in Attachment A.

The depths to ground water beneath the site ranged from approximately 7.5 to 8.6 feet on December 29, 1994. The apparent shallow ground water flow direction indicated by the June and December measurements is toward the east-southeast, which is generally consistent with our previous measurements.

COMBUSTIBLE VAPOR CONCENTRATIONS

GeoEngineers measured combustible vapor concentrations in the monitoring well casings of MW-5 and MW-9 through MW-11 on December 29, 1994. The measurements from March 1992 through the current reporting period are presented in Table 1. Field procedures are described in Attachment A.

The combustible vapor concentrations ranged from 450 ppm (parts per million) to 700 ppm in MW-5, MW-9 and MW-10. The combustible vapor concentrations were less than the lower threshold of significance of the TLV Sniffer, 400 ppm (parts per million), in MW-11 during the December monitoring event. The combustible vapor concentrations in the on-site monitoring wells generally decreased since the June 1994 monitoring event.

GROUND WATER ANALYTICAL RESULTS

GeoEngineers obtained ground water samples from MW-5 and MW-9 through MW-11 in December 1994. The samples were analyzed for BETX, and gasoline-, diesel- and heavy oil-range hydrocarbons. The ground water analytical data from March 1992 through the current reporting period are summarized in Table 2 and Figure 3. The MTCA Method A ground water cleanup levels also are included in Table 2 and Figure 3 for reference. Field procedures are

described in Attachment A. The laboratory reports, chain-of-custody records and our evaluation of the laboratory quality assurance/quality control program are included in Attachment B.

Ethylbenzene, toluene, xylenes and petroleum hydrocarbons either were not detected or were detected at concentrations less than the MTCA Method A cleanup levels in the ground water samples obtained from the monitoring wells in December 1994. Benzene was not detected in the December sample obtained from MW-11. Benzene was detected at concentrations exceeding the MTCA Method A cleanup level in the December samples obtained from MW-5, MW-9 and MW-10 at concentrations ranging from 6.5 to 43 $\mu\text{g/l}$ (micrograms per liter).

DISCUSSION

Diesel- and heavy oil-range hydrocarbons have been detected in the past in ground water samples obtained from MW-5, MW-9 and MW-10 at concentrations exceeding the MTCA Method A ground water cleanup level. Diesel- and heavy oil-range hydrocarbons have not been detected in ground water samples since March 1993 in MW-5 and since June 1993 in MW-9 and MW-10.

Gasoline-range hydrocarbons and BETX were not detected at concentrations exceeding MTCA Method A cleanup levels in the ground water samples obtained from the existing monitoring wells through the June 1993 sampling event, with the exception of the initial sample (March 1992) from MW-10. Gasoline-range hydrocarbons and BETX were detected in MW-9 and benzene was detected in MW-5 at concentrations exceeding the MTCA Method A cleanup levels during the March 1994 sampling event. Only trace amounts of BETX and gasoline-range hydrocarbons had been detected previously in these wells.

Gasoline-range hydrocarbons have not been detected in ground water samples obtained from MW-9 since April 1994. Benzene concentrations detected in ground water samples obtained from MW-5, MW-9 and MW-10 generally have decreased since March 1994, but still exceed the MTCA Method A cleanup level.

As discussed in our report dated November 18, 1994, the available data suggest that a release occurred in late 1993 or early 1994 in the gasoline UST area, and that (1) the rate of the release has diminished significantly since that time, or (2) the release was a one-time event over a relatively short period of time.

FUTURE MONITORING

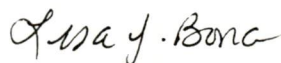
We recommend that ground water monitoring be discontinued at the site. The diesel- and heavy oil-range hydrocarbons previously present in MW-5, MW-9 and MW-10 have not been detected for the past seven to eight monitoring events. Remaining ground water contamination at the site is related to activities at the site subsequent to Unocal's operations, in our opinion.

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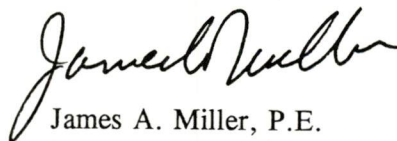
We appreciate the opportunity to provide these continued services to Unocal. Please contact us if you have questions regarding our ongoing monitoring activities at the site.

Yours very truly,

GeoEngineers, Inc.



Lisa J. Bona
Project Geologist



James A. Miller, P.E.
Principal

LJB:JAM:cms
Document ID: 9161183.R4

Attachments

Four copies submitted

cc: Mr. Wally Moon
✓ Washington State Dept. of Ecology
3190 - 160th Ave. S.E.
Bellevue, WA 98008-5452

TABLE 1 (Page 1 of 2)
GROUND WATER ELEVATIONS AND
COMBUSTIBLE VAPOR CONCENTRATIONS

Monitoring Well ¹	Date Measured	Water Depth from Ground Surface (feet)	Ground Water Elevation ² (feet)	Combustible Vapor Concentration ³ (ppm)
MW-5	03/23/92	8.20	4.53	<400
	06/09/92	7.85	4.74	<400
	09/01/92	9.23	3.36	<400
	12/03/92	8.82	3.77	<400
	03/19/93	9.57	3.02	<400
	06/16/93	8.42	4.13	<400
	09/22/93	9.02	3.53	<400
	01/12/94	8.77	3.78	<400
	03/30/94	8.43	4.12	--
	06/21/94	8.75	3.80	>10,000
	09/30/94	9.17	3.38	>10,000
	12/29/94	8.55	4.00	700
MW-6 ⁴	03/23/92	7.49	3.58	<400
	06/09/92	8.14	2.93	<400
	09/01/92	8.64	2.43	<400
	12/03/92	8.31	2.76	<400
MW-9	03/23/92	7.13	4.70	<400
	06/09/92	7.91	3.93	<400
	09/01/92	8.65	3.19	<400
	12/03/92 ⁵	--	--	--
	03/19/93	8.12	3.72	<400
	06/16/93	7.46	4.16	<400
	09/22/93	8.35	3.27	<400
	01/12/94	7.94	3.68	<400
	03/30/94	7.26	4.36	--
	06/22/94	--	--	--
	09/30/94	8.47	3.15	>10,000
	12/29/94	7.53	4.09	450
MW-10	03/23/92	7.56	2.38	<400
	06/09/92	8.12	2.06	<400
	09/01/92	8.46	1.72	<400
	12/03/92	9.11	0.83	<400
	03/19/93	8.05	2.13	<400
	06/16/93	7.83	2.18	<400
	09/22/93	8.32	1.69	<400
	01/12/94	8.06	1.95	<400
	03/30/94	7.94	2.07	--
	06/21/94	8.17	1.84	>10,000
	09/30/94	8.26	1.75	2,000
	12/29/94	7.63	2.39	500

Notes appear on page 2 of 2.

TABLE 1 (Page 2 of 2)

Monitoring Well ¹	Date Measured	Water Depth from Ground Surface (feet)	Ground Water Elevation ² (feet)	Combustible Vapor Concentration ³ (ppm)
MW-11 ⁶	06/22/92	8.71	0.74	<400
	09/01/92	8.77	0.68	<400
	12/03/92	8.35	1.10	<400
	03/19/93	8.51	0.94	<400
	06/16/93	8.27	1.00	<400
	09/22/93	8.59	0.68	<400
	01/12/94	8.45	0.82	<400
	03/30/94	8.37	0.90	—
	06/21/94	8.45	0.82	900
	09/30/94	8.56	0.71	<400
	12/29/94	7.82	1.45	<400

Notes:

¹Approximate locations of monitoring wells are shown in Figures 1, 2 and 3.

²Elevations are measured relative to the benchmark shown in Figure 2. The benchmark has an elevation of 10.41 feet.

³Measured with a Bacharach TLV Sniffer calibrated to hexane equipped with a 2-inch-diameter slip cap. Field procedures are described in Attachment A. The lower threshold of significance for this instrument in this application is 400 ppm.

⁴MW-6 was destroyed during construction of new facilities after the 12/03/92 monitoring event.

⁵MW-9 was not accessible during this monitoring episode because of construction damage to the well.

⁶MW-11 was installed on 06/19/93.

ppm = parts per million

— = not measured

TABLE 2 (PAGE 1 OF 4)
SUMMARY OF GROUND WATER CHEMICAL ANALYTICAL DATA
UNOCAL SERVICE STATION 5905
BOTHELL, WASHINGTON

Monitoring Well	Date Sampled	BETX ¹ (µg/l)				Gasoline-range Hydrocarbons ² (mg/l)	Diesel-range Hydrocarbons ³ (mg/l)	Heavy Oil-range Hydrocarbons ³ (mg/l)	Dissolved Lead ⁴ (µg/l)
		B	E	T	X				
MW-3	06/09/92	3.2	0.66	<0.50	1.1	<0.05	<0.50	--	<1.0
	09/01/92	<0.50	<0.50	<0.50	<1.0	<0.05	0.40	--	<2.0
MW-5	03/23/92	<0.50	<0.50	<0.50	2.5	0.40	<0.50	--	--
	04/20/92	--	--	--	--	--	--	--	<2.0
	06/09/92	<0.50	<0.50	1.0	<0.50	0.24	<0.50	--	<1.0
	09/01/92	<0.50	<0.50	<0.50	<1.0	0.12	<0.25	--	<2.0
	12/03/92	<0.50	0.95	2.3	3.5	<0.05	0.30	<0.38	--
	03/19/93	<0.50	<0.50	<0.50	<0.50	<0.05	0.28	1.5	--
	06/16/93	<0.50	<0.50	<0.50	<0.50	<0.01	<0.25	<0.75	--
	09/22/93	--	--	--	--	--	<0.25	<0.75	--
	01/12/94	--	--	--	--	--	<0.25	<0.75	--
	03/30/94	23	<0.50	6.6	0.60	0.14	<0.25	<0.75	--
	04/13/94	220	<0.50	60	11	0.29	<0.25	<0.75	<3.0 ⁵
	06/21/94	26	<0.50	0.60	<0.50	<0.10	<0.25	<0.75	--
	09/30/94	29	<0.50	<0.50	<1.0	0.17	<0.25	<0.75	--
	12/29/94	6.5	<0.50	<0.50	<1.0	0.10	<0.25	0.80	--
MW-6 Dup 1 ⁶ 921203-D ⁶	03/23/92	<0.50	<0.50	<0.50	<0.50	<0.10	<0.50	--	--
	04/20/92	--	--	--	--	--	--	--	<2.0
	06/09/92	<0.50	<0.50	<0.50	<0.50	<0.05	<0.50	--	<1.0
	09/01/92	<0.50	<0.50	<0.50	<1.0	<0.05	<0.25	--	2.2
	09/01/92	<0.50	<0.50	<0.50	<1.0	<0.05	--	--	--
	12/03/92	<0.50	<0.50	<0.50	<0.50	<0.50	<0.12	<0.38	<2.0
	12/03/92	<0.50	<0.50	<0.50	<0.50	<0.50	--	--	--
MW-7	03/23/92	<0.50	<0.50	<0.50	<0.50	<0.10	<0.50	--	--
	04/20/92	--	--	--	--	--	--	--	<2.0
	06/09/92	<0.50	<0.50	<0.50	<0.50	<0.05	<0.50	--	<1.0
	09/01/92	<0.50	<0.50	<0.50	<1.0	<0.05	<0.31	--	<2.0
MTCA Method A Cleanup Levels		5.0	30.0	40.0	20.0	1.0 ⁷			5

Notes appear on page 4 of 4.

TABLE 2 (Page 2 of 4)

Monitoring Well	Date Sampled	BETX ¹ (µg/l)				Gasoline-range Hydrocarbons ² (mg/l)	Diesel-range Hydrocarbons ³ (mg/l)	Heavy Oil-range Hydrocarbons ³ (mg/l)	Dissolved Lead ⁴ (µg/l)
		B	E	T	X				
MW-8	03/23/92	<0.50	<0.50	<0.50	<0.50	<0.10	<0.50	--	--
	04/20/92	--	--	--	--	--	--	--	<2.0
	06/09/92	<0.50	<0.50	<0.50	<0.50	<0.05	<0.50	--	<1.0
	09/01/92	<0.50	<0.50	<0.50	<1.0	<0.05	<0.25	--	<2.0
MW-9 930616-D ⁶	03/23/92	<0.50	<0.50	<0.50	<0.50	<0.10	0.88	<1.0 ⁸	--
	04/20/92	--	--	--	--	--	--	--	<2.0
	06/09/92 ⁹	0.56	<0.50	0.95	1.2	<0.05	<0.50	--	<1.0
	09/01/92 ^{10,11}	<0.50	<0.50	<0.50	<1.0	<0.05	0.46	--	<2.0
	12/03/92	--	--	--	--	--	--	--	--
	03/19/93	<0.50	<0.50	<0.50	<0.50	<0.05	0.39	1.7	--
	06/16/93	<0.50	<0.50	<0.50	<0.50	<0.10	0.31	1.1	--
	06/16/93	<0.50	<0.50	<0.50	<0.50	<0.10	--	--	--
	09/22/93 ⁶	<0.50	<0.50	<0.50	<0.50	--	<0.25	<0.75	--
	01/12/94	--	--	--	--	--	<0.25	<0.75	--
	03/30/94	2,200	42	660	37	1.9	<0.25	<0.75	--
	04/13/94	1,700	0.90	610	40	1.6	<0.25	<0.75	<3.0 ⁵
	06/22/94	350	<0.50	3.6	7.2	<0.10	<0.25	<0.75	--
	09/30/94	52	<0.50	<0.50	4.9	<0.05	<0.25	<0.75	--
	12/29/94	24	<0.50	<0.50	2.7	<0.05	<0.25	0.93	--
MW-10 Dup ⁶	03/23/92	55	<0.50	<0.50	10	<0.1	<0.50	--	--
	04/20/92	--	--	--	--	--	--	--	<2.0
	06/09/92	1.3	<0.50	<0.50	<0.50	0.073	<0.50	--	--
	06/09/92	--	--	--	--	--	<0.50	--	--
	09/01/92	4.9	<0.50	<0.50	<1.0	<0.05	<0.25	--	<2.0
	12/03/92	<0.50	<0.50	<0.50	<0.50	<0.05	0.17	<0.38	10.5
	03/19/93	<0.50	<0.50	<0.50	<0.50	<0.05	0.13	<0.38	--
	06/16/93	<0.50	<0.50	<0.50	<0.50	<0.1	0.29	0.90	<3.0
	09/22/93	--	--	--	--	--	<0.25	<0.75	--
	01/12/94	--	--	--	--	--	<0.25	<0.75	<3.0
	03/30/94	<0.50	<0.50	<0.50	<0.50	<0.10	<0.25	<0.75	--
MTCA Method A Cleanup Levels		5.0	30.0	40.0	20.0	1.0 ⁷			5

Notes appear on page 4 of 4.

TABLE 2 (Page 3 of 4)

Monitoring Well	Date Sampled	BETX ¹ (µg/l)				Gasoline-range Hydrocarbons ² (mg/l)	Diesel-range Hydrocarbons ³ (mg/l)	Heavy Oil-range Hydrocarbons ³ (mg/l)	Dissolved Lead ⁴ (µg/l)
		B	E	T	X				
MW-10 (Continued)	04/13/94	17	<0.50	1.7	<0.50	<0.10	<0.25	<0.75	--
	06/21/94	10	<0.50	0.60	<0.50	<0.10	<0.25	<0.75	--
	09/30/94	88	<0.50	<0.50	<1.0	<0.05	<0.25	<0.75	--
	12/29/94	43	<0.50	<0.50	<0.50	<0.05	<0.25	<0.75	--
MW-11 930319-D ⁶	06/22/92	<0.50	<0.50	<0.50	<0.50	<0.05	--	--	<1.0
	09/01/92	<0.50	<0.50	<0.50	<1.0	<0.05	<0.25	--	<2.0
	12/03/92	<0.50	<0.50	<0.50	<0.50	<0.05	0.16	<0.38	--
	03/19/93	<0.50	<0.50	<0.50	<0.50	<0.05	0.17	<0.38	--
	03/19/93	<0.50	<0.50	<0.50	<0.50	<0.05	--	--	--
	06/16/93	<0.50	<0.50	<0.50	<0.50	<0.10	<0.25	<0.75	--
	09/22/93	--	--	--	--	--	<0.25	<0.75	--
	01/12/94	--	--	--	--	--	<0.25	<0.75	--
	03/30/94	<0.50	<0.50	<0.50	<0.50	<0.10	<0.25	<0.75	--
	04/13/94	<0.50	<0.50	<0.50	<0.50	<0.10	<0.25	<0.75	<3.0 ⁵
	06/21/94	<0.50	<0.50	<0.50	<0.50	<0.10	<0.25	<0.75	--
	09/30/94	<0.5	<0.50	<0.50	<1.0	<0.05	<0.25	<0.75	--
	12/29/94	<0.5	<0.50	<0.50	<1.0	<0.05	<0.25	<0.75	--
MTCA Method A Cleanup Levels		5.0	30	40	20	1.0 ⁷			5

Notes appear on page 4 of 4.

TABLE 2 (Page 4 of 4)

Notes:

¹B = benzene, E = ethylbenzene, T = toluene, X = total xylenes. BETX analyzed by EPA Method 8020.

²Analyzed by Ecology Method WTPH-G.

³Analyzed by Ecology Method WTPH-D extended, except where footnoted.

⁴Dissolved lead analysis conducted on field-filtered ground water samples. Lead analyzed by EPA Method 7421.

⁵Sample also analyzed for total lead by EPA Method 7421. Total lead was detected at the following concentrations: 4.9 µg/l (MW-5), 5.9 µg/l (MW-9 and MW-10), and 6.9 µg/l (MW-11).

⁶Sample was obtained as a blind field duplicate.

⁷The MTCA Method A ground water cleanup level for the total of gasoline-, diesel- and heavy oil-range hydrocarbons is 1 mg/l if carbon ranges are distinctly quantified using gas chromatography methods.

⁸Chemical analysis by EPA Method 418.1.

⁹Additional samples were obtained from MW-9 on 06/09/92 and 07/15/92 and submitted to North Creek Analytical for analysis of heavy oil-range hydrocarbons by Ecology Method WTPH-418.1. Heavy oil-range hydrocarbons were detected in the 06/09/92 sample at a concentration of 8.2 mg/l, but were not detected in the 07/15/92 sample. Additional samples were obtained from MW-9 on 06/12/92 and 07/15/92 and submitted to NATEX/PNELI for analysis of heavy oil-range hydrocarbons by Ecology Method WTPH-418.1. Heavy oil-range hydrocarbons were not detected in the 06/12/92 sample, but were detected at a concentration of 1.3 mg/l in the 07/15/92 sample.

¹⁰Sample also analyzed for selected metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) by EPA 6000 and 7000 series methodology, flash point by ASTM Method D-93, and VOCs (volatile organic compounds) by EPA Methods 8010 and 8020. Barium was detected at a concentration of 0.33 mg/l. Other analytes were not detected. Flash point was greater than 210 degrees Fahrenheit.

¹¹Sample analyzed by North Creek Analytical for heavy oil-range hydrocarbons by Ecology Method WTPH-418.1. The analyte was not detected.

ppm = parts per million

µg/l = micrograms per liter

mg/l = milligrams per liter

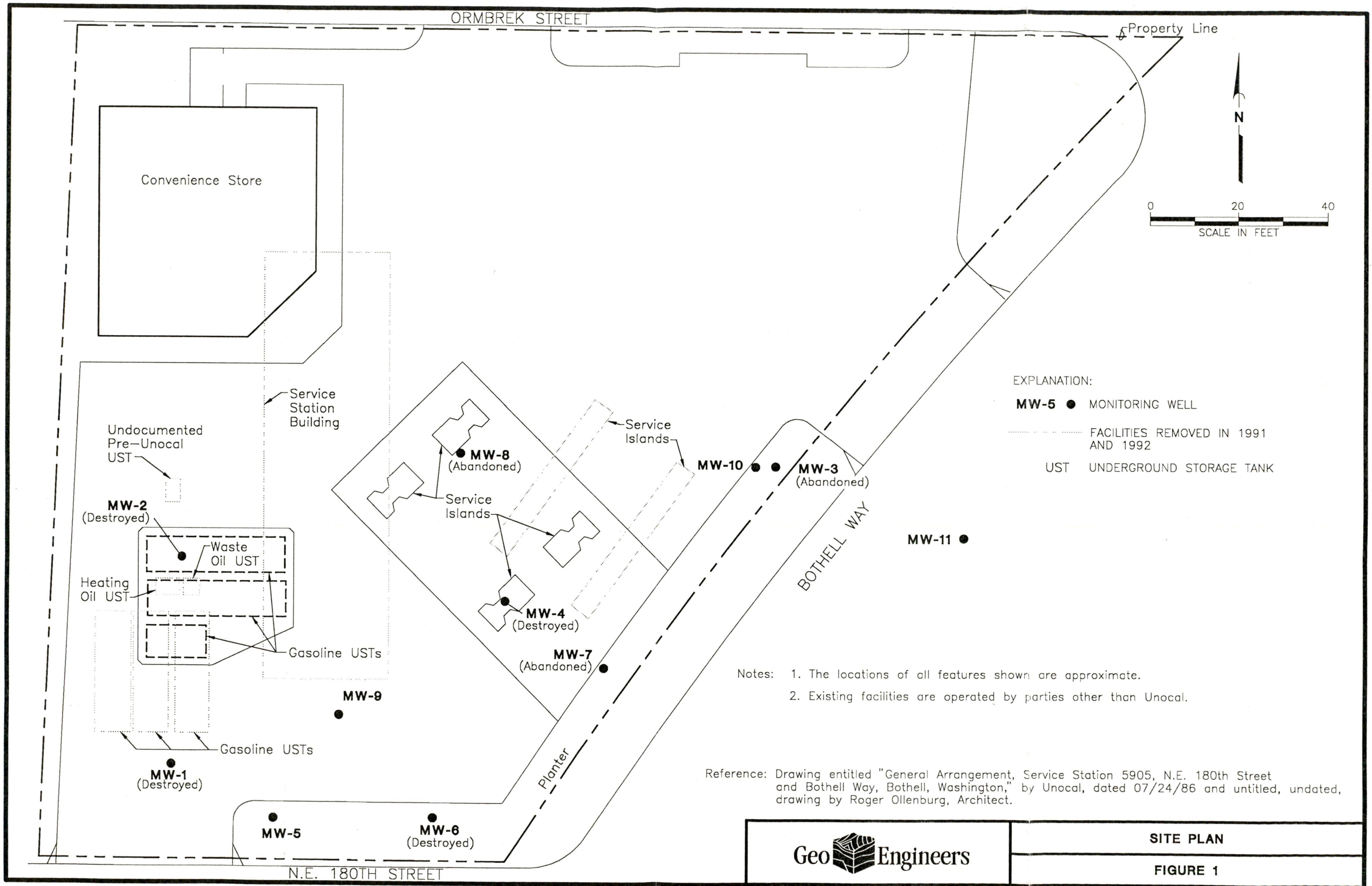
"--" = not tested

Shading indicates that analyte was detected at concentration greater than the MTCA Method A ground water cleanup level.

0161183R62:062295

0161183B.DWG

LJB:BDH

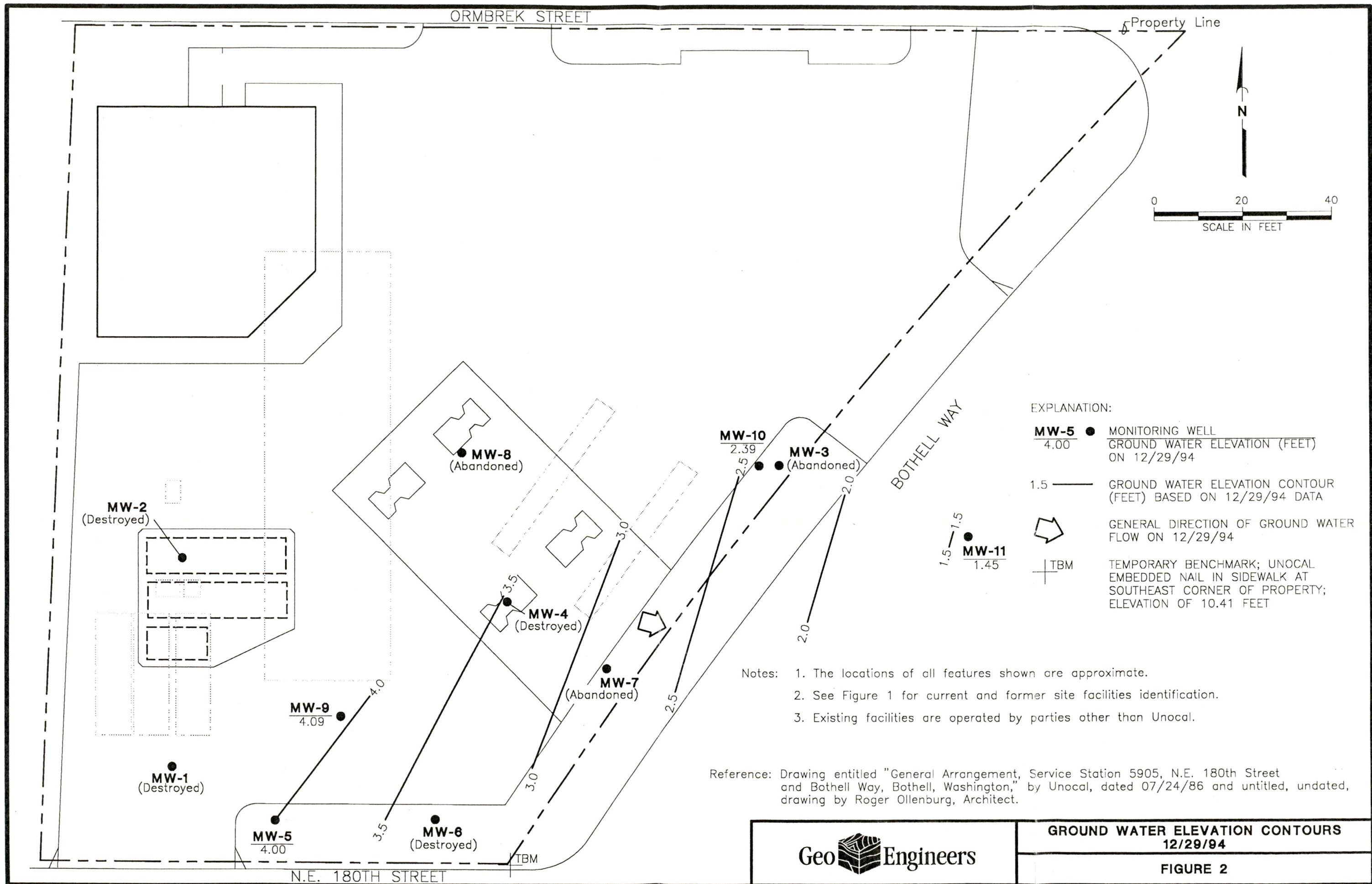


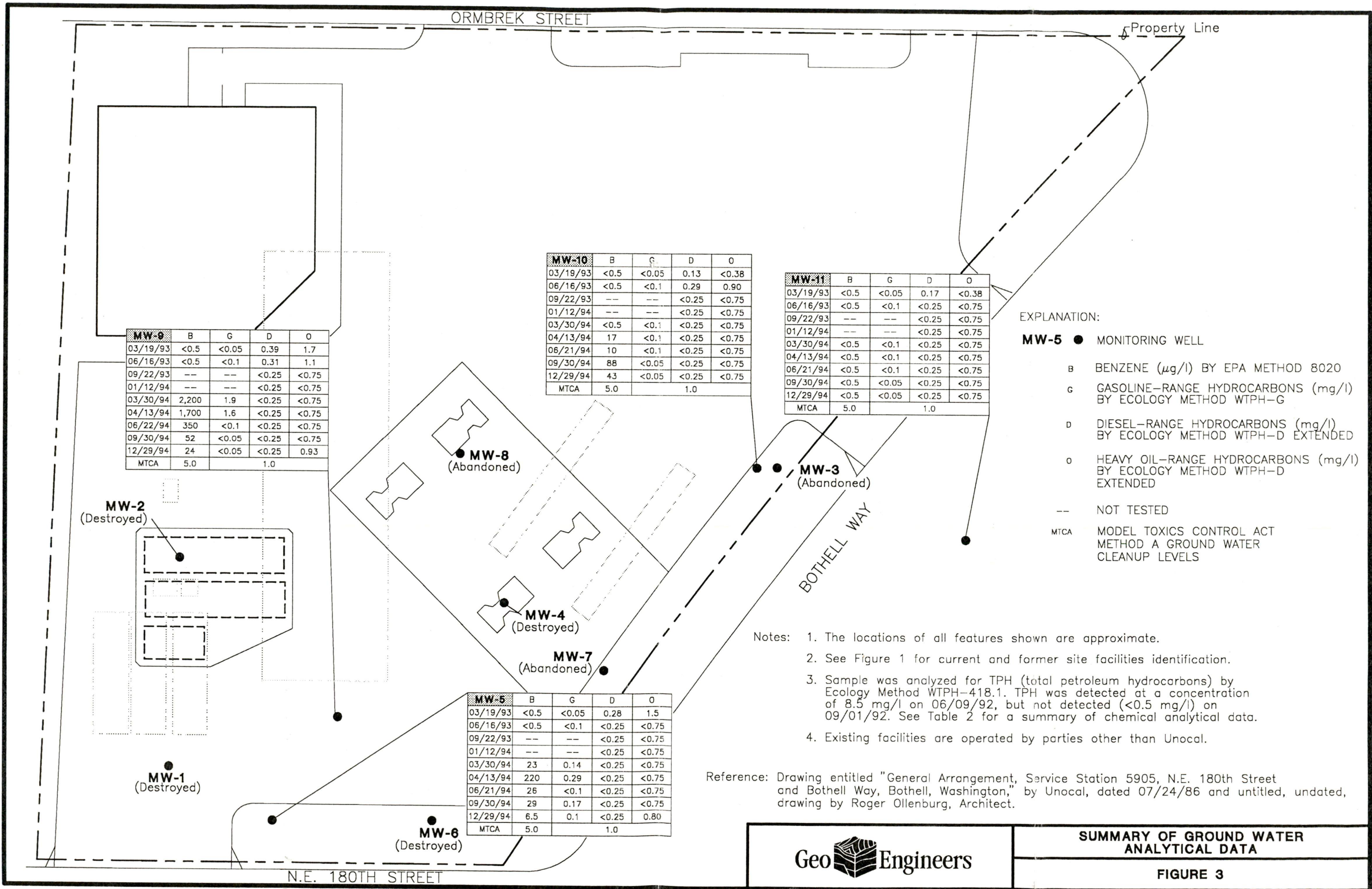
Geo  Engineers

SITE PLAN

FIGURE 1

LJB:BDH 0161183C.DWG 0161183R62:12/12/95





ATTACHMENT A

ATTACHMENT A

FIELD METHODS

GROUND WATER ELEVATIONS

The depths to the shallow ground water surface relative to the monitoring well casing rims were measured on December 29, 1994 using an electric water level indicator. The indicator was cleaned with an Liquinox wash solution and a distilled water rinse prior to its use in each well. Ground water elevations were calculated by subtracting the depths to water from the casing rim elevations. The ground water elevations measured on December 29 are summarized in Table 1. The ground water elevations measured in December are shown in Figure 2.

COMBUSTIBLE VAPOR CONCENTRATIONS

Combustible vapor concentrations were measured in monitoring wells MW-5 and MW-9 through MW-11 on December 29, 1994 using a Bacharach TLV Sniffer calibrated to hexane. The measurements in MW-5, MW-9 and MW-11 were obtained from each well casing using a 2-inch-diameter slip cap connected to the TLV Sniffer. A 4-inch-diameter slip cap was connected to the TLV Sniffer when measuring MW-10. The lower threshold of significance for the TLV Sniffer in this application is 400 ppm (parts per million), or 3.6 percent of the lower explosive limit of hexane. The combustible vapor concentrations measured on June 21 and September 30 are presented in Table 1.

GROUND WATER SAMPLING PROGRAM

Ground water samples were obtained by GeoEngineers from MW-5 and MW-9 through MW-11 on December 29, 1994. The water samples were obtained with disposable polyethylene bailers after at least three well volumes of water were removed from each well casing. A new bailer and cord were used to sample each monitoring well. The water samples were transferred to laboratory-prepared bottles in the field and were kept cold during transport to the analytical laboratory. Chain-of-custody procedures were followed during transport of the samples to the analytical laboratory.

PURGE WATER DISPOSAL

Purge and decontamination water generated during the December 1994 sampling events was collected temporarily in a 55-gallon drum. We understand that Unocal arranged for disposal of the drum of purge and decontamination water.

ATTACHMENT B

ATTACHMENT B

CHEMICAL ANALYTICAL PROGRAM

ANALYTICAL METHODS

Chain-of-custody procedures were followed during the transport of the field samples to the analytical laboratory. The samples were held in cold storage pending extraction and/or analysis. The analytical results, analytical methods reference and laboratory QA/QC (quality assurance/quality control) records are included in this attachment. The analytical results are also summarized in the text and tables of this report.

ANALYTICAL DATA REVIEW

The laboratory maintains an internal quality assurance program as documented in its laboratory quality assurance manual. The laboratory uses a combination of blanks, surrogate recoveries, duplicates, matrix spike recoveries, matrix spike duplicate recoveries, blank spike recoveries and blank spike duplicate recoveries to evaluate the validity of the analytical results. The laboratory also uses data quality goals for individual chemicals or groups of chemicals based on the long-term performance of the test methods. The data quality goals were included in the laboratory reports. The laboratory compared each group of samples with the existing data quality goals and noted any exceptions in the laboratory report. The laboratory QA/QC and data quality exceptions documented by the laboratory were reviewed by GeoEngineers using the applicable data validation guidelines from the following documents: "Guidance Document for the Assessment of RCRA Environmental Data Quality" draft dated 1988; "National Functional Guidelines for Organic Data Review" draft dated 1991; and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses" dated 1988.

ANALYTICAL DATA REVIEW SUMMARY

No significant data quality exceptions were noted in the laboratory report or during our review. Based on our data quality review, it is our opinion that the analytical data are of acceptable quality for their intended use.

GeoEngineers, Inc. 8410 154th Avenue N.E. Redmond, WA 98052 Attention: Lisa Bona	Client Project ID: UNOCAL #5905, #9161-183-R04 Sample Matrix: Water Analysis Method: WTPH-G First Sample #: 412-1820	Sampled: Dec 29, 1994 Received: Dec 30, 1994 Analyzed: Jan 7, 1995 Reported: Jan 10, 1995
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TOTAL PETROLEUM HYDROCARBONS-GASOLINE RANGE

Sample Number	Sample Description	Sample Result $\mu\text{g/L}$ (ppb)	Surrogate Recovery %
412-1820	MW-5	100	93
412-1821	MW-9	N.D.	93
412-1822	MW-10	N.D.	90
412-1823	MW-11	N.D.	85
BLK010795	Method Blank	N.D.	87

GeoEngineers

JAN 19 1995

Routing

File

Reporting Limit:

50

4-Bromofluorobenzene surrogate recovery control limits are 50 - 150 %.

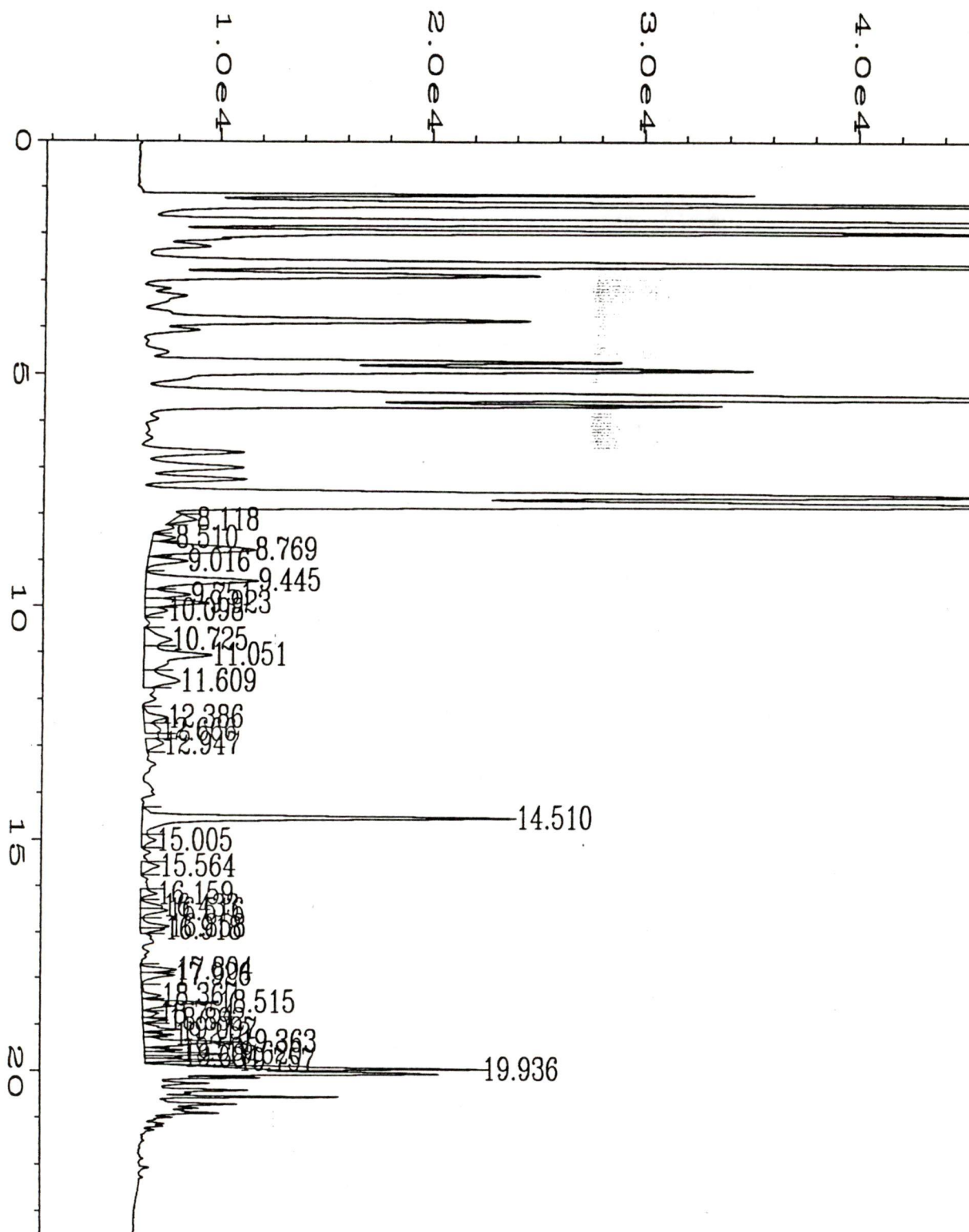
Volatile Total Petroleum Hydrocarbons are quantitated as Gasoline Range Organics (toluene - dodecane).

Analytes reported as N.D. were not detected above the stated Reporting Limit.

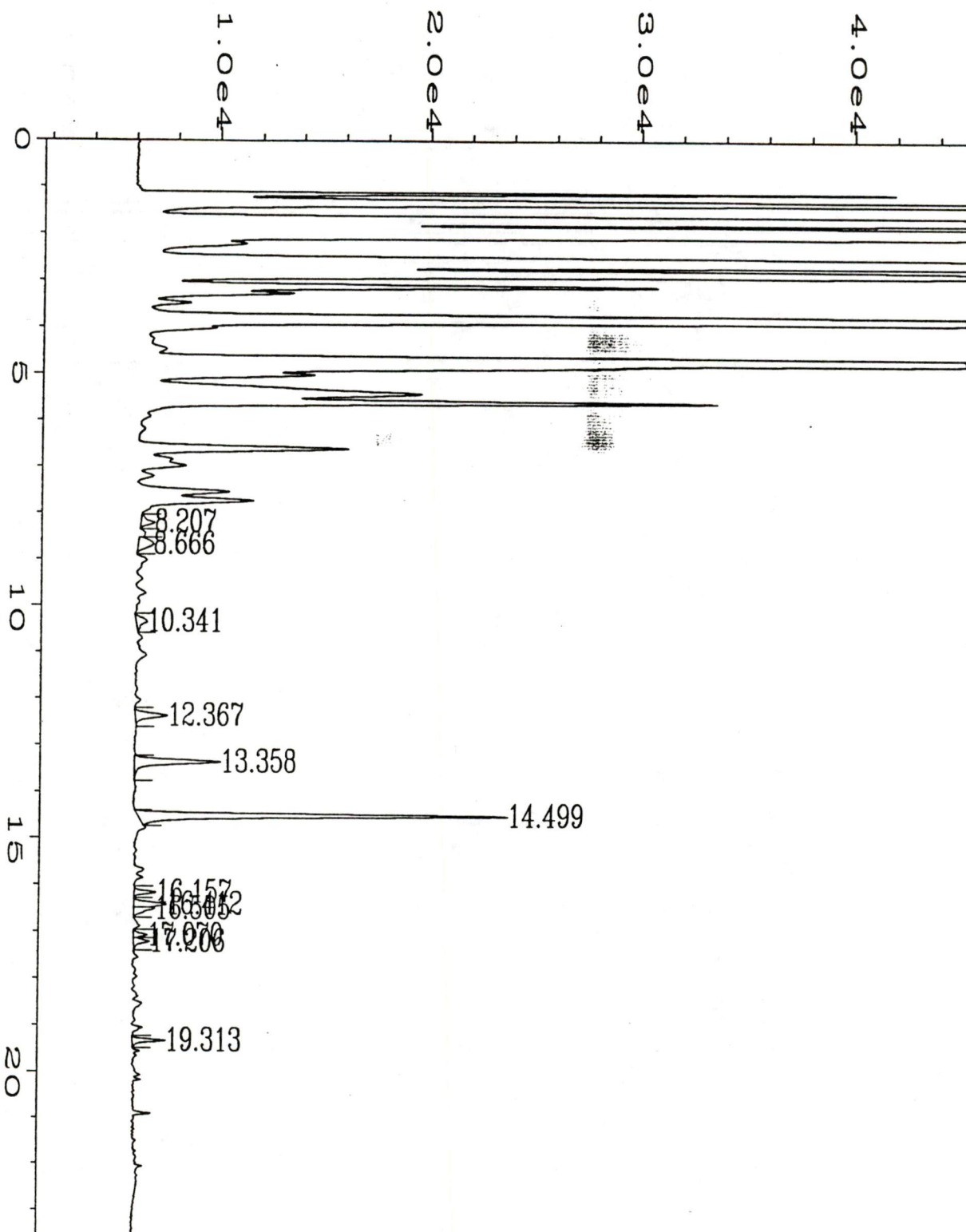
NORTH CREEK ANALYTICAL Inc.



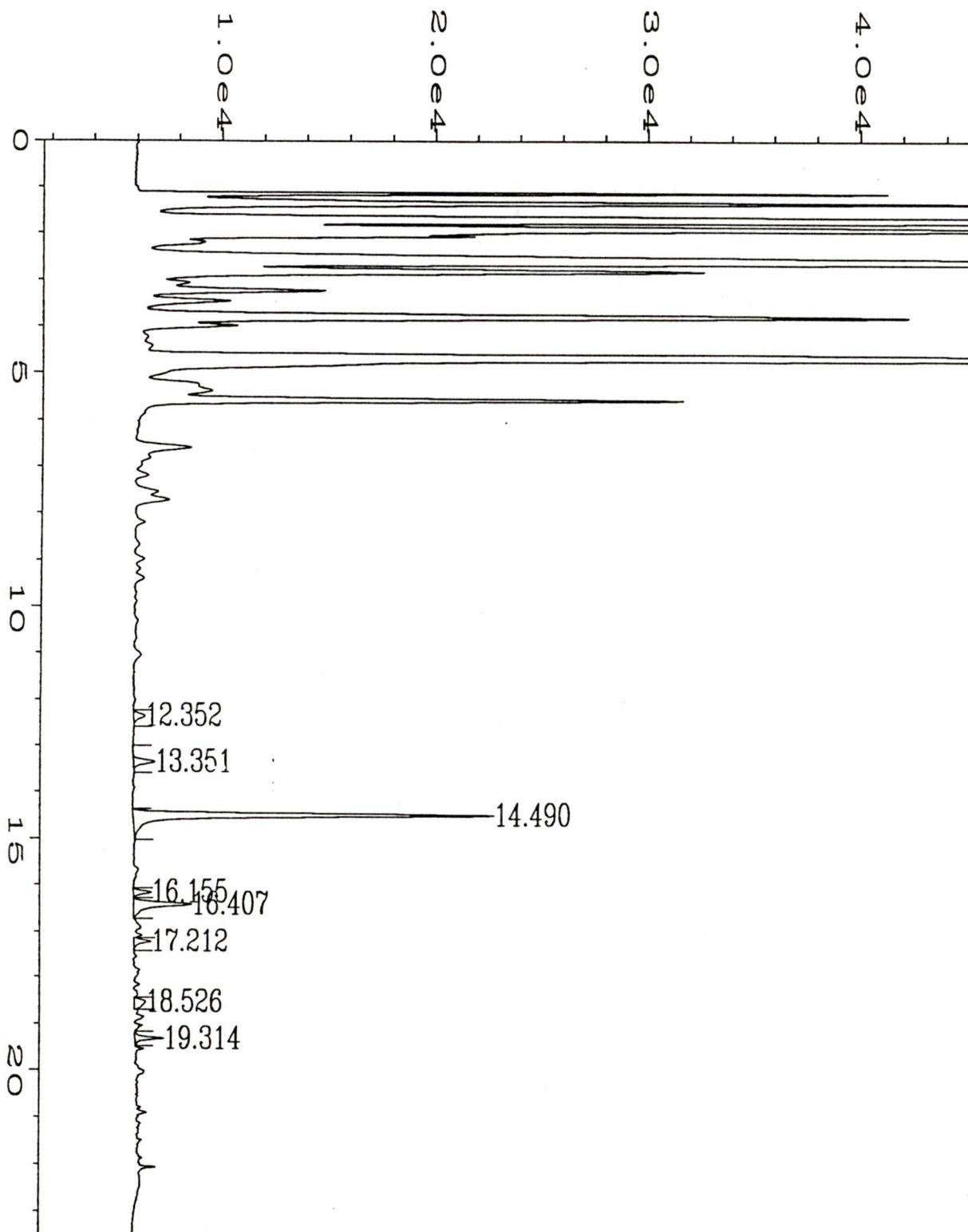
Laura Dutton
Project Manager



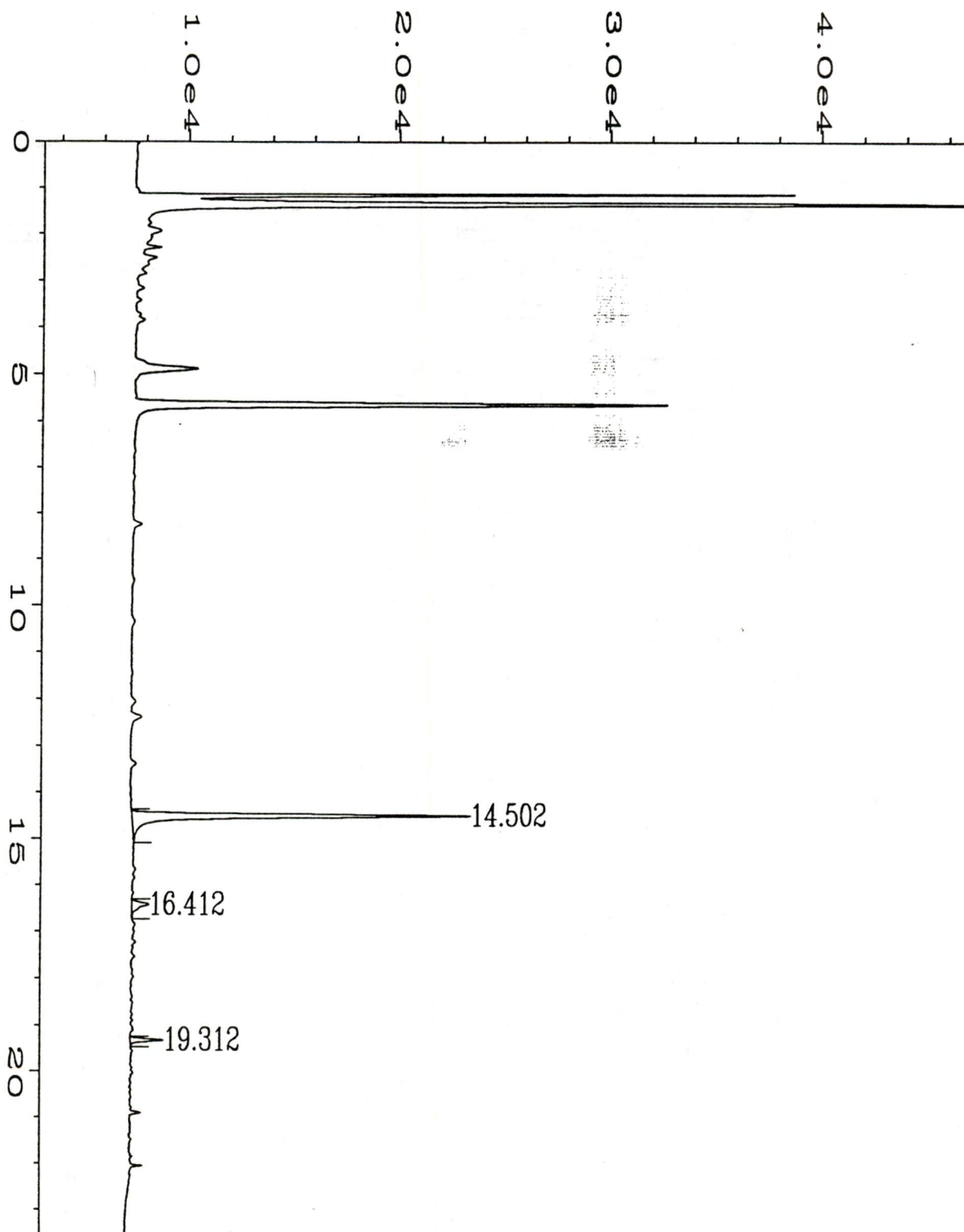
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Operator	:	Vial Number	: 10
Instrument	: GC#6	Injection Number	: 1
Sample Name	: 4121820	Sequence Line	: 3
Run Time Bar Code:		Instrument Method:	WA-WATER.MTH
Acquired on	: 07 Jan 95 01:03 PM	Analysis Method	: WA-WATER.MTH
Report Created on:	07 Jan 95 01:26 PM		
Sample Info	: 5 ml		



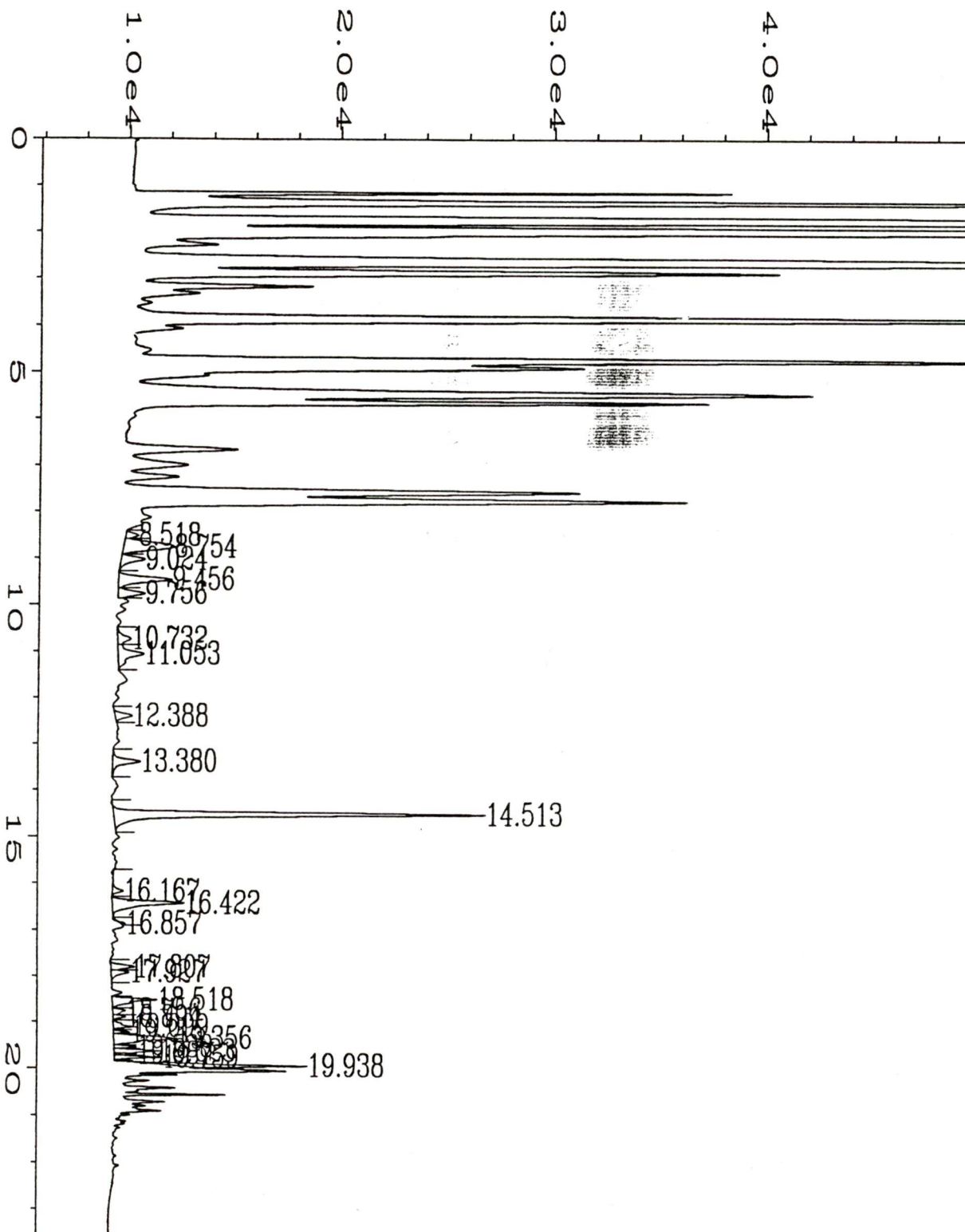
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Operator	:	Vial Number	: 11
Instrument	: GC#6	Injection Number	: 1
Sample Name	: 4121821	Sequence Line	: 3
Run Time Bar Code:		Instrument Method:	WA-WATER.MTH
Acquired on	: 07 Jan 95 01:33 PM	Analysis Method	: WA-WATER.MTH
Report Created on:	07 Jan 95 01:56 PM		
Sample Info	: 5 ml		



Data File Name	: C:\HPCHEM\2\DATA\010795\012F0301.D	Page Number	: 1
Operator	:	Vial Number	: 12
Instrument	: GC#6	Injection Number	: 1
Sample Name	: 4121822	Sequence Line	: 3
Run Time Bar Code:		Instrument Method:	WA-WATER.MTH
Acquired on	: 07 Jan 95 02:03 PM	Analysis Method	: WA-WATER.MTH
Report Created on:	07 Jan 95 02:27 PM		
Sample Info	: 5 ml		



Data File Name	: C:\HPCHEM\2\DATA\010995\021F0601.D	Page Number	: 1
Operator	:	Vial Number	: 21
Instrument	: GC#6	Injection Number	: 1
Sample Name	: 4121823 r1	Sequence Line	: 6
Run Time Bar Code:		Instrument Method:	WA-WATER.MTH
Acquired on	: 09 Jan 95 04:53 PM	Analysis Method	: WA-WATER.MTH
Report Created on:	09 Jan 95 05:17 PM		
Sample Info	: 5 ml		



Data File Name	: C:\HPCHEM\2\DATA\011095\012F0201.D	Page Number	: 1
Operator	:	Vial Number	: 12
Instrument	: GC#6	Injection Number	: 1
Sample Name	: 4121824 r1	Sequence Line	: 2
Run Time Bar Code:		Instrument Method:	WA-WATER.MTH
Acquired on	: 10 Jan 95 11:39 AM	Analysis Method	: WA-WATER.MTH
Report Created on:	10 Jan 95 12:02 PM		
Sample Info	: 5 ml		

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Lisa Bona

Client Project ID: UNOCAL #5905, #9161-183-R04
Sample Matrix: Water
Analysis Method: WTPH-G
Units: µg/L (ppb)

Analyst: R. Lister
F. Shino

Analyzed: Jan 7, 1995
Reported: Jan 10, 1995

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT Laboratory Control Sample

Gasoline

Spike Conc.
Added: 100

Spike
Result: 79

%
Recovery: 79

Upper Control
Limit %: 114

Lower Control
Limit %: 55

PRECISION ASSESSMENT Sample Duplicate

Gasoline Range
Organics

Sample
Number: 412-1822

Original
Result: N.D.

Duplicate
Result: N.D.

Relative % Difference Relative Percent Difference values are not reported at sample concentration levels less than 10 times the Detection Limit.

Maximum
RPD: 38

NORTH CREEK ANALYTICAL Inc.



Laura Dutton
Project Manager

% Recovery: $\frac{\text{Spike Result}}{\text{Spike Concentration Added}} \times 100$

Relative % Difference: $\frac{\text{Original Result} - \text{Duplicate Result}}{(\text{Original Result} + \text{Duplicate Result}) / 2} \times 100$

GeoEngineers, Inc. 8410 154th Avenue N.E. Redmond, WA 98052 Attention: Lisa Bona	Client Project ID: UNOCAL #5905, #9161-183-R04 Sample Matrix: Water Analysis Method: EPA 8020 First Sample #: 412-1820	Sampled: Dec 29, 1994 Received: Dec 30, 1994 Analyzed: Jan 7, 1995 Reported: Jan 10, 1995
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BTEX DISTINCTION

Sample Number	Sample Description	Benzene $\mu\text{g/L}$ (ppb)	Toluene $\mu\text{g/L}$ (ppb)	Ethyl Benzene $\mu\text{g/L}$ (ppb)	Xylenes $\mu\text{g/L}$ (ppb)	Surrogate Recovery %
412-1820	MW-5	6.5	N.D.	N.D.	N.D.	90
412-1821	MW-9	24	N.D.	N.D.	2.7	87
412-1822	MW-10	43	N.D.	N.D.	N.D.	87
412-1823	MW-11	N.D.	N.D.	N.D.	N.D.	92
412-1824	PURGE	11	N.D.	N.D.	N.D.	94
BLK010795	Method Blank	N.D.	N.D.	N.D.	N.D.	88

Reporting Limits:	0.50	0.50	0.50	1.0
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4-Bromofluorobenzene surrogate recovery control limits are 55 - 144 %.
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.



Laura Dutton
Project Manager

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Lisa Bona

Client Project ID: UNOCAL #5905, #9161-183-R04
Sample Matrix: Water
Analysis Method: EPA 8020
Units: $\mu\text{g/L}$ (ppb)
QC Sample #: 412-1824

Analyst: R. Lister
F. Shino
Analyzed: Jan 7, 1995
Reported: Jan 10, 1995

MATRIX SPIKE QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Sample Result:	11	N.D.	N.D.	N.D.
Spike Conc. Added:	20.0	20.0	20.0	60.0
Spike Result:	24.8	19.2	19.6	53.1
Spike % Recovery:	69%	96%	98%	89%
Spike Dup. Result:	23.9	17.2	18.2	56.0
Spike Duplicate % Recovery:	65%	86%	91%	93%
Upper Control Limit %:	138	121	126	130
Lower Control Limit %:	57	78	83	77
Relative % Difference:	3.7%	11%, Q-7	7.4%	5.5%
Maximum RPD:	9.0	9.0	13	20

NORTH CREEK ANALYTICAL Inc. Please Note:

Q-7 = The RPD value for this QC sample is outside of the advisory limit established by NCA. Additional sources for assessment of method precision, such as field dups, should be referenced.



Laura Dutton
Project Manager

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Lisa BonaClient Project ID: UNOCAL #5905, #9161-183-R04
Sample Matrix: Water
Analysis Method: WTPH-D Extended
First Sample #: 412-1820Sampled: Dec 29, 1994
Received: Dec 30, 1994
Extracted: Jan 4, 1995
Analyzed: Jan 7, 1995
Reported: Jan 10, 1995**TOTAL PETROLEUM HYDROCARBONS - DIESEL RANGE EXTENDED**

Sample Number	Sample Description	Diesel Result mg/L (ppm)	Heavy Oil Result mg/L (ppm)	Surrogate Recovery %
412-1820	MW-5	N.D.	0.80	95
412-1821	MW-9	N.D.	0.93	92
412-1822	MW-10	N.D.	N.D.	93
412-1823	MW-11	N.D.	N.D.	104
BLK010495	Method Blank	N.D.	N.D.	101

Reporting Limit:

0.25

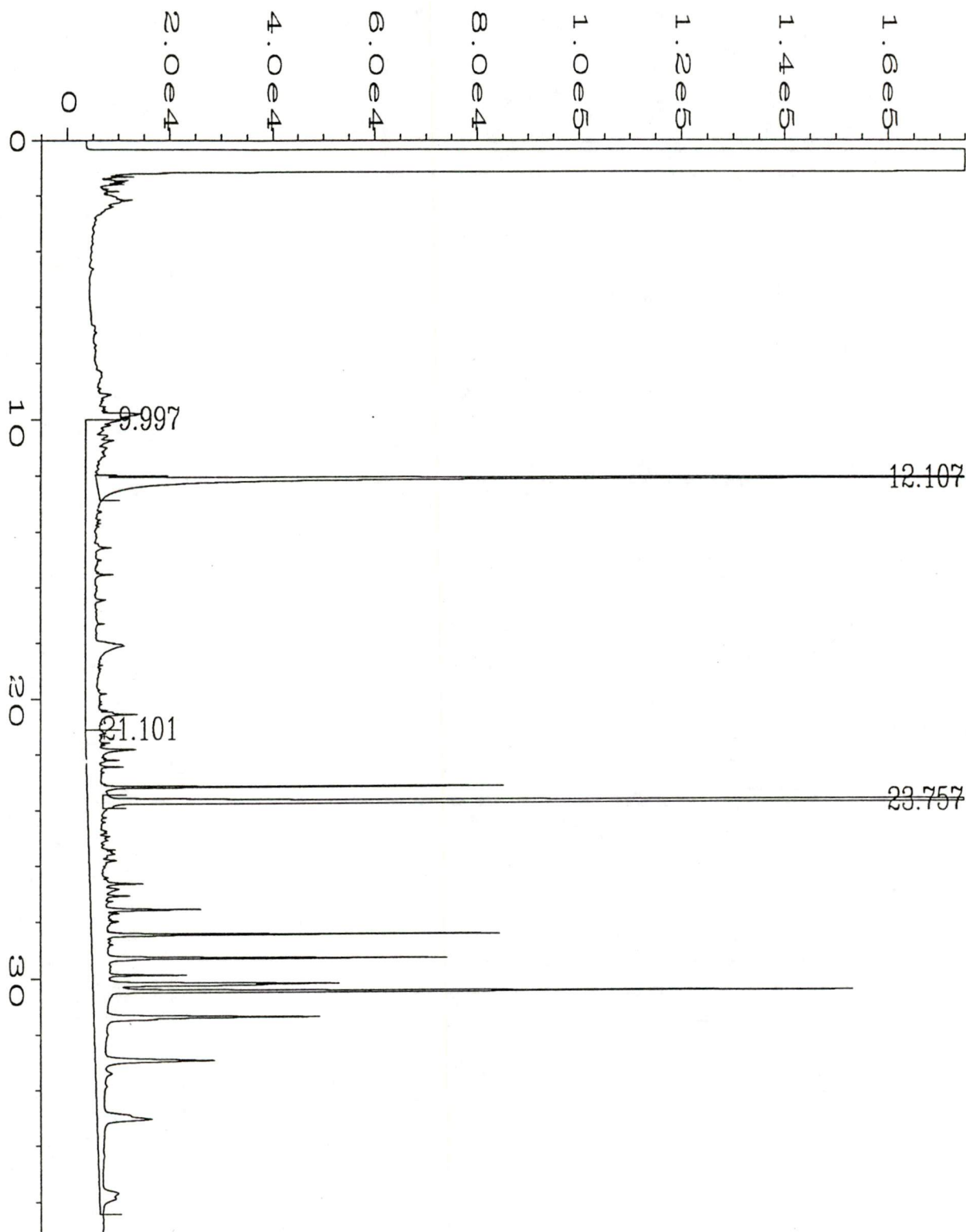
0.75

2-Fluorobiphenyl surrogate recovery control limits are 50 - 150%.

Extractable Hydrocarbons are quantitated as Diesel Range Organics (C12 - C24) and Heavy Oil Range Organics (>C24).

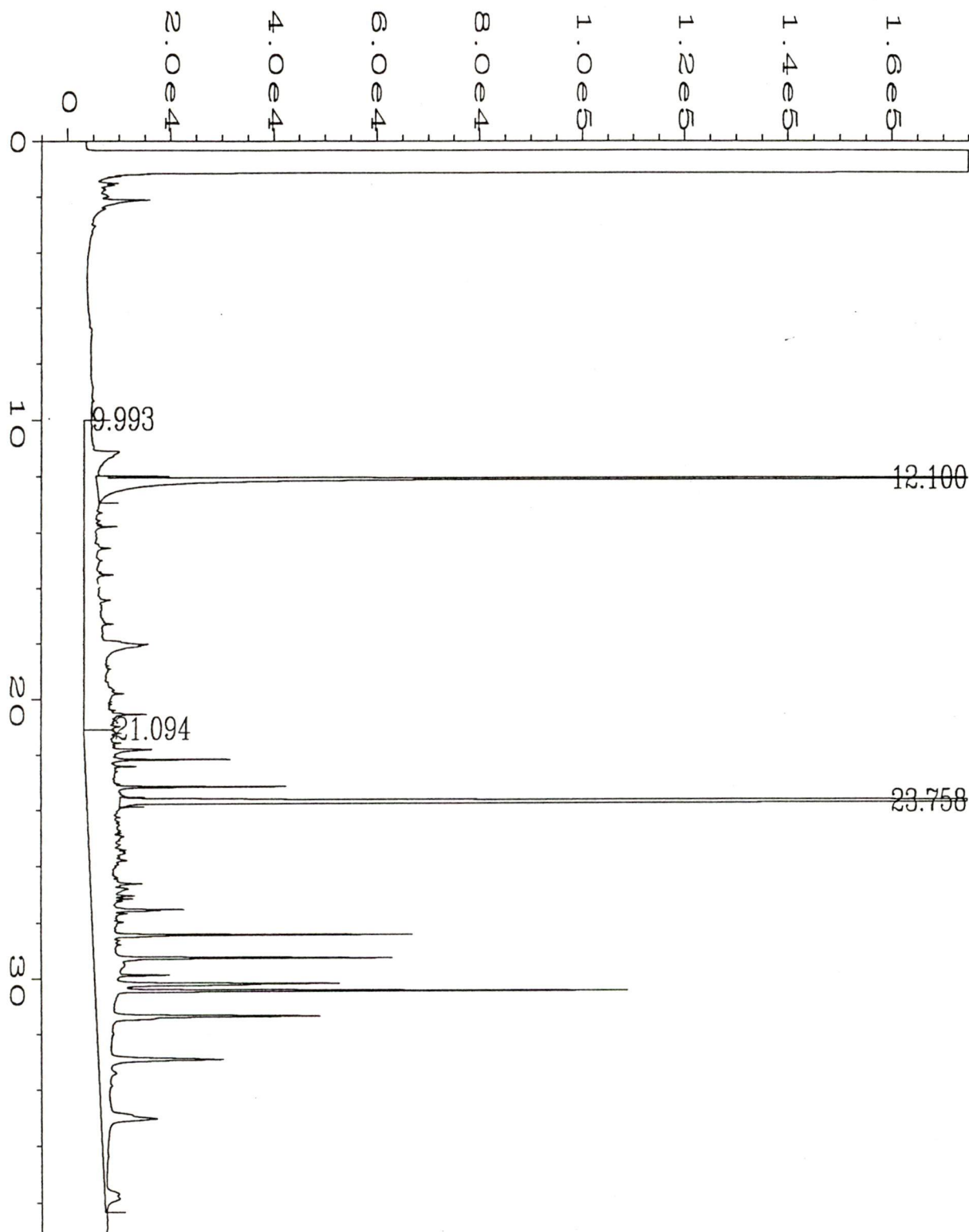
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.Laura Dutton
Project Manager



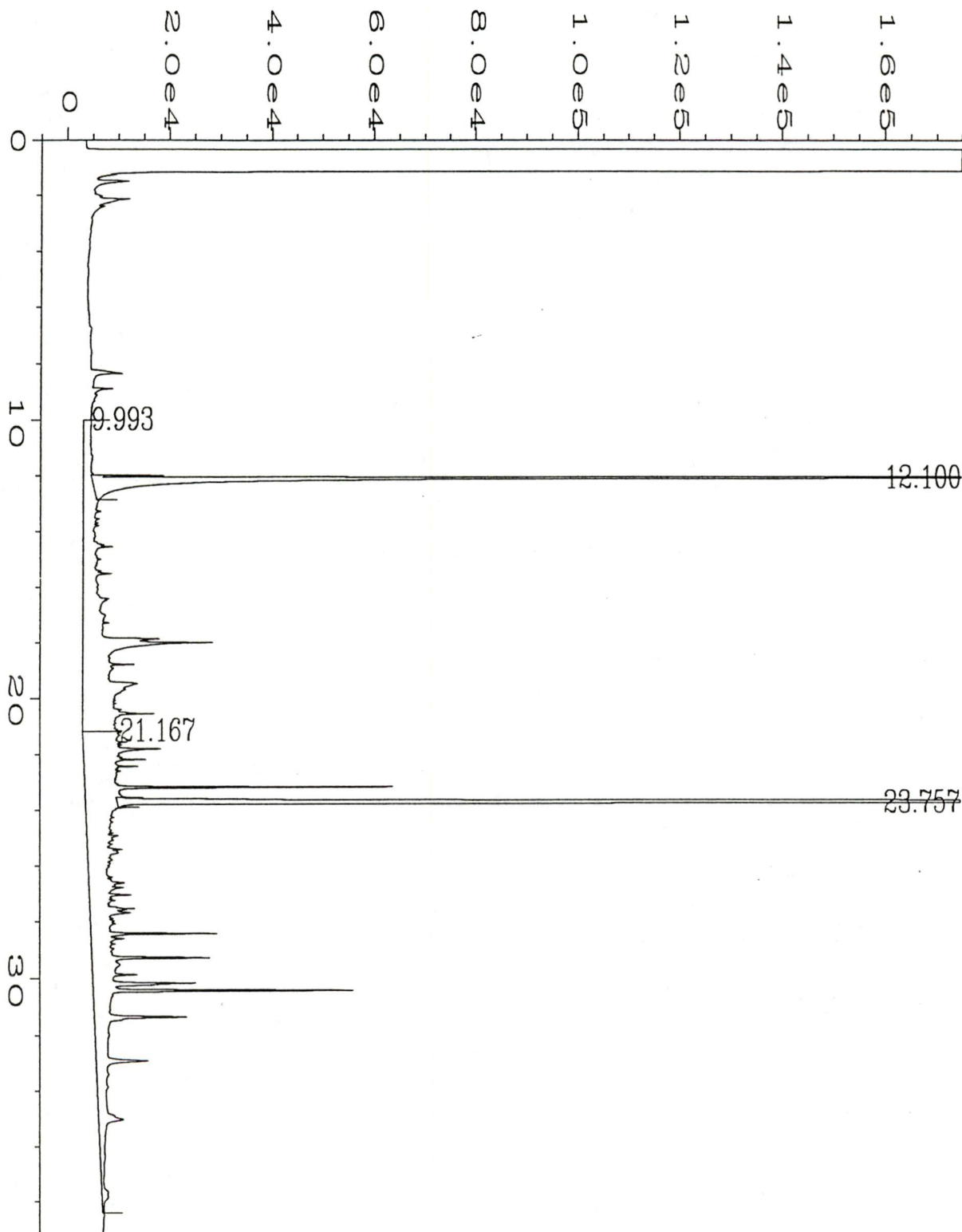
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Data File Name	: C:\HPCHEM\2\DATA\JAN06\066R0801.D	Page Number	: 1
Operator	: DAVE	Vial Number	: 66
Instrument	: ROBERT	Injection Number	: 1
Sample Name	: 412-1820	Sequence Line	: 8
Run Time Bar Code:		Instrument Method	: TPH3R.MTH
Acquired on	: 07 Jan 95 07:38 AM	Analysis Method	: BLK.MTH
Report Created on:	09 Jan 95 01:11 PM		



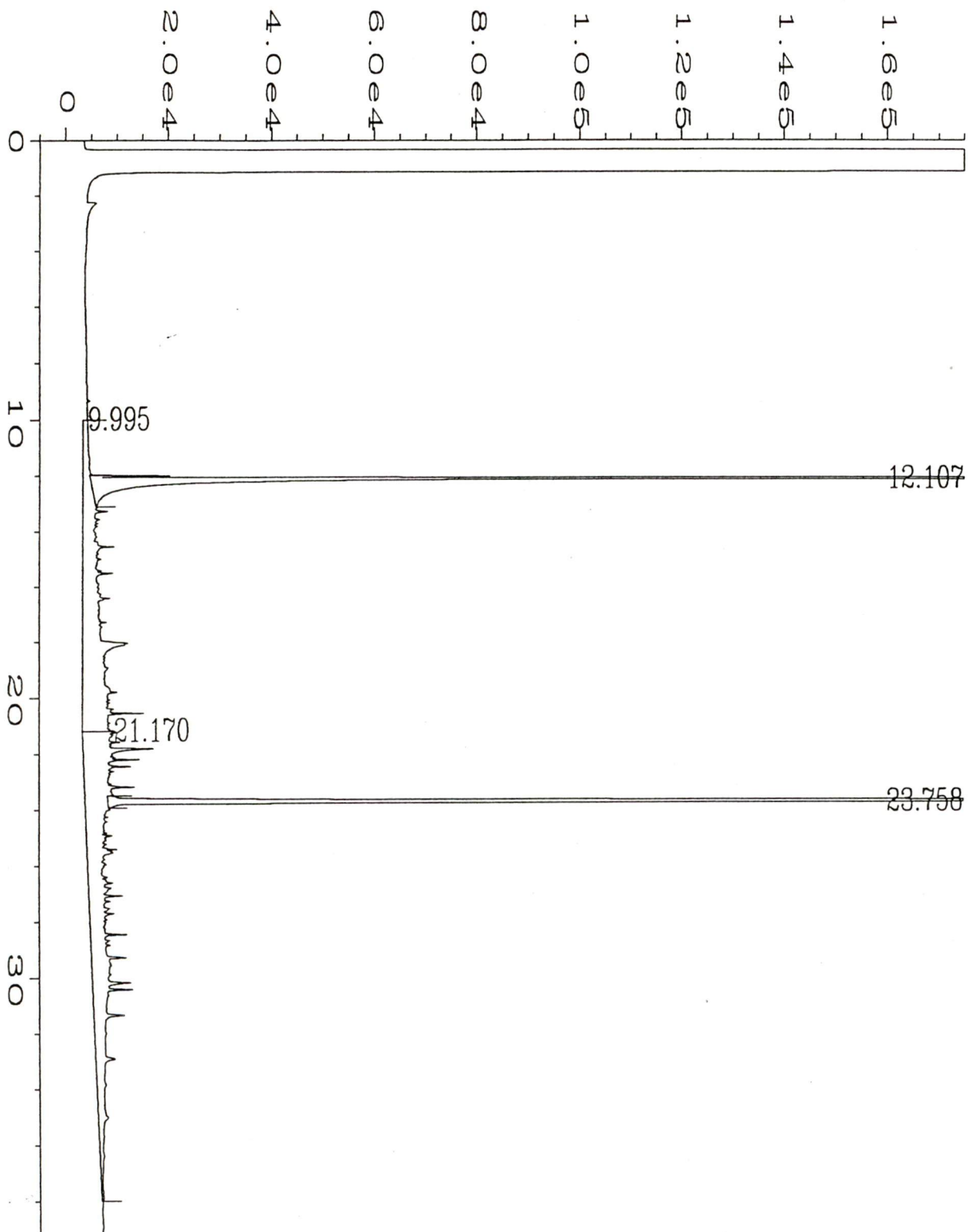
user modified

Data File Name	: C:\HPCHEM\2\DATA\JAN06\067R0801.D	Page Number	: 1
Operator	: DAVE	Vial Number	: 67
Instrument	: ROBERT	Injection Number	: 1
Sample Name	: 412-1821	Sequence Line	: 8
Run Time Bar Code:		Instrument Method:	TPH3R.MTH
Acquired on	: 07 Jan 95 08:28 AM	Analysis Method	: BLK.MTH
Report Created on:	09 Jan 95 01:14 PM		



user modified

Data File Name	: C:\HPCHEM\2\DATA\JAN06\068R0801.D	Page Number	: 1
Operator	: DAVE	Vial Number	: 68
Instrument	: ROBERT	Injection Number	: 1
Sample Name	: 412-1822	Sequence Line	: 8
Run Time Bar Code:		Instrument Method	: TPH3R.MTH
Acquired on	: 07 Jan 95 09:18 AM	Analysis Method	: BLK.MTH
Report Created on:	09 Jan 95 01:16 PM		



user modified

Data File Name	: C:\HPCHEM\2\DATA\JAN06\069R0801.D	Page Number	: 1
Operator	: DAVE	Vial Number	: 69
Instrument	: ROBERT	Injection Number	: 1
Sample Name	: 412-1823	Sequence Line	: 8
Run Time Bar Code:		Instrument Method	: TPH3R.MTH
Acquired on	: 07 Jan 95 10:08 AM	Analysis Method	: BLK.MTH
Report Created on:	09 Jan 95 01:19 PM		

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Lisa Bona

Client Project ID: UNOCAL #5905, #9161-183-R04
Sample Matrix: Water
Analysis Method: WTPH-D
Units: mg/L (ppm)

Analyst: D. Anderson

Extracted: Jan 4, 1995
Analyzed: Jan 7, 1995
Reported: Jan 10, 1995

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT Laboratory Control Sample

Diesel

Spike Conc.
Added: 2.1

Spike
Result: 2.3

%
Recovery: 110

Upper Control
Limit %: 126

Lower Control
Limit %: 71

PRECISION ASSESSMENT Sample Duplicate

Diesel Range
Organics

Sample
Number: 412-1796

Original
Result: N.D.

Duplicate
Result: N.D.

Relative % Difference Relative Percent Difference values are not reported at sample concentration levels less than 10 times the Detection Limit.

Maximum
RPD: 39

NORTH CREEK ANALYTICAL Inc.



Laura Dutton
Project Manager

% Recovery:	$\frac{\text{Spike Result}}{\text{Spike Concentration Added}} \times 100$
Relative % Difference:	$\frac{\text{Original Result} - \text{Duplicate Result}}{(\text{Original Result} + \text{Duplicate Result}) / 2} \times 100$

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Lisa Bona

Client Project ID: UNOCAL #5905, #9161-183-R04
Sample Matrix: Water
Analysis Method: EPA 413.2 (I.R.)
First Sample #: 412-1824

Sampled: Dec 29, 1994
Received: Dec 30, 1994
Extracted: Jan 4, 1995
Analyzed: Jan 5, 1995
Reported: Jan 10, 1995

TOTAL OIL & GREASE

Sample Number	Sample Description	Sample Result mg/L (ppm)
412-1824	PURGE	2.7
BLK010495	Method Blank	N.D.

Reporting Limit:**1.0**

Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

Laura Dutton
Project Manager

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Lisa Bona

Client Project ID: UNOCAL #5905, #9161-183-R04
Sample Matrix: Water
Analysis Method: EPA 413.2 (I.R.)
Units: mg/L (ppm)

Analyst: C. Days

Extracted: Jan 4, 1995
Analyzed: Jan 5, 1995
Reported: Jan 10, 1995

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT Laboratory Control Sample

Oil and
Grease

Spike Conc.
Added: 4.2

Spike
Result: 3.8

%
Recovery: 91

Upper Control
Limit %: 134

Lower Control
Limit %: 60

PRECISION ASSESSMENT Sample Duplicate

Oil and
Grease

Sample
Number: 412-1871

Original
Result: 5.3

Duplicate
Result: 4.3

Relative % Difference Relative Percent Difference values are not reported at sample concentration levels less than ten times the Detection Limit.

Maximum
RPD: 45

NORTH CREEK ANALYTICAL Inc.



Laura Dutton
Project Manager

% Recovery: $\frac{\text{Spike Result}}{\text{Spike Concentration Added}} \times 100$

Relative % Difference: $\frac{\text{Original Result} - \text{Duplicate Result}}{(\text{Original Result} + \text{Duplicate Result}) / 2} \times 100$



Chain of Custody Record #:

CONSULTANT INFORMATION

Firm: G E U Engineers	Project Number: 9161-183-1204
Address: 8410 154 TH Ave 1200 MONROE	NE
Phone: 861-6000	Fax: 861-6050
CERT CRRS Code: _____-600	
Project Manager: LISA Bunn	
Sample Collection by: Don W. J.	

Quality Assurance Data Level:

B

A: Standard Summary

B: Standard + Chromatograms

Laboratory Turnaround Days:

10

5

1

2

1

☐ Oregon ☐ Washington Hydrocarbon Methods[illegible]

NCA SAMPLE NUMBER

4121820

1821

1822

1823

1824

Relinquished by:

Firm:

Date & Time

Received by:

Firm:

Date & Time

1. The Byll GET 12/29/21 1500 ~~Stina~~ Hey NCA 12/30/21 0930
2.
3.

Final Report Approval

Were all requested results provided?

☐ yes☐ no

Define

Were results within requested turnaround?

☐ **yes**

no

"No"

Final Approval Signature:

on back

Page 1 of 1

Rev. 2.1, 9/94

Comments: Normal TAT please

Distribution: White - Laboratory Yellow - Consultant Photocopy - Unocal

Firm:

Date: