Progress Report No. 4
Vapor Extraction System Monitoring
Unocal Service Station 5353
Seattle, Washington

June 15, 1994

For

Unocal CERT - Northern Region

GeoEngineers

June 15, 1994

Geotechnical, Geoenvironmental and Geologic Services

Unocal CERT - Northern Region
P.O. Box 76
Seattle, Washington 98111

Attention: Dr. Mark Brearley, R.G.

We are submitting two copies of our "Progress Report No. 4, Vapor Extraction System Monitoring" for the site of Unocal Service Station 5353 in Seattle, Washington. This progress report summarizes VES-related monitoring activities conducted between July 15, 1993 and March 10, 1994. Future progress reports will be provided to Unocal to update the information presented in this report. Contractual terms for our services are described in blanket contract number B1982G.

We appreciate the opportunity to be of continued service to Unocal. Please call if you have questions regarding this report.

Yours very truly,

GeoEngineers, Inc.

Stephen C. Perrigo
Principal

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CONTENTS

Page No.

INTRODUCTION 1

PREVIOUS STUDIES 1

SCOPE 2

VES OPERATION AND MONITORING 2
- GENERAL 2
- VES MAINTENANCE 3
- VES OPERATIONAL DATA 3
  - Flow Rate and Applied Vacuum Measurements 3
  - Combustible Vapor Measurements 3
  - TVH and Methane Concentrations 4
- MONITORING WELLS AND RECOVERY WELLS DATA 4
  - Ground Water Measurements 4
  - Combustible Vapors 5
    - Recovery Wells 5
    - Monitoring Wells 5
  - Ground Vacuum 5

WATER DISPOSAL 6

CONCLUSIONS AND RECOMMENDATIONS 6

LIMITATIONS 7

TABLES

	Table No.
Vapor Extraction System, Operational Configurations	1
Vapor Extraction System Operation and Monitoring Data	2
Volumes of Recovered Gasoline and Methane	3
Water and Product Levels in Monitoring and Recovery Wells	4
Subsurface Combustible Vapor Monitoring Data, Recovery Wells	5
Subsurface Combustible Vapor Monitoring Data, Monitoring Wells	6
Ground Vacuum Monitoring Data, Recovery Wells	7
Ground Vacuum Monitoring Data, Monitoring Wells	8

FIGURES

	Figure No.
Vicinity Map	1
Site and Immediate Vicinity	2
Monitoring Well Locations	3
Vapor Extraction System Layout	4
Ground Water Elevations on 12/29/93 and 12/30/93	5

CONTENTS (continued)

FIGURES (Continued) — Figure No.

Combustible Vapor Concentrations in Selected Wells on 09/15/93 — 6
Ground Vacuums on 08/03/93 — 7

APPENDICES — Page No.

Appendix A - Monitoring and Recovery Wells Measurements and Sampling — A-1
Ground Water Elevations — A-1
Combustible Vapor Concentrations — A-1
Ground Vacuum — A-1
VES Measurements and Sampling — A-1
Measurements — A-1
Vapor Sampling — A-1
Purge and Decontamination Water — A-2

Appendix B - Chemical Analytical Program — B-1
Analytical Methods — B-1
Analytical Data Review — B-1
Analytical Data Review Summary — B-1
Chemical Analytical Data and Chain-of-Custody Record — B-2 ... B-117

PROGRESS REPORT NO. 4
VAPOR EXTRACTION SYSTEM MONITORING
UNOCAL SERVICE STATION 5353
SEATTLE, WASHINGTON
FOR
UNOCAL CERT - NORTHERN REGION

INTRODUCTION

This report summarizes the results of GeoEngineers' VES (vapor extraction system) monitoring and related activities conducted at the site of Unocal Service Station 5353 from July 15, 1993 through March 10, 1994. The property owned by Unocal consists of the southern half of the city block bounded by Mercer Street to the south, Westlake Avenue North to the west, Valley Street to the north and Terry Avenue North to the east. Unocal Service Station 5353 (600 Westlake Avenue North) and an adjacent Denny's restaurant (601 Terry Avenue North) are located on the Unocal property. The northern half of the city block described above is owned by the city of Seattle. The Ecology (Washington State Department of Ecology) UST (underground storage tank) site number is 008463. The site location is shown relative to surrounding physical features in Figure 1. The site location and the immediate vicinity are shown in Figure 2.

PREVIOUS STUDIES

Unocal Service Station 5353 is the site of an 80,000-gallon release of leaded premium gasoline that occurred in 1980. Site characterization and remediation activities completed at the site between 1980 and 1981 included drilling and installing 32 monitoring wells, and installing a free product recovery system. Over 40,000 gallons of free product were recovered between 1980 and 1983. The free product recovery system was taken out of operation in 1983 because of a decreasing recovery rate. A VES was installed at the site in 1988 to mitigate combustible vapors in the soil beneath the site and to reduce explosive potential. The VES design and installation details, and monitoring data obtained during VES operation before July 15, 1993 are presented in the following reports: "Progress Report No. 1" dated July 12, 1988, "Interim Status Report" dated October 3, 1988, "Progress Report No. 2" dated January 3, 1991 and "Progress Report No. 3" dated October 1, 1993.

GeoEngineers conducted additional subsurface explorations, including drilling and installation of 18 monitoring wells, from October 1991 to February 1992. The purpose of those supplemental explorations was to define the approximate extent and concentrations of residual petroleum contamination in soil and ground water in the vicinity of the site. The results of this study are presented in our "Supplemental Report of Geoenvironmental Services" dated July 7, 1992. The approximate locations of monitoring wells installed at the site in 1980 and additional monitoring wells installed in 1991 and 1992 are shown in Figure 3.

In October 1991, the city of Seattle requested that Unocal take steps to monitor combustible vapors in buildings, crawl spaces, vaults and other surface or subsurface structures on the city's property where vapors could potentially accumulate and result in health and safety hazards. Vapor monitoring of the city property occupying the northern half of the city block bounded by Mercer Street, Terry Avenue, Fairview Street and Westlake Avenue was implemented by GeoEngineers in October 1991. The results of monitoring from October 1991 to July 1992 are presented in our "Report of Geoenvironmental Services," dated December 2, 1992.

A site assessment, including tank removal activities and the installation of six monitoring wells, was performed at the city of Seattle property north of the Unocal site in early 1991. The assessment was completed by SCS (SCS Engineers) for the city of Seattle. The results of the SCS study, as summarized in their reports dated January 1991 and May 1991, indicate that petroleum-related soil and ground water contamination is present beneath the city of Seattle property. The approximate locations of the six monitoring wells installed by SCS are shown in Figure 3.

GeoEngineers performed aquifer testing at the site in February 1993. The results of these activities are summarized in our "Report of Hydrogeological Services" dated May 27, 1993.

The results of soil and ground water sampling activities completed during this reporting period will be summarized in a separate report to Unocal.

SCOPE

The purpose of our services conducted during the current reporting period was to monitor operation of the VES. The specific scope of services completed during this reporting period is as follows.

1. Periodically maintain and monitor the operation of the VES, as described in the "VES Operation and Monitoring" section of this report.
2. Dispose of purge and decontamination water stored on site at GeoEngineers' Redmond sanitary sewer connection in accordance with Metro Discharge Authorization Number 393.

VES OPERATION AND MONITORING

GENERAL

The system operated continuously from the beginning of this reporting period to November 15. The blower was turned off on November 15 to allow vapor sampling in monitoring wells by Dr. Paul Lundegard of Unocal. The blower would not restart after vapor sampling. The blower was repaired by A.L. Sleister & Sons, Inc. on January 5 and the system was subsequently monitored on January 6. The system was turned off again from February 15 to 25 to allow additional vapor sampling. The system then was operated continuously through March 9. The on and off periods and the system operational configuration during these periods are summarized in Table 1. During this reporting period, vapors were extracted from the northeastern, northwestern, southeastern and southwestern collection areas at the Unocal site and

the eastern and western collection areas on the Seattle property. The locations of the vapor collection areas are shown in Figure 4.

The current reporting period, July 15, 1993 through March 10, 1994, comprised 238 days. The VES operated for approximately 177 days of the reporting period.

VES monitoring was conducted on a regular basis during the current reporting period. The monitoring frequency, approximately monthly when the system was operating, depended on the operational configuration of the VES. VES monitoring activities included (1) obtaining combustible vapor concentrations and ground vacuum in select monitoring and recovery wells, (2) measuring VES operational characteristics including flow rate, applied vacuum and vapor temperature, and (3) obtaining vapor samples from the VES sample port for field measurement of combustible vapor concentration and for chemical analysis of methane and TVH. Not all of these activities were completed during each monitoring visit. Monitoring data and estimated equivalent gasoline and methane recovery are summarized in Tables 2 through 8. Our field procedures for monitoring activities are described in Appendix A. Laboratory reports for vapor sample chemical analyses and our review of the laboratory QA/QC (quality assurance/quality control) program are presented in Appendix B.

VES MAINTENANCE

A new vacuum gauge, with a range of 0 to 50 inches of water column, was added to the system at the beginning of the reporting period.

The ground vacuums measured in monitoring and recovery wells on our March 9, 1994 visit were lower than usual. The water trap on the VES was emptied on March 10. Vacuums measured in the recovery wells increased after emptying the water trap.

VES OPERATIONAL DATA

VES flow rates, vapor stream temperatures, applied vacuums and system operational configurations observed during this reporting period are presented in Table 2. Data for the preceding six month period are included for comparison.

Flow Rate and Applied Vacuum Measurements

The flow rate ranged from 115 to 120 cfm (cubic feet per minute) during the reporting period, with a time-weighted average of about 119 cfm. The applied vacuum ranged from 27 to 34 inches of water column during the reporting period. The applied vacuums are dependent on the VES operational configuration and are probably also dependent on soil moisture content, ground water levels and moisture content of the extracted vapors.

Combustible Vapor Measurements

The vapor stream extracted from the subsurface was characterized by obtaining field measurements of combustible vapors and by obtaining vapor samples for chemical analysis of

TVH and methane. Measurements and vapor samples were obtained from the effluent vapor stream and are representative of the vapor stream emitted to the atmosphere. The concentration of combustible vapors in the vapor stream generally were low (120 ppm [parts per million] or less) over the reporting period, with a temporary increase to 520 ppm when the system was restarted on January 5, 1994.

TVH and Methane Concentrations

Vapor samples obtained from the effluent stream on the dates indicated in Table 2 were analyzed for TVH and methane. Laboratory results are summarized in Table 2. Laboratory reports and our review of the laboratory QA/QC program are presented in Appendix B. The laboratory reported the methane concentration in the sample obtained on January 6, 1994 as a percentage. During the period between August 3 and October 15, 1993, the laboratory reported methane concentrations in parts per million. In Table 2, we have converted the January methane value to parts per million, for the purpose of comparison to the older data. The unit of parts per million is used throughout the remainder of this report.

TVH was not detected in the samples obtained during the reporting period. During the period from August 3 to October 15, 1993 methane concentrations ranged from 21 to 80 ppm. The methane concentration was 1,200 ppm in the sample obtained on January 6, 1994, immediately after the system was restarted after a down period of 51 days.

The approximate volume of recovered methane (converted to cubic feet) was calculated for this reporting period using laboratory data, measured vapor flow rates and known durations of VES operational configurations. The recovered gasoline vapor volume could not be calculated because the TVH concentrations were less than laboratory detection limits. The calculated volume of methane for the reporting period and cumulative totals of gasoline and methane for the life of the system through March 9, 1994 are presented in Table 3. The equivalent of 10,455 cubic feet of methane were recovered during this reporting period. The equivalent of approximately 4,728 gallons of gasoline and 193,944 cubic feet of methane have been recovered by the system from its initial start-up to March 9, 1994. Daily emissions of gasoline vapors to the atmosphere during this reporting period did not exceed the 15 pounds per day allowed by the PSAPCA permit. All volume calculations are based on an assumption of standard temperature and pressure.

MONITORING WELLS AND RECOVERY WELLS DATA

Ground Water Measurements

Ground water levels were measured in selected monitoring wells on December 29 and 30, 1993 and March 9, 1994, as summarized in Table 4. Data for the previous six month period are included in the table for comparison. The ground water elevations presented in Table 4 are referenced to the city of Seattle datum. The ground water elevations in the vicinity of the site ranged from about 8.4 to 10.7 feet on December 29 and 30, 1993 and from about 7.6 to 11.3 feet on March 9, 1993, with the exception of MW-41 which is located significantly upgradient of the

site. The general direction of ground water flow is toward the east and northeast. This is consistent with past observations at this site. Inferred ground water contours based on measurements obtained from the selected wells on December 29 and December 30, 1993 are shown in Figure 5.

Combustible Vapors

Recovery Wells. Combustible vapors were measured in the recovery wells on August 3 and September 15, 1993 and March 9, 1994. The results are presented in Table 5. Data for the preceding six month period are included in the table for comparison.

Combustible vapor concentrations in the recovery wells located on the Unocal site were less than 100 ppm during this reporting period with the exception of a concentration of 500 ppm in RW-4A on March 9, 1994.

Combustible vapor concentrations in the recovery wells located on the Seattle property were greater than 10,000 ppm, with the exception of concentrations of 5,800 and 2,000 ppm in SMW-5 on September 15, 1993 and March 9, 1994, respectively.

Monitoring Wells. Combustible vapor concentrations were measured in selected monitoring wells (generally, those wells installed in 1991 or 1992) on August 3 and September 15, 1993 and March 9, 1994. The results are presented in Table 6. Data for the preceding six month period are included in the table for comparison.

Combustible vapor concentrations in monitoring well SMW-4, located on city of Seattle property, were greater than 10,000 ppm. The combustible vapor concentrations in MW-32A through MW-35 ranged from less than 100 ppm to 500 ppm during the reporting period. These monitoring wells are located near the vapor extraction system. The combustible vapor concentrations measured in MW-36 and MW-41 ranged from 380 to 4,000 ppm. The combustible vapor concentrations in MW-37, MW-38 and MW-43 varied from less than 100 ppm to greater than 10,000 ppm during the reporting period. The remaining wells had combustible vapor concentrations greater than 10,000 ppm. Combustible vapor concentrations measured in selected monitoring wells (generally, those wells installed in 1991 or 1992) on September 15, 1993 are shown in Figure 6.

Ground Vacuum

Ground vacuum was measured in the recovery wells and in the monitoring wells on August 3 and September 15, 1993 and March 9 and/or March 10, 1994. The results are presented in Tables 7 and 8. Data from the preceding six month period are included in the table for comparison.

Vacuum measured in the recovery wells on the Unocal site ranged from 0 to 1.4 inches of water column in August and September 1993. On March 9, 1994, the vacuum in the recovery wells ranged from 0 to 1.0 inches. Vacuum in the recovery wells on the Seattle property ranged from 0 to 0.04 inches of water column. A general downward trend in recovering well vacuums

was observed from August 1993 to March 1994. Vacuum in the recovery wells is dependent on the VES operational configuration, and is probably also dependent on soil moisture content, ground water levels and moisture content of the extracted vapors. On March 10, 1994, the VES water trap was drained. After draining the water trap, vacuums in the recovery wells ranged from 0 to 2.0 inches.

Vacuum in the monitoring wells ranged from 0 to 0.36 inches of water column when measured in August 1993. No measurable vacuums were observed in the monitoring wells in September 1993 and March 1994. Changes in the ground vacuum between monitoring dates could be dependent on soil moisture content, ground water levels, changing atmospheric pressure conditions, and applied vacuum in the recovery wells. However, we believe that ground vacuum was affected by equipment inefficiencies at the beginning of the reporting period that were subsequently corrected, and high moisture content in the vapor stream resulting in an accumulation of water in the system at the end of the reporting period. Ground vacuum measured on August 3, 1993 and inferred vacuum contours based on these data are shown in Figure 7.

WATER DISPOSAL

Purge and decontamination water that was stored on site in one 55-gallon drum was aerated using a Rotron blower equipped with a flexible hose on October 15, 1993. The water was aerated to remove the volatile hydrocarbons from the water. A composite sample (COMPOSITE DRUM) was obtained from the aerated water for chemical analysis of BETX by EPA Method 8020, and fats, oil and grease by EPA Method 413.2 on October 15. Chemical analytical testing of COMPOSITE DRUM confirmed that the water quality is in compliance with GeoEngineers' Metro disposal permit criteria specified in Metro Discharge Authorization 393. The water was disposed of into the Metro sanitary sewer connection at GeoEngineers' Redmond office on February 23, 1994.

CONCLUSIONS AND RECOMMENDATIONS

The low TVH and methane concentrations in vapor samples obtained from the effluent vapor stream indicate that the VES is successfully removing vapors from within its area of influence. The comparatively low combustible vapor concentrations in the recovery wells and on-site monitoring wells indicate that the VES is effective in removing vapors from the immediate vicinity of the Unocal site.

High concentrations of combustible vapors remain beneath the Seattle property and other surrounding properties.

Although TVH and methane concentrations in the effluent stream remain low, we recommend continuing to operate the VES. The VES introduces oxygen into the subsurface which enhances natural biodegradation of the nonvolatile hydrocarbons which are not removed by the VES.

We recommend that future monitoring of VES operational characteristics and routine maintenance be continued on a monthly basis. We also recommend that measurements in the recovery and monitoring wells continue to be taken on a quarterly basis.

LIMITATIONS

We have prepared this report for use by Unocal in their evaluation of ongoing vapor extraction efforts at Service Station 5353. This report may be made available to potential buyers of the property and to regulatory agencies. This report is not intended for use by others and the information contained herein may not be applicable to other sites.

Our services have been completed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty or other conditions, express or implied, should be understood.

We appreciate the opportunity to be of service on this project. Please call if you have any questions regarding this report.

Respectfully submitted,

GeoEngineers, Inc.

Norman L. Puri, P.E.
Environmental Engineer

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Principal

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TABLE 1
VAPOR EXTRACTION SYSTEM
OPERATIONAL CONFIGURATIONS

Operating Period		System Status	System Configuration[1]					
			Unocal				Seattle[2]	
Start	End	(On/Off)	NW	NE	SW	SE	W	E
12/08/90	01/16/91	Off	-	-	-	-	-	-
01/16/91	01/31/91	On	-	-	O	O	-	-
01/31/91	02/15/91	Off	-	-	-	-	-	-
02/15/91	03/04/91	On	-	-	-	O	-	-
03/04/91	03/18/91	Off	-	-	-	-	-	-
03/18/91	04/01/91	On	-	-	O	O	-	-
04/01/91	04/18/91	Off	-	-	-	-	-	-
04/18/91	05/01/91	On	-	-	-	O	-	-
05/01/91	05/20/91	Off	-	-	-	-	-	-
05/20/91	06/05/91	On	O	O	O	O	-	-
06/05/91	06/19/91	Off	-	-	-	-	-	-
06/19/91	07/03/91	On	-	-	O	O	-	-
07/03/91	07/16/91	Off	-	-	-	-	-	-
07/16/91	08/01/91	On	O	O	O	O	-	-
08/01/91	08/19/91	Off	-	-	-	-	-	-
08/19/91	08/29/91	On	-	-	O	O	-	-
08/29/91	09/16/91	Off	-	-	-	-	-	-
09/16/91	10/03/91	On	-	-	O	O	-	-
10/03/91	10/15/91	Off	-	-	-	-	-	-
10/15/91	10/31/91	On	-	-	O	O	-	-
10/31/91	11/15/91	Off	-	-	-	-	-	-
11/15/91	12/02/91	On	O	O	O	O	-	-
12/02/91	12/16/91	Off	-	-	-	-	-	-
12/16/91	12/30/91	On	-	-	O	O	-	-
12/30/91	01/21/92	Off	-	-	-	-	-	-
01/21/92	02/11/92	On	-	-	O	O	-	-
02/11/92	02/28/92	On	-	-	-	-	O	O
02/28/92	03/13/92	On	-	-	-	-	O	-
03/13/92	03/27/92	On	-	-	-	O	-	-
03/27/92	04/13/92	On	-	-	O	O	O	O
04/13/92	04/23/92	On	-	-	O	O	-	-
04/23/92	05/08/92	On	-	-	O	O	O	O
05/08/92	05/21/92	On	-	-	-	O	O	-
05/21/92	06/05/92	On	-	-	-	O	O	O
06/05/92	06/18/92	On	-	-	O	O	-	-
06/18/92	06/24/92	On	-	-	O	O	O	O
06/24/92	11/15/93	On	O	O	O	O	O	O
11/15/93	01/05/94	Off	-	-	-	-	-	-
01/06/94	02/15/94	On	O	O	O	O	O	O
02/15/94	02/25/94	Off	-	-	-	-	-	-
02/25/94	Present	On	O	O	O	O	O	O

Notes:

[1] '-' = closed, 'O' = open

[2] The city of Seattle wells were not connected to the system before January 31, 1992.

TABLE 2
VAPOR EXTRACTION SYSTEM OPERATION AND MONITORING DATA

Date	Time	Flow Rate (cfm)	Vapor Temperature (°F)	Vacuum (inches)[1]	System Operational Configuration[2]						Effluent Vapor[3]			
					Unocal				Seattle		Combustible Vapor Concentration[4] (ppm)	TVH (mg/m^3)[5]	TVH (ppm)[6]	Methane (ppm)[7]
					NW	NE	SW	SE	W	E				
01/08/93	0800	118	<50	1.2	O	O	O	O	O	O	140	<500	<175	100
02/19/93	0816	120	<50	–	O	O	O	O	O	O	200	<500	<175	77
03/22/93	1430	120	<50	–	O	O	O	O	O	O	220	<500	<175	65
04/30/93	0730	0	–	0	O	O	O	O	O	O	<100	–	–	–
06/29/93	0807	120	62	24	O	O	O	O	O	O	<100	<500	<175	37
08/03/93	0800	118	70	27	O	O	O	O	O	O	<100	<500	<175	47
09/15/93	0900	120	66	32	O	O	O	O	O	O	<100	<500	<175	21
10/15/93	0600	120	60	34	O	O	O	O	O	O	120	<500	<175	80
01/06/94	0700	120	–	34	O	O	O	O	O	O	520	<500	<175	1,200
03/09/94	0700	115	60	34	O	O	O	O	O	O	<100	<500	<175	<500

Notes:

[1]Vacuum expressed as inches of water column.

[2]"-" = closed; "O" = open

[3]Measurements and samples were obtained from the vapor stream as it exited the subsurface.

[4]Measurement made with Bacharach TLV Sniffer calibrated to hexane.

[5]Total volatile hydrocarbons analysis by GC/FID, expressed as mg/m^3.

[6]Total volatile hydrocarbons analysis by GC/FID, expressed as ppm. GeoEngineers converted all values reported in mg/m^3 to ppm using the Ideal Gas Law and an assumed average molecular weight of 70 grams per mole for the hydrocarbon vapors.

[7]Methane analysis by GC/FID, expressed as ppm.

cfm = cubic feet per minute

ppm = parts per million (volume basis)

mg/m^3 = milligrams per cubic meter

"–" = no measurement taken

TABLE 3
VOLUMES OF RECOVERED GASOLINE AND METHANE

Operation Period Start Date	Operation Period Duration (days)	Estimated Equivalent Total Recovery	
		Gasoline (gallons)	Methane (cubic feet)
07/14/93	21	0	109
08/03/93	43	0	251
09/15/93	30	0	261
10/15/93	31	0	322
01/06/94	40	0	8,294
02/25/94	12	0	1,218
Total (07/14/93 - 03/09/94)	177	0	10,455
Previous Cumulative Total		4,728	183,489
TOTAL		4,728	193,944

TABLE 4 (Page 1 of 2)
WATER AND PRODUCT LEVELS IN MONITORING AND RECOVERY WELLS

Well	Casing Rim Elevation[1] (feet)	02/16/93		04/30/93		07/14/93		12/29/93 or 12/30/93		03/09/94	
		Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)
MW-1	20.12	NM	NM	10.48	--	NM	NM	NM	NM	NM	NM
MW-2	20.07	NM	NM	NM	NM	10.11[2]	0.06	NM	NM	NM	NM
MW-3	19.38	NM	NM	NM	NM	10.23[2]	0.01	NM	NM	NM	NM
MW-11	19.82	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
MW-13	21.73	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
MW-14	19.28	NM	NM	10.35	--	NM	NM	NM	NM	NM	NM
MW-15	20.48	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
MW-16	21.19	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
MW-17	21.28	NM	NM	11.55	--	NM	NM	NM	NM	NM	NM
MW-18	21.09	NM	NM	NM	NM	10.79	--	NM	NM	NM	NM
MW-19	20.97	NM	NM	NM	NM	11.03[2]	0.42	NM	NM	NM	NM
MW-24	21.49	NM	NM	10.81	--	NM	NM	NM	NM	NM	NM
MW-25	21.16	NM	NM	12.83	--	NM	NM	NM	NM	NM	NM
MW-27	20.71	NM	NM	11.94	--	NM	NM	NM	NM	NM	NM
MW-29	18.63	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
MW-32A	20.70	9.57	--	9.84	--	NM	NM	9.97	--	10.04	--
MW-33	20.75	9.57	--	10.10	--	NM	NM	9.93	--	10.17	--
MW-34	21.42	10.08	--	10.53	--	NM	NM	10.41	--	10.55	--
MW-35	20.10	10.14	--	10.32	--	NM	NM	9.87	--	NM	NM
MW-36	17.80	NM	NM	NM	NM	NM	NM	8.38	--	9.19	--
MW-37	21.01	10.33	--	10.41	--	NM	NM	10.42[2]	0.40	10.71[2]	0.10
MW-38	16.52	NM	NM	NM	NM	NM	NM	NM	NM	7.59	--
MW-39	24.47	NM	NM	NM	NM	NM	NM	NM	NM	11.27	--
MW-40	20.89	9.69	--	10.42	--	NM	NM	10.21	--	10.43	--
MW-41	27.00	NM	NM	15.55	--	NM	NM	15.76	--	15.68	--
MW-42	20.34	10.23	--	10.97	--	NM	NM	10.72	--	10.83	--

Notes appear on page 2 of 2.

TABLE 4 (Page 2 of 2)

Well	Casing Rim Elevation[1] (feet)	02/16/93		04/30/93		07/14/93		12/29/93 or 12/30/93		03/09/94	
		Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)	Water Elevation[1] (feet)	Product Thickness (feet)
MW-43	21.04	NM	NM	10.49	--	NM	NM	NM	NM	10.55	--
MW-44	18.73	NM	NM	10.69	--	NM	NM	NM	NM	10.30	--
MW-45	18.15	9.14	--	10.02	--	NM	NM	9.36	--	9.75	--
MW-46	16.91	NM	NM	9.80	--	NM	NM	NM	NM	8.17	--
MW-47	19.83	NM	NM	NM	NM	NM	NM	10.33	--	9.35	--
MW-48	18.49	8.80	--	8.06	--	NM	NM	NM	NM	10.39	--
MW-49	12.61	8.97	--	NM	NM	NM	NM	NM	NM	--	--
RW-4A	21.28	NM	--	NM	NM	NM	NM	NM	NM	NM	NM
RW-5A	21.40	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
RW-7	20.66	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
RW-8	19.92	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
RW-9	20.61	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
RW-10	20.59	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
RW-26	20.72	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
RW-28	21.17	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

Notes:

[1]Elevations referenced to city of Seattle datum.

[2]Water table elevations corrected for presence of free product. A specific gravity of 0.85 was assumed for the free product.

NM = not measured

"--" = none detected

TABLE 5
SUBSURFACE COMBUSTIBLE VAPOR MONITORING DATA[1]
RECOVERY WELLS

Vapor Collection Area[2]	Well Number	01/08/93	02/19/93	03/22/93	04/30/93	06/29/93	07/14/93	08/03/93	09/15/93	03/09/94
Northwest	RW-7	100	--	--	100	--	--	<100	<100	<100
	RW-8	<100	<100	<100	<100	<100	--	<100	<100	<100
	RW-9	100	100	<100	<100	<100	--	<100	<100	<100
	RW-10	<100	<100	<100	<100	<100	--	<100	<100	<100
	RW-26	<100	<100	--	160	<100	--	<100	<100	<100
Northeast	RW-28	--	<100	<100	--	<100	--	<100	<100	<100
Southwest	RW-5A	<100	120	--	<100	--	--	<100	<100	<100
Southeast	RW-4A	220	160	--	220	--	--	<100	<100	500
Seattle West	SMW-2S	--	>10,000	>10,000	--	--	>10,000	>10,000	>10,000	>10,000
	SMW-5	--	>10,000	>10,000	--	>10,000	>10,000	>10,000	5,800	2,000
Seattle East	MW-32	--	>10,000	>10,000	>10,000	>10,000	--	>10,000	>10,000	>10,000
	MW-49	--	>10,000	>10,000	>10,000	>10,000	--	>10,000	>10,000	>10,000
VES Operational Configuration[3]										
Northwest		O	O	O	O	O	O	O	O	O
Northeast		O	O	O	O	O	O	O	O	O
Southwest		O	O	O	O	O	O	O	O	O
Southeast		O	O	O	O	O	O	O	O	O
Seattle West		O	O	O	O	O	O	O	O	O
Seattle East		O	O	O	O	O	O	O	O	O

Notes:

[1]Vapor concentrations were measured using a Bacharach TLV Sniffer calibrated to hexane. Results are expressed in parts per million.

[2]Vapor collection areas are shown in Figure 4.

[3]VES operational configuration shows the configuration of vapor withdrawal at the time the concentrations were measured.

'O' = open; '-' = closed

'--' = not measured

TABLE 6 (Page 1 of 2)
SUBSURFACE COMBUSTIBLE VAPOR MONITORING DATA[1]
MONITORING WELLS

Well Number	Date										
	01/08/93	02/19/93	03/02/93	03/04/93	03/22/93	04/30/93	06/29/93	07/14/93	08/03/93	09/15/93	03/09/94
MW-1	--	--	--	--	--	<100	<100	--	--	--	--
MW-2	--	<100	--	--	<100	--	<100	>10,000	--	--	--
MW-3	--	--	--	--	--	--	<100	>10,000	--	--	--
MW-11	--	--	--	--	--	--	--	--	--	--	--
MW-13	--	--	--	--	--	--	--	--	--	--	--
MW-14	>10,000	>10,000	--	--	>10,000	>10,000	3,000	--	--	--	--
MW-15	--	--	--	--	--	--	--	--	--	--	--
MW-16	--	--	--	--	--	--	--	--	--	--	--
MW-17	<100	<100	--	--	900	>10,000	<100	--	--	--	--
MW-18	--	--	--	--	--	--	--	>10,000	--	--	--
MW-19	--	--	--	--	--	--	--	>10,000	--	--	--
MW-24	--	200	--	--	<100	<100	<100	--	--	--	--
MW-25	--	--	--	--	--	>10,000	--	--	--	--	--
MW-27	<100	<100	--	--	--	<100	<100	--	--	--	--
MW-29	--	--	--	--	--	--	--	--	--	--	--
MW-32A	<100	800	--	--	<100	5,000	<100	--	<100	<100	500
MW-33	<100	<100	--	--	<100	100	<100	--	<100	<100	150
MW-34	100	100	--	--	<100	<100	<100	--	<100	<100	100
MW-35	150	2,000	--	--	--	>10,000	<100	--	<100	<100	--
MW-36	--	--	--	--	--	--	--	--	1,600	3,000	380
MW-37	>10,000	>10,000	--	>10,000	500	>10,000	<100	--	<100	<100	>10,000
MW-38	--	--	--	--	--	--	--	--	<100	>10,000	>10,000
MW-39	--	--	--	--	--	--	--	--	>10,000	>10,000	>10,000
MW-40	>10,000	>10,000	--	>10,000	>10,000	420	>10,000	--	>10,000	>10,000	>10,000
MW-41	2,100	3,000	--	--	1,700	3,000	3,000	--	4,000	3,600	3,000
MW-42	520	<100	--	--	>10,000	>10,000	>10,000	--	>10,000	>10,000	>10,000
MW-43	>10,000	>10,000	8,000	9,000	>10,000	>10,000	>10,000	--	>10,000	<100	>10,000
MW-44	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	--	>10,000	>10,000	>10,000

Notes appear on page 2 of 2.

TABLE 6 (Page 2 of 2)

Well Number	Date										
	01/08/93	02/19/93	03/02/93	03/04/93	03/22/93	04/30/93	06/29/93	07/14/93	08/03/93	09/15/93	03/09/94
MW-45	>10,000	>10,000	--	--	>10,000	>10,000	>10,000	--	--	>10,000	>10,000
MW-46	>10,000	4,000	--	--	>10,000	220	<100	--	--	--	>10,000
MW-47	>10,000	>10,000	>10,000	>10,000	>10,000	--	>10,000	--	>10,000	>10,000	>10,000
MW-48	--	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	--	>10,000	>10,000	>10,000
SMW-4	--	--	--	--	--	--	--	--	>10,000	>10,000	>10,000
VES Operational Configuration[2]											
Northwest	O	O	O	O	O	O	O	O	O	O	O
Northeast	O	O	O	O	O	O	O	O	O	O	O
Southwest	O	O	O	O	O	O	O	O	O	O	O
Southeast	O	O	O	O	O	O	O	O	O	O	O
Seattle West	O	O	O	O	O	O	O	O	O	O	O
Seattle East	O	O	O	O	O	O	O	O	O	O	O

Notes:

[1]Vapor concentrations were measured using a Bacharach TLV Sniffer calibrated to hexane. Results are expressed in parts per million.

[2]VES operational configuration shows the configuration of vapor withdrawal at the time the vapor concentrations were measured.

'O' = open; '-' = closed

'--' = not measured

TABLE 7.
GROUND VACUUM MONITORING DATA[1]
RECOVERY WELLS

Vapor Collection Area[2]	Well Number	Date								
		01/08/93	02/19/93	03/22/93	04/30/93	06/29/93	08/03/93	09/15/93	03/09/94	03/10/94
Northwest	RW-7	0.48	--	--	0.00	--	1.00	0.00	0.10	0.50
	RW-8	0.54	0.43	0.30	0.00	0.41	0.42	0.00	0.10	0.50
	RW-9	0.52	0.44	0.30	0.00	0.42	0.44	0.00	0.10	0.50
	RW-10	0.54	0.46	0.40	0.00	0.42	0.40	0.00	0.00	0.50
	RW-26	0.42	0.36	--	0.00	0.34	0.34	0.00	0.20	0.50
Northeast	RW-28	--	0.00	0.10	0.00	--	0.00	0.00	0.00	0.00
Southwest	RW-5A	0.52	0.20	--	0.00	--	1.40	1.20	0.20	0.50
Southeast	RW-4A	2.00	1.80	--	0.00	--	1.00	0.04	1.00	2.00
Seattle West	SMW-2S	--	0.10	0.10	--	--	0.00	0.00	0.00	--
	SMW-5	--	0.20	0.00	--	0.01	0.00	0.00	0.00	--
Seattle East	MW-32	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--
	MW-49	--	0.20	0.00	0.00	0.00	0.04	0.00	0.00	--
VES Operational Configuration[2]										
Northwest		O	O	O	O	O	O	O	O	O
Northeast		O	O	O	O	O	O	O	O	O
Southwest		O	O	O	O	O	O	O	O	O
Southeast		O	O	O	O	O	O	O	O	O
Seattle West		O	O	O	O	O	O	O	O	O
Seattle East		O	O	O	O	O	O	O	O	O

Notes:

[1]Measured using Magnehelic vacuum gauges. Results are expressed in inches of water column.

[2]VES operational configuration shows the configuration of vapor withdrawal at the time the vacuum was measured. "O" = open, "-" = closed.

"--" = not measured

TABLE 8 (Page 1 of 2)
GROUND VACUUM MONITORING DATA[1]
MONITORING WELLS

Well Number	Date							
	01/08/93	02/19/93	03/22/93	04/30/93	06/29/93	08/03/93	09/15/93	03/09/94
MW-1	--	--	--	0.00	0.01	--	--	--
MW-2	--	--	0.20	--	0.03	--	--	--
MW-3	--	--	--	--	0.01	--	--	--
MW-11	--	--	--	--	--	--	--	--
MW-13	--	--	--	--	--	--	--	--
MW-14	0.00	0.00	0.00	0.00	0.00	--	--	--
MW-15	--	--	--	--	--	--	--	--
MW-16	--	--	--	--	--	--	--	--
MW-17	0.00	0.00	0.00	0.00	0.01	--	--	--
MW-18	--	--	--	--	--	--	--	--
MW-19	--	--	--	--	--	--	--	--
MW-24	--	0.00	0.00	0.00	0.01	--	--	--
MW-25	--	--	--	0.00	--	--	--	--
MW-27	0.00	0.00	--	0.00	0.01	--	--	--
MW-29	--	--	--	--	--	--	--	--
MW-32A	0.46	0.40	0.35	0.00	0.40	0.36	0.00	0.00
MW-33	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
MW-34	0.22	0.18	0.10	0.00	0.24	0.20	0.00	0.00
MW-35	0.32	0.29	--	0.00	0.28	0.22	0.00	--
MW-36	--	--	--	--	--	0.00	0.00	0.00
MW-37	0.14	0.07	0.20	0.00	--	--	0.00	0.00
MW-38	--	--	--	--	--	0.00	0.00	0.00
MW-39	--	--	--	--	--	0.00	0.00	0.00
MW-40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MW-41	0.02	0.02	0.10	0.00	0.00	0.00	0.00	0.00
MW-42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MW-43	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
MW-44	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00

Notes appear on page 2 of 2.

TABLE 8 (Page 2 of 2)

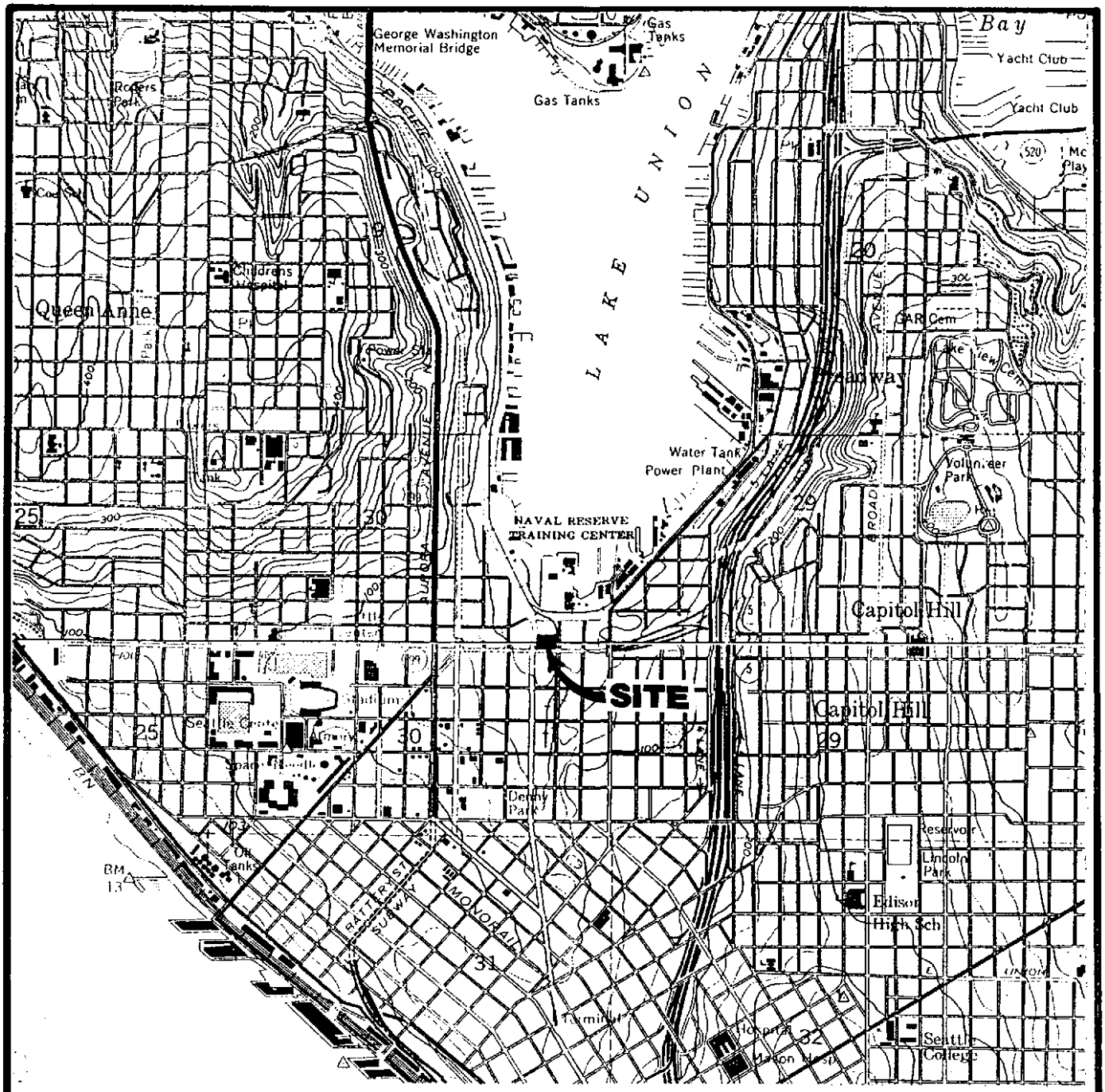
Well Number	Date							
	01/08/93	02/19/93	03/22/93	04/30/93	06/29/93	08/03/93	09/15/93	03/09/94
MW-45	0.00	0.00	0.05	0.00	0.01	--	0.00	0.00
MW-46	0.00	0.00	0.00	0.00	0.00	--	--	0.00
MW-47	0.00	0.00	0.00	--	0.00	0.00	0.00	0.00
MW-48	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SMW-4	--	--	--	--	--	0.00	0.00	0.00
Vapor Collection System Operational Status[2]								
Northwest	O	O	O	O	O	O	O	O
Northeast	O	O	O	O	O	O	O	O
Southwest	O	O	O	O	O	O	O	O
Southeast	O	O	O	O	O	O	O	O
Seattle West	O	O	O	O	O	O	O	O
Seattle East	O	O	O	O	O	O	O	O

Notes:

[1]Measured using Magnehelic vacuum gauges. Results are expressed in inches of water column.

[2]VES operational configuration shows the configuration of vapor withdrawal at the time the vacuum was measured.

"–" = not measured; "O" = open; "-" = closed



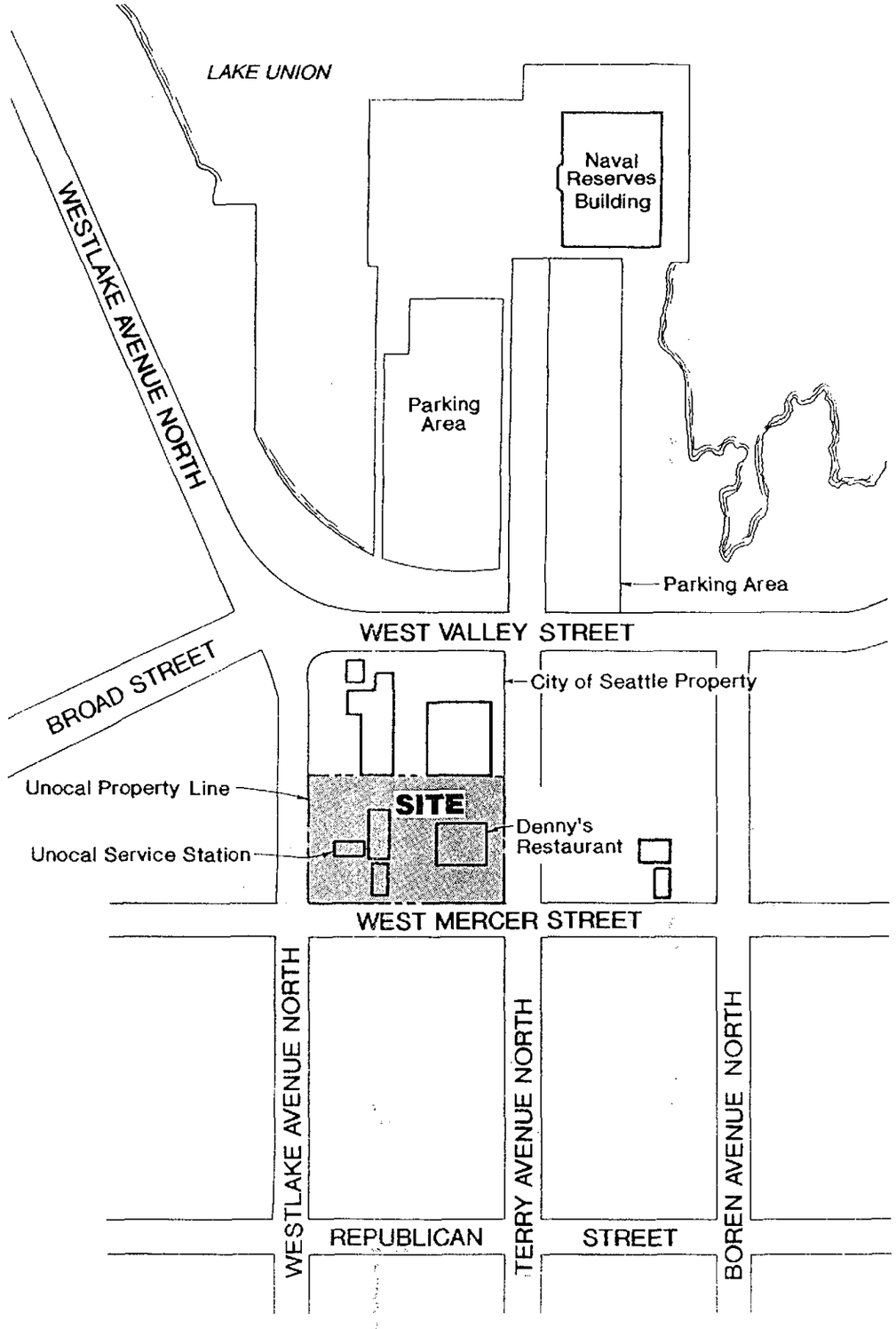
REFERENCE: USGS TOPOGRAPHIC QUADRANGLE MAPS "SEATTLE NORTH, WASH.," PHOTOREVISED 1968 AND "SEATTLE SOUTH, WASH.," PHOTOREVISED 1973.

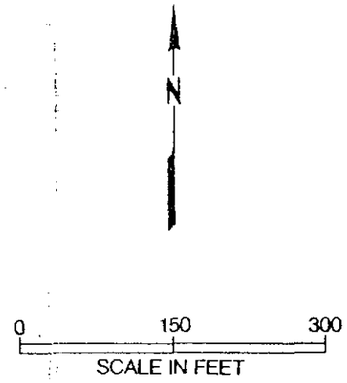
Geo Engineers

VICINITY MAP

FIGURE 1

0161-013-R04 AMA:KKT 2/13/92



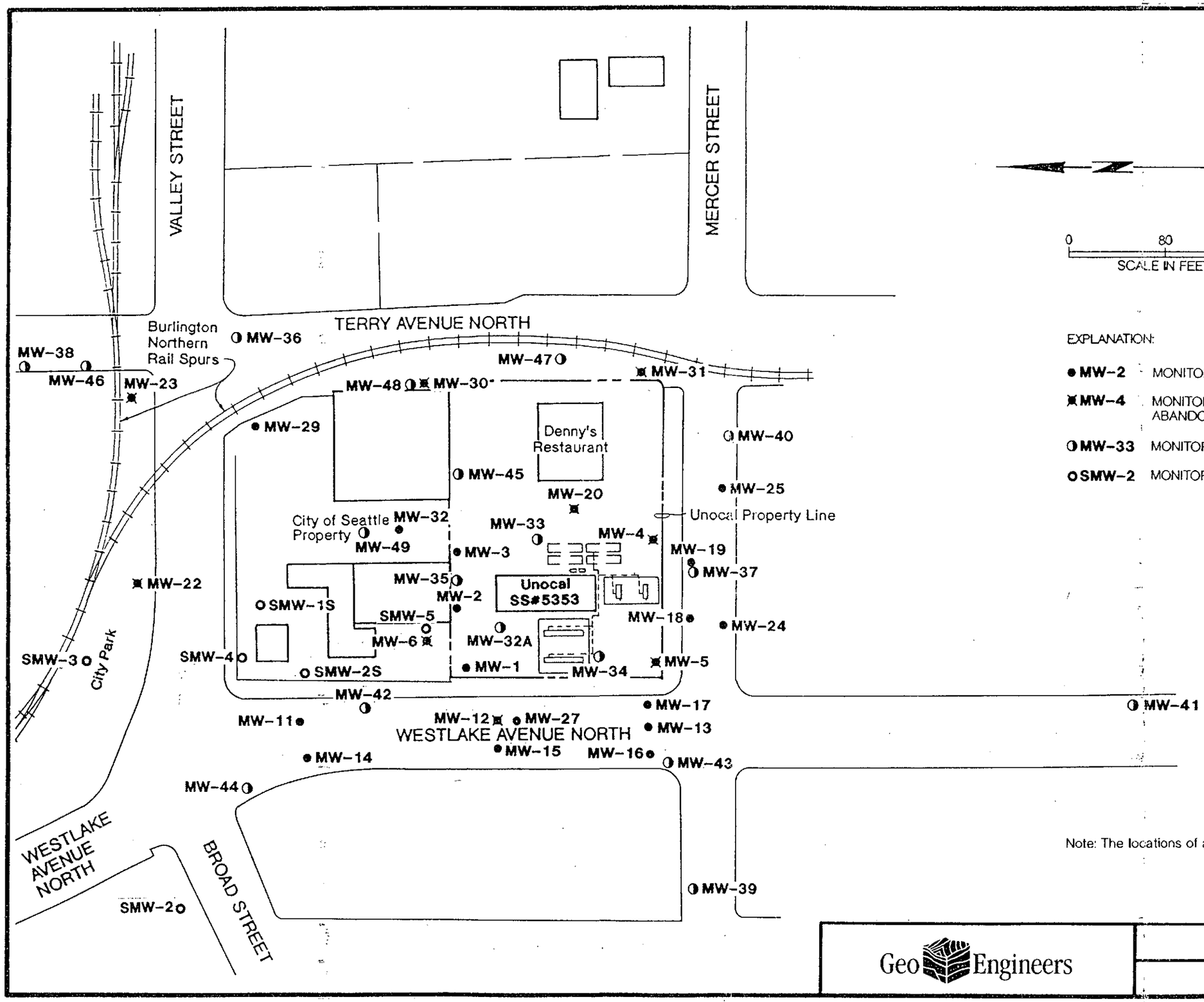


REFERENCE: CITY OF SEATTLE DEPARTMENT OF ENGINEERING, AERIAL PHOTOGRAPHY OF NE 1/4 OF THE SE 1/4 SEC. 30, T. 25, R.4, W.M.

Geo Engineers

SITE AND IMMEDIATE VICINITY

FIGURE 2



Note: The locations of all features shown are approximate.

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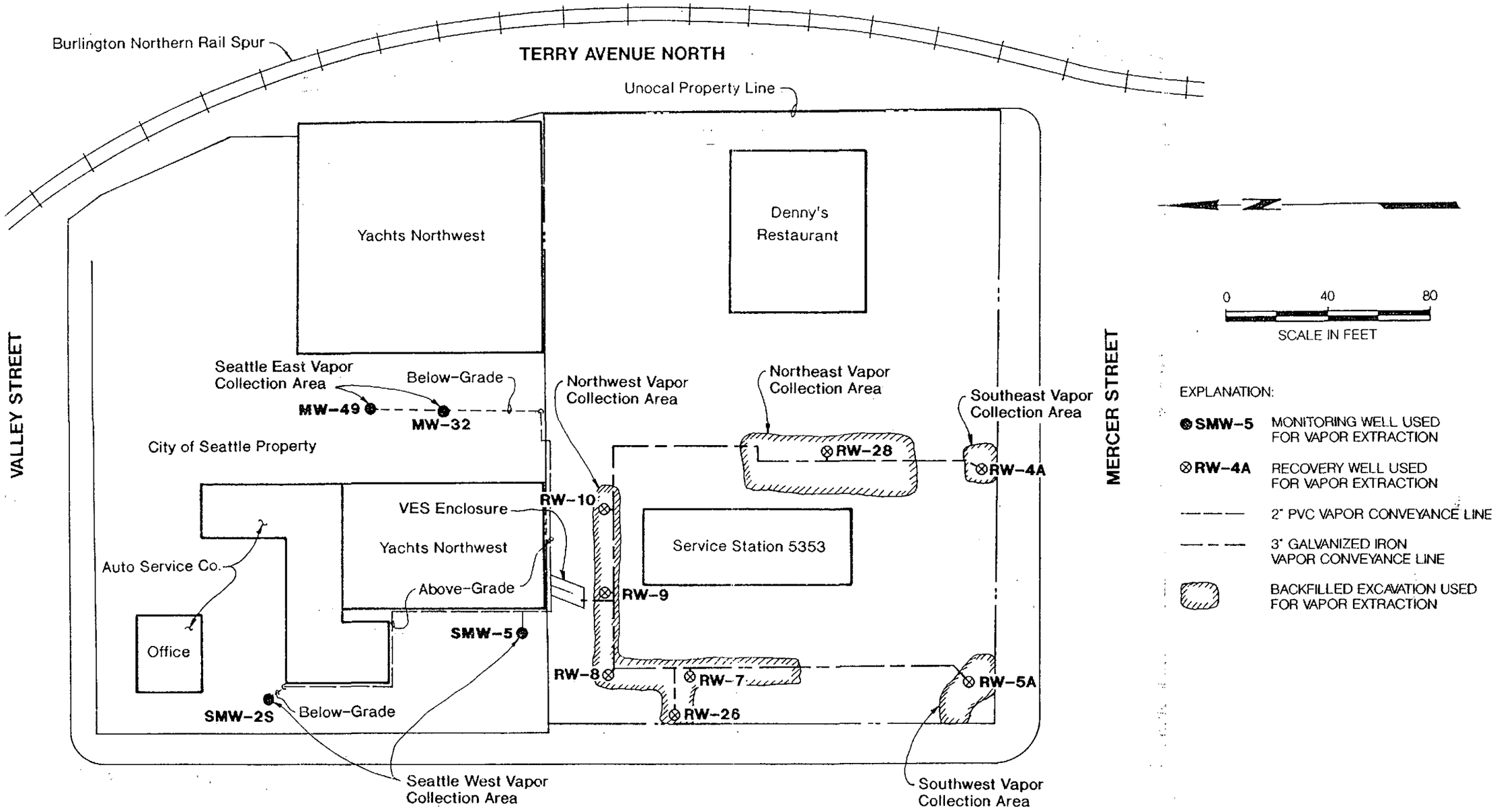
MONITORING WELL LOCATIONS

FIGURE 3

10-1-93
0161-013-R69 NLP BOH 8/24/93(B)



Note: The locations of all features shown are approximate.

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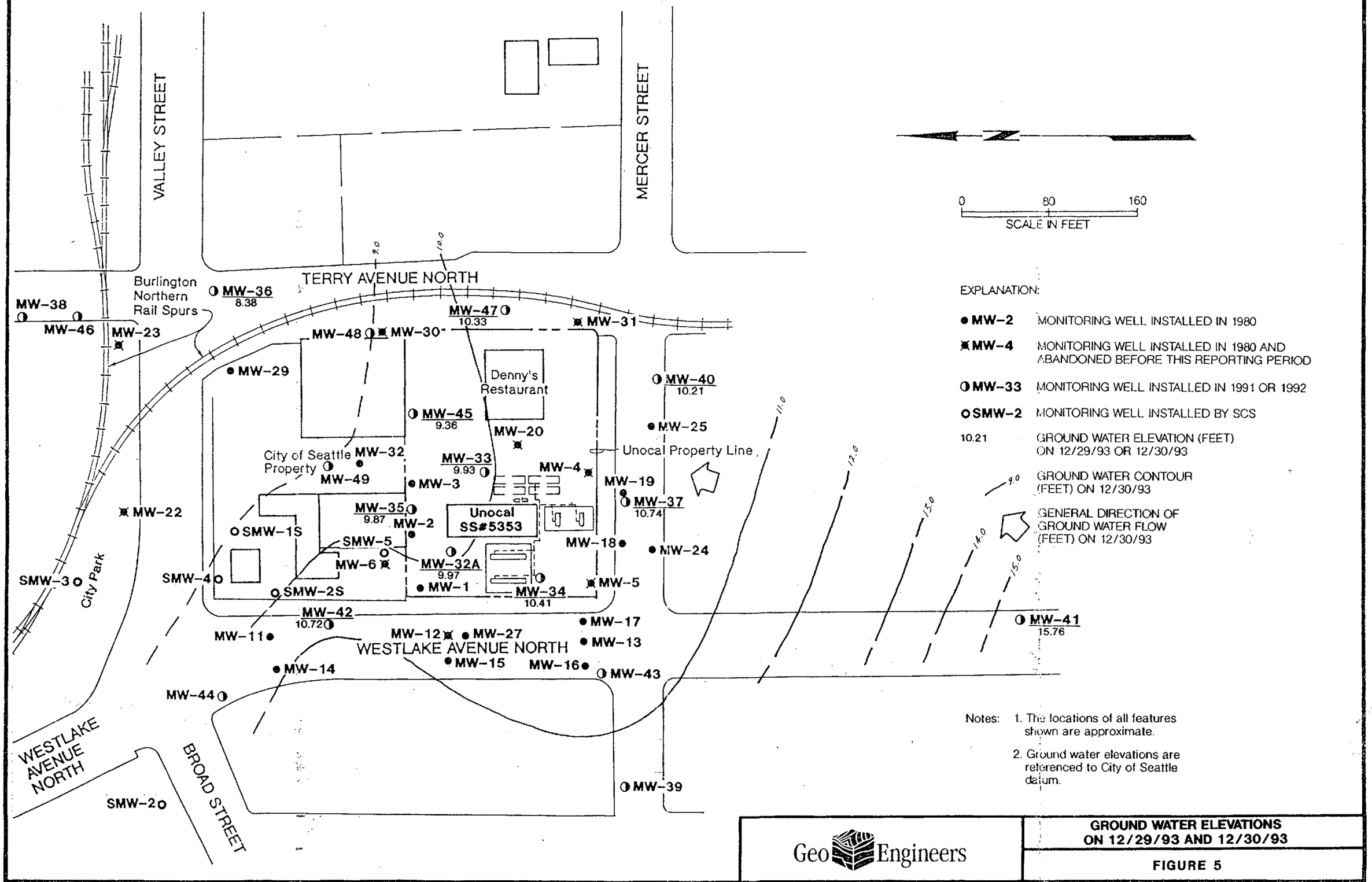
VAPOR EXTRACTION SYSTEM LAYOUT

FIGURE 4

061-013-R04 DEH:PMB 02-12-92 Rev: DEH:JJH 3/3/92 (3)



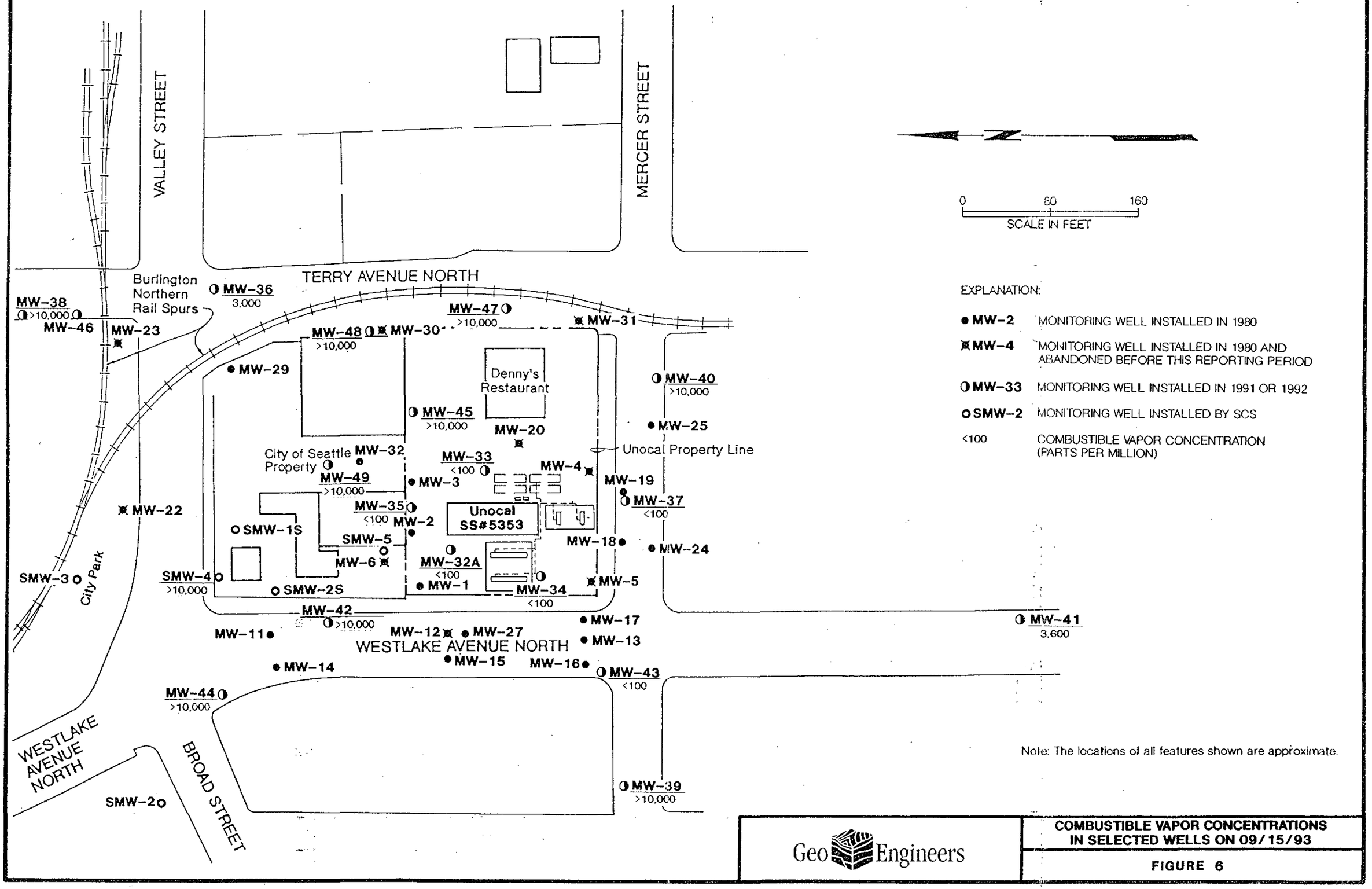
Notes:
1. The locations of all features shown are approximate.
2. Ground water elevations are referenced to City of Seattle datum.

Geo Engineers

GROUND WATER ELEVATIONS ON 12/29/93 AND 12/30/93

FIGURE 5

0161-013-R6 NLP BDH 6/24/94 (3)



Note: The locations of all features shown are approximate.

0161-013-R6 NLP BOH 9/24/93(B)

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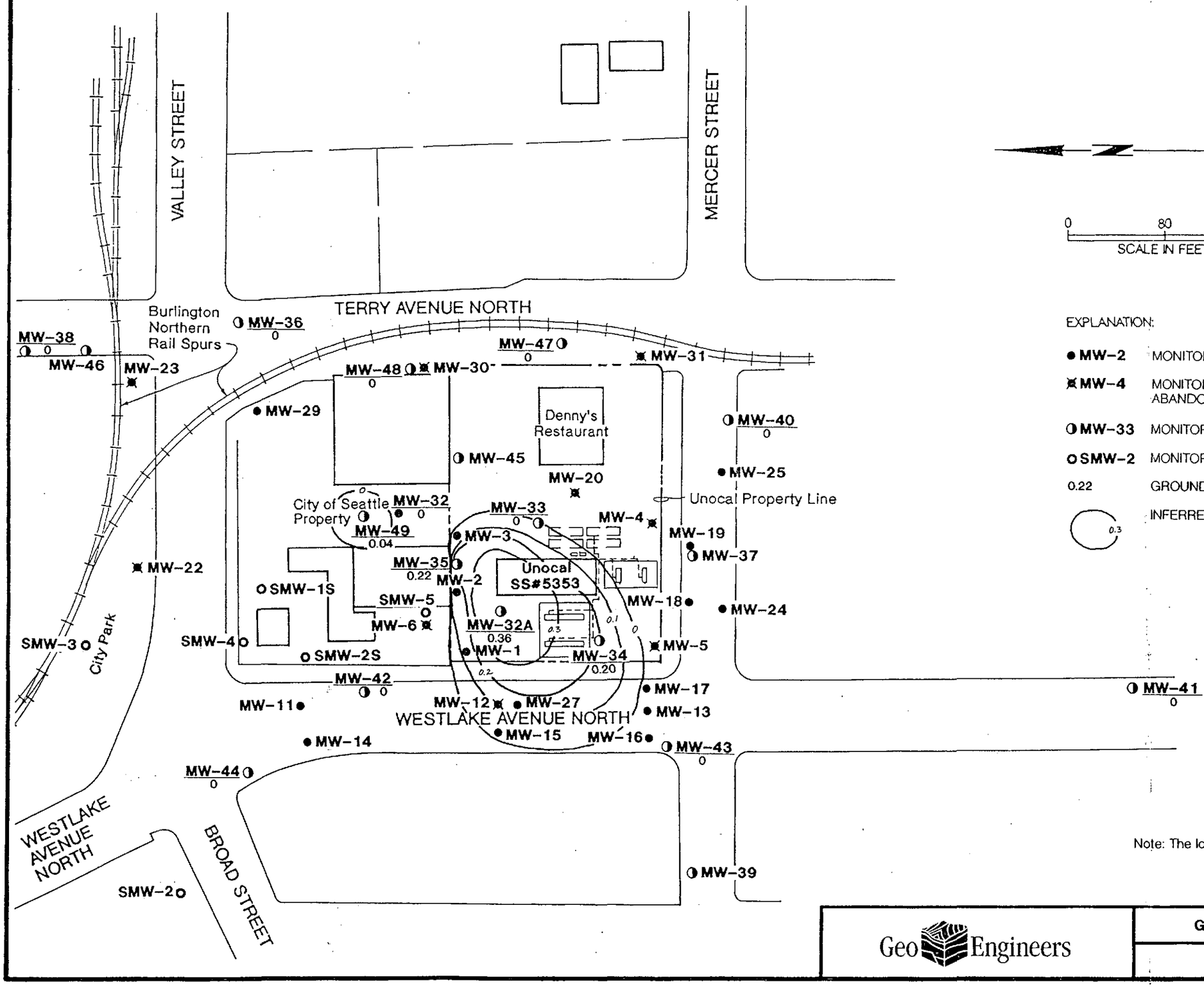
COMBUSTIBLE VAPOR CONCENTRATIONS IN SELECTED WELLS ON 09/15/93

FIGURE 6



EXPLANATION:

- ● MW-2 — MONITORING WELL INSTALLED IN 1980
- ⊠ MW-4 — MONITORING WELL INSTALLED IN 1980 AND ABANDONED BEFORE THIS REPORTING PERIOD
- ◑ MW-33 — MONITORING WELL INSTALLED IN 1991 OR 1992
- ○ SMW-2 — MONITORING WELL INSTALLED BY SCS
- 0.22 — GROUND VACUUM (INCHES OF WATER)
- 0.3 — INFERRED GROUND VACUUM CONTOUR

Note: The locations of all features shown are approximate.

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GROUND VACUUMS ON 08/03/93

FIGURE 7

0161-013-R9 NLP:BDH 8/24/95(B)

APPENDIX A

APPENDIX A

MONITORING AND RECOVERY WELLS MEASUREMENTS AND SAMPLING

GROUND WATER ELEVATIONS

Depths to the ground water table relative to the monitoring well casing rims were measured on December 29 and December 30, 1993 and March 9, 1994. The measurements were made using an electric water level indicator. The water level indicator was cleaned with a Liquinox solution wash and a distilled water rinse prior to use in each well. Ground water elevations were calculated by subtracting the water table depths from the casing rim elevations. The ground water elevations are summarized in Table 4.

COMBUSTIBLE VAPOR CONCENTRATIONS

Combustible vapor concentrations were measured in selected recovery and monitoring well casings on the dates indicated in Tables 5 and 6. A Bacharach TLV Sniffer calibrated to hexane was used to measure the combustible vapor concentrations in the well casings. A slip cap was used to produce a temporary seal in the monitoring well casings when obtaining vapor concentrations. The lower threshold of significance for the TLV Sniffer in this application is 100 ppm (parts per million), equivalent to 1 percent of the LEL (lower explosive limit) of hexane.

GROUND VACUUM

Ground vacuum was measured in the accessible monitoring and recovery well casings with a Magnehelic gauge with a resolution of 0.01 inches of water column. A slip cap enabled a tight fit around the monitoring well casings. Vacuum pressures were measured in the well casings while the on-site VES was operating. The ground vacuum data are presented in Tables 7 and 8.

VES MEASUREMENTS AND SAMPLING

MEASUREMENTS

The operating efficiency of the VES was monitored with manufactured meters permanently installed on the system. The meters include the following: (1) air flow meter, (2) vapor temperature meter, and (3) vacuum pressure gauge.

Combustible vapor concentrations also were obtained from the system using a Bacharach TLV Sniffer calibrated to hexane. The sample port for vapor measurement and sampling is located in the vapor conveyance line between the blower and the discharge stack. The data are presented in Table 2.

VAPOR SAMPLING

Vapor samples were obtained from the sample port in the vapor conveyance line on the dates listed in Table 2. The vapor samples were collected in evacuated stainless steel containers by opening the valve in the sample port and allowing the vacuum in the canister to draw in the

vapors. Chain-of-custody procedures were followed in transporting the vapor samples to the testing laboratory. The laboratory data sheets and chain-of-custody records are in Appendix B.

PURGE AND DECONTAMINATION WATER

Purge and decontamination water was stored on site in one 55-gallon drum. Air was injected into the drums on October 15, 1993 in an attempt to remove the volatile hydrocarbons from the water. A drum sample was obtained with a disposable bailer and analyzed for BETX, and fats, oil and grease on October 15, 1993. Based on chemical analytical results the BETX, and fats, oil and grease concentrations of the purge water are in compliance with GeoEngineers' Metro disposal permit criteria and the water was transported to GeoEngineers' Redmond facility for disposal in the sanitary sewer on February 23, 1994.

APPENDIX B

APPENDIX B

CHEMICAL ANALYTICAL PROGRAM

ANALYTICAL METHODS

Chain-of-custody procedures were followed during the transport of the field samples to the analytical laboratory. The water sample was 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 appendix. 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.

AnalyticalTechnologies,Inc. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

SIGNATURE PAGE

Reviewed by: _____
ATI Project Manager

Client:	GEO ENGINEERS REDMOND, WASHINGTON
Project Name:	UNOCAL W. LAKE & MERCER
Project Number:	161-013-R69
Project Location:	VES
Accession Number:	401195
Project Manager:	NORM PURI
Sampled By:	MAX WILLS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: METHANE

Accession:	401195
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL W. LAKE & MERCER
Project Location:	VES
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

[0] Page 1
Date 26-Jan-94

Accession:	401195
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL W. LAKE & MERCER
Project Location:	VES
Test:	METHANE
Analysis Method:	ASTM D1946
Extraction Method:	N/A
Matrix:	AIR
QC Level:	B

Lab Id:	001		Sample Date/Time:	06-JAN-94 0700
Client Sample Id:	940106		Received Date:	10-JAN-94
Batch: GEA311			Extraction Date:	N/A
Blank: A	Dry Weight %:	N/A	Analysis Date:	20-JAN-94

Parameter:	Units:	Results:	Rpt Lmts:	Q:
METHANE	%	0.12	0.05	
ANALYST	INITIALS	KW		

Comments:

% x 1,000,000 = 1200 ppm

C = .12 %

1200 ppm by Cainy Papadakis on 2/14/94

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"Method Report Summary"

Accession Number: 401195
Client: GEO ENGINEERS
Project Number: 161-013-R69
Project Name: UNOCAL W. LAKE & MERCER
Project Location: VES
Test: METHANE

Client Sample Id:	Parameter:	Unit:	Result:
940106	METHANE	%	0.12

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	401195
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL W. LAKE &
Project Location:	VES
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Accession: 401195
Client: GEO ENGINEERS
Project Number: 161-013-R69
Project Name: UNOCAL W. LAKE &
Project Location: VES
Test: TOTAL VOLATILE HYDROCARBONS IN CANISTER
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A
Matrix: AIR
QC Level: I

Lab Id: 001
Client Sample Id: 940106
Sample Date/Time: 06-JAN-94 0700
Received Date: 10-JAN-94

Batch: CAB004
Blank: A
Dry Weight %: N/A
Extraction Date: N/A
Analysis Date: 11-JAN-94

Parameter:	Units:	Results:	Rpt Lmts:	Q:
TOTAL VOLATILE HYDROCARBONS	MG/M3	ND	500	
ANALYST	INITIALS	LKD		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: METHANE

Accession:	401195
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL W. LAKE & MERCER
Project Location:	VES
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: Air Blank
Batch: GEA311
Analysis Method: ASTM D1946
Extraction Method: N/A

Blank Id: A Date Analyzed: 20-JAN-94 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
METHANE	%	ND	0.05

Comments:
ANALYST: KW

CHECK STANDARD (POST-RUN)
DATE: 1-21-94
METHOD: ASTM D1946

COMPOUND	RF (IC)	RF (CS)	%D	QC LIMIT
CARBON MONOXIDE	1.85E-05	1.84E-05	0.4	15
METHANE	2.05E-05	2.05E-05	0.4	15

SOURCE FOR CONTROL LIMIT IS INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND ASTM D1946.

Common notation for Organic reporting

N/S = NOT SUBMITTED
N/A = NOT APPLICABLE
D = DILUTED OUT
UG = MICROGRAMS
UG/L = PARTS PER BILLION.
UG/KG = PARTS PER BILLION.
MG/M3 = MILLIGRAM PER CUBIC METER.
PPMV = PART PER MILLION BY VOLUME.
MG/KG = PARTS PER MILLION.
MG/L = PARTS PER MILLION.
< = LESS THAN DETECTION LIMIT.
* = VALUES OUTSIDE OF QUALITY CONTROL LIMITS

SOURCES FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND REFERENCED METHOD.

ORGANIC SOILS ARE REPORTED ON A DRYWEIGHT BASIS.

ND = NOT DETECTED ABOVE REPORTING LIMIT.

RPT LIMIT = REPORTING LIMITS BASED ON METHOD DETECTION LIMIT STUDIES.

RPD = RELATIVE PERCENT DIFFERENCE (OR DEVIATION)

ATI/GC/FID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME IONIZATION DETECTOR (FID).

ATI/GC/FIX
ATI GAS CHROMATOGRAPHIC METHOD FOR ANALYSIS OF FIXED GASES EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD) AND FLAME IONIZATION DETECTOR (FID).

ATI/GC/FPD
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME PHOTOMETRIC DETECTOR (FPD) IN SULFUR-SPECIFIC MODE.

ATI/GC/PID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH PHOTOIONIZATION DETECTOR (PID).

ATI/GC/TCD
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD).

LJT = LISA THOMASON
CD = CHRISTY DRAPER
IP = INGRID PITTMAN
RP = ROB PEREZ
SKR = SVETLANA RODKINA
DGH = DARREL HALSELL
KW = KAREN WADSWORTH
PB = PAMELA BREWTON
MV = MONIQUE VERHEYDEN
SW = STEVE WILHITE

Quality Control Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	401195
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL W. LAKE &
Project Location:	VES
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Date 12-Jan-94

"QC Report"

Title: Bag/Can Blank
Batch: CAB004
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A

Blank Id: A Date Analyzed: 11-JAN-94 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
BENZENE	MG/M3	ND	1
ETHYL BENZENE	MG/M3	ND	1
TOLUENE	MG/M3	ND	5
XYLENES	MG/M3	ND	2
TOTAL PETROLEUM HYDROCARBON	MG/M3	ND	500
TRIFLUOROTOLUENE (PID)	%REC/SURR	91	70-130
TRIFLUOROTOLUENE (FID)	%REC/SURR	85	70-130
ANALYST	INITIALS	LKD	

Comments:

"QC Report"

Title: Bag/Can Reagent
Batch: CAB004
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A

RS Date Analyzed: 11-JAN-94
RSD Date Analyzed: 11-JAN-94

RS Date Extracted: N/A
RSD Date Extracted: N/A

Parameters:	Spike Added	Sample Conc	RS Conc	RS %Rec	RSD Conc	RSD %Rec	RPD	RPD Lmts	Rec Lmts
BENZENE	50	<1	46	92	43	86	7	11	82-120
TOLUENE	50	<5	47	94	45	90	4	14	77-125
Surrogates:									
TRIFLUOROTOLUENE (PID)				90		90			70-130

Comments:

Notes:
UNITS IN MG/M3 = MILLIGRAM PER CUBIC METER N/S = NOT SUBMITTED
< = LESS THAN REPORTING LIMIT
SOURCE FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND METHOD REFERENCE.
UNITS IN UG = MICROGRAMS. N/S = NOT SUBMITTED

Common notation for Organic reporting

N/S = NOT SUBMITTED
N/A = NOT APPLICABLE
D = DILUTED OUT
UG/L = PARTS PER BILLION.
UG/KG = PARTS PER BILLION.
MG/KG = PARTS PER MILLION.
MG/L = PARTS PER MILLION.
< = LESS THAN DETECTION LIMIT.
* = VALUES OUTSIDE OF QUALITY CONTROL LIMITS
SOURCES FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND REFERENCED METHOD.
ORGANIC SOILS ARE REPORTED ON A DRY WEIGHT BASIS.
** COMPOUNDS FLAGGED IN METHOD ARE NOT WITHIN THE FIVE POINT CURVE. THEY ARE SEARCHED FOR QUALITATIVELY.
ND = NOT DETECTED ABOVE REPORTING LIMIT.

SR-SHELLEY REAMSMA
MLP-MELISSA POPE
TSH-TRICIA HOLSTON
LKD-LEIGH DUVALL
MM-MIKE MCKENZIE
KWS-KENDALL SMITH
RY-RON YOKUM
KKS-KIMBERLY SMITH
GF-GREG FOOTE
ALM-AMY LEE MILLER
NC-NICOLE CALL
JP-JOSEPH POPE
JENNIFER ALEXANDER
HEATHER BIANCALANA
PAM-PENNY A. MALOUIN
RLE-ROBERT L. ELSPERMAN
MCW-M. CLAUDIA WALTON

PROJECT SAMPLE INSPECTION FORM

Accession #: 401195 Date received: 1/10/94

1.	Was there a Chain of Custody?	(YES)	NO	7.	Are samples correctly preserved for analysis required?	(YES)	NO	
2.	Was Chain of Custody properly relinquished?	(YES)	NO	8.	Is there sufficient volume for analysis requested?	(YES)	NO	
3.	Were samples received cold? (At 4° or on ice)	(YES)	NO	9.	Were samples received within holding time?	(YES)	NO	
4.	Were all containers properly labeled and identified?	(YES)	NO	10.	Was there headspace greater than ¼" in diameter in volatile bottles?	YES	NO	(N/A)
5.	Were samples received in proper containers for analysis requested?	(YES)	NO	11.	If sent, were matrix spike bottles returned?	YES	NO	(N/A)
6.	Were all sample containers received intact?	(YES)	NO					

Tracking Number: 933-DES Shipped By: UPS

Cooler Number: N/S

Out of Control Events and Inspection Comments:

Inspected By: S.F. Date: 1/10/94 Logged By: S.F. 1/11/94 Date: 1/10/94

L. Kitt LK 1/11/94

CHAIN OF CUSTODY

ATI LAB. I.D. # 401195

AnalyticalTechnologies, Inc.
11 EAST OLIVE ROAD PHONE (904) 474-1001
PENSACOLA, FLORIDA 32514

PART 1 — Bottle Shipment Information

CLIENT:	CLIENT PROJECT NUMBER:
Geo Engineers	0161-013-R69

SAMPLE CONTAINERS SHIPPED

	PRESERVATIVE							PLASTIC CONTAINERS								GLASS CONTAINERS										
QTY.	H_2SO_4	HNO3	HCl	Zn ACETATE	$Na_2S_2O_3$	UNPRESERVED	NaOH	4 oz.	8 oz.	16 oz.	32 oz.	½ gallon	1 gallon	Whirl-pak	100-ML-SPECIMEN CUP	120 ml (A)	120 ml (C)	1 liter (A)	1 liter (C)	40 ml Vial	4 oz. wm	8 oz. wm	16 oz. wm	32 oz. wm	DI Trip Blank	GE Summa Canister
1																										AT190

RELINQUISHED	TIME	DATE	RECEIVED	TIME	DATE
[signature]		11/17/93			

PART 2 — Sample Information

SAMPLE MATRIX

DW DRINKINGWATER
WW WASTEWATER
GW GROUNDWATER
SW SURFACEWATER
SO SOIL
OL OIL
AR AIR
SL SLUDGE

PARAMETERS AND PRESERVATIVES

SAMPLE I.D.	DATE	TIME	MATRIX	TOTAL VOLATILE HYDROCARBONS	METHANE								TOTAL	LAB USE ONLY
940106	1/6/94	0700am	Air	X	X								1	

ST.
PHONE
PROJECT N... NORM

TURN
STANDARD - 14
RUSH: (MUST BE APP...
0-48 HOURS - 2 x STD
3-7 DAYS - 1.5 x STD PRI...
TCLP - 1 WEEK RUSH - 1.5...

...RM #11490 — METRO PRINTING, INC., HUNTSVILLE, A...

Analytical**Technologies,**Inc. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

SIGNATURE PAGE

GeoEngineers

AUG 2 6 1993

Routing NLP

File

Reviewed by: _____
ATI Project Manager

Client: GEO ENGINEERS
REDMOND, WASHINGTON

Project Name: WESTLAKE/MERCER
Project Number: 0161-013-R69 T5.1
Project Location: VES
Accession Number: 308168

Project Manager: NORM PURI
Sampled By: MTW/NLP

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: METHANE

Accession:	308168
Client:	GEO ENGINEERS
Project Number:	0161-013-R69 T5.1
Project Name:	WESTLAKE/MERCER
Project Location:	VES
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Accession:	308168
Client:	GEO ENGINEERS
Project Number:	0161-013-R69 T5.1
Project Name:	WESTLAKE/MERCER
Project Location:	VES
Test:	METHANE
Analysis Method:	ATI/GC/FIX
Extraction Method:	N/A
Matrix:	AIR
QC Level:	I

Lab Id:	001	Sample Date/Time:	03-AUG-93 0800
Client Sample Id:	930803-1	Received Date:	05-AUG-93
Batch: GEA239	Dilution Factor: 1	Extraction Date:	N/A
Blank: A	Dry Weight %: N/A	Analysis Date:	23-AUG-93

Parameter:	Units:	Results:	Rpt Lmts:	Q:
METHANE	PPMV	47	5	
ANALYST	INITIALS	RP		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"Method Report Summary"

Accession Number: 308168
Client: GEO ENGINEERS
Project Number: 0161-013-R69 TS.1
Project Name: WESTLAKE/MERCER
Project Location: VES
Test: METHANE

Client Sample Id:	Parameter:	Unit:	Result:
930803-1	METHANE	PPMV	47

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	308168
Client:	GEO ENGINEERS
Project Number:	0161-013-R69 T5.1
Project Name:	WESTLAKE/MERCER
Project Location:	VES
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Date 13-Aug-93

Accession:	308168
Client:	GEO ENGINEERS
Project Number:	0161-013-R69 T5.1
Project Name:	WESTLAKE/MERCER
Project Location:	VES
Test:	TOTAL VOLATILE HYDROCARBONS IN CANISTER
Analysis Method:	5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method:	N/A
Matrix:	AIR
QC Level:	I

Lab Id:	001		Sample Date/Time:	03-AUG-93 0800	
Client Sample Id:	930803-1		Received Date:	05-AUG-93	
Batch: CAB130	Dilution Factor:	1	Extraction Date:	N/A	
Blank: A	Dry Weight %:	N/A	Analysis Date:	11-AUG-93	

Parameter:	Units:	Results:	Rpt Lmts:	Q:
TOTAL VOLATILE HYDROCARBONS	MG/M3	ND	500	
ANALYST	INITIALS	TSH		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: METHANE

Accession:	308168
Client:	GEO ENGINEERS
Project Number:	0161-013-R69 T5.1
Project Name:	WESTLAKE/MERCER
Project Location:	VES
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: Air Blank
Batch: GEA239
Analysis Method: ATI/GC/FIX
Extraction Method: N/A

Blank Id: A Date Analyzed: 23-AUG-93 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
METHANE	PPMV	ND	5

Comments:
ANALYST: ROB PEREZ

"QC Report"

'itle: Air Reagent
:atch: GEA239
.nalysis Method: ATI/GC/FIX
:xtraction Method: N/A

RS Date Analyzed: 23-AUG-93
RSD Date Analyzed: 23-AUG-93

RS Date Extracted: N/A
RSD Date Extracted: N/A

'arameters:	Spike Added	Sample Conc	RS Conc	RS Rec%	RSD Conc	RSD Rec%	Rpd	Rpd Lmts	Rec Lmts
ETHANE	100	<5	99	99	96	96	3	50	50-150

urrogates:

omments:

otes:
PPMV = PARTS PER MILLION PER VOLUME < = LESS THAN REPORTING LIMIT.
* = VALUES OUTSIDE OF QUALITY CONTROL LIMITS.
SOURCE FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND REFERENCE METHOD.
N/S = NOT SUBMITTED N/A = NOT APPLICABLE D = DILUTED OUT

Common notation for Organic reporting

= NOT SUBMITTED
= NOT APPLICABLE
DILUTED OUT
G/L = PARTS PER BILLION.
G/KG = PARTS PER BILLION.
M3 = MILLIGRAM PER CUBIC METER.
V = PART PER MILLION BY VOLUME.
G/KG = PARTS PER MILLION.
G/L = PARTS PER MILLION.
LESS THAN DETECTION LIMIT.
VALUES OUTSIDE OF QUALITY CONTROL LIMITS
RCES FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM
ND REFERENCED METHOD.
GANIC SOILS ARE REPORTED ON A DRYWEIGHT BASIS.
= NOT DETECTED ABOVE REPORTING LIMIT.

TI/GC/FID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME IONIZATION DETECTOR (FID).

/GC/FIX
ATI GAS CHROMATOGRAPHIC METHOD FOR ANALYSIS OF FIXED GASES EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD) AND FLAME IONIZATION DETECTOR (FID).

TI/GC/FPD
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME PHOTOMETRIC DETECTOR (FPD) IN SULFUR-SPECIFIC MODE.

/GC/PID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH PHOTOIONIZATION DETECTOR (PID).

/GC/TCD
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD).

= LISA THOMASON
= CHRISTY DRAPER
= JOE POPE
= INGRID PITTMAN
= ROB PEREZ
= SVETLANA RODKINA
GH = DARREL HALSELL

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	308168
Client:	GEO ENGINEERS
Project Number:	0161-013-R69 T5.1
Project Name:	WESTLAKE/MERCER
Project Location:	VES
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: BAG/CAN BLANK
Batch: CAB130
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A

Blank Id: A Date Analyzed: 11-AUG-93 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
BENZENE	MG/M3	ND	1
ETHYL BENZENE	MG/M3	ND	1
TOLUENE	MG/M3	ND	5
XYLENES	MG/M3	ND	2
TOTAL PETROLEUM HYDROCARBON	MG/M3	ND	500
TRIFLUOROTOLUENE (PID)	%REC/SURR	99	70-130
TRIFLUOROTOLUENE (FID)	%REC/SURR	100	70-130
ANALYST	INITIALS	KWS	

Comments:

"QC Report"

itle: BAG/CAN REAGENT
atch: CAB130
nalysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
xtraction Method: N/A

RS Date Analyzed: 11-AUG-93 RS Date Extracted: N/A
RSD Date Analyzed: 11-AUG-93 RSD Date Extracted: N/A

arameters:	Spike Added	Sample Conc	RS Conc	RS Rec%	RSD Conc	RSD Rec%	Rpd	Rpd Lmts	Rec Lmts
ENZENE	50	<1	50	100	53	106	6	11	82-120
OLUENE	50	<5	52	104	55	110	6	14	77-125
urrogates:									
RIFLUOROTOLUENE (PID)				99		99			70-130

omments:

otes:
UNITS IN MG/M3 = MILLIGRAM PER CUBIC METER N/S = NOT SUBMITTED
< = LESS THAN REPORTING LIMIT
SOURCE FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND METHOD REFERENCE.
UNITS IN UG = MICROGRAMS. N/S = NOT SUBMITTED

Common notation for Organic reporting

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= NOT APPLICABLE
DILUTED OUT
G/L = PARTS PER BILLION.
G/KG = PARTS PER BILLION.
KG = PARTS PER MILLION.
L = PARTS PER MILLION.
= LESS THAN DETECTION LIMIT.
= VALUES OUTSIDE OF QUALITY CONTROL LIMITS
RCES FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM
REFERENCED METHOD.
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E SEARCHED FOR QUALITATIVELY.
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/GC/PID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH PHOTOIONIZATION DETECTOR (PID).

/GC/TCD
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD).

SHELLEY REAMSMA
-MELISSA POPE
SH-TRICIA HOLSTON
D-LEIGH DUVALL
MIKE MCKENZIE
-KENDALL SMITH
Y-RON YOKUM
KS-KIMBERLY SMITH
GREG FOOTE
DIANNA FOX
-CLAIRE FORNSEL

CHAIN OF CUSTODY

ATI LAB. I.D. # 308168

Analytical Technologies, Inc.
11 EAST OLIVE ROAD
PENSACOLA, FLORIDA 32514
PHONE (904) 474-1001

PART 1 — Bottle Shipment Information

CLIENT: GeoEngineers

CLIENT PROJECT NUMBER: 161-013-R69 T5.1

	PRESERVATIVE							PLASTIC CONTAINERS								GLASS CONTAINERS												
SAMPLE CONTAINERS SHIPPED	H_2SO_4	HNO_3	HCl	Zn ACETATE	$Na_2S_2O_3$	UNPRESERVED	NaOH	4 oz.	8 oz.	16 oz.	32 oz.	½ gallon	1 gallon	Whirl-pak	100-ML SPECIMEN CUP	120 ml (A)	120 ml (C)	1 liter (A)	1 liter (C)	40 ml Vial	4 oz. wm	8 oz. wm	16 oz. wm	32 oz. wm	DI Trip Blank	EL Summa Canister	
QTY.																												
1																											✓	ATOO4

RELINQUISHED	TIME	DATE	RECEIVED	TIME	DATE
Lynne Y. Wilcox	1510	7-30-93			

PART 2 — Sample Information

SAMPLE MATRIX

W DRINKINGWATER
.W WASTEWATER
GW GROUNDWATER
W SURFACEWATER
O SOIL
OL OIL
AR AIR
SL SLUDGE

PARAMETERS AND PRESERVATIVES

SAMPLE I.D.	DATE	TIME	MATRIX	TOTAL VOLATILE HYDROCARBONS	METHANE (GC)									TOTAL	LAB USE ONLY
930803-1	8/3/93	0800	AIR	X	X									1	

Analytical**Technologies,**Inc. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

SIGNATURE PAGE

Reviewed by: Cathy Papadellis
ATI Project Manager

Client:	GEO ENGINEERS REDMOND, WASHINGTON
Project Name:	UNOCAL
Project Number:	161-013-R69
Project Location:	N/S
Accession Number:	309582
Project Manager:	NORM PURI
Sampled By:	MTW

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: METHANE

Accession:	309582
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL
Project Location:	N/S
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Date 22-Sep-93

Accession:	309582
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL
Project Location:	N/S
Test:	METHANE
Analysis Method:	ATI SOP 640
Extraction Method:	N/A
Matrix:	AIR
QC Level:	B

Lab Id:	001	Sample Date/Time:	15-SEP-93 0900
Client Sample Id:	930915-1	Received Date:	17-SEP-93
Batch: GEA262		Extraction Date:	N/A
Blank: A	Dry Weight %: N/A	Analysis Date:	21-SEP-93

Parameter:	Units:	Results:	Rpt Lmts:	Q:
METHANE	PPMV	21	10	
ANALYST	INITIALS	RP		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"Method Report Summary"

Accession Number: 309582
Client: GEO ENGINEERS
Project Number: 161-013-R69
Project Name: UNOCAL
Project Location: N/S
Test: METHANE

Client Sample Id:	Parameter:	Unit:	Result:
930915-1	METHANE	PPMV	21

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	309582
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL
Project Location:	N/S
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Accession: 309582
Client: GEO ENGINEERS
Project Number: 161-013-R69
Project Name: UNOCAL
Project Location: N/S
Test: TOTAL VOLATILE HYDROCARBONS IN CANISTER
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A
Matrix: AIR
QC Level: I

Lab Id: 001 Sample Date/Time: 15-SEP-93 0900
Client Sample Id: 930915-1 Received Date: 17-SEP-93

Batch: CAB156 Extraction Date: N/A
Blank: B Dry Weight %: N/A Analysis Date: 21-SEP-93

Parameter:	Units:	Results:	Rpt Lmts:	Q:
TOTAL VOLATILE HYDROCARBONS	MG/M3	ND	500	
ANALYST	INITIALS	TSH		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: METHANE

Accession:	309582
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL
Project Location:	N/S
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: Air Blank
Batch: GEA262
Analysis Method: ATI SOP 640
Extraction Method: N/A

Blank Id: A Date Analyzed: 21-SEP-93 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
METHANE	PPMV	ND	5

Comments:
ANALYST: ROB PEREZ

Common notation for Organic reporting

/S = NOT SUBMITTED
/A = NOT APPLICABLE
= DILUTED OUT
G/L = PARTS PER BILLION.
G/KG = PARTS PER BILLION.
G/M3 = MILLIGRAM PER CUBIC METER.
PMV = PART PER MILLION BY VOLUME.
G/KG = PARTS PER MILLION.
G/L = PARTS PER MILLION.
= LESS THAN DETECTION LIMIT.
= VALUES OUTSIDE OF QUALITY CONTROL LIMITS
OURCES FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM
ND REFERENCED METHOD.
RGANIC SOILS ARE REPORTED ON A DRYWEIGHT BASIS.
= NOT DETECTED ABOVE REPORTING LIMIT.

TI/GC/FID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME IONIZATION DETECTOR (FID).

TI/GC/FIX
ATI GAS CHROMATOGRAPHIC METHOD FOR ANALYSIS OF FIXED GASES EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD) AND FLAME IONIZATION DETECTOR (FID).

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JT = LISA THOMASON
D = CHRISTY DRAPER
P = JOE POPE
P = INGRID PITTMAN
P = ROB PEREZ
KR = SVETLANA RODKINA
GH = DARREL HALSELL

INDEPENDANT QC CHECK STANDARD

DATE: 9/21/93 CC STANDARD ID: 01-FGS-6-3
BATCH: GEA262 IQC STANDARD ID: 01-FGS-7-1

COMPOUND NAME	RF (CC)	RF (IQC)	%D	QC LIMIT
METHANE	2.52E-04	2.66E-04	5.6	15

PARENT SOURCE:

01-FGS-6-3:SCOTT SPECIALTY GASES, CAN MIX 234, LOT#4-A-KC-5-17-93

01-FGS-7-1:AIR PRODUCTS, METHANE PRIMARY STANDARD, LOT#07334

SOURCE FOR CONTROL LIMIT IS INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND ATI SOP 640.

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	309582
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNOCAL
Project Location:	N/S
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: Bag/Can Blank
Batch: CAB156
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A

Blank Id: B Date Analyzed: 21-SEP-93 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
BENZENE	MG/M3	ND	1
ETHYL BENZENE	MG/M3	ND	1
TOLUENE	MG/M3	ND	5
XYLENES	MG/M3	ND	2
TOTAL PETROLEUM HYDROCARBON	MG/M3	ND	500
TRIFLUOROTOLUENE (PID)	%REC/SURR	99	70-130
TRIFLUOROTOLUENE (FID)	%REC/SURR	99	70-130
ANALYST	INITIALS	GF	

Comments:

"QC Report"

'itle: BAG/CAN REAGENT
;atch: CAB156
,nalysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
:xtraction Method: N/A

RS Date Analyzed: 20-SEP-93 RS Date Extracted: N/A
RSD Date Analyzed: 20-SEP-93 RSD Date Extracted: N/A

'arameters:	Spike Added	Sample Conc	RS Conc	RS %Rec	RSD Conc	RSD %Rec	RPD	RPD Lmts	Rec Lmts
;ENZENE	50	<1	45	90	41	82	9	11	82-120
'OLUENE	50	<5	46	92	42	84	9	14	77-125
;urrogates:									
'RIFLUOROTOLUENE (PID)				97		96			70-130

:omments:

iotes:
UNITS IN MG/M3 = MILLIGRAM PER CUBIC METER N/S = NOT SUBMITTED
< = LESS THAN REPORTING LIMIT
SOURCE FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND METHOD REFERENCE.
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KG = PARTS PER MILLION.
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* COMPOUNDS FLAGGED IN METHOD ARE NOT WITHIN THE FIVE POINT CURVE. THEY
E SEARCHED FOR QUALITATIVELY.
= NOT DETECTED ABOVE REPORTING LIMIT.

-SHELLEY REAMSMA
P-MELISSA POPE
-TRICIA HOLSTON
-LEIGH DUVALL
MIKE MCKENZIE
S-KENDALL SMITH
-RON YOKUM
-KIMBERLY SMITH
GREG FOOTE
F-CLAIRE FORNSEL
M-AMY LEE MILLER
NICOLE CALL
JOSEPH POPE

Analytical Technologies, Inc.

PROJECT SAMPLE INSPECTION FORM

Accession #: 309582 Date received: 17-SEP-93

1.	Was there a Chain of Custody?	(YES) NO	7.	Are samples correctly preserved for analysis required?	(YES) NO	
2.	Was Chain of Custody properly relinquished?	(YES) NO	8.	Is there sufficient volume for analysis requested?	(YES) NO	
3.	Were samples received cold?	(YES) NO	9.	Were samples received within holding time?	(YES) NO	
4.	Were all containers properly labeled and identified?	(YES) NO	10.	Was there headspace greater than ¼" in diameter in volatile bottles?	YES NO	(N/A)
5.	Were samples received in proper containers for analysis requested?	(YES) NO	11.	If sent, were matrix spike bottles returned?	YES NO	(N/A)
6.	Were all sample containers received intact?	(YES) NO				

Tracking Number: 1Z9330F50100000380 Shipped By: UPS

Cooler Number: N/A

Out of Control Events and Inspection Comments:

Inspected By: [signature] Date: 9/18/93 Logged By: [signature] Date: 9/18/93

HAIN OF CUSTODY

LAB. I.D. # 309582

AnalyticalTechnologies,Inc.
11 EAST OLIVE ROAD, PENSACOLA, FLORIDA 32514
PHONE (904) 474-1001

RT 1 — Bottle Shipment Information

IENT: Geoengineers	CLIENT PROJECT NUMBER: 161-013-R69

PRESERVATIVE: H_2SO_4, HNO_3, HCl, Zn ACETATE, $Na_2S_2O_3$, UNPRESERVED, NaOH
PLASTIC CONTAINERS: 4 oz., 8 oz., 16 oz., 32 oz., ½ gallon, 1 gallon, Whirl-pak, 100-ML SPECIMEN CUP
GLASS CONTAINERS: 120 ml (A), 120 ml (C), 1 liter (A), 1 liter (C), 40 ml Vial, 4 oz. wm, 8 oz. wm, 16 oz. wm, 32 oz. wm, DI Trip Blank, 6L Summa Canister

AMPLE INERS PPED / QTY.	H_2SO_4	HNO_3	HCl	Zn ACETATE	$Na_2S_2O_3$	UNPRESERVED	NaOH	4 oz.	8 oz.	16 oz.	32 oz.	½ gallon	1 gallon	Whirl-pak	100-ML SPECIMEN CUP	120 ml (A)	120 ml (C)	1 liter (A)	1 liter (C)	40 ml Vial	4 oz. wm	8 oz. wm	16 oz. wm	32 oz. wm	DI Trip Blank	6L Summa Canister
																										ATI65

ELINQUISHED	TIME	DATE	RECEIVED	TIME	DATE
L.G. Wilson Jr.	1445	8-R-93			

ART 2 — Sample Information — **PARAMETERS AND PRESERVATIVES**

SAMPLE MATRIX
DRINKINGWATER — OL OIL
WASTEWATER — AR AIR
GROUNDWATER — SL SLUDGE
W SURFACEWATER
O SOIL

SAMPLE I.D.	DATE	TIME	MATRIX	METHANE	TVH									TOTAL	LAB USE ONLY
130915-1	9/15/93	0900	AIR	X	X									1	

TOTAL NUMBER OF BOTTLES/CONTAINERS 1

INQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
MTW MAX WILLS	09/15	1900	Anita Johnson	9/17/93	1000

NT GEOENGINEERS
ESS 8410 154th AVENE
REDMOND
ATE WA ZIP 98052
E NO. 206 861-6000
ECT MANAGER (person to receive data) NORM PURI

PROJECT NUMBER 161-013-R69
PROJECT NAME UNOCAL
SAMPLED BY MTW
SAMPLE SITE
PURCHASE ORDER NUMBER

REQUEST FAX DATA BY ______ (FAX #)
REQUEST VERBAL RESULTS BY ______ (DATE)
NEED DATA PACKAGE BY ______ (DATE)
QUALITY CONTROL REPORTING LEVEL (circle one)
NONE 1 2 3 4
NEED ______ EXTRA COPIES OF REPORT

TURN AROUND TIMES (check one)
STANDARD - 14 TO 21 DAYS — X
RUSH: (MUST BE APPROVED IN ADVANCE)
0-48 HOURS - 2 x STD PRICE ☐
3-7 DAYS - 1.5 x STD PRICE ☐
TCLP - 1 WEEK RUSH - 1.5 x STD PRICE ☐

SPECIAL INSTRUCTIONS:
ANALYZE FOR METHAN AND TVH ONLY. STANDARD TAT

SIGNATURE PAGE

Reviewed by: _____
ATI Project Manager

GeoEngineers

NOV 12 1993

Routing

File

Client: GEO ENGINEERS
REDMOND, WASHINGTON

Project Name: UNOCAL W. LAKE
Project Number: NORM PURI
Project Location: VES 161-013-R69
Accession Number: 310702

Project Manager: NORM PURI
Sampled By: MTW

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	310702
Client:	GEO ENGINEERS
Project Number:	NORM PURI
Project Name:	UNOCAL W. LAKE
Project Location:	VES 161-013-R69
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Accession: 310702
Client: GEO ENGINEERS
Project Number: NORM PURI
Project Name: UNOCAL W. LAKE
Project Location: VES 161-013-R69
Test: TOTAL VOLATILE HYDROCARBONS IN CANISTER
Analysis Method: 8020 / SW 846, 3rd Edition, September 1986 and Revision 1, July 1992
Extraction Method: N/A
Matrix: AIR
QC Level: I

Lab Id: 001
Client Sample Id: 931015-1

Sample Date/Time: 15-OCT-93 0530
Received Date: 26-OCT-93

Batch: ETB135
Blank: C

Dry Weight %: N/A

Extraction Date: N/A
Analysis Date: 29-OCT-93

Parameter:	Units:	Results:	Rpt Lmts:	Q:
TOTAL VOLATILE HYDROCARBONS	MG/M3	ND	500	
ANALYST	INITIALS	RY		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: METHANE

Accession:	310702
Client:	GEO ENGINEERS
Project Number:	NORM PURI
Project Name:	UNOCAL W. LAKE
Project Location:	VES 161-013-R69
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Accession: 310702
Client: GEO ENGINEERS
Project Number: NORM PURI
Project Name: UNOCAL W. LAKE
Project Location: VES 161-013-R69
Test: METHANE
Analysis Method: ATI SOP 640
Extraction Method: N/A
Matrix: AIR
QC Level: N

Lab Id: 001
Client Sample Id: 931015-1

Sample Date/Time: 15-OCT-93 0530
Received Date: 26-OCT-93

Batch: GEA284
Blank: A

Dry Weight %: N/A

Extraction Date: N/A
Analysis Date: 05-NOV-93

Parameter:	Units:	Results:	Rpt Lmts:	Q:
METHANE	PPMV	80	10	
ANALYST	INITIALS	RP		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"Method Report Summary"

Accession Number: 310702
Client: GEO ENGINEERS
Project Number: NORM PURI
Project Name: UNOCAL W. LAKE
Project Location: VES 161-013-R69
Test: METHANE

Client Sample Id:	Parameter:	Unit:	Result:
931015-1	METHANE	PPMV	80

Common notation for Organic reporting

/S = NOT SUBMITTED
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= DILUTED OUT
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G/M3 = MILLIGRAM PER CUBIC METER.
PMV = PART PER MILLION BY VOLUME.
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ND REFERENCED METHOD.

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D = NOT DETECTED ABOVE REPORTING LIMIT.

PT LIMIT = REPORTING LIMITS BASED ON METHOD DETECTION LIMIT STUDIES.

PD = RELATIVE PERCENT DIFFERENCE (OR DEVIATION)

TI/GC/FID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME IONIZATION DETECTOR (FID).

TI/GC/FIX
ATI GAS CHROMATOGRAPHIC METHOD FOR ANALYSIS OF FIXED GASES EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD) AND FLAME IONIZATION DETECTOR (FID).

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JT = LISA THOMASON
D = CHRISTY DRAPER
P = INGRID PITTMAN
P = ROB PEREZ
KR = SVETLANA RODKINA
GH = DARREL HALSELL
W = KAREN WADSWORTH
B = PAMELA BREWTON

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	310702
Client:	GEO ENGINEERS
Project Number:	NORM PURI
Project Name:	UNOCAL W. LAKE
Project Location:	VES 161-013-R69
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: Bag/Can Blank
Batch: ETB135
Analysis Method: 8020 / SW 846, 3rd Edition, September 1986 and Revision 1, July 1992
Extraction Method: N/A

Blank Id: C Date Analyzed: 29-OCT-93 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
BENZENE	MG/M3	ND	1
ETHYL BENZENE	MG/M3	ND	1
TOLUENE	MG/M3	ND	5
XYLENES	MG/M3	ND	2
TOTAL PETROLEUM HYDROCARBON	MG/M3	ND	500
TRIFLUOROTOLUENE (PID)	%REC/SURR	98	70-130
TRIFLUOROTOLUENE (FID)	%REC/SURR	99	70-130
ANALYST	INITIALS	GF	

Comments:

"QC Report"

itle: Bag/Can Reagent
atch: ETB135
lysis Method: 8020 / SW 846, 3rd Edition, September 1986 and Revision 1, July 1992
raction Method: N/A

RS Date Analyzed: 27-OCT-93
RSD Date Analyzed: 27-OCT-93

RS Date Extracted: N/A
RSD Date Extracted: N/A

arameters:	Spike Added	Sample Conc	RS Conc	RS %Rec	RSD Conc	RSD %Rec	RPD	RPD Lmts	Rec Lmts
ZENE	50	<1	43	86	41	82	5	11	82-120
UENE	50	<5	45	90	42	84	7	14	77-125
urrogates:									
FLUOROTOLUENE (PID)				99		96			70-130

mments:

otes:
UNITS IN MG/M3 = MILLIGRAM PER CUBIC METER N/S = NOT SUBMITTED
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R-SHELLEY REAMSMA
LP-MELISSA POPE
SH-TRICIA HOLSTON
KD-LEIGH DUVALL
M-MIKE MCKENZIE
WS-KENDALL SMITH
Y-RON YOKUM
KS-KIMBERLY SMITH
F-GREG FOOTE
EF-CLAIRE FORNSEL
LM-AMY LEE MILLER
C-NICOLE CALL
-JOSEPH POPE

ANLYTICAL TECHNOLOGIES, INC. 11 East Olive Rd. Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: FIXED GASES AND METHANE

CHECK STANDARD (POST-RUN)
DATE: 11-05-93
METHOD: ATI SOP 640

COMPOUND	RF (CC)	RF (CS)	%D	QC LIMIT
METHANE	7.00E-02	7.10E-02	1.4	15

SOURCE FOR CONTROL LIMIT IS INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND ATI SOP 640.

Analytical**Technologies,** Inc. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

SIGNATURE PAGE

Reviewed by: _____
ATI Project Manager

Client:	GEO ENGINEERS REDMOND, WASHINGTON
Project Name:	UNICAL WESTLAKE AND MERCER
Project Number:	161-013-R69
Project Location:	UNICAL WESTLAKE AND MERCER
Accession Number:	403499
Project Manager:	NORM PURI
Sampled By:	AWM

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: METHANE

Accession:	403499
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNICAL WESTLAKE AND MERCER
Project Location:	UNICAL WESTLAKE AND MERCER
Department:	SEMI-VOLATILE FUELS

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Date 30-Mar-94

Accession:	403499
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNICAL WESTLAKE AND MERCER
Project Location:	UNICAL WESTLAKE AND MERCER
Test:	METHANE
Analysis Method:	ASTM D1946
Extraction Method:	N/A
Matrix:	AIR
QC Level:	N

Lab Id:	001		Sample Date/Time:	09-MAR-94 0710
Client Sample Id:	940309-1		Received Date:	18-MAR-94
Batch: GEA041			Extraction Date:	N/A
Blank: A	Dry Weight %:	N/A	Analysis Date:	28-MAR-94

Parameter:	Units:	Results:	Rpt Lmts:	Q:
METHANE	%	ND	0.05	
ANALYST	INITIALS	KW		

Comments:

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UG/KG = PARTS PER BILLION.
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RPD = RELATIVE PERCENT DIFFERENCE (OR DEVIATION)

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ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME IONIZATION DETECTOR (FID).

ATI/GC/FIX
ATI GAS CHROMATOGRAPHIC METHOD FOR ANALYSIS OF FIXED GASES EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD) AND FLAME IONIZATION DETECTOR (FID).

ATI/GC/FPD
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH FLAME PHOTOMETRIC DETECTOR (FPD) IN SULFUR-SPECIFIC MODE.

ATI/GC/PID
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH PHOTOIONIZATION DETECTOR (PID).

ATI/GC/TCD
ATI GAS CHROMATOGRAPHIC METHOD EMPLOYING DIRECT INJECTION ON COLUMN WITH THERMAL CONDUCTIVITY DETECTOR (TCD).

LJT = LISA THOMASON
CD = CHRISTY DRAPER
IP = INGRID PITTMAN
RP = ROB PEREZ
SKR = SVETLANA RODKINA
DGH = DARREL HALSELL
KW = KAREN WADSWORTH
PB = PAMELA BREWTON
MV = MONIQUE VERHEYDEN
SW = STEVE WILHITE
DC = DAVID CELESTIAL

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Analysis Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	403499
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNICAL WESTLAKE AND MERCER
Project Location:	UNICAL WESTLAKE AND MERCER
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Date 24-Mar-94

Accession:	403499
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNICAL WESTLAKE AND MERCER
Project Location:	UNICAL WESTLAKE AND MERCER
Test:	TOTAL VOLATILE HYDROCARBONS IN CANISTER
Analysis Method:	5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method:	N/A
Matrix:	AIR
QC Level:	I

Lab Id:	001		Sample Date/Time:	09-MAR-94 0710
Client Sample Id:	940309-1		Received Date:	18-MAR-94
Batch: ETB056			Extraction Date:	N/A
Blank: A	Dry Weight %:	N/A	Analysis Date:	21-MAR-94

Parameter:	Units:	Results:	Rpt Lmts:	Q:
TOTAL VOLATILE HYDROCARBONS	MG/M3	ND	500	
ANALYST	INITIALS	KKS		

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 EAST OLIVE ROAD PENSACOLA, FLORIDA 32514

QUALITY CONTROL REPORT

ANALYSIS: METHANE PLUS FIXED GASES

ACCESSION:	403499
CLIENT:	GEO ENGINEERS
PROJECT NUMBER:	161-013-R69
PROJECT NAME:	UNICAL WESTLAKE AND MERCER
PROJECT LOCATION:	UNICAL WESTLAKE AND MERCER
DEPARTMENT:	SEMI-VOLATILE FUELS

NITROGEN BLANK ANALYSIS

DATE: 3-28-94

METHOD: ASTM D1946

BATCH: GEA041

COMPOUND	UNITS	REPORTING LIMIT	RESULT
METHANE	VOLUME %	0.05	ND

CHECK STANDARD (POST-RUN)

DATE: 3-28-94

METHOD: ASTM D1946

BATCH: GEA041

COMPOUND	RF (IC)	RF (PS)	%D	QC LIMITS
METHANE	1.98 E-5	1.99 E-5	0.51	15

SOURCE FOR CONTROL LIMIT IS INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND ASTM D1946.

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

Quality Control Report

Analysis: TOTAL VOLATILE HYDROCARBONS IN CANISTER

Accession:	403499
Client:	GEO ENGINEERS
Project Number:	161-013-R69
Project Name:	UNICAL WESTLAKE AND MERCER
Project Location:	UNICAL WESTLAKE AND MERCER
Department:	GC/VOA

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: Bag/Can Blank
Batch: ETB056
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A

Blank Id: A Date Analyzed: 21-MAR-94 Date Extracted: N/A

Parameters:	Units:	Results:	Reporting Limits:
BENZENE	MG/M3	ND	1
ETHYL BENZENE	MG/M3	ND	1
TOLUENE	MG/M3	ND	5
XYLENES	MG/M3	ND	2
TOTAL PETROLEUM HYDROCARBON	MG/M3	ND	500
TRIFLUOROTOLUENE (PID)	%REC/SURR	103	70-130
TRIFLUOROTOLUENE (FID)	%REC/SURR	107	70-130
ANALYST	INITIALS	LKD	

Comments:

ANALYTICAL TECHNOLOGIES, INC. 11 East Olive Road Pensacola, Florida 32514 (904) 474-1001

"QC Report"

Title: Bag/Can Reagent
Batch: ETB056
Analysis Method: 5030/8020/8015 / SW 846, 3rd Edition, Sep. 1986 and Rev. 1, July 1992
Extraction Method: N/A

RS Date Analyzed: 21-MAR-94
RSD Date Analyzed: 21-MAR-94

RS Date Extracted: N/A
RSD Date Extracted: N/A

Parameters:	Spike Added	Sample Conc	RS Conc	RS %Rec	RSD Conc	RSD %Rec	RPD	RPD Lmts	Rec Lmts
BENZENE	50	<1	48	96	49	98	2	11	82-120
TOLUENE	50	<5	48	96	49	98	2	14	77-125
Surrogates:									
TRIFLUOROTOLUENE (PID)				98		99			70-130

Comments:

Notes:
UNITS IN MG/M3 = MILLIGRAM PER CUBIC METER N/S = NOT SUBMITTED
< = LESS THAN REPORTING LIMIT
SOURCE FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM AND METHOD REFERENCE.
UNITS IN UG = MICROGRAMS. N/S = NOT SUBMITTED

Common notation for Organic reporting

[illegible]/S = NOT SUBMITTED
[illegible]/A = NOT APPLICABLE
[illegible] = DILUTED OUT
UG/L = PARTS PER BILLION.
UG/KG = PARTS PER BILLION.
[illegible]G/KG = PARTS PER MILLION.
[illegible]G/L = PARTS PER MILLION.
< = LESS THAN DETECTION LIMIT.
* = VALUES OUTSIDE OF QUALITY CONTROL LIMITS
[illegible]OURCES FOR CONTROL LIMITS ARE INTERNAL LABORATORY QUALITY ASSURANCE PROGRAM
[illegible]ND REFERENCED METHOD.
[illegible]RGANIC SOILS ARE REPORTED ON A DRY WEIGHT BASIS.
** COMPOUNDS FLAGGED IN METHOD ARE NOT WITHIN THE FIVE POINT CURVE. THEY
[illegible]RE SEARCHED FOR QUALITATIVELY.
[illegible]D = NOT DETECTED ABOVE REPORTING LIMIT.

SR-SHELLEY REAMSMA
MLP-MELISSA POPE
[illegible]SH-TRICIA HOLSTON
[illegible]KD-LEIGH DUVALL
[illegible]M-MIKE MCKENZIE
KWS-KENDALL SMITH
[illegible]KS-KIMBERLY SMITH
[illegible]F-GREG FOOTE
[illegible]C-NICOLE CALL
JP-JOSEPH POPE
JA-JENNIFER ALEXANDER
[illegible]B-HEATHER BIANCALANA
[illegible]AM-PENNY A. MALOUIN
MCW-MARIE CLAUDIA WALTON
SB-SHARON BRADDOCK

PROJECT SAMPLE INSPECTION FORM

Accession #: 403494 Date received: 18-MAR-94

1.	Was there a Chain of Custody?	YES	NO	7.	Are samples correctly preserved for analysis required?	YES	NO
2.	Was Chain of Custody properly relinquished?	YES	NO	8.	Is there sufficient volume for analysis requested?	YES	NO
3.	Were samples received cold? (At 4° or on ice)	YES	NO	9.	Were samples received within holding time?	YES	NO
4.	Were all containers properly labeled and identified?	YES	NO	10.	Was there headspace greater than ¼" in diameter in volatile bottles?	YES	NO N/A
5.	Were samples received in proper containers for analysis requested?	YES	NO	11.	If sent, were matrix spike bottles returned?	YES	NO N/A
6.	Were all sample containers received intact?	YES	NO				

Tracking Number: NIS Shipped By: HD

Cooler Number: NIS

Out of Control Events and Inspection Comments:

Inspected By: DRB Date: 3-16-94 Logged By: DRB Date: 3-18-94

CHAIN OF CUSTODY RECORD

GEOENGINEERS, INC.
8410 154TH AVENUE N.E.
REDMOND, WASHINGTON 98052
(206) 861-6000

Geo Engineers

DATE 3/9/94
PAGE 1 OF 1
LAB ATI Puget
LAB NO.

PROJECT NAME/LOCATION Unocal Westlake and Mercer
PROJECT NUMBER 161-013-R69
PROJECT MANAGER Norm Puri
SAMPLED BY AWM

SAMPLE IDENTIFICATION		SAMPLE COLLECTION			# OF	ANALYSIS REQUIRED			NOTES/COMMENTS
LAB	GEOENGINEERS	DATE	TIME	MATRIX	JARS	TVH	Me. Hexane		(Preserved, filtered, etc.)
	940309-1	3/9/94	0710	Air	1	X	X		No BETX necessary

RELINQUISHED BY	FIRM GET	RELINQUISHED BY	FIRM	RELINQUISHED BY	FIRM
SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED NAME Norman Puri		PRINTED NAME		PRINTED NAME	
DATE 3/9/94	TIME 1300	DATE	TIME	DATE	TIME
RECEIVED BY	FIRM ATI	RECEIVED BY	FIRM	RECEIVED BY	FIRM
SIGNATURE David R Baer II		SIGNATURE		SIGNATURE	
PRINTED NAME David R Baer II		PRINTED NAME		PRINTED NAME	
DATE 3-15-94	TIME 1731	DATE	TIME	DATE	TIME

ADDITIONAL COMMENTS:

Analytical Technologies, Inc.
560 Naches Avenue, S.W., Suite 101, Renton, WA 98055 (206) 228-8335
Karen L. Mixon, Laboratory Manager

ATI I.D. # 9310-154

November 8, 1993

GeoEngineers
NOV 09 1993
Routing
File

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond WA 98052

Attention : Norm Puri

Project Number : 0161-013-R04

Project Name : Unocal - WL&M

Dear Mr. Puri:

On October 18, 1993, Analytical Technologies, Inc. (ATI), received two samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Sincerely,

Elaine M. Walker

Elaine M. Walker
Project Manager

EMW/hal/elf

Enclosure

Analytical Technologies, Inc.

ATI I.D. # 9310-154

SAMPLE CROSS REFERENCE SHEET

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

ATI #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
9310-154-1	MW-2	10/15/93	PRODUCT
9310-154-2	COMPOSITE DRUM	10/15/93	WATER

----- TOTALS -----

MATRIX	# SAMPLES
PRODUCT	1
WATER	1

ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of the report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

ANALYTICAL SCHEDULE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

ANALYSIS	TECHNIQUE	REFERENCE	LAB
PURGEABLE HALOCARBONS	GC/ELCD	EPA 8010	R
BETX	GC/PID	EPA 8020	R
TOTAL PETROLEUM HYDROCARBONS	GC/FID	WA DOE WTPH-G	R
TOTAL PETROLEUM HYDROCARBONS	GC/FID	WA DOE WTPH-D	R
OIL & GREASE	IR	EPA 413.2	R
LEAD	AA/GF	EPA 7421	R

R = ATI - Renton
SD = ATI - San Diego
PHX = ATI - Phoenix
PNR = ATI - Pensacola
FC = ATI - Fort Collins
JB = Subcontract

Analytical Technologies, Inc.

ATI I.D. # 9310-154

CASE NARRATIVE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

CASE NARRATIVE: VOLATILE ORGANICS ANALYSIS

One (1) sample was received by ATI on October 18, 1993, for the following analysis: EPA method 8010.

All corresponding quality assurance and quality control results defined as blank spike/blank spike duplicate (BS/BSD), method blank and surrogate recoveries were within the ATI established control limits.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R04	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/25/93
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/25/93
SAMPLE MATRIX	: PRODUCT	UNITS	: mg/Kg
EPA METHOD	: 8010	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BROMODICHLOROMETHANE	<0.10
BROMOFORM	<0.10
BROMOMETHANE	<0.50
CARBON TETRACHLORIDE	<0.10
CHLOROBENZENE	<0.25
CHLOROETHANE	<0.50
CHLOROFORM	<0.10
CHLOROMETHANE	<1.0
1,2-DIBROMOETHANE (EDB)	<0.25
1,2-DICHLOROBENZENE	<0.25
1,3-DICHLOROBENZENE	<0.25
1,4-DICHLOROBENZENE	<0.25
DIBROMOCHLOROMETHANE	<0.10
1,1-DICHLOROETHANE	<0.10
1,2-DICHLOROETHANE	<0.10
1,1-DICHLOROETHENE	<0.10
CIS-1,2-DICHLOROETHENE	<0.10
TRANS-1,2-DICHLOROETHENE	<0.10
1,2-DICHLOROPROPANE	<0.10
CIS-1,3-DICHLOROPROPENE	<0.10
TRANS-1,3-DICHLOROPROPENE	<0.10
METHYLENE CHLORIDE	<1.0
1,1,2,2-TETRACHLOROETHANE	<0.10
TETRACHLOROETHENE	<0.10
1,1,1-TRICHLOROETHANE	<0.10
1,1,2-TRICHLOROETHANE	<0.10
TRICHLOROETHENE	<0.10
TRICHLOROFLUOROMETHANE	<0.25
VINYL CHLORIDE	<0.50

SURROGATE PERCENT RECOVERY		LIMITS
BROMOCHLOROMETHANE	86	38 - 140

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-154-1

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/15/93
PROJECT #	: 0161-013-R04	DATE RECEIVED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/25/93
CLIENT I.D.	: MW-2	DATE ANALYZED	: 10/26/93
SAMPLE MATRIX	: PRODUCT	UNITS	: mg/Kg
EPA METHOD	: 8010	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BROMODICHLOROMETHANE	<0.10
BROMOFORM	<0.10
BROMOMETHANE	<0.50
CARBON TETRACHLORIDE	<0.10
CHLOROBENZENE	<0.25
CHLOROETHANE	<0.50
CHLOROFORM	<0.10
CHLOROMETHANE	<1.0
1,2-DIBROMOETHANE (EDB)	<0.25
1,2-DICHLOROBENZENE	<0.25
1,3-DICHLOROBENZENE	<0.25
1,4-DICHLOROBENZENE	<0.25
DIBROMOCHLOROMETHANE	<0.10
1,1-DICHLOROETHANE	<0.10
1,2-DICHLOROETHANE	<0.10
1,1-DICHLOROETHENE	<0.10
CIS-1,2-DICHLOROETHENE	<0.10
TRANS-1,2-DICHLOROETHENE	<0.10
1,2-DICHLOROPROPANE	<0.10
CIS-1,3-DICHLOROPROPENE	<0.10
TRANS-1,3-DICHLOROPROPENE	<0.10
METHYLENE CHLORIDE	<1.0
1,1,2,2-TETRACHLOROETHANE	<0.10
TETRACHLOROETHENE	<0.10
1,1,1-TRICHLOROETHANE	<0.10
1,1,2-TRICHLOROETHANE	<0.10
TRICHLOROETHENE	<0.10
TRICHLOROFLUOROMETHANE	<0.25
VINYL CHLORIDE	<0.50

SURROGATE PERCENT RECOVERY		LIMITS
BROMOCHLOROMETHANE	79	38 - 140

Analytical Technologies, Inc.

ATI I.D. # 9310-154

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : PRODUCT
EPA METHOD : 8010

SAMPLE I.D. # : BLANK
DATE EXTRACTED : 10/25/93
DATE ANALYZED : 10/25/93
UNITS : mg/Kg

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
CHLOROBENZENE	<0.250	4.00	4.16	104	4.55	114	9
1,1-DICHLOROETHENE	<0.100	4.00	4.08	102	4.34	109	6
TRICHLOROETHENE	<0.100	4.00	4.01	100	4.33	108	8

CONTROL LIMITS	% REC.	RPD
CHLOROBENZENE	71 - 163	20
1,1-DICHLOROETHENE	30 - 161	22
TRICHLOROETHENE	55 - 146	24

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOCHLOROMETHANE	90	93	38 - 140

Analytical Technologies, Inc.

ATI I.D. # 9310-154

CASE NARRATIVE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

CASE NARRATIVE : BETX - GASOLINE ANALYSIS

Two (2) samples were received by ATI on October 18, 1993, for BETX analysis according to EPA method 8020 and gasoline range hydrocarbons according to WA DOE WTPH-G.

The surrogate recovery of bromofluorobenzene for sample 9310-154-2 (COMPOSITE DRUM) was outside of the ATI established control limits due to matrix interference.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R04	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/18/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BENZENE	<0.5
ETHYLBENZENE	<0.5
TOLUENE	<0.5
TOTAL XYLENES	<0.5
FUEL HYDROCARBONS	<100
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	111	76 - 120
TRIFLUOROTOLUENE	102	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-154

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R04	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/19/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BENZENE	<0.5
ETHYLBENZENE	<0.5
TOLUENE	<0.5
TOTAL XYLENES	<0.5
FUEL HYDROCARBONS	<100
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	109	76 - 120
TRIFLUOROTOLUENE	102	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-154

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R04	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/20/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BENZENE	<0.5
ETHYLBENZENE	<0.5
TOLUENE	<0.5
TOTAL XYLENES	<0.5
FUEL HYDROCARBONS	<100
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	110	76 - 120
TRIFLUOROTOLUENE	102	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-154-1

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/15/93
PROJECT #	: 0161-013-R04	DATE RECEIVED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: MW-2	DATE ANALYZED	: 10/20/93
SAMPLE MATRIX	: PRODUCT	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 50

COMPOUNDS	RESULTS
BENZENE	1300
ETHYLBENZENE	310
TOLUENE	1700
TOTAL XYLENES	4100
FUEL HYDROCARBONS	50000
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	112	76 - 120
TRIFLUOROTOLUENE	99	50 - 150

AnalyticalTechnologies, Inc.

ATI I.D. # 9310-154-2

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/15/93
PROJECT #	: 0161-013-R04	DATE RECEIVED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: COMPOSITE DRUM	DATE ANALYZED	: 10/20/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS	
BENZENE	<0.5	
ETHYLBENZENE	1.5	
TOLUENE	1.8	
TOTAL XYLENES	480	D5

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	157 F	76 - 120

D5 = Value from a twenty fold diluted analysis.
F = Out of limits due to matrix interference.

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-154

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : WATER
METHOD : WA DOE WTPH-G/8020(BETX)

SAMPLE I.D. # : BLANK
DATE EXTRACTED : N/A
DATE ANALYZED : 10/18/93
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	<0.500	20.0	19.0	95	N/A	N/A	N/A
TOLUENE	<0.500	20.0	20.1	101	N/A	N/A	N/A
TOTAL XYLENES	<0.500	40.0	40.2	101	N/A	N/A	N/A
GASOLINE	<100	1000	1060	106	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
BENZENE	80 - 111	20
TOLUENE	78 - 111	20
TOTAL XYLENES	80 - 114	20
GASOLINE	75 - 120	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOFLUOROBENZENE	112	N/A	76 - 120
TRIFLUOROTOLUENE	102	N/A	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-154

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : WATER
METHOD : WA DOE WTPH-G/8020(BETX)

SAMPLE I.D. # : BLANK
DATE EXTRACTED : N/A
DATE ANALYZED : 10/19/93
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	<0.500	20.0	19.2	96	N/A	N/A	N/A
TOLUENE	<0.500	20.0	20.5	102	N/A	N/A	N/A
TOTAL XYLENES	<0.500	40.0	40.7	102	N/A	N/A	N/A
GASOLINE	<100	1000	1110	111	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
BENZENE	80 - 111	20
TOLUENE	78 - 111	20
TOTAL XYLENES	80 - 114	20
GASOLINE	75 - 120	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOFLUOROBENZENE	110	N/A	76 - 120
TRIFLUOROTOLUENE	103	N/A	50 - 150

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-154

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : WATER
METHOD : WA DOE WTPH-G/8020(BETX)

SAMPLE I.D. # : BLANK
DATE EXTRACTED : N/A
DATE ANALYZED : 10/20/93
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	<0.500	20.0	19.1	96	N/A	N/A	N/A
TOLUENE	<0.500	20.0	20.3	102	N/A	N/A	N/A
TOTAL XYLENES	<0.500	40.0	41.0	102	N/A	N/A	N/A
GASOLINE	<100	1000	1160	116	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
BENZENE	80 - 111	20
TOLUENE	78 - 111	20
TOTAL XYLENES	80 - 114	20
GASOLINE	75 - 120	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOFLUOROBENZENE	111	N/A	76 - 120
TRIFLUOROTOLUENE	104	N/A	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-154

CASE NARRATIVE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

CASE NARRATIVE : TOTAL PETROLEUM HYDROCARBONS (WA DOE WTPH-D) ANALYSIS

One (1) water sample was received by ATI on October 18, 1993, for analysis by WA DOE WTPH-D extended method. The sample was extracted on October 18, 1993, and analyzed on October 19, 1993.

The relative percent difference (RPD) between the associated quality control sample 9310-155-1 and its duplicate was outside of ATI established control limits due to a high level of target analytes.

The surrogate recovery for sample 9310-154-1 (MW-2) was outside of ATI established control limits due to sample dilution.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

TOTAL PETROLEUM HYDROCARBONS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R04	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/18/93
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/18/93
SAMPLE MATRIX	: WATER	UNITS	: mg/L
METHOD	: WA DOE WTPH-D	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
FUEL HYDROCARBONS	<0.25
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL
FUEL HYDROCARBONS	<0.75
HYDROCARBON RANGE	C24 - C34
HYDROCARBON QUANTITATION USING	MOTOR OIL

SURROGATE PERCENT RECOVERY		LIMITS
o-TERPHENYL	101	50 - 150

AnalyticalTechnologies, Inc.

ATI I.D. # 9310-154-1

TOTAL PETROLEUM HYDROCARBONS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/15/93
PROJECT #	: 0161-013-R04	DATE RECEIVED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/18/93
CLIENT I.D.	: MW-2	DATE ANALYZED	: 10/19/93
SAMPLE MATRIX	: PRODUCT	UNITS	: mg/L
METHOD	: WA DOE WTPH-D	DILUTION FACTOR	: 50

COMPOUNDS	RESULTS
FUEL HYDROCARBONS	200
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL
FUEL HYDROCARBONS	150
HYDROCARBON RANGE	C24 - C34
HYDROCARBON QUANTITATION USING	MOTOR OIL

SURROGATE PERCENT RECOVERY			LIMITS
TERPHENYL	154	I	50 - 150

I = Surrogate out of limits due to sample dilution.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

TOTAL PETROLEUM HYDROCARBONS
QUALITY CONTROL DATA

CLIENT	: GEOENGINEERS, INC.	SAMPLE I.D. #	: 9310-155-1
PROJECT #	: 0161-013-R04	DATE EXTRACTED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	DATE ANALYZED	: 10/19/93
SAMPLE MATRIX	: WATER	UNITS	: mg/L
METHOD	: WA DOE WTPH-D		

COMPOUND	SAMPLE RESULT	SAMPLE DUP. RESULT	RPD	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
DIESEL	15.7	20.8	28G	N/A	N/A	N/A	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
DIESEL	N/A	20

SURROGATE RECOVERIES	SAMPLE	SAMPLE DUP.	LIMITS
O-TERPHENYL	139	112	50 - 150

= Out of limits due to high levels of target analytes in sample.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

TOTAL PETROLEUM HYDROCARBONS
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : WATER
METHOD : WA DOE WTPH-D

SAMPLE I.D. # : BLANK
DATE EXTRACTED : 10/18/93
DATE ANALYZED : 10/18/93
UNITS : mg/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
DIESEL	<0.250	2.50	2.47	99	2.56	102	4
CONTROL LIMITS				% REC.			RPD
DIESEL				70 - 115			20
SURROGATE RECOVERIES		SPIKE		DUP. SPIKE		LIMITS	
O-TERPHENYL		103		106		50 - 150	

Analytical Technologies, Inc.

ATI I.D. # 9310-154

CASE NARRATIVE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

CASE NARRATIVE : OIL & GREASE ANALYSIS

One (1) water sample was received by ATI on October 18, 1993, for oil and grease analysis. This sample was extracted and analyzed in accordance with EPA method 413.2.

All corresponding quality assurance and quality control results defined as matrix spike/matrix spike duplicate (MS/MSD) and blank spike (BS) were within the ATI established control limits. The BS served as the Laboratory Control Sample (LCS). The relative percent difference (RPD) for sample 9310-138-7 and its duplicate was out of ATI established control limits. These samples were determined to be non-homogeneous.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

OIL & GREASE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE EXTRACTED	: 10/18/93
PROJECT #	: 0161-013-R04	DATE ANALYZED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	UNITS	: mg/L
EPA METHOD	: 413.2	SAMPLE MATRIX	: WATER

ATI I.D. #	CLIENT I.D.	OIL & GREASE
9310-154-2	COMPOSITE DRUM	25
METHOD BLANK	-	<1

AnalyticalTechnologies, Inc.

ATI I.D. # 9310-154

OIL & GREASE
QUALITY CONTROL DATA

CLIENT	: GEOENGINEERS, INC.	SAMPLE I.D. #	: 9310-138-7
PROJECT #	: 0161-013-R04	DATE EXTRACTED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	DATE ANALYZED	: 10/18/93
EPA METHOD	: 413.2	UNITS	: mg/L
SAMPLE MATRIX	: WATER		

COMPOUND	SAMPLE RESULT	SAMPLE DUP. RESULT	RPD	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
OIL & GREASE	2.70	5.83	73H	10	10.1	74	N/A	N/A	N/A

H = Out of limits.

$$\% \text{ Recovery} = \frac{(\text{Spiked Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Spike Result} - \text{Dup. Spike Result})|}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.

ATI I.D. # 9310-154

OIL & GREASE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M
EPA METHOD : 413.2
SAMPLE MATRIX : WATER

SAMPLE I.D. # : BLANK
DATE EXTRACTED : 10/18/93
DATE ANALYZED : 10/18/93
UNITS : mg/L

COMPOUND	SAMPLE RESULT	SAMPLE DUP. RESULT	RPD	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
OIL & GREASE	<1	N/A	N/A	10	8.92	89	9.20	92	3

$$\% \text{ Recovery} = \frac{(\text{Spiked Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Spike Result} - \text{Dup. Spike Result})|}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.

ATI I.D. # 9310-154

CASE NARRATIVE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

CASE NARRATIVE: METALS ANALYSIS

EPA SW-846 method 7421 was used to analyze the sample for the content of lead.

The percent recovery for lead in the matrix spike (MS) performed on sample 9310-144-4 was out of ATI established control limits due to matrix interference and has been flagged "F".

All other quality control parameters were within ATI established control limits.

Analytical Technologies, Inc.

ATI I.D. # 9310-154

METALS ANALYSIS

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

MATRIX : PRODUCT

ELEMENT	DATE PREPARED	DATE ANALYZED
LEAD	10/20/93	10/28/93

Analytical Technologies, Inc.

ATI I.D. # 9310-154

METALS ANALYSIS
DATA SUMMARY

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

MATRIX : PRODUCT
UNITS : mg/Kg

ATI I.D. #	CLIENT I.D.	LEAD
9310-154-1	MW-2	42
METHOD BLANK	-	<0.15

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-154

METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R04
PROJECT NAME : UNOCAL - WL&M

MATRIX : PRODUCT
UNITS : mg/Kg

ELEMENT	ATI I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC
LEAD	9310-144-4	3.2	2.9	10	5.21	1.38	146F
LEAD	BLANK	<0.15	N/A	N/A	1.48	1.25	118

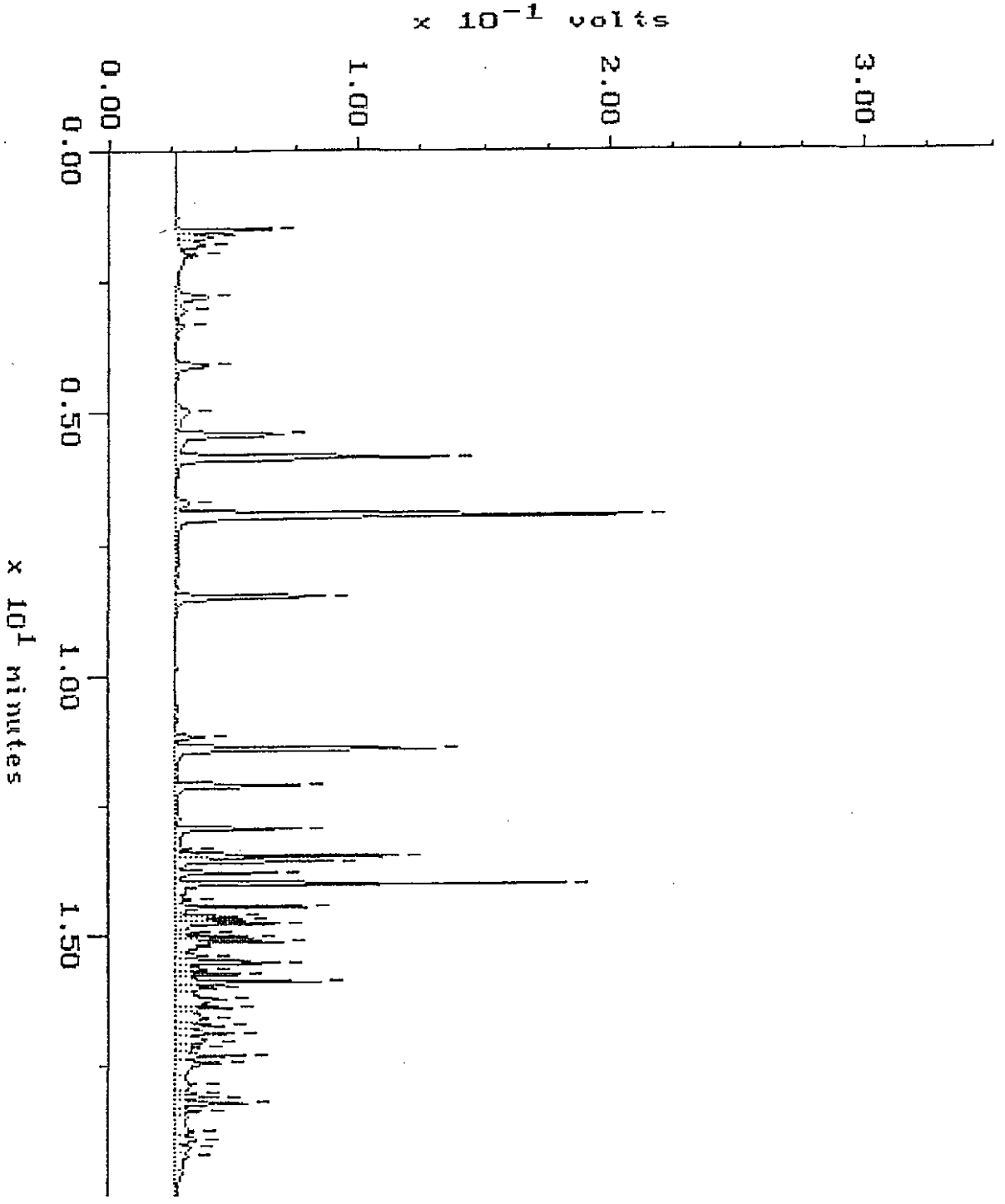
F = Out of limits due to matrix interference.

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

WA DOE WTPH-G

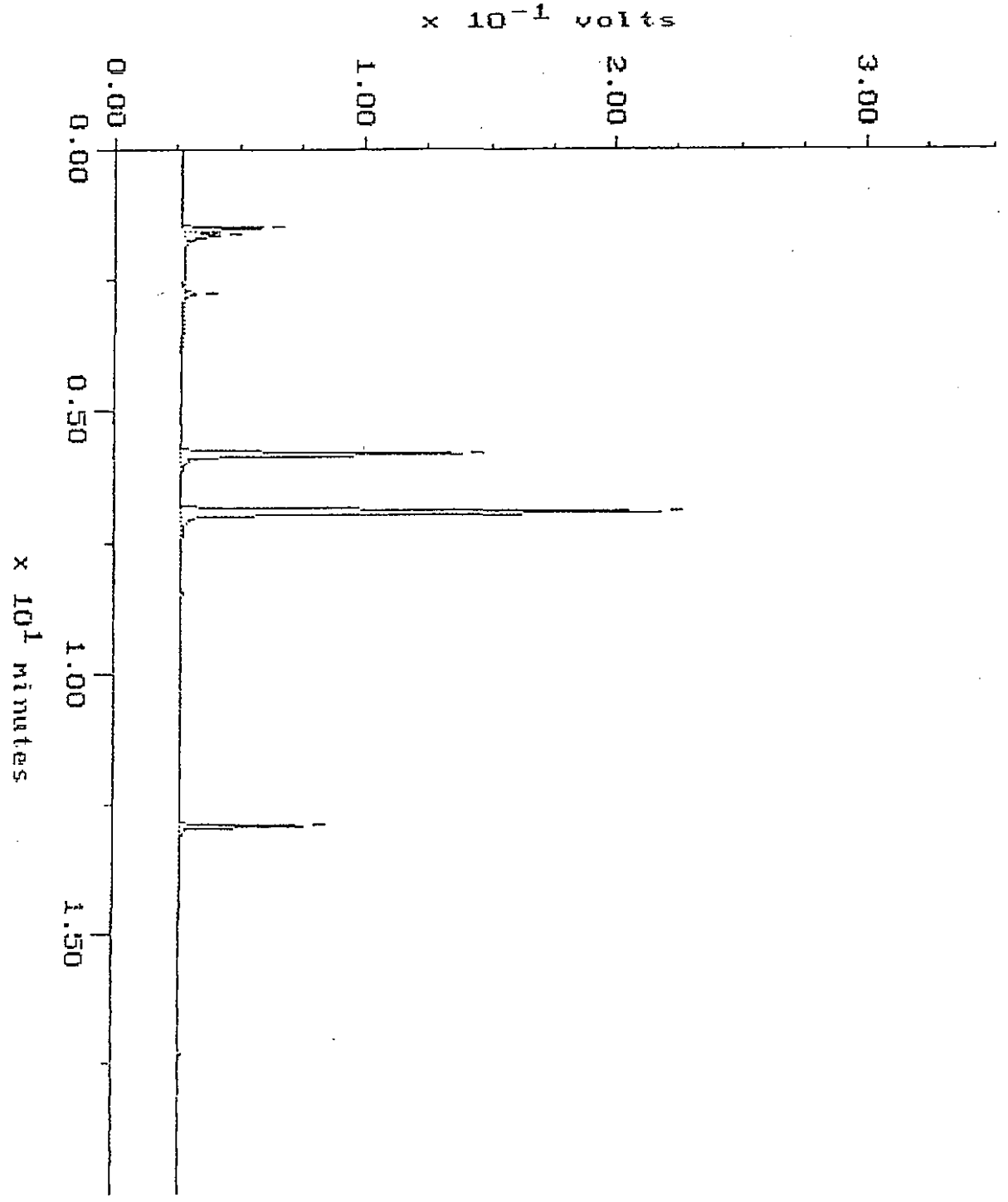
Sample: 9310-154-1 DIL Channel: FID Filename: RA199P37
Acquired: 20-OCT-93 4:43 Method: F:\BRO2\MAXDATA\PICARD\101993PC Operator: ATI
Dilution: 1 : 50.000
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.



Blank

WA DOE WTPH-G

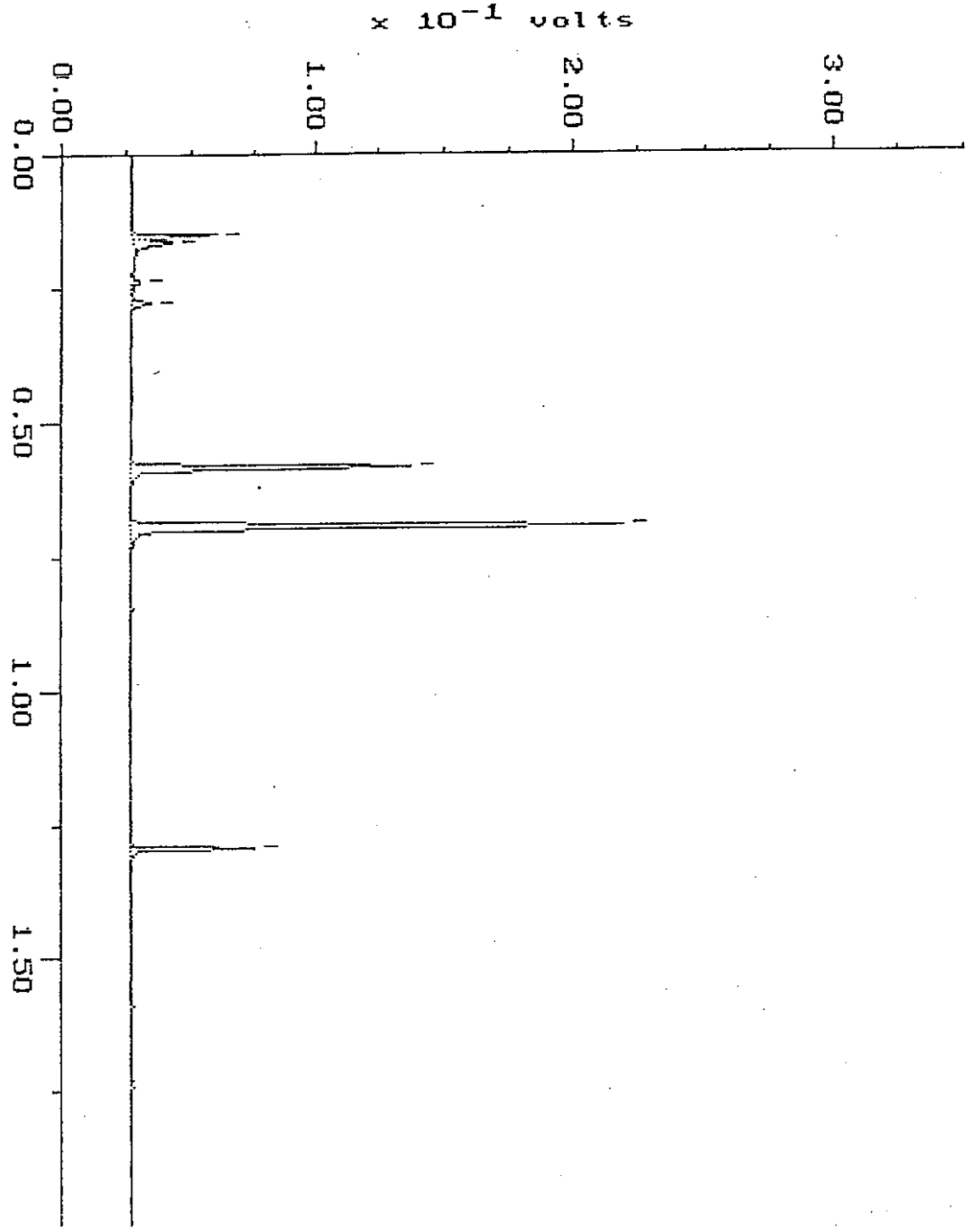
Sample: WRB 10-18 Channel: FID Filename: RA189P04
Acquired: 18-OCT-93 8:16 Method: F:\BRD2\MAXDATA\PICARD\101893PC Operator: ATI
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.



WA DOE WTPH-G

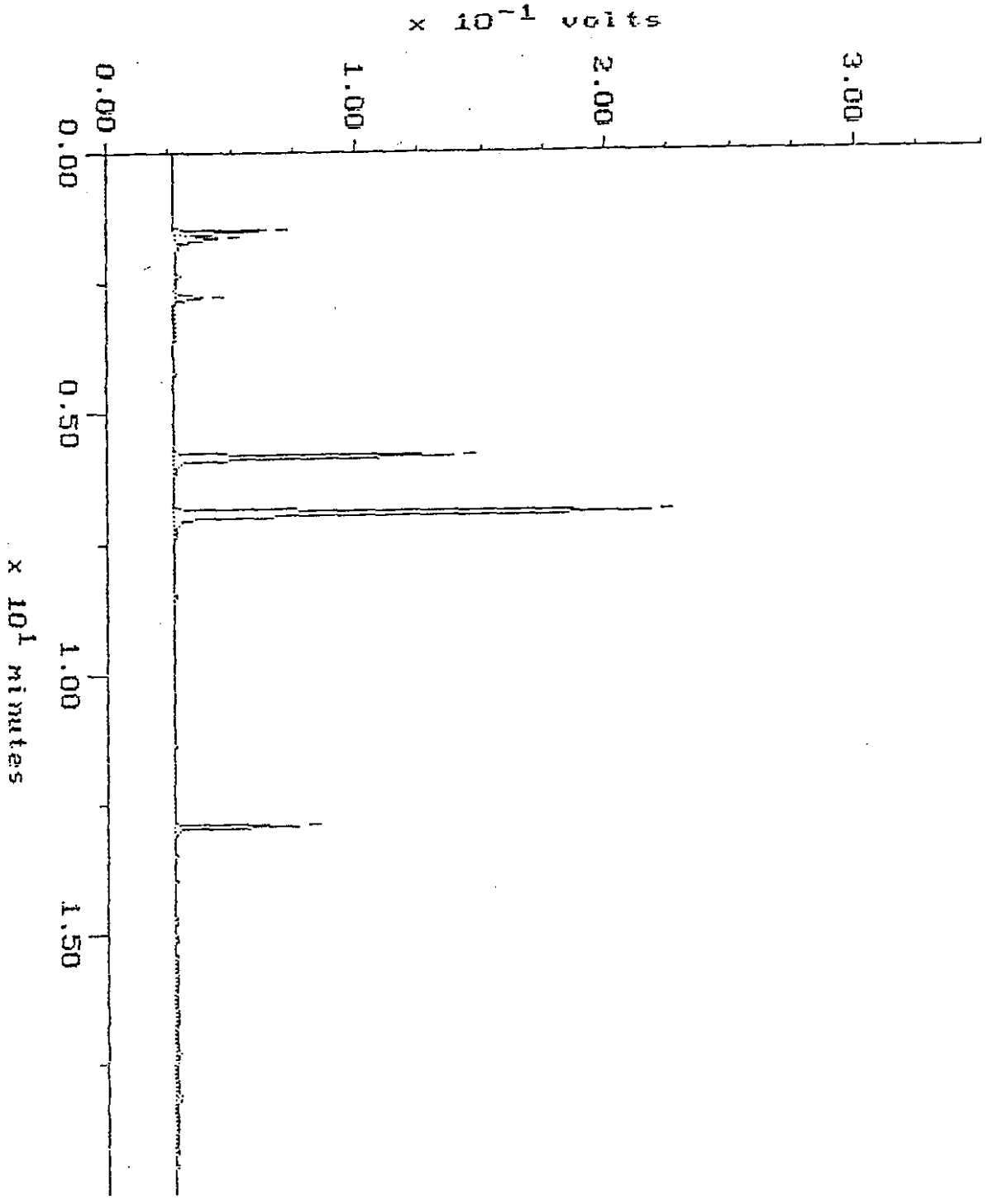
Blank

Sample: WRB 10-19 Channel: FID Filename: RA199P03
Acquired: 19-OCT-93 10:10 Method: F:\BRD2\MAXDATA\PICARD\10193PC Operator: ATI
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.



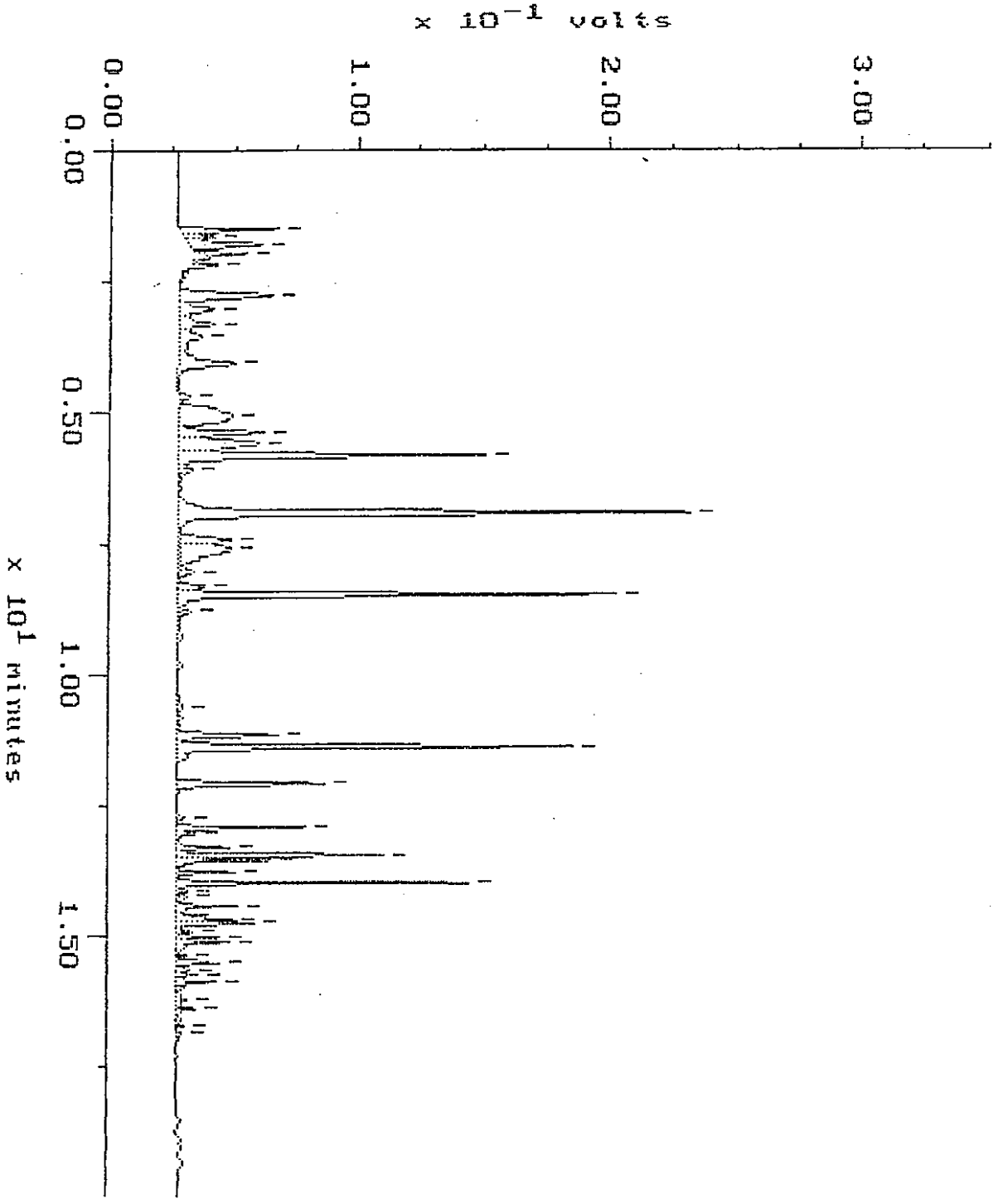
Blank WA DOE WTPH-G

Sample: WRB 10-20 Channel: FID Filename: RA209P05
Acquired: 20-OCT-93 9:46 Method: F:\BRD2\MAXDATA\PICARD\102093PC Operator: ATI
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.



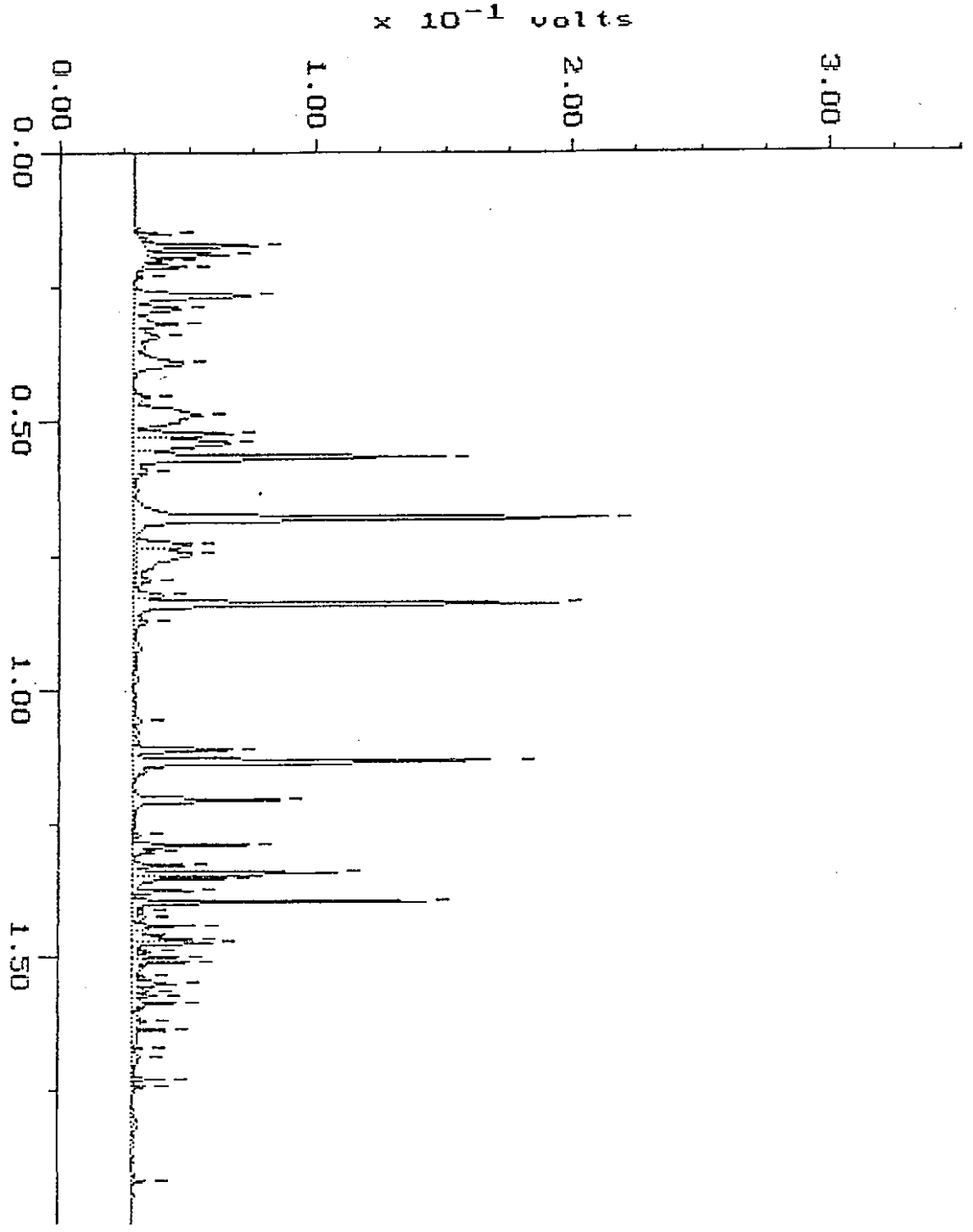
Continuing Calibration

Sample: STD-C G Channel: FID Filename: RA189P01
Acquired: 18-OCT-93 6:25 Method: F:\BRO2\MAXDATA\PICARD\101893PC Operator: ATI
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.

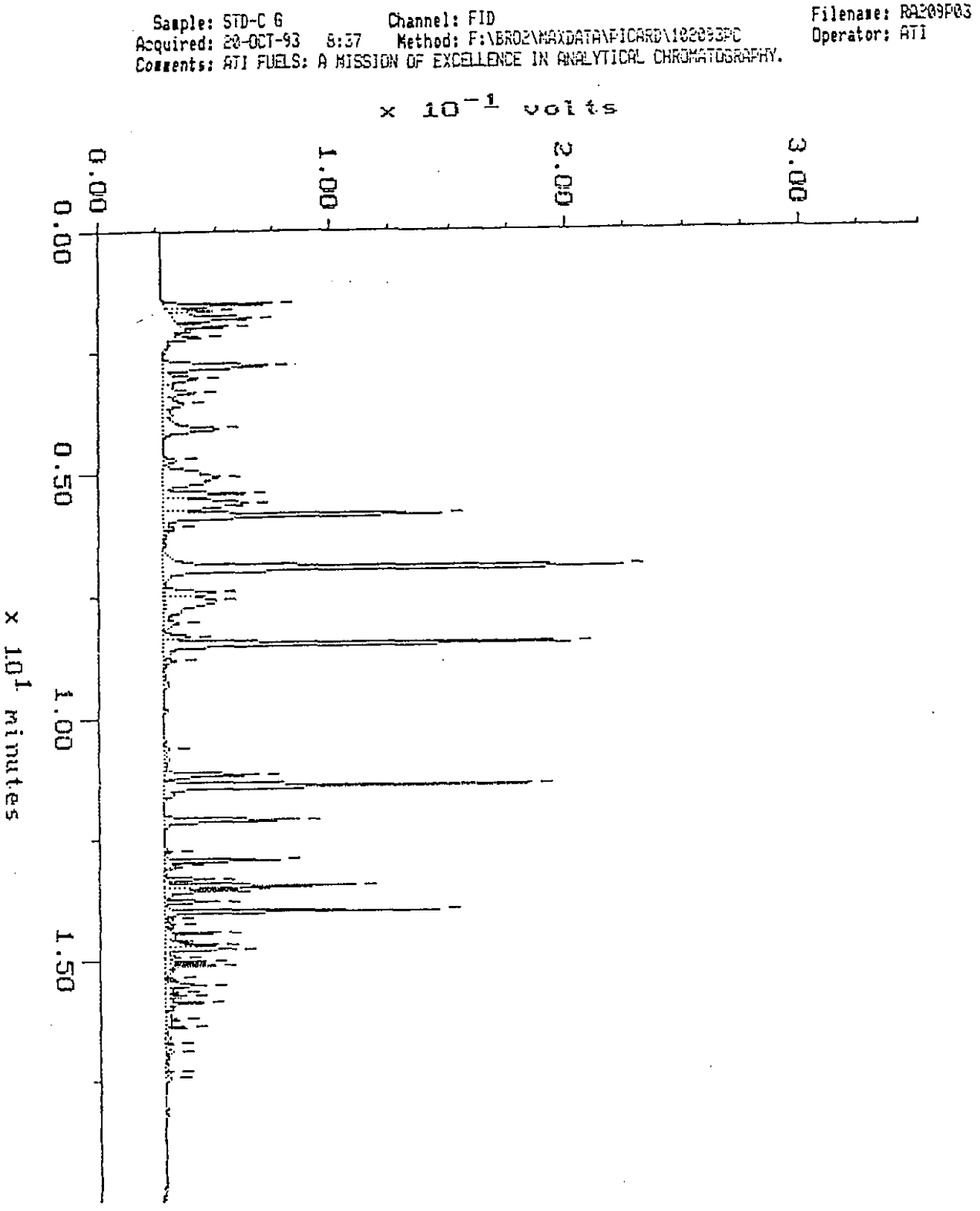


Continuing Calibration

Sample: STD-C G Channel: FID Filename: RR199F01
Acquired: 19-OCT-93 8:58 Method: F:\BRG2\MAXDATA\PICARD\101993PC Operator: ATI
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.

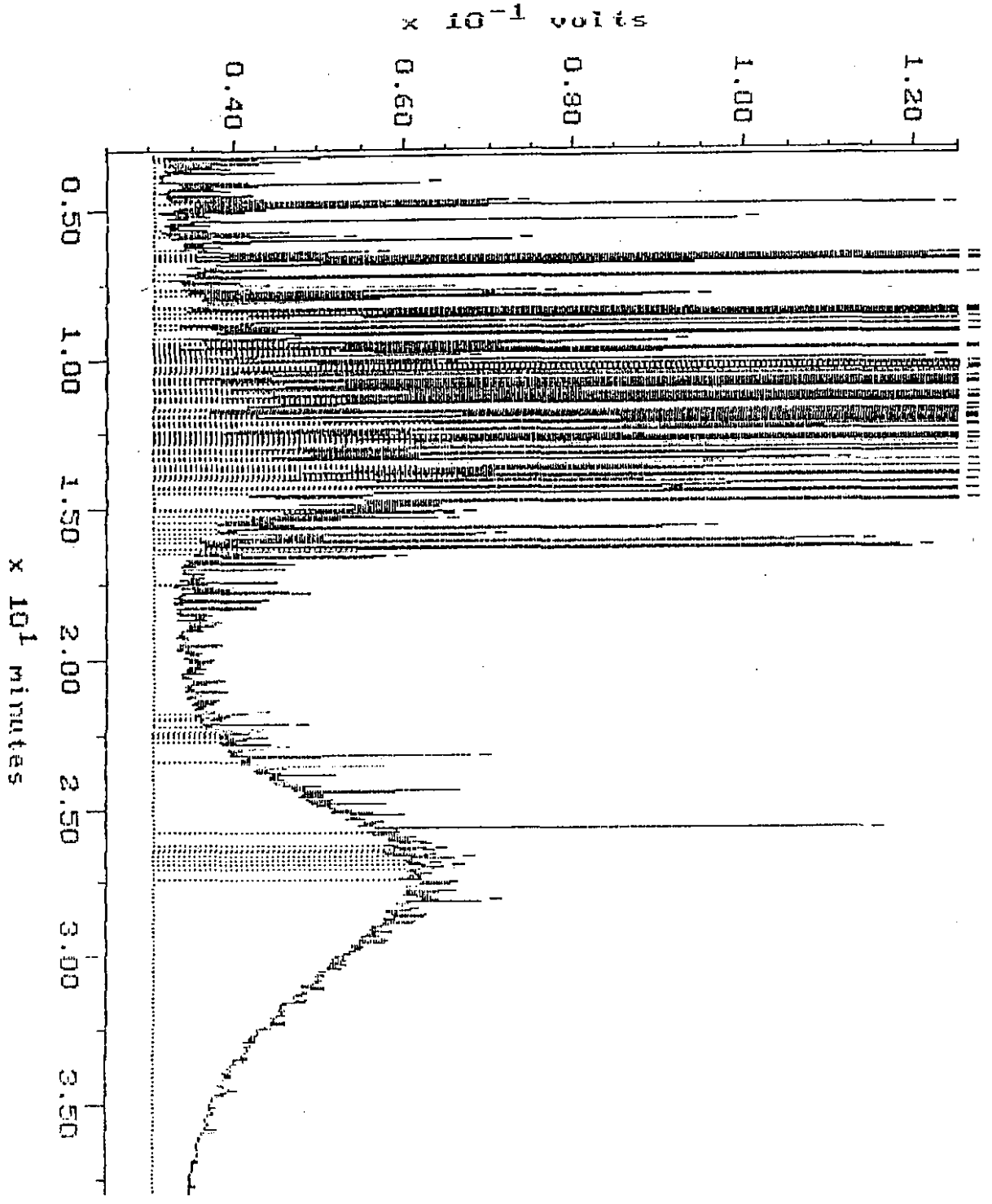


Continuing Calibration

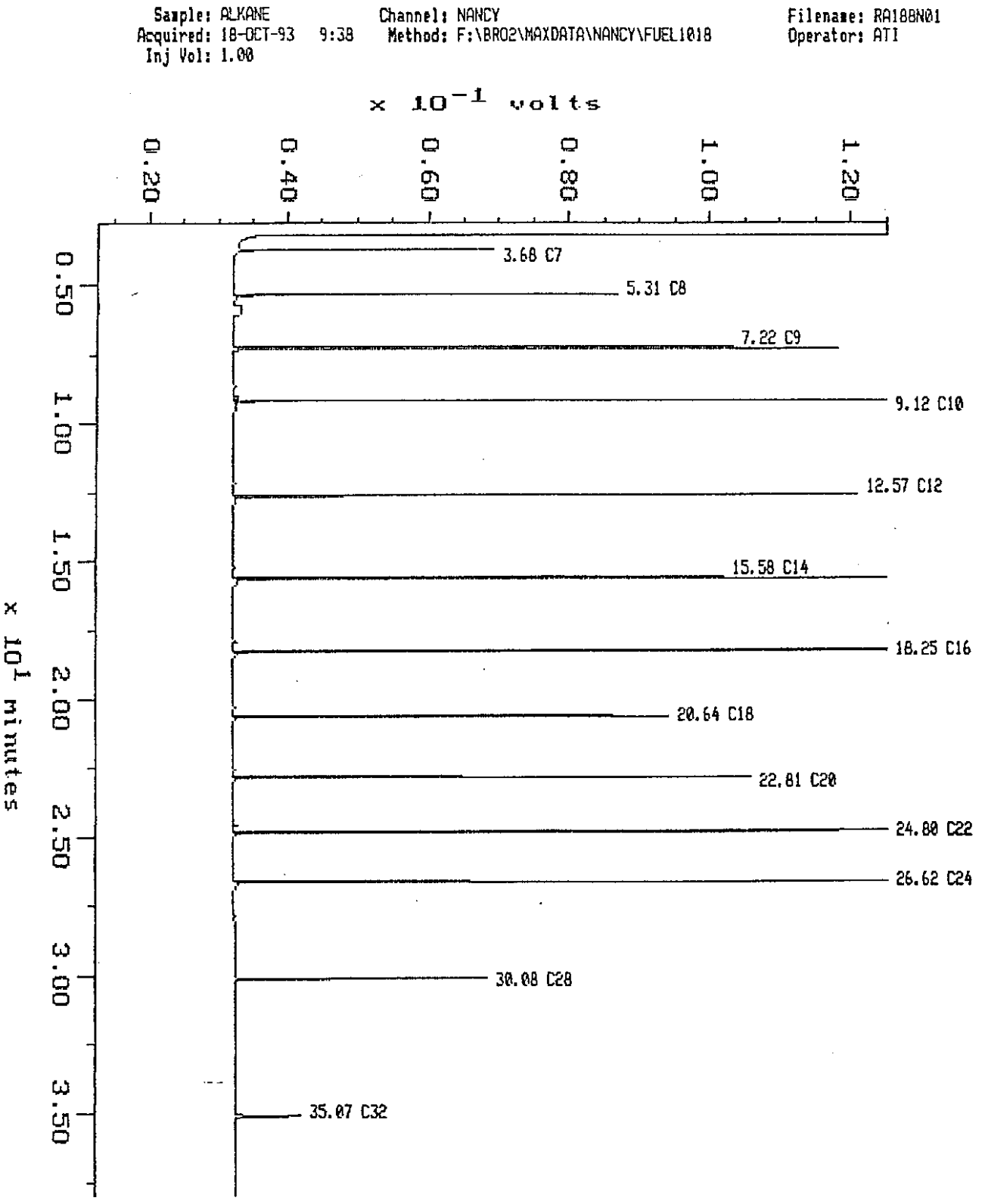


WA DOE WTPH-D

Sample: 9310-154-1 DIL
Acquired: 19-OCT-93 15:18
Dilution: 1 : 50.000
Channel: NANCY
Method: F:\BRO2\MAXDATA\NANCY\FUEL1019
Filename: RA198N07
Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE

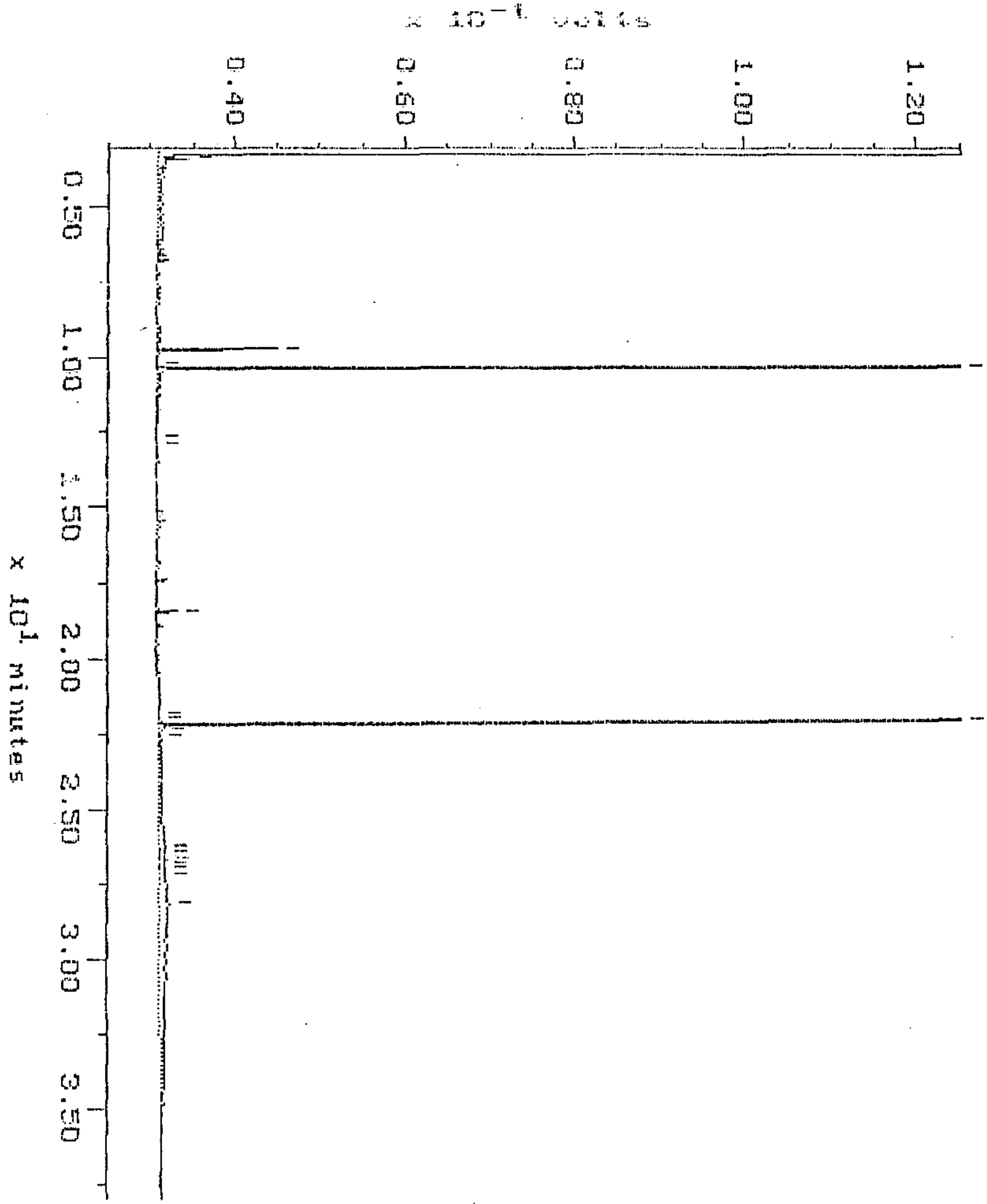


Alkane

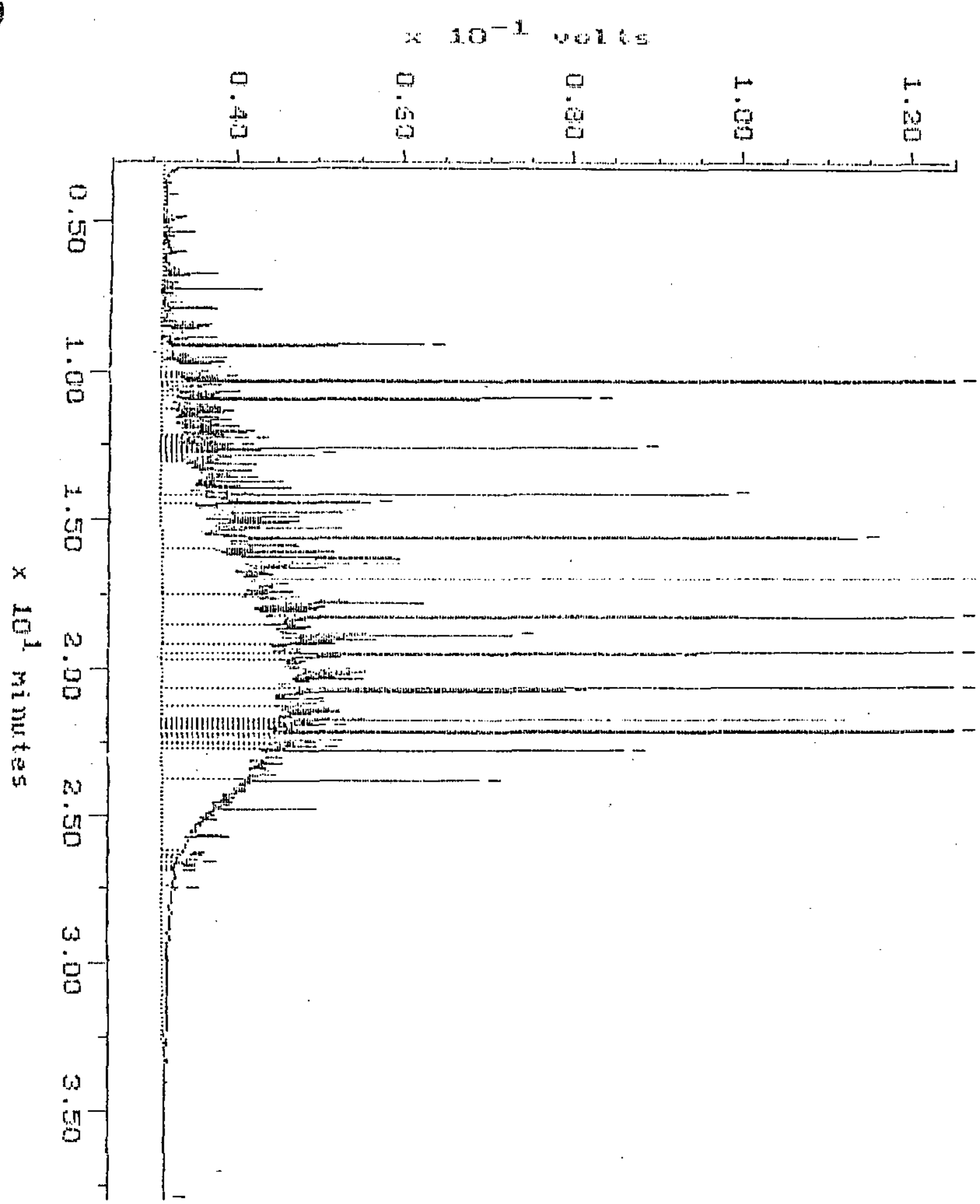

Sample: ALKANE
Acquired: 18-OCT-93 9:38
Inj Vol: 1.00
Channel: NANCY
Method: F:\BRO2\MAXDATA\NANCY\FUEL1018
Filename: RA188N01
Operator: ATI
x 10⁻¹ volts
0.20
0.40
0.60
0.80
1.00
1.20
0.50
1.00
1.50
2.00
2.50
3.00
3.50
x 10¹ minutes
3.68 C7
5.31 C8
7.22 C9
9.12 C10
12.57 C12
15.58 C14
18.25 C16
20.64 C18
22.81 C20
24.80 C22
26.62 C24
30.08 C28
35.07 C32

Blank

Sample: KRB 18-16 Channel: NANCY Filename: KA18CH08
Acquired: 18-OCT-93 15:28 Method: F:\BR02\MAXDATA\NANCY\FUEL1018 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



Sample: D 568 Channel: RAHC1 Filename: RA166R06
Acquired: 18-OCT-93 13:33 Method: F:\BR02\RAXDATA\RAHC1\FUEL1018 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



Continuing Calibration

Sample: NO 500 Channel: NANCY Filename: RA168N07
Acquired: 18-OCT-93 14:28 Method: F:\BRO2\MAXDATA\NANCY\FUEL1019 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE