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GeoEngineers

Report of Geoenvironmental Services
Supplemental Site Assessment
Rosen Site
Seattle, Washington

May 27, 1994

TOSCO 255 35330857
(AKA UNOCAL #5353)
FS 4644573
LUST # 3043

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For
Unocal CERT - Northern Region

GeoEngineers

May 27, 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 "Report of Geoenvironmental Services, Supplemental Site Assessment" for the Rosen site located southeast of Unocal Service Station 5353 in Seattle, Washington. This report summarizes assessment activities conducted during October 1993. 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

NLP:SCP:vvv
Document ID: 0161013.R2

cc: Washington State Dept. of Ecology
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REPORT OF GEOENVIRONMENTAL SERVICES
SUPPLEMENTAL SITE ASSESSMENT
ROSEN SITE
SEATTLE, WASHINGTON
FOR
UNOCAL CERT - NORTHERN REGION

INTRODUCTION

This report summarizes the results of GeoEngineers' supplemental site assessment activities conducted at the Rosen site from October 5 to 12, 1993. The Rosen site is located at 960 Republican Street, southwest of the intersection of Terry Avenue North and Mercer Street in Seattle, Washington. Unocal Service Station 5353 is located northeast of the intersection of Westlake Avenue North and Mercer Street, approximately 80 feet northwest of the Rosen site. The Rosen site is owned by a party other than Unocal. The Unocal site and the Rosen site are shown relative to surrounding physical features in Figure 1. Approximately 80,000 gallons of leaded premium gasoline was released from a product line leak at the Unocal site in early 1980.

Enviros (Enviros, Inc.) provided environmental consulting services to the owner of the Rosen site. Enviros contacted Dr. Mark Brearley of Unocal on September 30, 1993. Enviros indicated that during remedial excavation activities at the Rosen site, they encountered petroleum-related soil and ground water contamination which they believed was caused by an off-site source. In subsequent written submittals provided to Unocal, Enviros concluded that Unocal Service Station 5353 is a likely source of petroleum-related soil and ground water contamination in the saturated zone at the Rosen site.

BACKGROUND

AREA HISTORY

The two sites are located about 500 feet south of the present shoreline of Lake Union. The original shoreline of Lake Union extended south of the present alignment of Mercer Street. In the late 1800s, the south end of Lake Union was developed predominantly with lumber mills and related facilities. The accumulated deposits of sawdust and wood waste from the sawmills and other fill materials eventually extended the shoreline of Lake Union north to its present location.

The land use in the area of the two sites between the late 1800s and the present was primarily commercial, light industrial and heavy industrial, based on our historical research. GeoEngineers has identified 26 potential petroleum storage facilities, both former and current, within a quarter-mile radius of the two sites.

UNOCAL SITE HISTORY

The Unocal site was covered by Lake Union before the south shore of the lake was extended northward in the late 1800s. In 1893, the site was occupied by the Brace and Hergert

Mill Company. Century Brewing Company and Horluck Creameries Inc. occupied the site beginning sometime between 1917 and 1935, and extending to 1965. Unocal leased the site from 1965 to 1968 and has owned the site since 1968. The western half of the Unocal site has been occupied by and operated as a service station since 1965. The service station facility is currently operating. The eastern half of the Unocal site has been occupied by a Denny's restaurant since 1968.

ROSEN SITE HISTORY

The Rosen site either was covered by Lake Union or was very close to the south shoreline of the lake before the shoreline was extended northward in the late 1800s. A service station operated on the northern portion of the Rosen site from approximately 1935 to approximately 1962. The exact configuration of the service station facilities during this period is not known. Freeman & Lambdin, Inc. Fuel Retailers & Wholesalers operated on the southern portion of the Rosen site from approximately 1935 to approximately 1945. Continental Fuel Company operated on the southern portion of the site from approximately 1945 to approximately 1955. The type of fuel distributed by these two operations is not known.

ASSESSMENT AND CLEANUP HISTORY

Unocal employees detected a gasoline leak in a product line at the Unocal site in May 1980. The leak location was in the southwestern portion of the site, near the western service island. Unocal estimated that as much as 80,000 gallons of leaded premium gasoline had been released during the four month period prior to detection of the leak. The USTs (underground storage tanks) and the product lines were immediately replaced.

Thirty-two monitoring wells were installed in 1980 and 1981 to assess the extent of free product floating on the ground water. An extensive free product plume was encountered beneath the Unocal site, north to Valley Street, west into Westlake Avenue and south into Mercer Street.

A free product recovery system was installed at the site in June 1980. The recovery system was operated from June 1980 until October 1982. A total of approximately 41,900 gallons of gasoline was recovered during this period.

A subsurface VES (vapor extraction system) was installed at the site in June 1988. The VES has operated from June 1988 to the present. We estimate that the vapor equivalent of approximately 4,700 gallons of gasoline was recovered by the VES during this period.

Eighteen additional monitoring wells were drilled and installed in 1991 and 1992 to assess the extent of contaminated soil and ground water in the vicinity of the Unocal site. An area of contaminated soil was encountered extending beneath the Unocal site, north to Valley Street, west into Westlake Avenue and south into Mercer Street. Contaminated ground water was encountered beneath the site, and beneath Westlake Avenue, Mercer Street, Terry Avenue and possibly Valley Street.

The locations of the monitoring wells installed in 1991 and 1992, and the locations of the monitoring wells installed in 1980 which still exist are shown in Figure 1.

We understand, based on information provided by Enviros, that approximately 1,400 cubic yards of petroleum-contaminated soil was excavated from the northern portion of the Rosen site before October 1993. The limits of the excavation are shown in Figures 1 and 2.

SUBSURFACE SOIL CONDITIONS

Our interpretation of subsurface soil conditions is based on monitoring well borings completed in the vicinity of the Unocal site and the Rosen site, and on review of city of Seattle logs of borings completed in the vicinity. Mixed fill materials consisting of sand, sand with silt, silty sand, silty gravel, silt and sawdust were encountered in the borings. The fill materials extend to a depth of approximately 35 feet. Little horizontal continuity was observed in the non-sawdust fill units. Several large zones of sawdust and wood chips were encountered beneath the Unocal site and the Rosen site. The sawdust and wood chip zones ranged from several feet to greater than 10 feet in thickness. Native sand with varying amounts of gravel was encountered beginning at a depth of approximately 35 feet in the borings which extended to this depth. The base of the native sand unit was not encountered.

GROUND WATER CONDITIONS

Ground water is present at a depth of from 8 to 14 feet beneath the Unocal site. The surface of the Rosen site is topographically lower than the Unocal site, and the depth to ground water is correspondingly less. The general direction of ground water flow in the area is toward the northeast, although considerable variation in ground water flow direction occurs in localized areas.

SCOPE

The purpose of our most recent services was to evaluate the contaminant types present at the Rosen site. The specific scope of services completed is as follows:

1. Review the conclusions presented in two letters provided to Unocal by Enviros.
2. Obtain soil samples from the remedial excavation at the Rosen site. Conduct field screening on each soil sample for evidence of petroleum-related contamination using visual, water sheen and headspace vapor screening methods. Field screening methods are described in Appendix A.
3. Submit the soil samples for laboratory analysis of BETX by EPA Method 8020, gasoline-range hydrocarbons by Ecology Method WTPH-G, diesel- and heavy oil-range hydrocarbons by Ecology Method WTPH-D extended, and total lead by EPA Method 6010. Submit selected soil samples for laboratory analysis of HVOCs by EPA Method 8010.

4. Obtain two ground water grab samples from the remedial excavation at the Rosen site. Submit the ground water samples for laboratory analysis of BETX by EPA Method 8020 and gasoline-range hydrocarbons by Ecology Method WTPH-G.
5. Evaluate the laboratory analytical results in an attempt to identify the types of products present in the samples.

REVIEW OF ENVIROS LETTERS

GeoEngineers reviewed two draft letters provided to Unocal by Enviros. The letters summarized the results of Enviros' excavation activities at the Rosen site, and their conclusions based on field and laboratory results. The letters were dated November 4, 1993 and November 13, 1993 although they were provided to Unocal on October 4, 1993 and October 13, 1993.

In the letter dated November 4, 1993 Enviros made the following conclusions:

- "Sampling and field screening at the site indicates that the vadose-zone soil contamination consists of gasoline diesel (sic), and oil. BETX components were either non-detectable or were below cleanup levels. The source of these hydrocarbons appears to be the on-site fuel service station that was demolished in the 1960's."
- "The saturated zone soil and groundwater samples, however, contained primarily gasoline with minor concentrations of diesel. Benzene, and xylenes concentrations exceeded groundwater cleanup levels. The saturated zone contamination appears to be physically separated from and different in character than that of the vadose zone."

In the letter dated November 13, 1993 Enviros made the following conclusions:

- "In summary, Enviros believes that past on-site activities were not responsible for the ground water and saturated zone contamination at the Rosen property."
- "Enviros believes that the data indicate that the saturated zone and vadose soil zone have a different source of contamination. The saturated-zone wood debris contains visible product, whereas non-contaminated vadose-zone soil exists less than two feet above the water table. The Unocal Station (sic) across the street is a likely source for this saturated-zone contamination."

SAMPLING

SOIL

GeoEngineers obtained twenty-four soil samples from the north wall and base of the excavation at the Rosen site on October 11, 1993. The elevations of the sample locations were surveyed with respect to the ground surface near MW-40 in Mercer Street (assumed elevation of approximately 21.0 feet.) The excavation limits, the sample locations and elevations, the ground surface elevation and the approximate ground water elevation at soil sampling locations are shown in Figure 2. The north wall of the excavation was at a slope of 1:1 (horizontal to vertical) and approximately 12 feet high. Three vertical profiles of soil samples were obtained from the north

wall. Each profile consisted of four samples obtained from locations in a vertical line. Samples were obtained from each location by hand augering approximately 1 foot into the wall. The purpose of the samples was to evaluate the vertical and lateral distribution of contaminants in the north wall, and to evaluate the types of contaminants present. Four vertical profiles of soil samples were obtained from beneath the base of the excavation. Each profile consisted of three samples obtained from varying depths. The samples were obtained from each profile location by hand augering into the base of the excavation. The purpose of the samples was to evaluate the vertical distribution of contaminants immediately beneath the base of the excavation, to evaluate the lateral distribution of contaminants from northwest to southeast in the base of the excavation, and to evaluate the types of contaminants present in the samples. Each of the wall samples (W-1 through W-12) were submitted for laboratory analysis of BETX, gasoline-, diesel- and heavy oil-range hydrocarbons, and total lead. Sample W-11 also was submitted for laboratory analysis of HVOCs. The sample from each base profile with the highest field screening results (B-3, B-6, B-9 and B-12) was selected and submitted for laboratory analysis of BETX, gasoline-, diesel- and heavy oil-range hydrocarbons, and total lead. Sampling procedures are described in Appendix A. Field screening and chemical analytical results are summarized in Table 1. The laboratory reports and our review of the laboratory QA/QC program are included in Appendix B.

Benzene was detected in soil samples W-7, W-8, W-11, W-12 and B-9 at concentrations ranging from 0.69 to 4.8 mg/kg (milligrams per kilogram), exceeding the soil cleanup level (MTCA Method A soil cleanup level) of 0.5 mg/kg. Ethylbenzene was detected in soil sample B-6 at a concentration of 21 mg/kg, slightly exceeding the soil cleanup level of 20 mg/kg. Xylenes were detected in soil samples W-7, W-12, B-6 and B-9 at concentrations ranging from 22 to 110 mg/kg, exceeding the soil cleanup level of 20 mg/kg. In addition to those concentrations which exceed the cleanup levels, benzene, ethylbenzene, toluene and/or xylenes were detected at concentrations less than the soil cleanup levels in samples W-2, W-3, W-4, W-5, W-6, W-7, W-8, W-10, W-11, W-12, B-3, B-6, B-9 and B-12. BETX was not detected in the remaining soil samples tested.

Gasoline-range hydrocarbons were detected in soil samples W-3, W-7, W-8, W-11, W-12, B-3, B-6 and B-9 at concentrations ranging from 250 to 5,400 mg/kg, exceeding the soil cleanup level of 100 mg/kg. Gasoline-range hydrocarbons were detected at concentrations less than the soil cleanup level in samples W-2, W-4, W-5, W-6 and W-10. Gasoline-range hydrocarbons were not detected in the remaining soil samples tested.

Diesel-range hydrocarbons were detected in soil samples W-3, W-4, W-5, W-7, W-8, W-11, W-12, B-3, B-6 and B-9 at concentrations ranging from 210 to 7,800 mg/kg, exceeding the soil cleanup level of 200 mg/kg. Diesel-range hydrocarbons were detected at concentrations less than the soil cleanup level in samples W-1, W-2, W-10 and B-12. Diesel-range hydrocarbons were not detected in the remaining soil samples tested.

Heavy oil-range hydrocarbons were detected in soil samples W-3, W-5, W-7, W-8, W-12, B-3, B-6, B-9 and B-12 at concentrations ranging from 270 to 7,000 mg/kg, exceeding the soil cleanup level of 200 mg/kg. Heavy oil-range hydrocarbons were detected at concentrations less than the soil cleanup level in samples W-1 and W-2. Heavy oil-range hydrocarbons were not detected in the remaining soil samples tested.

Total lead either was not detected or was detected at concentrations less than the soil cleanup level of 250 mg/kg in the soil samples tested. HVOCs were not detected in soil sample W-11.

GROUND WATER

GeoEngineers obtained two ground water grab samples (GWATER-1 and GWATER-2) from the base of the excavation at the Rosen site on October 11, 1993. The samples were obtained from two hand auger boring locations as shown in Figure 2. The samples were obtained directly from the uncased hand auger borings. The purpose of the samples was to evaluate the types of ground water contaminants present in these locations. Because of the sample collection technique, the laboratory results for these samples should be used semiquantitatively, and should not be used to evaluate attainment of Method A cleanup levels. The two ground water grab samples were submitted for laboratory analysis of BETX and gasoline-range hydrocarbons. Chemical analytical results are summarized in Table 2. The laboratory reports and our review of the laboratory QA/QC program are included in Appendix B.

Benzene, ethylbenzene, toluene and xylenes were detected in sample GWATER-1 at concentrations of 2.4 μg/l (micrograms per liter), 2.1 μg/l, 2.4 μg/l and 12 μg/l, respectively. Gasoline-range hydrocarbons were detected in sample GWATER-1 at a concentration of 0.97 mg/l (milligrams per liter). Benzene was not detected in sample GWATER-2; the detection level was 25 μg/l because of dilution during laboratory analysis. Ethylbenzene, toluene and xylenes were detected in sample GWATER-2 at concentrations of 200 μg/l, 44 μg/l and 520 μg/l, respectively. Gasoline-range hydrocarbons were detected in sample GWATER-2 at a concentration of 28 mg/l.

LABORATORY DATA EVALUATION

The laboratory data for the soil and ground water samples were reviewed by EcoChem (EcoChem, Inc.) to evaluate the types of petroleum compounds and products present in the samples. EcoChem's methodology and conclusions are presented in their report dated May 3, 1994, included in Appendix C. The apparent identities of the contaminants present in the soil samples, based on EcoChem's report, are summarized in Table 1.

Based on EcoChem's evaluation of the data, samples W-1, W-3 and W-4, obtained from the western portion of the north excavation wall appear to have contained a mixture of diesel fuel and motor oil. Sample W-2, also obtained from the western portion of the north excavation wall, appears to have contained a mixture of aged gasoline and motor oil. Sample W-10, obtained

from the eastern portion of the north excavation wall, also appears to have contained a mixture of diesel fuel and motor oil. Samples W-5, W-7 and W-8, obtained from the central portion of the north wall, appear to have contained a mixture of aged gasoline and motor oil. Sample W-6, obtained from the central portion of the north excavation wall, appears to have contained aged gasoline, although the very small concentration of the contaminant made identification difficult. Samples W-11 and W-12, obtained from the eastern portion of the north excavation wall, and samples B-3, B-6, B-9 and B-12, obtained from the base of the excavation, appear to have contained a mixture of aged gasoline and hydraulic oil. Based on EcoChem's review of the laboratory data, the aged gasoline which apparently was present in samples W-2, W-5, W-6, W-7, W-8, W-11, W-12, B-3, B-6, B-9 and B-12 is probably more than 30 years old. Based on an evaluation of the chromatograms for the samples, the aged gasoline present at the Rosen site appears to be dissimilar to the fresher gasoline present in the ground water at the Unocal site, as described in our upcoming ground water monitoring report. Based on the available laboratory results, it was not possible to identify the contaminants present in ground water grab samples GWATER-1 and GWATER-2.

LIMITATIONS

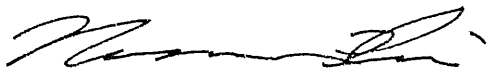
We have prepared this report for use by Unocal. This report is not intended for use by others and the information contained herein may not be applicable to other sites.

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.



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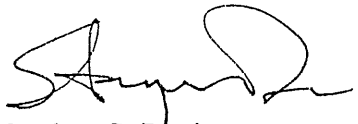
Environmental Engineer



Stephen C. Perrigo
Principal

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TABLE 1 (Page 1 of 2)
SUMMARY OF SOIL CHEMICAL ANALYTICAL DATA
ROSEN SITE EXCAVATION

Sample Number	Date Sampled	Sample Location	Elevation of Sample[1] (feet)	Field Screening Results[2] Headspace Vapors (ppm)	Sheen	BETX[3] (mg/kg) B	E	T	X	Gasoline-range Hydrocarbons[4] (mg/kg)	Diesel-range Hydrocarbons[5] (mg/kg)	Heavy Oil-range Hydrocarbons[5] (mg/kg)	Total Lead[6] (mg/kg)	Product Type[7]
W-1	10/11/93	North wall,west end	18.1	<100	SS	<0.028	<0.028	<0.028	<0.028	<6	21	45	25	D MO
W-2	10/11/93	North wall,west end	13.0	<100	SS	<0.031	<0.031	0.046	0.14	12	54	120	74	aG? MO
W-3	10/11/93	North wall,west end	10.5	260	MS	<0.16	0.19	<0.16	0.87	470	7,800	280	18	D MO
W-4	10/11/93	North wall,west end	9.5	120	HS	<0.030	<0.030	<0.030	0.063	44	210	<49	2.4	D MO
W-5	10/11/93	North wall,center	18.2	<100	SS	0.12	0.098	0.11	0.62	37	220	980	50	aG MO
W-6	10/11/93	North wall,center	13.4	200	MS	<0.027	<0.027	<0.027	0.036	6	<11	<42	6.0	aG?
W-7	10/11/93	North wall,center	10.7	640	HS	1.6	5.2	4.4	22	2,300	970	3,500	9.7	aG MO
W-8	10/11/93	North wall,center	9.1	200	HS	1.1	1.3	1.4	11	1,200	2,300	7,000	3.9	aG MO
W-9	10/11/93	North wall,east end	17.8	<100	SS	<0.028	<0.028	<0.028	<0.028	<6	<11	<44	4.3	None
W-10	10/11/93	North wall,east end	13.3	<100	SS	<0.027	<0.027	<0.027	0.076	35	42	<43	2.6	D MO
W-11[8]	10/11/93	North wall,east end	10.7	3,200	HS	0.69	6.7	2.8	19	2,300	280	<49	5.6	aG H
W-12	10/11/93	North wall,east end	9.7	3,800	HS	4.8	19	8.0	40	3,400	1,900	1,900	16	aG H
B-1	10/11/93	Base,northwest portion	9.8	<100	SS	--	--	--	--	--	--	--	--	
B-2	10/11/93	Base,northwest portion	9.1	<100	SS	--	--	--	--	--	--	--	--	
B-3	10/11/93	Base,northwest portion	8.7	<100	SS	<0.12	0.27	0.30	1.2	250	490	1,700	14	aG H
B-4	10/11/93	Base,central portion	10.0	<100	SS	--	--	--	--	--	--	--	--	
B-5	10/11/93	Base,central portion	9.5	1,800	HS	--	--	--	--	--	--	--	--	
B-6	10/11/93	Base,central portion	8.8	4,700	HS	<1.6[9]	21	6.4	110	5,400	2,900	2,200	68	aG H
B-7	10/11/93	Base,southeast portion	10.8	1,000	HS	--	--	--	--	--	--	--	--	
B-8	10/11/93	Base,southeast portion	10.1	1,300	HS	--	--	--	--	--	--	--	--	
B-9	10/11/93	Base,southeast portion	9.6	2,200	HS	1.3	14	5.6	55	3,800	3,700	3,400	46	aG H
B-10	10/11/93	Base,southeast portion	9.7	<100	NS	--	--	--	--	--	--	--	--	
B-11	10/11/93	Base,southeast portion	8.9	130	SS	--	--	--	--	--	--	--	--	
B-12	10/11/93	Base,southeast portion	7.9	200	SS	<0.069	<0.069	0.12	<0.069	<14	73	270	120	aG H
MTCA Method A Soil Cleanup Level						0.5	20	40	20	100	200	200	250	

Notes appear on page 2 of 2.

TABLE 1 (Page 2 of 2)

Notes:

[1]Sample elevations are with respect to a temporary benchmark at the ground surface near MW-40.

[2]See Appendix A for a description of field screening methods. NS = no sheen, SS = slight sheen, MS = moderate sheen, HS = heavy sheen.

[3]Analyzed by EPA Method 8020. B = benzene, E = ethylbenzene, T = toluene, X = xylenes.

[4]Analyzed by Ecology Method WTPH-G.

[5]Analyzed by Ecology Method WTPH-D (extended range, through n-C_{34}).

[6]Analyzed by EPA Method 6010.

[7]Evaluated by inspection of chromatograms by EcoChem. G = gasoline, aG = aged gasoline, D = diesel, MO = motor oil, H = hydraulic oil.

[8]Sample also was analyzed for HVOCs (halogenated volatile organic compounds) by EPA Method 8010. No HVOCs were detected.

[9]Laboratory detection level exceeds the MTCA Method A cleanup level.

Shading indicates concentration exceeding the MTCA Method A soil cleanup level.

ppm = parts per million

mg/kg = milligrams per kilogram

'--' = not tested

TABLE 2
SUMMARY OF EXCAVATION GROUND WATER CHEMICAL ANALYTICAL DATA

Sample Number	Sample Location	Sample Type	Date Sampled	BETX[1] (µg/l)				Gasoline-range Hydrocarbons[2] (mg/l)	Diesel-range Hydrocarbons[3] (mg/l)	Heavy Oil-range Hydrocarbons[3] (mg/l)
				B	E	T	X			
GWATER-1	Excavation base, northwest portion	Ground water grab sample from hand boring	10/11/93	2.4	2.1	2.4	12	0.97	–	–
GWATER-2	Excavation base, southeast portion	Ground water grab sample from hand boring	10/11/93	<25[4]	200	44	520	28	–	–
MTCA Method A Ground Water Cleanup Level				5	30	40	20	1.0[5]		

Notes:

[1]Analyzed by EPA Method 8020. B = benzene, E = ethylbenzene, T = toluene, X = xylenes.

[2]Analyzed by Ecology Method WTPH-G.

[3]Analyzed by Ecology Method WTPH-D (extended range, through N-C_{24}).

[4]Laboratory detection level exceeds the MTCA Method A cleanup level.

[5]The MTCA Method A ground water cleanup level for the sum of gasoline-, diesel- and heavy oil-range hydrocarbons is 1.0 mg/l if the carbon ranges are distinctly quantified using gas chromatography methods.

µg/l = micrograms per liter

mg/l = milligrams per liter

Shading indicates concentration exceeding the MTCA Method A ground water cleanup level.

EXPLANATION:

MW-2 ● MONITORING WELL INSTALLED IN 1980

MW-33 ◑ MONITORING WELL INSTALLED IN 1991 OR 1992

SMW-2S ⊗ MONITORING WELL INSTALLED BY SCS

N

0 80 160

SCALE IN FEET

VALLEY STREET

MERCER STREET

TERRY AVENUE NORTH

MW-38 MW-46 MW-36

MW-47 Denny's Restaurant

MW-48

Unocal Property Line

MW-29

MW-40

Rosen Site

Remedial Excavation

MW-45

City of Seattle Property

MW-32

MW-49

MW-3

MW-33

MW-35

MW-19

MW-37

MW-18

SMW-1S

MW-2

Unocal SS-5353

SMW-3

SMW-4

SMW-5

MW-32A

MW-34

MW-24

SMW-2S

MW-1

City Park

MW-11 MW-42 MW-27 MW-17 MW-13

MW-41

WESTLAKE AVENUE NORTH

MW-14 MW-15 MW-16 MW-43

MW-44

WESTLAKE AVENUE NORTH

BROAD STREET

MW-39

SMW-2

Note: The locations of all features shown are approximate.

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SITE VICINITY AND MONITORING WELL LOCATIONS

FIGURE 1

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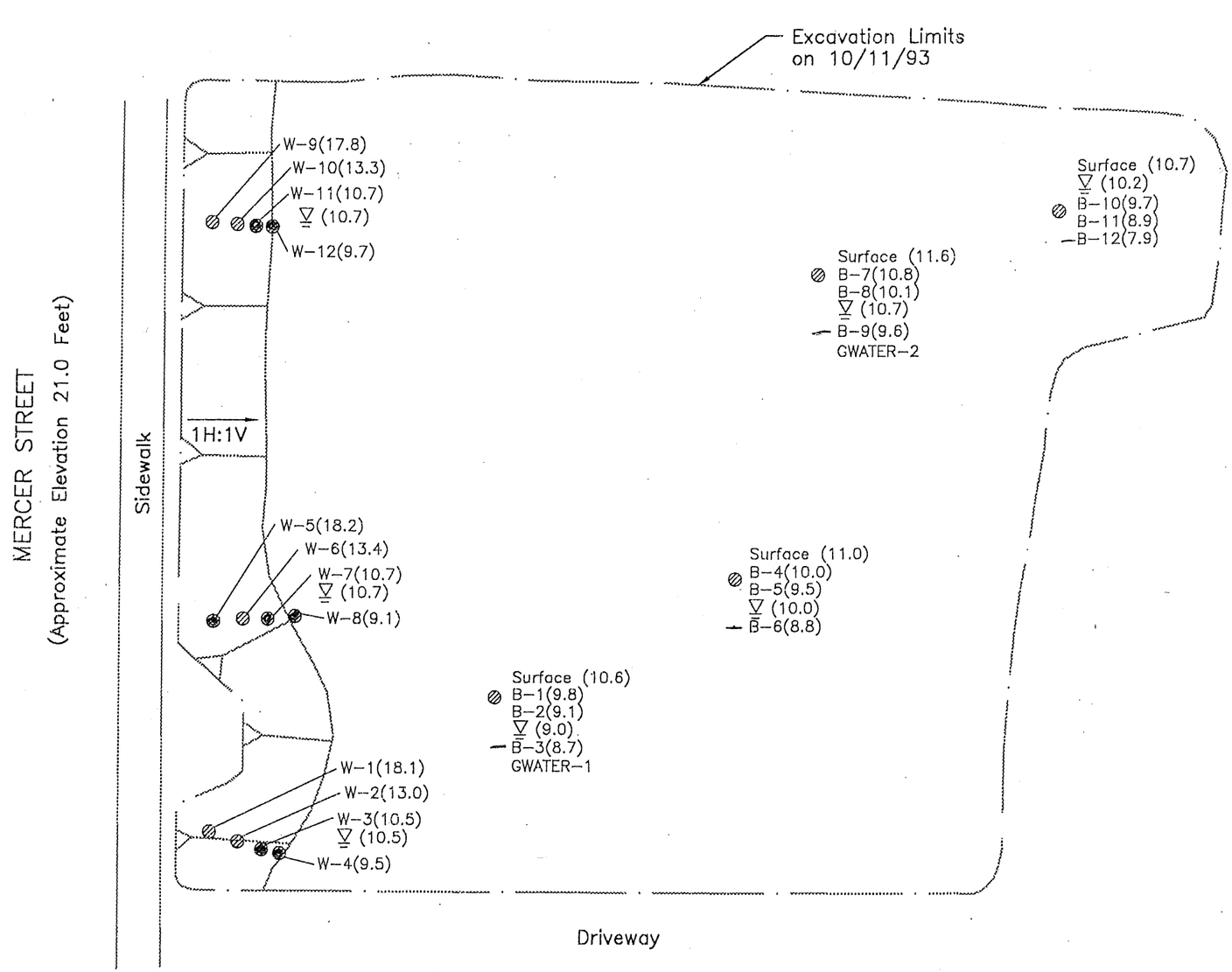

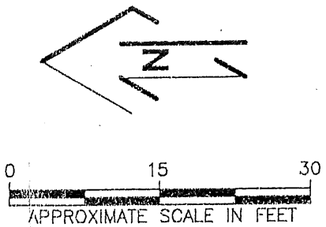

EXPLANATION:

W-1(18.1) ⊘ SOIL SAMPLE (APPROXIMATE ELEVATION OF SAMPLE)

(10.5) ▽ GROUND WATER OBSERVED DURING SAMPLING (APPROXIMATE ELEVATION)

Note: 1. The locations of all features shown are approximate.

2. Elevations are referenced to ground surface elevation near MW-40.

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EXCAVATION LIMITS AND SOIL SAMPLE LOCATIONS
ROSEN SITE

FIGURE 2

NLP:ANG:KKT 013B001.DWG 0161013R69:020194

APPENDIX A

APPENDIX A

FIELD METHODS

SOIL SAMPLING PROCEDURES

Representatives from GeoEngineers' staff determined the sampling locations based on a predetermined sampling plan, and examined and classified the soils encountered. Soil sample numbers, approximate locations, field screening and chemical analytical results are summarized in Table 1. Samples were obtained with a hand auger from the western, central and eastern portions of north wall of the excavation at depths of approximately 3 feet, 8 feet, 10 feet and 11.5 below ground surface from each location. The hand auger was advanced approximately 1 foot into the wall at each sampling location to obtain relatively fresh samples. Samples also were obtained from the base of the excavation at four locations, from three discrete depths at each location. The hand auger and nitrile gloves were decontaminated before each sampling attempt with a TSP solution wash and a distilled water rinse. The elevations of the sample locations were surveyed with respect to Mercer Street using an engineer's level.

Each sample was separated into two portions. The first portion was removed from the hand auger and placed directly in a laboratory-prepared sample jar, which subsequently was placed in a cooler with ice. The samples were kept cool during transport to the testing laboratory. Chain-of-custody procedures were followed. The laboratory report is included in Appendix B. The second portion was removed from the hand auger and placed in a plastic bag for field screening.

FIELD SCREENING

A GeoEngineers representative field screened soil samples obtained from the hand-augered borings. Field screening results are used as a general guideline to delineate areas of possible petroleum-related contamination. In addition, screening results are used to aid in the selection of soil samples for chemical analysis. The screening methods used include (1) visual screening, (2) water sheen screening and (3) headspace vapor screening. Field screening results are site-specific. Field screening results vary with temperature, moisture content, organic content, soil type, and type and age of contaminant.

Visual screening consists of inspecting the soil for stains indicative of petroleum-related contamination. Visual screening is generally more effective when contamination is related to heavy petroleum hydrocarbons, such as motor oil, or when hydrocarbon concentrations are high.

Water sheen screening and headspace vapor screening are more sensitive methods that have been effective in detecting contamination at concentrations less than regulatory cleanup guidelines. The presence or absence of a sheen or headspace vapors does not necessarily indicate the presence or absence of petroleum hydrocarbons.

Water sheen screening involves placing soil in water and observing the water surface for signs of sheen. Sheen screening may detect both volatile and nonvolatile petroleum hydrocarbons. Sheens observed are classified as follows:

No Sheen (NS)	No visible sheen on water surface.
Slight Sheen (SS)	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly. Natural organic matter in the soil may produce a slight sheen.
Moderate Sheen (MS)	Light to heavy sheen; may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on water surface.
Heavy Sheen (HS)	Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen.

Headspace vapor screening involves placing a soil sample in a plastic sample bag. Air is captured in the bag, and the bag is shaken to expose the soil to the air trapped in the bag. The probe of a Bacharach TLV Sniffer is inserted in the bag, and the TLV Sniffer measures the concentration of combustible vapors present within the sample bag headspace. Headspace vapor screening targets volatile petroleum hydrocarbon compounds. The TLV Sniffer measures combustible vapor concentrations in ppm (parts per million) and is calibrated to hexane. The TLV Sniffer is designed to quantify combustible gas concentrations up to 10,000 ppm.

GROUND WATER SAMPLING

Water samples GWATER-1 and GWATER-2 were obtained from uncased hand auger holes completed the base of the excavation for soil sampling on October 11, 1993. Each sample was obtained by submerging a laboratory-prepared 40-milliliter sample VOA and filling it from the water in the hand auger hole. The samples were kept cool during transport to the testing laboratory. Chemical analytical results are presented in Table 2. The laboratory report is included in Appendix B.

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: "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.

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

ATI I.D. # 9310-110

GeoEngineers

NOV 03 1993

Routing NLP

File

November 2, 1993

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

Attention : Norm Puri

Project Number : 0161-013-R69

Project Name : Unocal - West Lake & Mercer

Dear Mr. Puri:

On October 12, 1993, Analytical Technologies, Inc. (ATI), received 18 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/ms

Enclosure

Analytical Technologies, Inc.

ATI I.D. # 9310-110

SAMPLE CROSS REFERENCE SHEET

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
PROJECT NAME : UNOCAL - WL&M

ATI #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
9310-110-1	W-1	10/11/93	SOIL
9310-110-2	W-2	10/11/93	SOIL
9310-110-3	W-3	10/11/93	SOIL
9310-110-4	W-4	10/11/93	SOIL
9310-110-5	W-5	10/11/93	SOIL
9310-110-6	W-6	10/11/93	SOIL
9310-110-7	W-7	10/11/93	SOIL
9310-110-8	W-8	10/11/93	SOIL
9310-110-9	W-9	10/11/93	SOIL
9310-110-10	W-10	10/11/93	SOIL
9310-110-11	W-11	10/11/93	SOIL
9310-110-12	W-12	10/11/93	SOIL
9310-110-13	B-3	10/11/93	SOIL
9310-110-14	B-6	10/11/93	SOIL
9310-110-15	B-9	10/11/93	SOIL
9310-110-16	B-12	10/11/93	SOIL
9310-110-17	GWATER-1	10/11/93	WATER
9310-110-18	GWATER-2	10/11/93	WATER

----- TOTALS -----

MATRIX	# SAMPLES
SOIL	16
WATER	2

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.

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110

ANALYTICAL SCHEDULE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
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
LEAD	ICAP	EPA 6010	R
MOISTURE	GRAVIMETRIC	CLP SOW ILM01.0	R

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

Analytical Technologies, Inc.

ATI I.D. # 9310-110

CASE NARRATIVE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
PROJECT NAME : UNOCAL - WL&M

CASE NARRATIVE: VOLATILE ORGANICS ANALYSIS

One (1) soil sample was received by ATI on October 12, 1993, for the following analysis: EPA method 8010.

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R69	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	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8010	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BROMODICHLOROMETHANE	<0.010
BROMOFORM	<0.010
BROMOMETHANE	<0.050
CARBON TETRACHLORIDE	<0.010
CHLOROBENZENE	<0.025
CHLOROETHANE	<0.050
CHLOROFORM	<0.010
CHLOROMETHANE	<0.10
1,2-DIBROMOETHANE (EDB)	<0.025
1,2-DICHLOROBENZENE	<0.025
1,3-DICHLOROBENZENE	<0.025
1,4-DICHLOROBENZENE	<0.025
DIBROMOCHLOROMETHANE	<0.010
1,1-DICHLOROETHANE	<0.010
1,2-DICHLOROETHANE	<0.010
1,1-DICHLOROETHENE	<0.010
CIS-1,2-DICHLOROETHENE	<0.010
TRANS-1,2-DICHLOROETHENE	<0.010
1,2-DICHLOROPROPANE	<0.010
CIS-1,3-DICHLOROPROPENE	<0.010
TRANS-1,3-DICHLOROPROPENE	<0.010
METHYLENE CHLORIDE	<0.10
1,1,2,2-TETRACHLOROETHANE	<0.010
TETRACHLOROETHENE	<0.010
1,1,1-TRICHLOROETHANE	<0.010
1,1,2-TRICHLOROETHANE	<0.010
TRICHLOROETHENE	<0.010
TRICHLOROFLUOROMETHANE	<0.025
VINYL CHLORIDE	<0.050

SURROGATE PERCENT RECOVERY		LIMITS
BROMOCHLOROMETHANE	103	38 - 140

Analytical Technologies, Inc.

ATI I.D. # 9310-110-11

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/18/93
CLIENT I.D.	: W-11	DATE ANALYZED	: 10/18/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8010	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BROMODICHLOROMETHANE	<0.012
BROMOFORM	<0.012
BROMOMETHANE	<0.062
CARBON TETRACHLORIDE	<0.012
CHLOROBENZENE	<0.031
CHLOROETHANE	<0.062
CHLOROFORM	<0.012
CHLOROMETHANE	<0.12
1,2-DIBROMOETHANE (EDB)	<0.031
1,2-DICHLOROBENZENE	<0.031
1,3-DICHLOROBENZENE	<0.031
1,4-DICHLOROBENZENE	<0.031
DIBROMOCHLOROMETHANE	<0.012
1,1-DICHLOROETHANE	<0.012
1,2-DICHLOROETHANE	<0.012
1,1-DICHLOROETHENE	<0.012
CIS-1,2-DICHLOROETHENE	<0.012
TRANS-1,2-DICHLOROETHENE	<0.012
1,2-DICHLOROPROPANE	<0.012
CIS-1,3-DICHLOROPROPENE	<0.012
TRANS-1,3-DICHLOROPROPENE	<0.012
METHYLENE CHLORIDE	<0.12
1,1,2,2-TETRACHLOROETHANE	<0.012
TETRACHLOROETHENE	<0.012
1,1,1-TRICHLOROETHANE	<0.012
1,1,2-TRICHLOROETHANE	<0.012
TRICHLOROETHENE	<0.012
TRICHLOROFLUOROMETHANE	<0.031
VINYL CHLORIDE	<0.062

SURROGATE PERCENT RECOVERY		LIMITS
BROMOCHLOROMETHANE	74	38 - 140

Analytical Technologies, Inc.

ATI I.D. # 9310-110

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : SOIL
EPA METHOD : 8010

SAMPLE I.D. # : 9310-110-11
DATE EXTRACTED : 10/18/93
DATE ANALYZED : 10/18/93
UNITS : mg/Kg

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
CHLOROBENZENE	<0.0250	0.400	0.399	100	0.399	100	0
1,1-DICHLOROETHENE	<0.0100	0.400	0.425	106	0.444	111	4
TRICHLOROETHENE	<0.0100	0.400	0.390	98	0.401	100	3

CONTROL LIMITS	% REC.	RPD
CHLOROBENZENE	55 - 166	20
1,1-DICHLOROETHENE	35 - 141	22
TRICHLOROETHENE	49 - 139	24

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOCHLOROMETHANE	80	81	38 - 140

Analytical Technologies, Inc.

ATI I.D. # 9310-110

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT	: GEOENGINEERS, INC.	SAMPLE I.D. #	: BLANK
PROJECT #	: 0161-013-R69	DATE EXTRACTED	: 10/18/93
PROJECT NAME	: UNOCAL - WL&M	DATE ANALYZED	: 10/18/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8010		

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
CHLOROBENZENE	<0.0250	0.400	0.419	105	N/A	N/A	N/A
1,1-DICHLOROETHENE	<0.0100	0.400	0.467	117	N/A	N/A	N/A
TRICHLOROETHENE	<0.0100	0.400	0.418	105	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
CHLOROBENZENE	71 - 163	20
1,1-DICHLOROETHENE	51 - 161	22
TRICHLOROETHENE	55 - 146	24

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOCHLOROMETHANE	89	N/A	38 - 140

Analytical Technologies, Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R69	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/12/93
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. # 9310-110

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R69	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/13/93
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	106	76 - 120
TRIFLUOROTOLUENE	100	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-110-17

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: GWATER-1	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BENZENE	2.4
ETHYLBENZENE	2.1
TOLUENE	2.4
TOTAL XYLENES	12
FUEL HYDROCARBONS	970
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	110	76 - 120
TRIFLUOROTOLUENE	103	50 - 150

Analytical**Technologies,**Inc.

ATI I.D. # 9310-110-18

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: N/A
CLIENT I.D.	: GWATER-2	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 50

COMPOUNDS	RESULTS
BENZENE	<25
ETHYLBENZENE	200
TOLUENE	44
TOTAL XYLENES	520
FUEL HYDROCARBONS	28000
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	109	76 - 120
TRIFLUOROTOLUENE	97	50 - 150

Analytical**Technologies,**Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT	: GEOENGINEERS, INC.	SAMPLE I.D. #	: 9310-107-11
PROJECT #	: 0161-013-R69	DATE EXTRACTED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)		

COMPOUND	SAMPLE RESULT	SAMPLE DUP. RESULT	RPD	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
GASOLINE	<100	<100	NC	N/A	N/A	N/A	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
GASOLINE	N/A	20

SURROGATE RECOVERIES	SAMPLE	SAMPLE DUP.	LIMITS
TRIFLUOROTOLUENE	102	97	50 - 150

NC = Not Calculable.

Analytical Technologies, Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT	: GEOENGINEERS, INC.	SAMPLE I.D. #	: 9310-107-9
PROJECT #	: 0161-013-R69	DATE EXTRACTED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: WATER	UNITS	: ug/L
METHOD	: WA DOE WTPH-G/8020(BETX)		

COMPOUND	SAMPLE RESULT	SAMPLE DUP. RESULT	RPD	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
BENZENE	<0.500	N/A	N/A	20.0	19.1	96	19.0	95	1
TOLUENE	<0.500	N/A	N/A	20.0	20.4	102	20.1	101	1
TOTAL XYLENES	<0.500	N/A	N/A	40.0	40.7	102	40.3	101	1
GASOLINE	<100	<100	NC	1000	1030	103	1040	104	1

CONTROL LIMITS	% REC.	RPD
BENZENE	77 - 112	20
TOLUENE	72 - 113	20
TOTAL XYLENES	80 - 110	20
GASOLINE	58 - 127	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOFLUOROBENZENE	110	110	76 - 120
TRIFLUOROTOLUENE	102	102	50 - 150

NC = Not Calculable.

Analytical Technologies, Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
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 : 10/12/93
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	<0.500	20.0	19.5	98	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	40.9	102	N/A	N/A	N/A
GASOLINE	<100	1000	1070	107	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

Analytical Technologies, Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
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 : 10/13/93
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	<0.500	20.0	19.4	97	19.0	95	2
TOLUENE	<0.500	20.0	20.5	102	20.1	101	2
TOTAL XYLENES	<0.500	40.0	40.9	102	40.1	100	2
GASOLINE	<100	1000	1040	104	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	109	109	76 - 120
TRIFLUOROTOLUENE	103	N/A	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-110

CASE NARRATIVE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
PROJECT NAME : UNOCAL - WL&M

CASE NARRATIVE: BETX - GASOLINE ANALYSIS

Sixteen (16) soil samples were received by ATI on October 12, 1993, for BETX analysis according to EPA method 8020 and gasoline range hydrocarbons according to WA DOE WTPH-G.

The surrogate recoveries of bromofluorobenzene for samples 9310-110-3 (W-3), 9310-110-7 (W-7), 9310-110-8 (W-8), 9310-110-11 (W-11), 9310-110-12 (W-12), 9310-110-14 (B-6) and 9310-110-15 (B-9) were outside the ATI established control limits due to matrix interference.

The surrogate recovery of trifluorotoluene for sample 9310-110-15 (B-9) was outside the ATI established control limits due to matrix interference.

Analytical Technologies, Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 0161-013-R69	DATE RECEIVED	: N/A
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.025
ETHYLBENZENE	<0.025
TOLUENE	<0.025
TOTAL XYLENES	<0.025
FUEL HYDROCARBONS	<5
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	99	52 - 116
TRIFLUOROTOLUENE	97	50 - 150

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110-1

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-1	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.028
ETHYLBENZENE	<0.028
TOLUENE	<0.028
TOTAL XYLENES	<0.028
FUEL HYDROCARBONS	<6
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	84	52 - 116
TRIFLUOROTOLUENE	67	50 - 150

AnalyticalTechnologies, Inc.

ATI I.D. # 9310-110-2

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-2	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.031
ETHYLBENZENE	<0.031
TOLUENE	0.046
TOTAL XYLENES	0.14
FUEL HYDROCARBONS	12
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	91	52 - 116
TRIFLUOROTOLUENE	72	50 - 150

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110-3

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-3	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 5

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.16
ETHYLBENZENE	0.19
TOLUENE	<0.16
TOTAL XYLENES	0.87
FUEL HYDROCARBONS	470
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	144 F	52 - 116
TRIFLUOROTOLUENE	88	50 - 150

F = Out of limits due to matrix interference.

Analytical Technologies, Inc.

ATI I.D. # 9310-110-4

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-4	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.030
ETHYLBENZENE	<0.030
TOLUENE	<0.030
TOTAL XYLENES	0.063
FUEL HYDROCARBONS	44
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	88	52 - 116
TRIFLUOROTOLUENE	71	50 - 150

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110-5

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-5	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	0.12
ETHYLBENZENE	0.098
TOLUENE	0.11
TOTAL XYLENES	0.62
FUEL HYDROCARBONS	37
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	102	52 - 116
TRIFLUOROTOLUENE	86	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-110-6

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-6	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.027
ETHYLBENZENE	<0.027
TOLUENE	<0.027
TOTAL XYLENES	0.036
FUEL HYDROCARBONS	6
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	95	52 - 116
TRIFLUOROTOLUENE	82	50 - 150

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110-7

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-7	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 50

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	1.6
ETHYLBENZENE	5.2
TOLUENE	4.4
TOTAL XYLENES	22
FUEL HYDROCARBONS	2300
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	F	52 - 116
TRIFLUOROTOLUENE	126	50 - 150

F = Out of limits due to matrix interference.

Analytical**Technologies,**Inc.

ATI I.D. # 9310-110-8

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-8	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 5

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	1.1
ETHYLBENZENE	1.3
TOLUENE	1.4
TOTAL XYLENES	11
FUEL HYDROCARBONS	1200
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	F	52 - 116
TRIFLUOROTOLUENE	81	50 - 150

F = Out of limits due to matrix interference.

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110-9

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-9	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.028
ETHYLBENZENE	<0.028
TOLUENE	<0.028
TOTAL XYLENES	<0.028
FUEL HYDROCARBONS	<6
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	82	52 - 116
TRIFLUOROTOLUENE	80	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-110-10

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-10	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.027
ETHYLBENZENE	<0.027
TOLUENE	<0.027
TOTAL XYLENES	0.076
FUEL HYDROCARBONS	35
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	95	52 - 116
TRIFLUOROTOLUENE	79	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-110-11

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-11	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 20

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	0.69
ETHYLBENZENE	6.7
TOLUENE	2.8
TOTAL XYLENES	19
FUEL HYDROCARBONS	2300
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	F	52 - 116
TRIFLUOROTOLUENE	100	50 - 150

F = Out of limits due to matrix interference.

Analytical Technologies, Inc.

ATI I.D. # 9310-110-12

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: W-12	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 50

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	4.8
ETHYLBENZENE	19
TOLUENE	8.0
TOTAL XYLENES	40
FUEL HYDROCARBONS	3400
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	F	52 - 116
TRIFLUOROTOLUENE	135	50 - 150

F = Out of limits due to matrix interference.

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110-13

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: B-3	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.12
ETHYLBENZENE	0.27
TOLUENE	0.30
TOTAL XYLENES	1.2
FUEL HYDROCARBONS	250
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	89	52 - 116
TRIFLUOROTOLUENE	71	50 - 150

Analytical**Technologies,**Inc.

ATI I.D. # 9310-110-14

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: B-6	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 10

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<1.6
ETHYLBENZENE	21
TOLUENE	6.4
TOTAL XYLENES	110
FUEL HYDROCARBONS	5400
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	F	52 - 116
TRIFLUOROTOLUENE	60	50 - 150

F = Out of limits due to matrix interference.

AnalyticalTechnologies,Inc.

ATI I.D. # 9310-110-15

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: B-9	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 5

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	1.3
ETHYLBENZENE	14
TOLUENE	5.6
TOTAL XYLENES	55
FUEL HYDROCARBONS	3800
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	124 F	52 - 116
TRIFLUOROTOLUENE	41 F	50 - 150

F = Out of limits due to matrix interference.

Analytical Technologies, Inc.

ATI I.D. # 9310-110-16

BETX - GASOLINE
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 10/11/93
PROJECT #	: 0161-013-R69	DATE RECEIVED	: 10/12/93
PROJECT NAME	: UNOCAL - WL&M	DATE EXTRACTED	: 10/13/93
CLIENT I.D.	: B-12	DATE ANALYZED	: 10/14/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
BENZENE	<0.069
ETHYLBENZENE	<0.069
TOLUENE	0.12
TOTAL XYLENES	<0.069
FUEL HYDROCARBONS	<14
HYDROCARBON RANGE	TOLUENE TO DODECANE
HYDROCARBON QUANTITATION USING	GASOLINE

SURROGATE PERCENT RECOVERY		LIMITS
BROMOFLUOROBENZENE	59	52 - 116
TRIFLUOROTOLUENE	54	50 - 150

Analytical Technologies, Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : SOIL
METHOD : WA DOE WTPH-G/8020(BETX)

SAMPLE I.D. # : 9310-110-1
DATE EXTRACTED : 10/13/93
DATE ANALYZED : 10/13/93
UNITS : mg/Kg

COMPOUND	SAMPLE RESULT	SAMPLE DUP. RESULT	RPD	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
GASOLINE	<5.00	<5.00	NC	N/A	N/A	N/A	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
GASOLINE	N/A	20

SURROGATE RECOVERIES	SAMPLE	SAMPLE DUP.	LIMITS
TRIFLUOROTOLUENE	67	88	50 - 150

NC = Not Calculable.

Analytical**Technologies**, Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 0161-013-R69
PROJECT NAME : UNOCAL - WL&M
SAMPLE MATRIX : SOIL
METHOD : WA DOE WTPH-G/8020(BETX)

SAMPLE I.D. # : 9310-110-9
DATE EXTRACTED : 10/13/93
DATE ANALYZED : 10/13/93
UNITS : mg/Kg

COMPOUND	SAMPLE RESULT	SAMPLE DUP. RESULT	RPD	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
BENZENE	<0.0250	N/A	N/A	1.00	0.939	94	0.942	94	0
TOLUENE	<0.0250	N/A	N/A	1.00	0.987	99	0.993	99	1
TOTAL XYLENES	<0.0250	N/A	N/A	2.00	2.01	100	2.02	101	0
GASOLINE	<5.00	<5.00	NC	50.0	44.5	89	43.6	87	2

CONTROL LIMITS	% REC.	RPD
BENZENE	35 - 113	20
TOLUENE	43 - 107	20
TOTAL XYLENES	46 - 114	20
GASOLINE	50 - 112	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOFLUOROBENZENE	87	88	52 - 116
TRIFLUOROTOLUENE	88	90	50 - 150

NC = Not Calculable.

Analytical**Technologies,** Inc.

ATI I.D. # 9310-110

BETX - GASOLINE
QUALITY CONTROL DATA

CLIENT	: GEOENGINEERS, INC.	SAMPLE I.D. #	: BLANK
PROJECT #	: 0161-013-R69	DATE EXTRACTED	: 10/13/93
PROJECT NAME	: UNOCAL - WL&M	DATE ANALYZED	: 10/13/93
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: WA DOE WTPH-G/8020(BETX)		

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	<0.0250	1.00	1.04	104	N/A	N/A	N/A
TOLUENE	<0.0250	1.00	1.08	108	N/A	N/A	N/A
TOTAL XYLENES	<0.0250	2.00	2.17	109	N/A	N/A	N/A
GASOLINE	<5.00	50.0	53.5	107	N/A	N/A	N/A

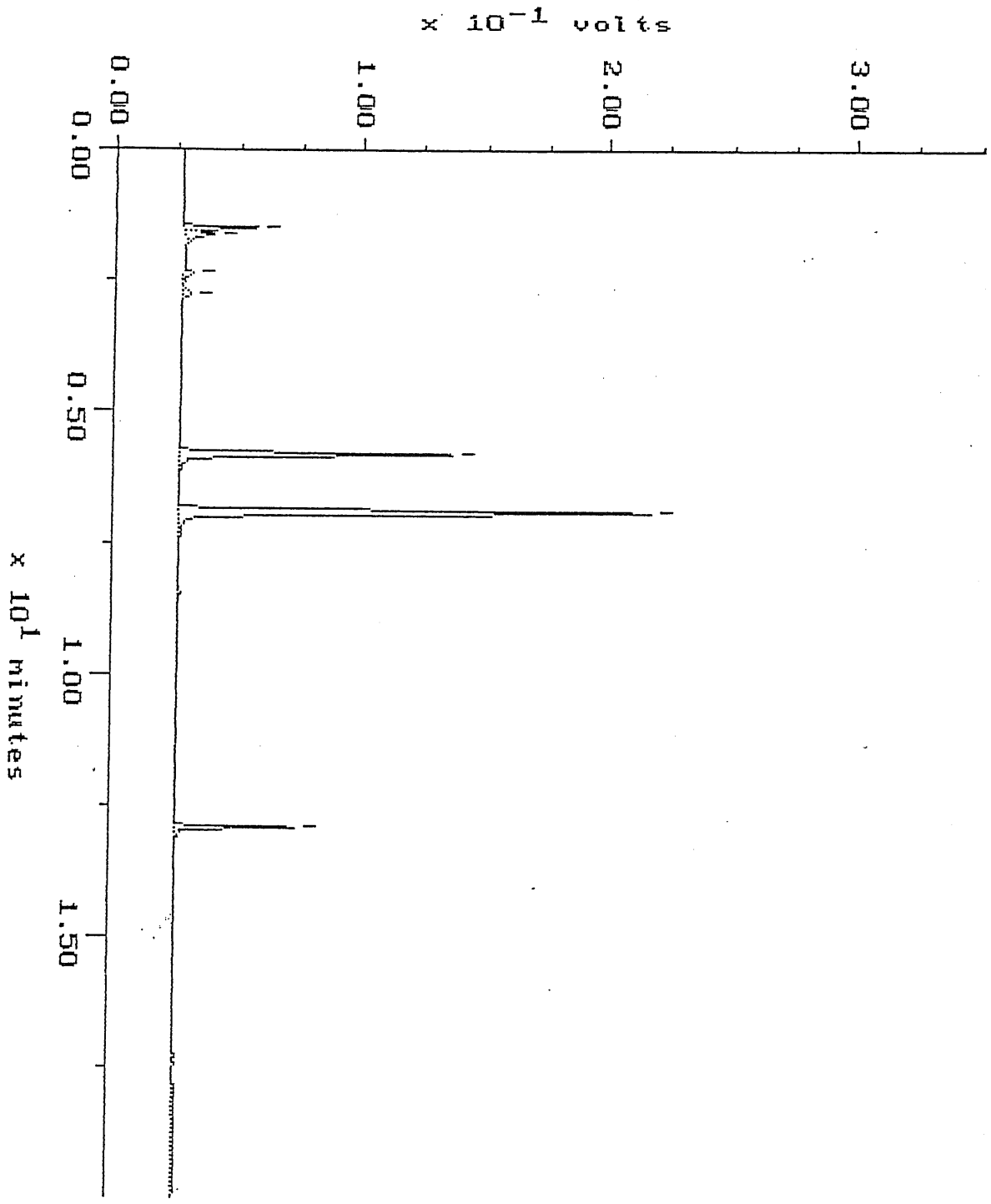
CONTROL LIMITS	% REC.	RPD
BENZENE	63 - 115	20
TOLUENE	75 - 110	20
TOTAL XYLENES	79 - 109	20
GASOLINE	80 - 119	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
BROMOFLUOROBENZENE	101	N/A	52 - 116
TRIFLUOROTOLUENE	99	N/A	50 - 150

WA DOE WTPH-G

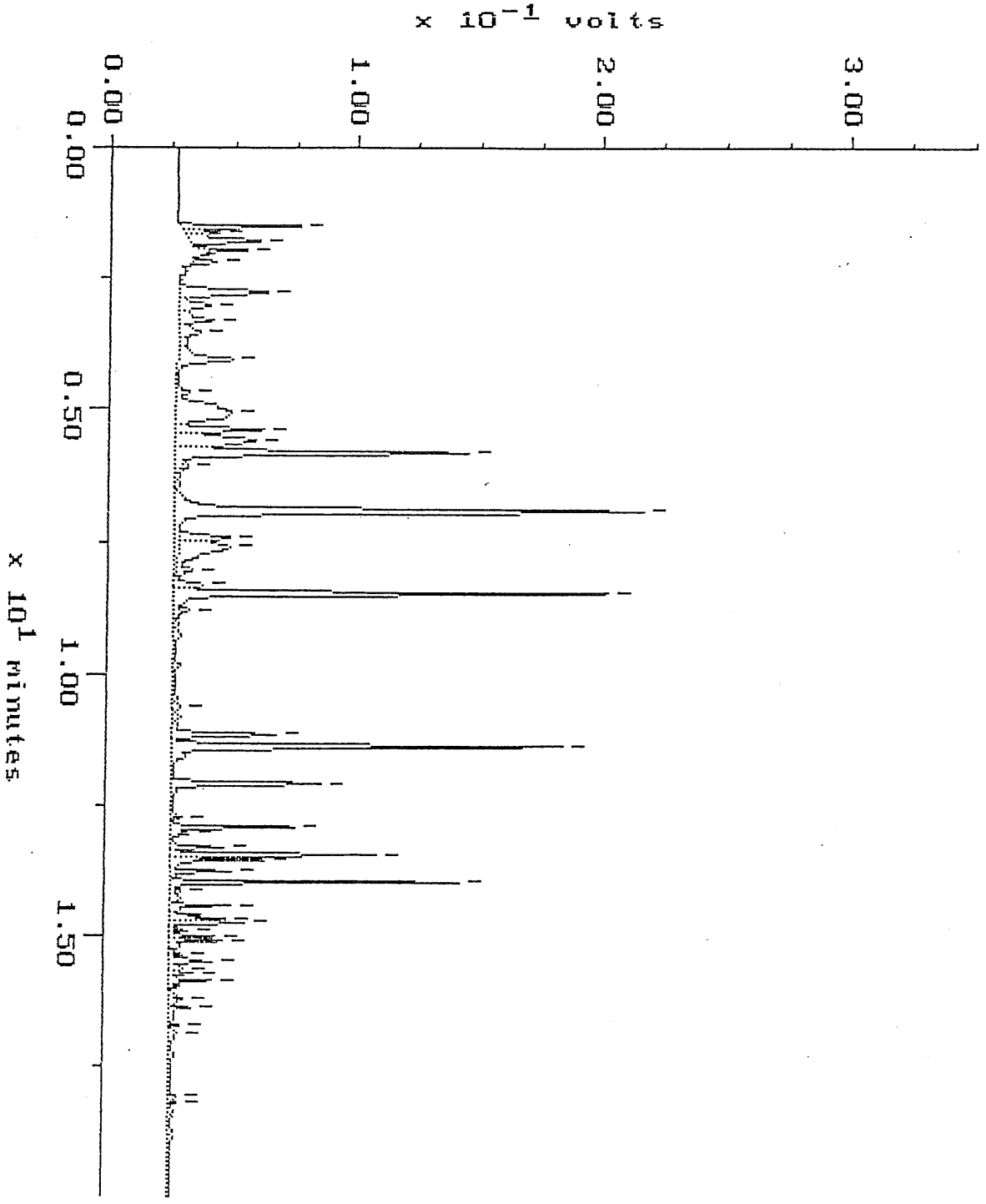
Blank

Sample: WRB 10-12 Channel: FID Filename: RA129P03
Acquired: 12-OCT-93 9:03 Method: F:\BRD2\MAXDATA\PICARD\101293PC Operator: ATI
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.



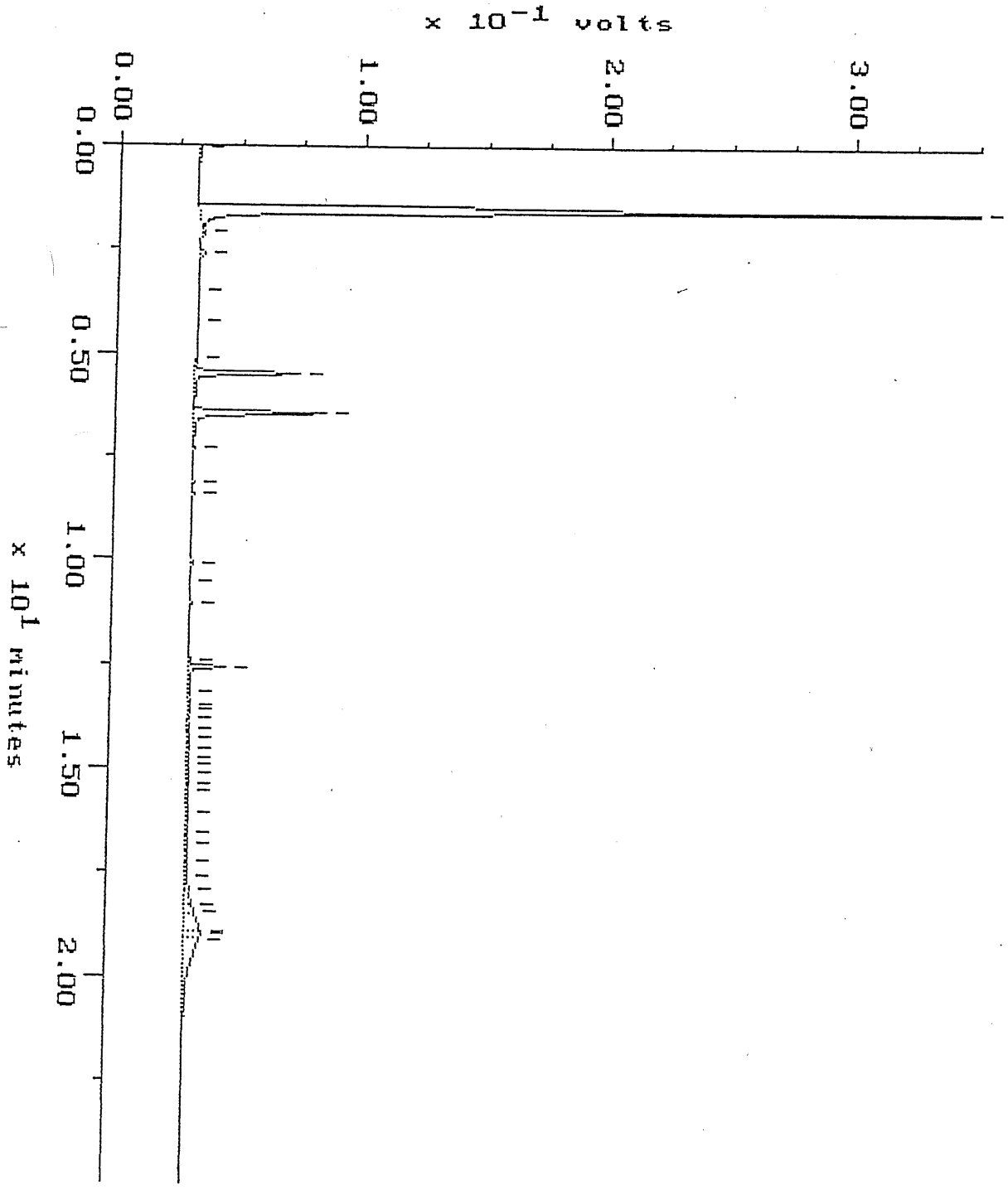
Continuing Calibration

Sample: STD-C 6 Channel: FID Filename: RA119P42
Acquired: 12-OCT-93 6:07 Method: F:\BRO2\MAXDATA\PICARD\101193PC Operator: ATI
Comments: ATI FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY.



WA DOE WTPH-G

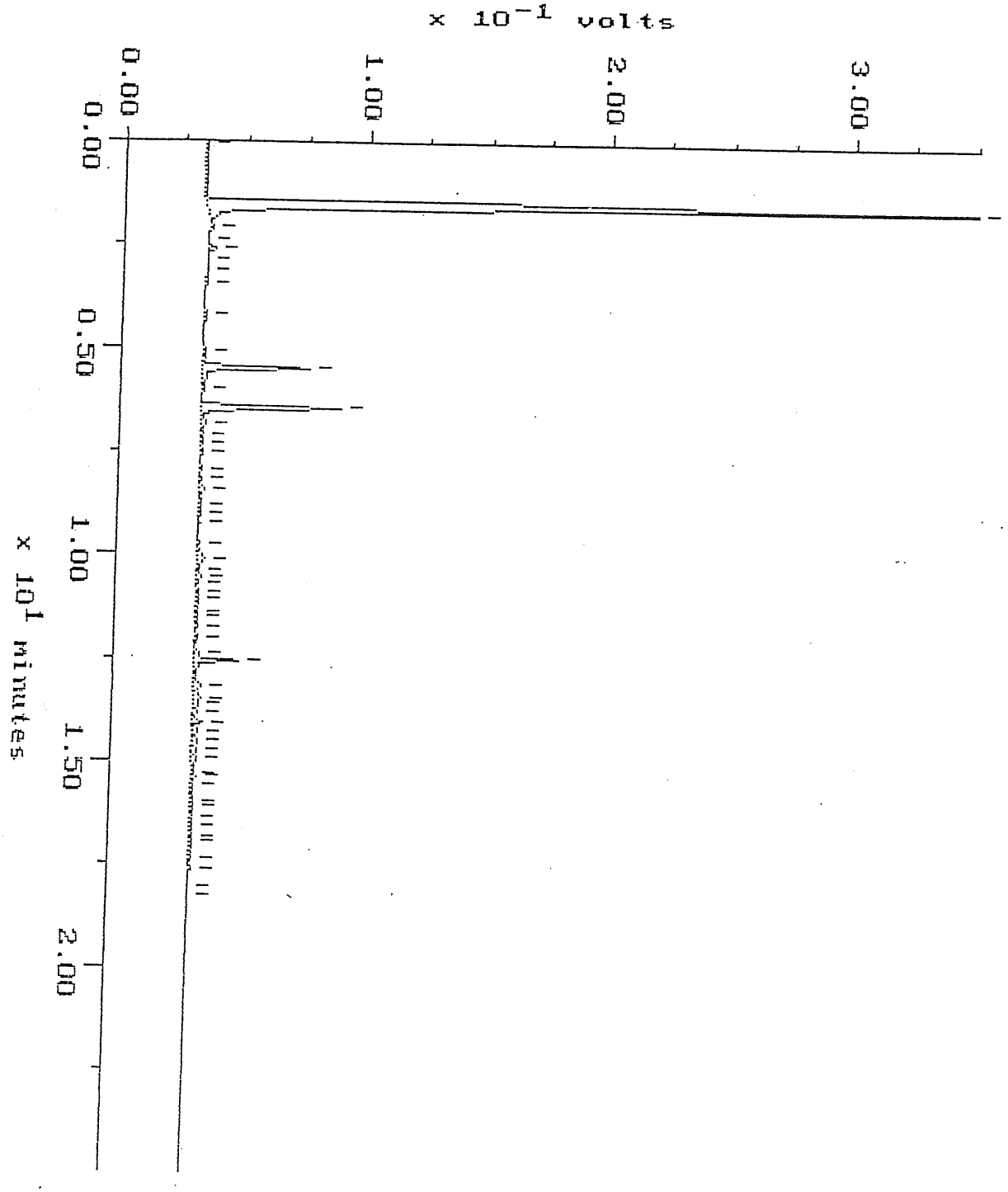
Sample: 9310-110-1 Channel: FID Filename: RA139G33
Acquired: 13-OCT-93 23:46 Method: F:\BRO2\MAXDATA\GLAD\101393GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



WA DOE WTPH-G

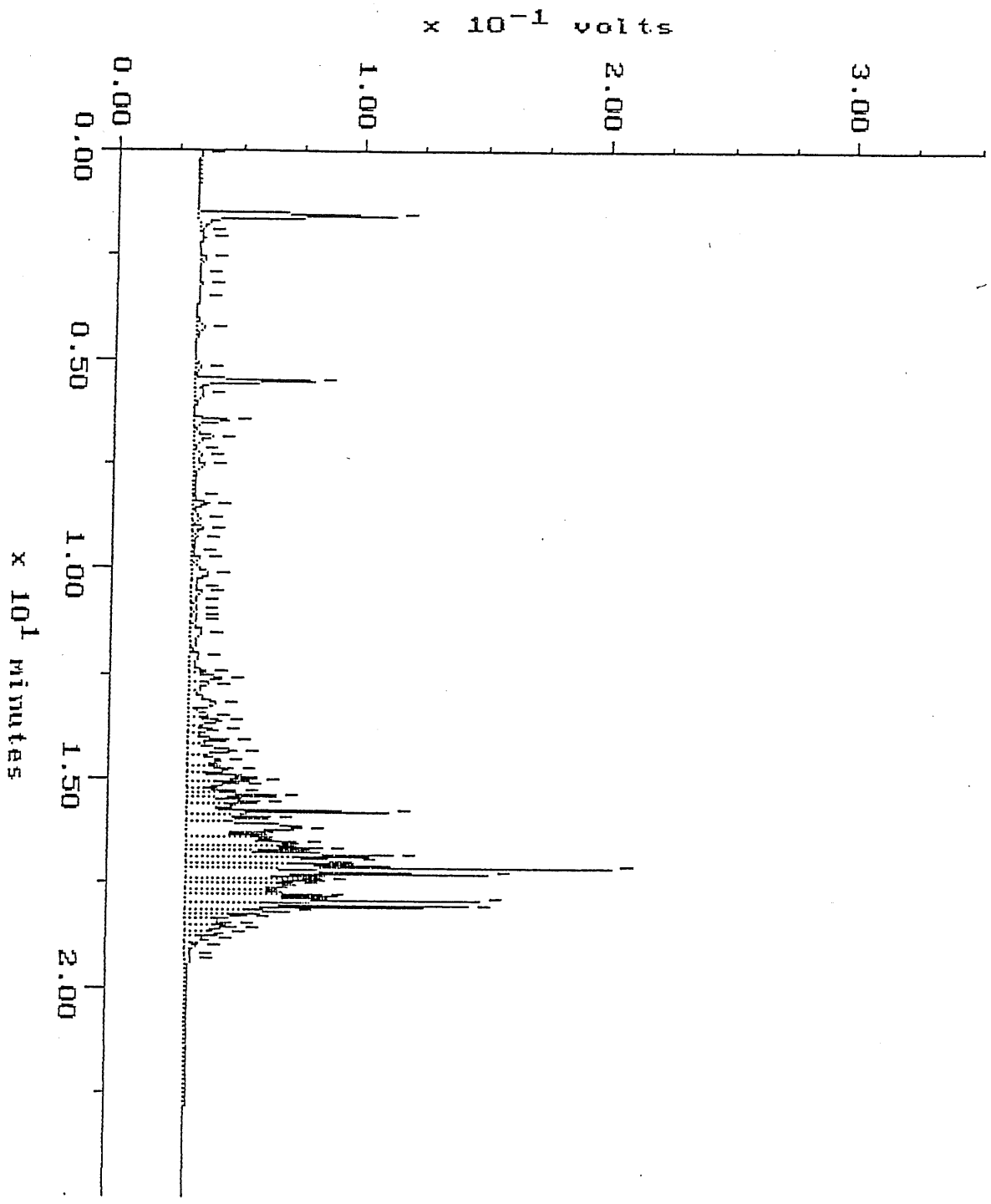
Sample: 9310-110-2 Channel: FID
Acquired: 13-OCT-93 19:03 Method: F:\BRO2\MAXDATA\GLAD\101393GS
Comments: ATI : A COMMITMENT TO QUALITY

Filename: RA139G23
Operator: ATI



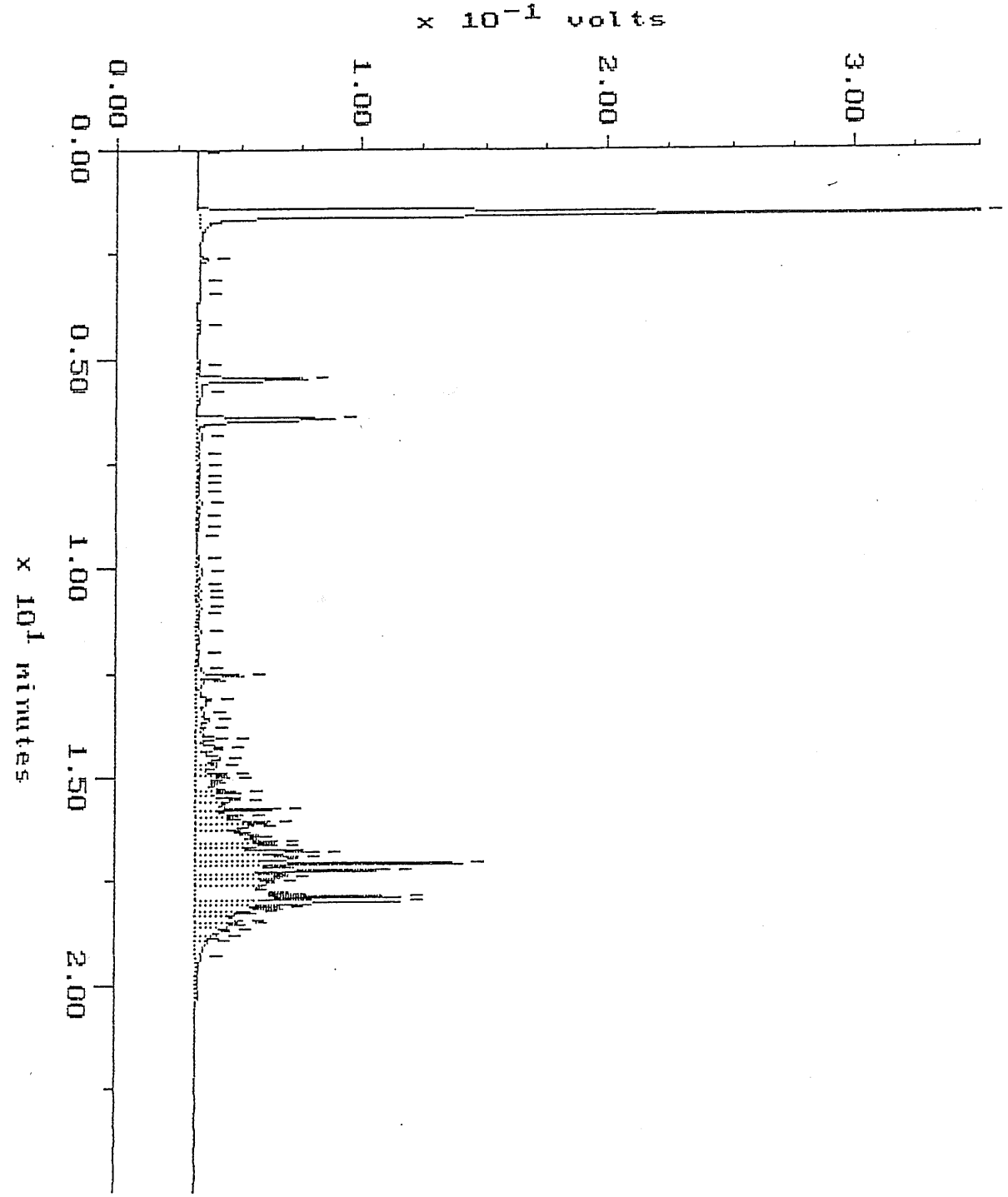
WA DOE WTPH-G

Sample: 9310-110-3 DIL Channel: FID Filename: RA139G44
Acquired: 14-OCT-93 4:57 Method: F:\BRO2\MAXDATA\GLAD\101393GS Operator: ATI
Dilution: 1 : 5.000
Comments: ATI : A COMMITMENT TO QUALITY



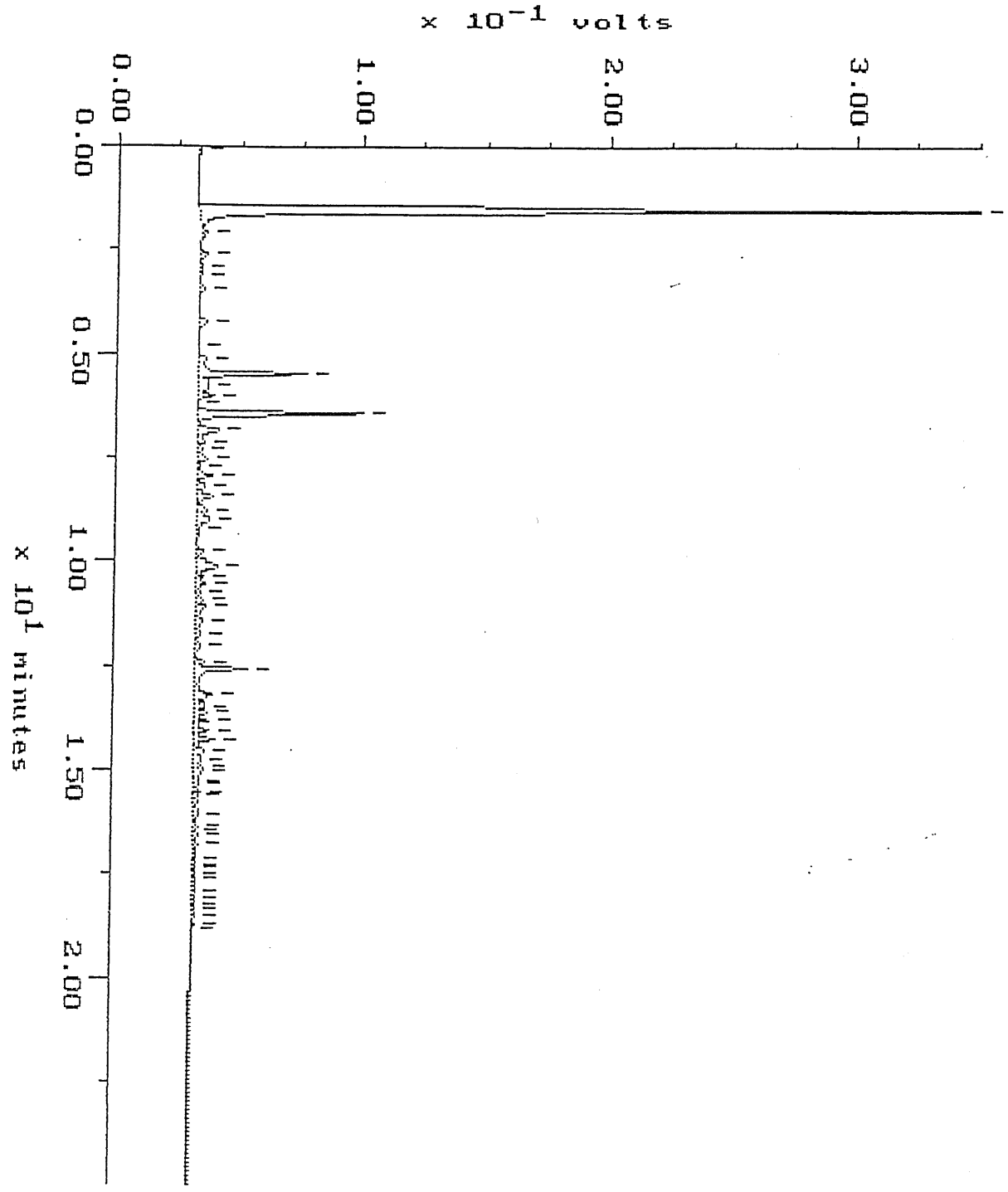
WA DOE WTPH-G

Sample: 9310-110-4 Channel: FID Filename: RA149620
Acquired: 14-OCT-93 18:16 Method: F:\BRO2\MAXDATA\GLAD\101493GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



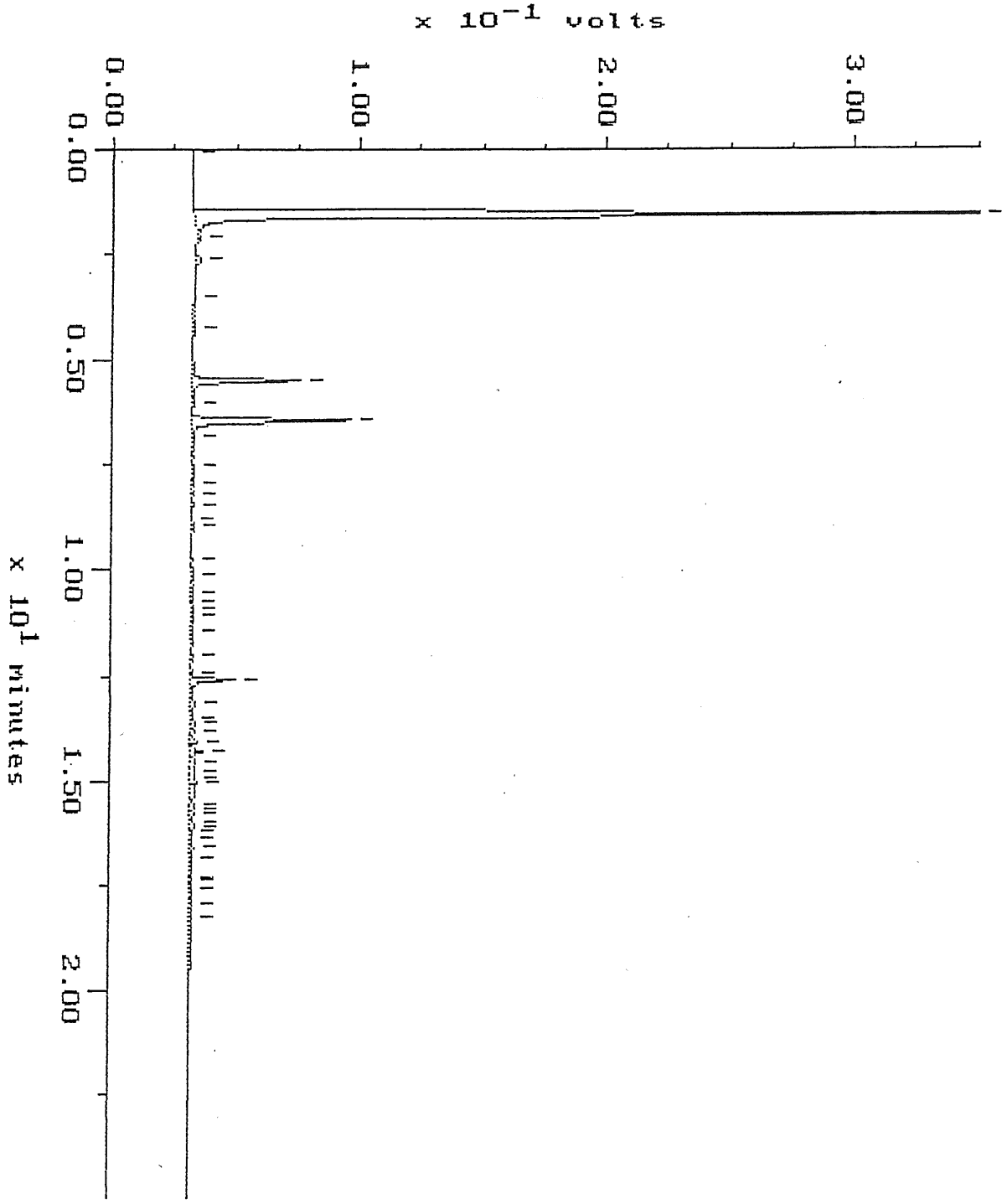
WA DOE WTPH-G

Sample: 9310-110-5 Channel: FID Filename: RA139G35
Acquired: 14-OCT-93 0:43 Method: F:\BRO2\MAXDATA\GLAD\101393GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



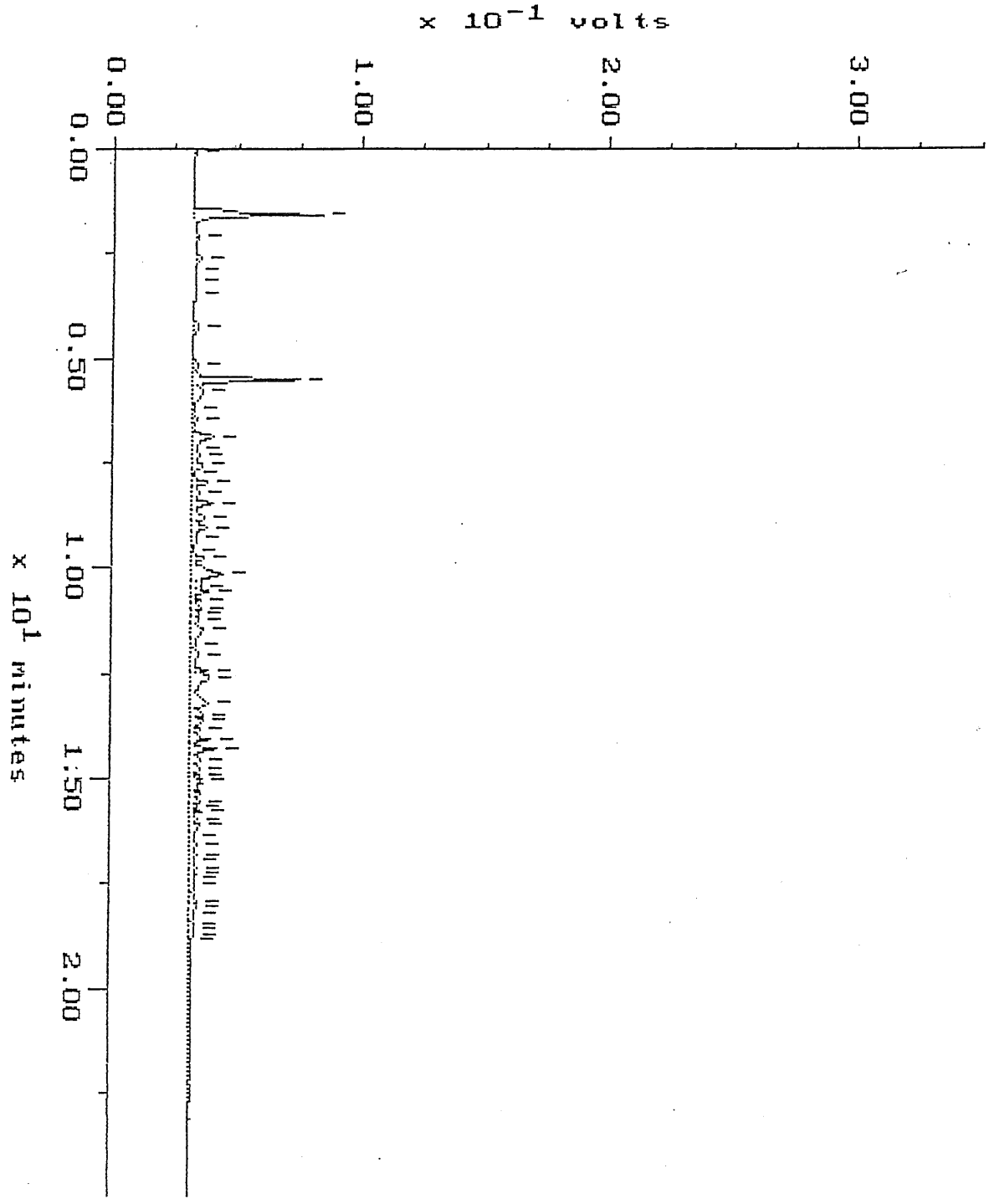
WA DOE WTPH-G

Sample: 9310-110-6 Channel: FID Filename: RA139G36
Acquired: 14-OCT-93 1:11 Method: F:\BRD2\MAXDATA\GLAD\101393GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



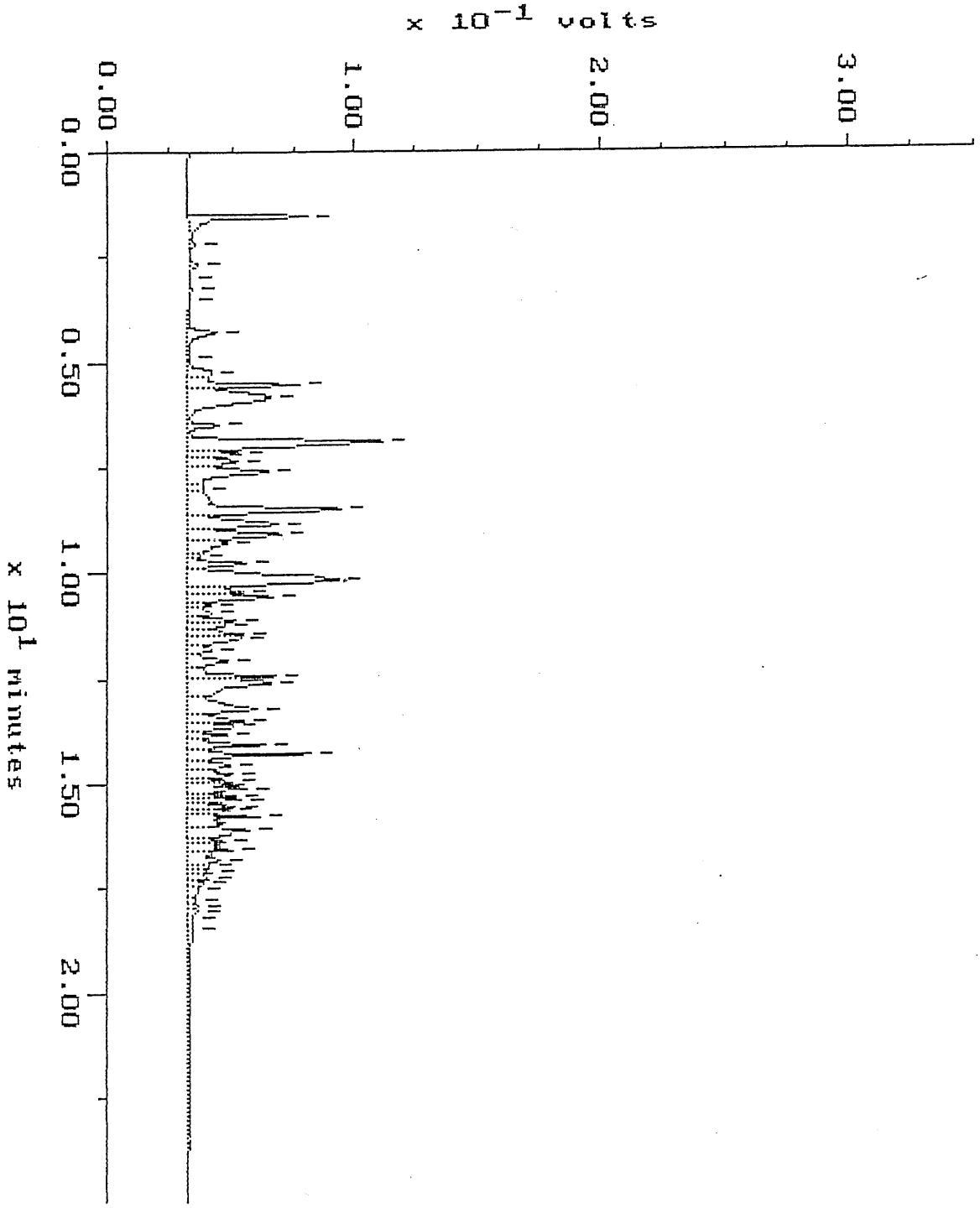
WA DOE WTPH-G

Sample: 9310-110-7 DIL Channel: FID Filename: RA139G46
Acquired: 14-OCT-93 5:54 Method: F:\BRO2\MAXDATA\GLAD\10139GS Operator: ATI
Dilution: 1 : 50.000
Comments: ATI : A COMMITMENT TO QUALITY



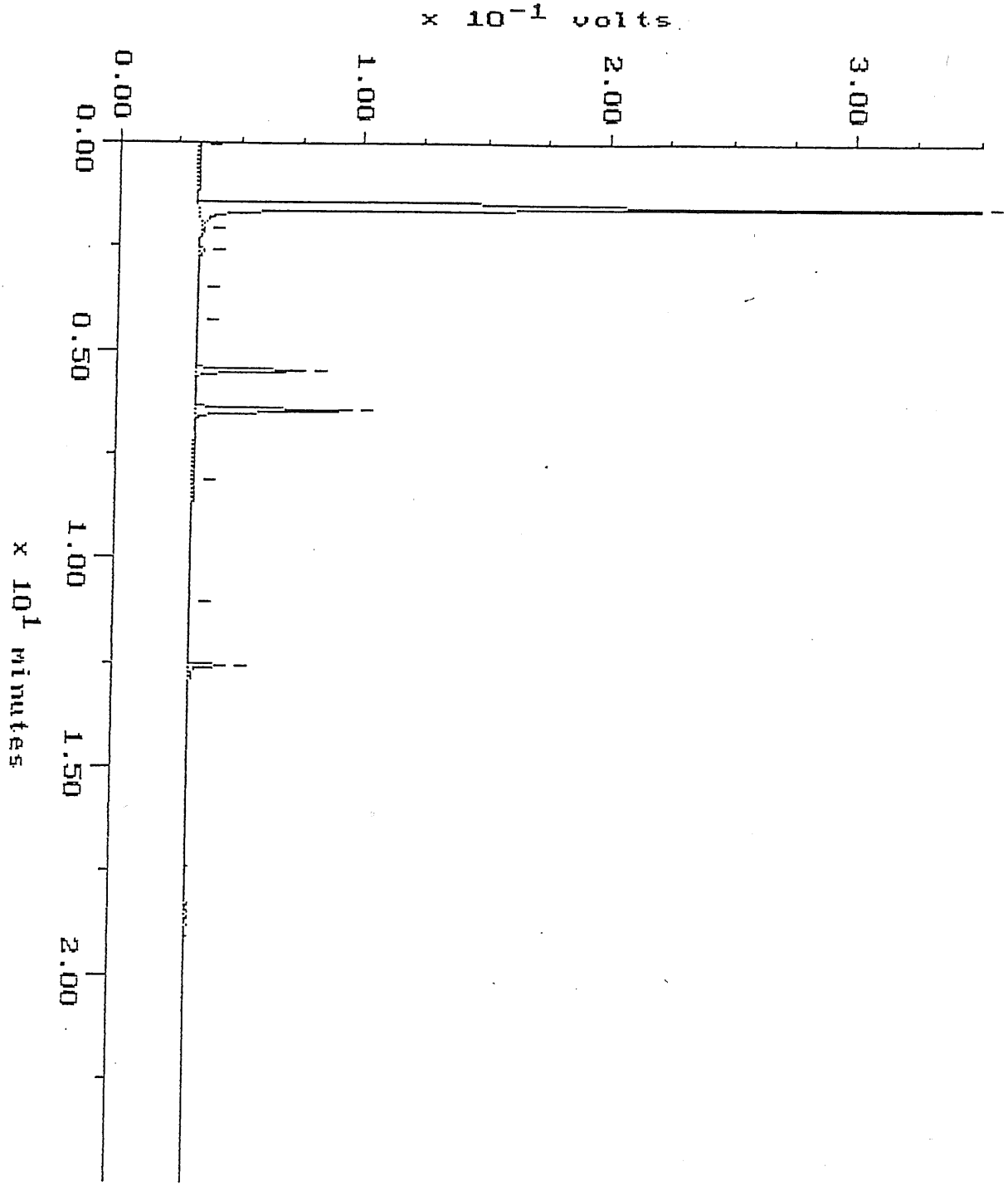
WA DOE WTPH-G

Sample: 9310-110-8 DIL Channel: FID Filename: RA139647
Acquired: 14-OCT-93 6:22 Method: F:\BRO2\MAXDATA\GLAD\101393GS Operator: ATI
Dilution: 1 : 5.000
Comments: ATI : A COMMITMENT TO QUALITY



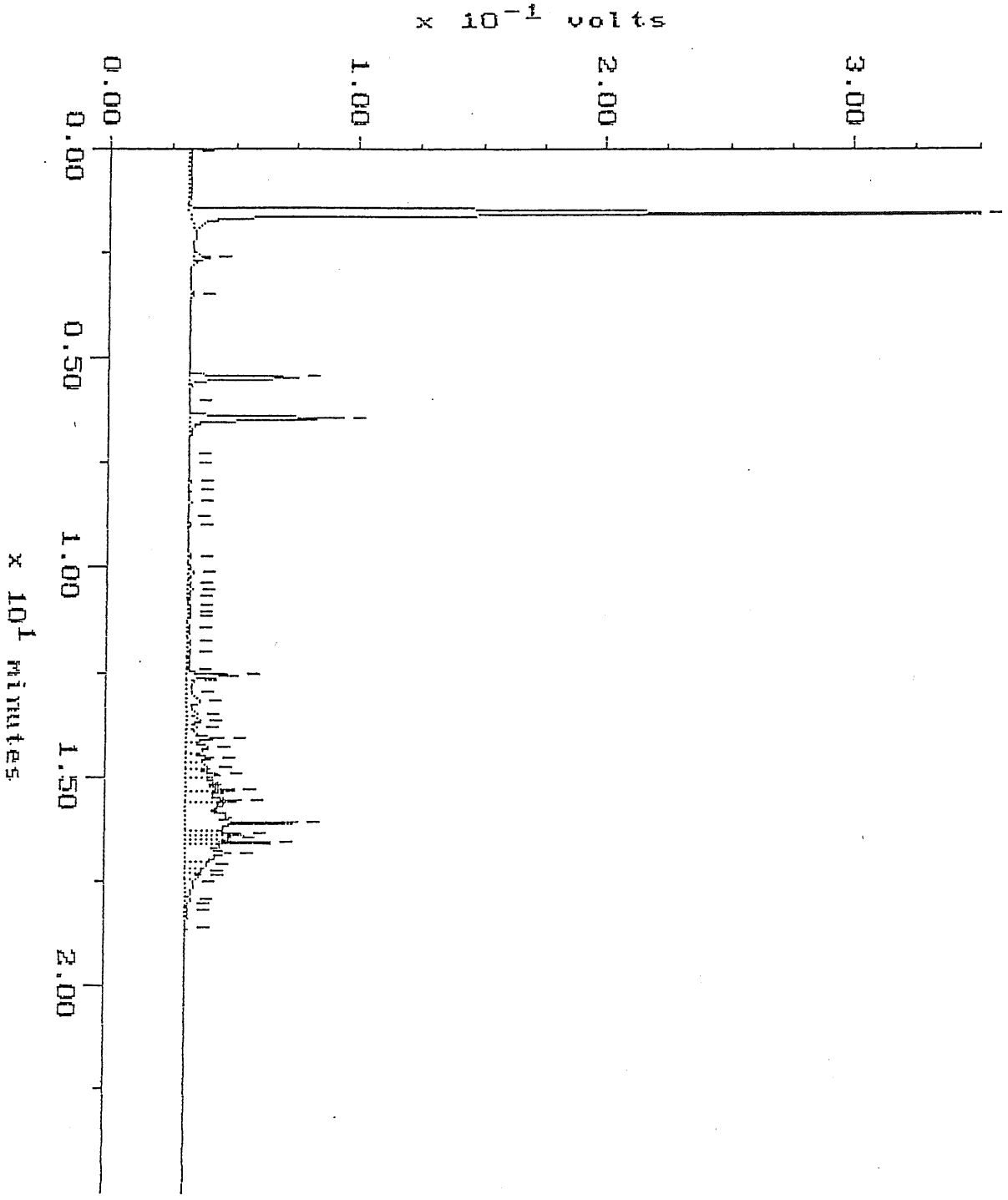
WA DOE WTPH-G

Sample: 9310-110-9 Channel: FID Filename: RA139G31
Acquired: 13-OCT-93 22:49 Method: F:\BRO2\MAXDATA\GLAD\101393GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



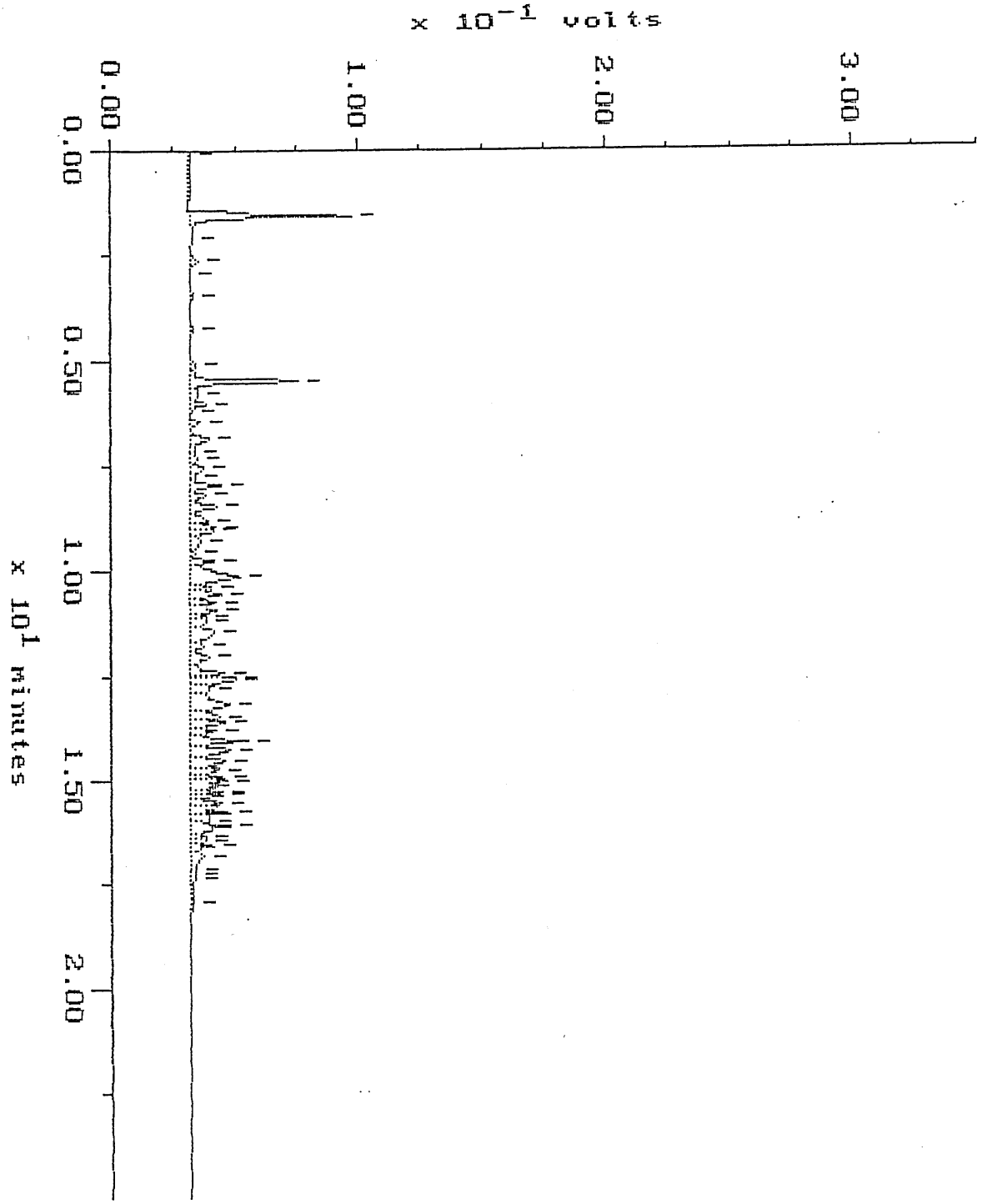
WA DOE WTPH-G

Sample: 9310-110-10 Channel: FID Filename: RA149G23
Acquired: 14-OCT-93 19:41 Method: F:\BRO2\MAXDATA\GLAD\101493GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



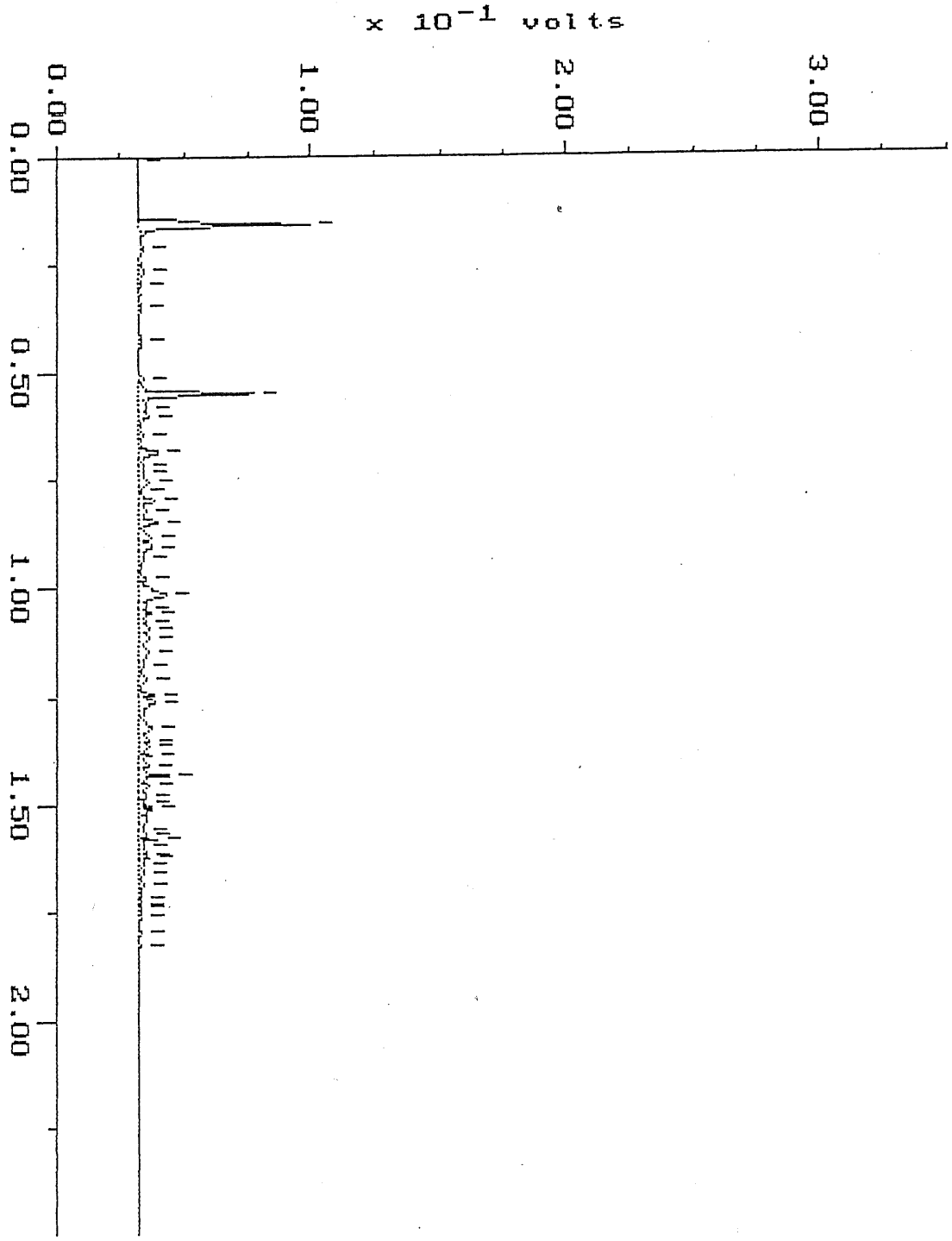
WA DOE WTPH-G

Sample: 9310-110-11 DIL Channel: FID Filename: RA149G24
Acquired: 14-OCT-93 20:09 Method: F:\BRO2\MAXDATA\GLAD\101493GS Operator: ATI
Dilution: 1 : 20.000
Comments: ATI : A COMMITMENT TO QUALITY



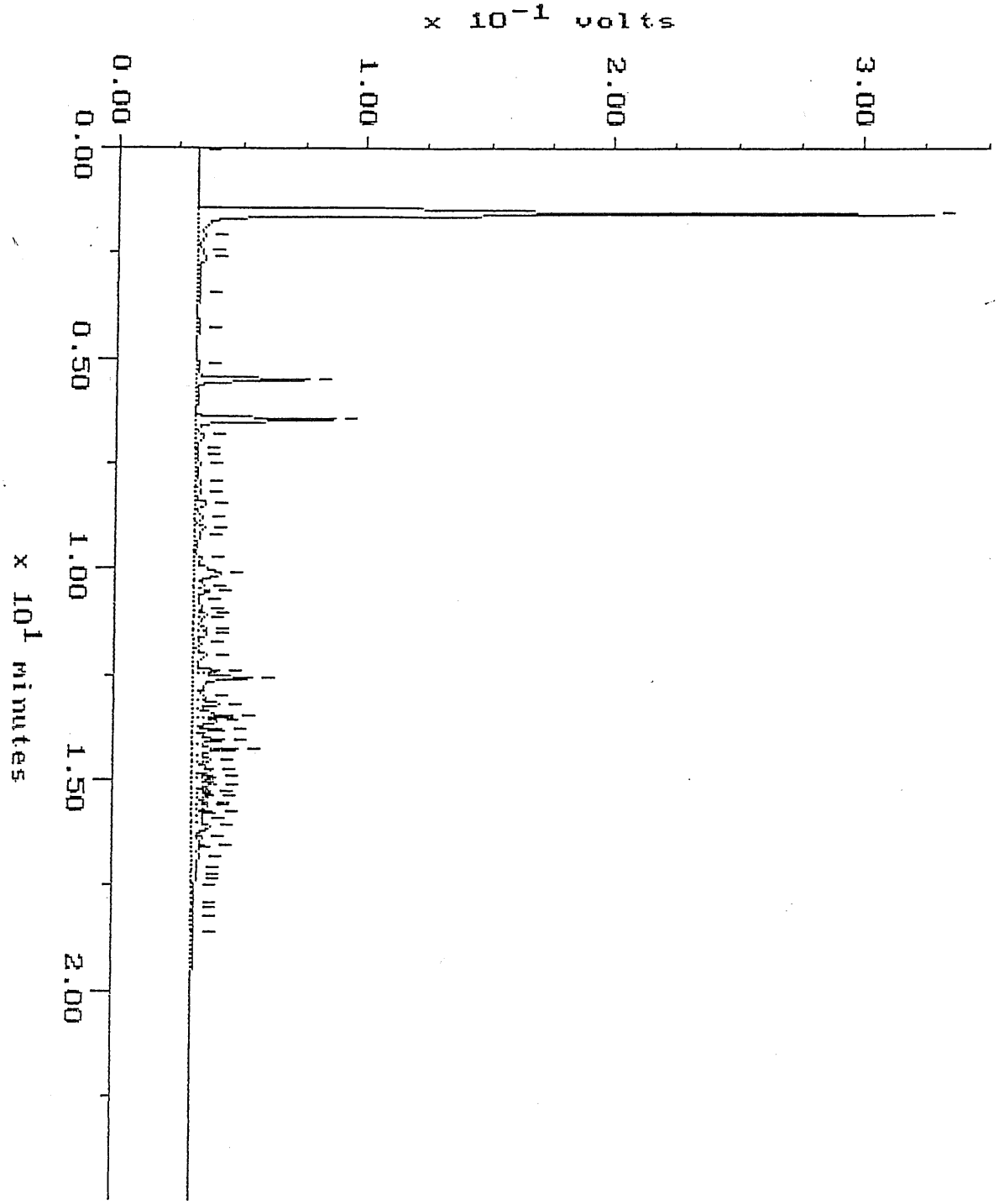
WA DOE WTPH-G

Sample: 9310-110-12 DIL Channel: FID Filename: RA139G41
Acquired: 14-OCT-93 3:32 Method: F:\BRO2\MAXDATA\GLAD\10139365 Operator: ATI
Dilution: 1 : 50.000
Comments: ATI : A COMMITMENT TO QUALITY



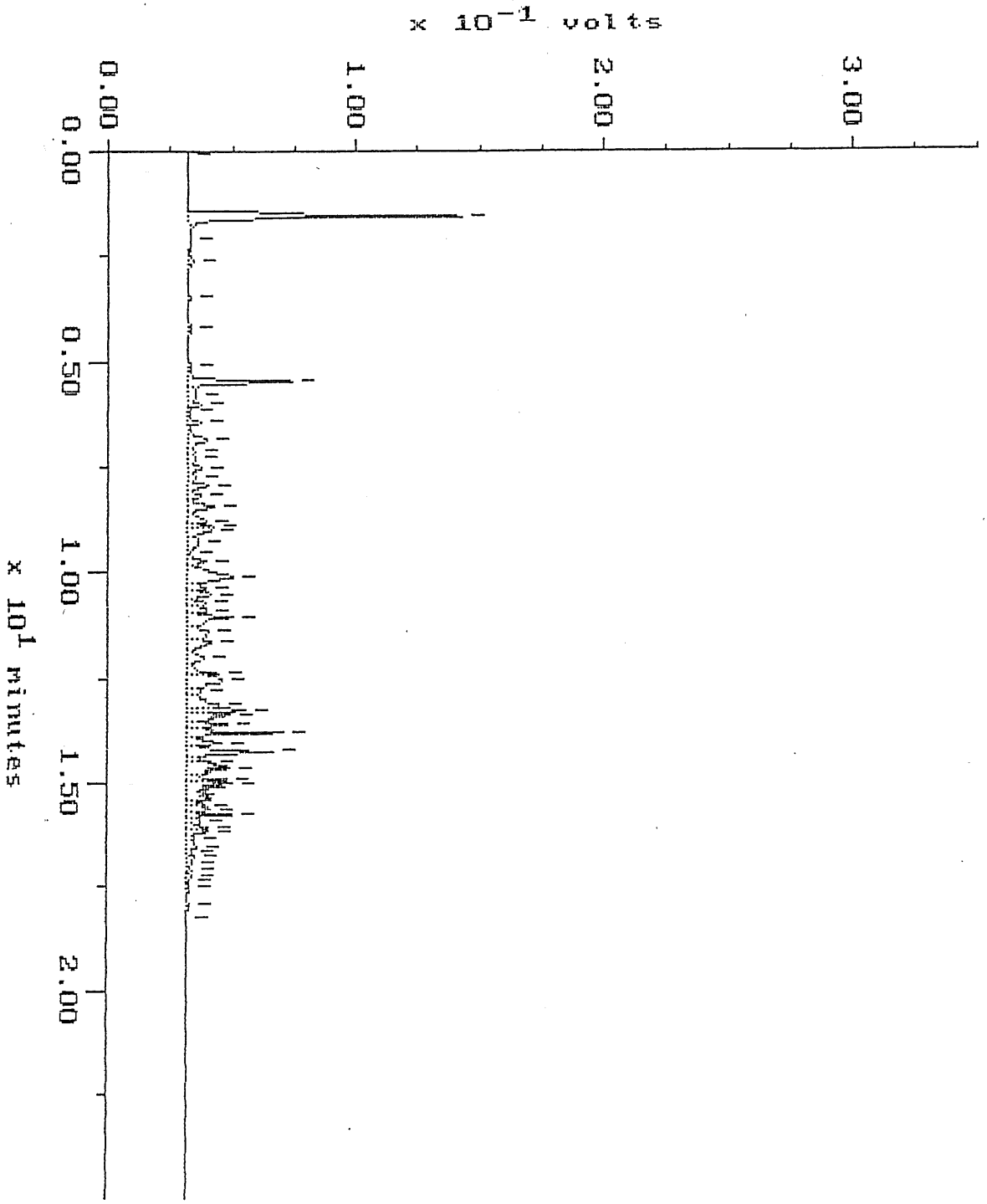
WA DOE WTPH-G

Sample: 9310-110-13 Channel: FID Filename: RA139G37
Acquired: 14-OCT-93 1:39 Method: F:\BRO2\MAXDATA\GLAD\10139GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



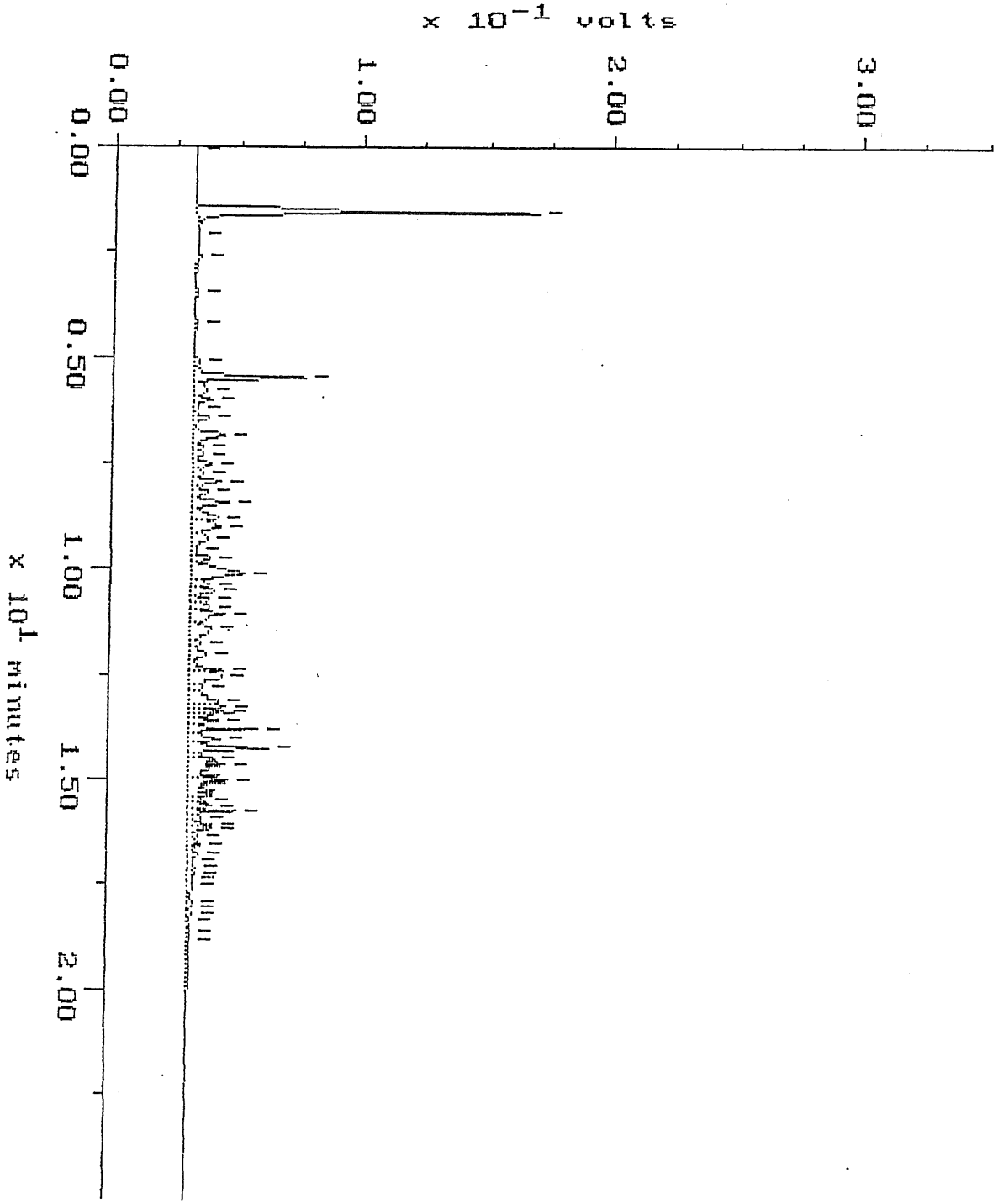
WA DOE WTPH-G

Sample: 9310-110-14 DIL Channel: FID Filename: RA149G18
Acquired: 14-OCT-93 17:20 Method: F:\BRD2\MAXDATA\GLAD\101493GS Operator: ATI
Dilution: 1 : 10.000
Comments: ATI : A COMMITMENT TO QUALITY



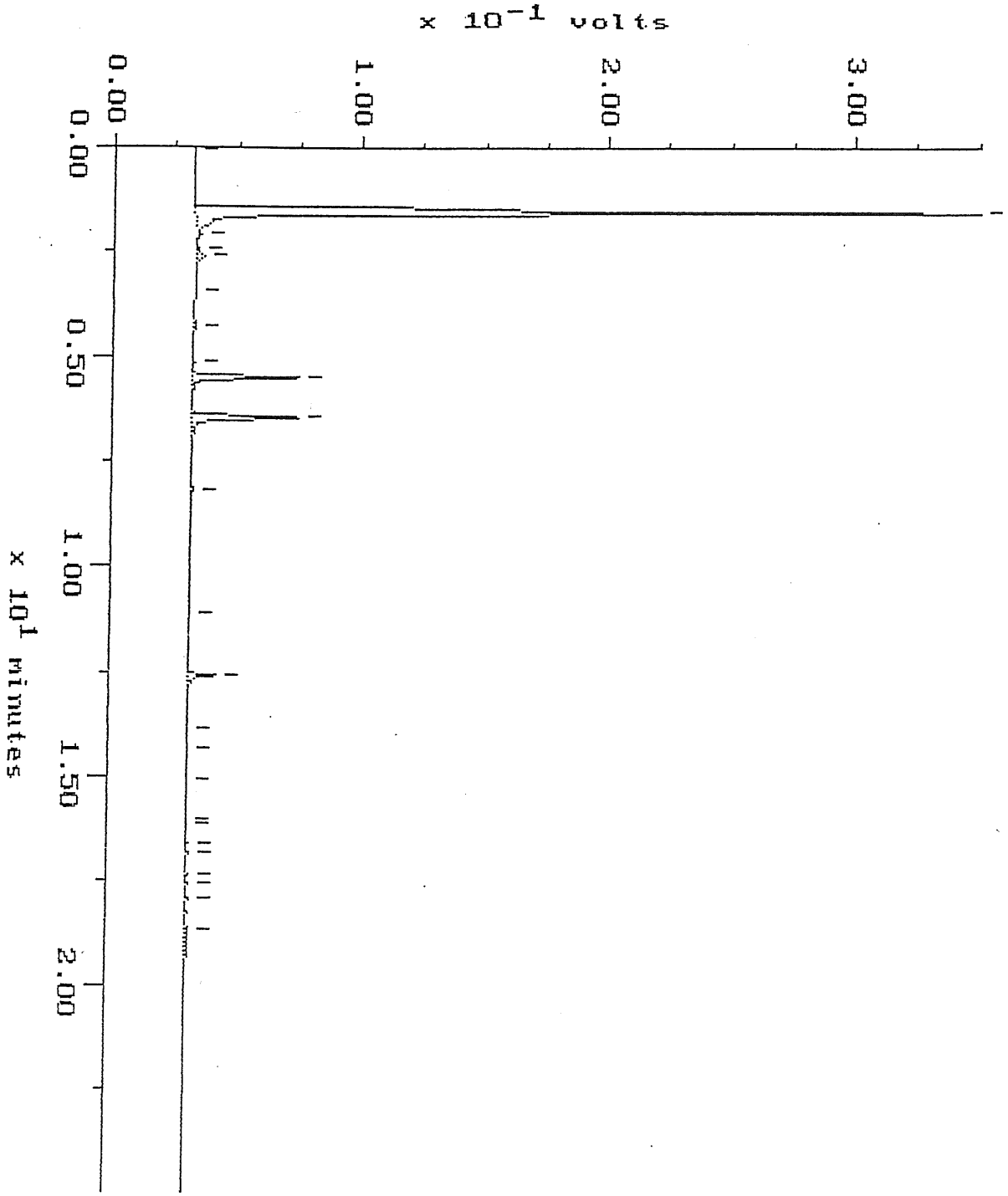
WA DOE WTPH-G

Sample: 9310-110-15 DIL Channel: FID Filename: RA149617
Acquired: 14-OCT-93 16:51 Method: F:\BRD2\MAXDATA\GLAD\101493GS Operator: ATI
Dilution: 1 : 5.000
Comments: ATI : A COMMITMENT TO QUALITY



WA DOE WTPH-G

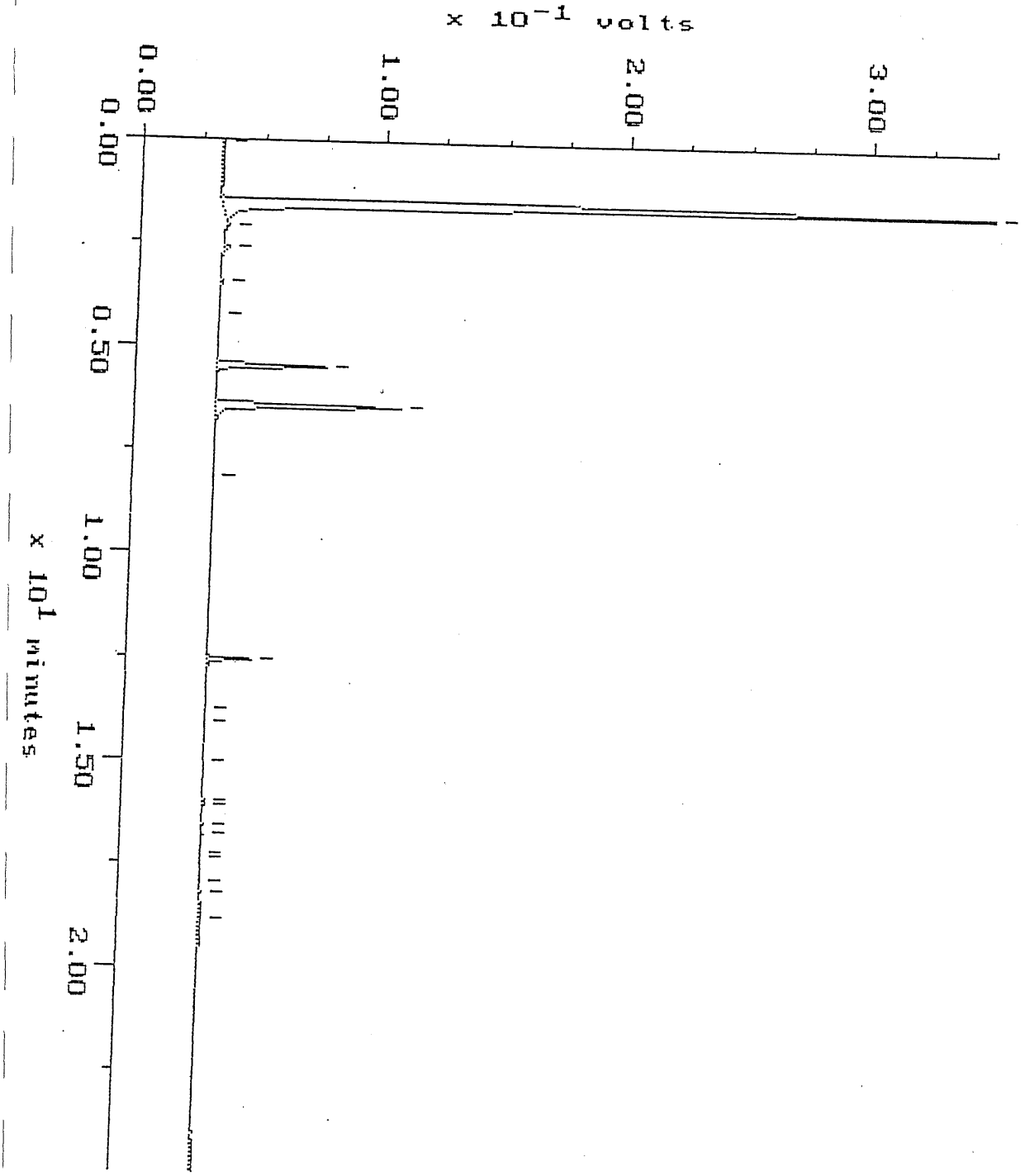
Sample: 9310-110-16 Channel: FID Filename: RA139G40
Acquired: 14-OCT-93 3:04 Method: F:\BRO2\MAXDATA\GLAD\101393GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



Blank

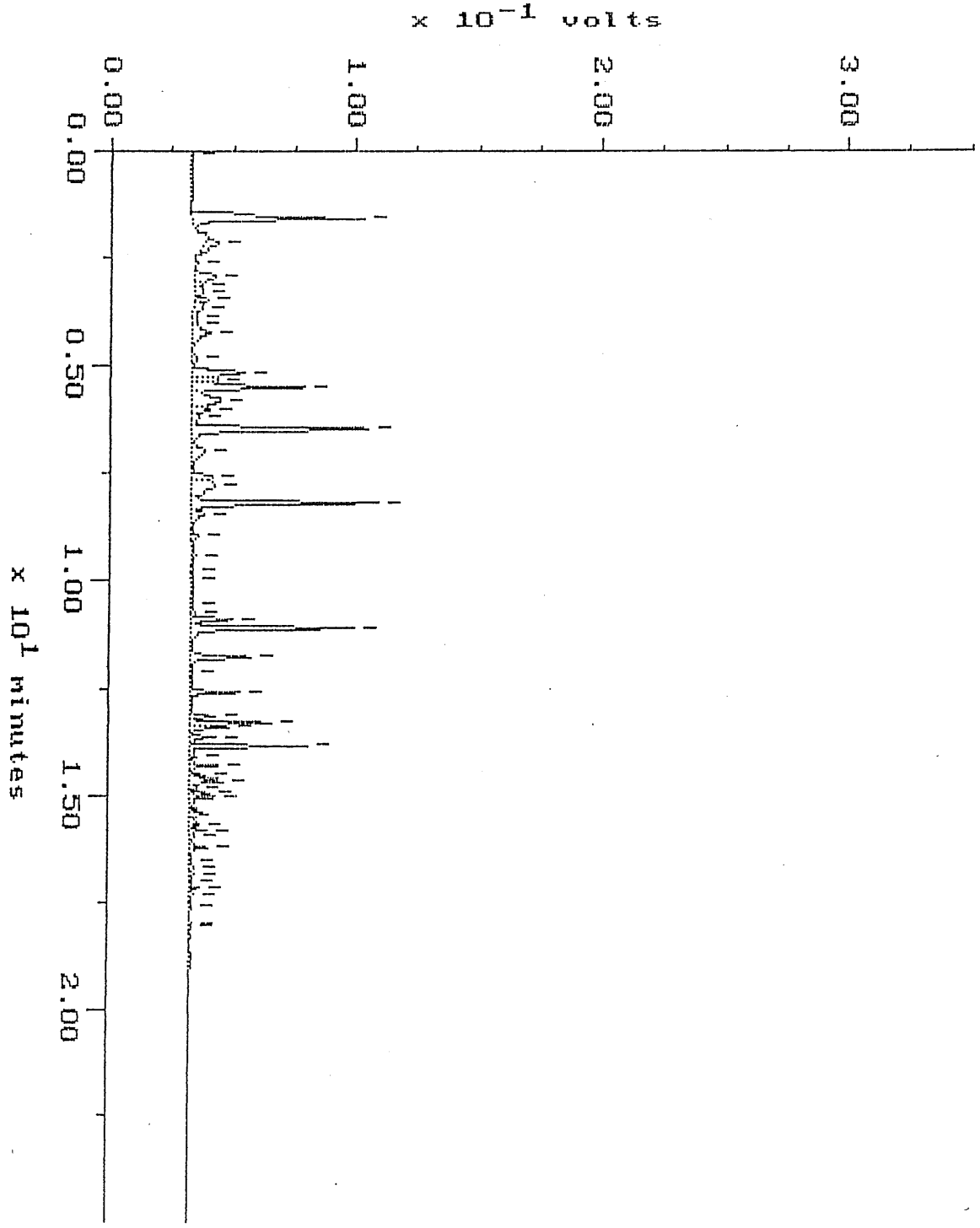
WA DOE WTPH-G

Sample: SRB-A 10-13 Channel: FID
Acquired: 13-OCT-93 16:40 Method: F:\BRD2\MAXDATA\GLAD\101393GS Filename: RA139G18
Comments: ATI : A COMMITMENT TO QUALITY Operator: ATI



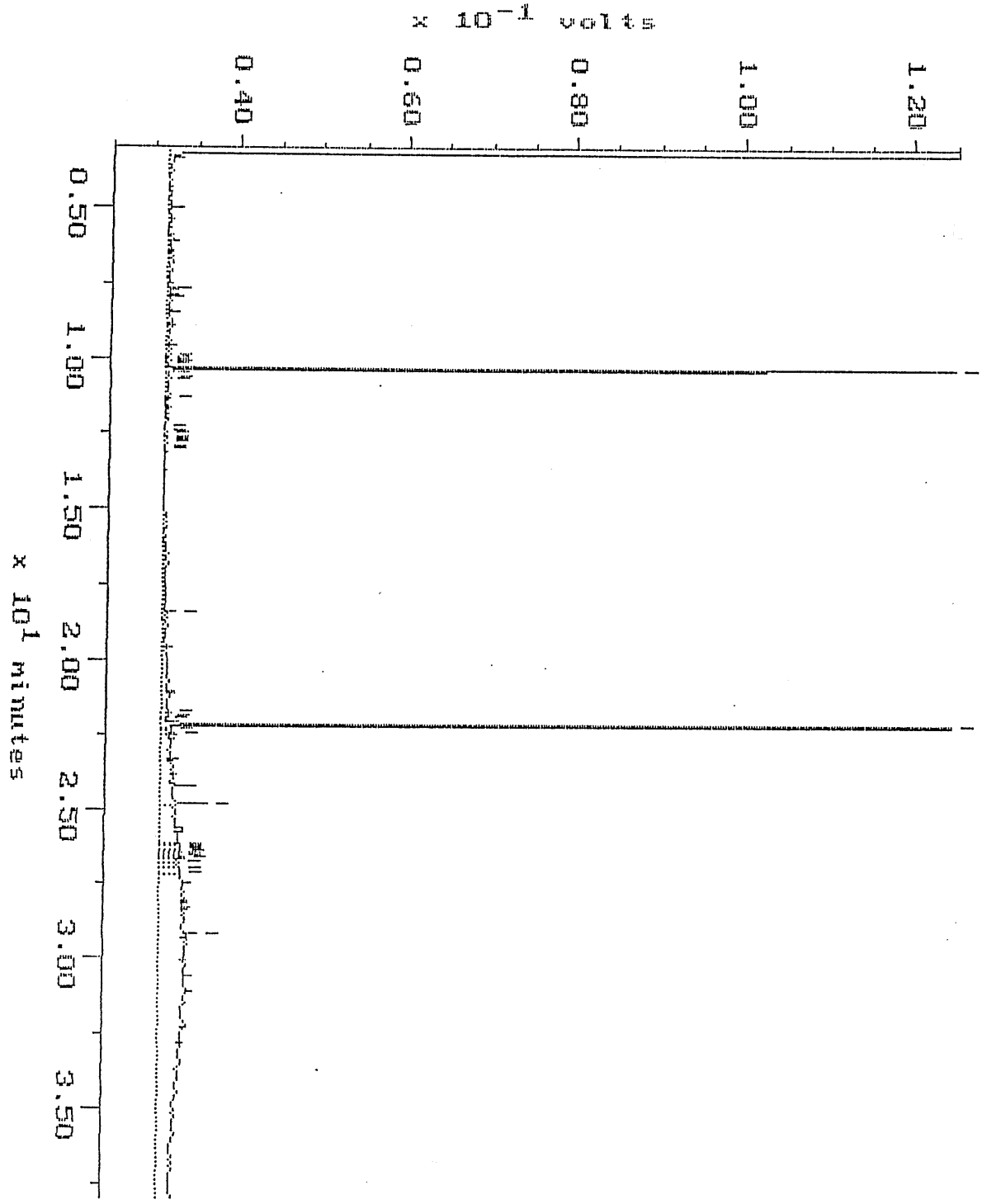
Continuing Calibration

Sample: STD-C G Channel: FID Filename: RA139G01
Acquired: 13-OCT-93 7:42 Method: F:\BRO2\MAXDATA\GLAD\101393GS Operator: ATI
Comments: ATI : A COMMITMENT TO QUALITY



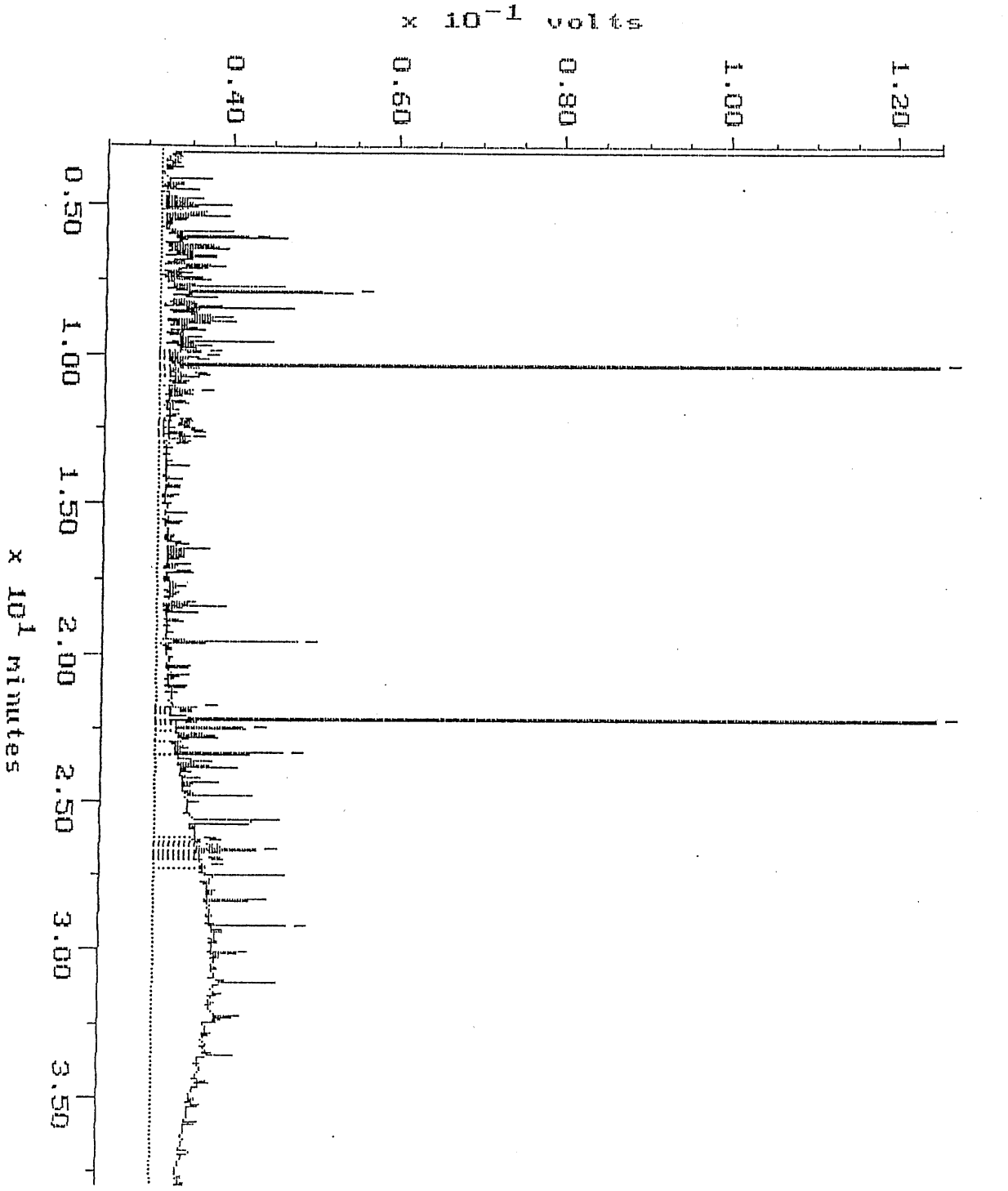
WA DOE WTPH-D

Sample: 9310-110-1 Channel: NANCY Filename: RA138N22
Acquired: 14-OCT-93 4:14 Method: F:\BRO2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



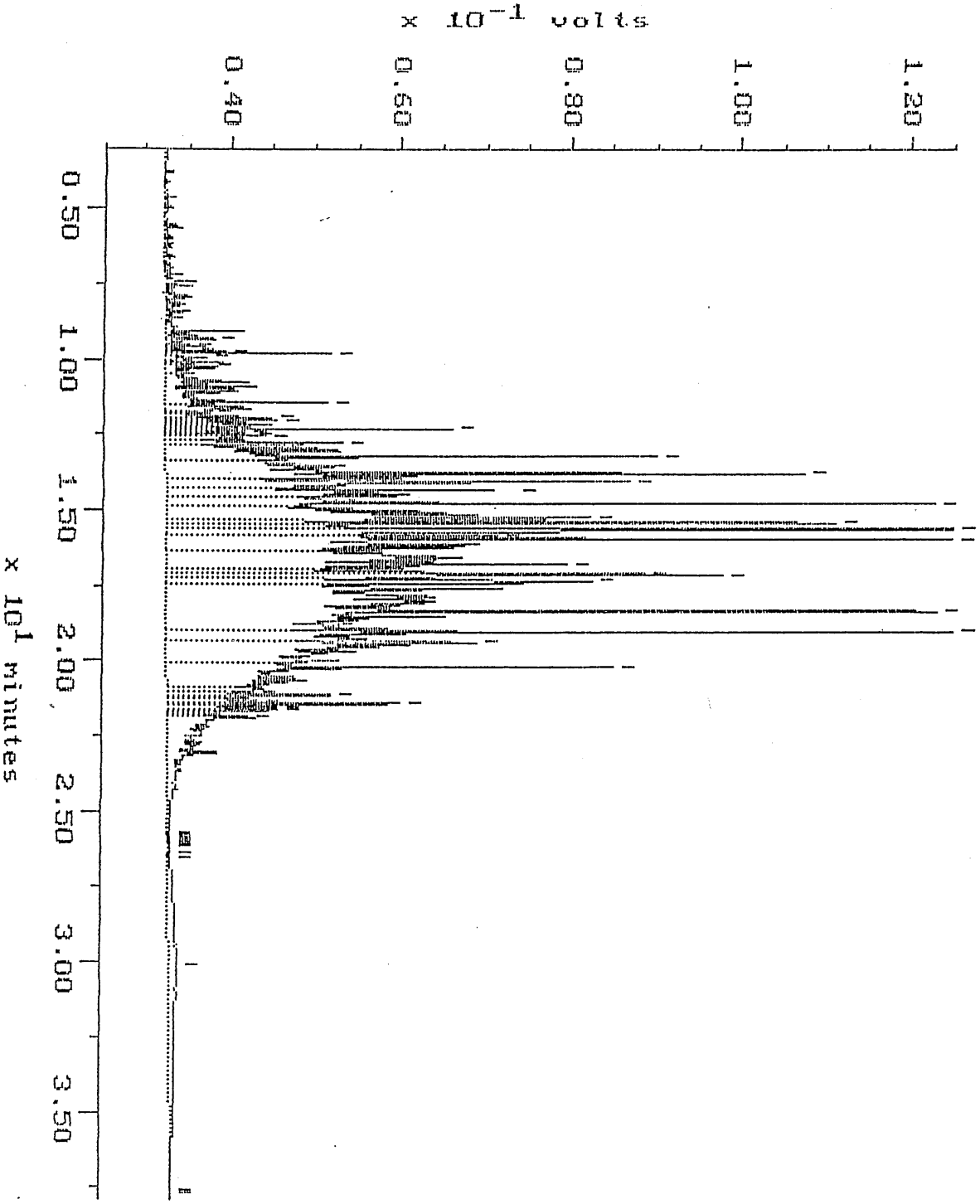
WA DOE WTPH-D

Sample: 9310-110-2 Channel: NANCY Filename: RA138N23
Acquired: 14-OCT-93 5:01 Method: F:\BRO2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



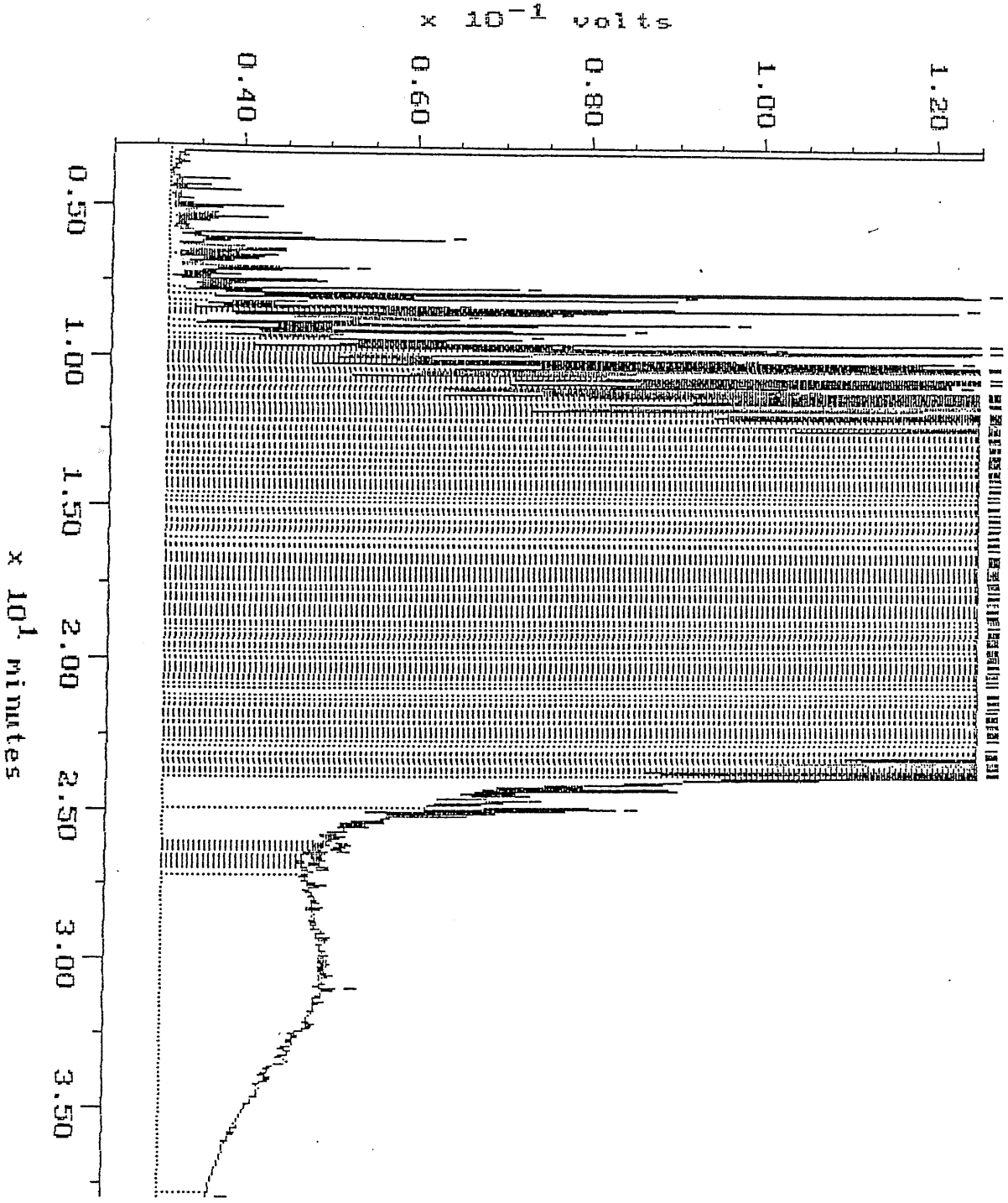
WA DOE WTPH-D

Sample: 9310-110-3DIL Channel: FRED Filename: RA148F05
Acquired: 14-OCT-93 18:19 Method: F:\BRO2\MAXDATA\FRED\FUEL1014 Operator: ATI
Dilution: 1 : 20.000
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



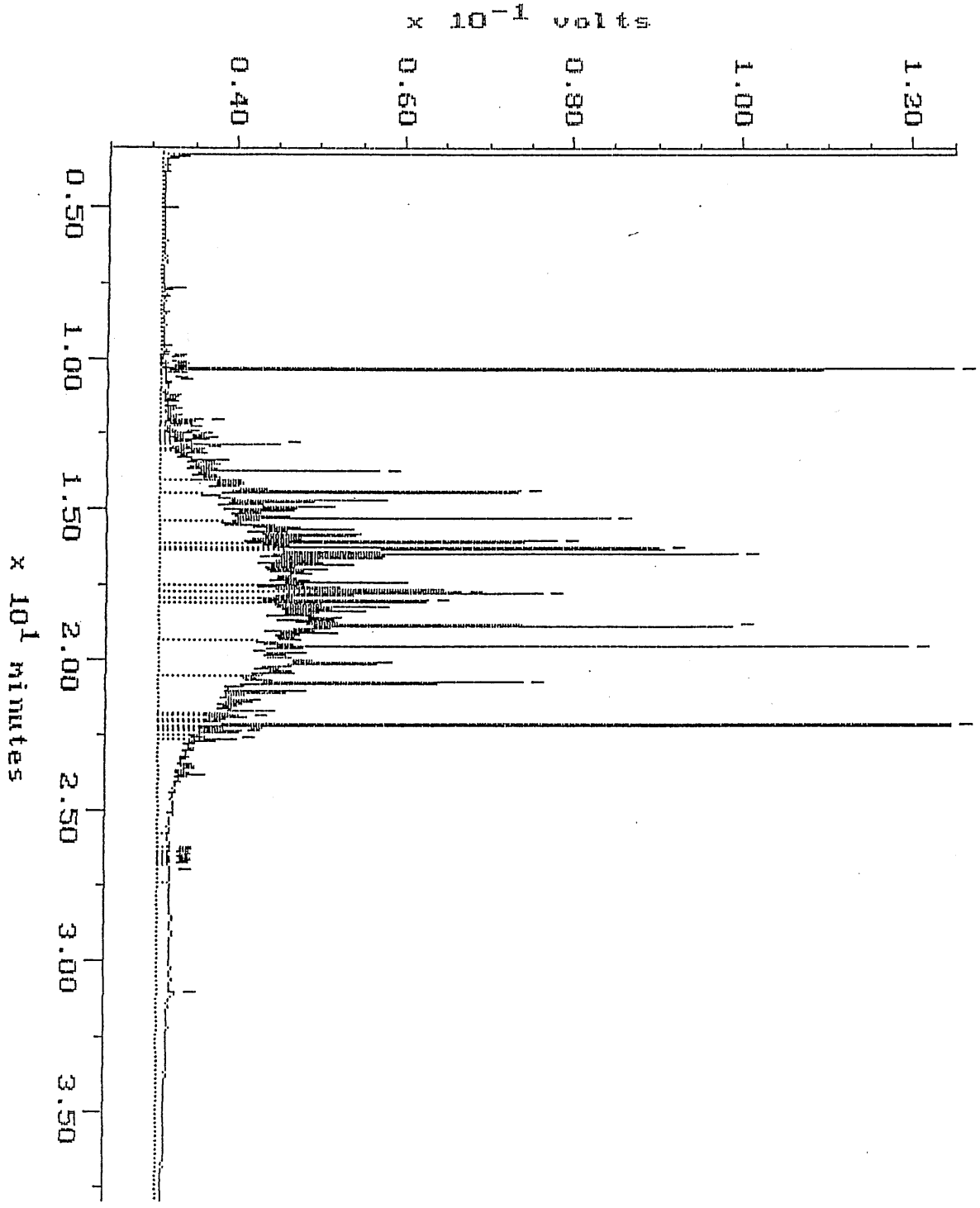
WA DOE WTPH-D

Sample: 9318-118-3 Channel: NANCY
Acquired: 14-OCT-93 5:48 Method: F:\GRO2\MAXDATA\NANCY\FUEL1013 Filename: RA138N24
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE Operator: ATI



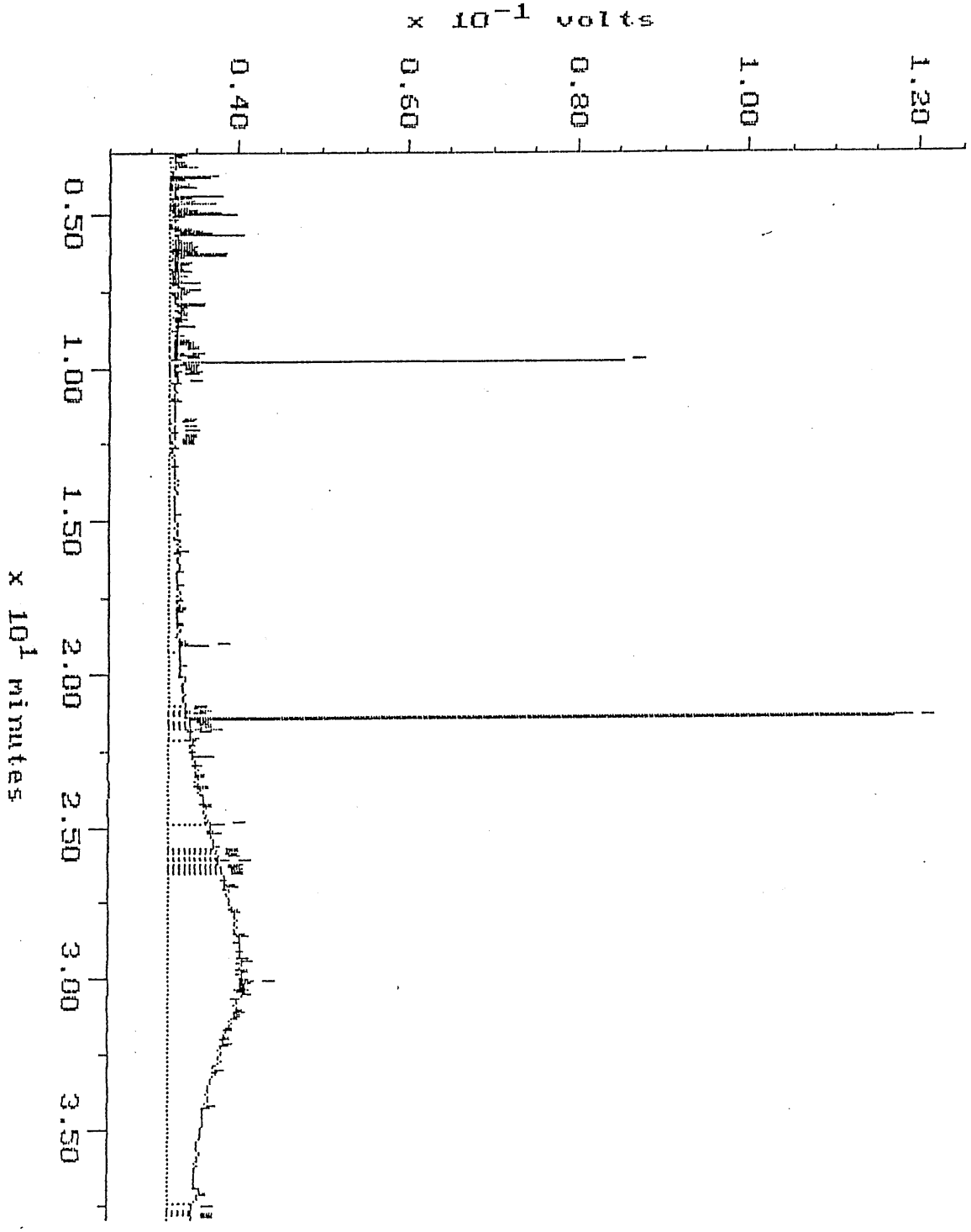
WA DOE WTPH-D

Sample: 9310-110-4 Channel: NANCY Filename: RA138N21
Acquired: 14-OCT-93 3:28 Method: F:\BRD2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



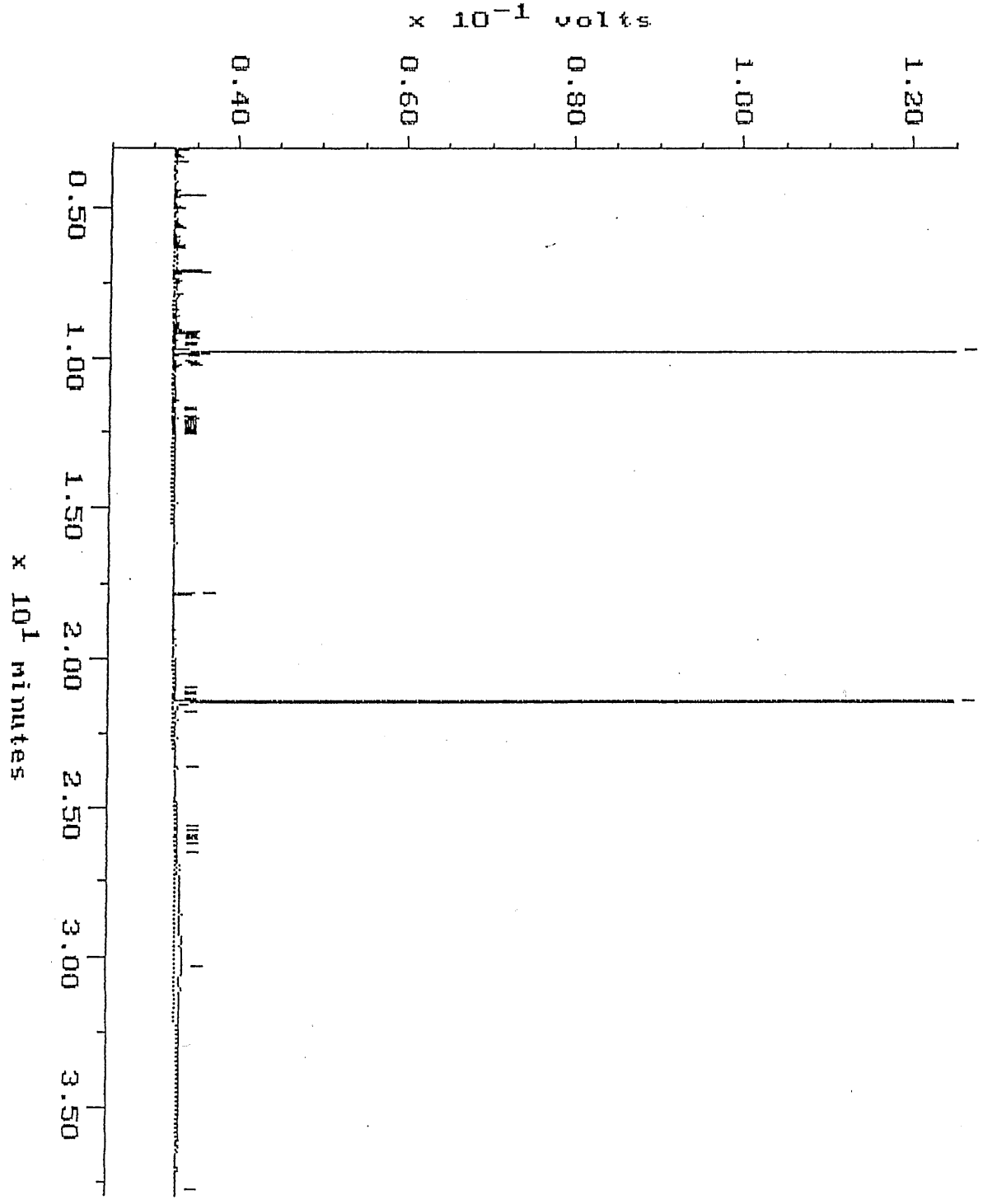
WA DOE WTPH-D

Sample: 9310-110-SDIL Channel: FRED Filename: RA148F06
Acquired: 14-OCT-93 19:07 Method: F:\BRO2\MAXDATA\FRED\FUEL1014 Operator: ATI
Dilution: 1 : 5.000
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



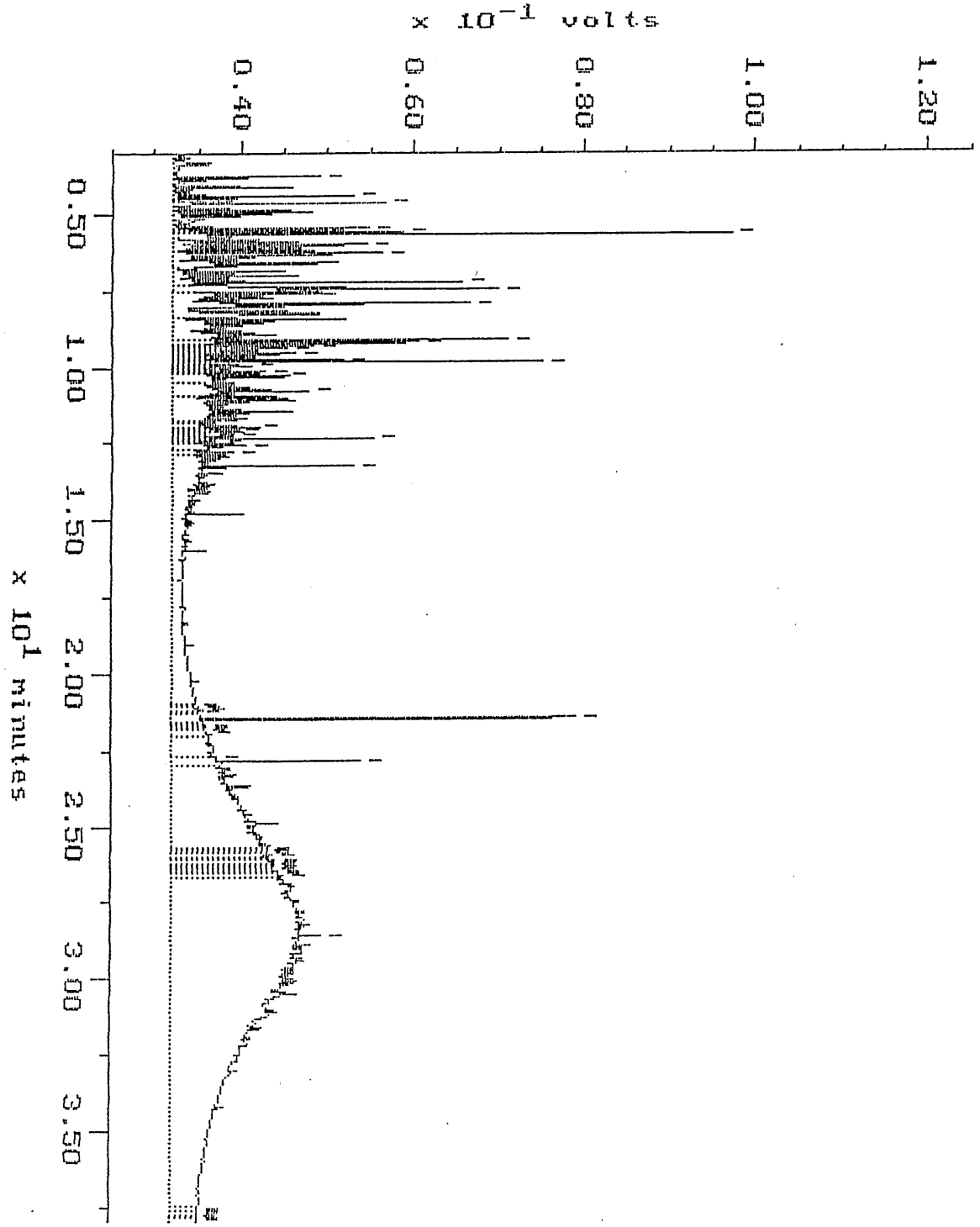
WA DOE WTPH-D

Sample: 9310-110-6 Channel: FRED Filename: RA138F04
Acquired: 14-OCT-93 0:52 Method: F:\BRO2\MAXDATA\FRED\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



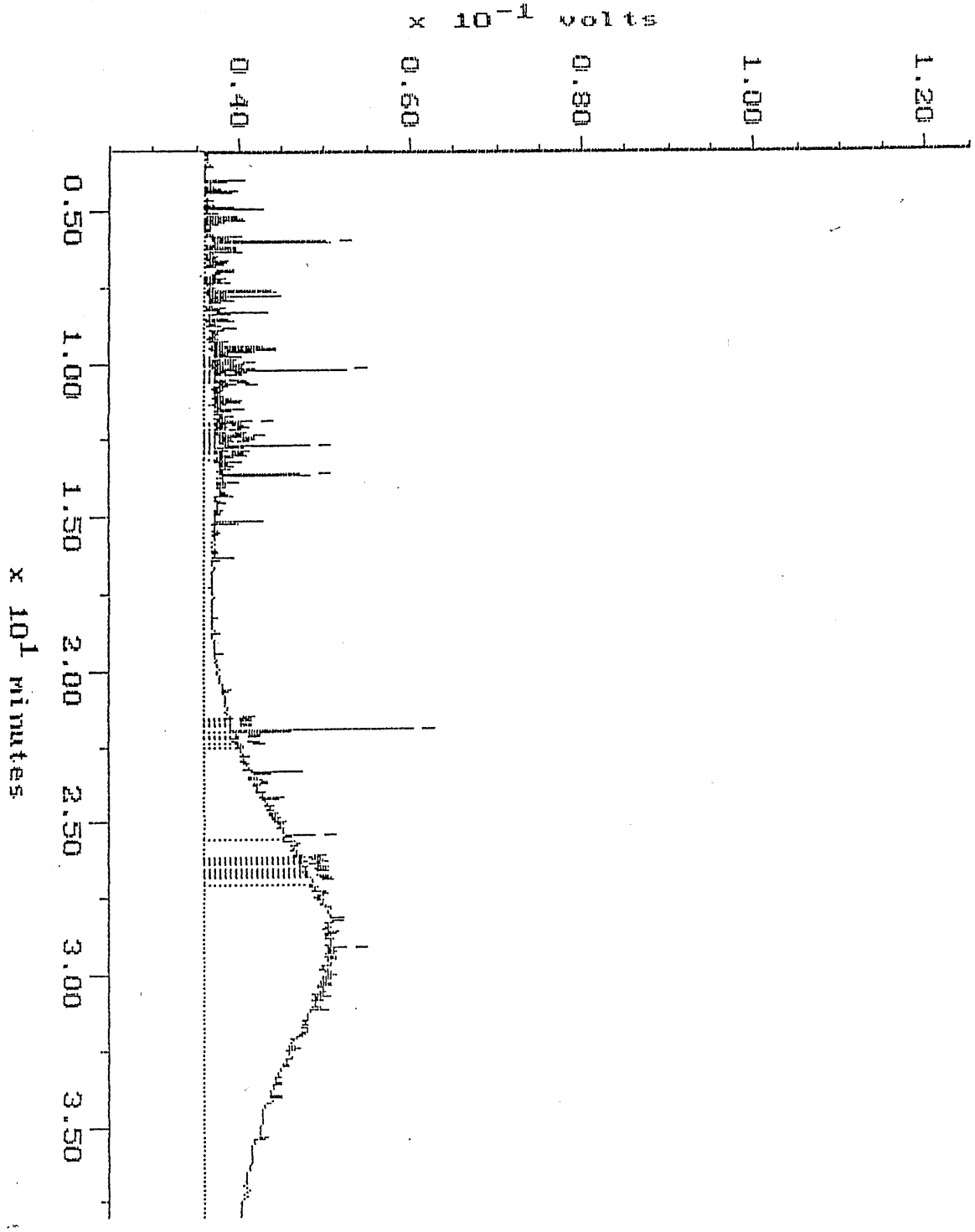
WA DOE WTPH-D

Sample: 9310-110-7DIL Channel: FRED Filename: RA148F07
Acquired: 14-OCT-93 19:56 Method: F:\BRO2\MAXDATA\FRED\FUEL1014 Operator: All
Dilution: 1 : 10.000
Comments: All RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



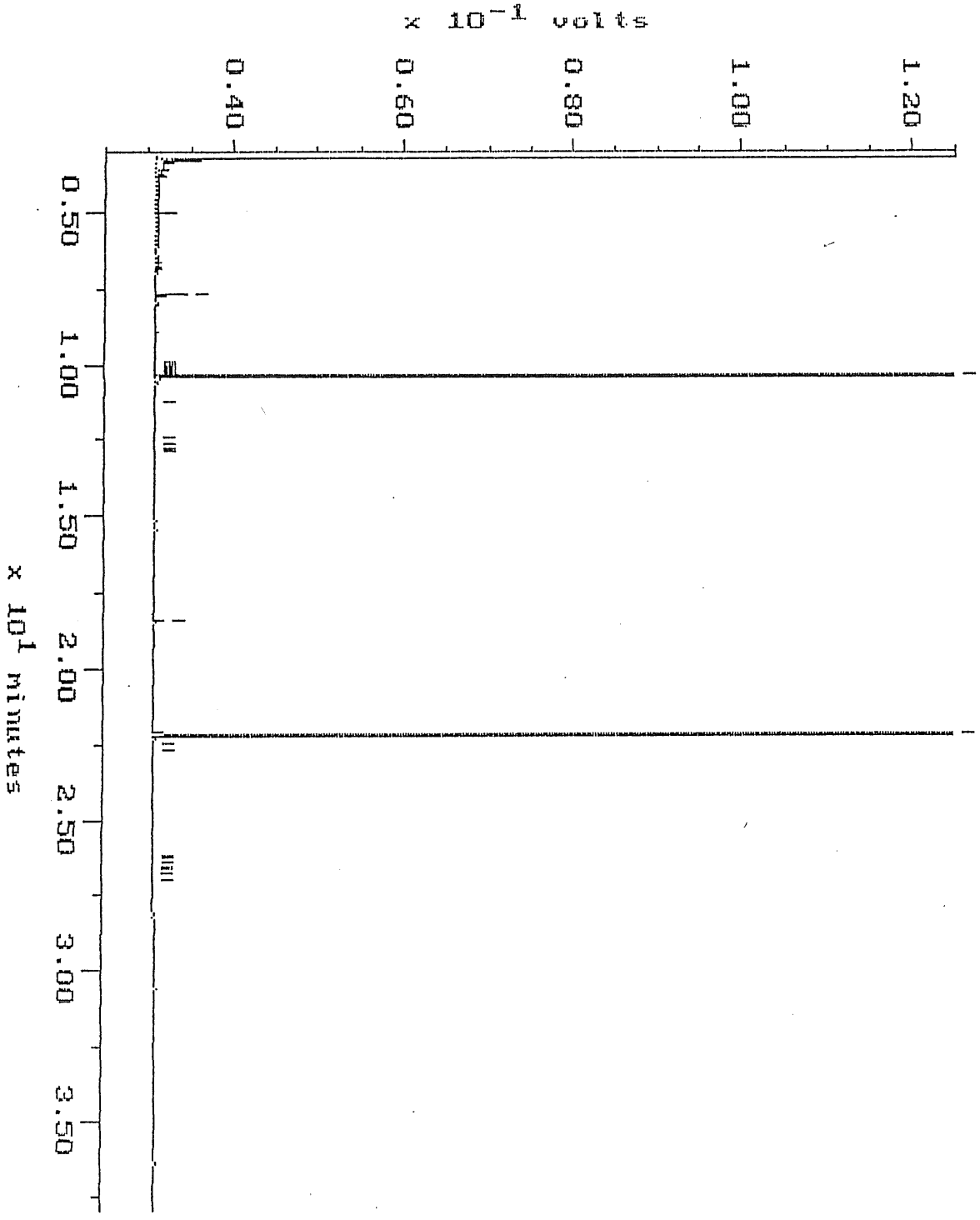
WA DOE WTPH-D

Sample: 9310-110-8DIL Channel: CLARENCE Filename: RA14BC31
Acquired: 15-OCT-93 12:43 Method: F:\BRO2\MAXDATA\SERGE-C\FUEL1014 Operator: ATI
Dilution: 1 : 20.000
Comments: ATI RUSH FUELS: DEDICATED TO QUALITY CLIENT SERVICE



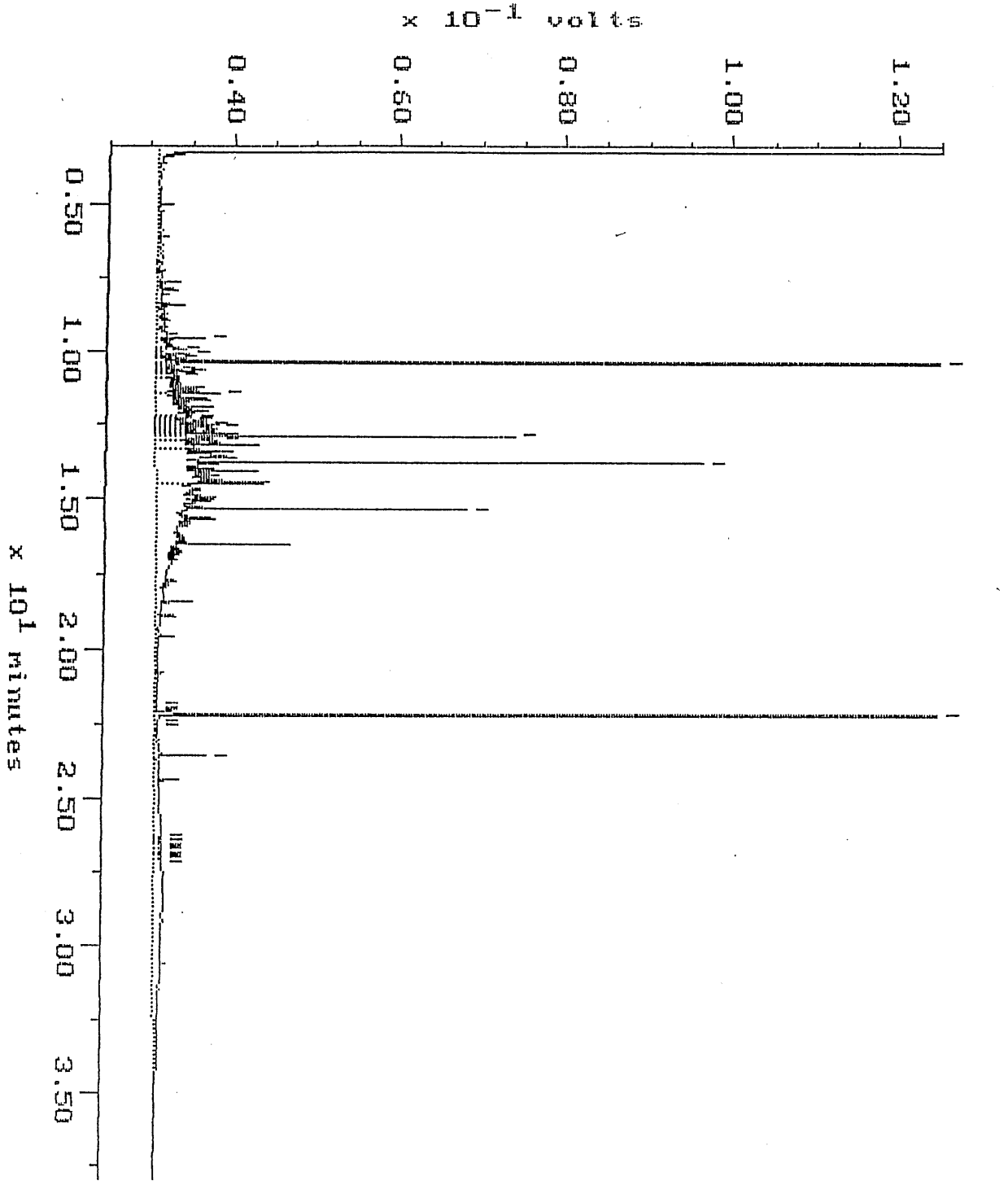
WA DOE WTPH-D

Sample: 9310-110-9 Channel: NANCY Filename: RA138H11
Acquired: 13-OCT-93 19:36 Method: F:\BRO2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



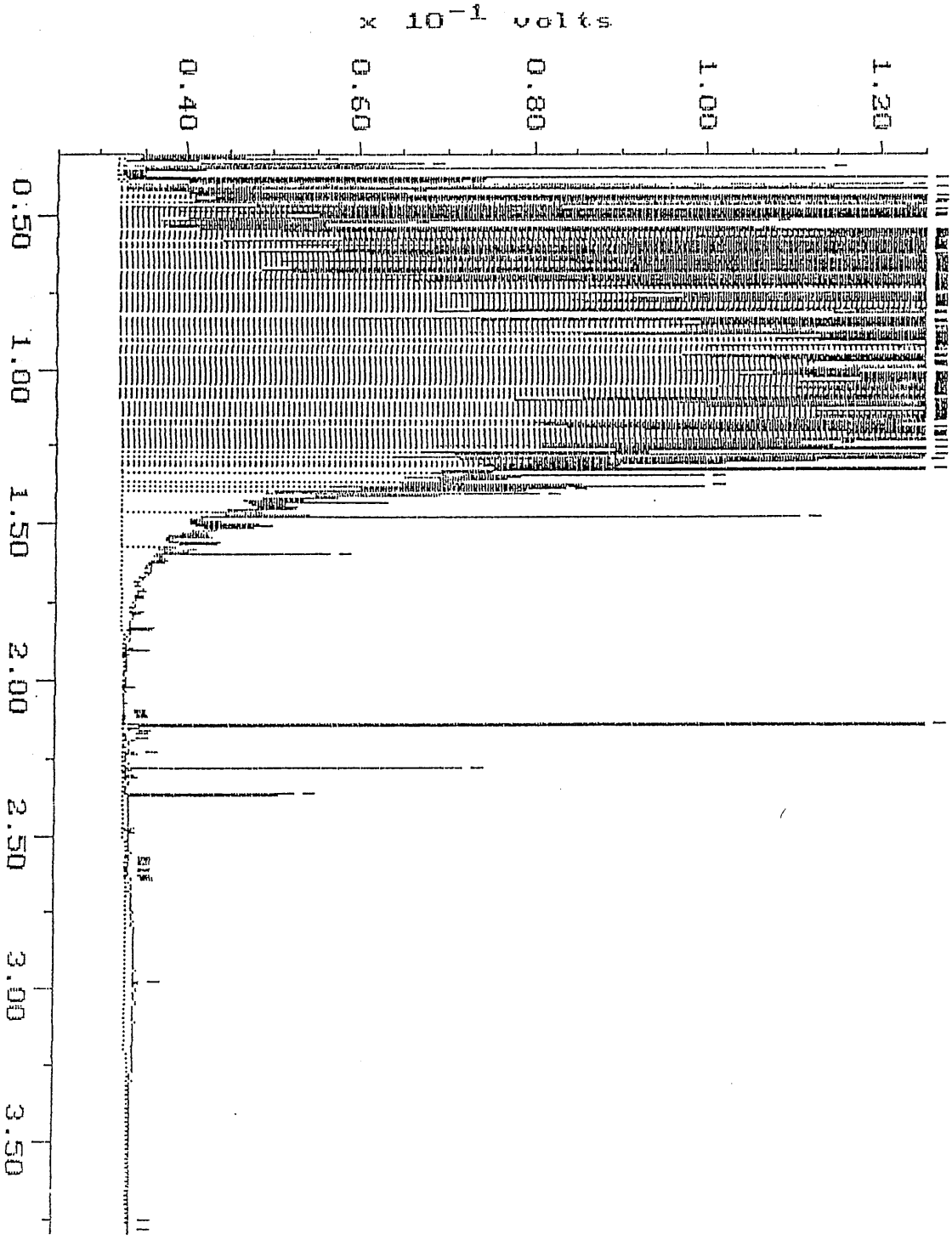
WA DOE WTPH-D

Sample: 9310-110-10 Channel: NANCY Filename: RA138N17
Acquired: 14-OCT-93 0:20 Method: F:\BRO2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



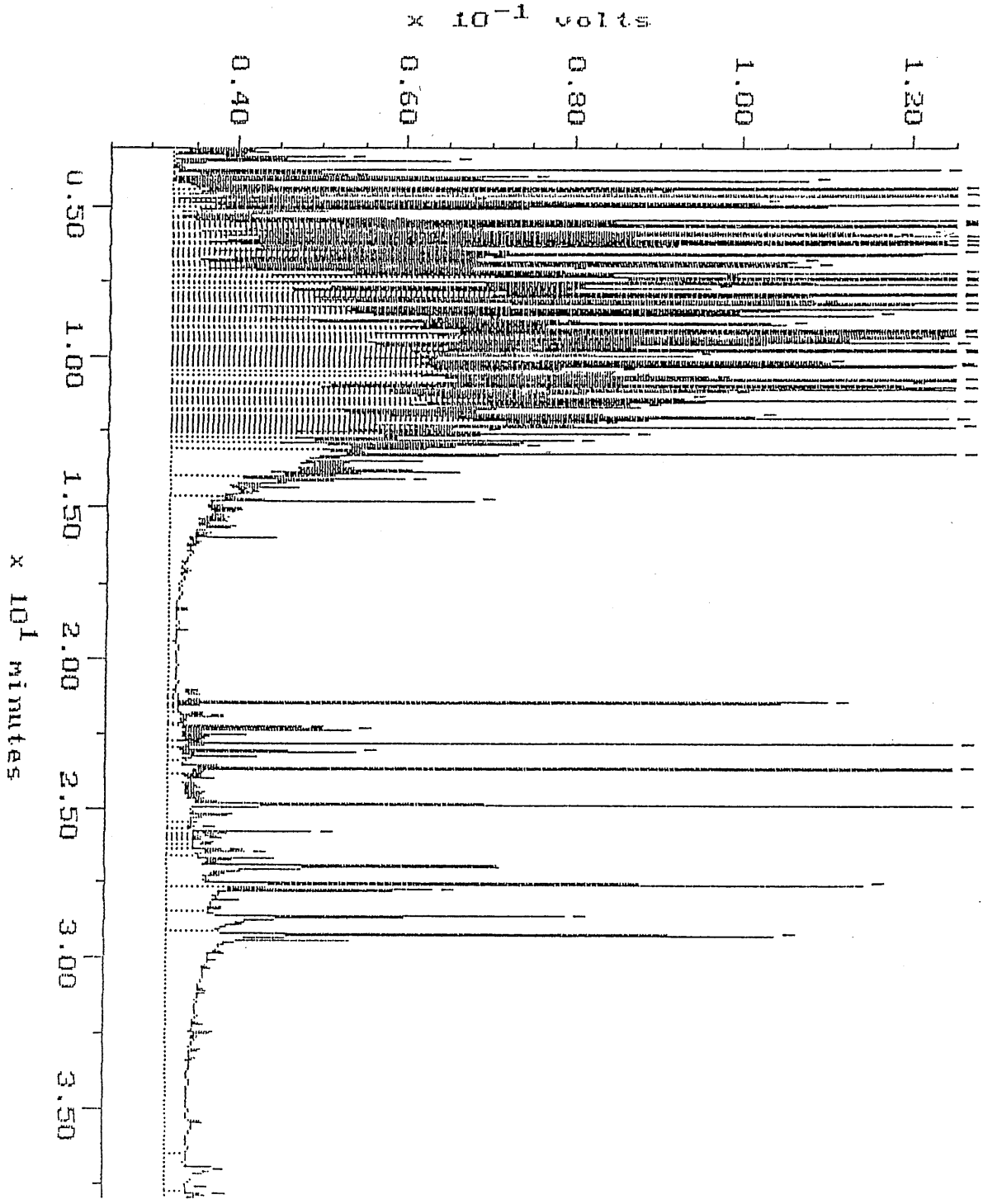
WA DOE WTPH-D

Sample: 9310-110-11 Channel: FRED Filename: RA148F04
Acquired: 14-OCT-93 17:30 Method: F:\RK02\MAXDATA\FRED\FUEL1014 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



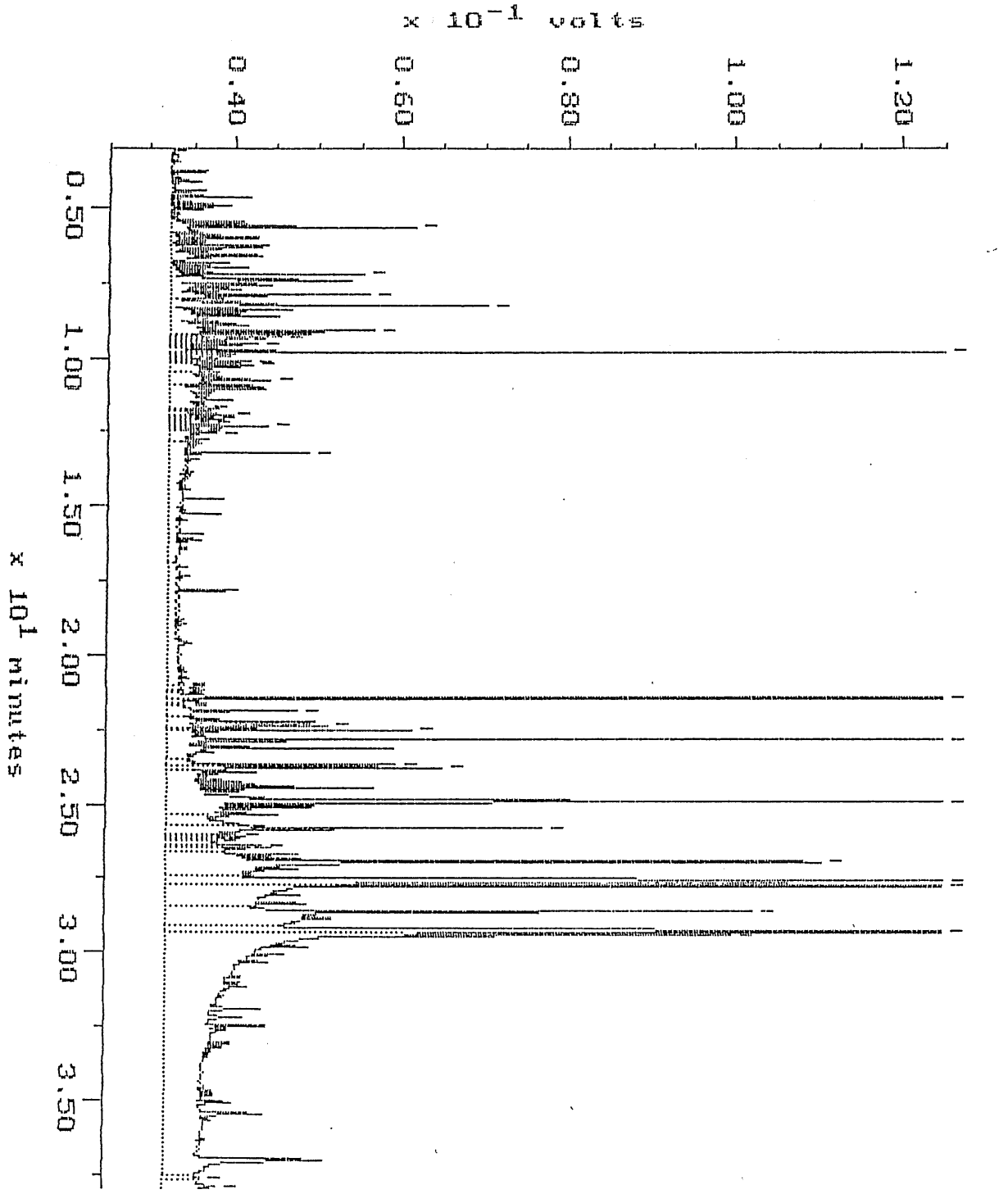
WA DOE WTPH-D

Sample: 9310-110-12DIL Channel: FRED Filename: RA148F12
Acquired: 14-OCT-93 23:57 Method: F:\BRO2\MAXDATA\FRED\FUEL1014 Operator: ATI
Dilution: 1 : 5.000
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



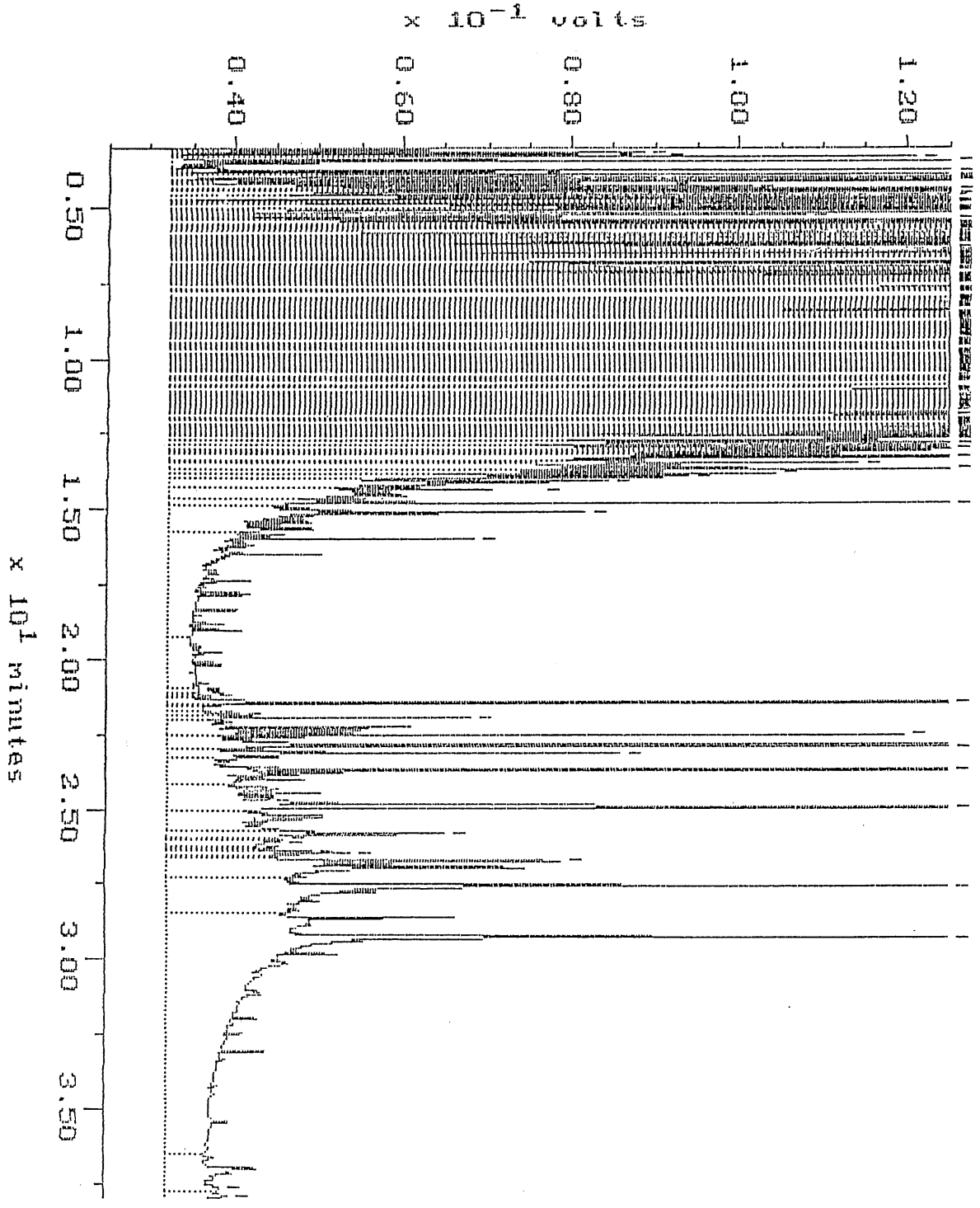
WA DOE WTPH-D

Sample: 9310-110-13 Channel: FRED Filename: RA148F13
Acquired: 15-OCT-93 0:44 Method: F:\BRO2\MAXDATA\FRED\FUEL1014 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



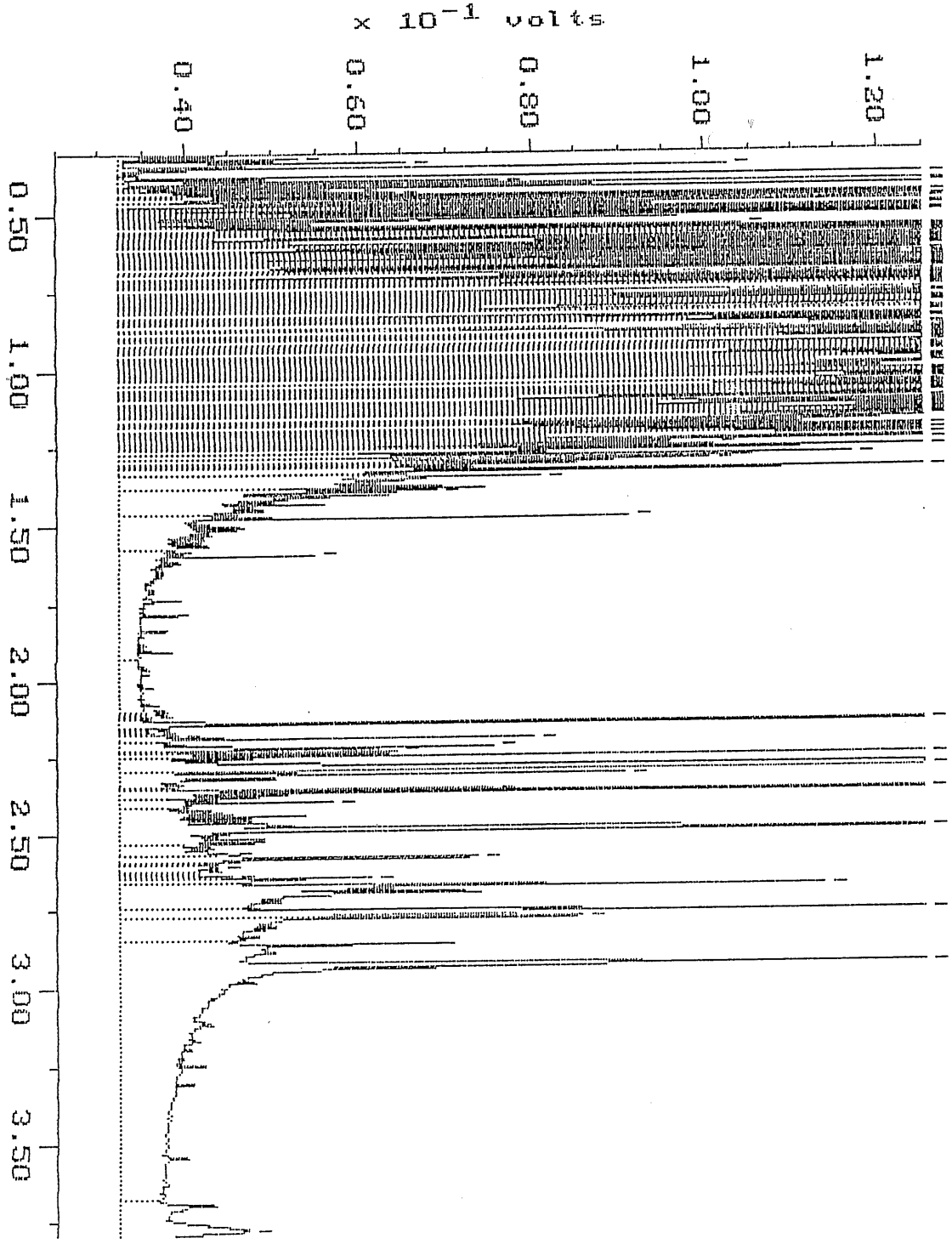
WA DOE WTPH-D

Sample: 9310-110-14 Channel: FRED Filename: RA148F14
Acquired: 15-OCT-93 1:32 Method: F:\BK02\MAXDATA\FRED\FUEL1014 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



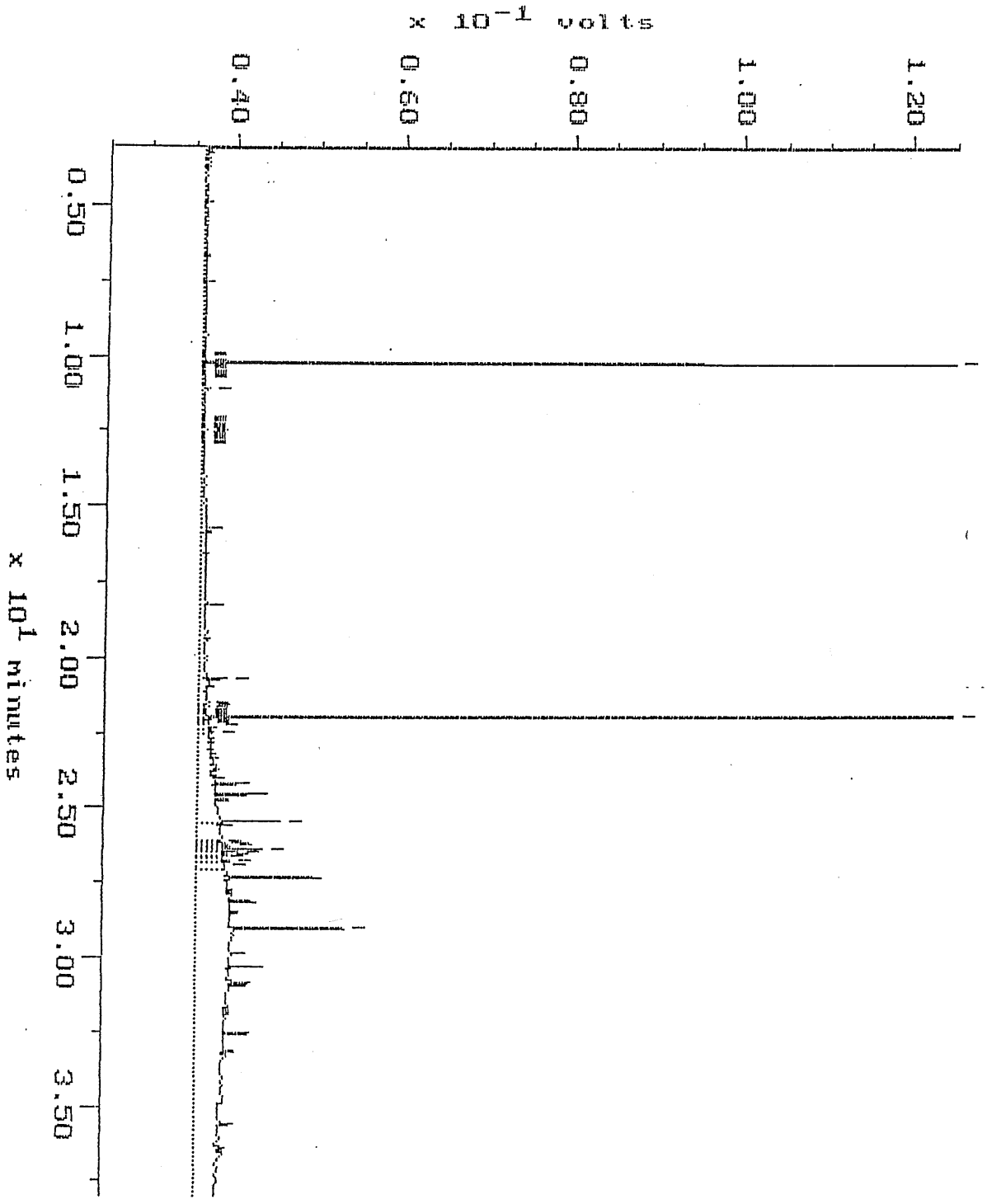
WA DOE WTPH-D

Sample: 9310-110-15 Channel: FRED Filename: RA148F15
Acquired: 15-OCT-93 2:19 Method: F:\BRO2\MAXDATA\FRED\FUEL1014 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY

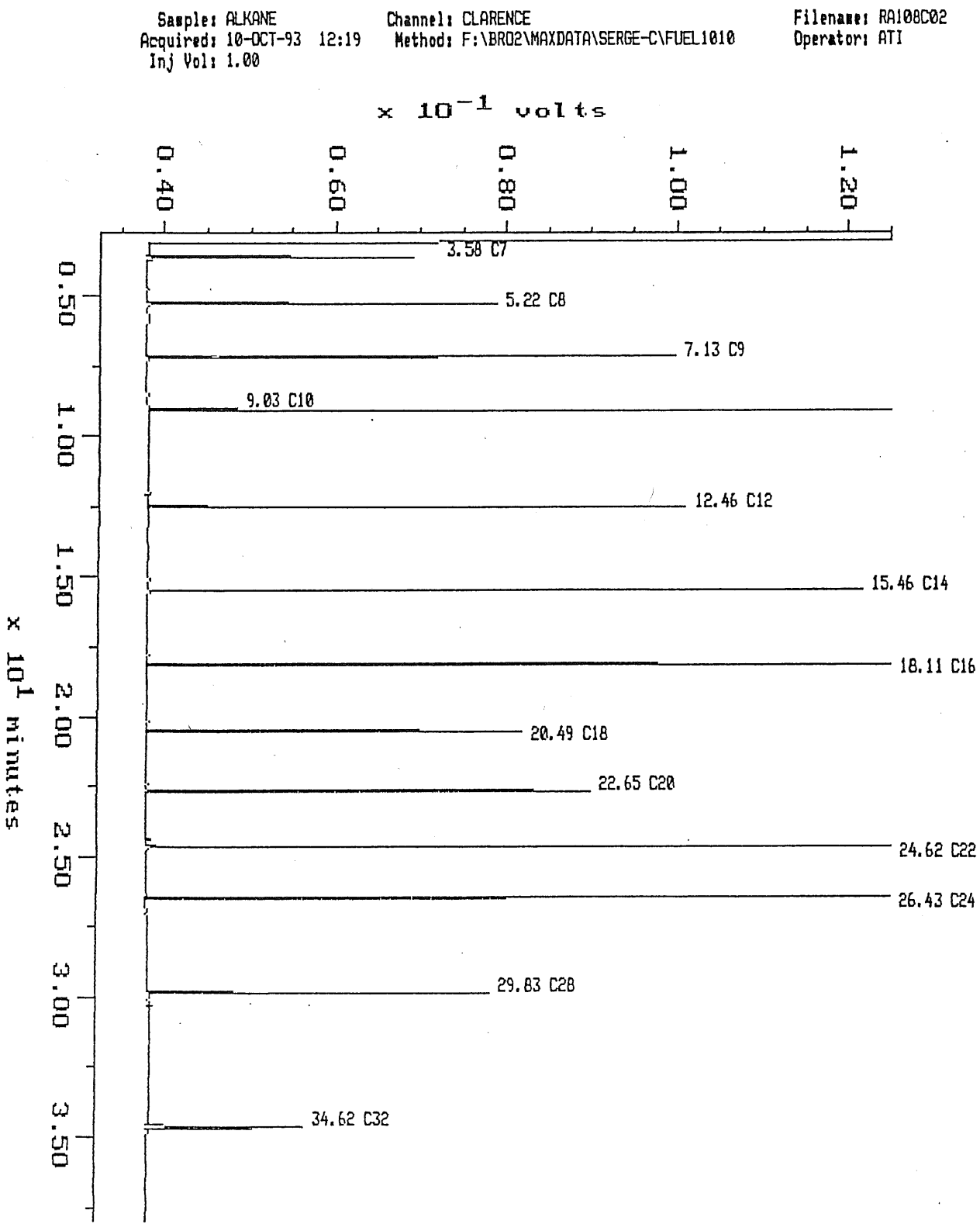


WA DOE WTPH-D

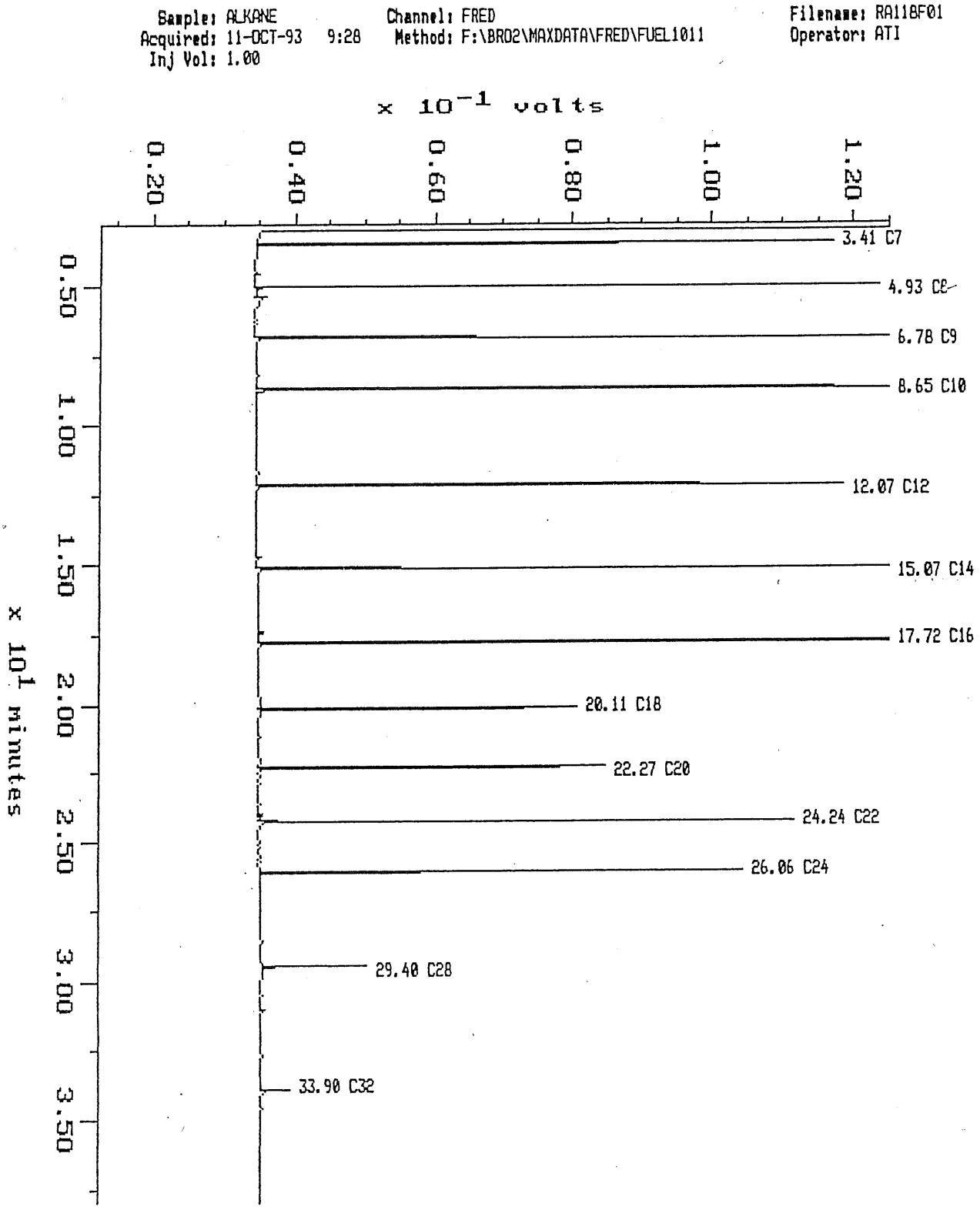
Sample: 9310-110-16 Channel: CLARENCE Filename: RA148C30
Acquired: 15-OCT-93 11:57 Method: F:\BRD2\MAXDATA\SERGE-C\FUEL1014 Operator: ATI
Comments: ATI RUSH FUELS: DEDICATED TO QUALITY CLIENT SERVICE



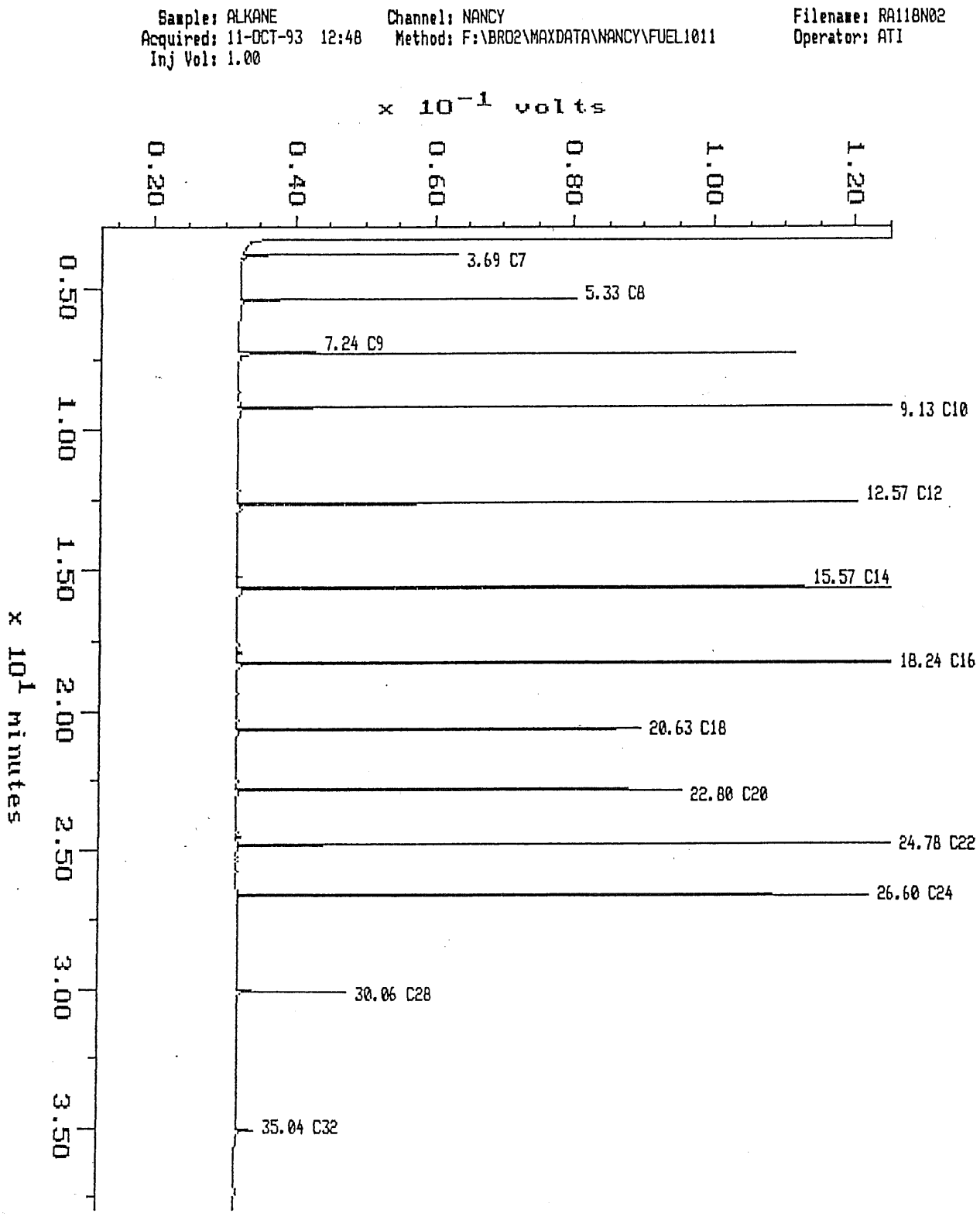
Alkane


Sample: ALKANE
Channel: CLARENCE
Filename: RA108C02
Acquired: 10-OCT-93 12:19
Method: F:\BRO2\MAXDATA\SERGE-C\FUEL1010
Operator: ATI
Inj Vol: 1.00
x 10⁻¹ volts
0.40
0.60
0.80
1.00
1.20
x 10¹ minutes
0.50
1.00
1.50
2.00
2.50
3.00
3.50
3.58 C7
5.22 C8
7.13 C9
9.03 C10
12.46 C12
15.46 C14
18.11 C16
20.49 C18
22.65 C20
24.62 C22
26.43 C24
29.83 C28
34.62 C32

Alkane

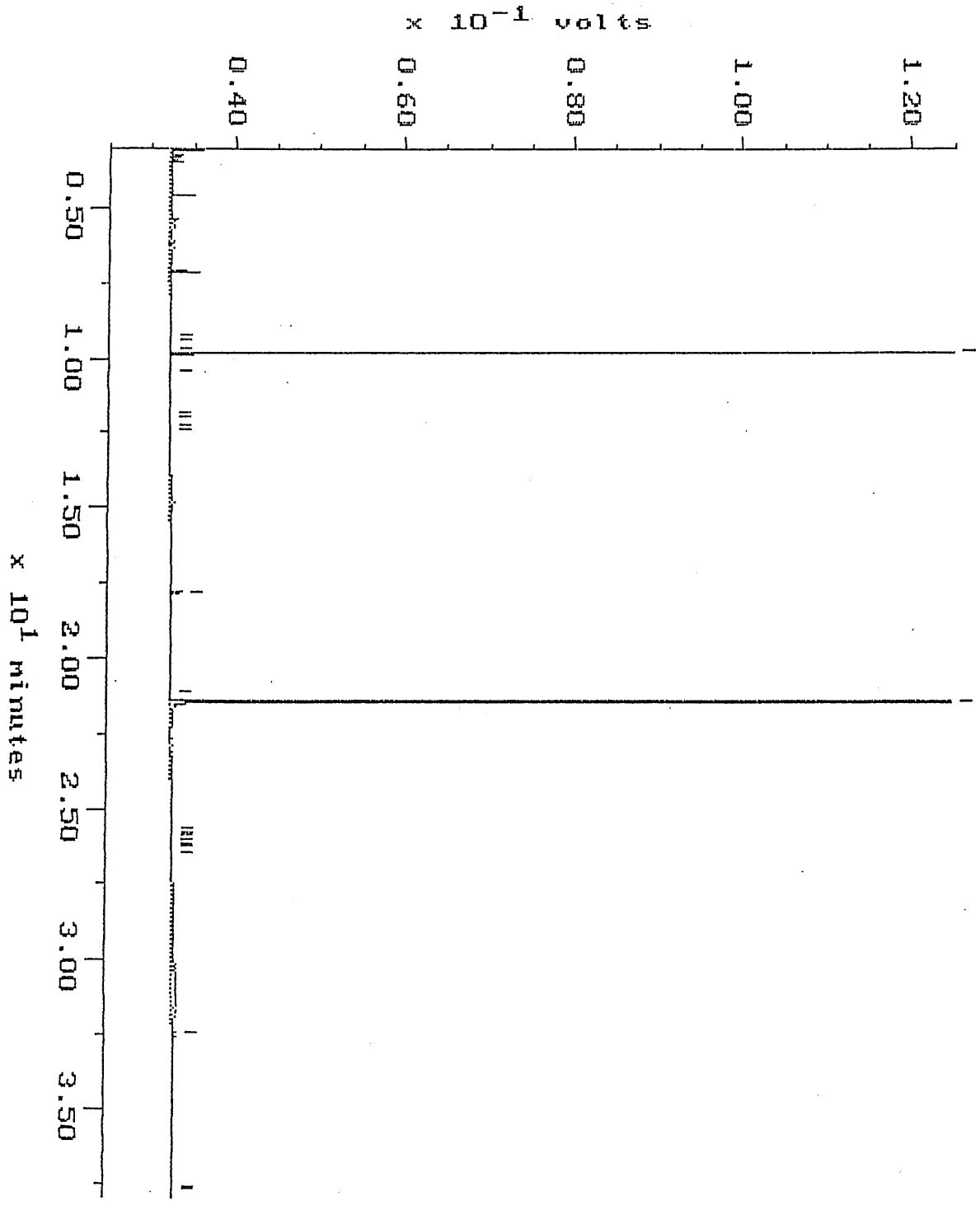

Sample: ALKANE
Acquired: 11-OCT-93 9:28
Inj Vol: 1.00
Channel: FRED
Method: F:\BRO2\MAXDATA\FRED\FUEL1011
Filename: RA118F01
Operator: ATI
x 10⁻¹ volts
0.20
0.40
0.60
0.80
1.00
1.20
x 10¹ minutes
0.50
1.00
1.50
2.00
2.50
3.00
3.50
3.41 C7
4.93 C8
6.78 C9
8.65 C10
12.07 C12
15.07 C14
17.72 C16
20.11 C18
22.27 C20
24.24 C22
26.06 C24
29.40 C28
33.90 C32

Alkane


Sample: ALKANE
Channel: NANCY
Filename: RA118N02
Acquired: 11-OCT-93 12:48
Method: F:\BRO2\MAXDATA\NANCY\FUEL1011
Operator: ATI
Inj Vol: 1.00
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
3.69 C7
5.33 C8
7.24 C9
9.13 C10
12.57 C12
15.57 C14
18.24 C16
20.63 C18
22.80 C20
24.78 C22
26.60 C24
30.06 C28
35.04 C32

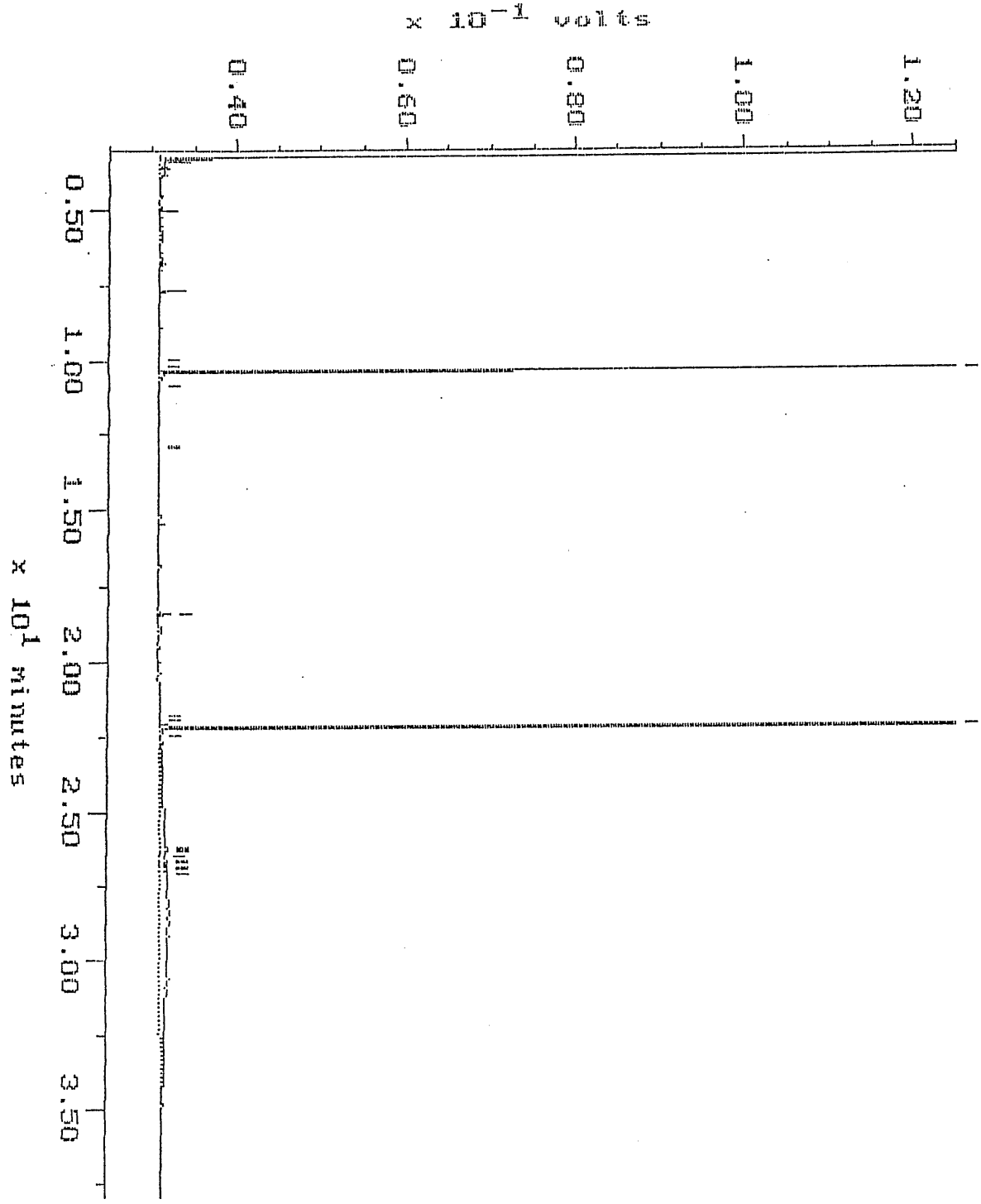
Blank

Sample: SRB 10-13 Channel: FRED Filename: RA138F03
Acquired: 14-OCT-93 0:04 Method: F:\BK02\MAXDATA\FRED\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



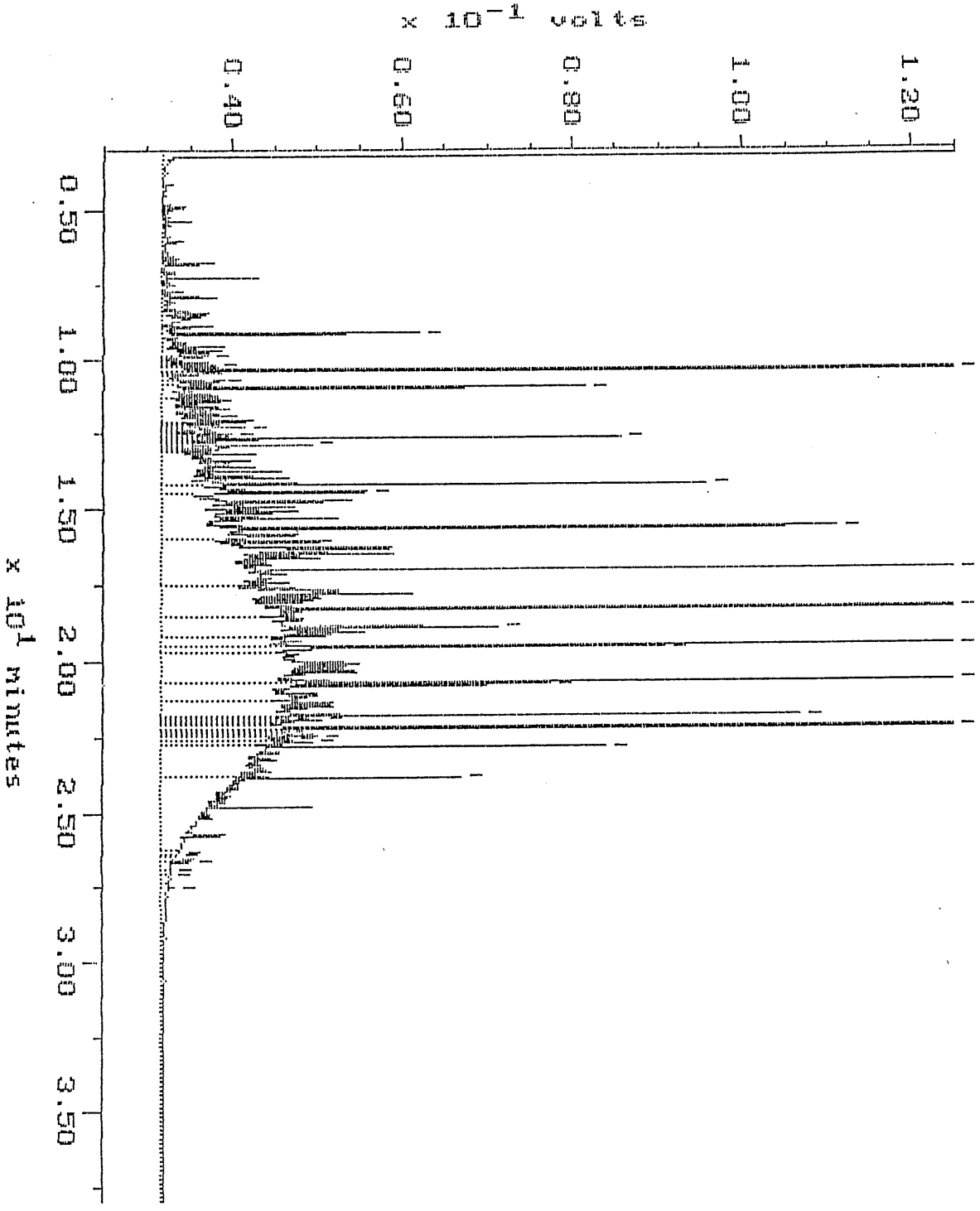
Blank

Sample: S&B 10-13 Channel: NANCY Filename: RA130N08
Acquired: 13-OCT-93 17:15 Method: F:\BRO2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



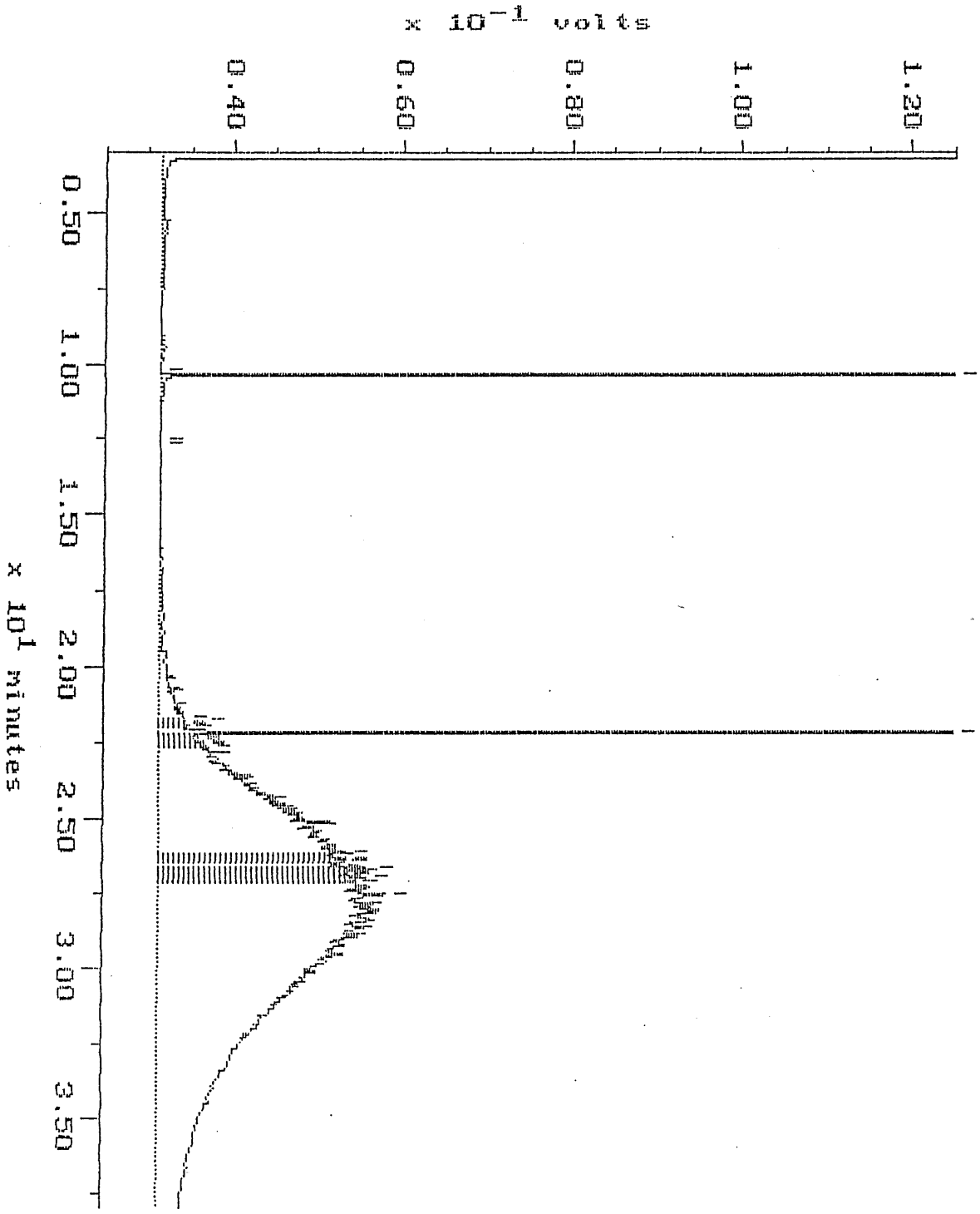
Continuing Calibration

Sample: D-500 Channel: NANCY Filename: RA136N01
Acquired: 13-OCT-93 9:59 Method: F:\BRD2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



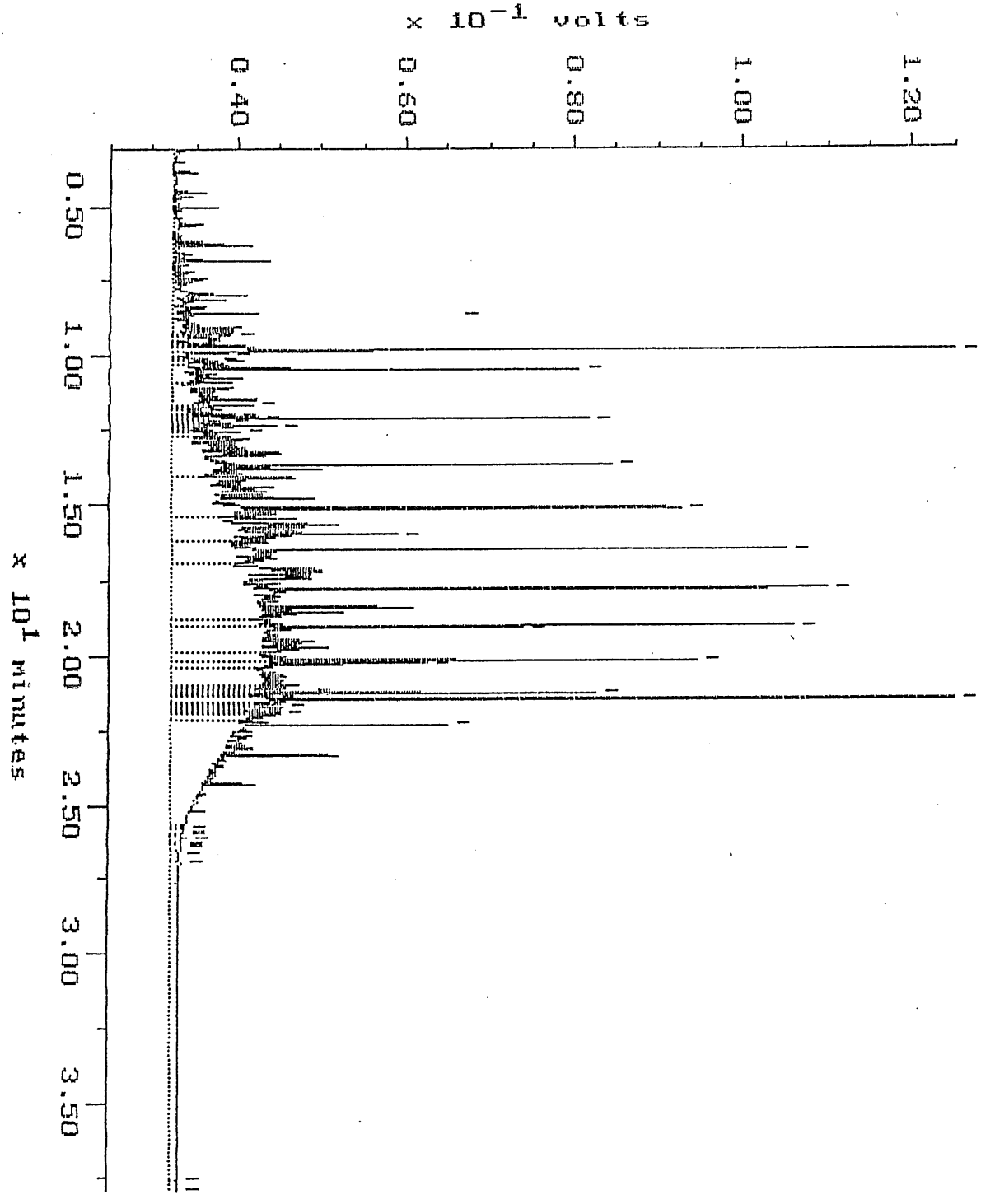
Continuing Calibration

Sample: MD 500 Channel: NANCY Filename: RA138N02
Acquired: 13-OCT-93 10:46 Method: F:\BRO2\MAXDATA\NANCY\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS:PROVIDERS OF EXCELLENCE AND QUALITY IN CLIENT SERVICE



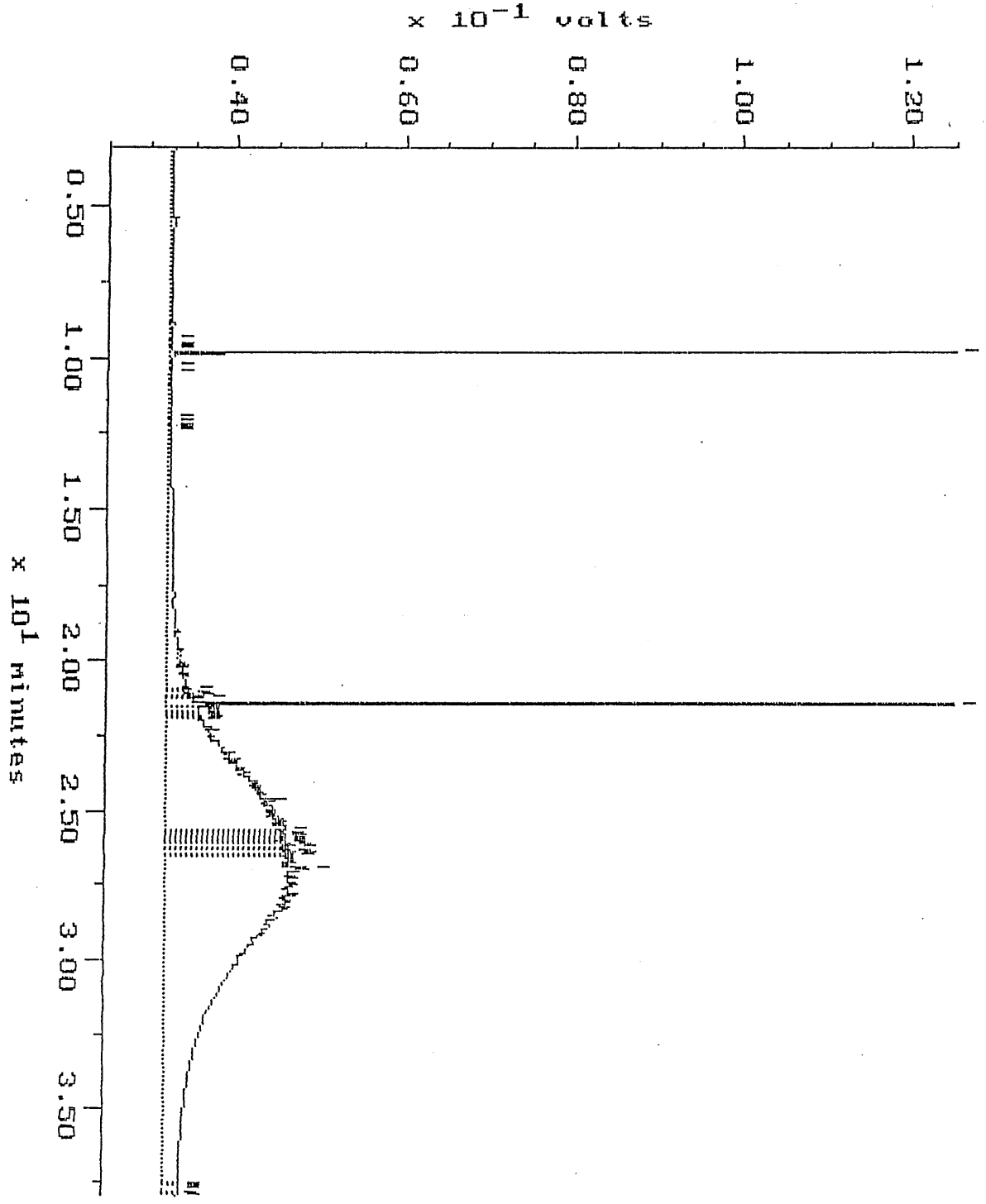
Continuing Calibration

Sample: D 500 Channel: FRED Filename: RA138F01
Acquired: 13-OCT-93 22:29 Method: F:\BK02\MAXDATA\FRED\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



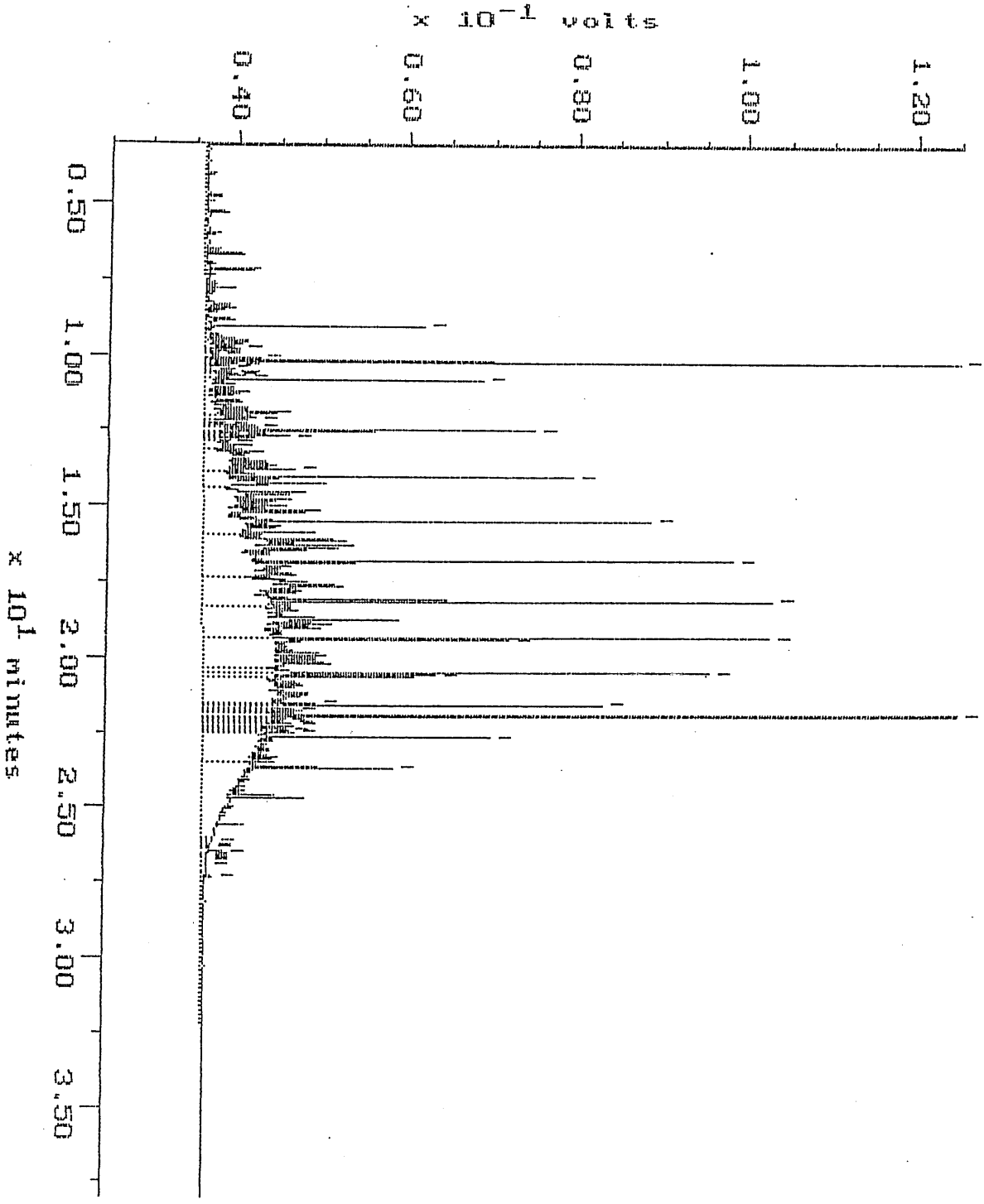
Continuing Calibration

Sample: MD 500 Channel: FRED Filename: RA138F02
Acquired: 13-OCT-93 23:17 Method: F:\BRD2\MAXDATA\FRED\FUEL1013 Operator: ATI
Comments: ATI RUSH FUELS: A MISSION OF EXCELLENCE IN ANALYTICAL CHROMATOGRAPHY



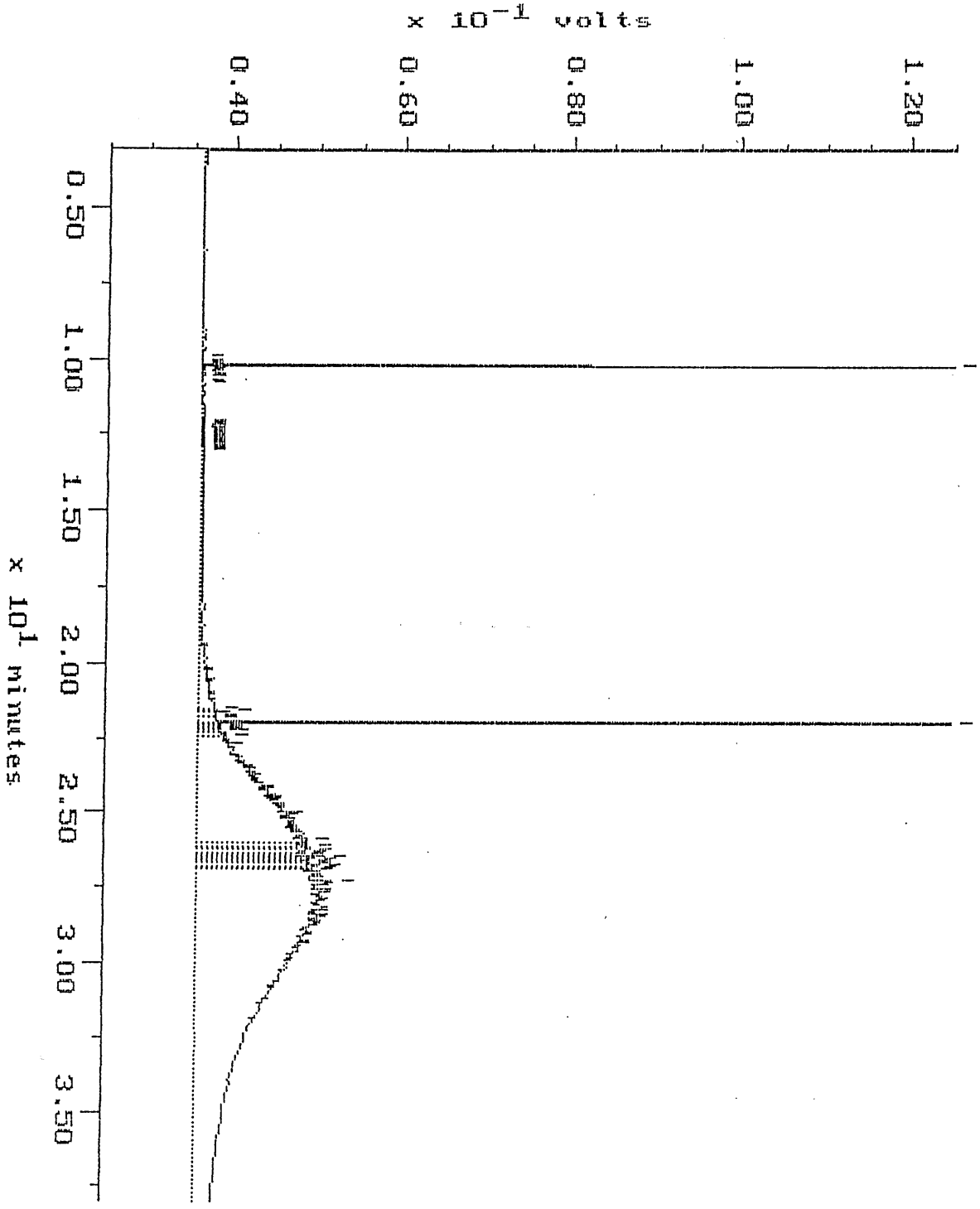
Continuing Calibration

Sample: D 500 Channel: CLARENCE
Acquired: 14-OCT-93 13:14 Method: F:\BR02\MAXDATA\SERGE-C\FUEL1014 Filename: RB148C02
Comments: ATI RUSH FUELS: DEDICATED TO QUALITY CLIENT SERVICE Operator: ATI



Continuing Calibration

Sample: MD 500 Channel: CLARENCE Filename: RA148C03
Acquired: 14-OCT-93 14:00 Method: F:\BRD2\MAXDATA\SERGE-C\FUEL1014 Operator: ATI
Comments: ATI RUSH FUELS: DEDICATED TO QUALITY CLIENT SERVICE



Analytical Technologies, Inc. 560 Avenue, Suite anton, 55 (20 3335

DATE: 10/11/93 Page 1 of 1 ATI ACCESSION # 7310-110

COMPANY: GeoEngineers
REPORT TO: Norm Puri
ADDRESS: 8410 154th Ave NE
Redmond WA 98052
PHONE: (206) 861-6000 FAX: (206) 861-6050
PROJECT MANAGER: Norm Puri
PROJECT NUMBER: 0161-013-R6.9
PROJECT NAME: Unocal, West Lake & Mercer

ATI will DISPOSE / RETURN samples (circle one)

Sample ID	Date	Time	Matrix	LabID	FUELS: TPH-HCID WA/OR	BETX/TPH-G combo WA/OR	BETX (by 8020)	TPH-G WA/OR	TPH-D extended WA/OR	8015 modified	418.1 WA/OR	413.2	AK-GRO	AK-DRO	ORGANIC COMPOUNDS: 8240 GCMS Volatiles	8270 GCMS Semivolatiles	8080 Pesticides/PCBs	PCB only (by 8080) STD/lo level	8010 Halogenated VOCs	8020 Aromatic VOCs	8310 HPLC PAHs	8040 Phenols	8140 OP Pesticides	8150 OC Herbicides	METALS: Metals (Indicate below *)	Total Lead	Priority Pollutant Metals (13)	TAL Metals (23)	TCLP: TCLP-Volatiles (ZHE-8240)	TCLP-Semivolatiles (8270)	TCLP-Pesticides (8080)	TCLP-Herbicides (8150)	TCLP-Metals (8 metals)	OTHER: % Moisture (please indicate)	Total # of Containers/sample
W-1	10/11/93	0840	Soil	1		X			X				X													X									1
W-2		0850		2		X			X																	X									1
W-3		0900		3		X			X																	X									1
W-4		0905		4		X			X																	X									1
W-5		0915		5		X			X																	X									1
W-6		0930		6		X			X																	X									1
W-7		0940		7		X			X																	X									1
W-8		0950		8		X			X																	X									1
W-9		1000		9		X			X																	X									1
W-10		1015		10		X			X																	X									1
W-11		1020		11		X			X										X							X									1
W-12		1025		12		X			X																	X									1

Turnaround Time	
STANDARD TAT	X
1 WEEK TAT	
4 WORK DAY TAT	
3 WORK DAY TAT	
2 WORK DAY TAT	
24 HOUR TAT	

Sample Receipt	
TOTAL # CONTAINERS RECVD	12
COC SEALS PRESENT?	Y
COC SEALS INTACT?	Y
RECEIVED COLD?	Y
RECEIVED INTACT?	Y
RECEIVED VIA:	COURIER

Special Instructions: Hold all samples for possible analysis for EDB/EDC.

* Metals needed:

Relinquished By:	Relinquished By:	Relinquished By:
Date: 10/12/93	Date:	Date:
Time: 0730	Time:	Time:
Received By:	Received By:	Received By:
Date: 10/13/93	Date:	Date:
Time: 0925	Time:	Time:

Corporate Offices: 5550 Morehouse Drive, San Diego, CA 92121 (619)458-9141

AnalyticalTechnologies, Inc.
560 Naches Avenue, S.W., Suite 101, Renton, WA 98055 (206) 228-8335

DATE: 10/11/93 Page 2 of 2 ATI ACCESSION # 1310-11

COMPANY: [illegible] Engineers
REPORT TO: Norm Part
ADDRESS: [illegible] 156th Ave NE
Redmond, WA 98052
PHONE: (206) 861-6000 FAX: (206) 861-6050
PROJECT MANAGER: Norm Part
PROJECT NUMBER: 111-013-R6A
PROJECT NAME: Unocal, West Lake & Mercer
ATI will (DISPOSE / RETURN samples (circle one)

Sample ID	Date	Time	Matrix	LabID
B-3	10/11/93	1135	Soil	13
B-6		1215		14
B-9		1250		15
B-12		1320		16
GWATER-1		—	Water	17
GWATER-2		1300		18

	FUELS											ORGANIC COMPOUNDS												METALS				TCLP					OTHER					
	TPH-HCID WA/OR	BETX/TPH-G combo WA/OR	BETX (by 8020)	TPH-G WA/OR	TPH-D extended WA/OR	8015 modified	418.1 WA/OR	413.2	AK-GRO	AK-DRO		8240 GCMS Volatiles	8270 GCMS Semivolatiles	8080 Pesticides/PCBs	PCB only (by 8080) STD/lo level	8010 Halogenated VOCs	8020 Aromatic VOCs	8310 HPLC PAHs	8040 Phenols	8140 OP Pesticides	8150 OC Herbicides		Metals (Indicate below *)	Total Lead	Priority Pollutant Metals (13)	TAL Metals (23)		TCLP-Volatiles (ZHE-8240)	TCLP-Semivolatiles (8270)	TCLP-Pesticides (8080)	TCLP-Herbicides (8150)	TCLP-Metals (8 metals)		% Moisture (please indicate)					Total # of Containers/sample
B-3		X			X				+															X													1
B-6		X			X				-															X													1
B-9		X			X				-															X													1
B-12		X			X				-															X													1
GWATER-1		X							-																													2
GWATER-2		X							-																													2

Turnaround Time	
STANDARD TAT	X
1 WEEK TAT	
4 WORK DAY TAT	
3 WORK DAY TAT	
2 WORK DAY TAT	
24 HOUR TAT	

Sample Receipt	
TOTAL # CONTAINERS RECVD	6
COC SEALS PRESENT?	Y
COC SEALS INTACT?	Y
RECEIVED COLD?	Y
RECEIVED INTACT?	Y
RECEIVED VIA:	COURIER

Special Instructions:
Hold all samples for possible analysis for EDB/EDC.
* Metals needed:

Relinquished By:	Relinquished By:	Relinquished By:
Date: 10/12/93	Date:	Date:
Time: 0730	Time:	Time:
Received By:	Received By:	Received By:
Date: 10/12/93	Date:	Date:
Time: 0925	Time:	Time:

Corporate Offices: 5550 Morehouse Drive, San Diego, CA 92121 (619)458-9141

APPENDIX C

EcoChem, Inc.

GeoEngineers

Environmental Science and Chemistry

MAY 05 1994

Routing NLP

File

MEMORANDUM

DATE: May 3, 1994

TO: Norm Puri, P.E.
GeoEngineers, Inc.

FROM: Teri Floyd, EcoChem, Inc. Teri A. Floyd

SUBJECT: CHEMICAL EVALUATION OF SOIL AND GROUNDWATER CONTAMINATION AT THE UNOCAL AND ROSEN SITES ON MERCER STREET
ECOCHEM PROJECT NO. 2202-01

This memorandum report presents EcoChem, Inc.'s (EcoChem) evaluation of the soil and groundwater contamination at the Rosen site on Mercer and Terry streets, and the Unocal site diagonally across Mercer Street.

Our evaluation is based on information contained in the following documents and on our professional judgment based on our experiences with related projects in the past. Specific documents reviewed included:

- Draft letter to Mr. Herb Rosen from Enviros, Inc. dated November 4, 1993, regarding "Groundwater gasoline contamination at the Rosen property at the Corner of Mercer and Terry Streets.

- Fax transmittal from Kathleen Goodman of Enviros to Steve Perrigo of GeoEngineers, dated October 4, 1993, containing information on sample R-EXW-2.

- Letter to Mr. Herb Rosen from Enviros, Inc., dated November 13, 1993, regarding "Summary of a Partial Review of the Data Concerning Possible Off-site Sources for the Gasoline Contamination at the Mercer-Terry Street Property.

- Letter to EcoChem from you, dated November 16, 1993, summarizing the problem and requesting a chemical evaluation of the products at the two sites. The letter includes attached maps and laboratory reports for GeoEngineer's fall 1993 sampling at both the Rosen and Unocal sites.

1401 Norton Building • 801 Second Avenue • Seattle WA 98104 • (206) 233-9332 • Fax (206) 233-0114

- A submittal from Analytical Technologies Inc. of the laboratory reports corresponding to GeoEngineers January 1994 groundwater sampling at the Unocal site.

- Chromatographic library from Analytical Technologies, Inc. for 1992 and 1993, showing the expected chromatograms for a large number of petroleum products using methods WTPH-G and WTPH-D.

PROJECT OBJECTIVE

The first objective of EcoChem's task was to identify the products at the two sites. Our second objective was to evaluate the potential for contamination at the Rosen site being due to the Unocal spill, based a knowledge of the chemical properties of the products involved. GeoEngineers would then combine this evaluation with other site information to confirm or dispute the conclusion in the Enviros report that the Rosen site is impacted by the release at the Unocal site.

CHEMICAL IDENTIFICATION OF PRODUCTS AT THE ROSEN SITE

A review of the chromatograms collected by GeoEngineers from the Rosen site reveals the presence of the following products:

- **Diesel No. 2 or a closely related product with a more narrow hydrocarbons range.** This product is present most clearly in wall samples W-3, W-4, and W-10. These samples contain no detectable benzene or toluene, present a typical diesel chromatographic pattern in WTPH-D, and a typical "diesel-tail" in the chromatogram for WTPH-G. Diesel was also reported as present at concentrations up to 800 mg/kg in excavated and vadose zone soils by Enviros.

- **Motor and hydraulic-range oils.** These oils are present in the majority of samples across the site. These heavy oils do not contain detectable benzene, toluene, or ethylbenzene; nor do they have a chromatographic response using method WTPH-G. The WTPH-D chromatographic shape for motor oil is characterized by a broad symmetric hump between C-18 and the end of the range. Hydraulic fluid is typically an asymmetric shape with significant fine structure in the same area. Numerous other petroleum oils also have chromatographic responses in this area, but motor oil and hydraulic fluid are generally the most common. Oil range hydrocarbons were also reported as ubiquitous across the site by Enviros; the highest concentration in their samples was 36,000 mg/kg.

- **A gasoline-range product, probably very old gasoline.** This product was detected in the three bottom samples from the center of the site and in several wall samples,

especially W-7, W-8, W-11, and W-12. Assuming that the product was originally gasoline, the WTPH-G chromatograms show a nearly complete loss of BETX and n-alkane components, followed by additional weathering so that the usual valley in gasoline, around 10 minutes in the chromatogram, is no longer present due to weathering of the components on either side of the valley. The WTPH-D chromatograms also show a marked loss of low hydrocarbon components, but retain the sharp decrease in concentration beyond C-13 or -14. This again is consistent with a very old gasoline. Specific markers of this material include (1) the benzene to WTPH-G ratio is generally less than 1 to 1000; (2) the toluene, ethylbenzene, and xylene concentrations are also low; (3) the WTPH-G chromatogram has lost low-end components, n-alkanes, and the valley around 10 minutes and appears continuously "hilly" from about 6 though 20 minutes; (4) the estimated concentrations by WTPH-G and WTPH-D are similar with a ratio between 0.5 and 2.0; (5) the WTPH-D chromatogram is much more symmetric than for fresher gasoline due to a significant loss of volatile components.

The gasoline-range product on the Rosen site is extensively weathered. Given its dispersion on the site and the weather in Western Washington, it is probably more than 30 years old. Throughout the remainder of this submittal, this product is referred to as "aged gasoline."

Although comparable chromatograms are not available for Enviros's work on-site, an aged gasoline component would be quite consistent with their findings of extensive gasoline contamination, with little or no BETX contamination.

Representative chromatograms of these products are shown in Figures 1 for WTPH-G analysis and 2 for WTPH-D analysis. A summary of the chemical results are presented in Table 1.

CHEMICAL IDENTIFICATION OF PRODUCTS AT THE UNOCAL SITE ON MERCER STREET

A review of chromatograms from GeoEngineer's Fall 1993 and Winter 1994 groundwater sampling at the Unocal site reveals the presence of significant gasoline contamination, centered in the area around MW-37 and MW-34. Free product is still measurable in MW-37. Table 2 lists chemical concentrations. Figure 3 shows the WTPH-G chromatogram of the product versus a fresh gasoline standard. Figure 4 shows the WTPH-D chromatogram of the product versus fresh gasoline and diesel standards. Note that the product in MW-37 contains a motor oil fraction in addition to the gasoline. This is a common occurrence on older gas station sites with ubiquitous motor oil contamination. The gasoline, which is an excellent solvent for motor oil, appears to extract the residual motor oil in surrounding soils and hold it in the free product phase.

A very similar pattern exists in adjacent wells, MW-34, MW-32A, MW-35, and MW-33. The chromatographic shape is very similar, but the benzene to xylene ratios are higher in the water samples than in the product sample. This is a direct consequence of the higher solubility in water

for benzene than for xylenes. The benzene to xylene ratios in these samples are a good indication that at least some of the contamination in these wells is due to current groundwater transport (which would favor benzene over xylenes) rather than purely residual contamination from the spill.

The gasoline product present on the Unocal site is significantly different from, and newer than, the aged gasoline present on the Rosen Site. The product is probably residual from the 1980 Unocal release. Throughout the remainder of this submittal, this product will be referred to as the "fresher" gasoline.

The patterns in upgradient wells MW-41, MW-42, and MW-43, and in downgradient MW-40 are different. The differences in MW-40 are the most significant, since the well is apparently downgradient of the Rosen site. Figures 5 and 6 show the WTPH-G and WTPH-D chromatograms for groundwater samples MW-40 and MW-33, product sample MW-37, and soil samples W-8 and W-10. Recall that the groundwater samples should contain more light-end components than the soil due to increased solubility. Note the strong similarities between the product sample MW-37, and well sample MW-33, approximately 120 feet downgradient. Note the strong similarities between W-8 and MW-40 located approximately 20 feet apart. MW-40 is located slightly closer to the product well MW-37, than is MW-33; yet the clear chromatogram of gasoline in the MW-33 and MW-37, is replaced in MW-40 with the pattern of the very old gasoline found at the Rosen site. The MW-40 WTPH-D chromatogram also shows a small amount of diesel contamination. From a chemical standpoint, the contamination in MW-40 is almost surely coming from the Rosen site and not from the Unocal spill. Since the nearness of MW-40 to MW-37 would argue for a more significant impact than the chemistry indicates, it would be interesting to find out if a utility corridor or other underground feature along Mercer Street is limiting groundwater flow from the Unocal site, or whether there is a very strong northward groundwater gradient across the Rosen site.

DISTRIBUTION AND MIGRATION POTENTIAL OF CONTAMINANTS AT THE ROSEN SITE

Samples from the bottom of the excavation pit at the Rosen site contain significant concentrations of the aged gasoline component discussed above. The sample from furthest south, B-12, is essentially clean. According to Enviros's report this location should be upgradient of on-site contamination. Samples B-6 and B-9 from the center of the site show almost identical levels of aged gasoline. These samples also contain spiky, asymmetric oil-range hydrocarbons visible in the WTPH-D chromatogram. Sample B-3, taken from the northwest section of the site, nearest the Unocal station, shows the same aged gasoline pattern as in the other samples, but the concentrations are an order of magnitude less than those in the center of the site.

Four samples were collected from the west section of the north wall, at the closest point of approach to the Unocal spill; these samples are designated W-1 (~3-feet bgs), W-2 (~7-feet bgs),

W-3 (~11 feet bgs at the water table), and W-4 (~12-feet bgs, at or just below the water table). The vadose zone samples were essentially clean; while W-3 contained 7,800 mg/kg of diesel. W-4, a foot deeper, contain diesel at 210 mg/kg. No gasoline was present in any of these samples. The "gasoline" concentrations found using WTPH-G are clearly due to the light-weight components of diesel which elute in the WTPH-G method. The WTPH-G chromatogram is unambiguously due to Diesel No. 2, not gasoline.

Four more wall samples were collected in the central portion of the north wall. Again, the vadose zone samples (W-5 and W-6) show only low levels of contamination. However, the contamination is aged gasoline, rather than diesel. The two samples from near the water table (W-7 and W-8) show significant concentrations of aged gasoline. The WTPH-G and WTPH-D chromatograms of these two samples best represent the aged gasoline found on this site. As discussed above and shown in Figures 5 and 6, they are very dissimilar to the chromatograms of fresher gasoline at the Unocal site.

The last four samples were collected from the eastern section of the north wall. The northeast section of the site was found by Enviros to be the most contaminated. Again the upper most sample (W-9) was clean. The other vadose zone sample was slightly contaminated, but with diesel no. 2, not gasoline. The two samples from near the water table (W-11 and W-12) were most contaminated, with 2,300 to 3,400 mg/kg of aged gasoline. The product found in these samples strongly resembles the product in the bottom samples (B-6 and B-9) and in the wall samples W-7 and W-8; while it does not resemble the fresher gasoline free-product found in MW-37.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are based on field observations contained in the Enviros reports, potentiometric data from the GeoEngineers letter to me, and chemical data from both sites:

- The oil and diesel contamination on the Rosen site was wide-spread, and due to historical on-site sources. The contamination was likely migrating northward and has contaminated the north wall of the excavation.

- The gasoline contamination on the Rosen site is very old, probably more than 30 years. The contamination in 1993 was apparently heaviest near the water table and in the wood debris layer. This observation is consistent with an old source of contamination, where the vadose zone has significantly remediated itself due to gravity flow of the gasoline toward to the water table, volatilization of the light-end hydrocarbons during the dry season, volatilization and biodegradation during the wetter seasons, and rainwater leaching of the residual soil component into the groundwater. These processes leave the highest residual contamination at the water

table. Here, the water table coincides with a layer of wood debris which acts as an effective sponge to the residual gasoline as it ages.

- The pattern of aged gasoline contamination at the Rosen site, which is highest in the central and northeastern sections of the site, is consistent with the known locations of the central portions of the service station overlying sampling points B-6 and B-9; while the pump islands were located further to the northeast. Over time the highest residual contamination would be at the water table beneath the original source area and downgradient of the source area (presumably to the north).

- The aged gasoline is continuing to leave the site in groundwater, and appears to have contaminated the groundwater at MW-40. Diesel from the Rosen site also appears to be impacting MW-40.

- Chemical concentrations and chromatographic patterns of groundwater samples from the Unocal site are consistent in interpretation. A major spill of gasoline occurred that has left free product in MW-37, and significant concentrations in adjacent wells, MW-32A, MW-33, MW-34, and MW-35. The product in MW-37 appears to be an essentially unweathered gasoline ("fresher gasoline"), containing between 0.5 and 1.0% benzene, and even higher percentages of the other BETX components. Groundwater contamination in the adjacent wells, approximately 100 to 150 feet away is chemically and chromatographically very similar, although some aging has occurred in the samples further from the source area. The fresher gasoline product does not appear related to the aged gasoline at the Rosen site.

- The chromatographic fingerprint of MW-40 is much more consistent with aged gasoline and diesel contamination coming from the Rosen site, than with fresher gasoline from the Unocal site. GeoEngineers potentiometric surfaces for the area indicate that MW-40 is probably downgradient from the Rosen. However, it is possible that underground utilities corridors may limit or facilitate groundwater flow along Mercer street.

I hope that this memorandum report is sufficiently detailed to meet your project needs. If you have any questions, please feel free to call me.

Table 1

Summary of GeoEngineers Data from 960 Republican Street Excavation

Data Collected Oct. 11, 1993; Data Analyzed at ATI-Renton using WA Methods

	Western Group				Central Group			
	W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8
Benzene	<0.028	<.031	<0.16	<0.03	0.12	<0.027	1.6	1.1
Ethylbenzene	<0.028	<.031	0.19	<0.03	0.098	<0.027	5.2	1.3
Toluene	<0.028	0.046	<0.16	<0.03	0.11	<0.027	4.4	1.4
Xylenes	<0.028	0.14	0.87	0.063	0.062	0.036	22	11
WTPH-G	<6	12	470	44	37	6	2300 d	1200 a
WTPH-D	21	54	7800	210	220 a	<11	970 b	2300 c
WTPH-MO	45	120	280	<49	980 a	<42	3500 b	7000 c
Identity	DZ, MO	AG?, MO	D2, MO	D2, MO	aG, MO	aG?	aG, MO	aG, MO

	Eastern Group				Bottom Samples			
	W-9	W-10	W-11	W-12	B-3	B-6	B-9	B-12
Benzene	<0.028	<0.027	0.69	4.8	0.12	<1.6	1.3	<0.069
Ethylbenzene	<0.028	<0.027	6.7	19	0.27	21	14	<0.069
Toluene	<0.028	<0.027	2.8	8	0.3	6.4	5.6	0.12
Xylenes	<0.028	0.076	19	40	1.2	110	55	<0.069
WTPH-G	<6	35	2300 c	3400 d	250	5400 b	3800 a	<14
WTPH-D	<11	42	280	1900 a	490	2900	3700	73
WTPH-MO	<44	<43	<49	1900	1700	2200	3400	270
Identity		D2, MO	aG, H	aG, H	aG, H	aG, H	aG, H	aG?, H?

Notes:

1. Chromatograms were evaluated relative to ATI's chromatographic library and based on professional judgement.
2. Chromatogram ID codes: G - gasoline, aG - aged gasoline, D2 - diesel, MO - motor oil, H - hydraulic fluid.
   All identifications are tenative and are based on c-range and c-gram shape.
   Closely related products are not eliminated based on this classification; but may be eliminated based on other information or a more detailed anaylsis of the data.
3. Units for BETX , WTPH-G, WTPH-D, and WTPH-MO are mg/kg, dry wt.

a - Reporting limit is elevated 5X due to dilution.

b - Reporting limit is elevated 10X due to dilution.

c - Reporting limit is elevated 20X due to dilution.

d - Reporting limit is elevated 50X due to dilution.

Table 2

Summary of Groundwater and Free Product Chemical Analytical Data

Data Collected Oct. and Dec., 1993, and Jan., 1994; Data analyzed at ATI-Renton using WA Methods.

	MW-37 (Product)		MW-32A		MW-33		MW-34	
	Oct. 93	Jan. 94	Oct.93	Dec. 94	Oct.93	Dec. 94	Oct.93	Dec. 94
Benzene	7,500	6,200 d	–	6,300 a	–	560 b	1,400	15,000 a
Ethylbenzene	28,000	27,000 d	–	940 b	–	250 b	120	1,500 a
Toluene	69,000	63,000	–	990 b	–	100 b	480	11,000 a
Xylenes	170,000	150,000	–	1,700 a	–	1,100 b	440	7,000 a
WTPH - G	2,000,000	1,600,000	–	19,000 b	–	7,200	4,200	52,000 a
WTPH - D	82,000	90,000	–	3,000	–	1,000	1,600	2,200
WTPH - MO	<94000	14,000	–	1,000	–	<750	970	<750
Identity	G	G		G		G	G	G

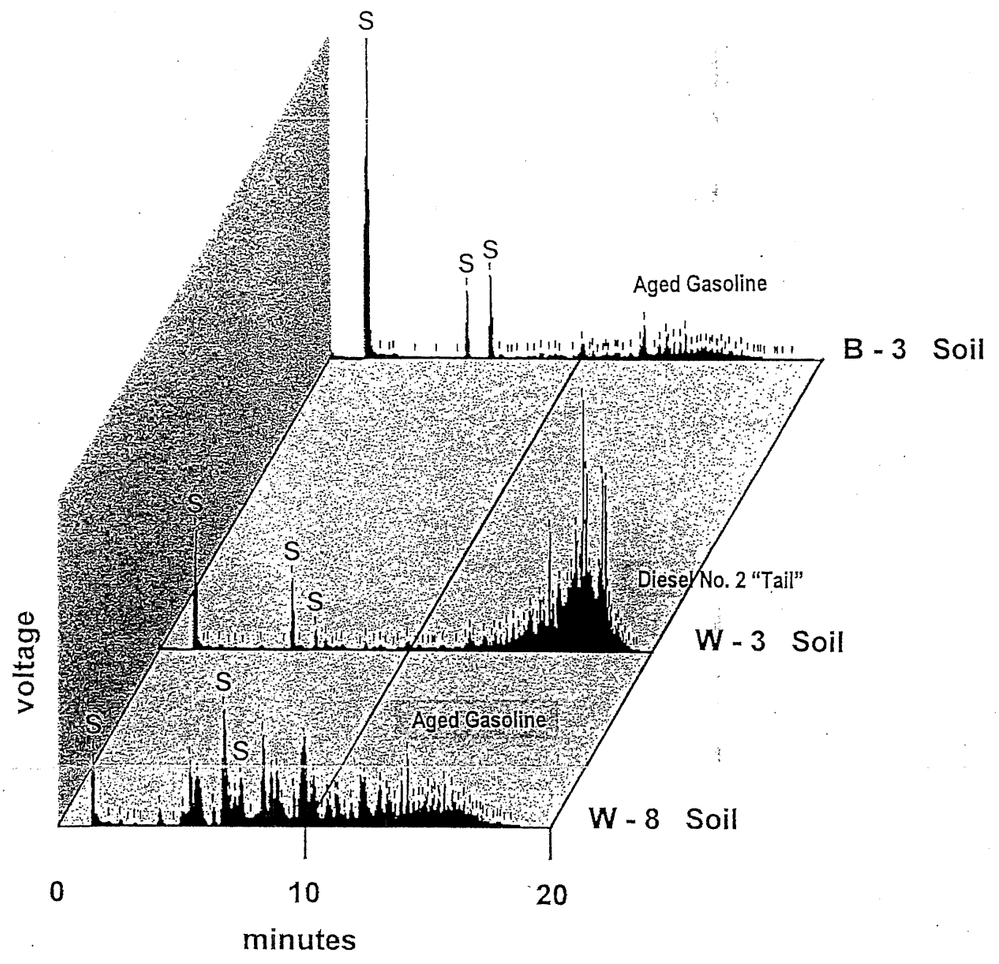
	MW-35		MW-40		GW-1	GW-2
	Oct.93	Dec. 94	Oct. 93	Dec. 94	Oct. 93	Oct. 93
Benzene	–	580 b	36	34 c	2	<25
Ethylbenzene	–	200 b	2	11 c	2	200
Toluene	–	40 b	2	1 c	2	44
Xylenes	–	720 b	5	7 c	12	520
WTPH - G	–	4,200 b	930	1,500 c	1	28
WTPH - D	–	1,000	1,800	5,400	–	–
WTPH - MO	–	<750	1,900	4,200	–	–
Identity		G	aG,MO	aG,MO	ND	ND

	MW-41		MW-42		MW-43		MTCA Method A
	Oct. 93	Dec. 94	Oct. 93	Dec. 94	Oct. 93	Dec. 94	GW Cleanup Level
Benzene	–	5	–	570 b	–	82	5
Ethylbenzene	–	<0.5	–	<0.5	–	11	30
Toluene	–	<0.5	–	1	–	1	40
Xylenes	–	<0.5	–	1	–	100	20
WTPH - G	–	<100	–	<100	–	340	1,000
WTPH - D	–	<0.25	–	1,300	–	320	1,000
WTPH - MO	–	<0.75	–	2,400	–	<750	1,000
Identity				G, MO		G	

Notes:

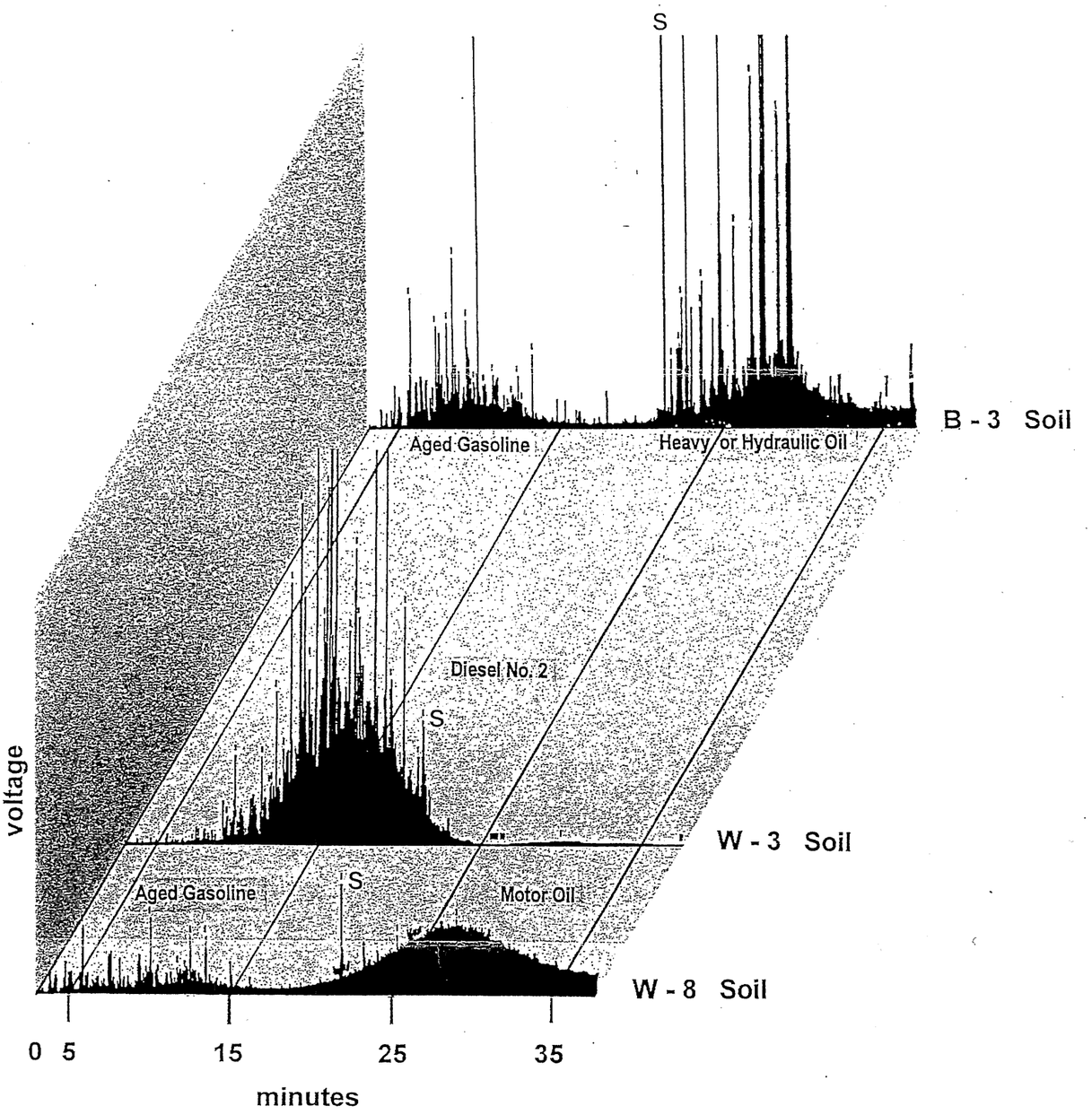
1. Units for BETX, WTPH-G, WTPH-D, and WTPH-MO are ug/L.
   Units for MW-37, product, are mg/Kg.
2. Chromatogram ID codes: G - gasoline, aG - aged gasoline, D2 - diesel, MO - motor oil, H - hydraulic fluid.
   All identifications are tenative and are based on c-range and c-gram shape.
   Closely related products are not eliminated based on this classification; but may be eliminated based on other information or a more detailed anaylsis of the data.

a - Reporting limit is elevated 250X due to dilution.
b - Reporting limit is elevated 10X due to dilution.
c - Reporting limit is elevated 2X due to dilution.
d - Reporting limit is elevated 200X due to dilution.



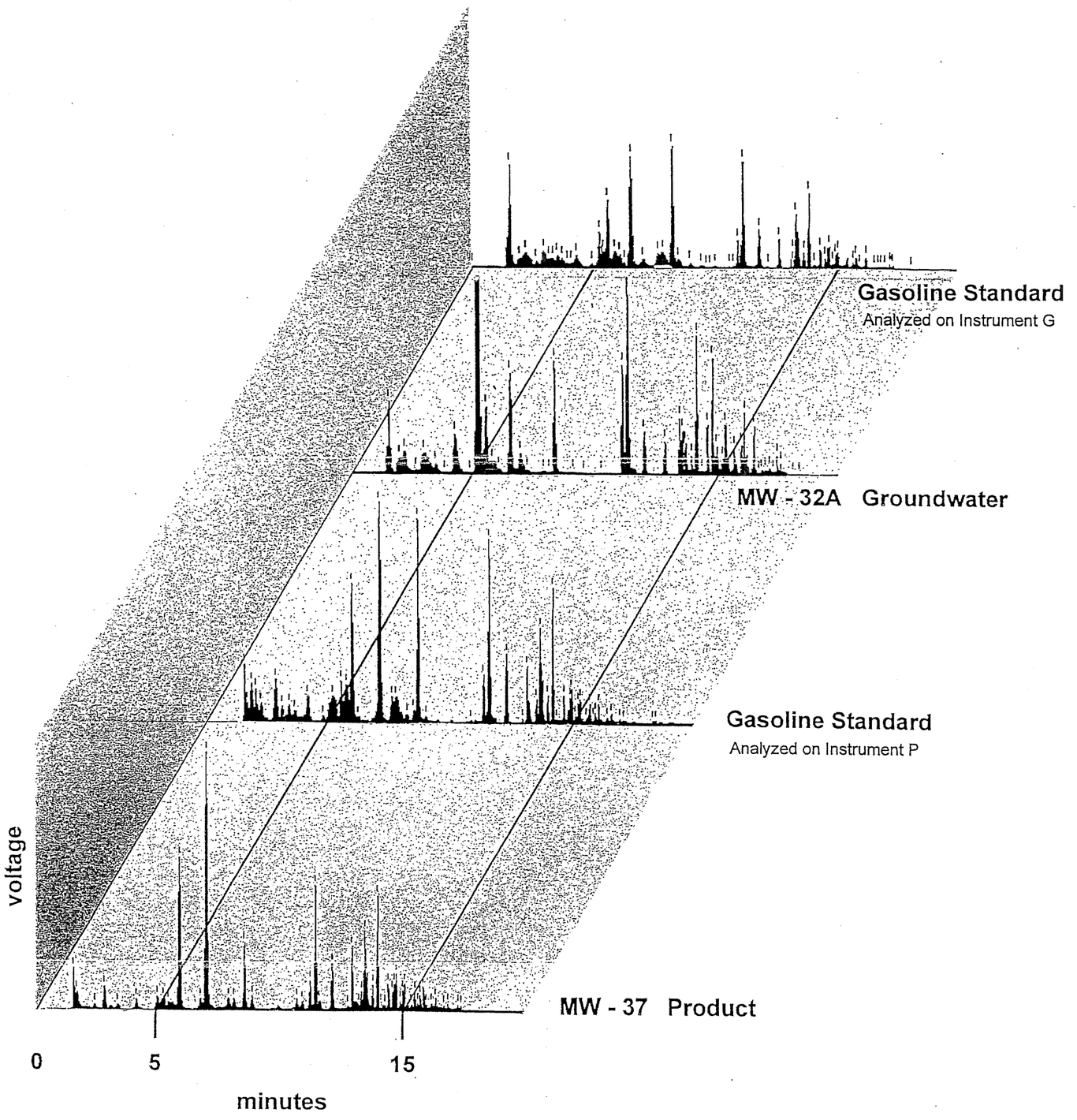
WTPH - G Representative Chromatograms of Product at Rosen Site

Figure 1



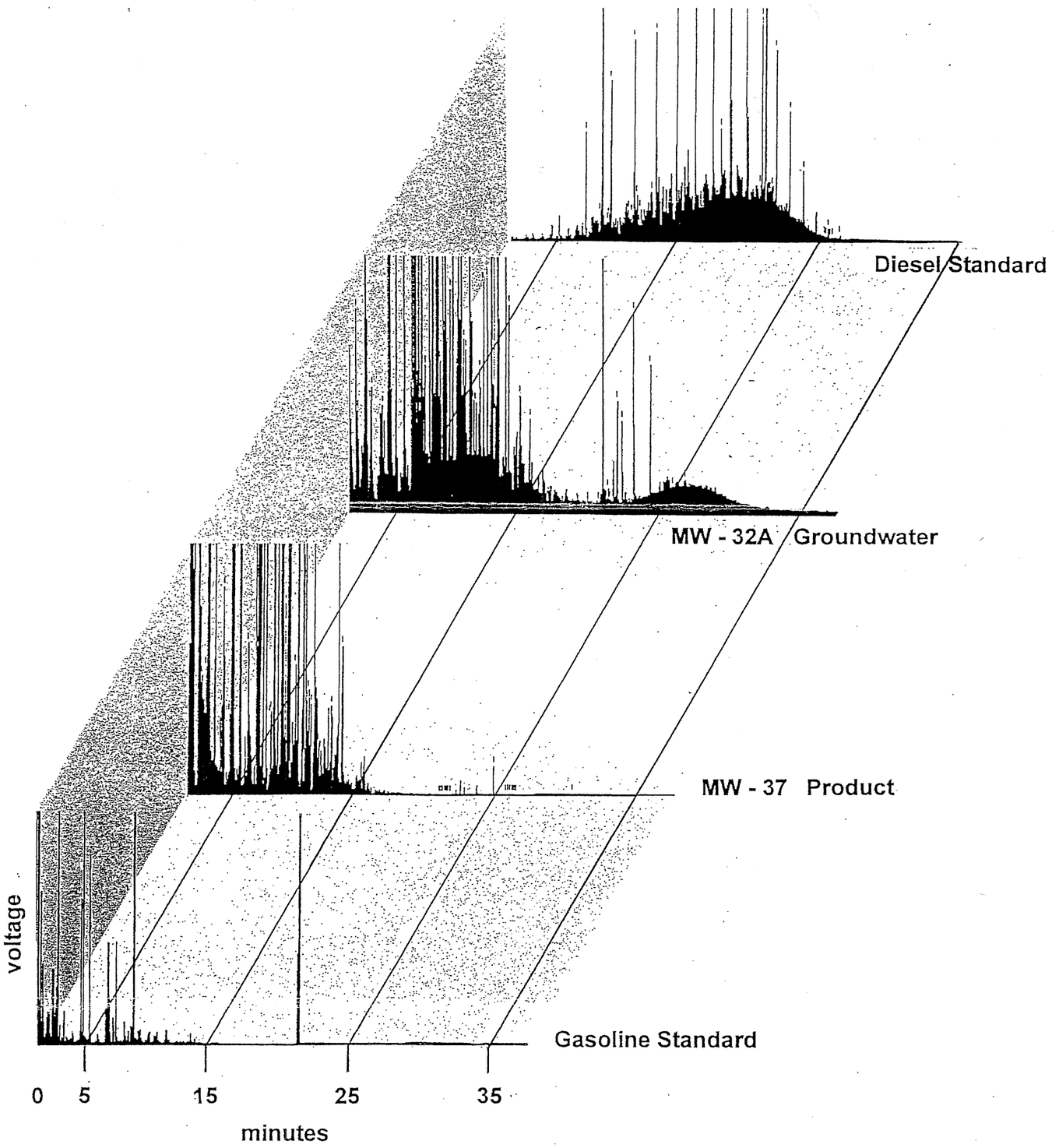
WTPH - D Representative Chromatograms of Product at Rosen Site

Figure 2



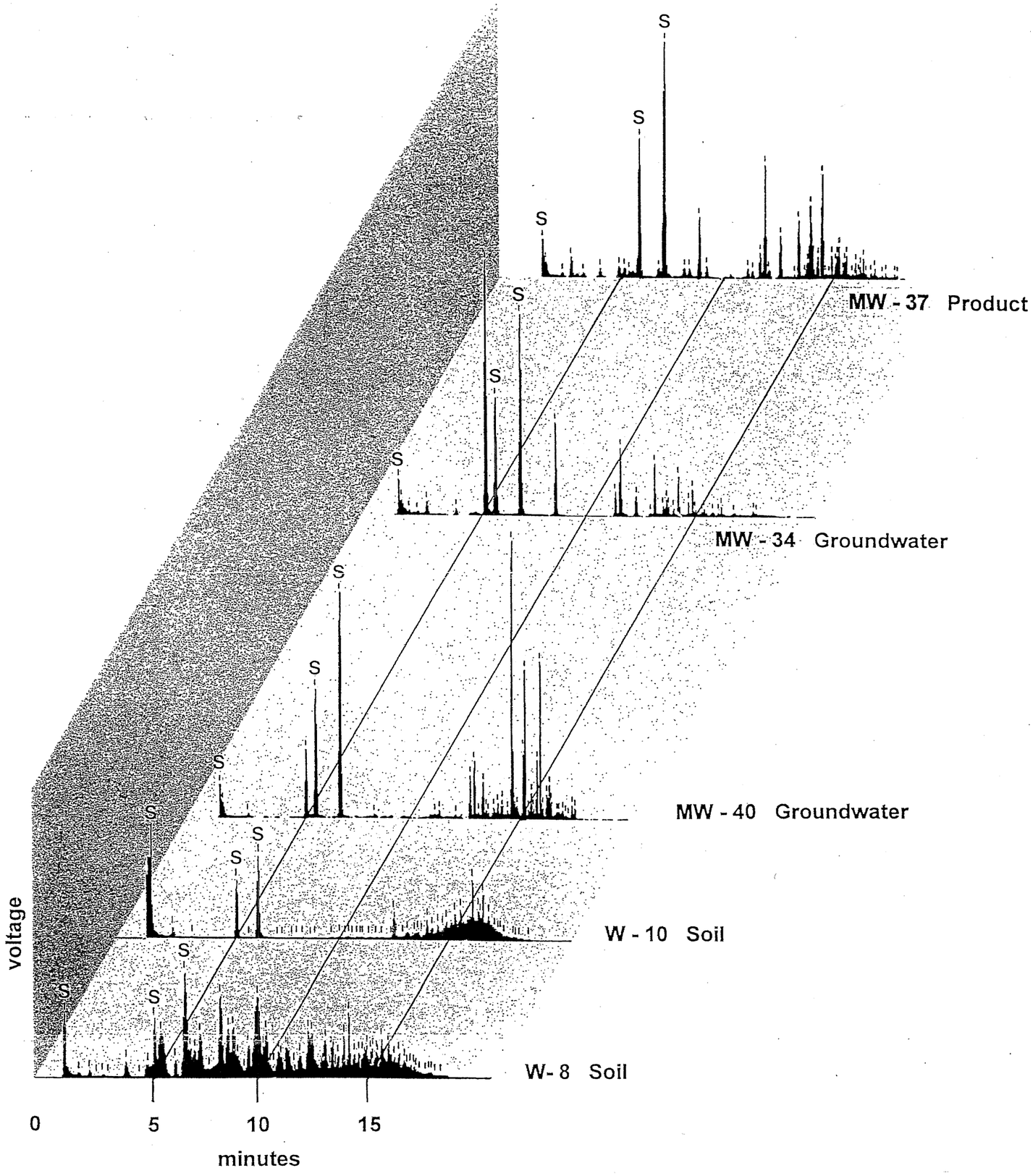
WTPH - G Chromatograms of Product & Groundwater Contamination at Unocal Site

Figure 3



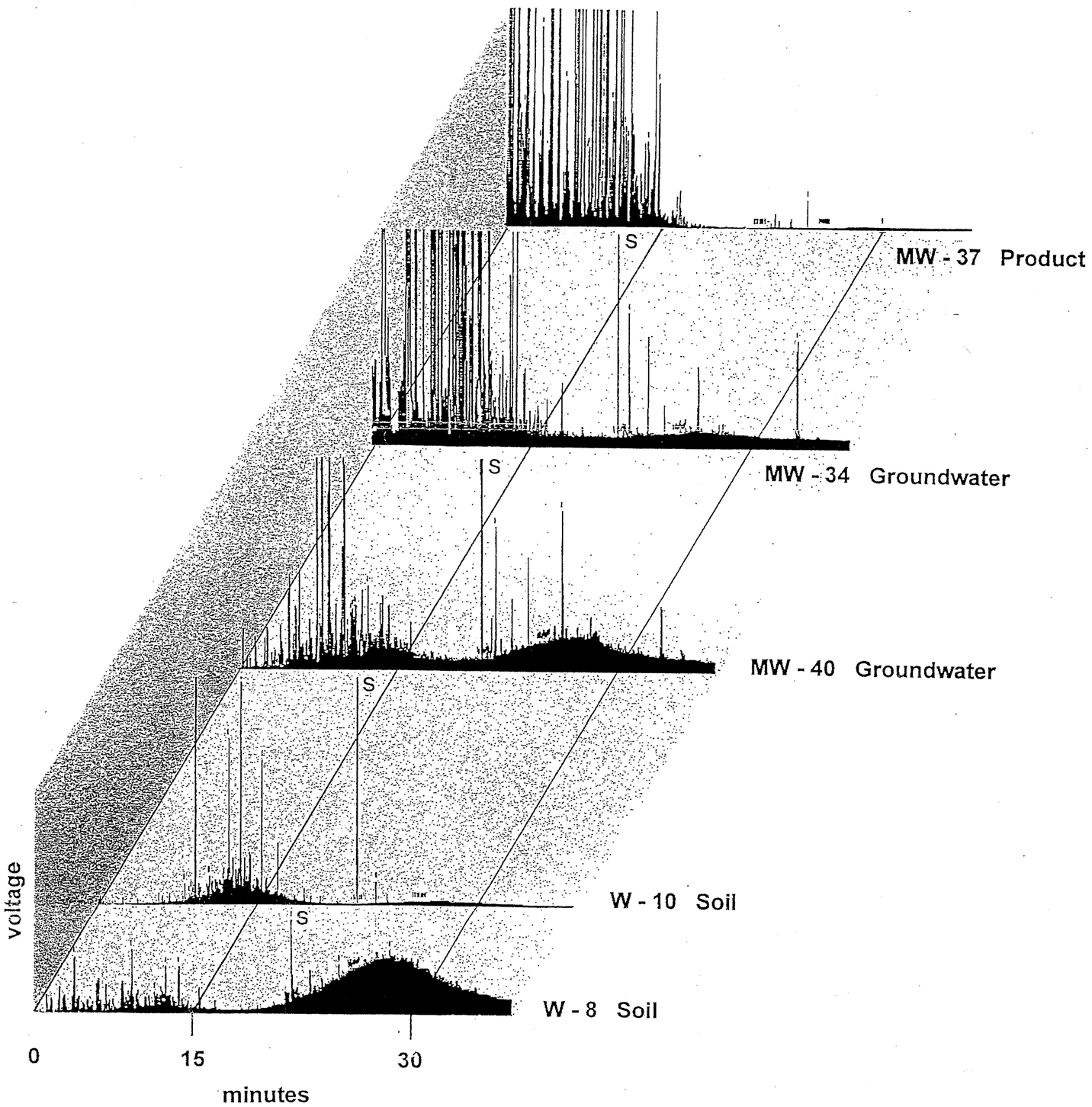
WTPH - D Chromatograms of Product & Groundwater Contamination at Unocal Site

Figure 4



WTPH - G Chromatograms Comparing Products at Rosen & Unocal Sites

Figure 5



WTPH - D Chromatograms Comparing Products at Rosen & Unocal Sites

Figure 6