Results of Ground Water Monitoring and VES Maintenance
Unocal Service Station 5353
June through December 1995
Seattle, Washington

April 2, 1996

For
Unocal ERS - West Region

GeoEngineers

Consulting Engineers and Geoscientists
Offices in Washington, Oregon, and Alaska

April 2, 1996

Unocal ERS - West Region
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Attention: Dr. Mark Brearley, R.G.

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File No. 9161-013-04

INTRODUCTION

This progress report summarizes GeoEngineers' quarterly subsurface monitoring activities conducted at the site of Unocal Service Station 5353 for the period June 7 through December 31, 1995. The site is an active service station located northeast of the intersection of Westlake Avenue North and Mercer Street in Seattle, Washington. The Ecology (Washington State Department of Ecology) UST (underground storage tank) site number is 8463 and the LUST (leaking UST) incident number for the site is 3043. The site layout and monitoring well locations are shown in Figure 1.

The purpose of our services was to: (1) monitor and sample ground water from selected monitoring wells, (2) monitor and maintain the VES (vapor extraction system), and (3) replace and/or repair monitoring well monuments at the site.

Water levels, free product thicknesses and combustible vapor concentrations were measured in selected monitoring wells on September 7, September 28 and December 8, 1995. Ground water samples were obtained from selected monitoring wells on September 7 and December 8, 1995. The approximate monitoring well locations are shown in Figure 1. The water levels, free product thicknesses and combustible vapor concentrations are presented in Table 1. The laboratory chemical analytical results are summarized in Table 2 and Figure 2. VES operation and monitoring data are presented in Table 3. GeoEngineers' scope of services completed for

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these monitoring activities is presented in Attachment A. Our ground water and vapor sampling procedures and monitoring well repair procedures are described in Attachment B. Chemical analytical data reports are presented in Attachment C.

GROUND WATER MONITORING RESULTS

COMBUSTIBLE VAPOR CONCENTRATIONS

- Combustible vapors were detected at concentrations greater than 10,000 ppm in 17 of the 22 on- and off-site monitoring wells measured during this reporting period (Table 1).
- Combustible vapor concentrations were detected at concentrations less than the lower threshold of significance in SMW-3, SMW-5 and MW-36 during this reporting period.

GROUND WATER AND FREE PRODUCT MEASUREMENTS

- Ground water was present in all the monitoring well casings measured during this reporting period at depths ranging from 3.27 to 15.03 below ground surface (Table 1).
- Free product was detected at thicknesses of 0.11 and 0.03 feet in MW-37 on September 7 and December 8, 1995, respectively. Free product was not detected in the remaining monitoring wells.
- The inferred ground water flow direction is to the northeast. This is consistent with the ground water flow direction during previous monitoring events.
- Fluctuations in the ground water levels appear to be the result of seasonal variations in precipitation.

GROUND WATER SAMPLING AND ANALYTICAL RESULTS

- BETX, gasoline-, diesel-, and/or heavy oil-range hydrocarbons were detected in ground water samples obtained from the following wells at concentrations greater than MTCA Method A cleanup levels: MW-32A, MW-33, MW-34, MW-36, MW-40, MW-42, MW-43, MW-44, MW-46, MW-47 and SMW-4 (Table 2 and Figure 2).
- The approximate limits of the plume of gasoline-contaminated ground water resulting from the release at Service Station 5353 are known. The downgradient (northerly) limit of the plume extends beyond the north property line but does not appear to extend to Valley Street.
- Petroleum hydrocarbons either were not detected or were detected at concentrations less than MTCA Method A cleanup levels in MW-41 and SMW-3.

VES MONITORING RESULTS

VES OPERATION AND MAINTENANCE

- The blower malfunctioned twice during this reporting period. New pulleys and fuses were replaced on September 13, 1995 and the spark arrestor filter was cleaned on October 17, 1995. The blower was operational after each of the above repairs were conducted.
- The blower was not operational during our December 1995 monitoring visit. The blower will be dismantled, repaired and replaced in early 1996.

Flow Rate, Applied Vacuum, Ground Vacuum and Temperature Measurements

- The flow rate varied between 67 and 105 cfm (cubic feet per minute) during this reporting period from June 7 to December 8, 1995.
- The time-weighted average flow rate during this reporting period was about 70 cfm.
- The applied vacuum was greater than 50 inches of water column during this reporting period. Applied vacuum is dependent on soil moisture content, ground water levels and moisture content of the extracted vapors.
- Ground vacuum was measured on September 28, 1995 in all the monitoring wells. Vacuum measured in the well casings ranged from 0 inches water column to 0.05 inches water column.
- The vapor temperature of the system was 55° Fahrenheit on our September 13, 1995 monitoring visit. This temperature is consistent with past recorded temperatures.

Combustible Vapor Field Measurements

- Field measurements were obtained from the effluent vapor stream to the atmosphere. The concentration of combustible vapors in the vapor stream was less than 400 ppm (parts per million) during this reporting period.

TVH and Methane Analytical Results

- One vapor sample, obtained in September 1995 from the effluent stream, was submitted for laboratory analysis of TVH (quantified as gasoline). Methane was not tested.
- The volume of gasoline vapor removed by the VES was calculated at 3.6 gallons of gasoline removed for 150 days of VES operation (Table 3).
- The equivalent of approximately 4,732 gallons of gasoline and 193,944 cubic feet of methane were recovered by the system from its initial start-up to December 1995.
- Daily emissions of gasoline vapors to the atmosphere during this reporting period did not exceed the 15 pounds per day allowed by the PSAPCA permit.

DISCUSSION

- Ground water and free product conditions appear consistent with conditions observed during past reporting periods. (Free product was only detected in MW-37 during this reporting period).
- Petroleum-related ground water contamination, primarily consisting of gasoline, is present beneath the site at concentrations exceeding the MTCA Method A cleanup levels. The chemical analytical results obtained during this reporting period are generally consistent with results obtained during previous reporting periods.
- The low TVH and methane concentrations in vapor samples obtained from the effluent vapor stream, and the comparatively low combustible vapor concentrations in the recovery wells and on-site monitoring wells indicate that the VES has been effective in removing vapors from vadose zone in the immediate vicinity of the Unocal site.
- Although TVH and methane concentrations in the effluent stream remain low, we recommend continuing to operate the VES. The VES introduces oxygen into the subsurface which enhances natural biodegradation of the nonvolatile hydrocarbons which are not removed by the VES. Unocal may wish to "pulse" the operation of the VES (such as two weeks on followed by two weeks off).

FUTURE MONITORING

- We recommend continued quarterly ground water and VES monitoring at the site. The results of our 1996 quarterly ground water monitoring/sampling and vapor sampling (March and June) will be summarized in one report to Unocal in July or August 1996.

LIMITATIONS

We have prepared this report for use by Unocal. This report may be made available to regulatory agencies. This report is not intended for use by others and the information contained herein is not applicable to other sites. Our interpretation of subsurface conditions is based on field observations and chemical analytical data from discrete locations. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

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

Respectfully submitted,

GeoEngineers, Inc.

David A. Cook
Project Geologist

for JAM
James A. Miller, P.E.
Principal

TMK:DAC:JAM:cms
Document ID: 9161013.PR2

Attachments

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TABLE 1 (Page 1 of 5)
GROUND WATER ELEVATIONS, PRODUCT THICKNESS AND COMBUSTIBLE VAPOR CONCENTRATIONS
UNOCAL SERVICE STATION 5353

Monitoring Well[1]	Date Measured	Depth to Water (feet)	Ground Water Elevation[2] (feet)	Combustible Vapor Concentration[3] (ppm)	Product Thickness (feet)
MW-32A	02/03/95	11.06	9.64	--	--
	03/08/95	11.29	9.69	>10,000	--
	04/18/95	11.00	9.70	--	--
	06/06/95	--	--	--	--
	09/07/95	11.35	9.35	>10,000	--
	09/28/95	11.27	9.43	>10,000	--
	12/08/95	10.61	10.09	--	--
MW-32	09/28/95	3.27	--	--	--
MW-33	02/03/95	11.01	9.74	--	--
	03/08/95	11.16	9.73	<400	--
	04/18/95	10.94	9.81	--	--
	06/06/95	--	--	--	--
	09/07/95	11.11	9.64	>10,000	--
	09/28/95	11.20	9.55	>10,000	--
	12/08/95	--	--	--	--
MW-34	02/03/95	11.24	10.18	--	--
	03/08/95	11.62	10.08	<400	--
	04/18/95	11.28	10.14	--	--
	06/06/95	11.73	9.97	<400	--
	09/07/95	11.55	9.87	5,800	--
	09/28/95	11.57	9.85	2,000	--
	12/08/95	10.92	10.50	--	--
MW-35	02/03/95	10.31	9.79	--	--
	03/08/95	10.67	9.60	800	--
	04/18/95	10.54	9.56	--	--
	06/06/95	10.67	9.60	700	--
	09/07/95	--	--	--	--
	09/28/95	10.67	9.43	>10,000	--
	12/08/95	--	--	--	--
MW-36	02/03/95	9.24	8.56	--	--
	03/08/95	9.07	8.97	<400	--
	04/18/95	7.97	9.83	--	--
	06/06/95	7.92	10.12	<400	--
	09/07/95	7.97	9.83	250	--
	09/28/95	8.11	9.69	--	--
	12/08/95	9.00	8.80	--	--

Notes appear on page 5 of 5.

TABLE 1 (Page 2 of 5)

Monitoring Well[1]	Date Measured	Depth to Water (feet)	Ground Water Elevation[2] (feet)	Combustible Vapor Concentration[3] (ppm)	Product Thickness (feet)
MW-37	02/03/95	11.02	9.99	–	Trace
	03/08/95	11.94	9.24	>10,000	--
	04/18/95	11.04	9.97	–	–
	06/06/95	11.76	9.43	>10,000	0.01
	09/07/95	11.30	9.80	>10,000	0.11
	09/28/95	11.17	9.84	<400	–
	12/08/95	10.22	10.79	>10,000	0.03
MW-38	02/03/95	8.62	7.90	--	–
	04/18/95	7.27	9.25	–	--
	06/06/95	–	–	--	--
	09/28/95	7.99	8.53	>10,000	–
MW-39	02/03/95	13.37	11.10	--	--
	04/18/95	13.22	11.25	--	--
	06/06/95	--	–	–	–
	09/28/95	13.45	11.02	>10,000	–
MW-40	02/03/95	10/96	9.93	--	--
	03/08/95	10.98	10.14	–	–
	04/18/95	10.81	10.08	–	--
	06/06/95	11.18	9.94	>10,000	--
	09/07/95	10.92	9.97	4,000	–
	09/28/95	11.08	9.81	>10,000	--
	12/08/95	10.30	10.59	3,000	–
MW-41	02/03/95	14.64	12.36	--	–
	03/08/95	14.72	12.48	–	–
	04/18/95	14.79	12.21	--	--
	06/06/95	15.02	12.18	6,000	--
	09/07/95	15.03	11.97	>10,000	--
	09/28/95	15.00	12.00	>10,000	–
	12/08/95	16.30	10.70	--	--
MW-42	02/03/95	9.66	10.68	–	–
	03/08/95	9.45	10.91	--	--
	04/18/95	9.33	11.01	–	–
	06/06/95	9.37	10.99	>10,000	--
	09/07/95	9.47	10.87	>10,000	--
	09/28//95	9.50	10.84	>10,000	--
	12/08/95	8.95	11.39	--	--

Notes appear on page 5 of 5.

TABLE 1 (Page 3 of 5)

Monitoring Well[1]	Date Measured	Depth to Water (feet)	Ground Water Elevation[2] (feet)	Combustible Vapor Concentration[3] (ppm)	Product Thickness (feet)
MW-43	02/03/95	11.01	10.00	--	--
	03/08/95	11.35	9.94	--	--
	04/18/95	11.08	9.93	--	--
	06/06/95	11.45	9.84	4,200	--
	09/07/95	11.30	9.74	>10,000	--
	09/28/95	11.14	9.90	>10,000	--
	12/08/95	10.85	10.19	>10,000	--
MW-44	02/03/95	8.37	10.36	--	--
	03/08/95	9.44	10.46	--	--
	04/18/95	7.91	10.82	--	--
	06/06/95	8.28	10.62	<400	--
	09/07/95	8.48	10.25	>10,000	--
	09/28/95	7.94	10.79	>10,000	--
	12/08/95	8.09	10.64	>10,000	--
MW-45	02/03/95	8.74	9.41	--	--
	03/08/95	7.92	9.23	--	--
	04/18/95	8.38	9.77	--	--
	06/06/95	8.55	9.86	>10,000	--
	09/07/95	8.53	9.62	>10,000	--
	09/28/95	8.59	9.56	>10,000	--
	12/08/95	--	--	--	--
MW-46	02/03/95	8.29	8.62	--	--
	03/08/95	8.00	8.91	>10,000	--
	04/18/95	7.24	9.67	--	--
	06/06/95	7.30	10.01	>10,000	--
	09/07/95	7.62	9.29	>10,000	--
	09/28/95	7.80	9.11	>10,000	--
	12/08/95	8.32	8.59	--	--
MW-47	02/03/95	10.67	9.16	--	--
	03/08/95	10.88	9.16	>10,000	--
	04/18/95	10.68	9.15	--	--
	06/06/95	10.91	9.13	600	--
	09/07/95	10.85	8.98	>10,000	--
	09/28/95	10.76	9.07	>10,000	--
	12/08/95	10.40	9.43	--	--
MW-48	02/03/95	9.29	9.20	--	--
	04/18/95	8.78	9.71	--	--
	06/06/95	--	--	--	--
	09/28/95	8.99	9.50	>10,000	--

Notes appear on page 5 of 5.

TABLE 1 (Page 4 of 5)

Monitoring Well[1]	Date Measured	Depth to Water (feet)	Ground Water Elevation[2] (feet)	Combustible Vapor Concentration[3] (ppm)	Product Thickness (feet)
MW-49	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
	09/28/95	0.35	12.26	>10,000	--
RW-4A	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
RW-5A	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
RW-7	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
RW-8	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
RW-9	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
RW-10	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
RW-26	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
RW-28	02/03/95	--	--	--	--
	04/18/95	--	--	--	--
	06/06/95	--	--	--	--
SMW-1S	09/28/95	--	--	--	--
SMW-3	03/08/95	10.24	--	800	--
	06/06/95	10.23	--	300	--
	09/07/95	10.89	--	<400	--
	12/08/95	11.36	--	--	--
SMW-4	03/08/95	8.14	--	>10,000	--
	06/06/95	8.90	--	>10,000	--
	09/07/95	--	--	--	--
	09/28/95	8.99	--	2,000	--
	12/08/95	7.56	--	>10,000	--
SMW-5	09/28/95	9.98	--	<400	--

Notes appear on page 5 of 5.

TABLE 1 (Page 5 of 5)

Notes:

[1]Approximate locations of monitoring wells are shown in Figure 1.

[2]Elevations are measured relative to the city of Seattle datum.

[3]Measured with a Bacharach TLV Sniffer calibrated to hexane equipped with a 2-inch-diameter clip cap.

ppm = parts per million

"--" = either not detected or not measured

Field procedures are described in Attachment B.

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TABLE 2 (Page 1 of 3)
SUMMARY OF MONITORING WELL GROUND WATER CHEMICAL ANALYTICAL DATA
UNOCAL SERVICE STATION 5353

Sample Number	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			
MW-32A	03/08/95	5,800	990	1,700	2,900	21	2.3	2.3
	09/07/95	4,200	730	470	2,000	20	2.5	1.5
	12/08/95	1,600	420	86	910	11	1.2	<0.75
MW-33	03/08/95	650	320	<25	420	4.9	1.4	2.0
	09/07/95	550	230	140	620	9.7	1.4	0.82
	12/08/95	880	280	240	760	13	1.9	1.8
MW-34	03/08/95	2,400	250	1,500	1,300	8.2	1.1	0.48
	06/06/95	4,200	330	1,000	1,200	9.1	2.3	<0.75
	09/07/95	4,800	560	2,300	2,000	18	1.8	0.93
	12/08/95	12,000	1,200	9,200	5,500	68	2.9	1.6
MW-35	03/08/95	400	120	<25	93	2.6	1.2	1.3
	06/06/95	62	27	1.4	36	0.81	1.0	0.93
MW-36	03/08/95	2.6	<0.5	<0.5	<1.0	<0.05	0.56	1.2
	06/06/95	1.0	<0.5	<0.5	<1.0	<0.05	<0.25	<0.75
	09/07/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25	<0.75
	12/08/95	1.1	<0.5	<0.5	<1.0	<0.05	0.51	1.2
MW-37	03/08/95	3,100	1,200	2,400	6,700	34	3.2	1.4
	06/06/95[4]	3,700	1,300	2,400	7,900	45	4.6	2.5
Laboratory Duplicate	06/06/95[4]	5,100	2,400	6,000	14,000	90	--	--
MW-40	03/08/95	11	11	<0.5	<1.0	0.97	2.6	2.6
	06/06/95	6.8	4.1	4.3	21	1.5	2.3	1.6
	09/07/95	11	0.57	0.91	<1.0	0.65	13[5]	66[5]
	12/08/95	2.7	<0.5	3	<1.0	0.50	1.4	4.8
MW-41	03/08/95	1.6	<0.5	<0.5	<1.0	<0.05	<0.25	<0.75
	06/06/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25[6]	<0.75[6]
	09/07/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25	<0.75
	12/08/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25	0.82
MTCA Method A Ground Water Cleanup Levels		5	30	40	20	1.0[7]		

Notes appear on page 3 of 3.

TABLE 2 (Page 2 of 3)

Sample Number	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			
MW-42	03/08/95	790	<25	<25	<50	0.13	0.67	1.2
	06/06/95	500	<0.5	<0.59	<1.0	0.12	0.92	1.5
	09/07/95	210	42	4.1	230	3	0.78	1.2
	12/08/95	380	<2.0	<2.0	<4.0	0.20	1.3	1.9
MW-43	03/08/95	25	<0.5	<0.5	<1.0	<0.05	0.65	2.4
	06/06/95	8.2	<0.5	<0.5	<1.0	<0.05	0.69	1.5
	09/07/95	10	<0.5	<0.5	<1.0	<0.05	<0.25	0.85
	12/08/95	37	<0.5	<0.5	<1.0	<0.05	0.96	3.1
MW-44	03/08/95	<0.5	<0.5	<0.5	<1.0	<0.05	0.29	0.94
	06/06/95	<0.5	<0.5	<0.5	1.6	<0.05	<0.25	0.82
	09/07/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25	<0.75
	12/08/95	<0.5	<0.5	<0.5	<1.0	<0.05	0.52	2.5
MW-45	03/08/95	3,000	790	95	3,300	16	1.5	1.1
	06/06/95	1,700	500	10	1,500	8.1	1.0[8]	0.98[8]
MW-46	03/08/95	<0.5	<0.5	<0.5	<1.0	<0.05	0.72	3.6
	06/06/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25	1.4
	09/07/95	<0.5	<0.5	<0.5	<1.0	<0.05	0.71	5.6
	12/08/95	<0.5	<0.5	<0.5	<1.0	<0.05	1.4	14
MW-47	03/08/95	5.3	<0.5	<0.5	<1.0	<0.05	0.33	1.6
	06/06/95	15	<0.5	0.59	2.3	0.07	0.38	0.78
	09/07/95	1.7	<0.5	<0.5	<1.0	<0.05	0.26	<0.75
	12/08/95	<0.5	<0.5	<0.5	<1.0	0.74	0.58	2.0
SMW-3	03/08/95	<0.5	<0.5	<0.5	<1.0	<0.05	0.40[8]	2.5[8]
	06/06/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25	<0.75
	09/07/95	<0.5	<0.5	<0.5	<1.0	<0.05	<0.25	<0.75
	12/08/95	<0.5	<0.5	<0.5	<1.0	<0.05	0.30	<0.75
SMW-4	03/08/95	13,000	2,400	<250[9]	6,200	39	4.1	5.1
	06/06/95	9,400	2,700	44	4,900	41	5.5	<0.75
	12/08/95	8,100	2,600	57	3,600	40	1.5[6]	0.92[6]
MTCA Method A Ground Water Cleanup Levels		5	30	40	20	1.0[7]		

Notes appear on page 3 of 3.

TABLE 2 (Page 3 of 3)

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_{34}).

[4]Results should be considered estimated based on high variability of sample and laboratory duplicate.

[5]Data are considered not representative of ground water quality because the monitoring well had previously been exposed to surface water.

[6]Results should be considered estimated because of surrogate recovery exceptions.

[7]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.

[8]It is our opinion these chemical analytical results are not representative of ground water quality in SMW-3, as discussed in the text of this report.

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

µg/l = micrograms per liter

mg/l = milligrams per liter

"--" = not tested

Shading indicates that the concentrations are equal to or exceeding the MTCA Method A cleanup levels.

Chemical analyses by North Creek Analytical. Laboratory reports are in Attachment B.

Document ID: 161013P3.WK1

TABLE 3
VAPOR EXTRACTION SYSTEM OPERATION, MONITORING DATA AND VOLUMES OF RECOVERED GASOLINE AND METHANE
UNOCAL SERVICE STATION 5353

Operation Period Start or Sampling Date	Operation Period Duration (days)	Estimated Equivalent Total Recovery		Effluent Vapor[1]	
		Gasoline (gallons)	Methane (cubic feet)	TVH[2] (ppm)	Methane[3] (ppm)
03/10/94	259	0	0	<175	<500
01/30/95	99	0[4]	0[4]	–	–
05/25/95	12	0[4]	0[4]	–	–
09/28/95	**150**	**3.6**	–	**4.1[5]**	–
12/08/95	–	–	–	–	–
Total (03/10/94-06/06/95)	370	0[4]	0[4]	NA	NA
Total (06/07/95-12/08/95)	185	3.6	–	NA	NA
Previous Cumulative Total	NA	4,728	193,944	NA	NA
TOTAL	NA	4,732	193,944	NA	NA

Notes:

[1]Measurements and samples were obtained from the VES exhaust stack.

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

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

[4]Volumes of recovered gasoline and methane cannot be calculated because vapor sample concentrations were less than laboratory detection levels.

[5]BETX also were analyzed: B = 0.043 ppm; E = 0.021 ppm; T = 0.010 ppm; X = 0.023 ppm.

ppm = parts per million

"–" = not tested

NA = not applicable

Bolding indicates information for the current reporting period.

Document ID: 161013P2.WK1

EXPLANATION:

- **MW-2** ● MONITORING WELL INSTALLED IN 1980
- **MW-32A** ◑ MONITORING WELL INSTALLED IN 1991 OR 1992
- **SMW-2S** ⊗ MONITORING WELL INSTALLED BY SCS
- 10.09 GROUND WATER ELEVATION (FEET) ON 12/08/95
- GENERAL DIRECTION OF GROUND WATER FLOW ON 12/08/95

N

0 80 160

SCALE IN FEET

VALLEY STREET

MERCER STREET

TERRY AVENUE NORTH

Unocal Property Line

MW-36 8.80

MW-38

MW-46 8.59

MW-47 9.43

MW-48

MW-29

MW-40 10.59

Denny's Restaurant

MW-45

City of Seattle Property

MW-32

MW-49

MW-3

MW-33

MW-19

MW-35

MW-37 10.79

Unocal SS-5353

SMW-1S

MW-2

MW-18

MW-24

SMW-5

MW-32A 10.09

SMW-3 ⊗

SMW-4 ⊗

SMW-2S ⊗

MW-1

MW-34 10.50

City Park

MW-17

MW-42 11.39

MW-41 10.70

MW-11

MW-27

WESTLAKE AVENUE NORTH

MW-13

MW-15

MW-14

MW-16

MW-44 10.64

MW-43 10.19

WESTLAKE AVENUE NORTH

BROAD STREET

MW-39

SMW-2

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

2. Ground water elevations are referenced to City of Seattle datum.

Geo Engineers

GROUND WATER ELEVATIONS ON 12/08/95

FIGURE 1

TMK:BDH 0161013E.DWG 0161013R04:01/30/96

MW-46	B	G	D	O
03/08/95	<0.5	<0.05	0.72	3.6
06/06/95	<0.5	<0.05	<0.25	1.4
09/07/95	<0.5	<0.05	0.71	5.6
12/08/95	<0.5	<0.05	1.4	14
MTCA	5.0	1.0		

MW-45	B	G	D	O
03/08/95	3,000	16	1.5	1.1
06/06/95	1,700	8.1	1.0	0.98
MTCA	5.0	1.0		

MW-38	B	G	D	O
03/08/95	2.0	<0.05	0.56	1.2
06/06/95	1.0	<0.05	<0.25	<0.75
09/07/95	<0.5	<0.05	<0.25	<0.75
12/08/95	1.1	<0.05	0.51	1.2
MTCA	5.0	1.0		

MW-47	B	G	D	O
03/08/95	5.3	<0.05	0.33	1.6
06/06/95	15	0.73	0.38	0.78
09/07/95	1.7	<0.05	0.26	<0.75
12/08/95	<0.5	0.74	0.58	2.0
MTCA	5.0	1.0		

MW-32	B	G	D	O
03/08/95	650	5.9	1.4	2.0
09/07/95	550	9.7	1.4	0.82
12/07/95	800	13	1.9	1.8
MTCA	5.0	1.0		

MW-40	B	G	D	O
03/08/95	11	0.97	2.6	2.6
06/06/95	6.8	1.5	2.3	1.6
09/07/95	11	0.65	13	66
12/08/95	2.7	0.50	1.4	4.8
MTCA	5.0	1.0		

MW-35	B	G	D	O
03/08/95	400	2.6	1.2	1.3
06/06/95	62	0.51	1.0	0.93
MTCA	5.0	1.0		

MW-37	B	G	D	O
03/08/95	3,100	34	3.2	1.4
06/06/95	5,100	90	4.6	2.5
MTCA	5.0	1.0		

MW-32A	B	G	D	O
03/08/95	5,800	21	2.3	2.3
09/07/95	4,200	20	2.5	1.5
12/08/95	1,600	11	1.2	<0.75
MTCA	5.0	1.0		

SMW-3	B	G	D	O
03/08/95	<0.5	<0.05	0.40	2.5
06/06/95	<0.5	<0.05	<0.25	<0.75
09/07/95	<0.5	<0.05	<0.25	<0.75
12/08/95	<0.5	<0.05	0.30	<0.75
MTCA	5.0	1.0		

MW-34	B	G	D	O
03/08/95	2,400	8.2	1.1	0.48
06/06/95	4,200	9.1	2.3	<0.75
09/07/95	4,800	18	1.8	0.93
12/08/95	68	68	2.9	1.6
MTCA	5.0	1.0		

MW-41	B	G	D	O
03/08/95	1.6	<0.05	<0.25	<0.75
06/06/95	<0.5	<0.05	<0.25	<0.75
09/07/95	<0.5	<0.05	<0.25	<0.75
12/08/95	<0.5	<0.05	<0.25	0.82
MTCA	5.0	1.0		

SMW-4	B	G	D	O
03/08/95	13,000	39	4.1	5.1
06/06/95	9,400	41	5.5	<0.75
12/08/95	8,100	40	1.5	0.92
MTCA	5.0	1.0		

MW-43	B	G	D	O
03/08/95	25	<0.05	0.65	2.4
06/06/95	8.2	<0.05	0.69	1.5
09/07/95	10	<0.05	<0.25	0.85
12/08/95	37	<0.05	0.96	3.1
MTCA	5.0	1.0		

MW-42	B	G	D	O
03/08/95	790	0.13	0.67	1.2
06/06/95	500	0.12	0.92	1.5
09/07/95	210	3	0.78	1.2
12/08/95	380	0.20	1.3	1.9
MTCA	5.0	1.0		

MW-44	B	G	D	O
03/08/95	<0.5	<0.05	0.29	0.94
06/06/95	<0.5	<0.05	<0.25	0.82
09/07/95	<0.5	<0.05	<0.25	<0.75
12/08/95	<0.5	<0.05	0.52	<2.5
MTCA	5.0	1.0		

VALLEY STREET

MERCER STREET

TERRY AVENUE NORTH

WESTLAKE AVENUE NORTH

BROAD STREET

WESTLAKE AVENUE NORTH

MW-38 ◑

MW-48 ◑

MW-29 ●

MW-48 ◑

MW-32 ●

MW-3 ●

MW-19 ◑

MW-18 ◑

MW-24

⊗SMW-1S

⊗SMW-5

⊗SMW-2S

●MW-1

MW-11 ●

MW-27 ●

MW-17 ●

MW-13 ●

MW-14 ●

MW-15 ●

MW-16 ●

MW-39 ◑

SMW-2 ⊗

N

0 80 160

SCALE IN FEET

EXPLANATION:

MW-2 ● MONITORING WELL INSTALLED IN 1980

MW-33 ◑ MONITORING WELL INSTALLED IN 1991 OR 1992

SMW-2S ⊗ MONITORING WELL INSTALLED BY SCS

B BENZENE (µg/l) BY EPA METHOD 8020

G GASOLINE-RANGE HYDROCARBONS (mg/l) BY ECOLOGY METHOD WTPH-G

D DIESEL-RANGE HYDROCARBONS (mg/l) BY ECOLOGY METHOD WTPH-D EXTENDED

O HEAVY OIL-RANGE HYDROCARBONS (mg/l) BY ECOLOGY METHOD WTPH-D EXTENDED

MTCA MODEL TOXICS CONTROL ACT METHOD A GROUND WATER CLEANUP LEVEL

Geo Engineers

SUMMARY OF GROUND WATER ANALYTICAL DATA

FIGURE 2

TMK:BDH 01610130.DWG 0161013R04:01/30/96

ATTACHMENT A

ATTACHMENT A

SCOPE OF SERVICES

Our scope of services completed during the reporting period of Progress Report No. 2 is summarized below.

1. Measure the depth to ground water and free product thickness, if any, in accessible wells. Field monitoring procedures are described in Attachment B.
2. Measure the concentration of combustible vapors in the casing of accessible wells using a Bacharach TLV combustible gas meter and associated drop hose.
3. Measure ground vacuum in accessible well casings using Dwyer Magnehelic vacuum gauges.
4. Obtain ground water samples from SMW-3, SMW-4, MW-32A, MW-33 through MW-37, MW-40 through MW-47 and submit for chemical analysis of BETX by EPA Method 8020, gasoline-range hydrocarbons by Ecology Method WTPH-G and diesel- and heavy oil-range hydrocarbons by Ecology Method WTPH-D extended.
5. Obtain a vapor sample from the VES and submit it for chemical analysis of BETX and TVH by gasoline.
6. Obtain a composite purge and decontamination water sample from the existing drums on site and submit the sample for chemical analysis of BETX by EPA Method 8020 and FOG (fats, oils and grease) by EPA Method 413.2.
7. Locate MW-32A and MW-33 from beneath the asphalt on the site.
8. Repair broken monitoring well monuments of MW-37, MW-40 through MW-44 in the streets (Mercer, Terry and Westlake) with high-rated traffic monuments. Replace monitoring well monuments (MW-32A, MW-33 through MW-35, MW-37, MW-38, MW-45 and MW-46 and MW-48) on private property with new flush grade monuments.
9. Evaluate the field and laboratory data with regard to existing regulatory concerns.

ATTACHMENT B

ATTACHMENT B

FIELD PROCEDURES

DEPTH TO GROUND WATER AND FREE PRODUCT THICKNESS

The depths to the ground water table were measured relative to the well casing rims. The measurements were made using an ORS interface probe or an electric water level indicator. The ground water and product levels were measured to the nearest 0.01 foot. The instruments were cleaned with a Liquinox wash and a distilled water rinse prior to use in each well.

COMBUSTIBLE VAPOR CONCENTRATIONS

Combustible vapor concentrations were measured in accessible well casings on the site using a Bacharach TLV combustible gas meter calibrated to hexane and associated drop hose. The lower threshold of significance for the TLV in this application is 400 ppm (4 percent of the lower explosive limit of hexane).

GROUND VACUUM

Ground vacuum was measured in the accessible monitoring and recovery well casings on September 28, 1995. The measurements were made with a Magnehelic gauge with a resolution of 0.01 inches of water column. A slip cap enabled a tight fit around the monitoring well casings. Vacuum pressures were measured in the well casings while the on-site VES was operating.

VES, MEASUREMENTS AND SAMPLING

MEASUREMENTS

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

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

VAPOR SAMPLING

The vapor sample was obtained from the sample port in the vapor conveyance line on September 28, 1995. The vapor sample was collected in an evacuated stainless steel container by opening the valve in the sample port and allowing the vacuum in the canister to draw in the vapors. Chain-of-custody procedures were followed in transporting the vapor samples to the testing laboratory. The laboratory data sheets and chain-of-custody records are presented in Attachment C.

MONITORING WELL REPAIR

Fourteen monitoring well monuments (MW-32A, MW-33, MW-34, MW-35, MW-38, MW-45, MW-46, MW-48, MW-37, MW-40, MW-41, MW-43, MW-44, MW-48) were replaced with either new Morrison Dubuque high-rated traffic or McDonald Manufactured flush-grade monuments by Cascade Drilling on August 31, 1995. Prior to the repair of the above mentioned monitoring wells, MW-36, MW-39 and MW-47 were repaired by GeoEngineers representatives. During the well repair process the monitoring well casing from MW-34 was broken. However, Cascade drilling repaired the PVC casing with a new PVC coupling prior to leaving the site.

ATTACHMENT C

ATTACHMENT C

CHEMICAL ANALYTICAL PROGRAM

ANALYTICAL METHODS

Chain-of-custody procedures were followed during the transport of the field samples to the analytical laboratory. The samples were held in cold storage pending extraction and/or analysis. The analytical results, analytical methods reference and laboratory QA/QC (quality assurance/quality control) records are included in this 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 data quality exceptions documented by the laboratory in the laboratory reports were reviewed by GeoEngineers using the applicable data validation guidelines from the following documents: "Guidance Document for the Assessment of RCRA Environmental Data Quality," Draft dated 1988; "National Functional Guidelines For Organic Data Review," Draft dated 1991; and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses," dated 1988.

ANALYTICAL DATA REVIEW SUMMARY

No significant data quality exceptions were documented in the laboratory report or noted during our review. Based on the data quality review all data are acceptable for their intended use.

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GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Dana Carlisle

Project Name: UNOCAL Seattle, #5353
Client Project : #9161-013-R04

NCA Project #: B509129

Received: Sep 8, 1995
Reported: Sep 29, 1995

PROJECT SUMMARY PAGE

Laboratory Sample Number	Sample Description	Sample Matrix	Date Sampled
B509129-01	MW-32A	Water	9/7/95
B509129-02	MW-33	Water	9/7/95
B509129-03	MW-34	Water	9/7/95
B509129-04	MW-36	Water	9/7/95
B509129-05	MW-40	Water	9/7/95
B509129-06	MW-41	Water	9/7/95
B509129-07	MW-42	Water	9/7/95
B509129-08	MW-43	Water	9/7/95
B509129-09	MW-44	Water	9/7/95
B509129-10	MW-46	Water	9/7/95
B509129-11	MW-47	Water	9/7/95

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File

The results in this report apply to the samples analyzed in accordance with the chain of custody document.
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NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

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8410 154th Avenue N.E.	Client Project :	#9161-013-R04	
Redmond, WA 98052			Received: Sep 8, 1995
Attention: Dana Carlisle	NCA Project #:	B509129	Reported: Sep 29, 1995

PROJECT SUMMARY PAGE

Laboratory Sample Number	Sample Description	Sample Matrix	Date Sampled
B509129-12	PURGE	Water	9/7/95
B509129-13	SMW-3	Water	9/7/95

GeoEngineers

OCT 30 1995

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Laura Dutton

Laura Dutton
Project Manager

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9405 S.W. Nimbus Avenue • Beaverton, OR 97008-7132 (503) 643-9200 • FAX 644-2202

GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Sep 7, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Sep 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-G	Analyzed: Sep 12-13, 1995
Attention: Dana Carlisle	First Sample #:	B509129-01	Reported: Sep 29, 1995

TOTAL PETROLEUM HYDROCARBONS-GASOLINE RANGE

Sample Number	Sample Description	Sample Result µg/L (ppb)	Surrogate Recovery %
B509129-01	MW-32A	20,000	134
B509129-02	MW-33	9,700	S-2
B509129-03	MW-34	18,000	117
B509129-04	MW-36	N.D.	101
B509129-05	MW-40	650	S-2
B509129-06	MW-41	N.D.	96
B509129-07	MW-42	3,000	143
B509129-08	MW-43	N.D.	98
B509129-09	MW-44	N.D.	74
B509129-10	MW-46	N.D.	76

Reporting Limit:	**50**

4-Bromofluorobenzene surrogate recovery control limits are 50 - 150 %.
Volatile Total Petroleum Hydrocarbons are quantitated as Gasoline Range Organics (toluene - dodecane).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

Please Note:
S-2 = The Surrogate Recovery for this sample cannot be accurately quantified due to interference from coeluting organic compounds present in the sample.

509129.GEO <3>

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9405 S.W. Nimbus Avenue • Beaverton, OR 97008-7132 (503) 643-9200 • FAX 644-2202

GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Sep 7, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Sep 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-G	Analyzed: Sep 12-13, 1995
Attention: Dana Carlisle	First Sample #:	B509129-11	Reported: Sep 29, 1995

TOTAL PETROLEUM HYDROCARBONS-GASOLINE RANGE

Sample Number	Sample Description	Sample Result µg/L (ppb)	Surrogate Recovery %
B509129-11	MW-47	N.D.	88
B509129-12	PURGE	4,500	86
B509129-13	SMW-3	N.D.	95
BLK091295	Method Blank	N.D.	98

Reporting Limit:	50

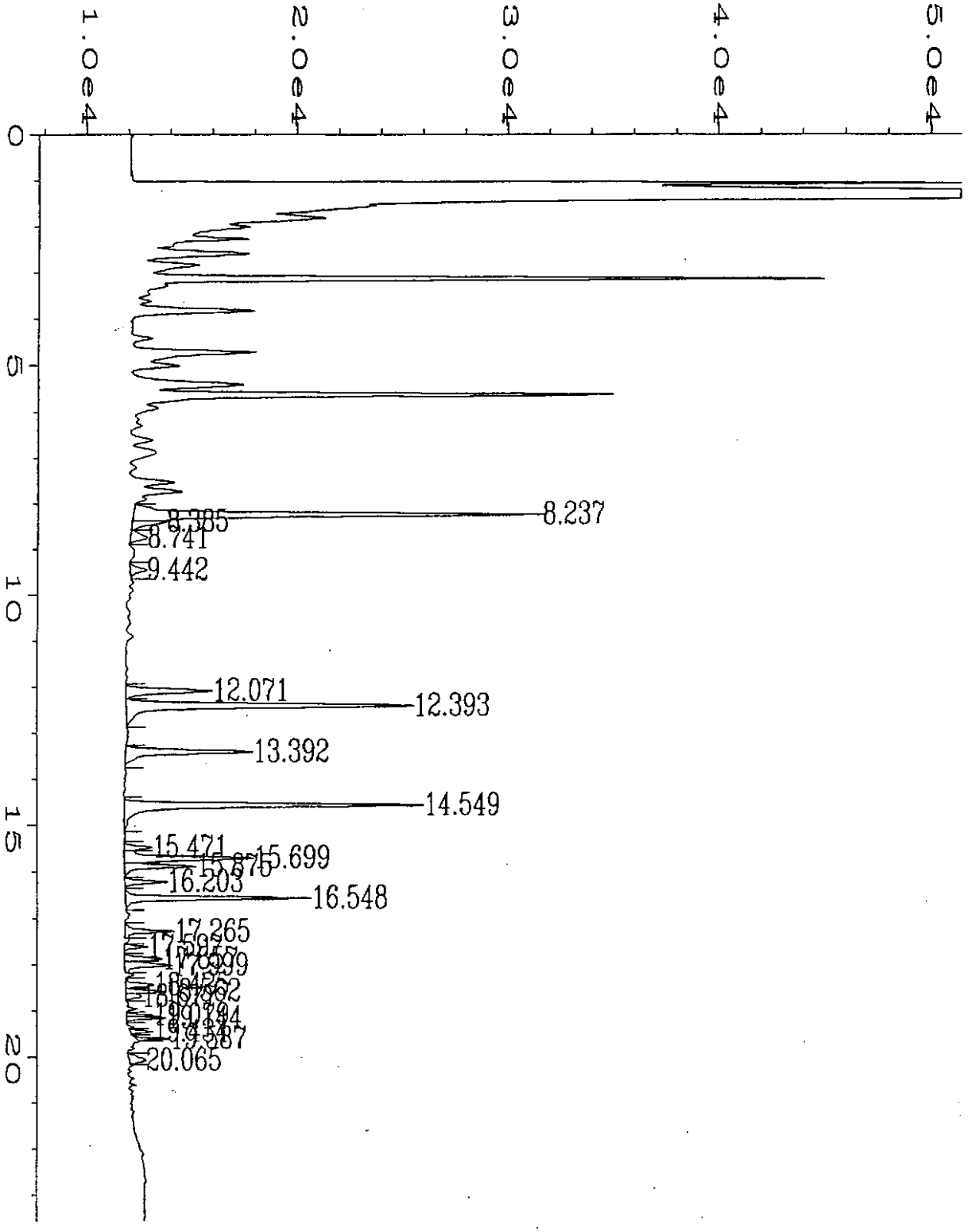
4-Bromofluorobenzene surrogate recovery control limits are 50 - 150 %.
Volatile Total Petroleum Hydrocarbons are quantitated as Gasoline Range Organics (toluene - dodecane).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

509129.GEO <4>



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Operator :
Instrument : GC#8
Sample Name : gas std
Run Time Bar Code:
Acquired on : 11 Sep 95 05:21 PM
Report Created on: 11 Sep 95 05:45 PM
Sample Info : 500 ng v-8j

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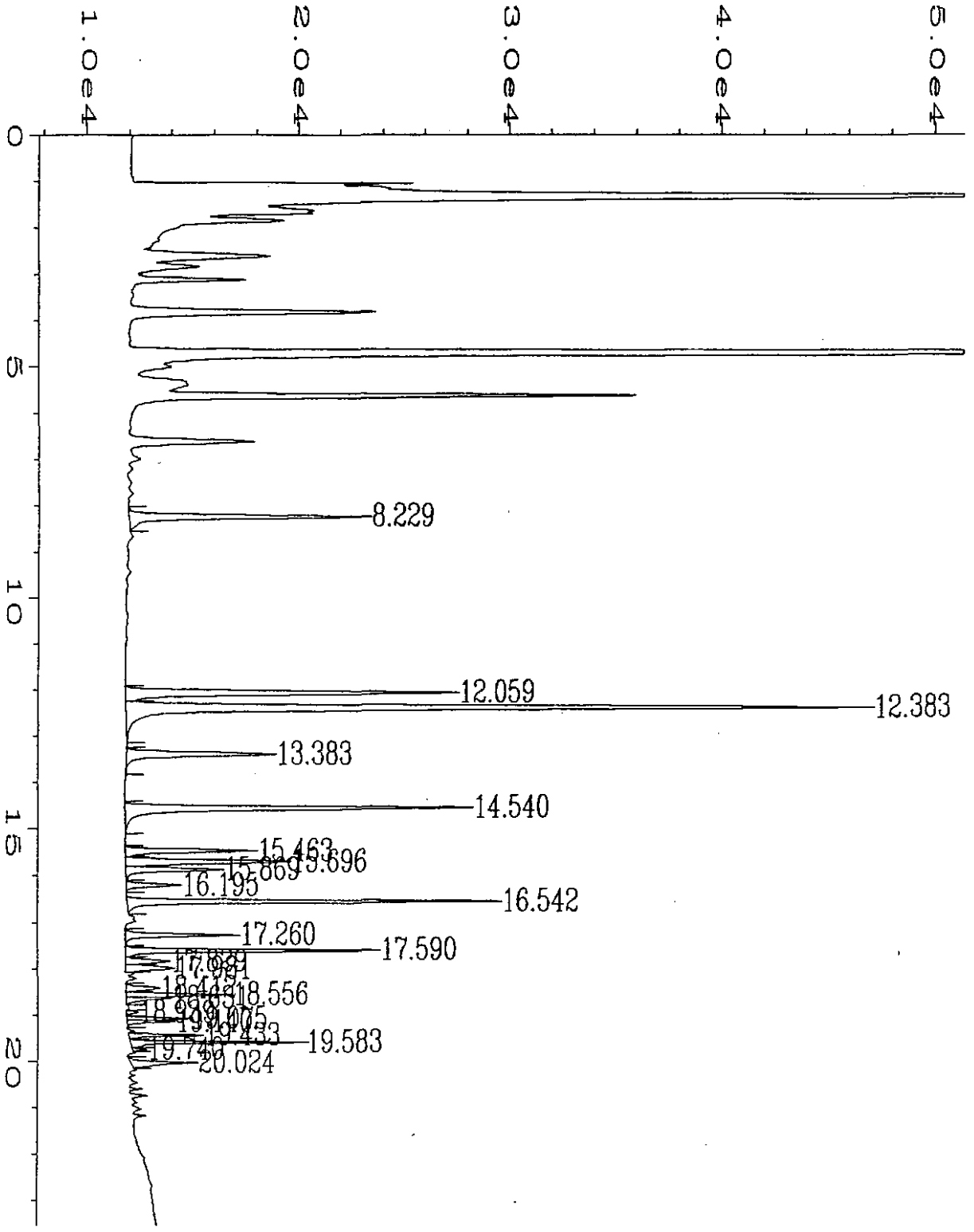
Vial Number : 18
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



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Report Created on: 13 Sep 95 11:01 AM
Multiplier : 100
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Vial Number : 6
Injection Number : 1
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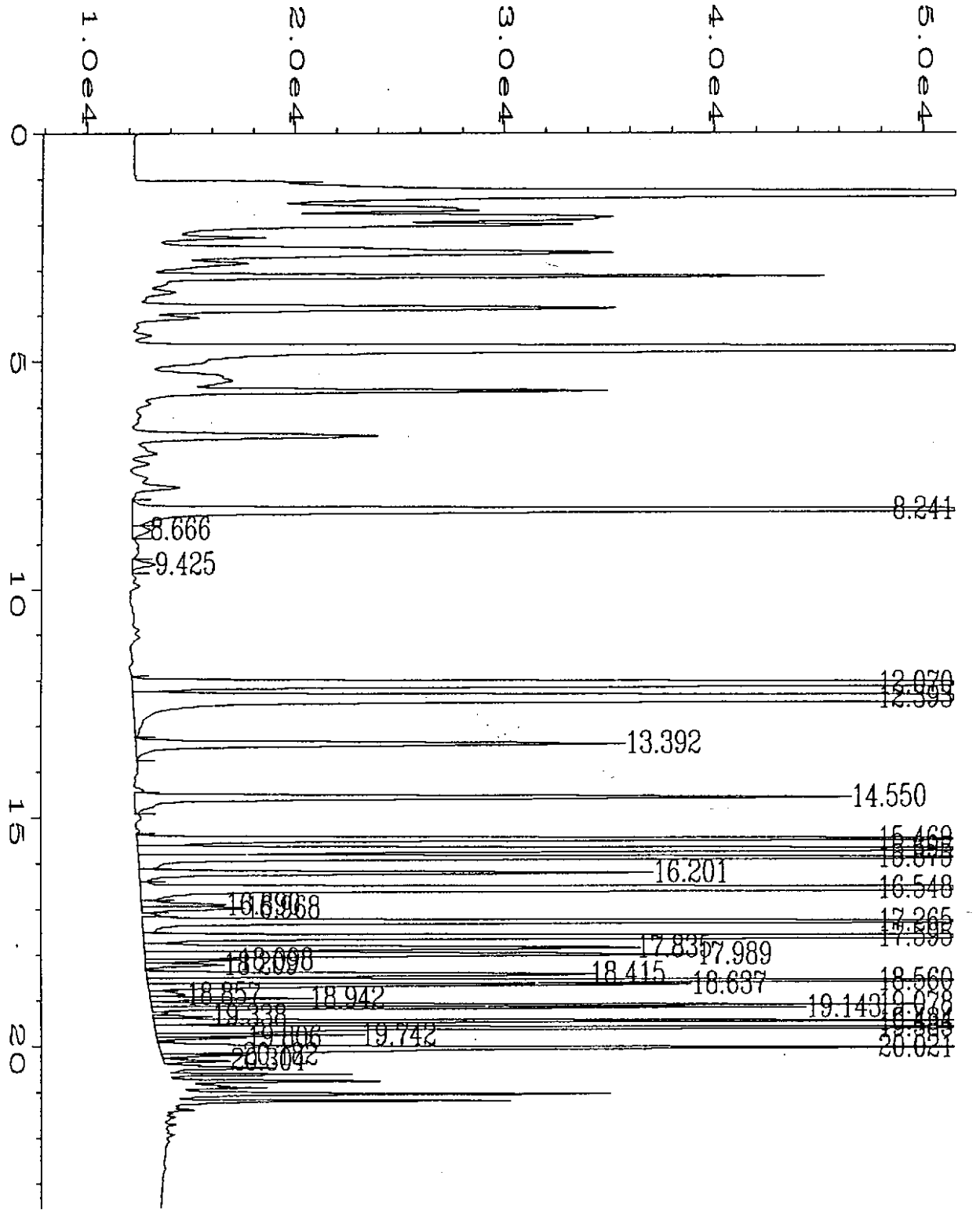
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



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Instrument : GC#8
Sample Name : B509129-02
Run Time Bar Code:
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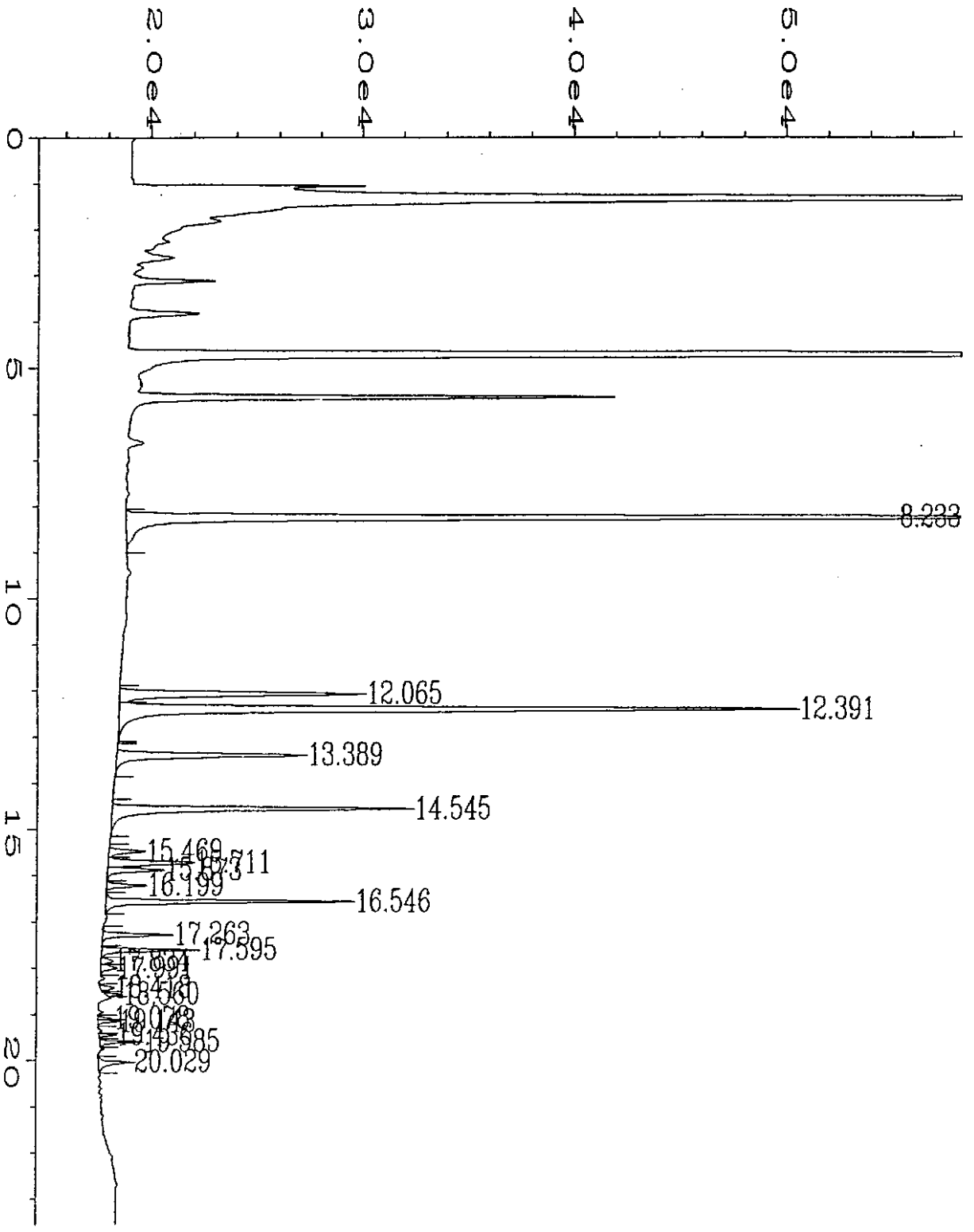
Report Created on: 11 Sep 95 06:50 PM
Multiplier : 5
Sample Info : 1 ml

Page Number : 1
Vial Number : 20
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



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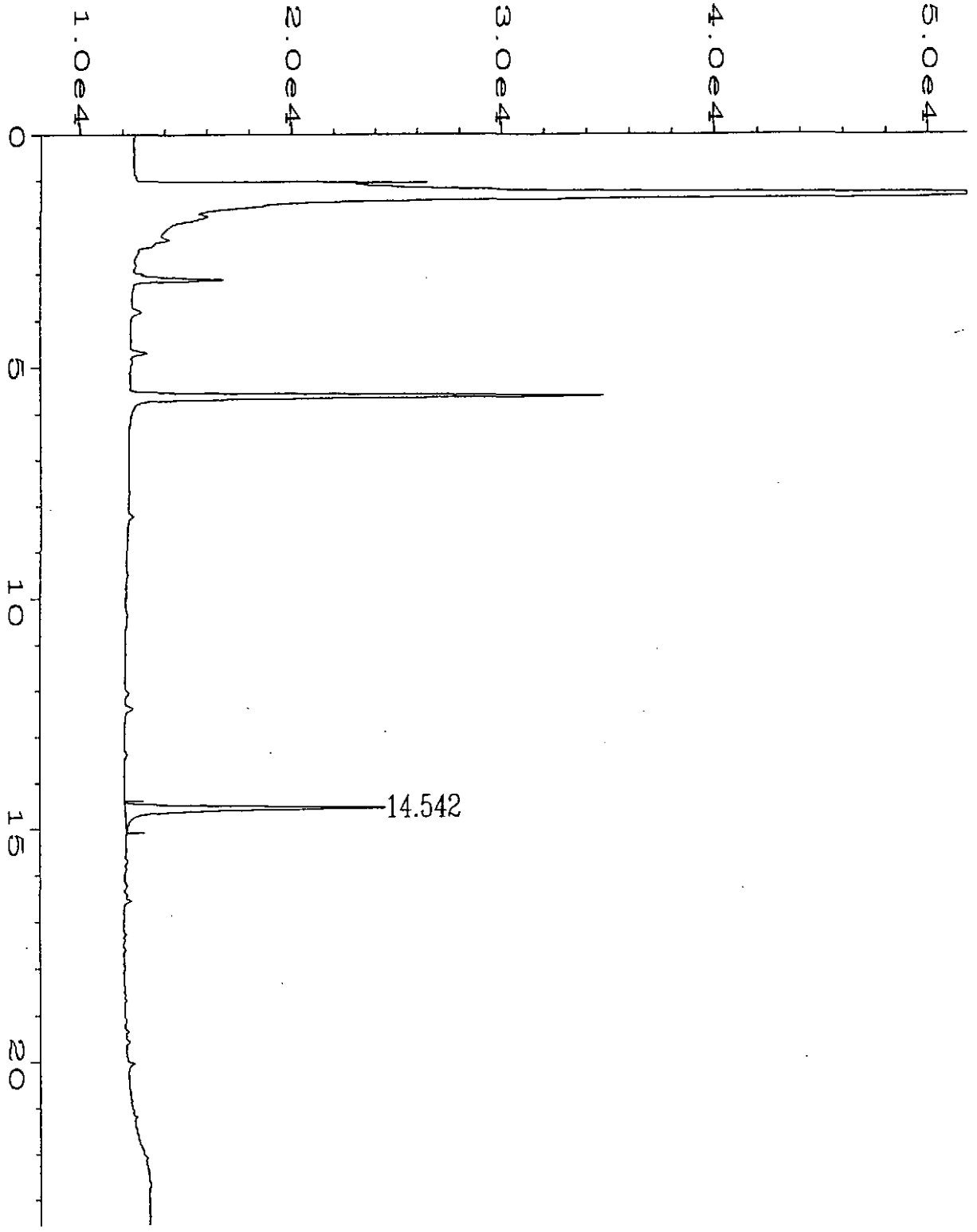
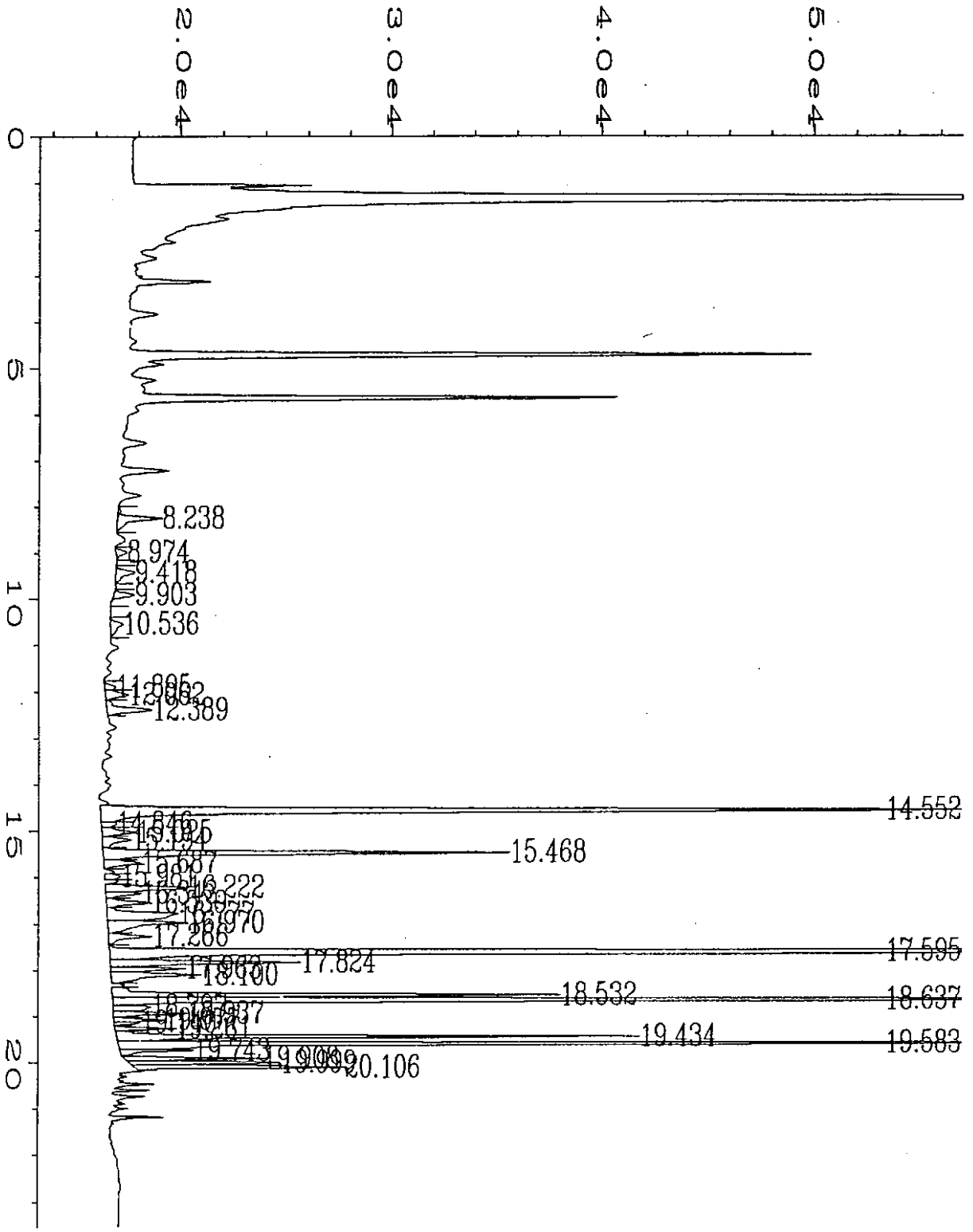
Operator :
Instrument : GC#8
Sample Name : B509129-03 r1
Run Time Bar Code:
Acquired on : 13 Sep 95 12:15 PM
Report Created on: 13 Sep 95 12:39 PM
Multiplier : 100
Sample Info : 50 ul

Page Number : 1
Vial Number : 9
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



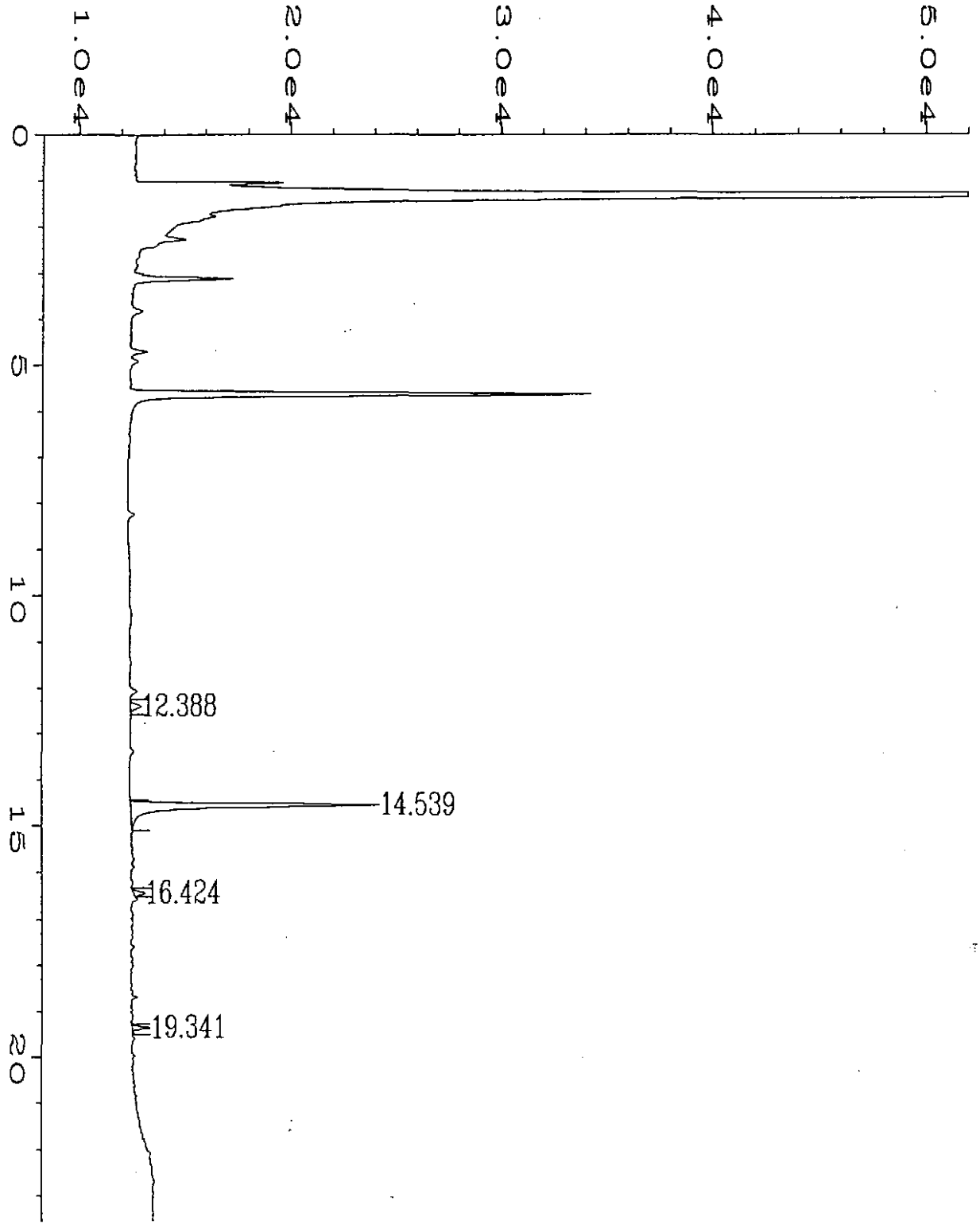
Data File Name : C:\HPCHEM\1\DATA\091295\022F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-04
Run Time Bar Code:
Acquired on : 11 Sep 95 07:32 PM
Report Created on: 11 Sep 95 07:56 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 22
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



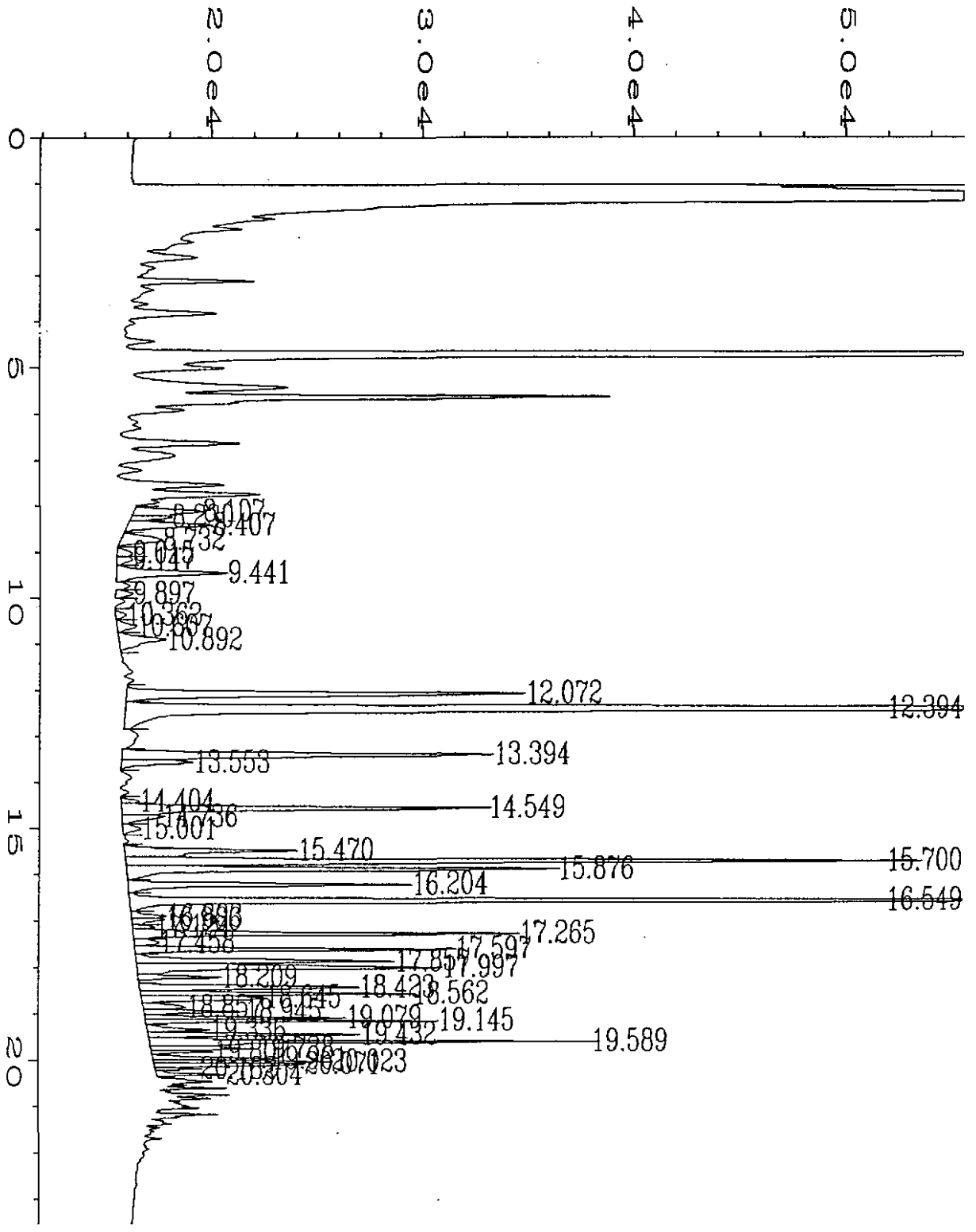
Data File Name : C:\HPCHEM\1\DATA\091395\010F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-05 r1
Run Time Bar Code:
Acquired on : 13 Sep 95 12:48 PM
Report Created on: 13 Sep 95 01:11 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 10
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



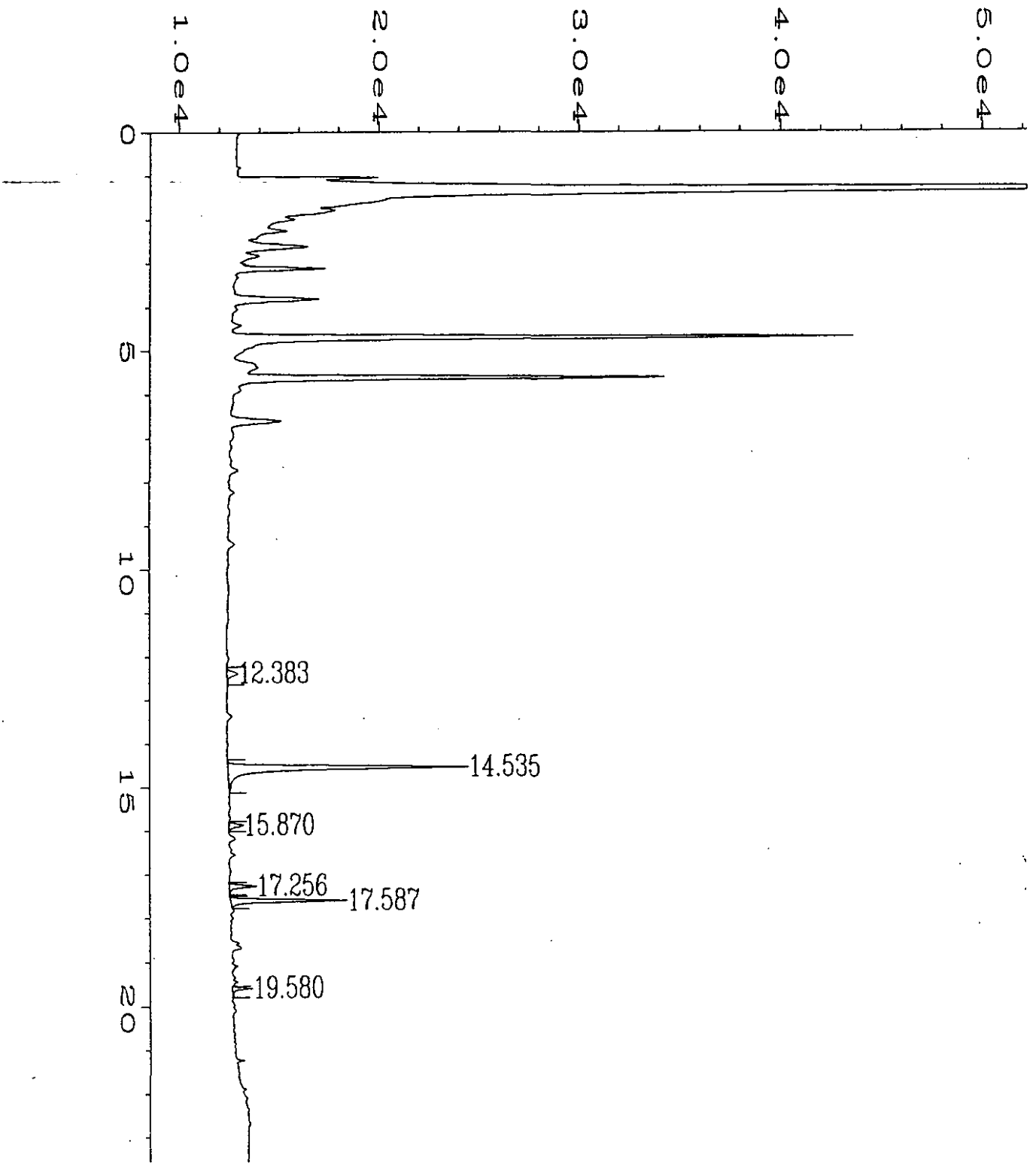
Data File Name : C:\HPCHEM\1\DATA\091295\026F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-06
Run Time Bar Code:
Acquired on : 11 Sep 95 09:41 PM
Report Created on: 11 Sep 95 10:05 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 26
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



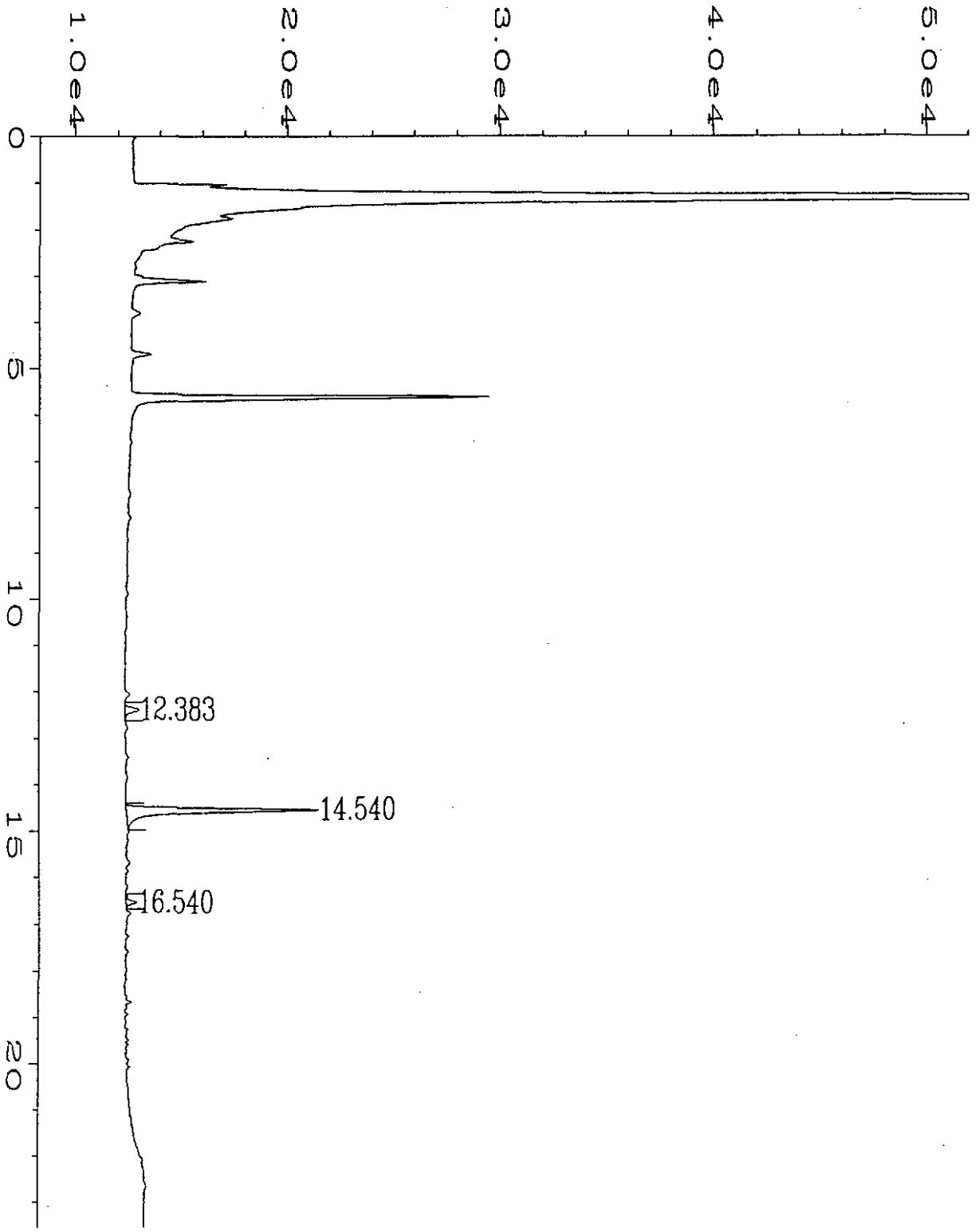
Data File Name : C:\HPCHEM\1\DATA\091395\011F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-07 r1
Run Time Bar Code:
Acquired on : 13 Sep 95 01:20 PM
Report Created on: 13 Sep 95 01:44 PM
Multiplier : 5
Sample Info : 1 ml

Page Number : 1
Vial Number : 11
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



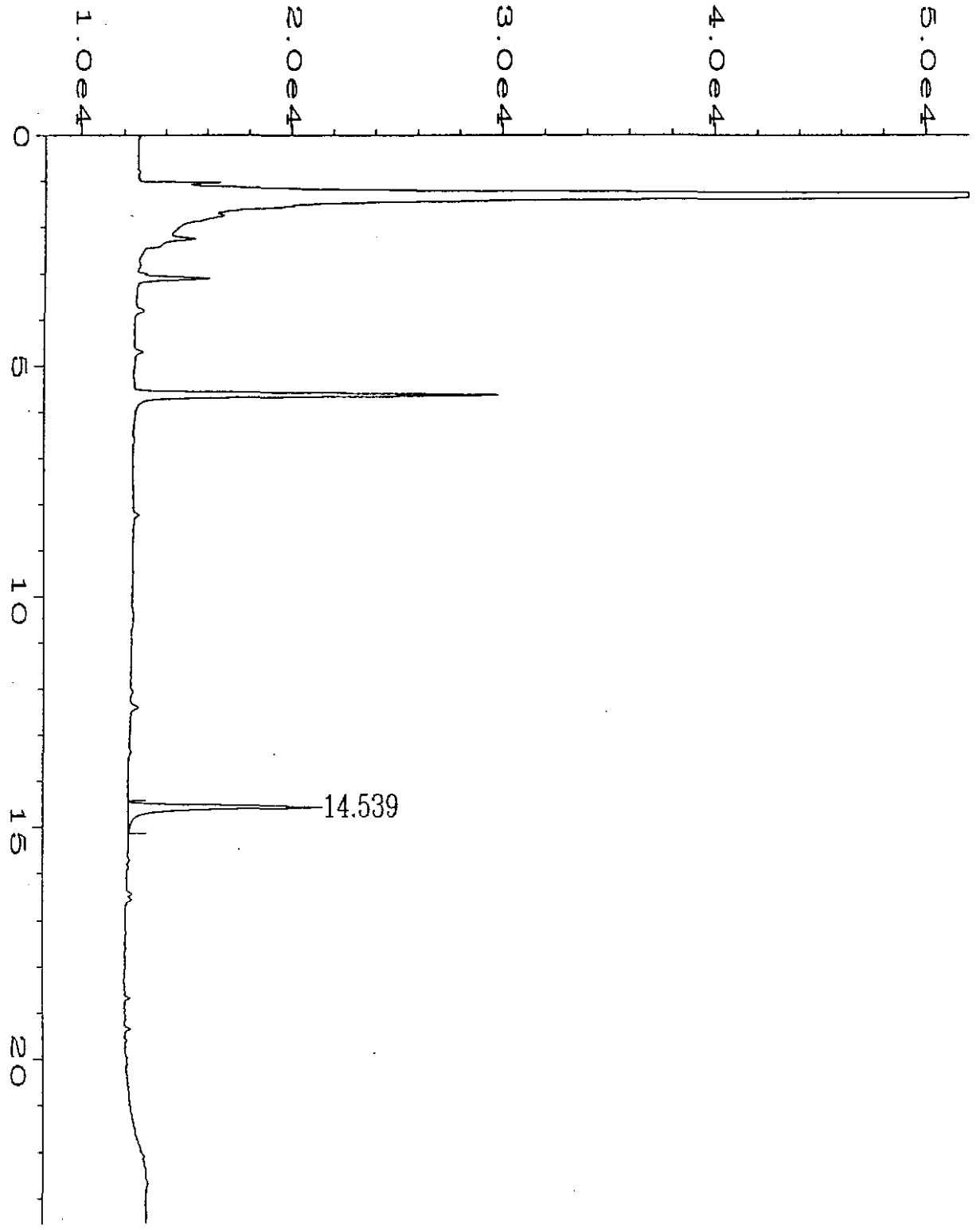
Data File Name : C:\HPCHEM\1\DATA\091295\029F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-08
Run Time Bar Code:
Acquired on : 11 Sep 95 11:18 PM
Report Created on: 11 Sep 95 11:42 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 29
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



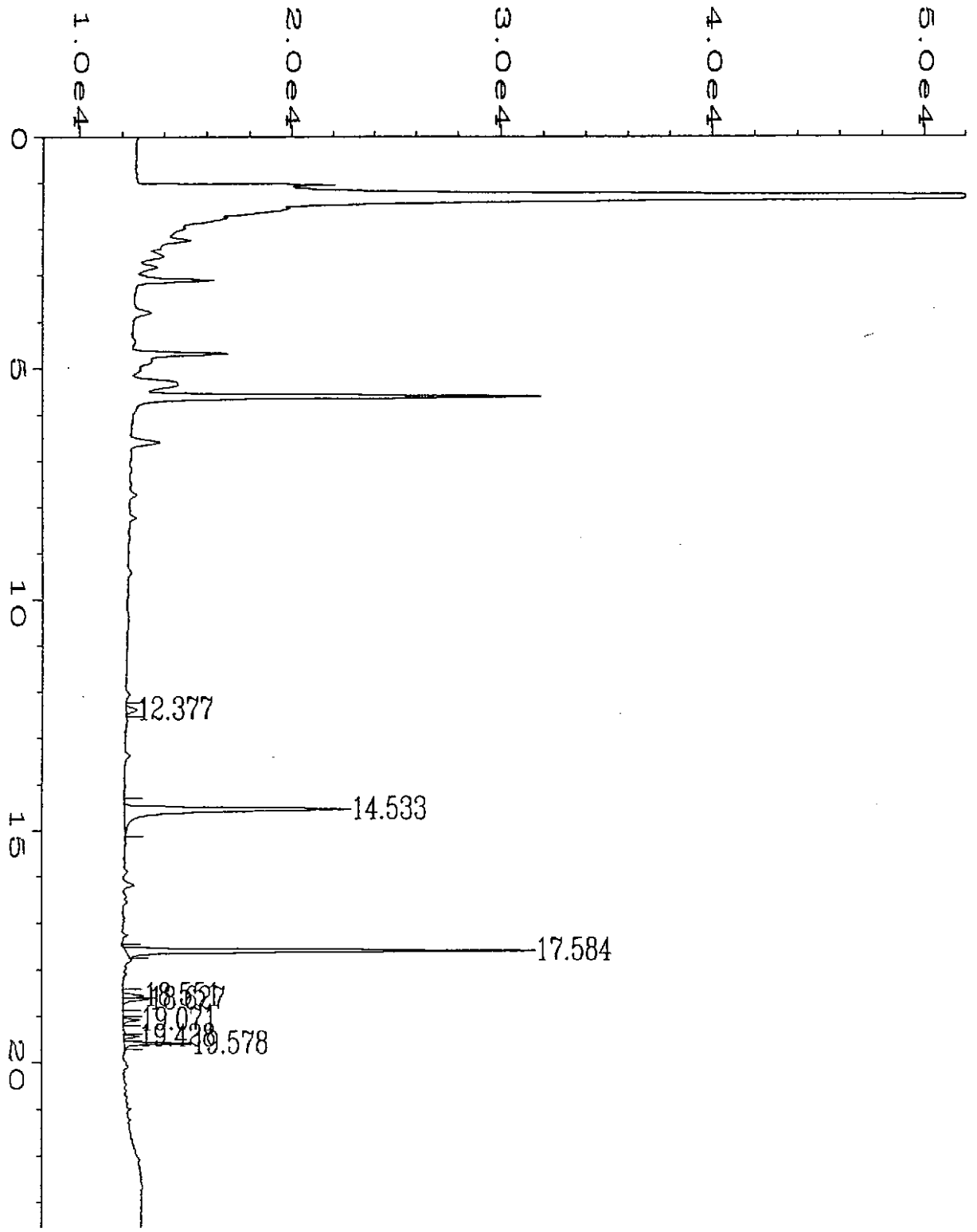
Data File Name : C:\HPCHEM\1\DATA\091295\030F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-09
Run Time Bar Code:
Acquired on : 11 Sep 95 11:50 PM
Report Created on: 12 Sep 95 00:14 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 30
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



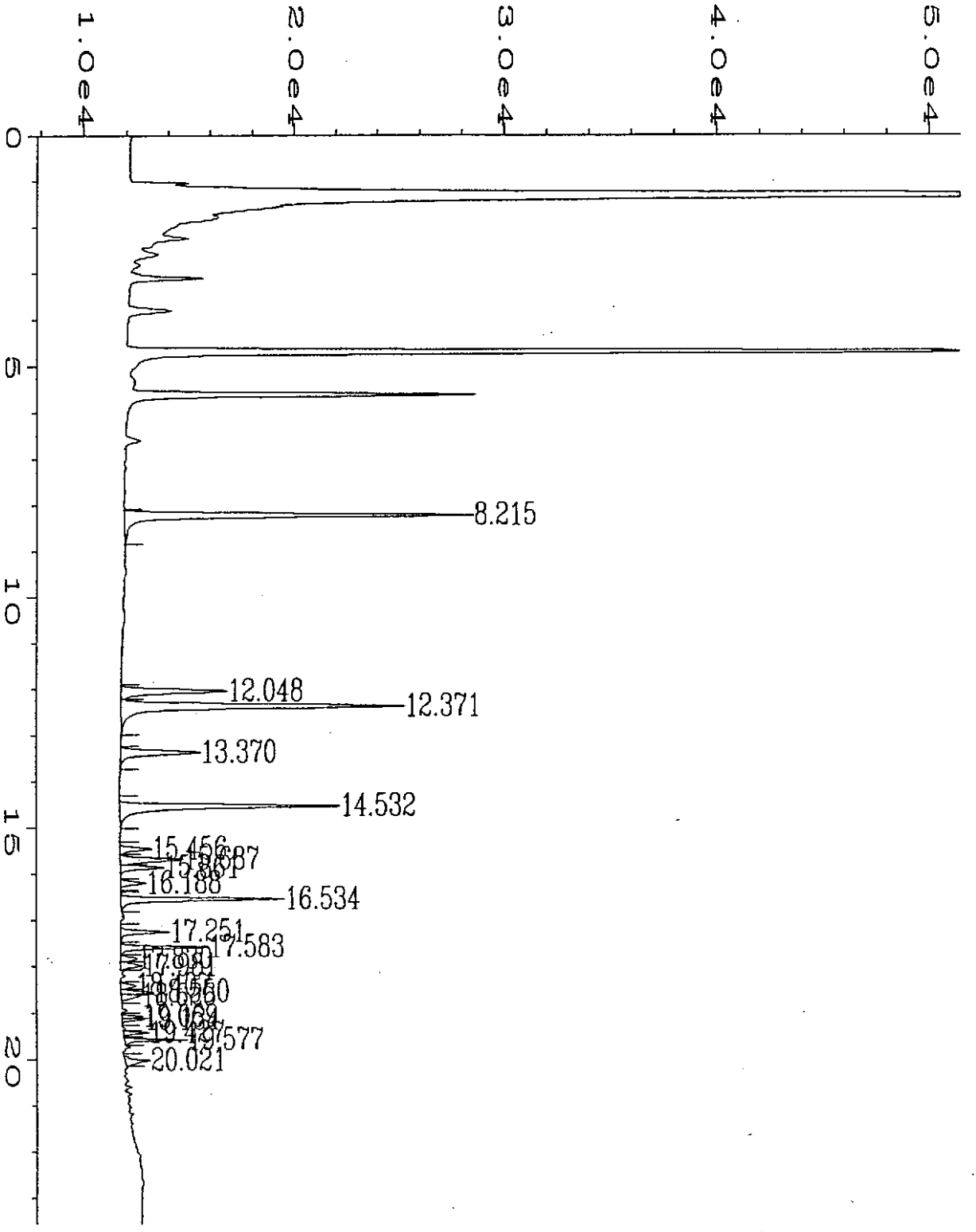
Data File Name : C:\HPCHEM\1\DATA\091295\031F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-10
Run Time Bar Code:
Acquired on : 12 Sep 95 00:22 AM
Report Created on: 12 Sep 95 00:46 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 31
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



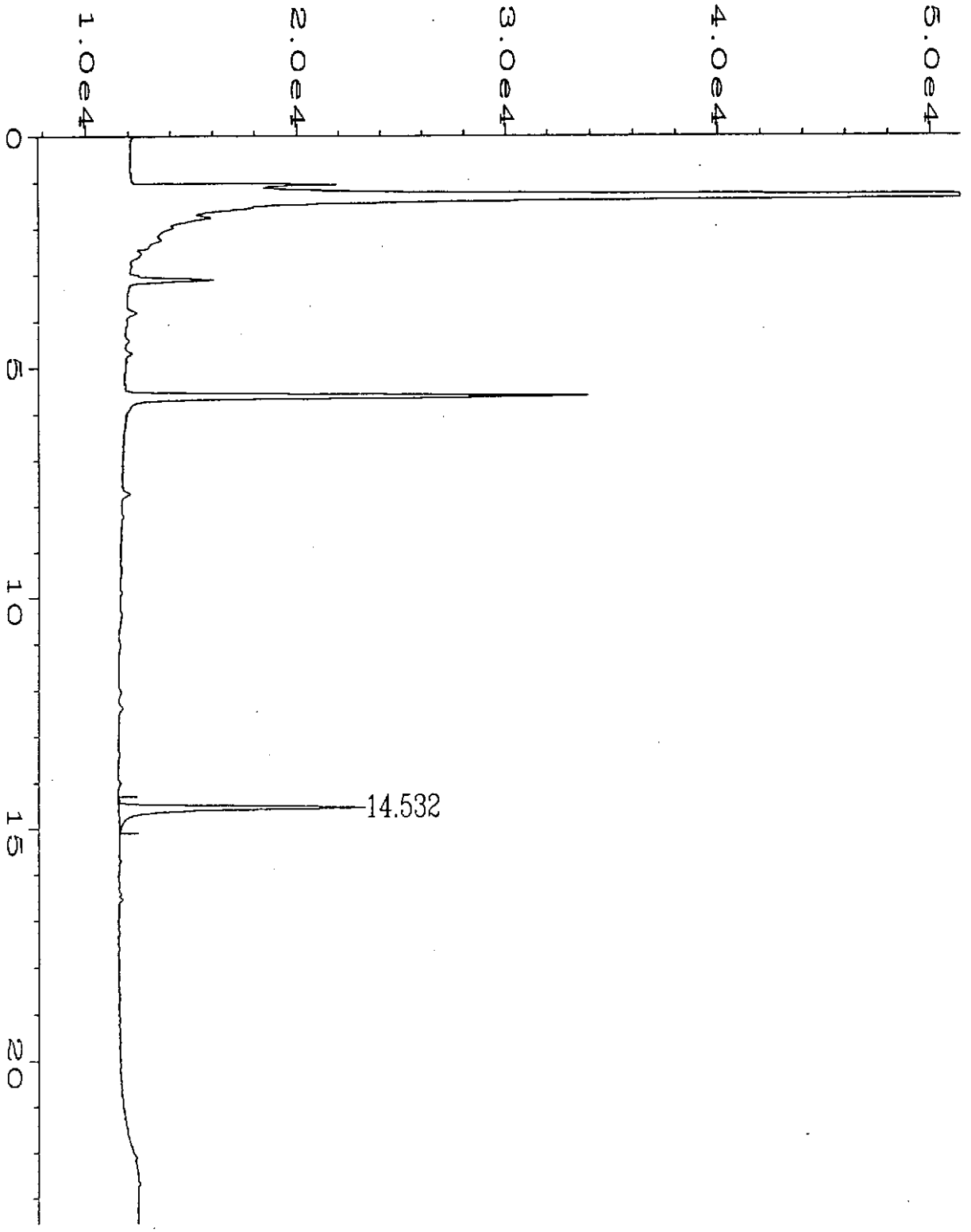
Data File Name : C:\HPCHEM\1\DATA\091295\032F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-11
Run Time Bar Code:
Acquired on : 12 Sep 95 00:55 AM
Report Created on: 12 Sep 95 01:18 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 32
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



Data File Name : C:\HPCHEM\1\DATA\091295\036F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-12
Run Time Bar Code:
Acquired on : 12 Sep 95 03:03 AM
Report Created on: 12 Sep 95 03:27 AM
Multiplier : 50
Sample Info : 100ul

Page Number : 1
Vial Number : 36
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



Data File Name : C:\HPCHEM\1\DATA\091295\038F0101.D
Operator :
Instrument : GC#8
Sample Name : B509129-13
Run Time Bar Code:
Acquired on : 12 Sep 95 04:08 AM
Report Created on: 12 Sep 95 04:32 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH

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GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Dana Carlisle

Client Project ID: UNOCAL Seattle, #5353
Sample Matrix: Water
Analysis Method: WTPH-G
Units: µg/L (ppb)

Analyst: B. Christlieb, F. Shino
Analyzed: Sep 12, 1995
Reported: Sep 29, 1995

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT
Laboratory Control Sample

	Gasoline
Spike Conc. Added:	100
Spike Result:	104
% Recovery:	104
Upper Control Limit %:	132
Lower Control Limit %:	56

PRECISION ASSESSMENT
Sample Duplicate

	Gasoline Range Organics	Gasoline Range Organics
Sample Number:	B509120-01	B509129-06
Original Result:	N.D.	N.D.
Duplicate Result:	N.D.	N.D.
Relative % Difference:	Relative Percent Difference values are not reported at sample concentration levels less than 10 times the Detection Limit.	
Maximum RPD:	50	50

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Laura Dutton
Project Manager

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

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

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GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Sep 7, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Sep 8, 1995
Redmond, WA 98052	Analysis Method:	EPA 8020	Analyzed: Sep 12-13, 1995
Attention: Dana Carlisle	First Sample #:	B509129-01	Reported: Sep 29, 1995

BTEX DISTINCTION

Sample Number	Sample Description	Benzene µg/L (ppb)	Toluene µg/L (ppb)	Ethyl Benzene µg/L (ppb)	Xylenes µg/L (ppb)	Surrogate Recovery %
B509129-01	MW-32A	4,200	470	730	2,000	111
B509129-02	MW-33	550	140	230	620	S-2
B509129-03	MW-34	4,800	2,300	560	2,000	104
B509129-04	MW-36	N.D.	N.D.	N.D.	N.D.	96
B509129-05	MW-40	11	0.91	0.57	N.D.	188, S-3
B509129-06	MW-41	N.D.	N.D.	N.D.	N.D.	94
B509129-07	MW-42	210	4.1	42	230	118
B509129-08	MW-43	10	N.D.	N.D.	N.D.	97
B509129-09	MW-44	N.D.	N.D.	N.D.	N.D.	94
B509129-10	MW-46	N.D.	N.D.	N.D.	N.D.	93
Reporting Limits:		**0.50**	**0.50**	**0.50**	**1.0**	

4-Bromofluorobenzene surrogate recovery control limits are 59 - 144 %.
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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Project Manager

Please Note:
S-2 = The Surrogate Recovery for this sample cannot be accurately quantified due to interference from coeluting organic compounds present in the sample.
S-3 = The Surrogate Recovery for Sample #B509129-05 is outside of NCA established control limits.

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GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Sep 7, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Sep 8, 1995
Redmond, WA 98052	Analysis Method:	EPA 8020	Analyzed: Sep 12-13, 1995
Attention: Dana Carlisle	First Sample #:	B509129-11	Reported: Sep 29, 1995

BTEX DISTINCTION

Sample Number	Sample Description	Benzene µg/L (ppb)	Toluene µg/L (ppb)	Ethyl Benzene µg/L (ppb)	Xylenes µg/L (ppb)	Surrogate Recovery %
B509129-11	MW-47	1.7	N.D.	N.D.	N.D.	97
B509129-12	PURGE	1,200	490	170	600	108
B509129-13	SMW-3	N.D.	N.D.	N.D.	N.D.	93
BLK091295	Method Blank	N.D.	N.D.	N.D.	N.D.	95
Reporting Limits:		**0.50**	**0.50**	**0.50**	**1.0**	

4-Bromofluorobenzene surrogate recovery control limits are 59 - 144 %.
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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Laura Dutton

Laura Dutton
Project Manager

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9405 S.W. Nimbus Avenue • Beaverton, OR 97008-7132 (503) 643-9200 • FAX 644-2202

GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Sep 7, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Sep 8, 1995
Redmond, WA 98052	Analysis Method:	EPA 8020	Analyzed: Sep 12-13, 1995
Attention: Dana Carlisle	First Sample #:	B509129-11	Reported: Sep 29, 1995

BTEX DISTINCTION

Sample Number	Sample Description	Benzene µg/L (ppb)	Toluene µg/L (ppb)	Ethyl Benzene µg/L (ppb)	Xylenes µg/L (ppb)	Surrogate Recovery %
B509129-11	MW-47	1.7	N.D.	N.D.	N.D.	97
B509129-12	PURGE	1,200	490	170	600	108
B509129-13	SMW-4	N.D.	N.D.	N.D.	N.D.	93
BLK091295	Method Blank	N.D.	N.D.	N.D.	N.D.	95
Reporting Limits:		**0.50**	**0.50**	**0.50**	**1.0**	

4-Bromofluorobenzene surrogate recovery control limits are 59 - 144 %.
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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Laura Dutton

Laura Dutton
Project Manager

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GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Dana Carlisle

Client Project ID: UNOCAL Seattle, #5353
Sample Matrix: Water
Analysis Method: EPA 8020
Units: µg/L (ppb)
QC Sample #: B509120-01

Analyst: B. Christlieb, F. Shino
Analyzed: Sep 12, 1995
Reported: Sep 29, 1995

MATRIX SPIKE QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Sample Result:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	10.0	10.0	10.0	30.0
Spike Result:	9.8	10.0	10.4	30.1
Spike % Recovery:	98%	100%	104%	100%
Spike Dup. Result:	9.8	10.1	10.4	30.2
Spike Duplicate % Recovery:	98%	101%	104%	101%
Upper Control Limit %:	115	116	122	122
Lower Control Limit %:	82	81	85	85
Relative % Difference:	0.0%	1.0%	0.0%	<1.0%
Maximum RPD:	16	16	16	17

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% Recovery: $\frac{\text{Spike Result - Sample Result}}{\text{Spike Conc. Added}} \times 100$

Relative % Difference: $\frac{\text{Spike Result - Spike Dup. Result}}{(\text{Spike Result + Spike Dup. Result}) / 2} \times 100$

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9405 S.W. Nimbus Avenue • Beaverton, OR 97008-7132 (503) 643-9200 • FAX 644-2202

GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled:	Sep 7, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received:	Sep 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-D Extended	Extracted:	Sep 13, 1995
Attention: Dana Carlisle	First Sample #:	B509129-01	Analyzed:	Sep 18, 1995
			Reported:	Sep 29, 1995

TOTAL PETROLEUM HYDROCARBONS - DIESEL RANGE EXTENDED

Sample Number	Sample Description	Diesel Result mg/L (ppm)	Heavy Oil Result mg/L (ppm)	Surrogate Recovery %
B509129-01	MW-32A	2.5 D-1	1.5	81
B509129-02	MW-33	1.4 D-1	0.82	67
B509129-03	MW-34	1.8 D-1	0.93	99
B509129-04	MW-36	N.D.	N.D.	84
B509129-05	MW-40	13	66	97
B509129-06	MW-41	N.D.	N.D.	64
B509129-07	MW-42	0.78	1.2	76
B509129-08	MW-43	N.D.	0.85	79
B509129-09	MW-44	N.D.	N.D.	70
B509129-10	MW-46	0.71	5.6	70
Reporting Limit:		**0.25**	**0.75**	

2-Fluorobiphenyl surrogate recovery control limits are 50 - 150%.
Extractable Hydrocarbons are quantitated as Diesel Range Organics (C12 - C24) and Heavy Oil Range Organics (>C24).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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Laura Dutton
Project Manager

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HYDROCARBON ANALYSIS FOOTNOTES

2/94, Rev. 3

VOLATILE HYDROCARBONS - GASOLINE RANGE ORGANICS

G 1 This sample appears to contain extractable diesel range organics.

G 2 The chromatogram for this sample does not resemble a typical gasoline pattern. Please refer to the sample chromatogram.

G 3 The total hydrocarbon result in this sample is primarily due to an individual compound(s) eluting in the volatile hydrocarbon range. Identification and quantitation by EPA 8010, 8021 or 8240 is recommended.

G 4 This sample contains compound(s) not identified as Benzene, Toluene, Ethyl benzene or Xylene.

G 5 This sample appears to contain or be saturated with gasoline product.

EXTRACTABLE HYDROCARBONS - DIESEL RANGE ORGANICS

D 1 This sample appears to contain volatile gasoline range organics.

D 2 The hydrocarbons present in this sample resemble heavy, non-resolvable oil range organics. Quantitation by TPH-Diesel Extended or TPH 418.1 is recommended.

D 3 The hydrocarbon concentration result in this sample is partially due to an individual peak(s) eluting in the diesel / motor oil carbon range.

D 4 The hydrocarbons present in this sample are a complex mixture of diesel range and heavy oil range organics.

D 5 The hydrocarbon result shown is an estimated (greater than) value due to the high concentration. Reanalysis is being performed to yield a quantitative result. An amended report will follow.

D 6 The sample chromatographic pattern does not resemble the fuel standard used for quantitation. A fuel fingerprint is advised.

D 7 This sample appears to contain or be saturated with diesel product.

Oils and Lubricants
[----------]
TRPH 418.1

Diesel & Fuel Oils
[----------]
Extractable Hydrocarbons (TPH-D)

Gasoline
[----------]
Volatile Hydrocarbons (TPH-G)

HYDROCARBON BOILING POINT RANGE

LOW LOW TO MEDIUM MEDIUM MEDIUM TO HIGH VERY HIGH

CARBON RANGE: C – 26

5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31+

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GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled:	Sep 7, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received:	Sep 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-D Extended	Extracted:	Sep 13, 1995
Attention: Dana Carlisle	First Sample #:	B509129-11	Analyzed:	Sep 18, 1995
			Reported:	Sep 29, 1995

TOTAL PETROLEUM HYDROCARBONS - DIESEL RANGE EXTENDED

Sample Number	Sample Description	Diesel Result mg/L (ppm)	Heavy Oil Result mg/L (ppm)	Surrogate Recovery %
B509129-11	MW-47	0.26	N.D.	81
B509129-13	SMW-3	N.D.	N.D.	76
BLK091395	Method Blank	N.D.	N.D.	78
Reporting Limit:		**0.25**	**0.75**	

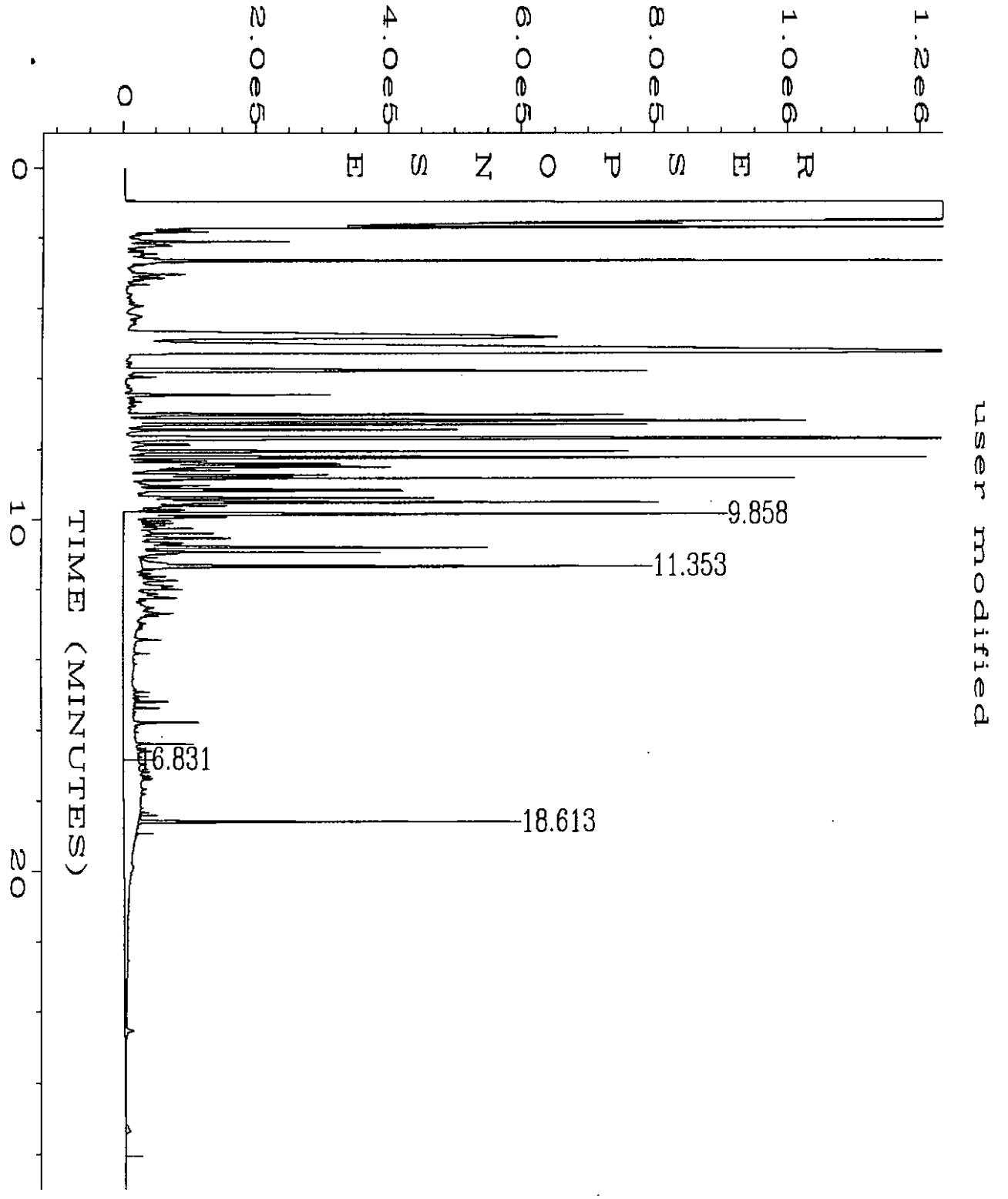
2-Fluorobiphenyl surrogate recovery control limits are 50 - 150%.
Extractable Hydrocarbons are quantitated as Diesel Range Organics (C12 - C24) and Heavy Oil Range Organics (>C24).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

Laura Dutton

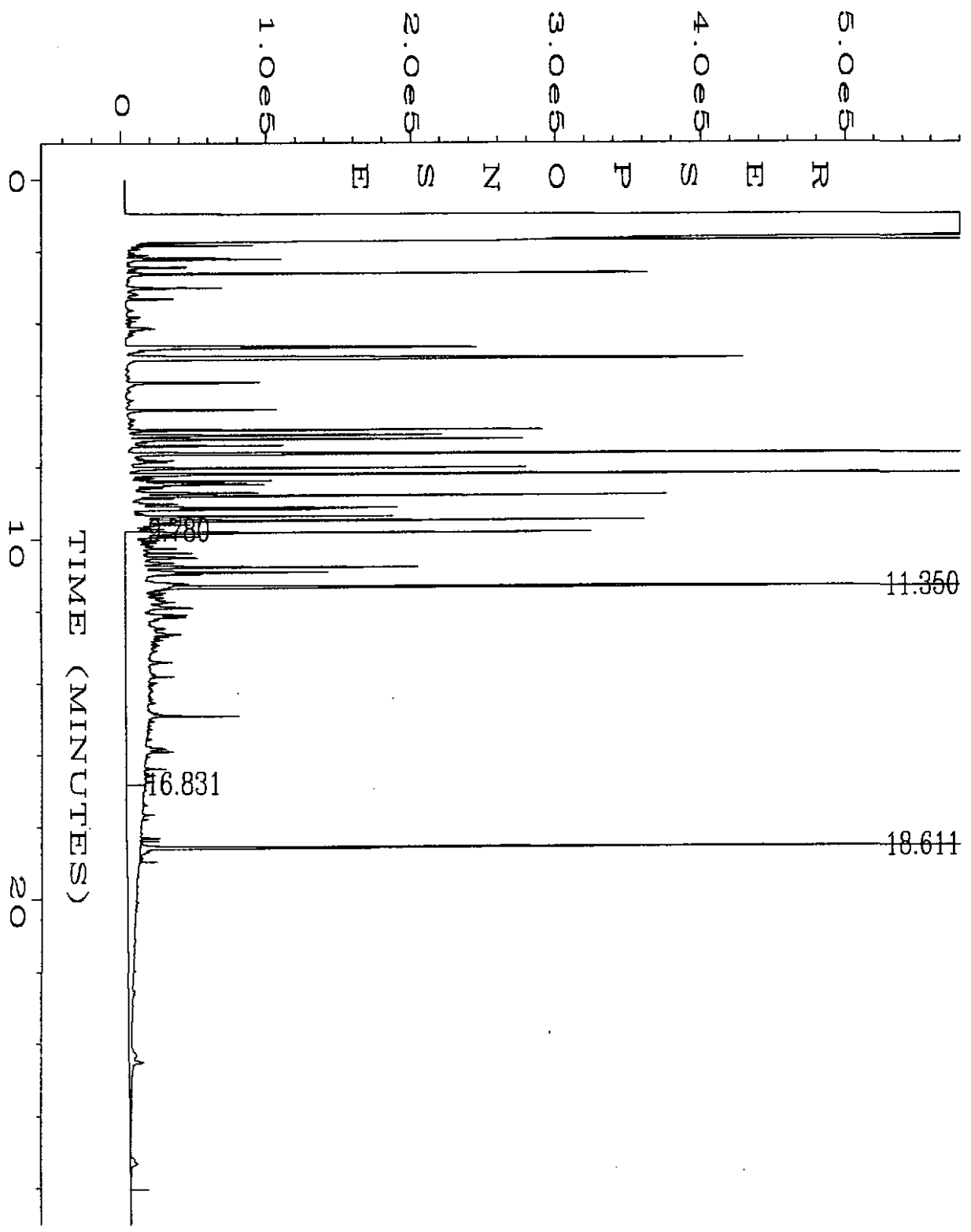
Laura Dutton
Project Manager

509129.GEO <10>



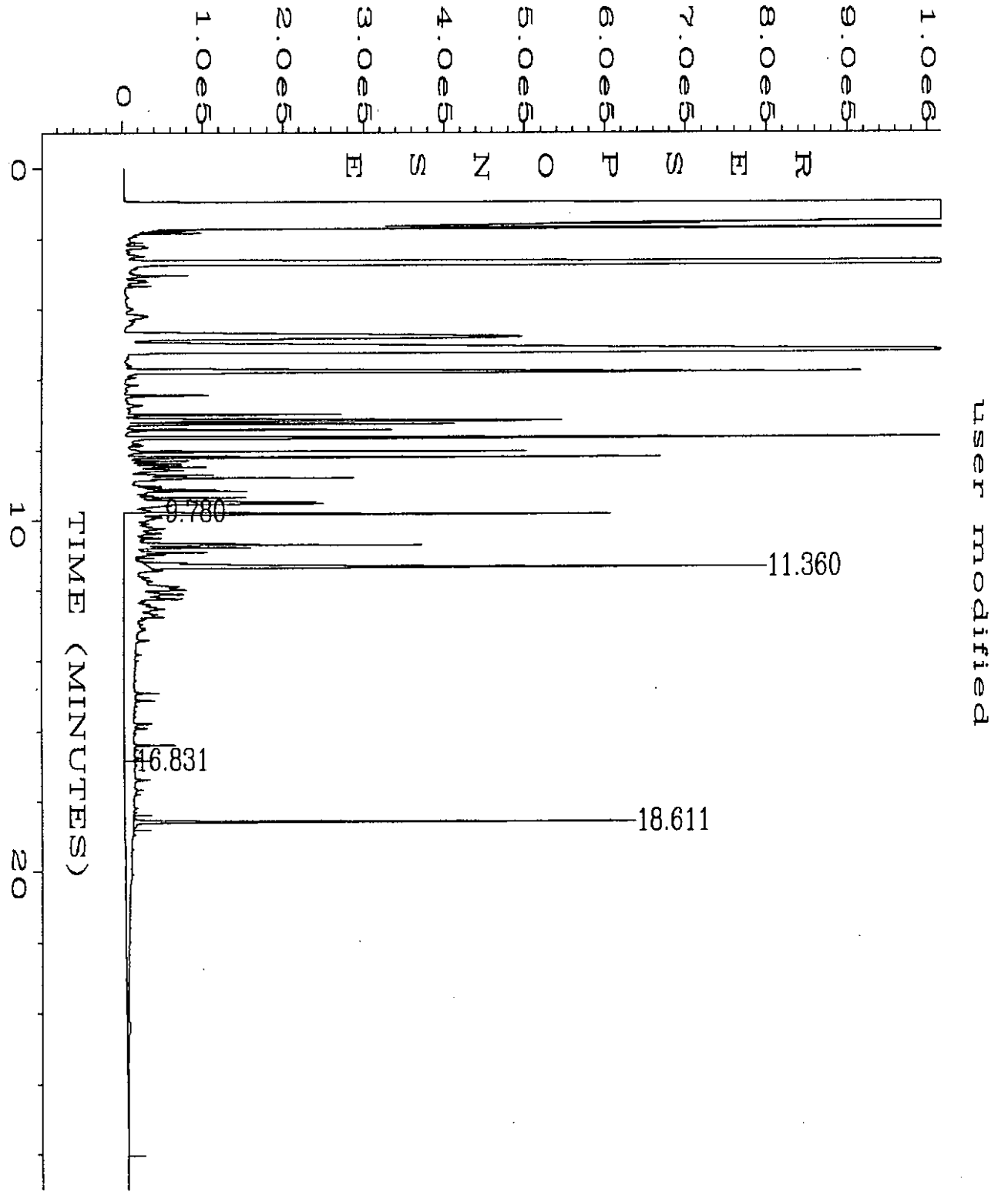
Data File Name : C:\HPCHEM\3\DATA\SEPT17\058R0701.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-01W
Run Time Bar Code:
Acquired on : 18 Sep 95 05:00 AM
Report Created on: 18 Sep 95 02:29 PM

Page Number : 1
Vial Number : 58
Injection Number : 1
Sequence Line : 7
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



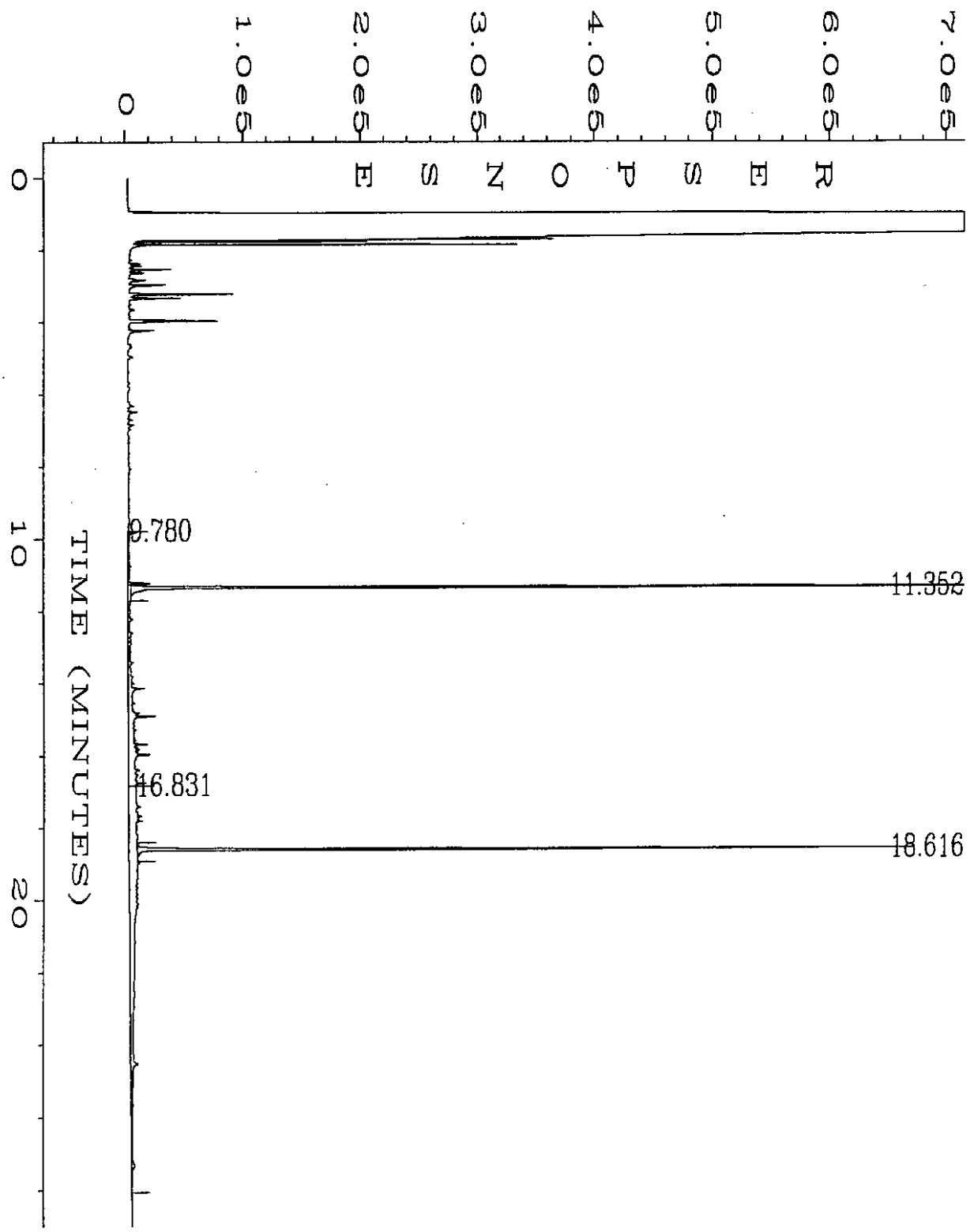
Data File Name : C:\HPCHEM\3\DATA\SEPT17\059R0701.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-02W
Run Time Bar Code:
Acquired on : 18 Sep 95 05:39 AM
Report Created on: 18 Sep 95 02:30 PM

Page Number : 1
Vial Number : 59
Injection Number : 1
Sequence Line : 7
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



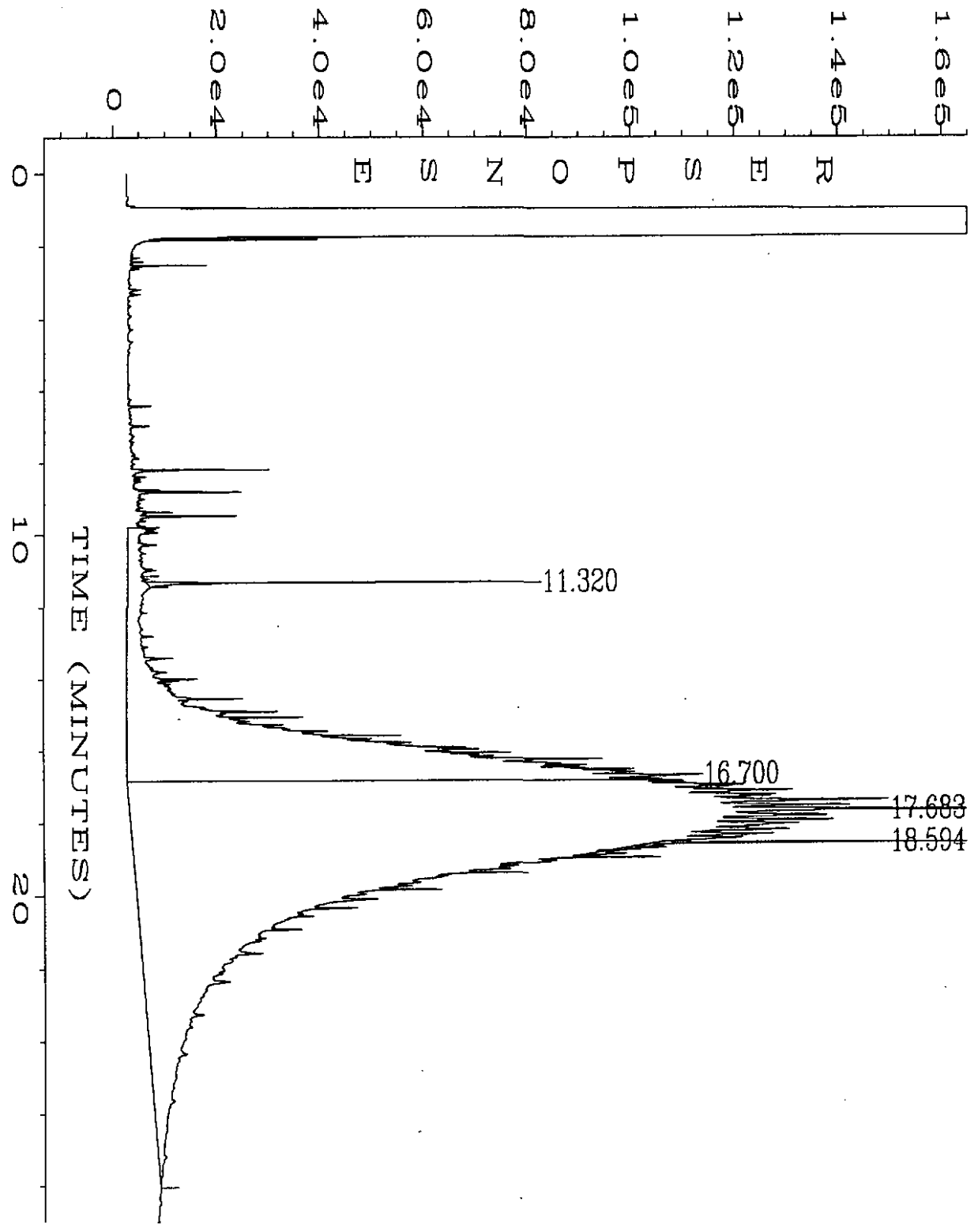
Data File Name : C:\HPCHEM\3\DATA\SEPT17\060R0701.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-03W
Run Time Bar Code:
Acquired on : 18 Sep 95 06:18 AM
Report Created on: 18 Sep 95 02:31 PM

Page Number : 1
Vial Number : 60
Injection Number : 1
Sequence Line : 7
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



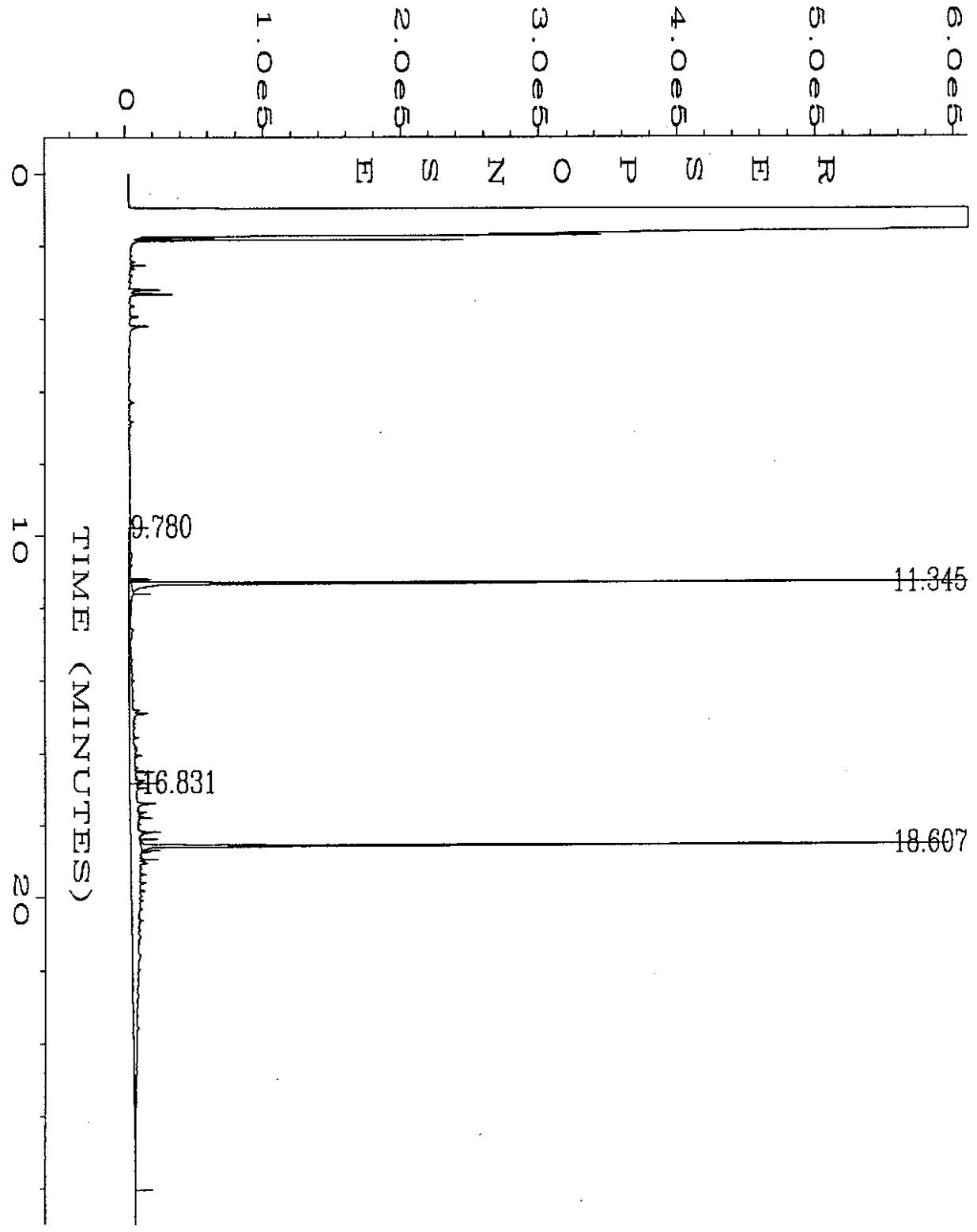
Data File Name : C:\HPCHEM\3\DATA\SEPT17\061R0701.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-04W
Run Time Bar Code:
Acquired on : 18 Sep 95 06:57 AM
Report Created on: 18 Sep 95 02:31 PM

Page Number : 1
Vial Number : 61
Injection Number : 1
Sequence Line : 7
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



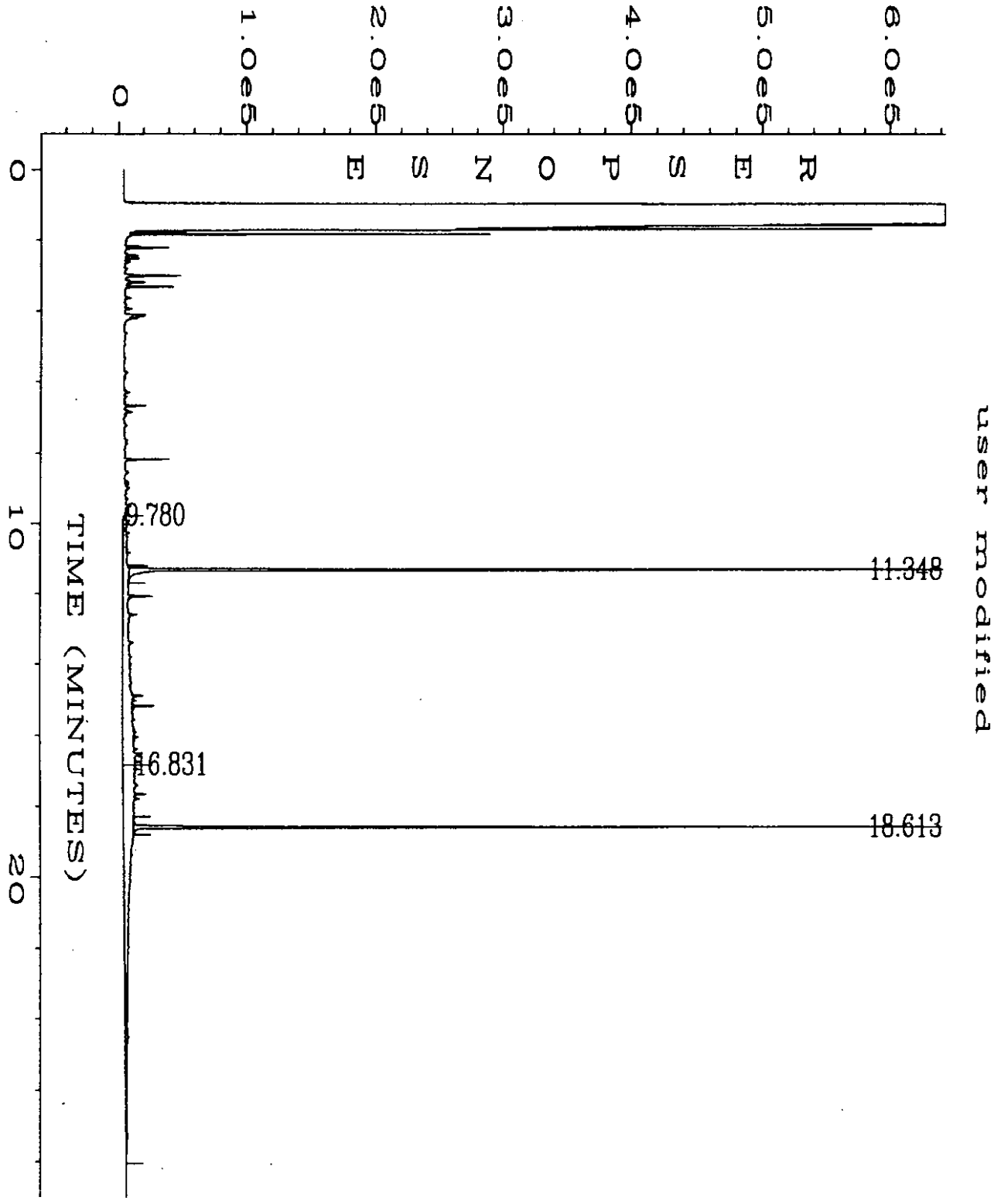
Data File Name : C:\HPCHEM\3\DATA\SEPT17\062R1101.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-05W 11X
Run Time Bar Code:
Acquired on : 18 Sep 95 09:33 AM
Report Created on: 18 Sep 95 04:18 PM

Page Number : 1
Vial Number : 62
Injection Number : 1
Sequence Line : 11
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



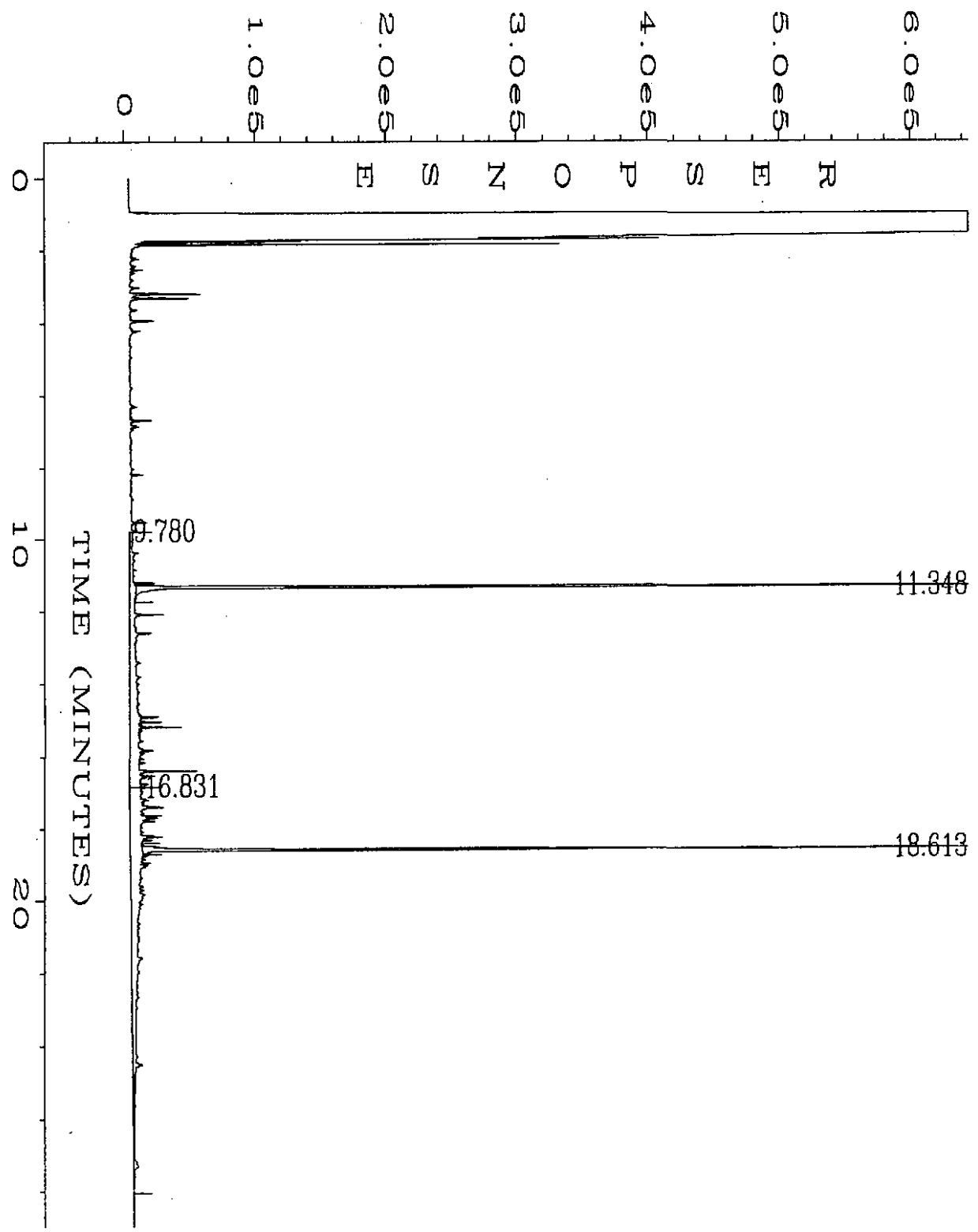
Data File Name : C:\HPCHEM\3\DATA\SEPT17\063R1101.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-06W
Run Time Bar Code:
Acquired on : 18 Sep 95 10:12 AM
Report Created on: 18 Sep 95 04:19 PM

Page Number : 1
Vial Number : 63
Injection Number : 1
Sequence Line : 11
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



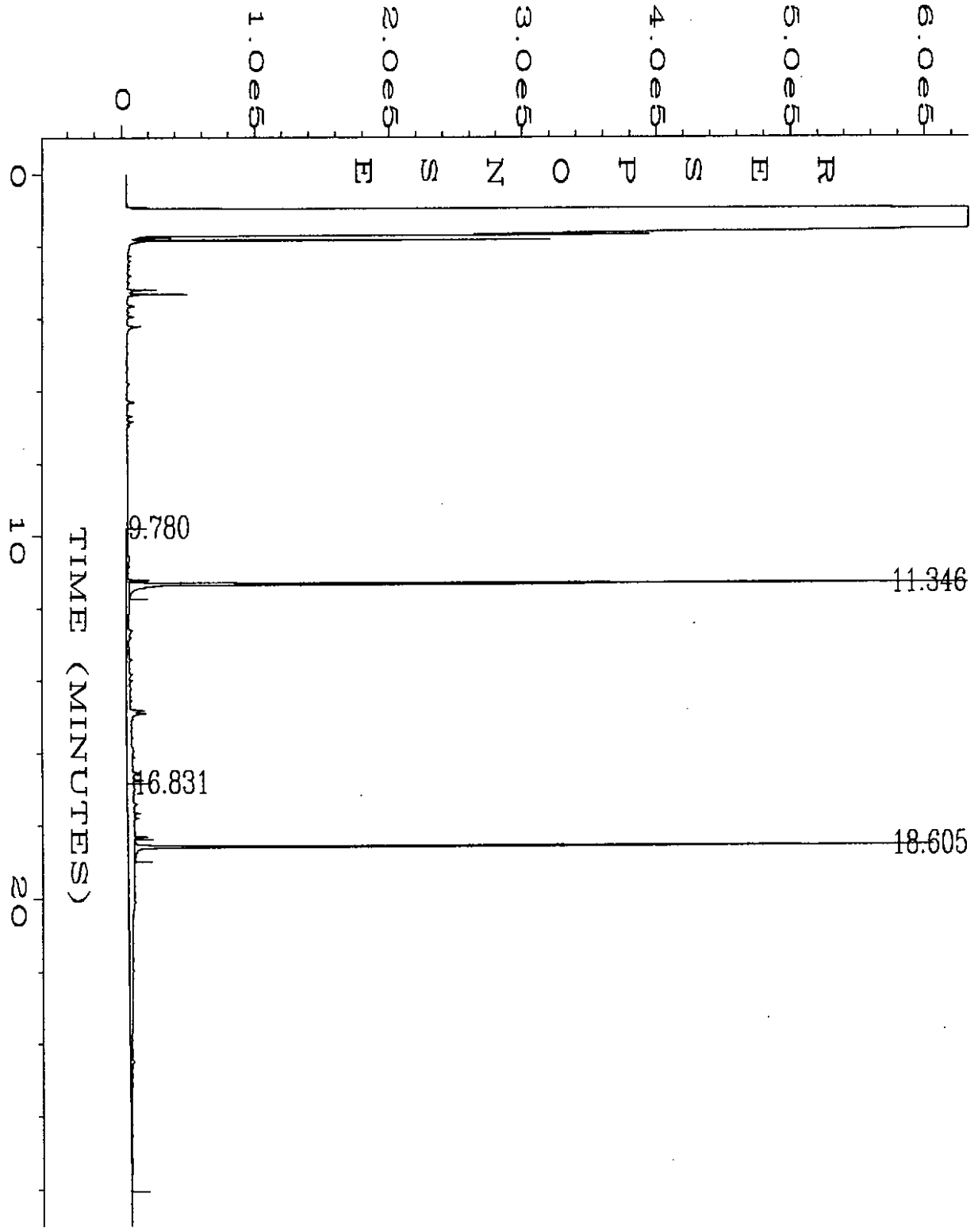
Data File Name : C:\HPCHEM\3\DATA\SEPT17\064R1301.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-07W
Run Time Bar Code:
Acquired on : 18 Sep 95 12:10 PM
Report Created on: 18 Sep 95 04:19 PM

Page Number : 1
Vial Number : 64
Injection Number : 1
Sequence Line : 13
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



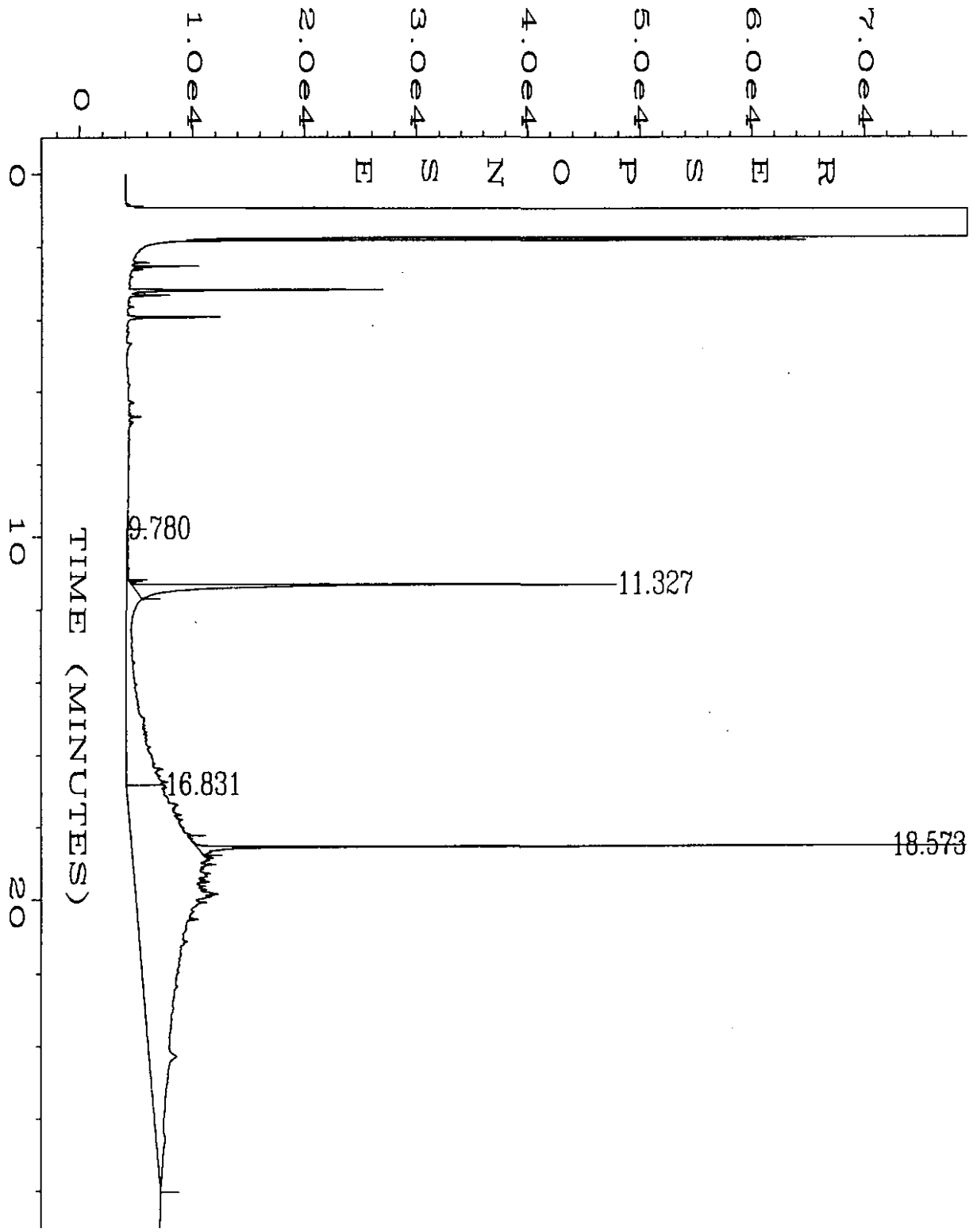
Data File Name : C:\HPCHEM\3\DATA\SEPT17\066R1301.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-08W
Run Time Bar Code:
Acquired on : 18 Sep 95 01:27 PM
Report Created on: 18 Sep 95 04:21 PM

Page Number : 1
Vial Number : 66
Injection Number : 1
Sequence Line : 13
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



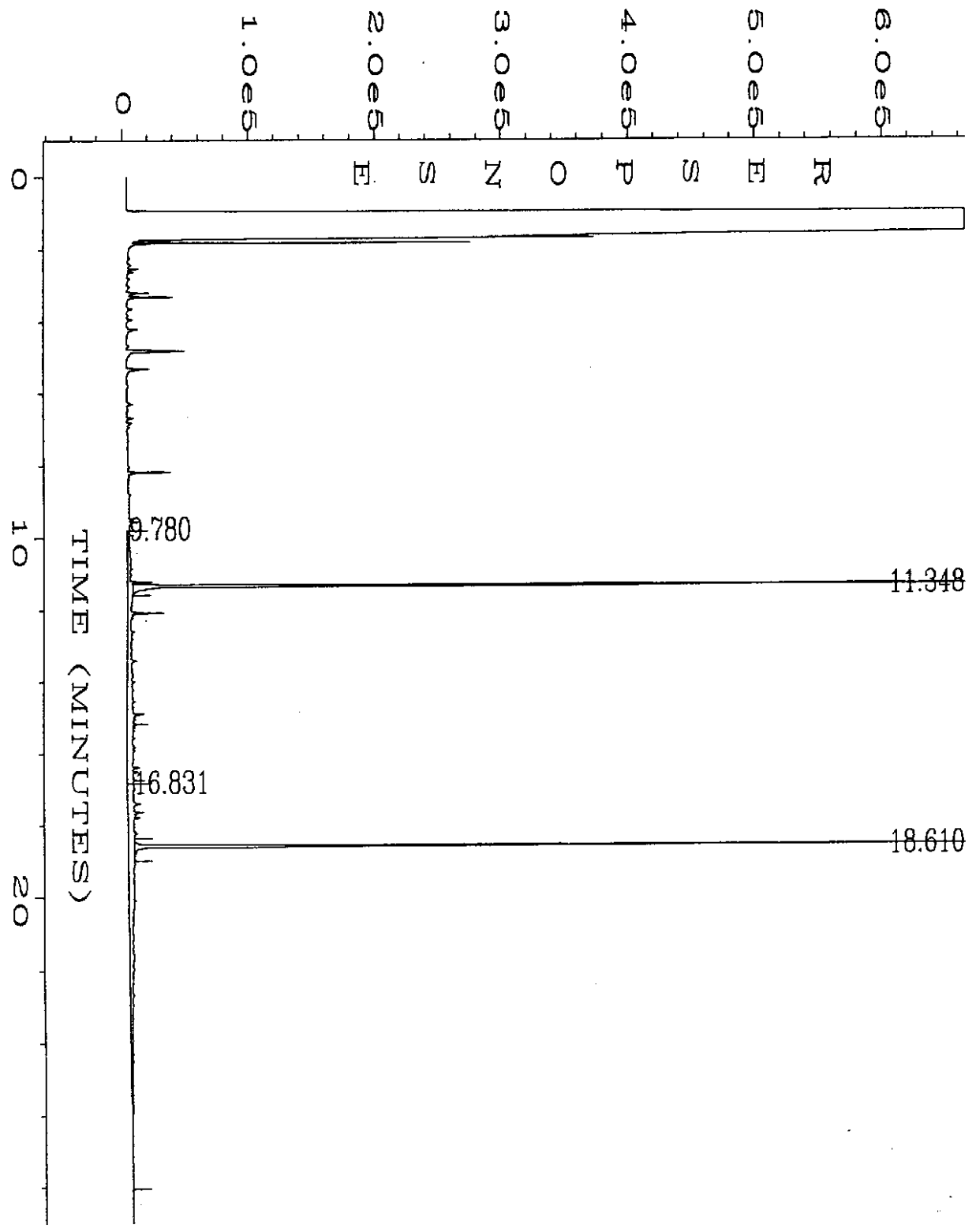
Data File Name : C:\HPCHEM\3\DATA\SEPT17\067R1501.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-09W
Run Time Bar Code:
Acquired on : 18 Sep 95 02:45 PM
Report Created on: 18 Sep 95 04:21 PM

Page Number : 1
Vial Number : 67
Injection Number : 1
Sequence Line : 15
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



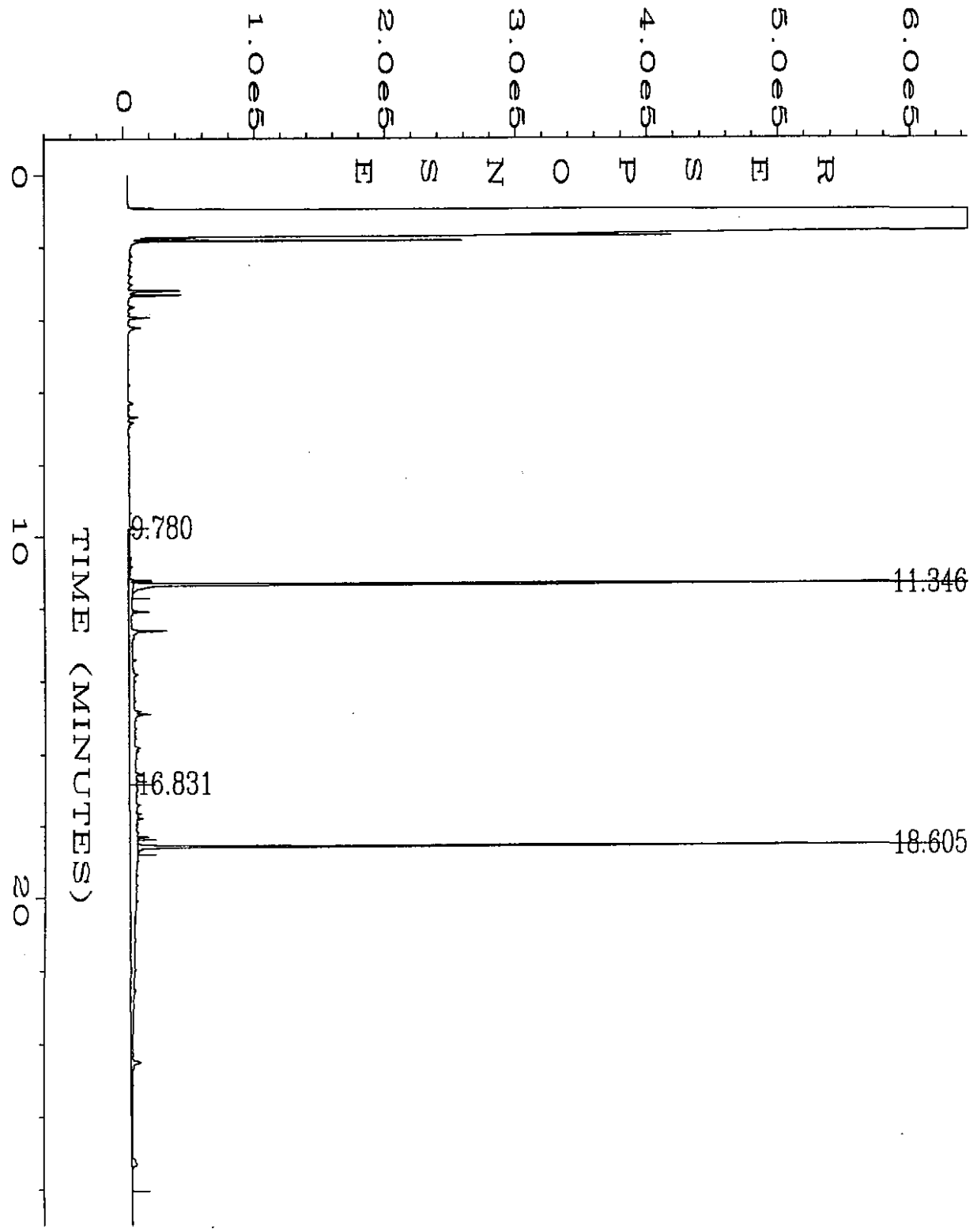
Data File Name : C:\HPCHEM\3\DATA\SEPT17\068R1501.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-10W 11X
Run Time Bar Code:
Acquired on : 18 Sep 95 03:24 PM
Report Created on: 18 Sep 95 04:22 PM

Page Number : 1
Vial Number : 68
Injection Number : 1
Sequence Line : 15
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



Data File Name : C:\HPCHEM\3\DATA\SEPT17\069R1501.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-11W
Run Time Bar Code:
Acquired on : 18 Sep 95 04:03 PM
Report Created on: 18 Sep 95 04:53 PM

Page Number : 1
Vial Number : 69
Injection Number : 1
Sequence Line : 15
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH



user modified

Data File Name : C:\HPCHEM\3\DATA\SEPT17\070R1501.D
Operator : TF
Instrument : INSTRUMEN
Sample Name : 509129-13W
Run Time Bar Code:
Acquired on : 18 Sep 95 04:42 PM
Report Created on: 18 Sep 95 05:28 PM

Page Number : 1
Vial Number : 70
Injection Number : 1
Sequence Line : 15
Instrument Method: TPHDX.MTH
Analysis Method : TPHE.MTH

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GeoEngineers, Inc.	Client Project ID: UNOCAL Seattle, #5353	Analyst: T. Fitzgibbon
8410 154th Avenue N.E.	Sample Matrix: Water	
Redmond, WA 98052	Analysis Method: WTPH-D	Extracted: Sep 13, 1995
Attention: Dana Carlisle	Units: mg/L (ppm)	Analyzed: Sep 18, 1995
		Reported: Sep 29, 1995

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT
Laboratory Control Sample

Diesel

Spike Conc. Added:	2.00
Spike Result:	1.52
% Recovery:	76
Upper Control Limit %:	119
Lower Control Limit %:	74

PRECISION ASSESSMENT
Sample Duplicate

Diesel Range Organics

Sample Number:	B509129-07
Original Result:	0.78
Duplicate Result:	0.88
Relative % Difference:	Relative Percent Difference values are not reported at sample concentration levels less than 10 times the Reporting Limit.
Maximum RPD:	44

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Laura Dutton

Laura Dutton
Project Manager

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

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

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UNOCAL CHAIN OF CUSTODY REPORT

UNOCAL INFORMATION

Facility Number: SS# 5353
Site Address: Westlake + Mercer
City, State, ZIP: SEATTLE
Site Release Number:
Unocal Manager: Dr. Mark Brearley
CERT INFO: (check one) o Evaluation X Remediation
o Detection o Demolition o Closure o Miscellaneous

CONSULTANT INFORMATION

Firm: GeoEngineers Project Number: 9161-013-R04
Address: 8410 154th
REDMOND WA.
Phone: 861-6000 Fax: 861-6050
Project Manager: Dawn Carlisle
Sample Collection by: Steve Chalk, Kevin Carey

Chain of Custody Record #:

Quality Assurance Data Level: A (B)
A: Standard Summary
B: Standard + Chromatograms
Laboratory Turnaround Days: 10 (5) 3 2 1

o Oregon X Washington Hydrocarbon Methods

SAMPLE IDENTIFICATION	SAMPLING DATE / TIME	MATRIX (W,S,O)	# OF CONTAINERS	TPH-HCID	TPH-Gas	BTEX (EPA 8020 Mod.)	TPH-Gas + BTEX	TPH-Diesel	TPH-Diesel Extended	TPH-418.1	Halogen. Volatiles (EPA 8010)	Aromatic Volatiles (EPA 8020)	Pesticides/PCBs or PCBs Only	GC/MS Volatiles (EPA 8240/8260)	GC/MS Semi Vols. (EPA 8270)	PAHs by HPLC (EPA 8310)	Lead: Total or Dissolved	TCLP Metals (8)	NCA SAMPLE NUMBER
1. MW-32A	090795/2045	W	3				X		X										B509129-01
2. MW-33	2015						X		X										02
3. MW-34	2045						X		X										03
4. MW-35							X		X										
5. MW-36	2325						X		X										04
6. MW-37							X		X										
7. MW-40	2300						X		X										05
8. MW-41	2215						X		X										06
9. MW-42	2120						X		X										07
10. MW-43	2235						X		X										08

Relinquished by:	Firm:	Date & Time	Received by:	Firm:	Date & Time
1. [signature]	CET	090795/2445	Jeff Cahlin	NCA	9/8/95
2.					
3.					

Final Report Approval
Were all requested results provided? yes no Define
Were results within requested turnaround? yes no "No"
Final Approval Signature: on back

Page 1 of 2

Comments:

Distribution: White - Laboratory Yellow - Consultant Photocopy - Unocal

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9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132 (503) 643-9200 FAX 644-2202

UNOCAL CHAIN OF CUSTODY REPORT

UNOCAL INFORMATION

Facility Number: SS # 5353
Site Address: Westlake & Mercer
City, State, ZIP: Seattle WA
Site Release Number:
Unocal Manager: Dr. Marla Brantley
CERT INFO: (check one) o Evaluation X Remediation
o Detection o Demolition o Closure o Miscellaneous

CONSULTANT INFORMATION

Firm: GeoEngineers Project Number: 9161-013-R04
Address: 8410 154th
Redmond WA
Phone: 861-6000 Fax: 861-6050
Project Manager: Dawn Carlisle
Sample Collection by: Shelby Cheek, Kevin Carroll

Chain of Custody Record #:

Quality Assurance Data Level: A (B)
A: Standard Summary
B: Standard + Chromatograms
Laboratory Turnaround Days: 10 (5) 3 2 1

o Oregon o Washington Hydrocarbon Methods

SAMPLE IDENTIFICATION	SAMPLING DATE / TIME	MATRIX (W,S,O)	# OF CONTAINERS	TPH-HCID	TPH-Gas	BTEX (EPA 8020 Mod.)	TPH-Gas + BTEX	TPH-Diesel	TPH-Diesel Extended	TPH-418.1	Halogen. Volatiles (EPA 8010)	Aromatic Volatiles (EPA 8020)	Pesticides/PCBs or PCBs Only	GC/MS Volatiles (EPA 8240/8260)	GC/MS Semi Vols. (EPA 8270)	PAHs by HPLC (EPA 8310)	Lead: Total or Dissolved	TCLP Metals (8)	Fe6	NCA SAMPLE NUMBER
1. MW-44	090795/1445	W	3				X		X											B509129-09
2. MW-45	/						X		X											
3. MW-46	1945						X		X											10
4. MW-47	2015						X		X											11
5. PURGE	2400					X													X	12
6. SMW-3	1945						X		X											
7. SMW-4	/						X		X											13
8.																				
9.																				
10.																				

Relinquished by:	Firm:	Date & Time	Received by:	Firm:	Date & Time
1. [signature]	GEI	090795/2445	[signature]	NCA	9/8/95
2.					
3.					

Final Report Approval

Were all requested results provided? yes no Define
Were results within requested turnaround? yes no "No"
Final Approval Signature: on back
Firm: Date:

Page 2 of 2
Rev. 2.2, 11/94

Comments:

Distribution: White - Laboratory Yellow - Consultant Photocopy - Unocal

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GeoEngineers, Inc.	Project Name:	UNOCAL Seattle, #5353	
8410 154th Avenue N.E.	Client Project :	#9161-013-R04	
Redmond, WA 98052			Received: Dec 8, 1995
Attention: Dave Cook	NCA Project #:	B512160	Reported: Dec 18, 1995

PROJECT SUMMARY PAGE

Laboratory Sample Number	Sample Description	Sample Matrix	Date Sampled
B512160-01	SMW-3	Water	12/8/95
B512160-02	SMW-4	Water	12/8/95
B512160-03	MW-32A	Water	12/8/95
B512160-04	MW-34	Water	12/8/95
B512160-05	MW-36	Water	12/8/95
B512160-06	MW-33	Water	12/8/95
B512160-07	MW-40	Water	12/8/95
B512160-08	MW-41	Water	12/8/95
B512160-09	MW-42	Water	12/8/95
B512160-10	MW-43	Water	12/8/95
B512160-11	MW-44	Water	12/8/95

GeoEngineers
DEC 19 1995

The results in this report apply to the samples analyzed in accordance with the chain of custody document.
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NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

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GeoEngineers, Inc.	Project Name:	UNOCAL Seattle, #5353	
8410 154th Avenue N.E.	Client Project :	#9161-013-R04	
Redmond, WA 98052			Received: Dec 8, 1995
Attention: Dave Cook	NCA Project #:	B512160	Reported: Dec 18, 1995

PROJECT SUMMARY PAGE

Laboratory Sample Number	Sample Description	Sample Matrix	Date Sampled
B512160-12	MW-46	Water	12/8/95
B512160-13	MW-47	Water	12/8/95

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NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

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GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Dec 8, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Dec 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-G	Analyzed: Dec 14-15, 1995
Attention: Dave Cook	First Sample #:	B512160-01	Reported: Dec 18, 1995

TOTAL PETROLEUM HYDROCARBONS-GASOLINE RANGE

Sample Number	Sample Description	Sample Result µg/L (ppb)	Surrogate Recovery %
B512160-01	SMW-3	N.D.	75
B512160-02	SMW-4	40,000	110
B512160-03	MW-32A	11,000	144
B512160-04	MW-34	68,000	128
B512160-05	MW-36	N.D.	73
B512160-06	MW-33	13,000	S-2
B512160-07	MW-40	500	S-2
B512160-08	MW-41	N.D.	77
B512160-09	MW-42	200	94
B512160-10	MW-43	N.D.	78
Reporting Limit:		50	

4-Bromofluorobenzene surrogate recovery control limits are 50 - 150 %.
Volatile Total Petroleum Hydrocarbons are quantitated as Gasoline Range Organics (toluene - dodecane).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

Laura Dutton
Project Manager

Please Note:
S-2 = The Surrogate Recovery for this sample cannot be accurately quantified due to interference from coeluting organic compounds present in the sample.

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9405 S.W. Nimbus Avenue • Beaverton, OR 97008-7132 (503) 643-9200 • FAX 644-2202

GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Dec 8, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Dec 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-G	Analyzed: Dec 14-15, 1995
Attention: Dave Cook	First Sample #:	B512160-11	Reported: Dec 18, 1995

TOTAL PETROLEUM HYDROCARBONS-GASOLINE RANGE

Sample Number	Sample Description	Sample Result µg/L (ppb)	Surrogate Recovery %
B512160-11	MW-44	N.D.	74
B512160-12	MW-66	N.D.	77
B512160-13	MW-47	74	86
BLK121495	Method Blank	N.D.	76

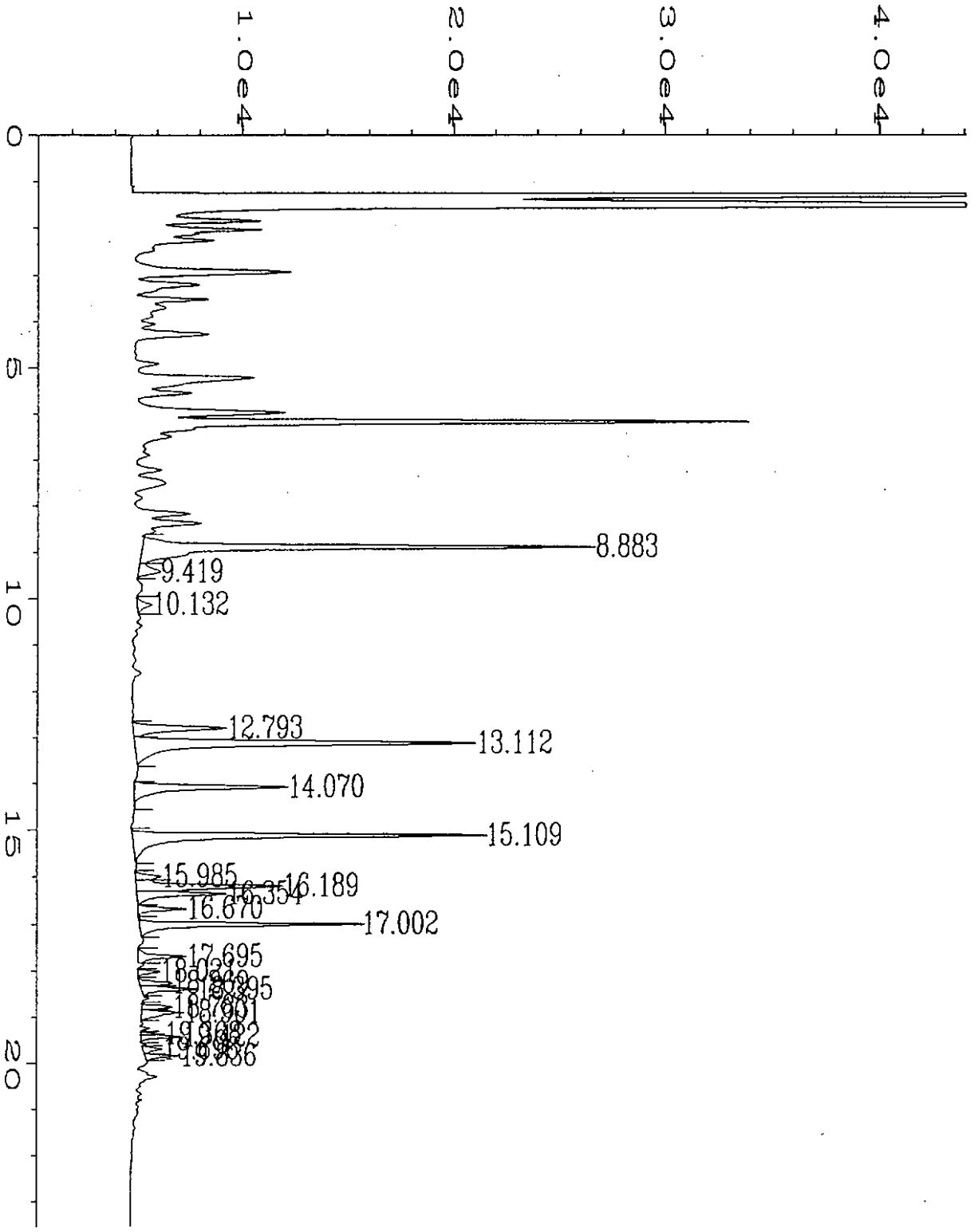
Reporting Limit:	50

4-Bromofluorobenzene surrogate recovery control limits are 50 - 150 %.
Volatile Total Petroleum Hydrocarbons are quantitated as Gasoline Range Organics (toluene - dodecane).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

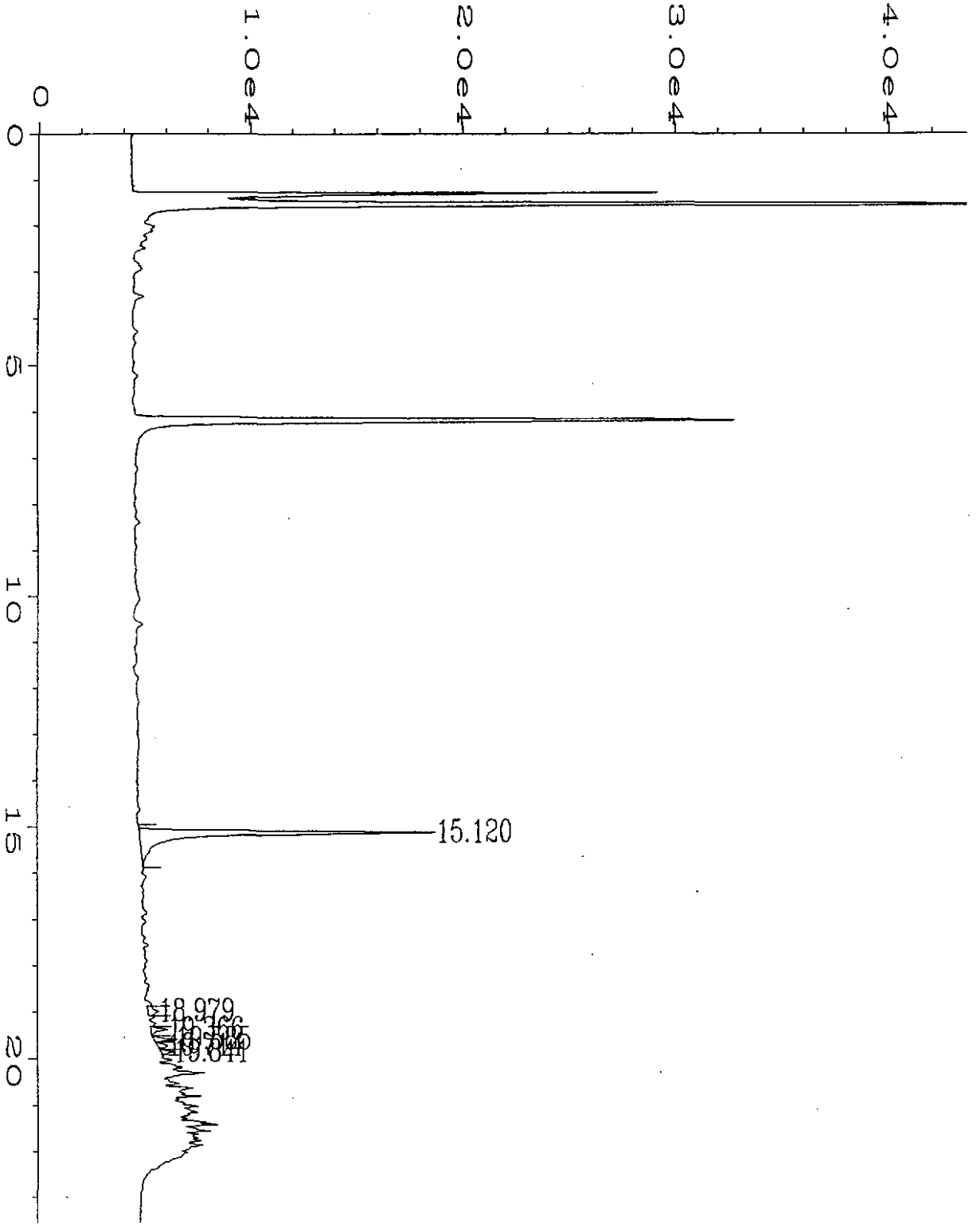
Laura Dutton
Project Manager

512160.GEO <4>



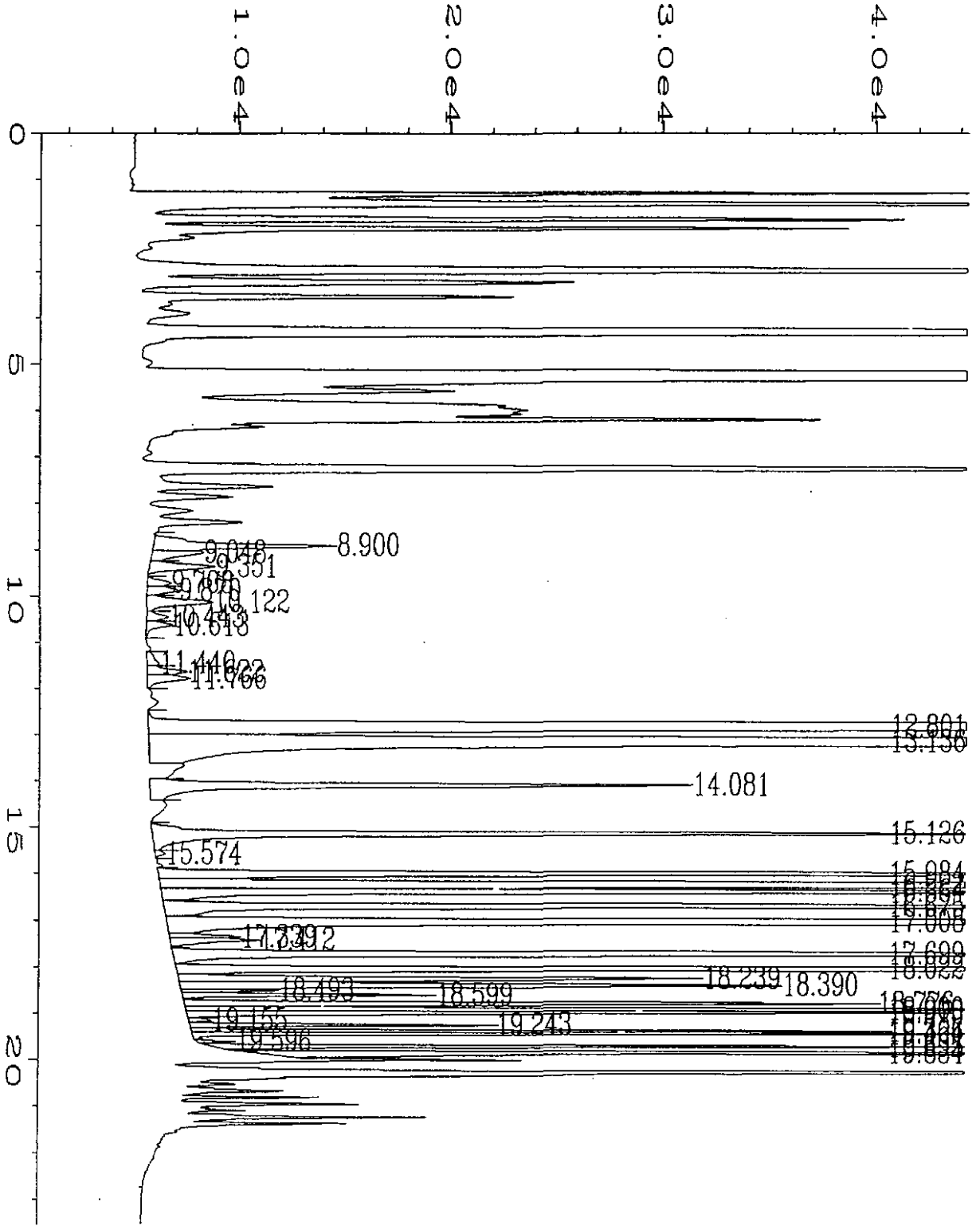
Data File Name : C:\HPCHEM\2\DATA\121495\002F0101.D
Operator :
Instrument : GC#6
Sample Name : gas std
Run Time Bar Code:
Acquired on : 14 Dec 95 09:46 AM
Report Created on: 14 Dec 95 10:10 AM
Sample Info : 500 ng V-10a

Page Number : 1
Vial Number : 2
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



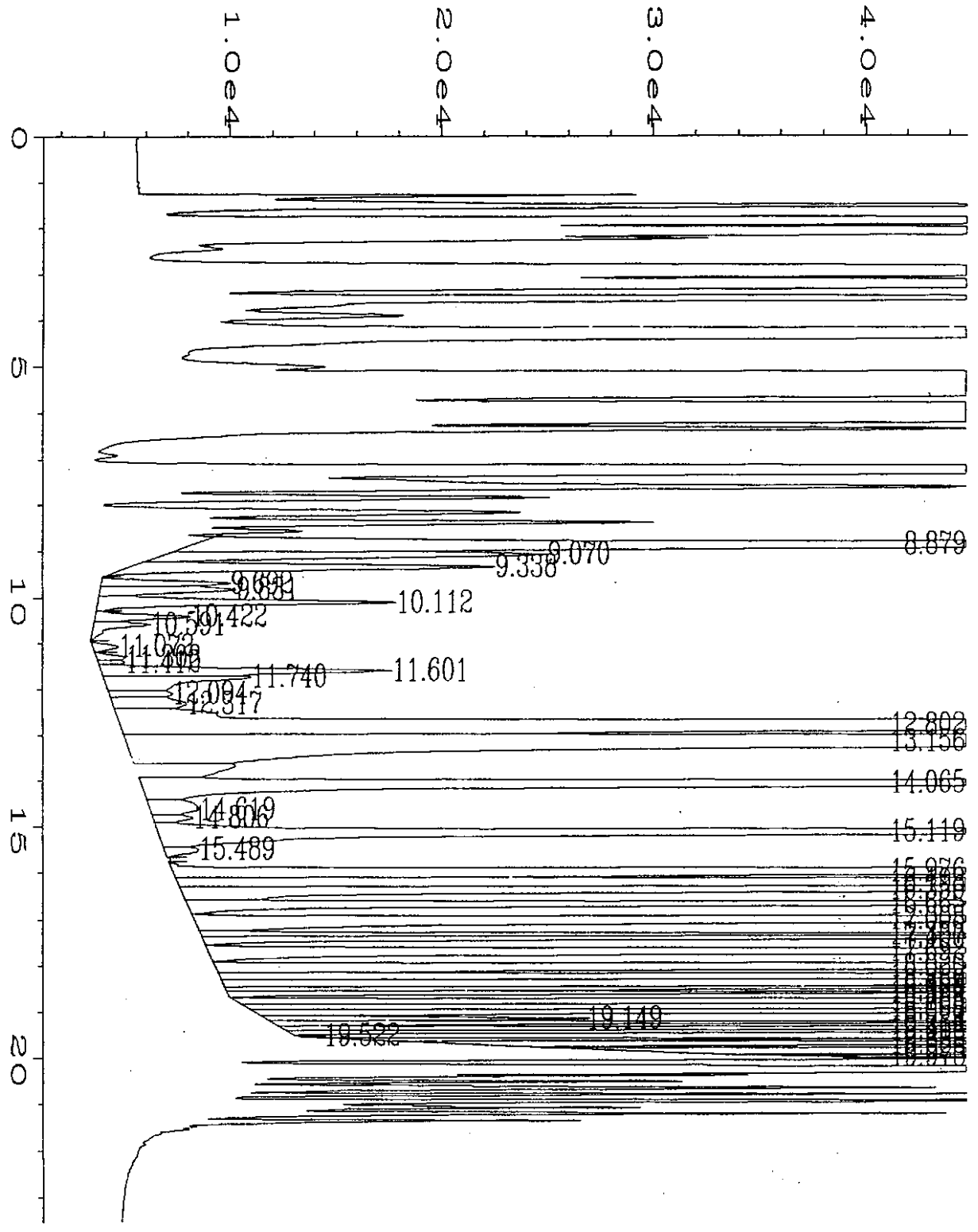
Data File Name : C:\HPCHEM\2\DATA\121495\008F0301.D
Operator :
Instrument : GC#6
Sample Name : b512160-01
Run Time Bar Code:
Acquired on : 14 Dec 95 12:43 PM
Report Created on: 14 Dec 95 01:07 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 8
Injection Number : 1
Sequence Line : 3
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



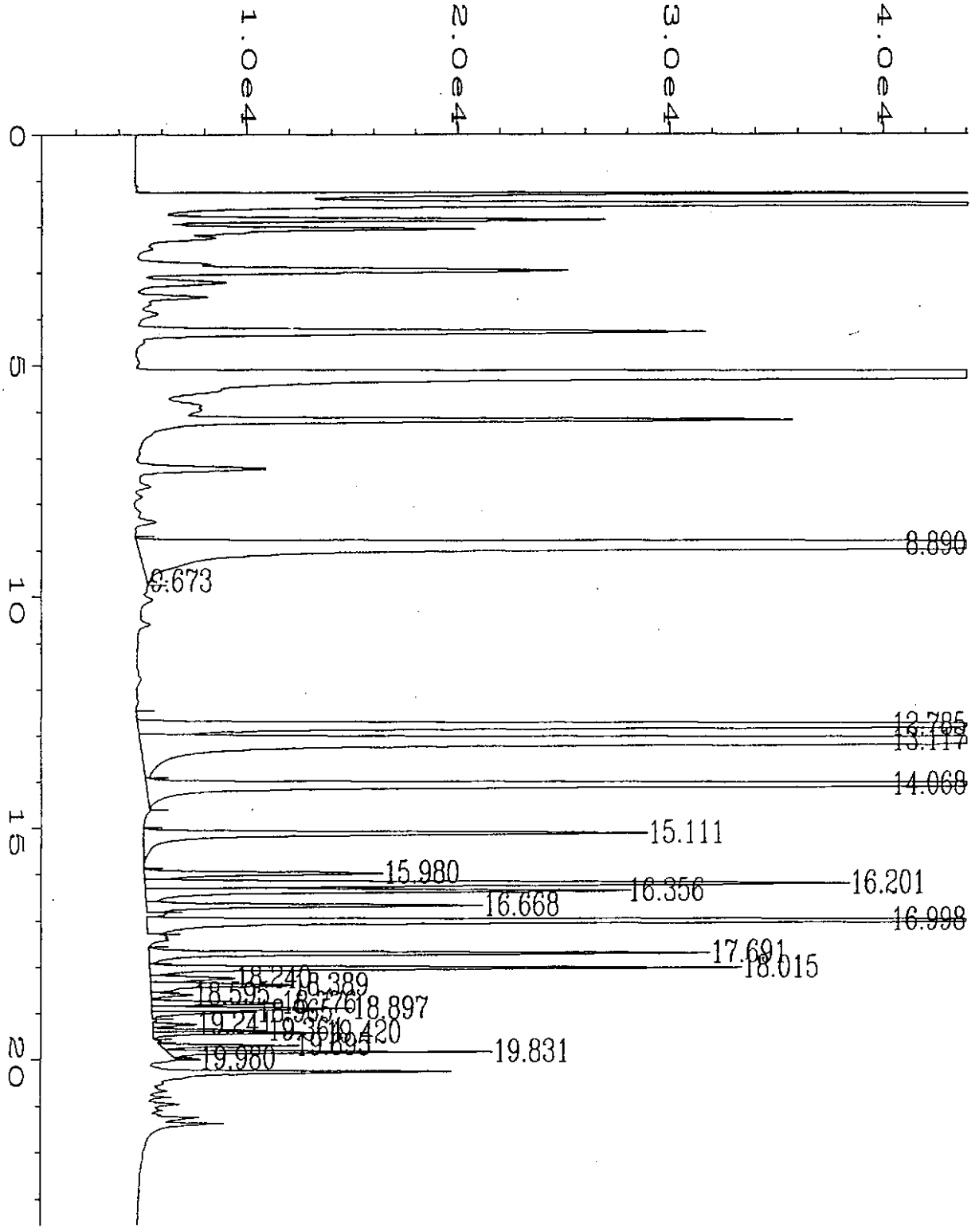
Data File Name : C:\HPCHEM\2\DATA\121495\009F0301.D
Operator :
Instrument : GC#6
Sample Name : b512160-02
Run Time Bar Code:
Acquired on : 14 Dec 95 01:12 PM
Report Created on: 14 Dec 95 01:36 PM
Multiplier : 20
Sample Info : 250 ul

Page Number : 1
Vial Number : 9
Injection Number : 1
Sequence Line : 3
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



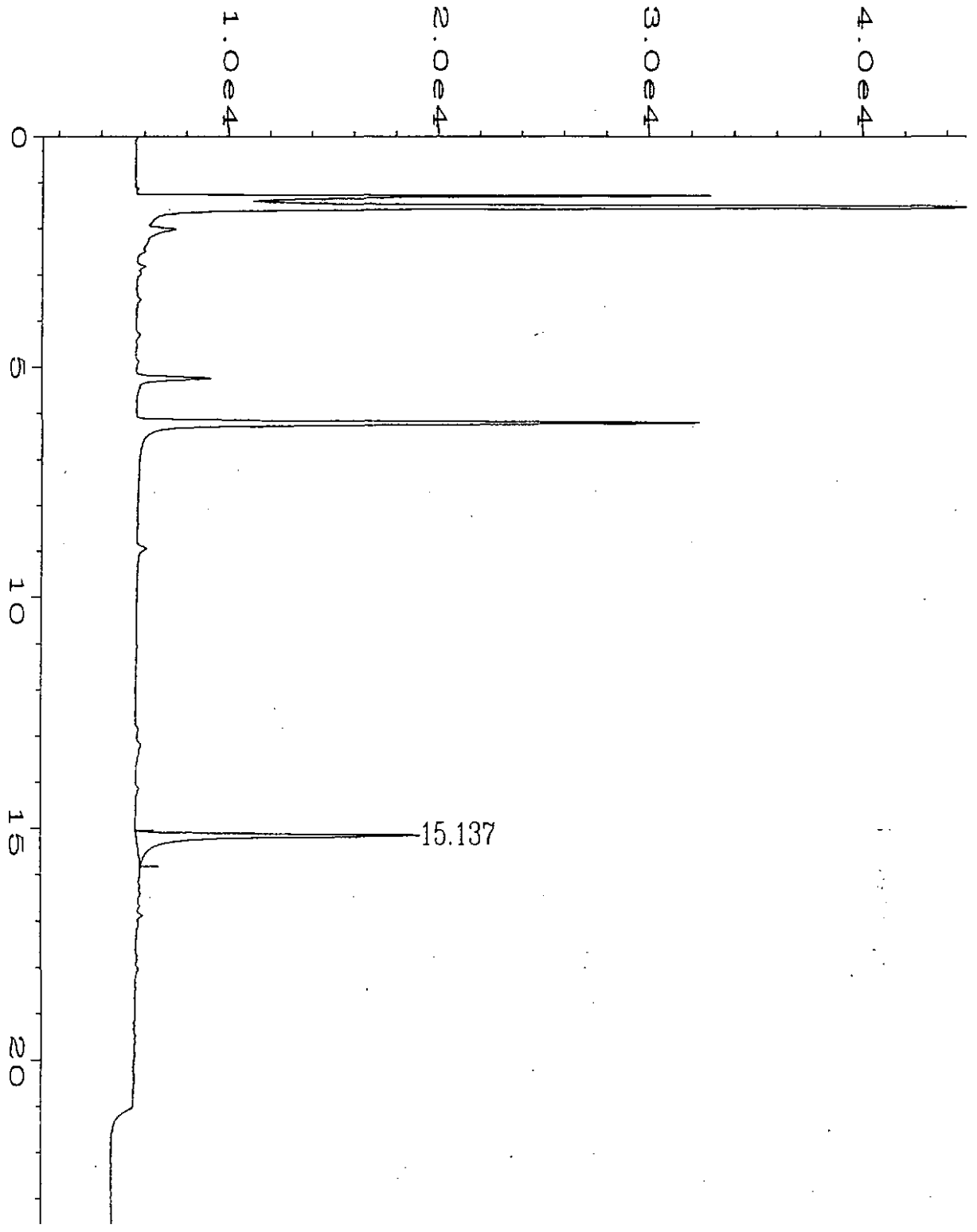
Data File Name : C:\HPCHEM\2\DATA\121495\010F0301.D
Operator :
Instrument : GC#6
Sample Name : b512160-03
Run Time Bar Code:
Acquired on : 14 Dec 95 01:42 PM
Report Created on: 14 Dec 95 02:06 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 10
Injection Number : 1
Sequence Line : 3
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



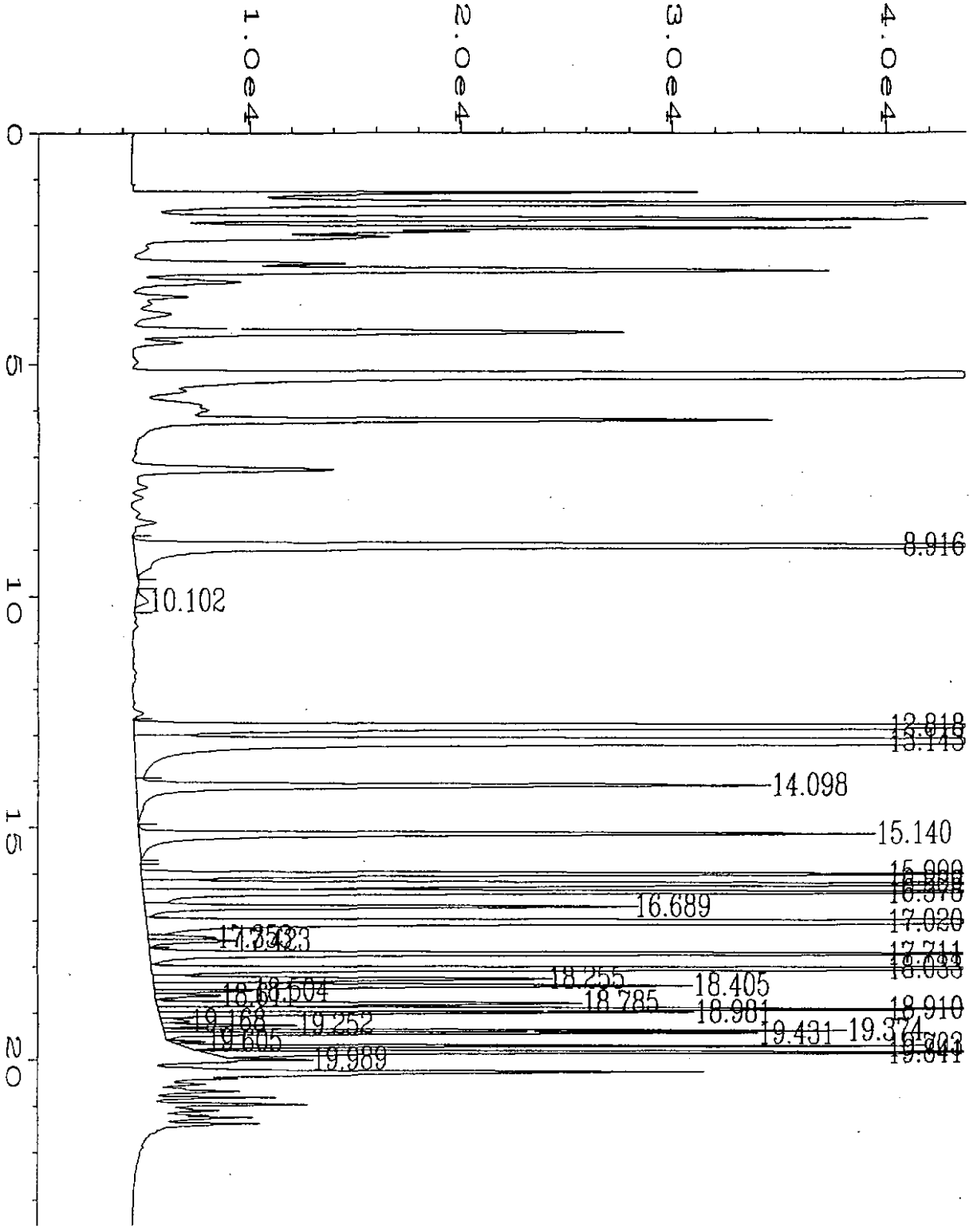
Data File Name : C:\HPCHEM\2\DATA\121495\011F0301.D
Operator :
Instrument : GC#6
Sample Name : b512160-04
Run Time Bar Code:
Acquired on : 14 Dec 95 02:11 PM
Report Created on: 14 Dec 95 02:35 PM
Multiplier : 50
Sample Info : 100 ul

Page Number : 1
Vial Number : 11
Injection Number : 1
Sequence Line : 3
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



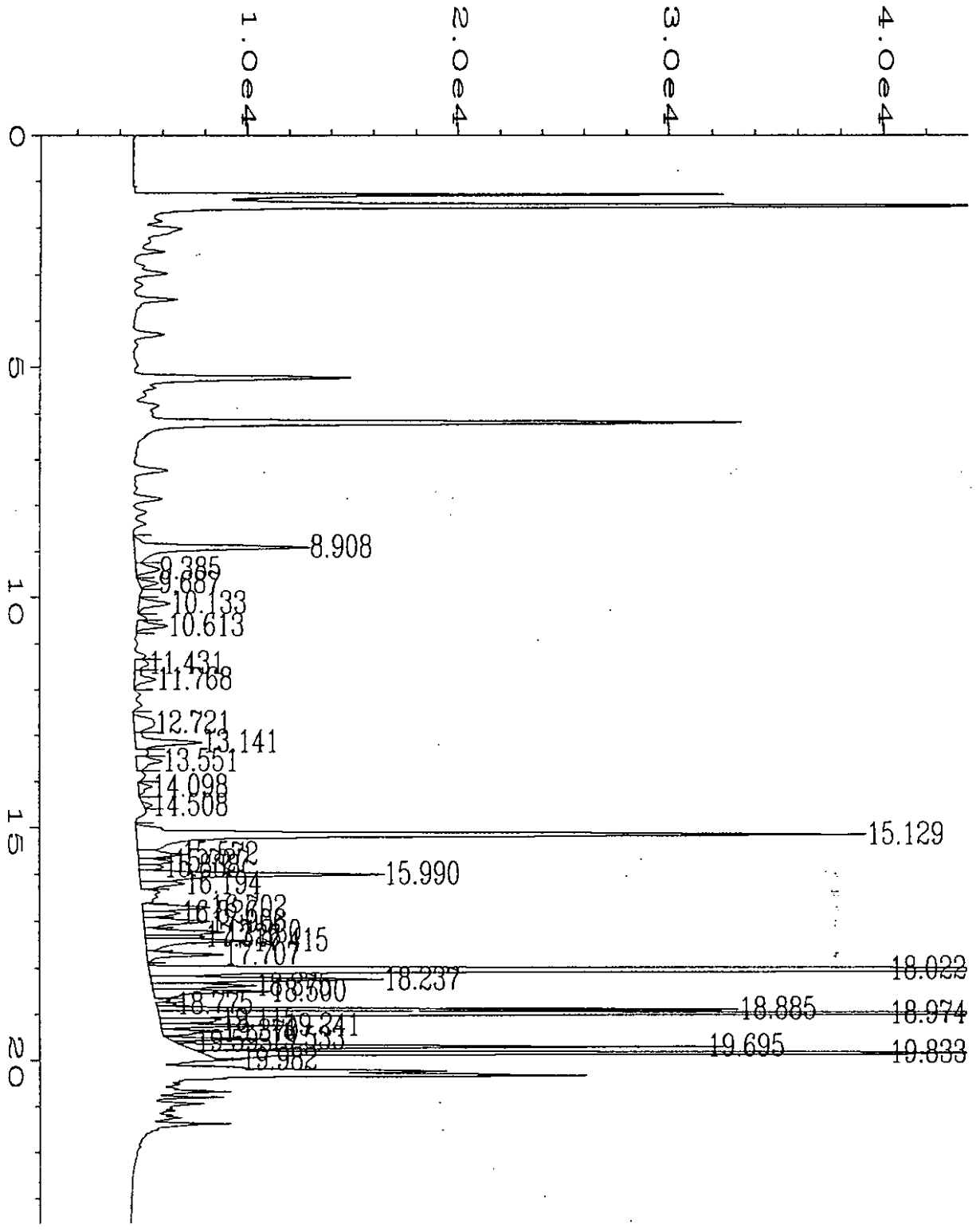
Data File Name : C:\HPCHEM\2\DATA\121495\019F0501.D
Operator :
Instrument : GC#6
Sample Name : b512160-05
Run Time Bar Code:
Acquired on : 14 Dec 95 06:11 PM
Report Created on: 14 Dec 95 06:34 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 19
Injection Number : 1
Sequence Line : 5
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



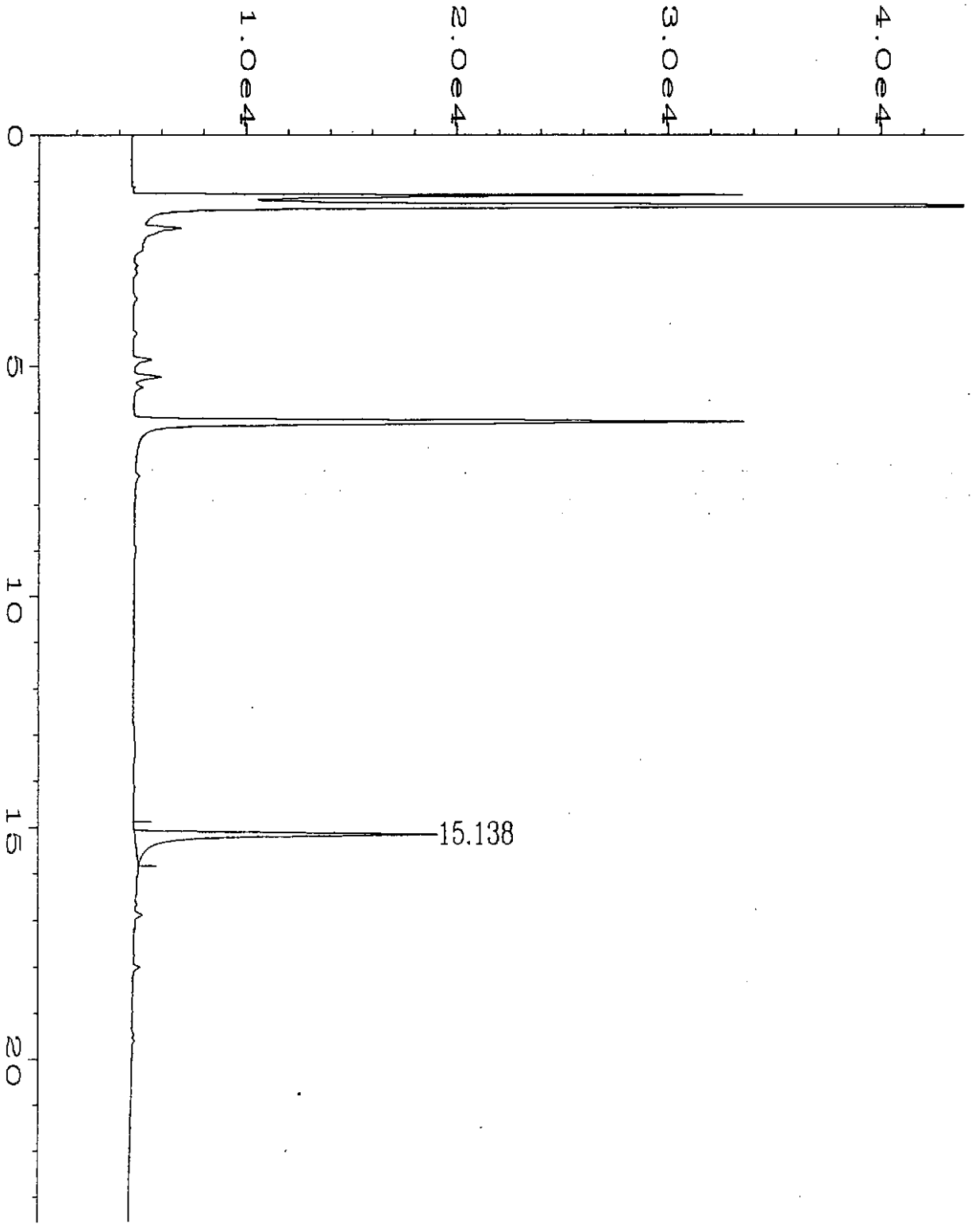
Data File Name : C:\HPCHEM\2\DATA\121595\004F0301.D
Operator :
Instrument : GC#6
Sample Name : b512160-06 r1
Run Time Bar Code:
Acquired on : 15 Dec 95 07:54 AM
Report Created on: 15 Dec 95 08:18 AM
Multiplier : 10
Sample Info : 500 ul

Page Number : 1
Vial Number : 4
Injection Number : 1
Sequence Line : 3
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



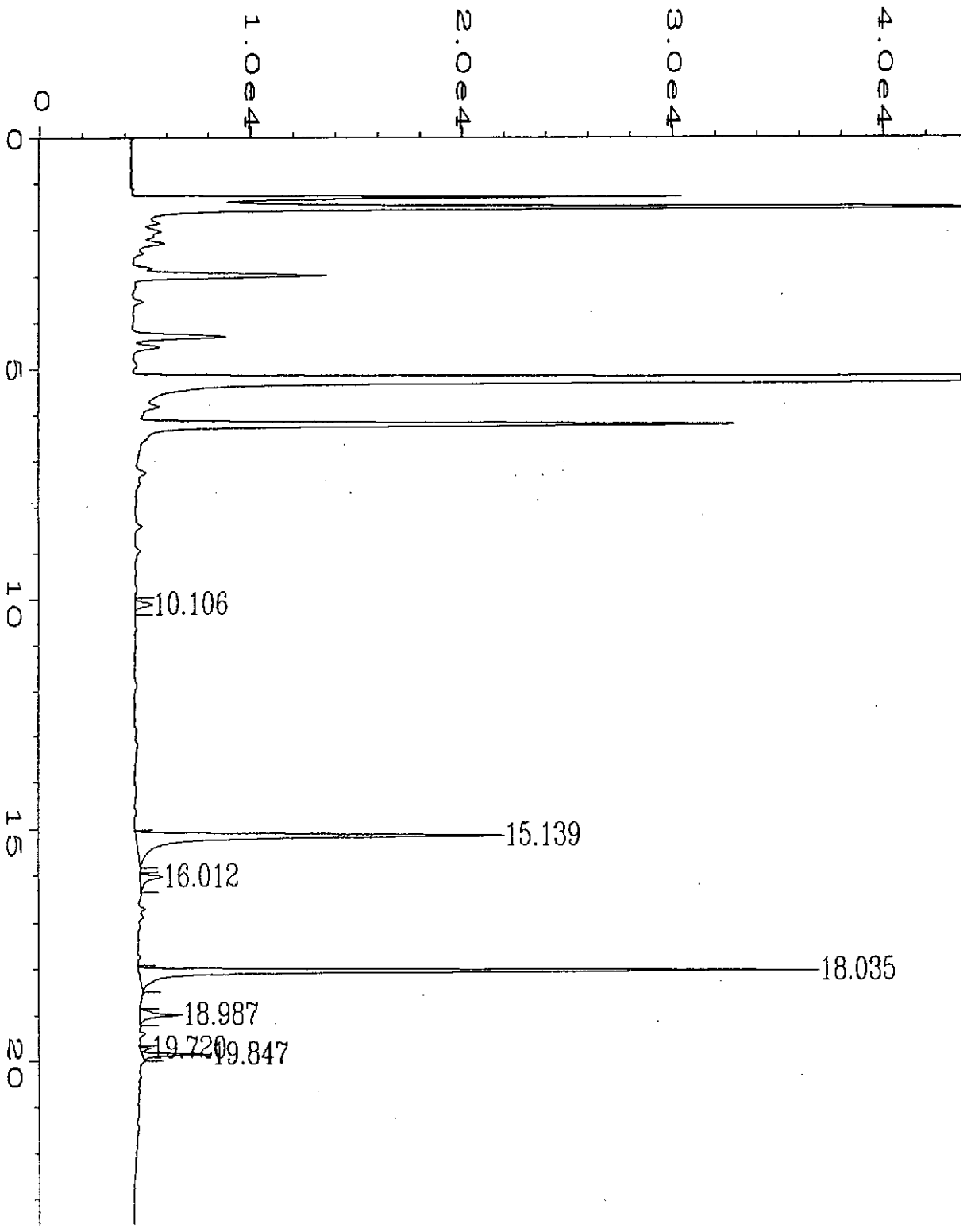
Data File Name : C:\HPCHEM\2\DATA\121495\021F0501.D
Operator :
Instrument : GC#6
Sample Name : b512160-07
Run Time Bar Code:
Acquired on : 14 Dec 95 07:09 PM
Report Created on: 14 Dec 95 07:33 PM
Sample Info : 5 ml

Page Number : 1
Vial Number : 21
Injection Number : 1
Sequence Line : 5
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



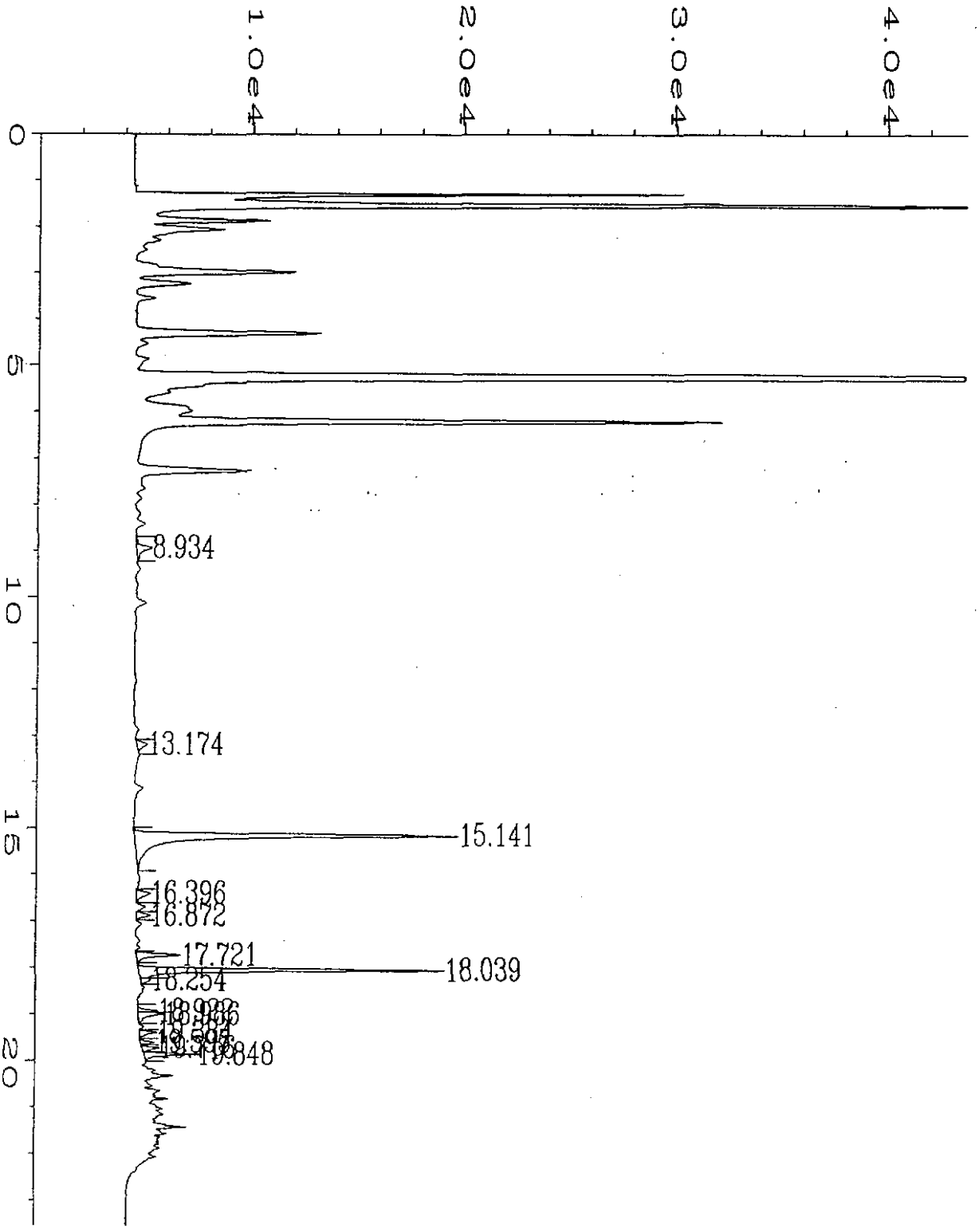
Data File Name : C:\HPCHEM\2\DATA\121495\035F1101.D
Operator :
Instrument : GC#6
Sample Name : b512160-08
Run Time Bar Code:
Acquired on : 15 Dec 95 02:01 AM
Report Created on: 15 Dec 95 02:25 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 35
Injection Number : 1
Sequence Line : 11
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



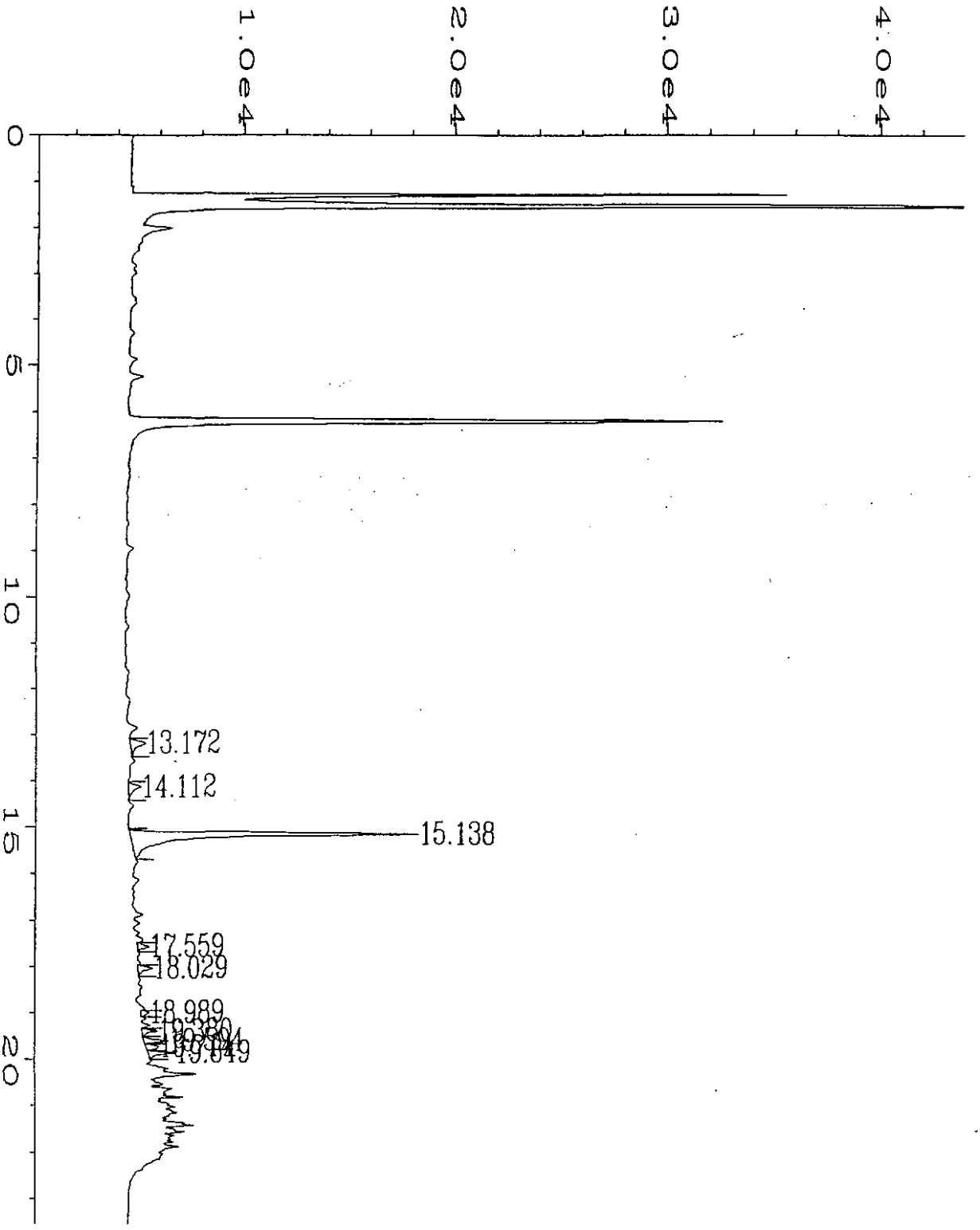
Data File Name : C:\HPCHEM\2\DATA\121595\006F0501.D
Operator :
Instrument : GC#6
Sample Name : b512160-09 r1
Run Time Bar Code:
Acquired on : 15 Dec 95 08:53 AM
Report Created on: 15 Dec 95 09:17 AM
Multiplier : 5
Sample Info : 1 ml

Page Number : 1
Vial Number : 6
Injection Number : 1
Sequence Line : 5
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



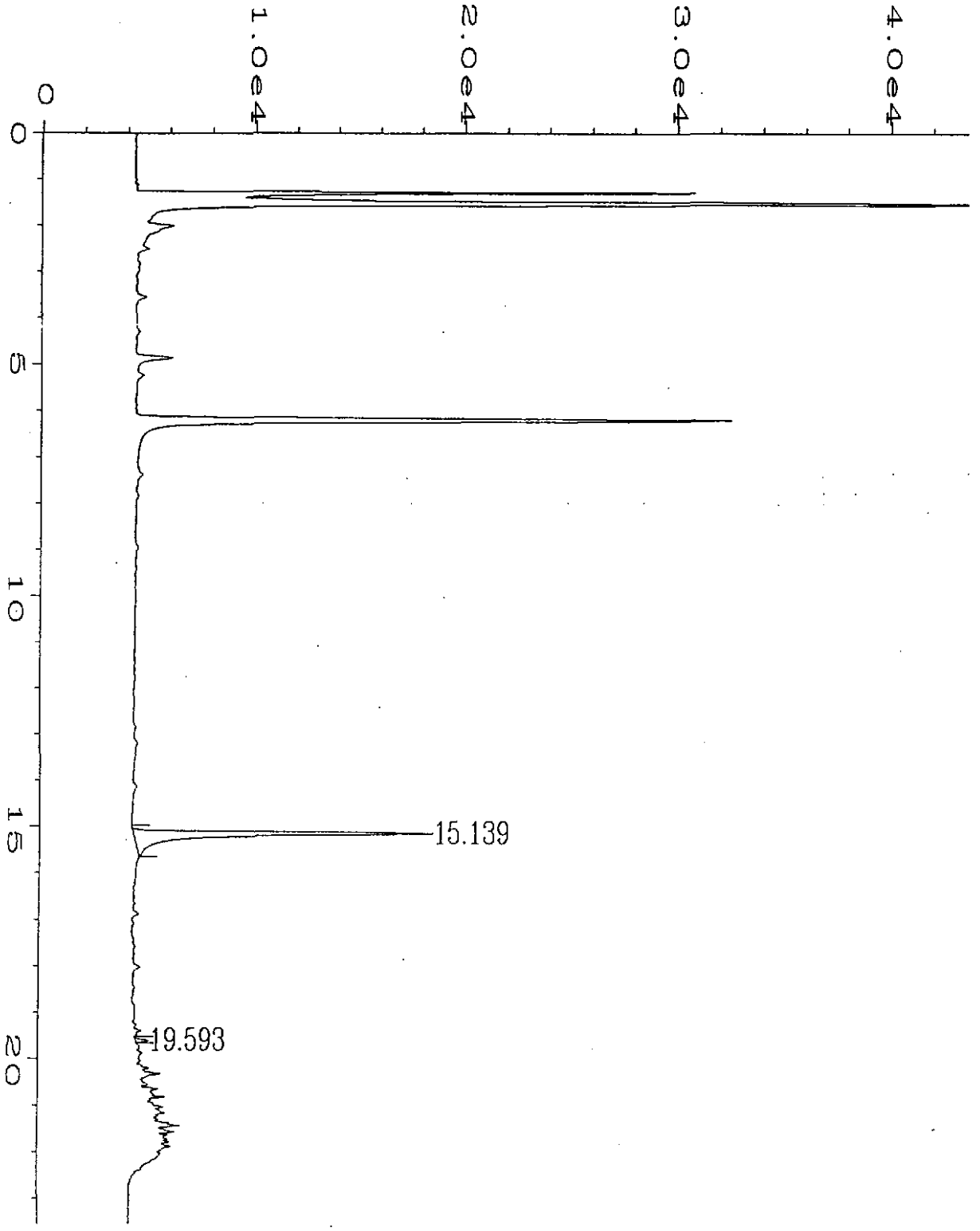
Data File Name : C:\HPCHEM\2\DATA\121595\007F0501.D
Operator :
Instrument : GC#6
Sample Name : b512160-10 r1
Run Time Bar Code:
Acquired on : 15 Dec 95 09:23 AM
Report Created on: 15 Dec 95 09:46 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 7
Injection Number : 1
Sequence Line : 5
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



Data File Name : C:\HPCHEM\2\DATA\121495\039F1301.D
Operator :
Instrument : GC#6
Sample Name : b512160-11
Run Time Bar Code:
Acquired on : 15 Dec 95 03:59 AM
Report Created on: 15 Dec 95 04:22 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 39
Injection Number : 1
Sequence Line : 13
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



Data File Name : C:\HPCHEM\2\DATA\121595\008F0501.D
Operator :
Instrument : GC#6
Sample Name : b512160-12 r1
Run Time Bar Code:
Acquired on : 15 Dec 95 09:52 AM
Report Created on: 15 Dec 95 10:16 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 8
Injection Number : 1
Sequence Line : 5
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH

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GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Dave Cook

Client Project ID: UNOCAL Seattle, #5353
Sample Matrix: Water
Analysis Method: WTPH-G
Units: µg/L (ppb)

Analyst: B. Christlieb
F. Shino

Analyzed: Dec 14-15, 1995
Reported: Dec 18, 1995

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT
Laboratory Control Sample

	Gasoline
Spike Conc. Added:	100
Spike Result:	94
% Recovery:	94
Upper Control Limit %:	132
Lower Control Limit %:	56

PRECISION ASSESSMENT
Sample Duplicate

	Gasoline Range Organics	Gasoline Range Organics
Sample Number:	B512160-02	B512160-09
Original Result:	40,000	200
Duplicate Result:	49,000	270
Relative % Difference:	20	Q-5
Maximum RPD:	50	50

Q-5 = RPD values are not reported at sample concentration levels <10 X the Reporting Limit.

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Project Manager

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

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

512160.GEO <5>

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GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Dec 8, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Dec 8, 1995
Redmond, WA 98052	Analysis Method:	EPA 8020	Analyzed: Dec 14-15, 1995
Attention: Dave Cook	First Sample #:	B512160-01	Reported: Dec 18, 1995

BTEX DISTINCTION

Sample Number	Sample Description	Benzene µg/L (ppb)	Toluene µg/L (ppb)	Ethyl Benzene µg/L (ppb)	Xylenes µg/L (ppb)	Surrogate Recovery %
B512160-01	SMW-3	N.D.	N.D.	N.D.	N.D.	77
B512160-02	SMW-4	8,100	57	2,600	3,600	101
B512160-03	MW-32A	1,600	86	420	910	113
B512160-04	MW-34	12,000	9,200	1,200	5,500	91
B512160-05	MW-36	1.1	N.D.	N.D.	N.D.	78
B512160-06	MW-33	800	240	280	760	130
B512160-07	MW-40	2.7	3.0	N.D.	N.D.	130
B512160-08	MW-41	N.D.	N.D.	N.D.	N.D.	78
B512160-09	MW-42	380	N.D. (R.L. = 2.0)	N.D. (R.L. = 2.0)	N.D. (R.L. = 4.0)	84
B512160-10	MW-43	37	N.D.	N.D.	N.D.	83
Reporting Limits:		**0.50**	**0.50**	**0.50**	**1.0**	

4-Bromofluorobenzene surrogate recovery control limits are 59 - 144 %.
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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Laura Dutton

Laura Dutton
Project Manager

512160.GEO <6>

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9405 S.W. Nimbus Avenue • Beaverton, OR 97008-7132 (503) 643-9200 • FAX 644-2202

GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Dec 8, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Dec 8, 1995
Redmond, WA 98052	Analysis Method:	EPA 8020	Analyzed: Dec 14-15, 1995
Attention: Dave Cook	First Sample #:	B512160-11	Reported: Dec 18, 1995

BTEX DISTINCTION

Sample Number	Sample Description	Benzene µg/L (ppb)	Toluene µg/L (ppb)	Ethyl Benzene µg/L (ppb)	Xylenes µg/L (ppb)	Surrogate Recovery %
B512160-11	MW-44	N.D.	N.D.	N.D.	N.D.	76
B512160-12	MW-46	N.D.	N.D.	N.D.	N.D.	79
B512160-13	MW-47	N.D.	N.D.	N.D.	N.D.	84
BLK121495	Method Blank	N.D.	N.D.	N.D.	N.D.	77
Reporting Limits:		**0.50**	**0.50**	**0.50**	**1.0**	

4-Bromofluorobenzene surrogate recovery control limits are 59 - 144 %.
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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Project Manager

512160.GEO <7>

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GeoEngineers, Inc.	Client Project ID: UNOCAL Seattle, #5353	Analyst:	B. Christlieb
8410 154th Avenue N.E.	Sample Matrix: Water		F. Shino
Redmond, WA 98052	Analysis Method: EPA 8020		
Attention: Dave Cook	Units: µg/L (ppb)	Analyzed:	Dec 14, 1995
	QC Sample #: B512201-01	Reported:	Dec 18, 1995

MATRIX SPIKE QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Sample Result:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	10.0	10.0	10.0	30.0
Spike Result:	10.1	9.4	9.7	30.4
Spike % Recovery:	101%	94%	97%	101%
Spike Dup. Result:	10.1	9.2	9.3	29.0
Spike Duplicate % Recovery:	101%	92%	93%	97%
Upper Control Limit %:	115	116	122	122
Lower Control Limit %:	82	81	85	85
Relative % Difference:	0.0%	2.2%	4.2%	4.6%
Maximum RPD:	16	16	16	17

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% Recovery:	Spike Result - Sample Result / Spike Conc. Added	x 100
Relative % Difference:	Spike Result - Spike Dup. Result / (Spike Result + Spike Dup. Result) / 2	x 100

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GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled: Dec 8, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received: Dec 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-D Extended	Extracted: Dec 14, 1995
Attention: Dave Cook	First Sample #:	B512160-01	Analyzed: Dec 14-15, 1995
			Reported: Dec 18, 1995

TOTAL PETROLEUM HYDROCARBONS - DIESEL RANGE EXTENDED

Sample Number	Sample Description	Diesel Result mg/L (ppm)	Heavy Oil Result mg/L (ppm)	Surrogate Recovery %
B512160-01	SMW-3	0.30	N.D.	84
B512160-02	SMW-4	1.5 D-1	0.92	48, S-4
B512160-03	MW-32A	1.2 D-1	N.D.	88
B512160-04	MW-34	2.9 D-1	1.6	133
B512160-05	MW-36	0.51	1.2	92
B512160-06	MW-33	1.9 D-1	1.8	109
B512160-07	MW-40	1.4	4.8	Diluted Out
B512160-08	MW-41	N.D.	0.82	96
B512160-09	MW-42	1.3	1.9	101
B512160-10	MW-43	0.96	3.1	70
Reporting Limit:		**0.25**	**0.75**	

2-Fluorobiphenyl surrogate recovery control limits are 50 - 150%.
Extractable Hydrocarbons are quantitated as Diesel Range Organics (C12 - C24) and Heavy Oil Range Organics (>C24).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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Project Manager

Please Note:
S-4 = The Surrogate Recovery for Sample #B512160-02 is outside of method established control limits.

512160.GEO <9>

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GeoEngineers, Inc.	Client Project ID:	UNOCAL Seattle, #5353	Sampled:	Dec 8, 1995
8410 154th Avenue N.E.	Sample Matrix:	Water	Received:	Dec 8, 1995
Redmond, WA 98052	Analysis Method:	WTPH-D Extended	Extracted:	Dec 14, 1995
Attention: Dave Cook	First Sample #:	B512160-11	Analyzed:	Dec 14-15, 1995
			Reported:	Dec 18, 1995

TOTAL PETROLEUM HYDROCARBONS - DIESEL RANGE EXTENDED

Sample Number	Sample Description	Diesel Result mg/L (ppm)	Heavy Oil Result mg/L (ppm)	Surrogate Recovery %
B512160-11	MW-44	0.52	2.5	64
B512160-12	MW-46	1.4	14	75
B512160-13	MW-47	0.58	2.0	92
BLK121495	Method Blank	N.D.	N.D.	67
Reporting Limit:		0.25	0.75	

2-Fluorobiphenyl surrogate recovery control limits are 50 - 150%.
Extractable Hydrocarbons are quantitated as Diesel Range Organics (C12 - C24) and Heavy Oil Range Organics (>C24).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

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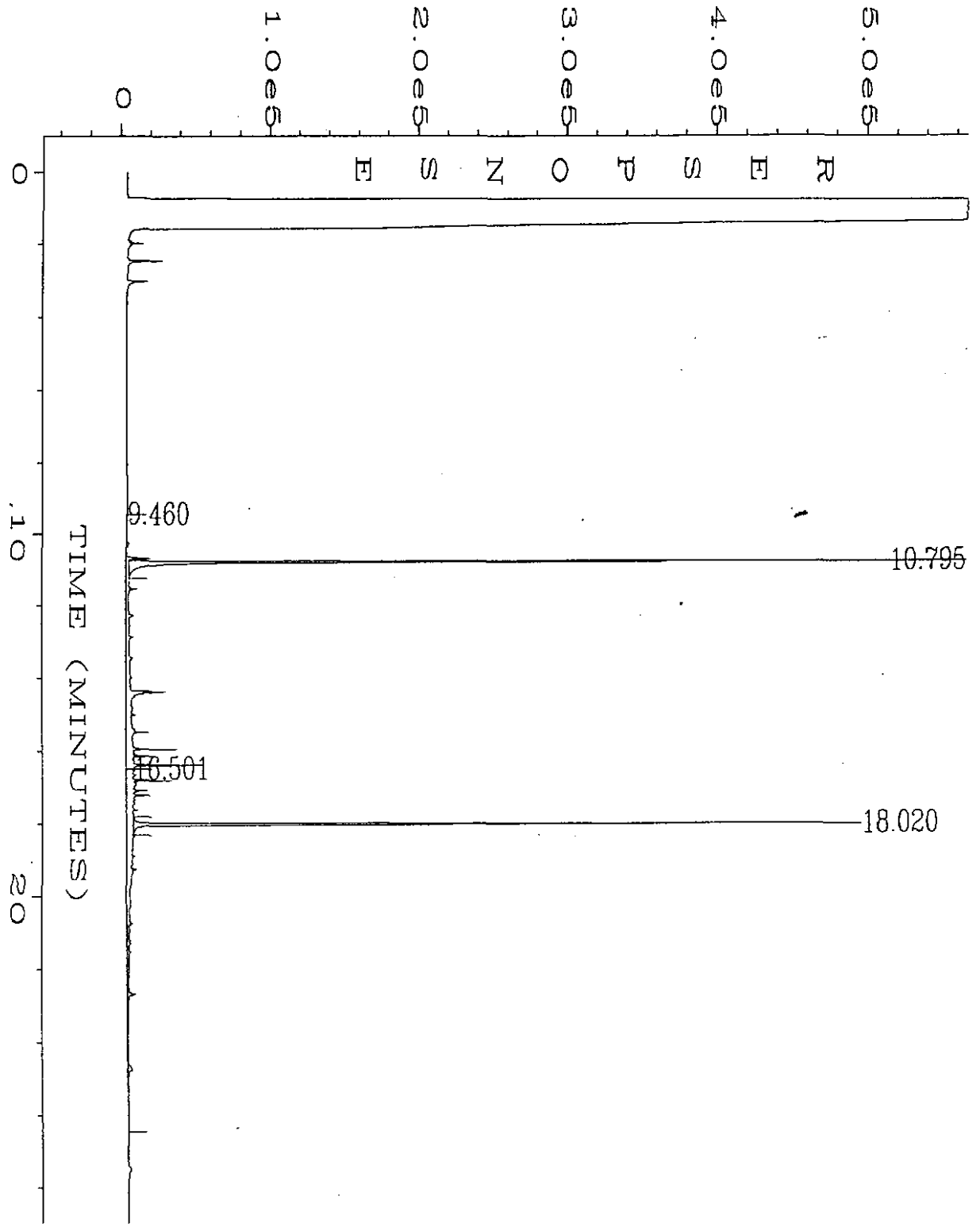
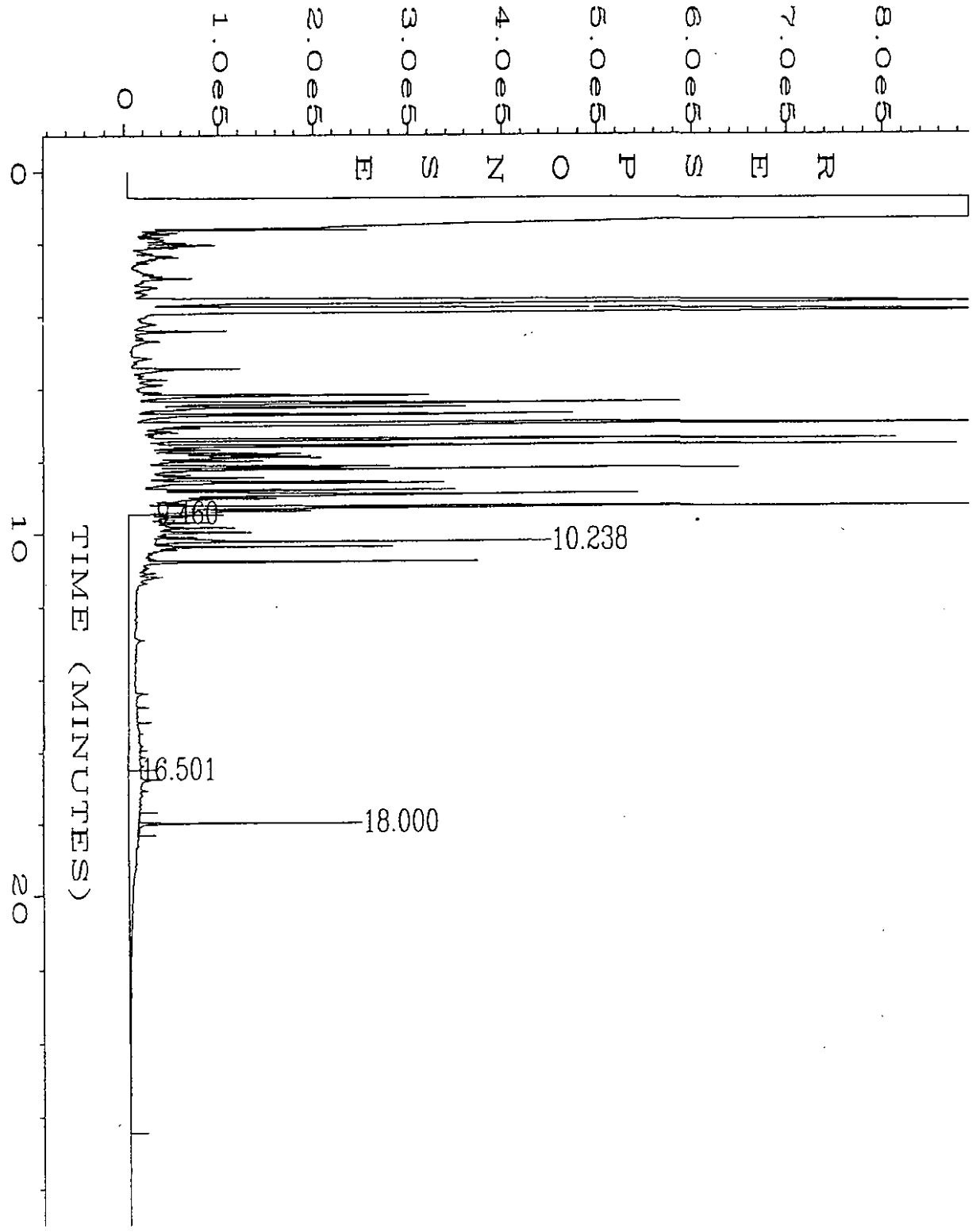
Project Manager



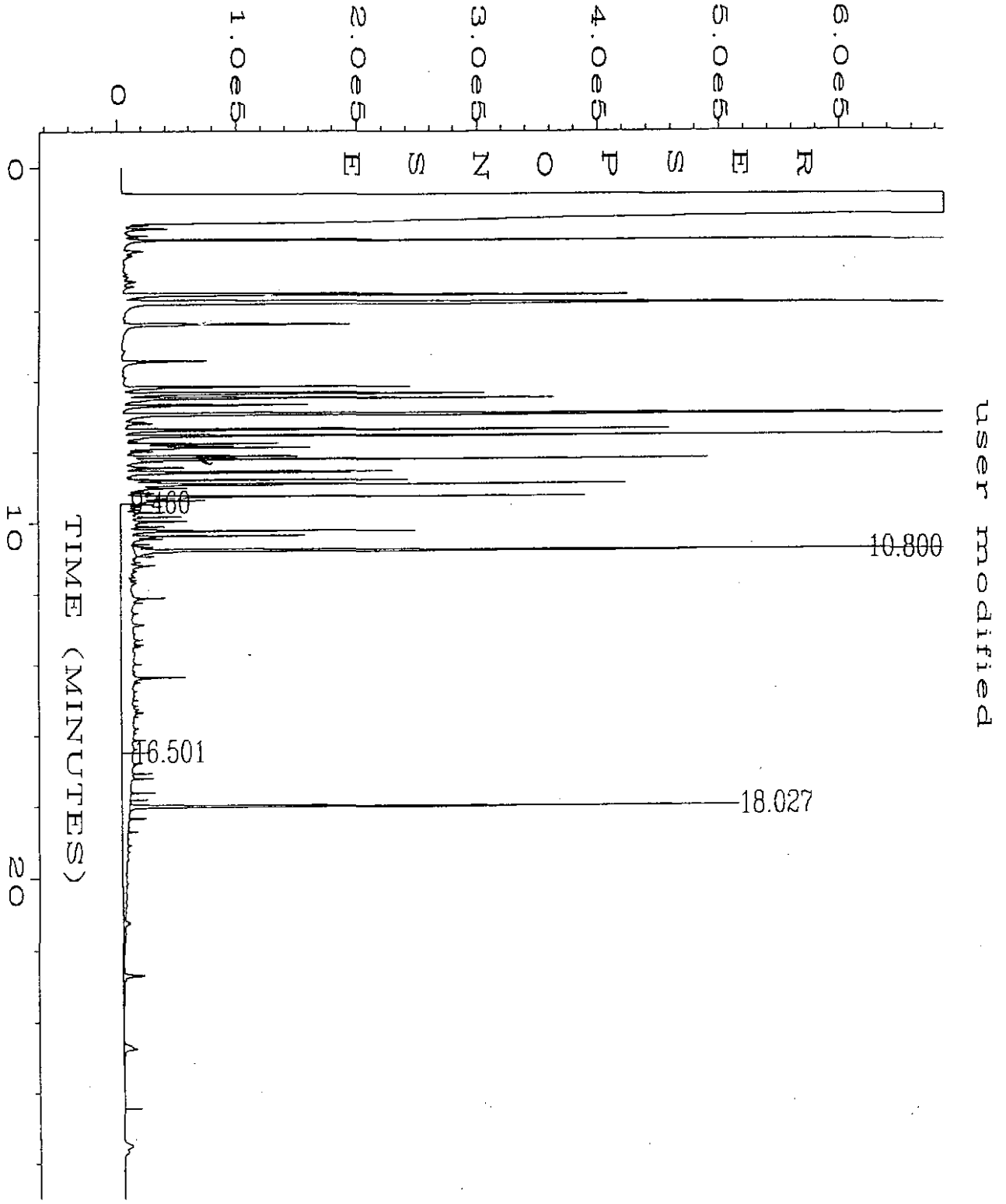
Data File Name : C:\HPCHEM\2\DATA\DEC14\006F0401.D
Operator : TF
Instrument : BOB
Sample Name : 512160-01W
Run Time Bar Code:
Acquired on : 14 Dec 95 11:34 PM
Report Created on: 15 Dec 95 00:10 AM

Page Number : 1
Vial Number : 6
Injection Number : 1
Sequence Line : 4
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



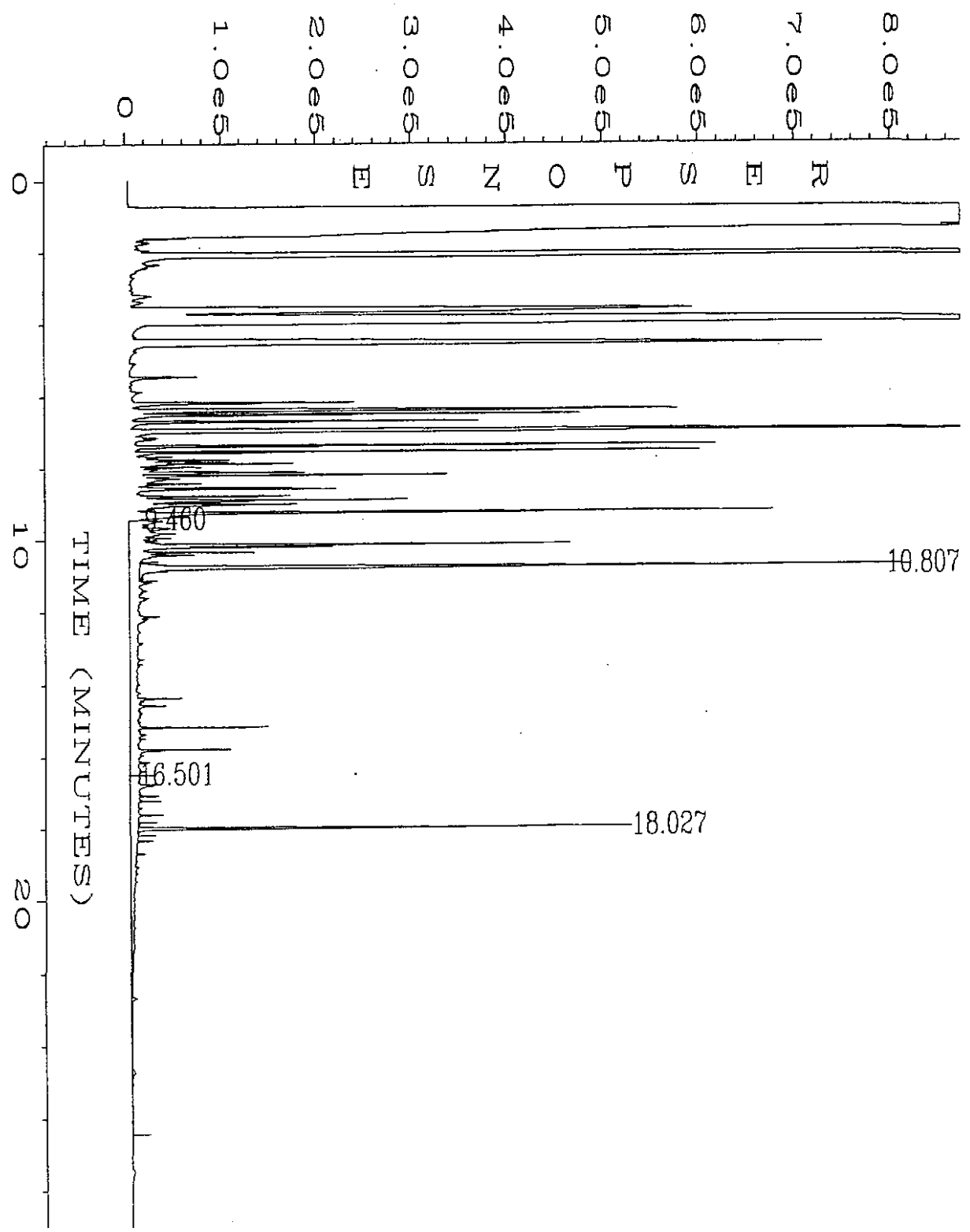
Data File Name : C:\HPCHEM\2\DATA\DEC14\007F0401.D
Operator : TF
Instrument : BOB
Sample Name : 512160-02W
Run Time Bar Code:
Acquired on : 15 Dec 95 00:12 AM
Report Created on: 15 Dec 95 00:48 AM

Page Number : 1
Vial Number : 7
Injection Number : 1
Sequence Line : 4
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



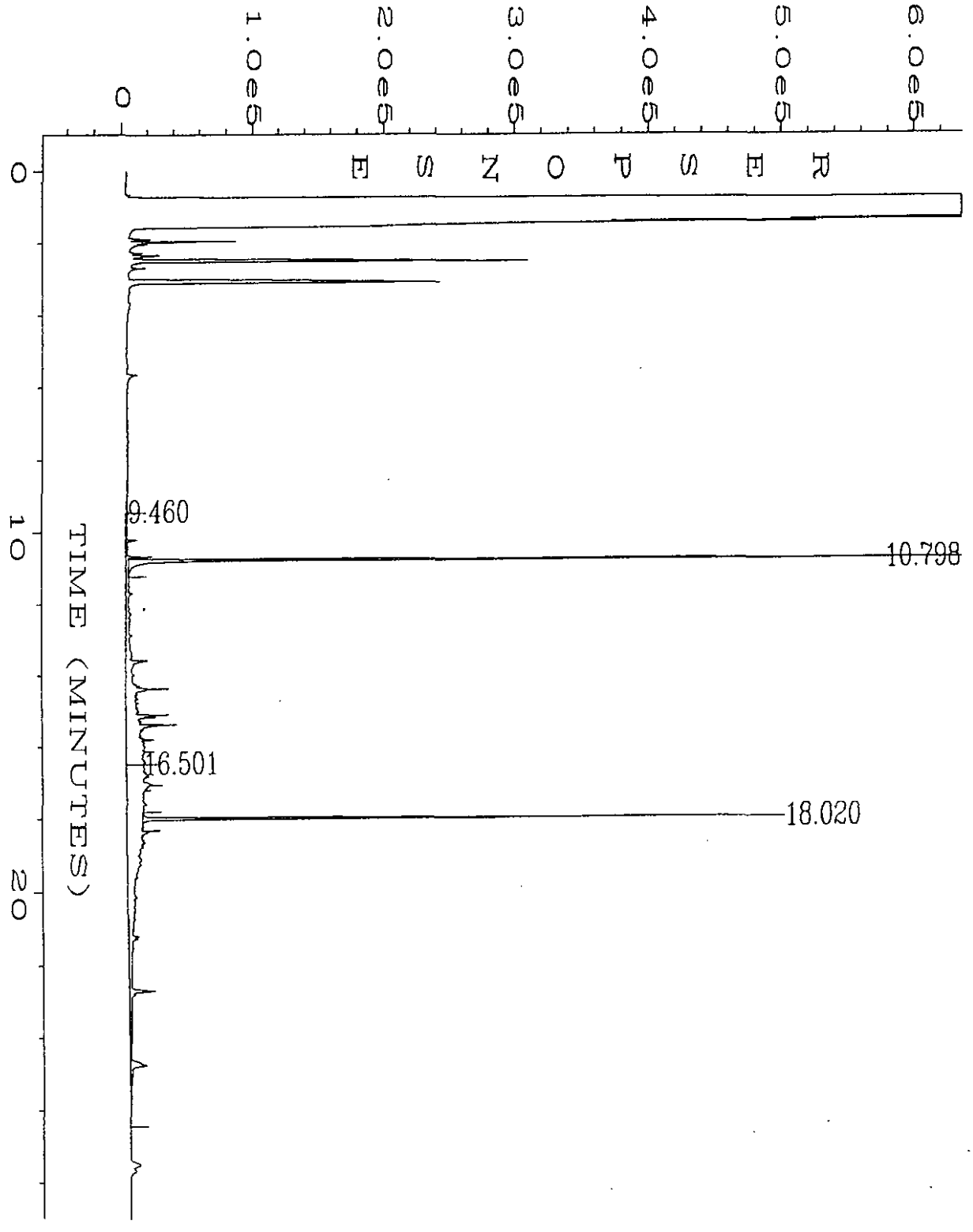
Data File Name : C:\HPCHEM\2\DATA\DEC14\008F0401.D
Operator : TF
Instrument : BOB
Sample Name : 512160-03W
Run Time Bar Code:
Acquired on : 15 Dec 95 00:50 AM
Report Created on: 15 Dec 95 01:27 AM

Page Number : 1
Vial Number : 8
Injection Number : 1
Sequence Line : 4
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



Data File Name : C:\HPCHEM\2\DATA\DEC14\009F0601.D
Operator : TF
Instrument : BOB
Sample Name : 512160-04W
Run Time Bar Code:
Acquired on : 15 Dec 95 02:06 AM
Report Created on: 15 Dec 95 02:43 AM

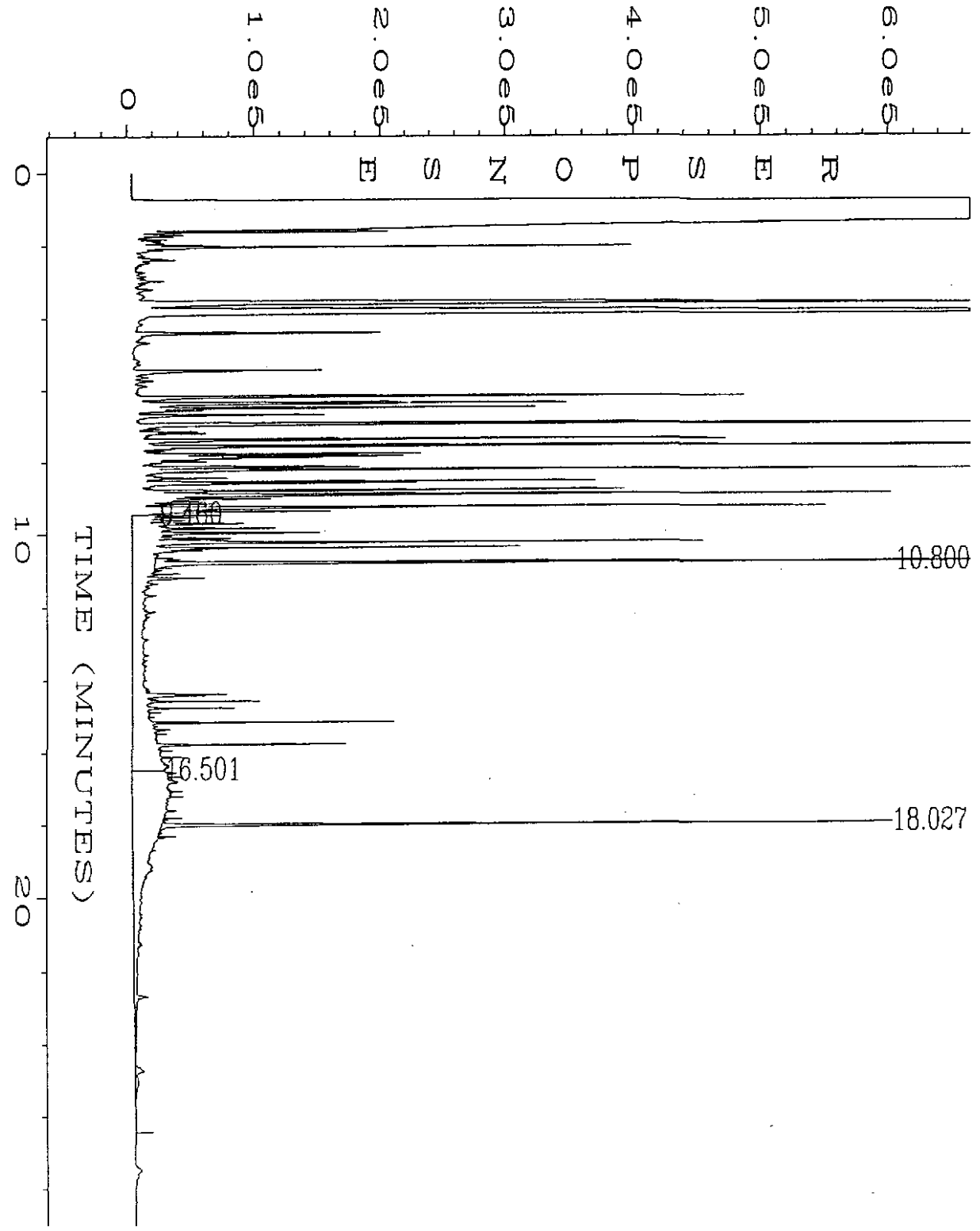
Page Number : 1
Vial Number : 9
Injection Number : 1
Sequence Line : 6
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



user modified

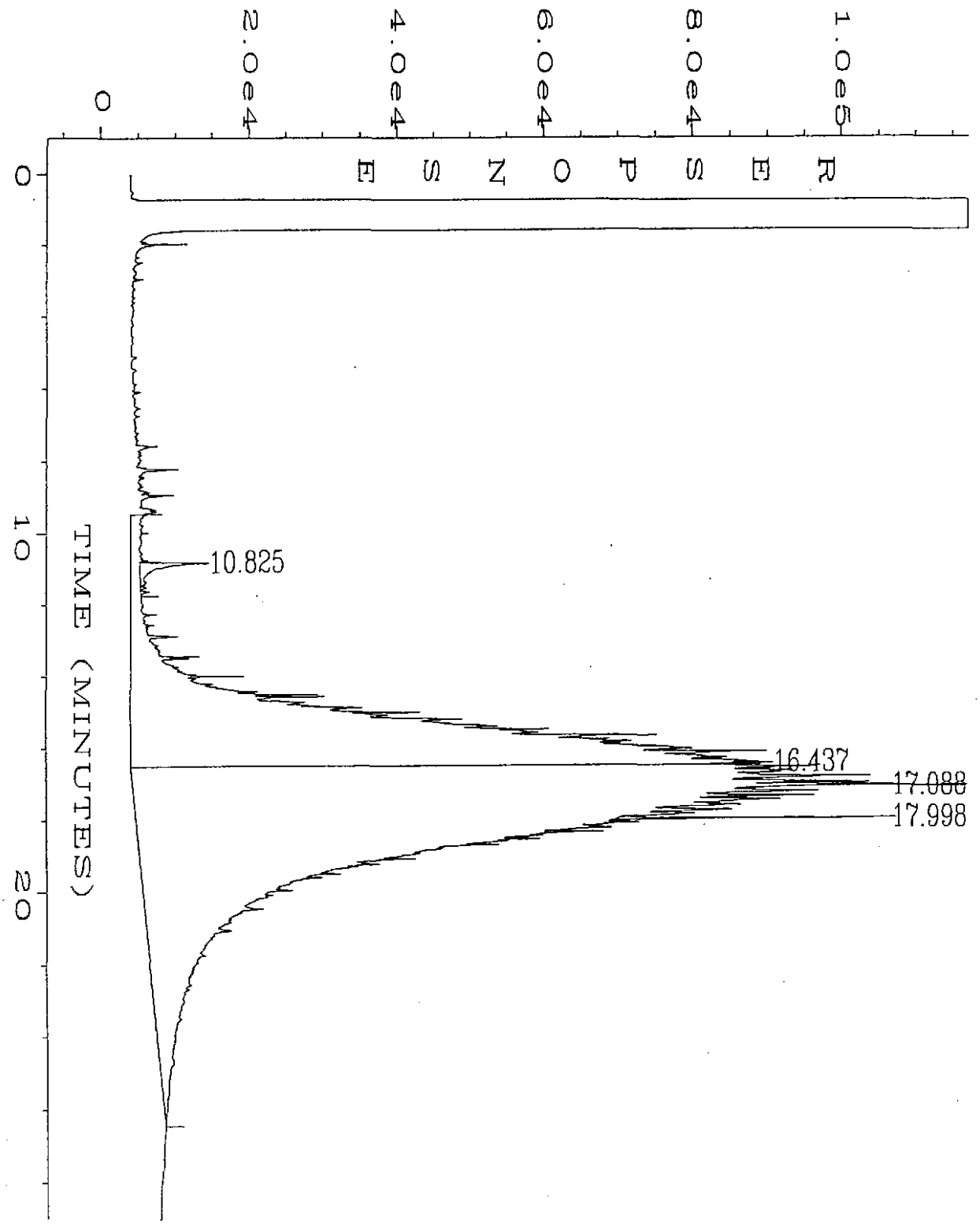
Data File Name : C:\HPCHEM\2\DATA\DEC14\011F0801.D
Operator : TF
Instrument : BOB
Sample Name : 512160-05W
Run Time Bar Code:
Acquired on : 15 Dec 95 03:23 AM
Report Created on: 15 Dec 95 03:59 AM

Page Number : 1
Vial Number : 11
Injection Number : 1
Sequence Line : 8
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



Data File Name : C:\HPCHEM\2\DATA\DEC14\012F0801.D
Operator : TF
Instrument : BOB
Sample Name : 512160-06W
Run Time Bar Code:
Acquired on : 15 Dec 95 04:01 AM
Report Created on: 15 Dec 95 04:37 AM

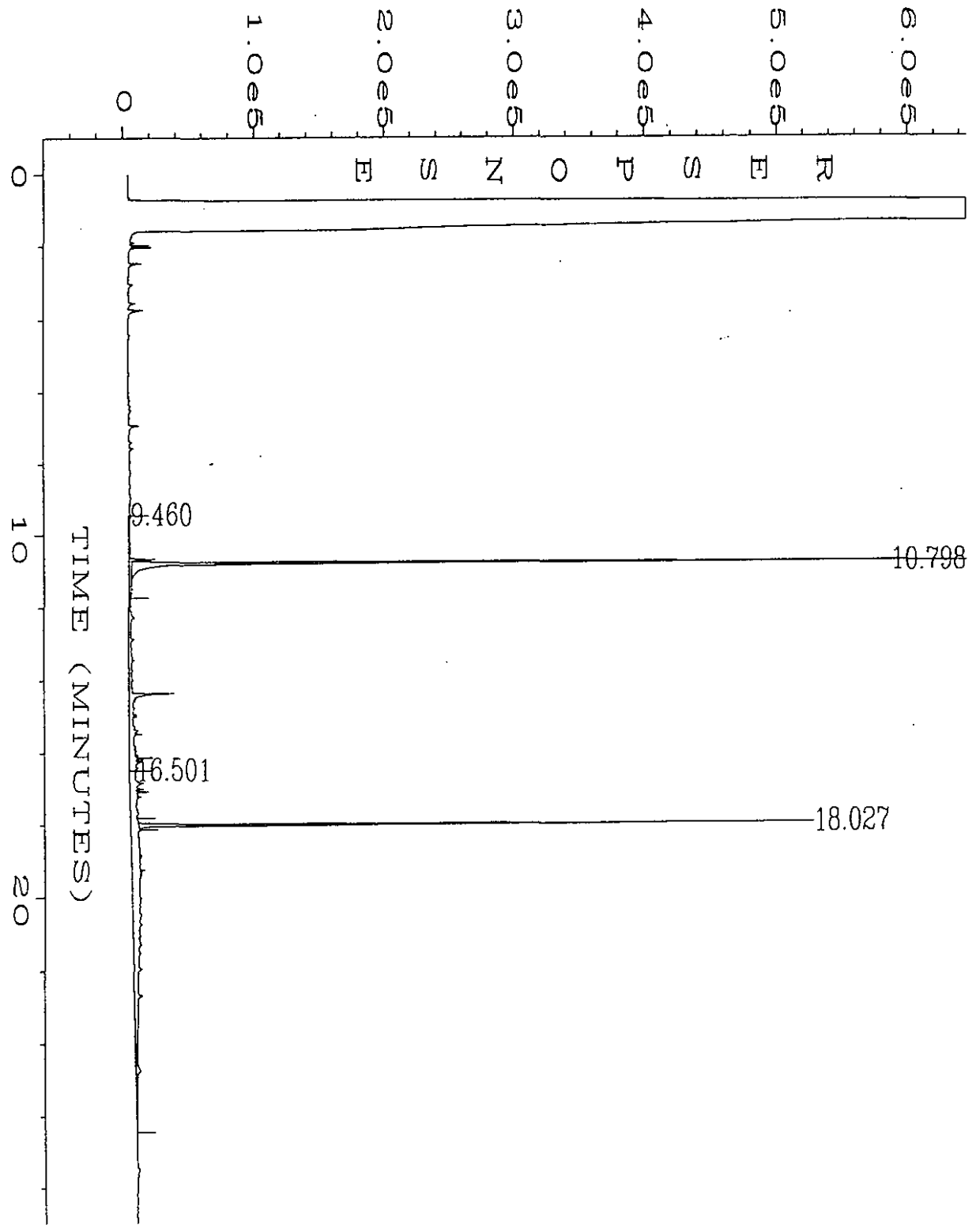
Page Number : 1
Vial Number : 12
Injection Number : 1
Sequence Line : 8
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



user modified

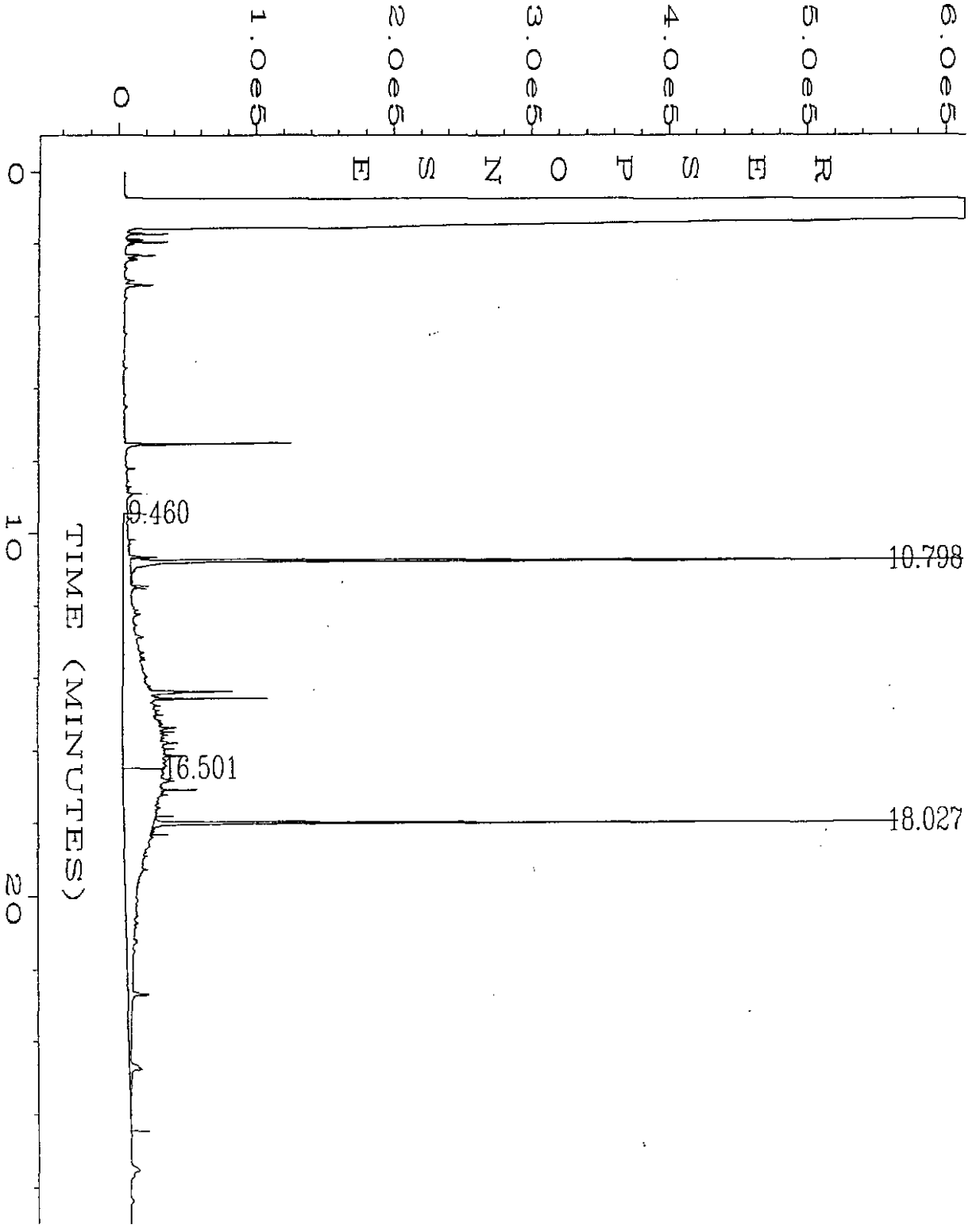
Data File Name : C:\HPCHEM\2\DATA\DEC14\026F1801.D
Operator : TF
Instrument : BOB
Sample Name : 512160-07S 11X
Run Time Bar Code:
Acquired on : 15 Dec 95 12:54 PM
Report Created on: 15 Dec 95 01:42 PM

Page Number : 1
Vial Number : 26
Injection Number : 1
Sequence Line : 18
Instrument Method: TPHD.MTH
Analysis Method : TPHE.MTH



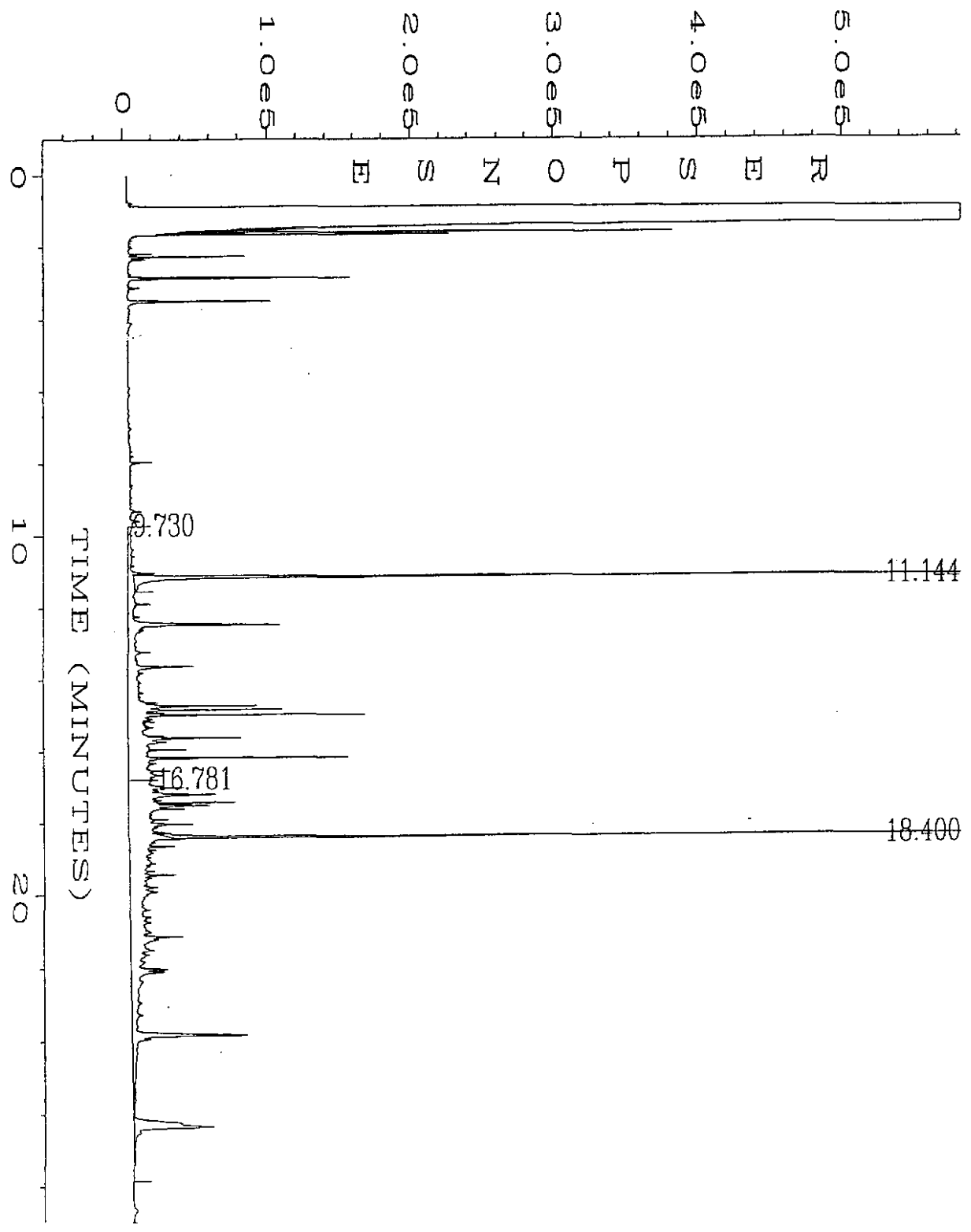
Data File Name : C:\HPCHEM\2\DATA\DEC14\014F1201.D
Operator : TF
Instrument : BOB
Sample Name : 512160-08W
Run Time Bar Code:
Acquired on : 15 Dec 95 07:12 AM
Report Created on: 15 Dec 95 07:48 AM

Page Number : 1
Vial Number : 14
Injection Number : 1
Sequence Line : 12
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



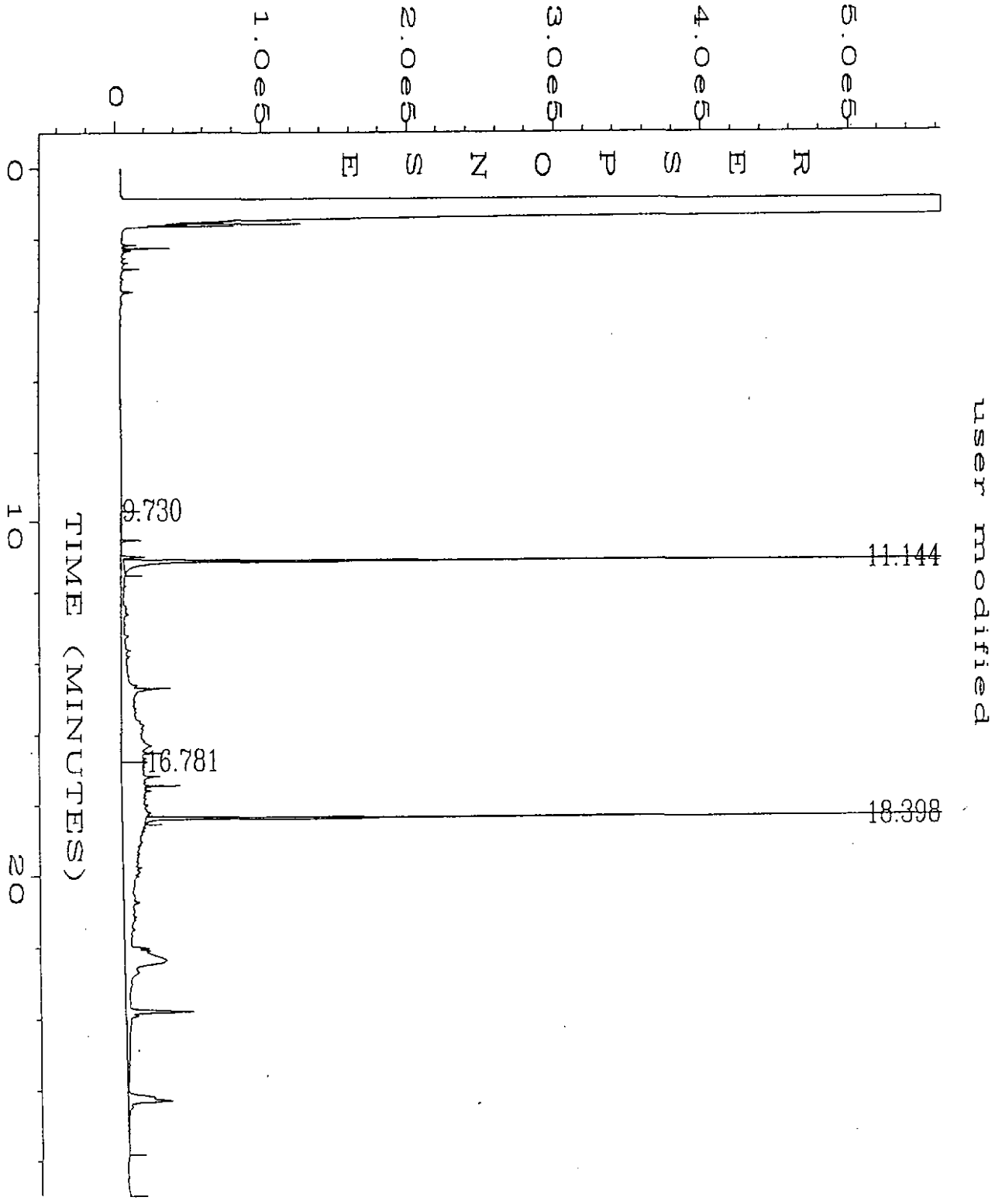
Data File Name : C:\HPCHEM\2\DATA\DEC14\015F1201.D
Operator : TF
Instrument : BOB
Sample Name : 512160-09W
Run Time Bar Code:
Acquired on : 15 Dec 95 07:50 AM
Report Created on: 15 Dec 95 08:26 AM

Page Number : 1
Vial Number : 15
Injection Number : 1
Sequence Line : 12
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



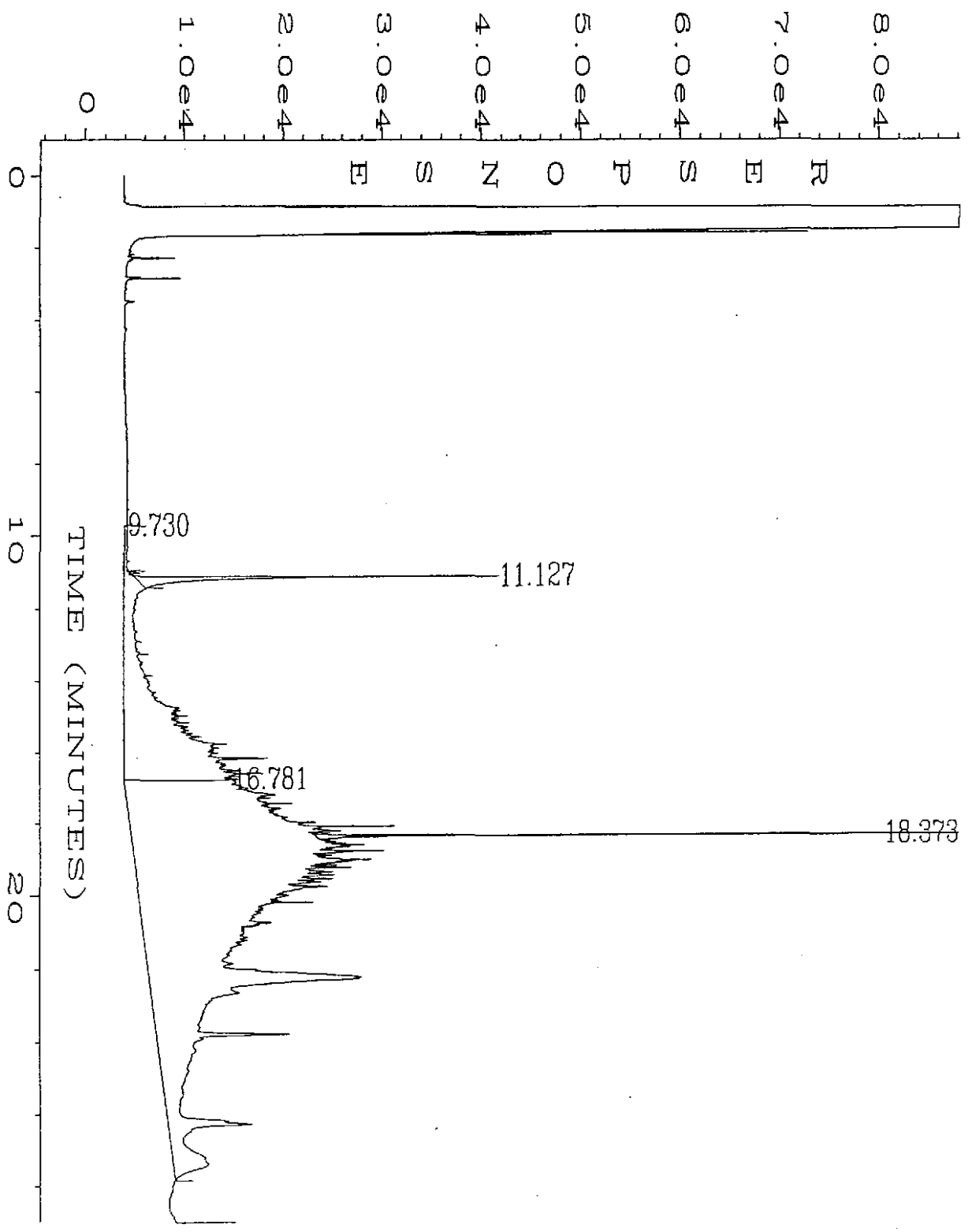
Data File Name : C:\HPCHEM\2\DATA\DEC14\058R0601.D
Operator : TF
Instrument : BOB
Sample Name : 512160-10W
Run Time Bar Code:
Acquired on : 15 Dec 95 02:45 AM
Report Created on: 15 Dec 95 03:21 AM

Page Number : 1
Vial Number : 58
Injection Number : 1
Sequence Line : 6
Instrument Method: TPHD.MTH
Analysis Method : TPHE.MTH



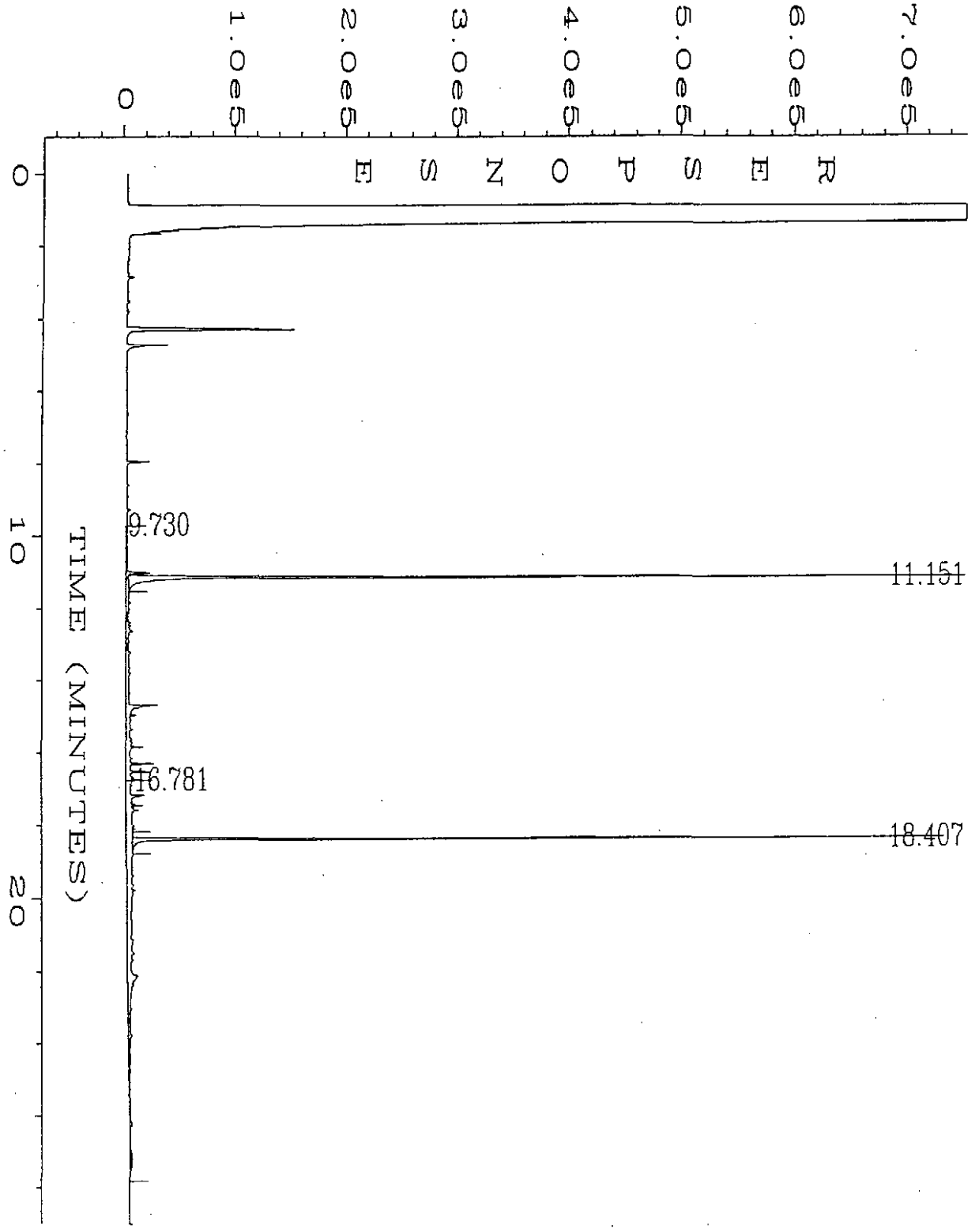
Data File Name : C:\HPCHEM\2\DATA\DEC14\059R0601.D
Operator : TF
Instrument : BOB
Sample Name : 512160-11W
Run Time Bar Code:
Acquired on : 15 Dec 95 03:23 AM
Report Created on: 15 Dec 95 03:59 AM

Page Number : 1
Vial Number : 59
Injection Number : 1
Sequence Line : 6
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



Data File Name : C:\HPCHEM\2\DATA\DEC14\060R0601.D
Operator : TF
Instrument : BOB
Sample Name : 512160-12W 5X
Run Time Bar Code:
Acquired on : 15 Dec 95 04:01 AM
Report Created on: 15 Dec 95 04:38 AM

Page Number : 1
Vial Number : 60
Injection Number : 1
Sequence Line : 6
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



Data File Name : C:\HPCHEM\2\DATA\DEC14\061R0601.D
Operator : TF
Instrument : BOB
Sample Name : 512160-13W
Run Time Bar Code:
Acquired on : 15 Dec 95 04:39 AM
Report Created on: 15 Dec 95 05:16 AM

Page Number : 1
Vial Number : 61
Injection Number : 1
Sequence Line : 6
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH

NORTH CREEK ANALYTICAL

18939 120th Avenue N.E., Suite 101 • Bothell, WA 98011-9508 (206) 481-9200 • FAX 485-2992
East 11115 Montgomery, Suite B • Spokane, WA 99206-4776 (509) 924-9200 • FAX 924-9290
9405 S.W. Nimbus Avenue • Beaverton, OR 97008-7132 (503) 643-9200 • FAX 644-2202

GeoEngineers, Inc.
8410 154th Avenue N.E.
Redmond, WA 98052
Attention: Dave Cook

Client Project ID: UNOCAL Seattle, #5353
Sample Matrix: Water
Analysis Method: WTPH-D
Units: mg/L (ppm)

Analyst: T. Fitzgibbon

Extracted: Dec 14, 1995
Analyzed: Dec 14-15, 1995
Reported: Dec 18, 1995

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT
Laboratory Control Sample

	Diesel
Spike Conc. Added:	2.04
Spike Result:	1.53
% Recovery:	75
Upper Control Limit %:	107
Lower Control Limit %:	69

PRECISION ASSESSMENT
Sample Duplicate

	Diesel Range Organics	Diesel Range Organics
Sample Number:	B512160-04	B512160-13
Original Result:	2.9	0.58
Duplicate Result:	3.3	0.52
Relative % Difference:	13	Q-5
Maximum RPD:	44	44

Q-5 = RPD values are not reported at sample concentration levels <10 X the Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

Laura Dutton
Project Manager

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

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

[redacted]
East 11115 Montgomery, Suite B, Spokane, WA 99206-4779 (509) 924-9200 FAX 924-9290
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132 (503) 643-9200 FAX 644-2202

NORTH CREEK ANALYTICAL

UNOCAL CHAIN OF CUSTODY REPORT

UNOCAL INFORMATION

Facility Number: 5353
Site Address: Westlake / Mercer
City, State, ZIP: Seattle
Site Release Number:
Unocal Manager: Dr. Mark Bradley
CERT INFO: (check one) o Evaluation ☒ Remediation
o Detection o Demolition o Closure o Miscellaneous

CONSULTANT INFORMATION

Firm: Geo Engineers Project Number: 0161-035-R04
Address: 8410 154th
Redmond WA
Phone: 861-6000 Fax: 861-6050
Project Manager: Dave Cook
Sample Collection by: Dan Wyll, Kevin Cirone

Chain of Custody Record #:

Quality Assurance Data Level: A ☒ B
A: Standard Summary
B: Standard + Chromatograms

Laboratory Turnaround Days: 10 ☒ 5 3 2 1

o Oregon ☒ Washington Hydrocarbon Methods

SAMPLE IDENTIFICATION	SAMPLING DATE / TIME	MATRIX (W,S,O)	# OF CONTAINERS	TPH-HCID	TPH-Gas	BTEX (EPA 8020 Mod.)	TPH-Gas - BTEX	TPH-Diesel	TPH-Diesel Extended	TPH-418.1	Halogen. Volatiles (EPA 8010)	Aromatic Volatiles (EPA 8020)	Pesticides/PCBs or PCBs Only	GC/MS Volatiles (EPA 8240/8260)	GC/MS SemiVols (EPA 8270)	PAHs by HPLC (EPA 8310)	Lead: Total or Dissolved	TCLP Metals (8)	NCA SAMPLE NUMBER
1. Street-3	12/8/95	W	3				X		X										B512160-01
2. Street-4	↓	↓	↓				X		X										-02
3. MW-32A							X		X										-03
4. MW-34							X		X										-04
5. MW-36							X		X										-05
6. MW-37							X		X										-06
7. MW-40							X		X										-07
8. MW-41							X		X										-08
9. MW-42							X		X										-09
10. MW-43							X		X										-10

	Relinquished by:	Firm:	Date & Time	Received by:	Firm:	Date & Time
1.	Dan Wyll	GEI	12/8/95 1330	Colette Weaver	NCA	12/08/95 1630
2.						
3.						

Final Report Approval

Were all requested results provided? yes no Define
Were results within requested turnaround? yes no "No"
Final Approval Signature: on back
Firm: Date:

Comments: Check ID TAT please

Rev. 2.2, 11/94

Distribution: White - Laboratory Yellow - Consultant Photocopy - Unocal

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East 11115 Montgomery, Spokane, WA 99206-4779 (509) 924-9200 FAX 924-9290
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132 (503) 643-9200 FAX 644-2202

NORTH CREEK ANALYTICAL

UNOCAL CHAIN OF CUSTODY REPORT

UNOCAL INFORMATION

Facility Number: 5353
Site Address: [illegible]
City, State, ZIP: Seattle
Site Release Number:
Unocal Manager: Dr. Mark Brearley, R.G.
CERT INFO: (check one) o Evaluation o Remediation o Detection o Demolition o Closure o Miscellaneous

CONSULTANT INFORMATION

Firm: [illegible] Project Number: 9161-013-R04
Address: [illegible]
Redmond
Phone: [illegible] Fax: [illegible]
Project Manager: Dave Cook
Sample Collection by: [illegible]

Chain of Custody Record #:

Quality Assurance Data Level: A / (B) (circled)
A: Standard Summary
B: Standard + Chromatograms
Laboratory Turnaround Days: 10 | 5 | 3 | 2 | 1

o Oregon o Washington Hydrocarbon Methods

SAMPLE IDENTIFICATION	SAMPLING DATE / TIME	MATRIX (W,S,O)	# OF CONTAINERS	TPH-HCID	TPH-Gas	BTEX (EPA 8020 Mod.)	TPH-Gas - BTEX	TPH-Diesel	TPH-Diesel Extended	TPH-418.1	Halogen. Volatiles (EPA 8010)	Aromatic Volatiles (EPA 8020)	Pesticides/PCBs or PCBs Only	GC/MS Volatiles (EPA 8240/8260)	GC/MS Semi-Vols. (EPA 8270)	PAHs by HPLC (EPA 8310)	Lead Total or Dissolved	TCLP Metals (8)					NCA SAMPLE NUMBER
1. MW-44	12/8/95	W	3				X		X														B512160-10
2. MW-46	↓	↓	3				X		X														-12
3. MW-47	↓	↓	3				X		X														-13
4.																							
5.																							
6.																							
7.																							
8.																							
9.																							
10.																							

	Relinquished by:	Firm:	Date & Time	Received by:	Firm:	Date & Time
1.	[illegible]	[illegible]	12/8/95 13[illegible]	Colette Weaver	NCA	12/08/95 1630
2.						
3.						

Final Report Approval

Were all requested results provided? yes / no
Were results within requested turnaround? yes / no
Define "No" on back
Final Approval Signature:
Firm: Date:

Page 2 of 2
Rev. 2.2, 11/94

Comments: Standard TAT please.

Distribution: White - Laboratory Yellow - Consultant Photocopy - Unocal

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40

WORK ORDER #: 9509323

Work Order Summary

CLIENT: Ms. Dana Carlisle
GeoEngineers
8410 154th Avenue NE
Redmond, WA 98052

BILL TO: Same

PHONE: 206-861-6040
FAX: 206-861-6050

DATE RECEIVED: 9/29/95
DATE COMPLETED: 10/11/95

INVOICE # 8234
P.O. # 555353
PROJECT # 161-013-R04 Unocal Seattle
AMOUNT$: $140.00

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	PRICE
01A	95-9-28-1	TO-3	0.2 psi	$125.00
01B	95-9-28-1 Duplicate	TO-3	0.2 psi	NC
02A	Method Spike	TO-3	NA	NC
03A	Lab Blank	TO-3	NA	NC

Misc. Charges	1 Liter Summa Canister Preparation (1) @ $15.00 each.	$15.00

CERTIFIED BY:_____ DATE:_____
Laboratory Director

AIR TOXICS LTD.

SAMPLE NAME: 95-9-28-1
ID#: 9509323-01A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name: 6100519 Date of Collection: 9/28/95
Dil. Factor: 2.0 Date of Analysis: 10/5/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.006	0.043	0.14
Toluene	0.002	0.008	0.021	0.080
Ethyl Benzene	0.002	0.009	0.010	0.044
Total Xylenes	0.002	0.009	0.023	0.10

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name: 6100519 Date of Collection: 9/28/95
Dil. Factor: 2.0 Date of Analysis: 10/5/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C5+ Hydrocarbons)	0.020	0.083	5.7 B	24 B
C2 - C4** Hydrocarbons	0.020	0.037	1.3	2.4

$\Sigma = 7.1$ ppm-v
ref. to MW=70

*TPH referenced to Gasoline (MW=100)
**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

B = Compound present in laboratory blank, background subtraction not performed.

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: 95-9-28-1 Duplicate
ID#: 9509323-01B

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name: 6100520 Date of Collection: 9/28/95
Dil. Factor: 2.0 Date of Analysis: 10/5/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.006	0.057	0.18
Toluene	0.002	0.008	0.025	0.096
Ethyl Benzene	0.002	0.009	0.011	0.048
Total Xylenes	0.002	0.009	0.021	0.093

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name: 6100520 Date of Collection: 9/28/95
Dil. Factor: 2.0 Date of Analysis: 10/5/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C5+ Hydrocarbons)	0.020	0.083	5.7 B	24 B
C2 - C4** Hydrocarbons	0.020	0.037	1.3	2.4

*TPH referenced to Gasoline (MW=100)
**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

B = Compound present in laboratory blank, background subtraction not performed.

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: Method Spike
ID#: 9509323-02A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name: 5100503 Date of Collection: NA
Dil. Factor: 1.0 Date of Analysis: 10/6/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	% Recovery
Benzene	0.001	0.003	72
Toluene	0.001	0.004	71
Ethyl Benzene	0.001	0.004	74
Total Xylenes	0.001	0.004	72

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name: 5100505 Date of Collection: NA
Dil. Factor: 1.0 Date of Analysis: 10/5/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	% Recovery
TPH* (C5+ Hydrocarbons)	0.010	0.042	108
C2 - C4** Hydrocarbons	0.010	0.018	108

*TPH referenced to Gasoline (MW=100)
**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

Container Type: NA

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank
ID#: 9509323-03A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name: 6100507 Date of Collection: NA
Dil. Factor: 1.0 Date of Analysis: 10/5/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name: 6100507 Date of Collection: NA
Dil. Factor: 1.0 Date of Analysis: 10/5/95

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C5+ Hydrocarbons)	0.010	0.042	0.075	0.31
C2 - C4** Hydrocarbons	0.010	0.018	Not Detected	Not Detected

*TPH referenced to Gasoline (MW=100)
**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

Container Type: NA