# Results of Ground Water Monitoring and Sampling February 1997 Unocal Service Station 5028 Blaine, Washington

March 28, 1997

For

76 Products Company

GeoEngineers

March 28, 1997

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

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P.O. Box 76
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Attention: Mr. Leigh Carlson

Results of Ground Water Monitoring and Sampling
February 1997
Unocal Service Station 5028
Blaine, Washington
File No. 9161-349-04

## INTRODUCTION

This report summarizes the results of our February 1997 ground water monitoring and sampling at Unocal Service Station 5028. This active service station is located at 247 "D" Street, southwest of the intersection between 2nd Street and "D" Street in Blaine, Washington. An Interstate 5 off-ramp is located west of the site, and a WSDOT (Washington State Department of Transportation) easement is located between the Unocal property and the off-ramp. The site is number 008472 in Ecology's (Washington State Department of Ecology) registered UST (underground storage tank) list and site incident number 1855 in Ecology's LUST (leaking UST) list. The site layout, service station facilities and monitoring well locations are shown in Figure 1.

GeoEngineers conducted a subsurface contamination study at the site in 1986. AGRA E&E (formerly RZA AGRA, Inc.) provided remedial consulting services at the site between 1990 and 1993. GeoEngineers conducted supplemental subsurface explorations at the site in October 1994 and has provided monitoring services at the site since October 1994. Five treatment wells (TW-1 through TW-5) were installed near the service islands and Regenesis' ORC™ (oxygen releasing compound) was placed in the treatment wells and two well points near the fuel USTs in July 1996. The results of previous studies and monitoring events are summarized in reports that are on file at Unocal and with Ecology.

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The purpose of our services in February 1997 was to monitor on- and off-site ground water conditions. Combustible vapor concentrations and depths to ground water were measured in monitoring wells MW-1 through MW-6; dissolved oxygen concentrations were measured in monitoring wells MW-1 through MW-6, Well Point 1 and Well Point 2, and treatment wells TW-1 through TW-5; and ground water samples were obtained from monitoring wells MW-1 through MW-6 on February 27, 1997. GeoEngineers' scope of services completed for these activities is presented in Attachment A. Our ground water sampling procedures are described in Attachment B. Combustible vapor concentrations and depths to ground water for February 1997 and the last three monitoring events (four monitoring events total) are summarized in Table 1. The inferred direction of shallow ground water flow and the ground water elevations in February 1997, based on our measurements, are shown in Figure 1. The dissolved oxygen concentrations for February 1997 and the last three monitoring events (four monitoring events total) are summarized in Table 2. The ground water analytical results for February 1997 and the last three sampling events (four sampling events total) are summarized in Table 3 and Figure 2. The laboratory reports and our review of the laboratory quality control program are included in Attachment C.

## SUMMARY OF MONITORING RESULTS

Following is a summary of the February 1997 monitoring results:

- Combustible vapors were detected in the well casing of monitoring well MW-2 at a concentration greater than 10,000 ppm (parts per million) in February 1997. Combustible vapors were not detected in the remaining well casings during this reporting period at concentrations exceeding the lower level of significance of the instrument for this application (400 ppm).
- Ground water was present in the six monitoring well casings at depths ranging from approximately 3.09 to 6.05 feet below the ground surface. These depths to ground water generally are consistent with previous measurements.
- The inferred ground water flow direction was toward the southwest which is consistent with the direction of shallow ground water flow during previous monitoring events.
- Dissolved oxygen concentrations in the monitoring wells, as measured with the in-situ probe of a YSI meter, ranged from 0.8 to 2.6 mg/l (milligrams per liter). Dissolved oxygen concentrations in the treatment wells and well points, as measured with the in-situ probe of a YSI meter, ranged from 8.9 mg/l to greater than 15.0 mg/l (the upper level of significance of the instrument used). Dissolved oxygen concentrations measured in the treatment wells and well points increased since measured in October 1996. Dissolved oxygen measurements have not increased noticeably in the monitoring wells since the ORC "socks" were installed in July 1996.

- One or more BETX (benzene, ethylbenzene, toluene, xylenes) compounds were detected at concentrations exceeding the MTCA (Model Toxics Control Act) Method A cleanup levels in the ground water samples obtained from MW-2 and MW-3.
- Gasoline-range hydrocarbon concentrations exceeded the MTCA Method A cleanup level in the ground water samples obtained from MW-2 and MW-3.
- The HVOC (halogenated volatile organic compound) vinyl chloride was detected at a concentration of 13.2 μg/l (micrograms per liter) in the sample obtained from MW-3. The MTCA Method A ground water cleanup level for vinyl chloride is 0.2 μg/l.
- The chemical analytical results for ground water monitoring generally were consistent with data from previous sampling events, with one exception. The benzene concentration detected in the February 1997 sample from MW-6 decreased relative to results of samples obtained since January 1995. As in October 1996, diesel-range hydrocarbon concentrations in samples from MW-2 and MW-3 have continued to remain below the MTCA Method A cleanup level.

## FUTURE MONITORING

GeoEngineers will continue to obtain ground water samples from monitoring wells MW-2, MW-3, MW-5 and MW-6 on a quarterly basis and from MW-1 and MW-4 on a semiannual basis for chemical analysis of BETX and petroleum hydrocarbons. Ground water samples from MW-3 and MW-4 also will be submitted for chemical analysis of HVOCs. We also will continue to obtain dissolved oxygen concentrations from the treatment wells and select monitoring wells. The results of the next reporting period (May 1997) will be summarized in our next report to 76 Products Company.

## LIMITATIONS

We have prepared this report for use by 76 Products Company. 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 continued services to Unocal. Please contact us if you have questions regarding our ongoing studies at the site.

Respectfully submitted,

GeoEngineers, Inc.

Lisa J. Bona
Project Geologist

Kurt S. Anderson, C.P.G.
Associate

LJB:KSA:vvl
Document ID: P:\9161349.R5

Attachments

Two copies submitted

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Wash. State Dept. of Ecology
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# TABLE 1
# GROUND WATER ELEVATIONS AND COMBUSTIBLE VAPOR CONCENTRATIONS
UNOCAL SERVICE STATION 5028
BLAINE, WASHINGTON

| Monitoring Well[1] | Date Sampled | Depth to Ground Water from Ground Surface (feet) | Ground Water Elevation[2] (feet) | Combustible Vapor Concentrations[3] (ppm) |
|---|---|---|---|---|
| MW-1 | 04/18/96 | 3.30 | 97.12 | – |
| | 07/25/96 | 4.13 | 96.29 | <400 |
| | 10/16/96 | 4.74 | 95.78 | <400 |
| | **02/27/97** | **4.47** | **95.95** | **<400** |
| MW-2 | 04/18/96 | 2.67 | 95.82 | >10,000 |
| | 07/25/96 | 4.29 | 94.20 | >10,000 |
| | 10/16/96 | 3.96 | 94.53 | >10,000 |
| | **02/27/97** | **3.67** | **94.82** | **>10,000** |
| MW-3 | 04/18/96 | 3.72 | 94.85 | – |
| | 07/25/96 | 4.74 | 93.83 | <400 |
| | 10/16/96 | 5.22 | 93.35 | <400 |
| | **02/27/97** | **3.79** | **94.78** | **<400** |
| MW-4 | 04/18/96 | 4.13 | 95.40 | <400 |
| | 07/25/96 | 4.88 | 94.65 | <400 |
| | 10/16/96 | 6.55 | 92.98 | <400 |
| | **02/27/97** | **6.05** | **93.48** | **<400** |
| MW-5 | 04/18/96 | 3.19 | 89.77 | <400 |
| | 07/25/96 | 4.06 | 88.90 | <400 |
| | 10/16/96 | 3.87 | 89.09 | <400 |
| | **02/27/97** | **3.09** | **89.87** | **<400** |
| MW-6 | 04/18/96 | 3.34 | 94.50 | <400 |
| | 07/25/96 | 4.22 | 93.62 | <400 |
| | 10/16/96 | 4.24 | 93.60 | <400 |
| | **02/27/97** | **4.41** | **93.43** | **<400** |

Notes:

[1]Approximate locations of monitoring wells are shown in Figures 1 and 2.

[2]Elevations are measured relative to the temporary benchmark shown in Figure 1. The benchmark has an assumed elevation of 100.00 feet.

[3]Measured with a Bacharach TLV Sniffer calibrated to hexane equipped with a polyethylene drop hose lowered to within 1 foot of the static water level.

ppm = parts per million

"–" = not measured

Bold indicates measurement was obtained during current reporting period.

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# TABLE 2 (Page 1 of 2)
# DISSOLVED OXYGEN CONCENTRATIONS
# MONITORING AND TREATMENT WELLS
## UNOCAL SERVICE STATION 5028
## BLAINE, WASHINGTON

| Well Number[1] | Date Sampled | Dissolved Oxygen-- Titration Method[2] (mg/l) | Dissolved Oxygen-- YSI Meter[3] (mg/l) |
|---|---|---|---|
| **Monitoring Wells** | | | |
| MW-1 | 04/18/96 | 4 | – |
| | 07/25/96 | 1.8 | 1.6 |
| | 10/16/96 | 3.0 | 2.2 |
| | **02/27/97** | – | **1.9** |
| MW-2 | 04/18/96 | 0.6 | – |
| | 07/25/96 | 0 | 1.0 |
| | 10/16/96 | 0 | 1.4 |
| | **02/27/97** | – | **0.8** |
| MW-3 | 04/18/96 | 0.4 | – |
| | 07/25/96 | 1.2 | 1.0 |
| | 10/16/96 | 0.4 | 1.0 |
| | **02/27/97** | – | **0.9** |
| MW-4 | 04/18/96 | 8 | – |
| | 07/25/96 | 2.0 | 2.7 |
| | 10/16/96 | 4.8 | 2.4 |
| | **02/27/97** | – | **2.2** |
| MW-5 | 04/18/96 | 4.8 | – |
| | 07/25/96 | 0.6 | 1.2 |
| | 10/16/96 | 2.0 | 1.6 |
| | **02/27/97** | – | **2.2** |
| MW-6 | 04/18/96 | 8 | – |
| | 07/25/96 | 2.2 | 2.6 |
| | 10/16/96 | 1.0 | 2.5 |
| | **02/27/97** | – | **2.6** |
| **Treatment Wells** | | | |
| Well Point 1 | 04/18/96 | 2.4 | – |
| | 07/25/96 | – | – |
| | 10/16/96 | – | 10.6 |
| | **02/27/97** | – | **>15.0** |
| Well Point 2 | 04/18/96 | 2.1 | – |
| | 07/25/96 | – | – |
| | 10/16/96 | – | 11.8 |
| | **02/27/97** | – | **>15.0** |
| TW-1 | 07/25/96 Baseline | 0.2 | 0.5 |
| | 07/25/96 With ORC[4] | – | 13 |
| | 10/16/96 | – | 7.2 |
| | **02/27/97** | – | **>15.0** |

Notes appear on page 2 of 2.

# TABLE 2 (Page 2 of 2)

| Well Number[1] | Date Sampled | Dissolved Oxygen--Titration Method[2] (mg/l) | Dissolved Oxygen--YSI Meter[3] (mg/l) |
|---|---|---|---|
| **Treatment Wells (continued)** | | | |
| TW-2 | 07/25/96 Basline | 0.6 | 0.7 |
| | 07/25/96 With ORC[4] | -- | 16 |
| | 10/16/96 | -- | 7.5 |
| | **02/27/97** | -- | **>15.0** |
| TW-3 | 07/25/96 Basline | 1.6 | 0.7 |
| | 07/25/96 With ORC[4] | -- | 16 |
| | 10/16/96 | -- | 8.0 |
| | **02/27/97** | -- | **>15.0** |
| TW-4 | 07/25/96 Basline | 1.6 | 0.7 |
| | 07/25/96 With ORC[4] | -- | 18 |
| | 10/16/96 | -- | 7.4 |
| | **02/27/97** | -- | **8.9** |
| TW-5 | 07/25/96 Basline | 3.6 | 1.8 |
| | 07/25/96 With ORC[4] | -- | 18 |
| | 10/16/96 | -- | 7.2 |
| | **02/27/97** | -- | **>15.0** |

Notes:

[1]Approximate well locations are shown in Figure 1.

[2]Samples obtained with a Waterra Model D25 footvalve and 5/8-inch-diameter HDPE tubing. Dissolved oxygen measured with a Hach Model OX-2P field filtration test kit.

[3]Dissolved oxygen measured with the in-situ probe of a YSI meter.

[4]After installation of Regenesis' ORC™ (oxygen-releasing compound) "socks."

mg/l = milligrams per liter.

"--" = not measured.

Bold indicates measurement was obtained during current reporting period.

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# TABLE 3 (Page 1 of 2)
## SUMMARY OF GROUND WATER CHEMICAL ANALYTICAL DATA
## MONITORING WELLS
UNOCAL SERVICE STATION 5028
BLAINE, WASHINGTON

| Monitoring Well[1] | Date Sampled | Halogenated Volatile Organic Compounds[2] (µg/l) | | | | | BETX[3] (µg/l) | | | | Gasoline-range Hydrocarbons[4] (mg/l) | Diesel-range Hydrocarbons[5] (mg/l) | Heavy Oil-range Hydrocarbons[5] (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cis 1,2-di-chloroethene | Chloro-ethane | 1,1-dichlor-oethane | 1,2-dichlor-oethane | Vinyl Chloride | B | E | T | X | | | |
| MW-1 | 04/18/96 | – | – | – | – | – | – | – | – | – | – | – | – |
| | 07/25/96 | – | – | – | – | – | <0.5 | <0.5 | <0.5 | <1.0 | <0.05 | <0.25 | <0.75 |
| | 10/16/96 | – | – | – | – | – | – | – | – | – | – | – | – |
| | **02/27/97** | – | – | – | – | – | **<0.500** | **<0.500** | **<0.500** | **<1.00** | **<0.0500** | **<0.250** | **<0.750** |
| MW-2 | 04/18/96 | – | – | – | – | – | 5,600 | 1,100 | 1,900 | 4,300 | 31 | 0.67 | <0.75 |
| | 07/25/96 | – | – | – | – | – | 7,920 | 463 | 189 | 901 | 5.78 | 0.689 | <0.75 |
| | 10/16/96 | – | – | – | – | – | 5,360 | 436 | 252 | 1,120 | 6.680 | <0.250 | <0.750 |
| | **02/27/97** | – | – | – | – | – | **6,790** | **832** | **661** | **2,800** | **16.3** | **0.280** | **<0.750** |
| MW-3 | 04/18/96 | 2.4 | 1.5 | <1.0 | 1.5 | 53 | 380 | 61 | 5.3 | 22 | 7.4 | 1.2 | <0.75 |
| | 07/25/96[6] | 1.21 | <1.0 | <1.0 | 1.27 | 22.3 | 372 | 40.2 | <1.0 | <10.0 | 4.34 | 0.997 | <0.75 |
| | 10/16/96 | 1.04 | 1.65 | <1.00 | 1.12 | 32.1 | 171 | 27.2 | 1.85 | 5.04 | 4.040 | <0.250 | <0.750 |
| | **02/27/97** | **1.47** | **1.85** | **<1.00** | **1.39** | **13.2** | **261** | **24.1** | **<2.50** | **6.01** | **2.58** | **<0.250** | **<0.750** |
| MW-4 | 04/18/96 | – | – | – | – | – | – | – | – | – | – | – | – |
| | 07/25/96[6] | 5.15 | <1.0 | <1.0 | <0.5 | <1.0[7] | <0.5 | <0.5 | <0.5 | <1.0 | <0.05 | <0.25 | <0.75 |
| | 10/16/96 | – | – | – | – | – | – | – | – | – | – | – | – |
| | **02/27/97** | **8.33** | **<1.00** | **<1.00** | **<1.00** | **<1.00[7]** | **<0.500** | **<0.500** | **<0.500** | **<1.00** | **<0.0500** | **<0.250** | **<0.750** |
| MW-5 | 04/18/96 | – | – | – | – | – | 2.9 | <0.5 | <0.5 | <1.0 | <0.05 | <0.25 | <0.75 |
| | 07/25/96 | – | – | – | – | – | 1.97 | <0.5 | <0.5 | <1.0 | <0.05 | <0.25 | <0.75 |
| | 10/16/96 | – | – | – | – | – | 1.02 | <0.500 | <0.500 | <1.00 | <0.0500 | <0.250 | <0.750 |
| | **02/27/97** | – | – | – | – | – | **0.836** | **<0.500** | **<0.500** | **<1.00** | **<0.0500** | **<0.250** | **<0.750** |
| MTCA Method A or Method B Single Component Cleanup Levels[8] | | 80 | NE | 800 | 5 | 0.2 | 5 | 30 | 40 | 20 | | 1.0[9] | |

Notes appear on page 2 of 2.

TABLE 3 (Page 2 of 2)

| Monitoring Well[1] | Date Sampled | Halogenated Volatile Organic Compounds[2] (µg/l) | | | | | BETX[3] (µg/l) | | | | Gasoline-range Hydrocarbons[4] (mg/l) | Diesel-range Hydrocarbons[5] (mg/l) | Heavy Oil-range Hydrocarbons[5] (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cis 1,2-di-chloroethene | Chloro-ethane | 1,1-dichlor-oethane | 1,2-dichlor-oethane | Vinyl Chloride | B | E | T | X | | | |
| MW-6 | 04/18/96 | -- | -- | -- | -- | -- | 5.9 | 0.54 | <0.5 | <1.0 | 0.061 | <0.25 | <0.75 |
| | 07/25/96 | -- | -- | -- | -- | -- | 76.2 | 3.68 | <0.5 | 1.92 | 0.149 | 0.321 | <0.75 |
| | 10/16/96 | -- | -- | -- | -- | -- | 10.6 | 0.760 | <0.500 | <1.00 | 0.0683 | <0.250 | <0.750 |
| | **02/27/97** | -- | -- | -- | -- | -- | **<0.500** | **<0.500** | **<0.500** | **<1.00** | **<0.0500** | **<0.250** | **<0.750** |
| MTCA Method A or Method B Single Component Cleanup Levels[8] | | 80 | NE | 800 | 5 | 0.2 | 5 | 30 | 40 | 20 | | 1.0[9] | |

Notes:

[1]Approximate monitoring well locations are shown in Figures 1 and 2.

[2]Analyzed by EPA Method 8010. Only those analytes detected are listed.

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

[4]Analyzed by Ecology Method WTPH-G.

[5]Analyzed by Ecology Method WTPH-D extended.

[6]Tetrochloroethene also was detected at a concentration of 1.02 µg/l (by EPA Method 8010).

[7]Detection limit exceeds the MTCA Method A cleanup level.

[8]Cleanup levels are MTCA Method A, except those for the compounds 1,1-dichloroethane and cis 1,2-dichloroethene, which are the MTCA Method B single component cleanup levels.

[9]The MTCA Method A ground water cleanup level for the sum of gasoline-, diesel- and heavy oil-range hydrocarbon concentrations is 1 mg/l if carbon ranges are distinctly quantified using gas chromatography methods.

µg/l = micrograms per liter

mg/l = milligrams per liter

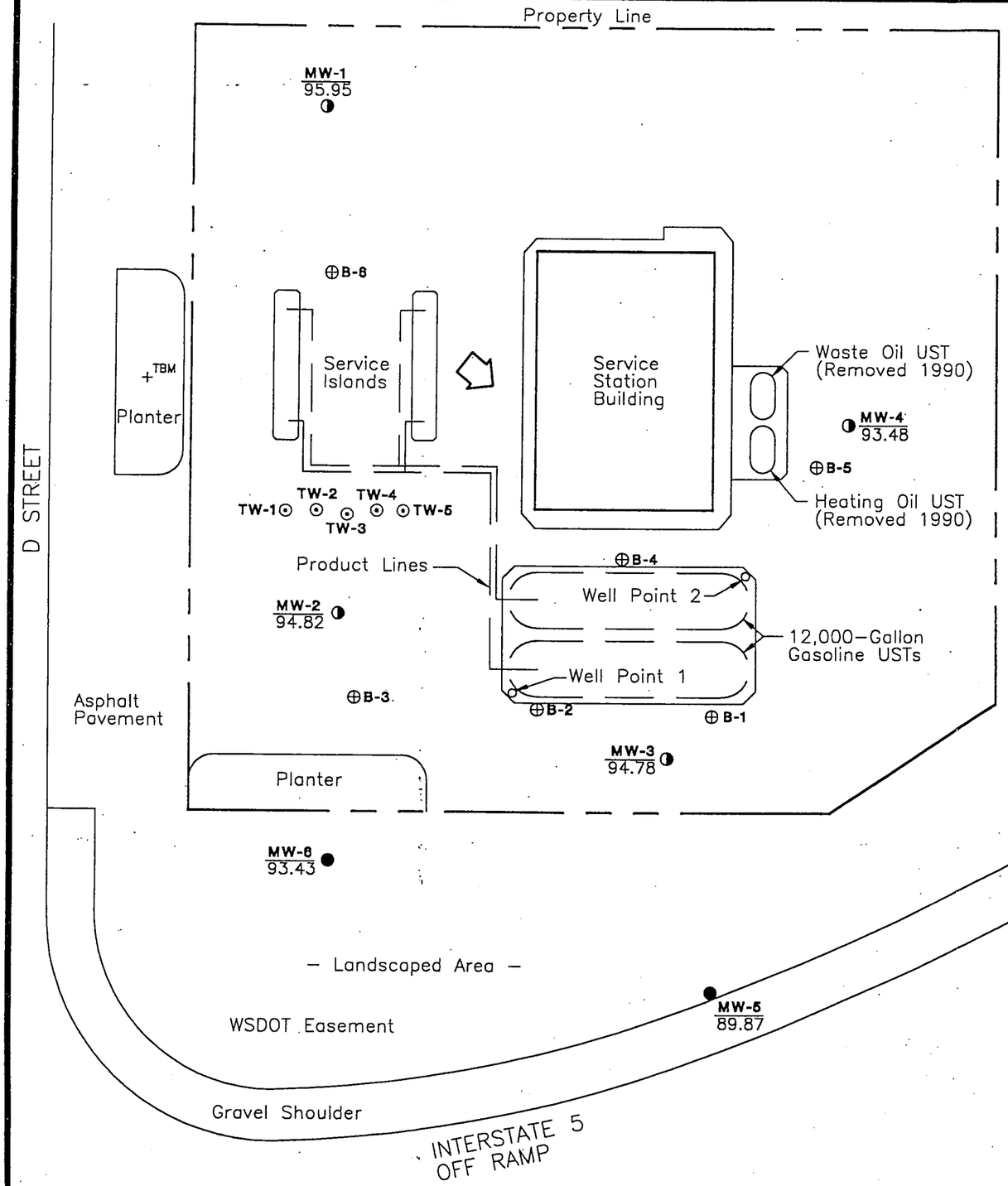
'--' = not analyzed

NE = not established

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

Bolding indicates sample was obtained during current reporting period.

Chemical analyses conducted by North Creek Analytical of Bothell, Washington. Laboratory reports for the current reporting period are included in Attachment C.




N

0 20 40

SCALE IN FEET

EXPLANATION:

- ⊙ TW-1 — TREATMENT WELL INSTALLED BY GEOENGINEERS, INC. IN 1996
- ◑ MW-1 — MONITORING WELL INSTALLED BY RZA AGRA, INC. IN 1993
- ● MW-5 — MONITORING WELL INSTALLED BY GEOENGINEERS, INC. IN 1994
- ⊕ B-1 — MONITORING WELL INSTALLED BY GEOENGINEERS, INC. IN 1986; ABANDONED IN 1993 OR BEFORE
- 94.82 — GROUND WATER ELEVATION (FEET) ON 02/27/97
- INFERRED GROUND WATER FLOW DIRECTION
- +TBM — TEMPORARY BENCHMARK LOCATED AT BASE OF COMMEMORATIVE SCULPTURE NORTH OF SERVICE STATION IN PLANTER
- UST — UNDERGROUND STORAGE TANK
- WSDOT — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

Note: The locations of all features shown are approximate.

Reference: Drawing entitled "Groundwater Surface Elevation Contour Map for 6 July 1993," by RZA AGRA, Inc., dated 07/93.

03/21/97

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Geo Engineers

**GROUND WATER ELEVATIONS ON 02/27/97**

**FIGURE 1**

| MW-1 | B | G | D | O |
|---|---|---|---|---|
| 04/18/96 | -- | -- | -- | -- |
| 07/25/96 | <0.5 | <0.05 | <0.25 | <0.75 |
| 10/16/96 | -- | -- | -- | -- |
| 02/27/97 | <0.500 | <0.0500 | <0.250 | <0.750 |
| MTCA | 5.0 | 1.0 | | |

| MW-4 | B | G | D | O |
|---|---|---|---|---|
| 04/18/96 | -- | -- | -- | -- |
| 07/25/96 | <0.5 | <0.05 | <0.25 | <0.75 |
| 10/16/96 | -- | -- | -- | -- |
| 02/27/97 | <0.500 | <0.0500 | <0.250 | <0.750 |
| MTCA | 5.0 | 1.0 | | |

| MW-2 | B | G | D | O |
|---|---|---|---|---|
| 04/18/96 | 5,600 | 31 | 0.67 | <0.75 |
| 07/25/96 | 7,920 | 5.78 | 0.689 | <0.75 |
| 10/16/96 | 5,360 | 6.680 | <0.250 | <0.750 |
| 02/27/97 | 6,790 | 16.3 | 0.280 | <0.750 |
| MTCA | 5.0 | 1.0 | | |

| MW-3 | B | G | D | O | VC |
|---|---|---|---|---|---|
| 04/18/96 | 380 | 7.4 | 1.2 | <0.75 | 53 |
| 07/25/96 | 372 | 4.34 | 0.997 | <0.75 | 22.3 |
| 10/16/96 | 171 | 4.040 | <0.250 | <0.750 | 32.1 |
| 02/27/97 | 261 | 2.58 | <0.250 | <0.750 | 13.2 |
| MTCA | 5.0 | 1.0 | | | 0.2 |

| MW-6 | B | G | D | O |
|---|---|---|---|---|
| 04/18/96 | 5.9 | 0.061 | <0.25 | <0.75 |
| 07/25/96 | 76.2 | 0.149 | 0.321 | <0.75 |
| 10/16/96 | 10.6 | 0.0683 | <0.250 | <0.750 |
| 02/27/97 | <0.500 | <0.0500 | <0.250 | <0.750 |
| MTCA | 5.0 | 1.0 | | |

| MW-5 | B | G | D | O |
|---|---|---|---|---|
| 04/18/96 | 2.9 | <0.05 | <0.25 | <0.75 |
| 07/25/96 | 1.97 | <0.05 | <0.25 | <0.75 |
| 10/16/96 | 1.02 | <0.0500 | <0.250 | <0.750 |
| 02/27/97 | 0.836 | <0.0500 | <0.250 | <0.750 |
| MTCA | 5.0 | 1.0 | | |

D STREET

INTERSTATE 5 OFF RAMP

N

0 20 40

SCALE IN FEET

EXPLANATION:

- ◑ **MW-1** MONITORING WELL INSTALLED BY RZA AGRA, INC. IN 1993
- ● **MW-5** MONITORING WELL INSTALLED BY GEOENGINEERS, INC. IN 1994
- B BENZENE ($\mu$g/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
- VC VINYL CHLORIDE ($\mu$g/l) BY EPA METHOD 8010
- MTCA MODEL TOXICS CONTROL ACT METHOD A GROUND WATER CLEANUP LEVELS
- -- NOT ANALYZED
- $\mu$g/l MICROGRAMS PER LITER
- mg/l MILLIGRAMS PER LITER

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

2. See Figure 1 for an identification of service station facilities.

Reference: Drawing entitled "Groundwater Surface Elevation Contour Map for 6 July 1993," by RZA AGRA, Inc., dated 07/93.

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**GROUND WATER CHEMICAL ANALYTICAL DATA**

**FIGURE 2**

ATTACHMENT A

# ATTACHMENT A

## SCOPE

The purpose of our recent services was to monitor on- and off-site ground water conditions. Our specific scope of services for the current reporting period is listed below.

1. Measure the depths to ground water in monitoring wells MW-1 through MW-6, calculate water table elevations relative to an assumed site datum, and estimate the shallow ground water flow direction.
2. Measure combustible vapor concentrations in the air spaces of the well casings of MW-1 through MW-6, using a Bacharach TLV Sniffer calibrated to hexane.
3. Measure dissolved oxygen concentrations in the monitoring well casings, well point casings and treatment well casings using an in-situ probe of a YSI meter.
4. Obtain ground water samples from monitoring wells MW-1 through MW-6. Submit the samples for 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 with a silica gel cleanup. Also submit the samples obtained from MW-3 and MW-4 for analysis of HVOCs by EPA Method 8010.
5. Evaluate the field and laboratory data with regard to existing regulatory concerns.

ATTACHMENT B

## ATTACHMENT B

# FIELD PROCEDURES

## COMBUSTIBLE VAPOR CONCENTRATIONS

Combustible vapor concentrations were measured in the monitoring well casings, using a Bacharach TLV Sniffer calibrated to hexane equipped with a polyethylene drop hose lowered to within 1 foot of the static water level. The lower threshold of significance for the TLV Sniffer in this application is 400 ppm (parts per million), equivalent to 4 percent of the LEL (lower explosive limit) of hexane. The field data are presented in Table 1.

## GROUND WATER ELEVATIONS

The depths to the ground water table relative to the monitoring well casing rims were measured using an electric water level indicator. The electric indicator was cleaned with a Liquinox solution wash and a distilled water rinse prior to use in each well. Ground water elevations were calculated by subtracting the water table depth from the surveyed casing rim elevations. The field data are presented in Table 1.

## GROUND WATER SAMPLING

Ground water samples were obtained from monitoring wells MW-1 through MW-6. Each water sample was obtained after at least three well volumes of water were removed using dedicated 5/8-inch-diameter HDPE (high density polyethylene) tubing and a Waterra Model D25 footvalve. The water samples were transferred in the field to laboratory-prepared sample containers and kept cool during transport to the testing laboratory. The sample containers were filled completely to eliminate headspace in the container. Hydrochloric acid (a preservative) was present in the bottles used for collection of water samples for analysis of HVOCs, BETX and gasoline-range hydrocarbons. Chain-of-custody procedures were followed in transporting the water samples to the testing laboratory.

## DISSOLVED OXYGEN

The dissolved oxygen concentrations were measured in ground water samples obtained from the six monitoring wells, well points and treatment wells with the in-situ probe of a YSI meter.

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 quality control records are included in this attachment. The analytical results also are summarized in the text, Table 3 and Figure 2 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 our data quality review, it is our opinion that the data are of acceptable quality for their intended use.

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| | | | |
|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## ANALYTICAL REPORT FOR SAMPLES:

| Sample Description | Laboratory Sample Number | Sample Matrix | Date Sampled |
|---|---|---|---|
| MW-1 | B702419-01 | Water | 2/27/97 |
| MW-2 | B702419-02 | Water | 2/27/97 |
| MW-3 | B702419-03 | Water | 2/27/97 |
| MW-4 | B702419-04 | Water | 2/27/97 |
| MW-5 | B702419-05 | Water | 2/27/97 |
| MW-6 | B702419-06 | Water | 2/27/97 |

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## Gasoline Hydrocarbons (Toluene to Dodecane) and BTEX by WTPH-G and EPA 8020A
### North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | Notes* |
|---|---|---|---|---|---|---|---|---|
| **MW-1** | | | **B702419-01** | | | | **Water** | |
| Gasoline Range Hydrocarbons | 0370168 | 3/9/97 | 3/9/97 | | 50.0 | ND | ug/l | |
| Benzene | " | " | " | | 0.500 | ND | " | |
| Toluene | " | " | " | | 0.500 | ND | " | |
| Ethylbenzene | " | " | " | | 0.500 | ND | " | |
| Xylenes (total) | " | " | " | | 1.00 | ND | " | |
| *Surrogate: 4-BFB (FID)* | " | " | " | *50.0-150* | | *103* | *%* | |
| *Surrogate: 4-BFB (PID)* | " | " | " | *50.0-150* | | *102* | " | |
| **MW-2** | | | **B702419-02** | | | | **Water** | |
| **Gasoline Range Hydrocarbons** | 0370168 | 3/9/97 | 3/10/97 | | 5000 | **16300** | ug/l | |
| **Benzene** | " | " | " | | 50.0 | **6790** | " | |
| **Toluene** | " | " | " | | 50.0 | **661** | " | |
| **Ethylbenzene** | " | " | " | | 50.0 | **832** | " | |
| **Xylenes (total)** | " | " | " | | 100 | **2800** | " | |
| *Surrogate: 4-BFB (FID)* | " | " | " | *50.0-150* | | *104* | *%* | |
| *Surrogate: 4-BFB (PID)* | " | " | " | *50.0-150* | | *98.1* | " | |
| **MW-3** | | | **B702419-03** | | | | **Water** | |
| **Gasoline Range Hydrocarbons** | 0370168 | 3/9/97 | 3/9/97 | | 250 | **2580** | ug/l | |
| **Benzene** | " | " | " | | 2.50 | **261** | " | |
| Toluene | " | " | " | | 2.50 | ND | " | |
| **Ethylbenzene** | " | " | " | | 2.50 | **24.1** | " | |
| **Xylenes (total)** | " | " | " | | 5.00 | **6.01** | " | |
| *Surrogate: 4-BFB (FID)* | " | " | " | *50.0-150* | | *101* | *%* | |
| *Surrogate: 4-BFB (PID)* | " | " | " | *50.0-150* | | *111* | " | |
| **MW-4** | | | **B702419-04** | | | | **Water** | |
| Gasoline Range Hydrocarbons | 0370168 | 3/9/97 | 3/9/97 | | 50.0 | ND | ug/l | |
| Benzene | " | " | " | | 0.500 | ND | " | |
| Toluene | " | " | " | | 0.500 | ND | " | |
| Ethylbenzene | " | " | " | | 0.500 | ND | " | |
| Xylenes (total) | " | " | " | | 1.00 | ND | " | |
| *Surrogate: 4-BFB (FID)* | " | " | " | *50.0-150* | | *105* | *%* | |
| *Surrogate: 4-BFB (PID)* | " | " | " | *50.0-150* | | *98.8* | " | |
| **MW-5** | | | **B702419-05** | | | | **Water** | |
| Gasoline Range Hydrocarbons | 0370168 | 3/9/97 | 3/10/97 | | 50.0 | ND | ug/l | |
| **Benzene** | " | " | " | | 0.500 | **0.836** | " | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions*

Laura L Dutton, Director, Office of Analytical Services

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|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Gasoline Hydrocarbons (Toluene to Dodecane) and BTEX by WTPH-G and EPA 8020A
## North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | Notes* |
|---|---|---|---|---|---|---|---|---|
| **MW-5 (continued)** | | | **B702419-05** | | | | **Water** | |
| Toluene | 0370168 | 3/9/97 | 3/10/97 | | 0.500 | ND | ug/l | |
| Ethylbenzene | " | " | " | | 0.500 | ND | " | |
| Xylenes (total) | " | " | " | | 1.00 | ND | " | |
| *Surrogate: 4-BFB (FID)* | " | " | " | *50.0-150* | | *107* | *%* | |
| *Surrogate: 4-BFB (PID)* | " | " | " | *50.0-150* | | *101* | " | |
| **MW-6** | | | **B702419-06** | | | | **Water** | |
| Gasoline Range Hydrocarbons | 0370168 | 3/9/97 | 3/9/97 | | 50.0 | ND | ug/l | |
| Benzene | " | " | " | | 0.500 | ND | " | |
| Toluene | " | " | " | | 0.500 | ND | " | |
| Ethylbenzene | " | " | " | | 0.500 | ND | " | |
| Xylenes (total) | " | " | " | | 1.00 | ND | " | |
| *Surrogate: 4-BFB (FID)* | " | " | " | *50.0-150* | | *105* | *%* | |
| *Surrogate: 4-BFB (PID)* | " | " | " | *50.0-150* | | *98.8* | " | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions.*

Laura Dutton

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|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Diesel Hydrocarbons (C12-C24) and Heavy Oil (C24-C40) by WTPH-D (extended) with Silica Gel Clean-up
North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | Notes* |
|---|---|---|---|---|---|---|---|---|
| **MW-1** | | | B702419-01 | | | | Water | |
| Diesel Range Hydrocarbons | 0370032 | 3/3/97 | 3/5/97 | | 0.250 | ND | mg/l | |
| Heavy Oil Range Hydrocarbons | " | " | " | | 0.750 | ND | " | |
| *Surrogate: 2-FBP* | " | " | " | *50.0-150* | | *88.5* | % | |
| **MW-2** | | | B702419-02 | | | | Water | 1 |
| **Diesel Range Hydrocarbons** | 0370032 | 3/3/97 | 3/5/97 | | 0.250 | **0.280** | mg/l | 2 |
| Heavy Oil Range Hydrocarbons | " | " | " | | 0.750 | ND | " | |
| *Surrogate: 2-FBP* | " | " | " | *50.0-150* | | *101* | % | |
| **MW-3** | | | B702419-03 | | | | Water | |
| Diesel Range Hydrocarbons | 0370032 | 3/3/97 | 3/5/97 | | 0.250 | ND | mg/l | |
| Heavy Oil Range Hydrocarbons | " | " | " | | 0.750 | ND | " | |
| *Surrogate: 2-FBP* | " | " | " | *50.0-150* | | *82.0* | % | |
| **MW-4** | | | B702419-04 | | | | Water | |
| Diesel Range Hydrocarbons | 0370032 | 3/3/97 | 3/5/97 | | 0.250 | ND | mg/l | |
| Heavy Oil Range Hydrocarbons | " | " | " | | 0.750 | ND | " | |
| *Surrogate: 2-FBP* | " | " | " | *50.0-150* | | *77.6* | % | |
| **MW-5** | | | B702419-05 | | | | Water | |
| Diesel Range Hydrocarbons | 0370032 | 3/3/97 | 3/5/97 | | 0.250 | ND | mg/l | |
| Heavy Oil Range Hydrocarbons | " | " | " | | 0.750 | ND | " | |
| *Surrogate: 2-FBP* | " | " | " | *50.0-150* | | *89.7* | % | |
| **MW-6** | | | B702419-06 | | | | Water | |
| Diesel Range Hydrocarbons | 0370032 | 3/3/97 | 3/5/97 | | 0.250 | ND | mg/l | |
| Heavy Oil Range Hydrocarbons | " | " | " | | 0.750 | ND | " | |
| *Surrogate: 2-FBP* | " | " | " | *50.0-150* | | *93.9* | % | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions*

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| | | | |
|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Halogenated Volatile Organics by EPA Method 8010B (modified)
## North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | Notes* |
|---|---|---|---|---|---|---|---|---|
| **MW-3** | | | **B702419-03** | | | | **Water** | |
| Bromodichloromethane | 0370001 | 2/28/97 | 3/1/97 | | 1.00 | ND | ug/l | |
| Bromoform | " | " | " | | 1.00 | ND | " | |
| Bromomethane | " | " | " | | 1.00 | ND | " | |
| Carbon tetrachloride | " | " | " | | 1.00 | ND | " | |
| Chlorobenzene | " | " | " | | 1.00 | ND | " | |
| **Chloroethane** | " | " | " | | 1.00 | **1.85** | " | |
| Chloroform | " | " | " | | 1.00 | ND | " | |
| Chloromethane | " | " | " | | 1.00 | ND | " | |
| Dibromochloromethane | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,3-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,4-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,1-Dichloroethane | " | " | " | | 1.00 | ND | " | |
| **1,2-Dichloroethane** | " | " | " | | 1.00 | **1.39** | " | |
| 1,1-Dichloroethene | " | " | " | | 1.00 | ND | " | |
| **cis-1,2-Dichloroethene** | " | " | " | | 1.00 | **1.47** | " | |
| trans-1,2-Dichloroethene | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichloropropane | " | " | " | | 1.00 | ND | " | |
| cis-1,3-Dichloropropene | " | " | " | | 1.00 | ND | " | |
| trans-1,3-Dichloropropene | " | " | " | | 1.00 | ND | " | |
| Methylene chloride | " | " | " | | 5.00 | ND | " | |
| 1,1,2,2-Tetrachloroethane | " | " | " | | 1.00 | ND | " | |
| Tetrachloroethene | " | " | " | | 1.00 | ND | " | |
| 1,1,1-Trichloroethane | " | " | " | | 1.00 | ND | " | |
| 1,1,2-Trichloroethane | " | " | " | | 1.00 | ND | " | |
| Trichloroethene | " | " | " | | 1.00 | ND | " | |
| Trichlorofluoromethane | " | " | " | | 1.00 | ND | " | |
| **Vinyl chloride** | " | " | " | | 1.00 | **13.2** | " | |
| *Surrogate: 4-BFB (ELCD)* | " | " | " | *50.0-150* | | *113* | *%* | |
| **MW-4** | | | **B702419-04** | | | | **Water** | |
| Bromodichloromethane | 0370001 | 2/28/97 | 3/1/97 | | 1.00 | ND | ug/l | |
| Bromoform | " | " | " | | 1.00 | ND | " | |
| Bromomethane | " | " | " | | 1.00 | ND | " | |
| Carbon tetrachloride | " | " | " | | 1.00 | ND | " | |
| Chlorobenzene | " | " | " | | 1.00 | ND | " | |
| Chloroethane | " | " | " | | 1.00 | ND | " | |
| Chloroform | " | " | " | | 1.00 | ND | " | |

North Creek Analytical, Inc.

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|---|---|---|
| Geo Engineers - Redmond | Project: UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: Lisa Bona | Reported: 3/11/97 08:26 |

## Halogenated Volatile Organics by EPA Method 8010B (modified)
### North Creek Analytical - Bothell

| Analyte | Batch Number | Date Prepared | Date Analyzed | Surrogate Limits | Reporting Limit | Result | Units | Notes |
|---|---|---|---|---|---|---|---|---|
| **MW-4 (continued)** | | | B702419-04 | | | | Water | |
| Chloromethane | 0370001 | 2/28/97 | 3/1/97 | | 1.00 | ND | ug/l | |
| Dibromochloromethane | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,3-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,4-Dichlorobenzene | " | " | " | | 1.00 | ND | " | |
| 1,1-Dichloroethane | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichloroethane | " | " | " | | 1.00 | ND | " | |
| 1,1-Dichloroethene | " | " | " | | 1.00 | ND | " | |
| **cis-1,2-Dichloroethene** | " | " | " | | 1.00 | **8.33** | " | |
| trans-1,2-Dichloroethene | " | " | " | | 1.00 | ND | " | |
| 1,2-Dichloropropane | " | " | " | | 1.00 | ND | " | |
| cis-1,3-Dichloropropene | " | " | " | | 1.00 | ND | " | |
| trans-1,3-Dichloropropene | " | " | " | | 1.00 | ND | " | |
| Methylene chloride | " | " | " | | 5.00 | ND | " | |
| 1,1,2,2-Tetrachloroethane | " | " | " | | 1.00 | ND | " | |
| Tetrachloroethene | " | " | " | | 1.00 | ND | " | |
| 1,1,1-Trichloroethane | " | " | " | | 1.00 | ND | " | |
| 1,1,2-Trichloroethane | " | " | " | | 1.00 | ND | " | |
| Trichloroethene | " | " | " | | 1.00 | ND | " | |
| Trichlorofluoromethane | " | " | " | | 1.00 | ND | " | |
| Vinyl chloride | " | " | " | | 1.00 | ND | " | |
| *Surrogate: 4-BFB (ELCD)* | " | " | " | *50.0-150* | | *98.5* | % | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions.*

Laura Dutton

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| | | | |
|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Gasoline Hydrocarbons (Toluene to Dodecane) and BTEX by WTPH-G and EPA 8020A/Quality Control
## North Creek Analytical - Bothell

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit / Recov. Limits | Recov. % | RPD Limit | RPD % | Notes* |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 0370168** | **Date Prepared: 3/9/97** | | | | | **Extraction Method: EPA 5030** | | | | |
| **Blank** | **0370168-BLK1** | | | | | | | | | |
| Gasoline Range Hydrocarbons | 3/9/97 | | | ND | ug/l | 50.0 | | | | |
| Benzene | " | | | ND | " | 0.500 | | | | |
| Toluene | " | | | ND | " | 0.500 | | | | |
| Ethylbenzene | " | | | ND | " | 0.500 | | | | |
| Xylenes (total) | " | | | ND | " | 1.00 | | | | |
| *Surrogate: 4-BFB (FID)* | " | *16.0* | | *16.8* | " | *50.0-150* | *105* | | | |
| *Surrogate: 4-BFB (PID)* | " | *16.0* | | *15.9* | " | *50.0-150* | *99.4* | | | |
| **LCS** | **0370168-BS1** | | | | | | | | | |
| Gasoline Range Hydrocarbons | 3/9/97 | 500 | | 541 | ug/l | 80.0-120 | **108** | | | |
| *Surrogate: 4-BFB (FID)* | " | *16.0* | | *17.6* | " | *50.0-150* | *110* | | | |
| **Duplicate** | **0370168-DUP1** | **B702419-03** | | | | | | | | |
| Gasoline Range Hydrocarbons | 3/9/97 | | 2580 | 2680 | ug/l | | | 25.0 | **3.80** | |
| *Surrogate: 4-BFB (FID)* | " | *16.0* | | *16.5* | " | *50.0-150* | *103* | | | |
| **Matrix Spike** | **0370168-MS1** | **B702419-04** | | | | | | | | |
| Benzene | 3/9/97 | 10.0 | ND | 9.47 | ug/l | 70.0-130 | **94.7** | | | |
| Toluene | " | 10.0 | ND | 9.03 | " | 70.0-130 | **90.3** | | | |
| Ethylbenzene | " | 10.0 | ND | 8.98 | " | 70.0-130 | **89.8** | | | |
| Xylenes (total) | " | 30.0 | ND | 26.8 | " | 70.0-130 | **89.3** | | | |
| *Surrogate: 4-BFB (PID)* | " | *16.0* | | *16.0* | " | *50.0-150* | *100* | | | |
| **Matrix Spike Dup** | **0370168-MSD1** | **B702419-04** | | | | | | | | |
| Benzene | 3/9/97 | 10.0 | ND | 9.39 | ug/l | 70.0-130 | **93.9** | 15.0 | **0.848** | |
| Toluene | " | 10.0 | ND | 9.01 | " | 70.0-130 | **90.1** | 15.0 | **0.222** | |
| Ethylbenzene | " | 10.0 | ND | 9.02 | " | 70.0-130 | **90.2** | 15.0 | **0.444** | |
| Xylenes (total) | " | 30.0 | ND | 27.2 | " | 70.0-130 | **90.7** | 15.0 | **1.56** | |
| *Surrogate: 4-BFB (PID)* | " | *16.0* | | *15.8* | " | *50.0-150* | *98.8* | | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions.*

Laura L Dutton, Director, Office of Analytical Services

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

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SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | | |
|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Diesel Hydrocarbons (C12-C24) and Heavy Oil (C24-C40) by WTPH-D (extended) with Silica Gel Clean-up/Quality Control
## North Creek Analytical - Bothell

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit / Recov. Limits | Recov. % | RPD Limit | RPD % | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 0370032** | **Date Prepared: 3/3/97** | | | | | **Extraction Method: EPA 3520/600 Series** | | | | |
| **Blank** | **0370032-BLK1** | | | | | | | | | |
| Diesel Range Hydrocarbons | 3/6/97 | | | ND | mg/l | 0.250 | | | | |
| Heavy Oil Range Hydrocarbons | " | | | ND | " | 0.750 | | | | |
| *Surrogate: 2-FBP* | " | *0.344* | | *0.230* | " | *50.0-150* | *66.9* | | | |
| **LCS** | **0370032-BS1** | | | | | | | | | |
| Diesel Range Hydrocarbons | 3/5/97 | 2.04 | | 1.71 | mg/l | 39.0-121 | **83.8** | | | |
| *Surrogate: 2-FBP* | " | *0.344* | | *0.267* | " | *50.0-150* | *77.6* | | | |
| **Duplicate** | **0370032-DUP1** | **B702419-01** | | | | | | | | |
| Diesel Range Hydrocarbons | 3/5/97 | | ND | ND | mg/l | | | 44.0 | | |
| *Surrogate: 2-FBP* | " | *0.687* | | *0.616* | " | *50.0-150* | *89.7* | | | |
| **Duplicate** | **0370032-DUP2** | **B702419-06** | | | | | | | | |
| Diesel Range Hydrocarbons | 3/5/97 | | ND | ND | mg/l | | | 44.0 | | |
| *Surrogate: 2-FBP* | " | *0.687* | | *0.549* | " | *50.0-150* | *79.9* | | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions*

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SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

| | | | |
|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Halogenated Volatile Organics by EPA Method 8010B (modified)/Quality Control
## North Creek Analytical - Bothell

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit / Recov. Limits | Recov. % | RPD Limit | RPD % | Notes* |
|---|---|---|---|---|---|---|---|---|---|---|
| **Batch: 0370001** | **Date Prepared: 2/28/97** | | | | | **Extraction Method: EPA 5030** | | | | |
| **Blank** | **0370001-BLK1** | | | | | | | | | |
| Bromodichloromethane | 2/28/97 | | | ND | ug/l | 1.00 | | | | |
| Bromoform | " | | | ND | " | 1.00 | | | | |
| Bromomethane | " | | | ND | " | 1.00 | | | | |
| Carbon tetrachloride | " | | | ND | " | 1.00 | | | | |
| Chlorobenzene | " | | | ND | " | 1.00 | | | | |
| Chloroethane | " | | | ND | " | 1.00 | | | | |
| Chloroform | " | | | ND | " | 1.00 | | | | |
| Chloromethane | " | | | ND | " | 1.00 | | | | |
| Dibromochloromethane | " | | | ND | " | 1.00 | | | | |
| 1,2-Dichlorobenzene | " | | | ND | " | 1.00 | | | | |
| 1,3-Dichlorobenzene | " | | | ND | " | 1.00 | | | | |
| 1,4-Dichlorobenzene | " | | | ND | " | 1.00 | | | | |
| 1,1-Dichloroethane | " | | | ND | " | 1.00 | | | | |
| 1,2-Dichloroethane | " | | | ND | " | 1.00 | | | | |
| 1,1-Dichloroethene | " | | | ND | " | 1.00 | | | | |
| cis-1,2-Dichloroethene | " | | | ND | " | 1.00 | | | | |
| trans-1,2-Dichloroethene | " | | | ND | " | 1.00 | | | | |
| 1,2-Dichloropropane | " | | | ND | " | 1.00 | | | | |
| cis-1,3-Dichloropropene | " | | | ND | " | 1.00 | | | | |
| trans-1,3-Dichloropropene | " | | | ND | " | 1.00 | | | | |
| Methylene chloride | " | | | ND | " | 5.00 | | | | |
| 1,1,2,2-Tetrachloroethane | " | | | ND | " | 1.00 | | | | |
| Tetrachloroethene | " | | | ND | " | 1.00 | | | | |
| 1,1,1-Trichloroethane | " | | | ND | " | 1.00 | | | | |
| 1,1,2-Trichloroethane | " | | | ND | " | 1.00 | | | | |
| Trichloroethene | " | | | ND | " | 1.00 | | | | |
| Trichlorofluoromethane | " | | | ND | " | 1.00 | | | | |
| Vinyl chloride | " | | | ND | " | 1.00 | | | | |
| *Surrogate: 4-BFB (ELCD)* | " | *4.00* | | *4.14* | " | *50.0-150* | *103* | | | |
| **Matrix Spike** | **0370001-MS1** | | **B702423-01** | | | | | | | |
| Chlorobenzene | 2/28/97 | 10.0 | ND | 9.11 | ug/l | 70.0-130 | **91.1** | | | |
| 1,1-Dichloroethene | " | 10.0 | ND | 9.07 | " | 70.0-130 | **90.7** | | | |
| Trichloroethene | " | 10.0 | ND | 9.27 | " | 70.0-130 | **92.7** | | | |
| *Surrogate: 4-BFB (ELCD)* | " | *4.00* | | *3.86* | " | *50.0-150* | *96.5* | | | |

North Creek Analytical, Inc.

**Refer to end of report for text of notes and definitions.*

Laura Dutton

Laura L Dutton, Director, Office of Analytical Services

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| | | | |
|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Halogenated Volatile Organics by EPA Method 8010B (modified)/Quality Control
## North Creek Analytical - Bothell

| Analyte | Date Analyzed | Spike Level | Sample Result | QC Result | Units | Reporting Limit / Recov. Limits | Recov. % | RPD Limit | RPD % | Notes* |
|---|---|---|---|---|---|---|---|---|---|---|
| **Matrix Spike Dup** | 0370001-MSD1 | | B702423-01 | | | | | | | |
| Chlorobenzene | 2/28/97 | 10.0 | ND | 9.30 | ug/l | 70.0-130 | 93.0 | 20.0 | 2.06 | |
| 1,1-Dichloroethene | " | 10.0 | ND | 9.04 | " | 70.0-130 | 90.4 | 20.0 | 0.331 | |
| Trichloroethene | " | 10.0 | ND | 9.24 | " | 70.0-130 | 92.4 | 20.0 | 0.324 | |
| *Surrogate: 4-BFB (ELCD)* | " | *4.00* | | *4.00* | " | *50.0-150* | *100* | | | |

*Refer to end of report for text of notes and definitions.*

North Creek Analytical, Inc.

Laura Dutton

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| | | | |
|---|---|---|---|
| Geo Engineers - Redmond | Project: | UNOCAL #5028 | Sampled: 2/27/97 |
| 8410 154th Ave NE | Project Number: | 9161-349-04 | Received: 2/27/97 |
| Redmond, WA 98052 | Project Manager: | Lisa Bona | Reported: 3/11/97 08:26 |

## Notes and Definitions

| # | Note |
|---|---|
| 1 | This sample appears to contain volatile range organics. |
| 2 | The diesel range organics present are due to hydrocarbons eluting primarily in the gasoline range. |
| 3 | Analyses are not controlled on RPD values from sample concentrations less than 10 times the reporting limit. |
| DET | Analyte DETECTED |
| ND | Analyte NOT DETECTED at or above the reporting limit |
| NR | Not Reported |
| dry | Sample results reported on a dry weight basis |
| Recov. | Recovery |
| RPD | Relative Percent Difference |

North Creek Analytical, Inc.

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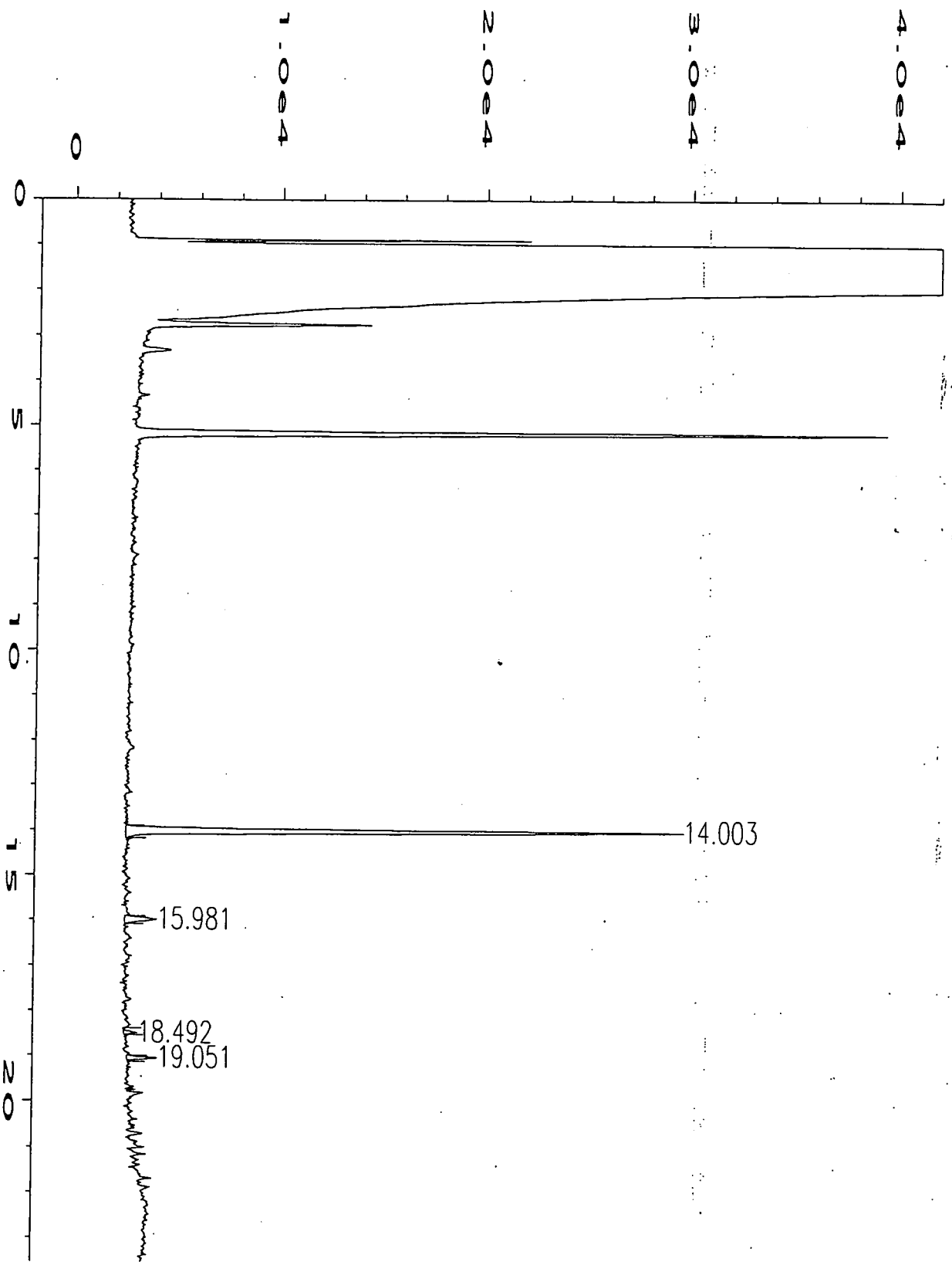
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132

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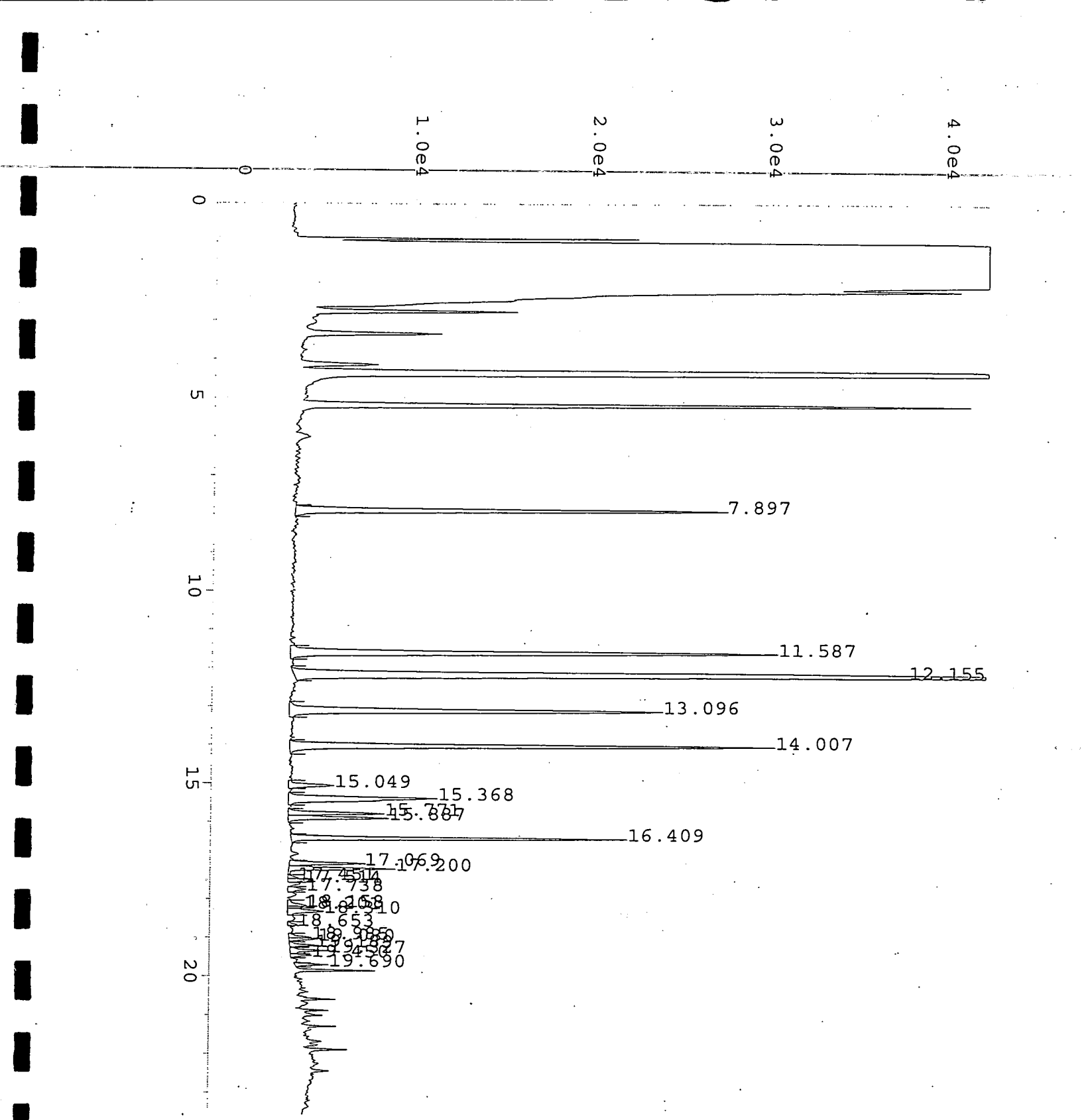
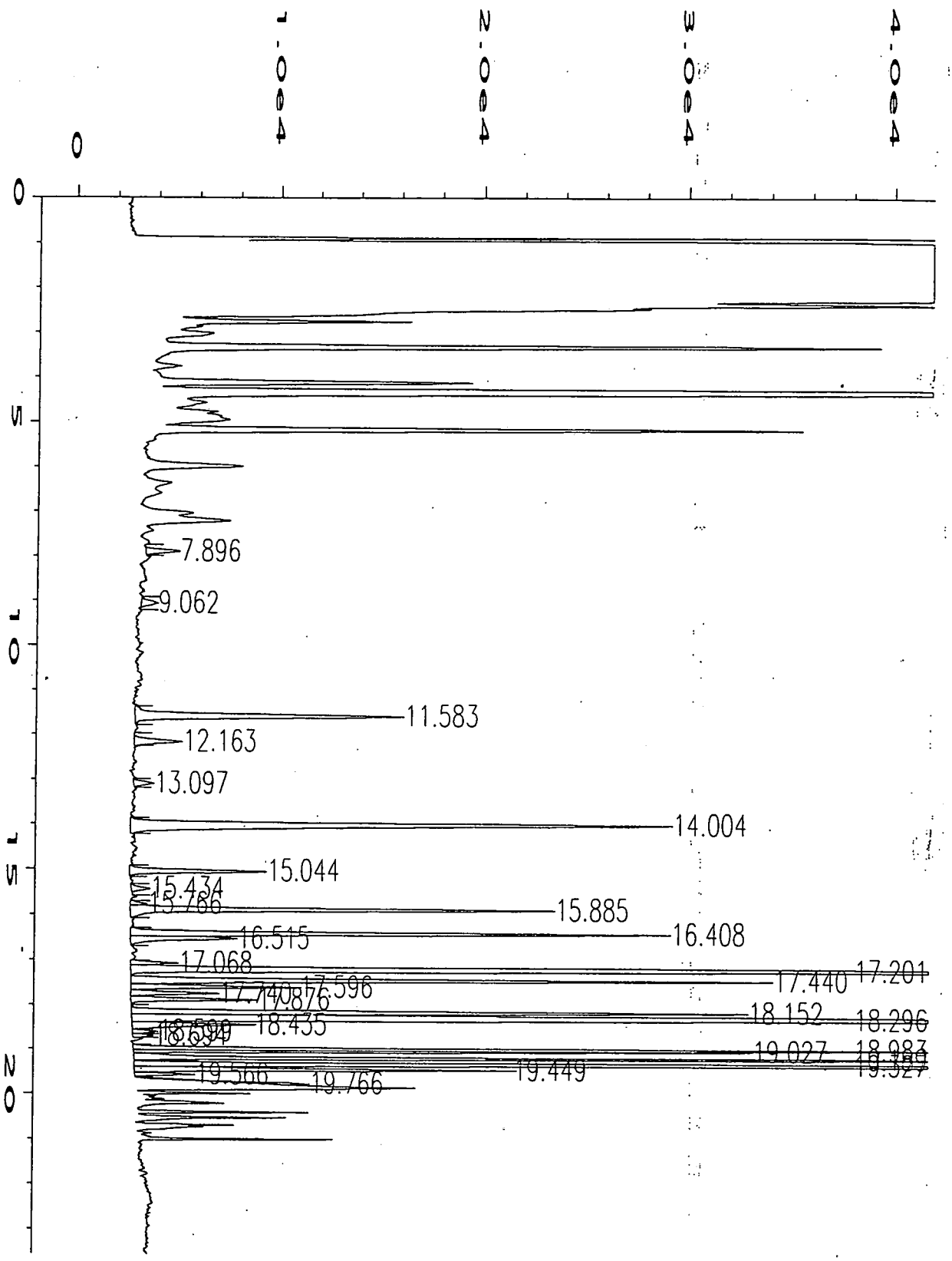
Operator : TLC
Instrument : GC #4
Sample Name : b702419-01
Run Time Bar Code:
Acquired on : 09 Mar 97 05:48 PM
Report Created on: 09 Mar 97 06:12 PM
Sample Info : 5 ml

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



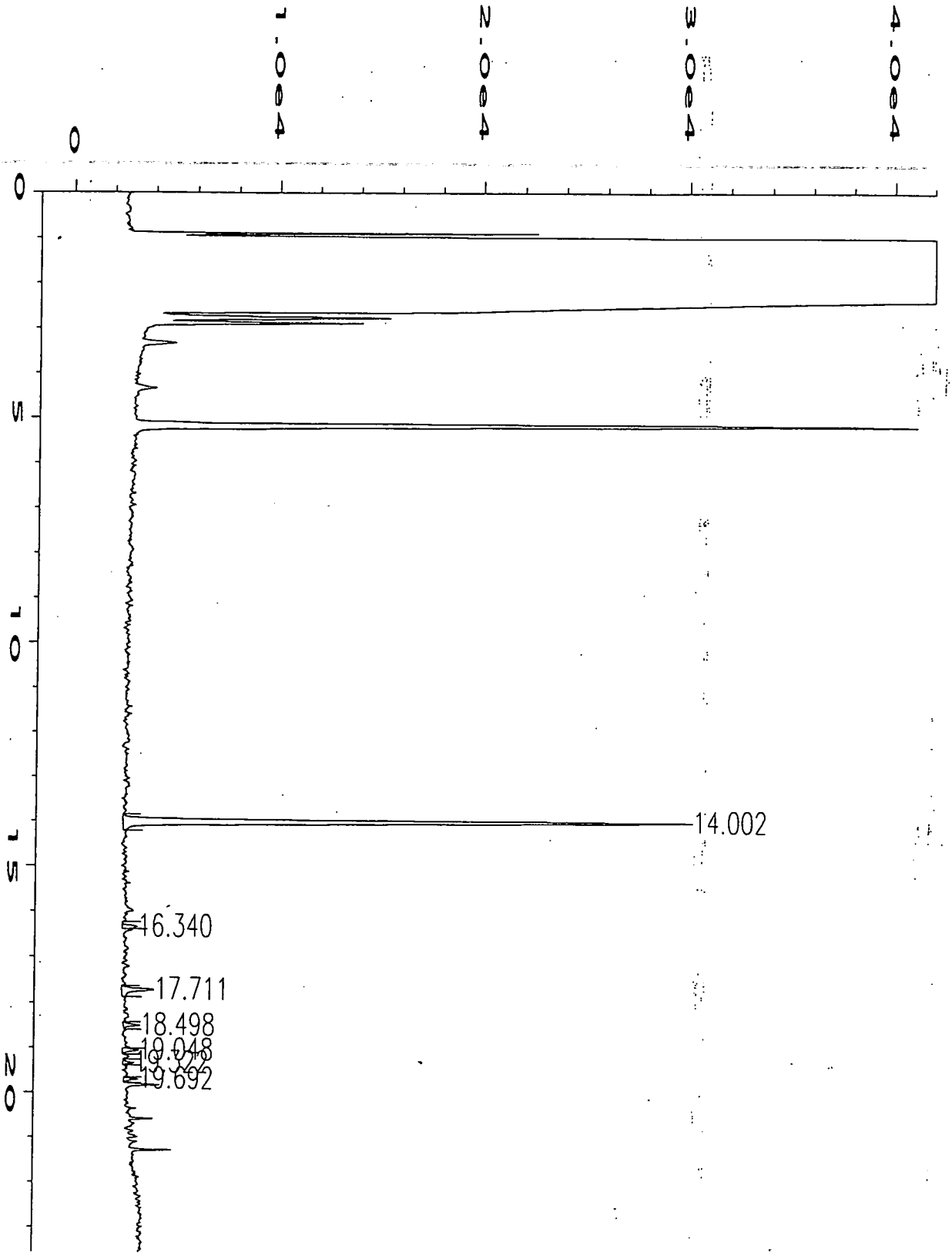

Data File Name : C:\HPCHEM\2\DATA\031097\005F0101.D
Operator : TLC
Instrument : GC #4
Sample Name : b702419-02 r1
Run Time Bar Code:
Acquired on : 10 Mar 97 09:28 AM
Report Created on: 10 Mar 97 09:52 AM
Multiplier : 100
Sample Info : 50 ul

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

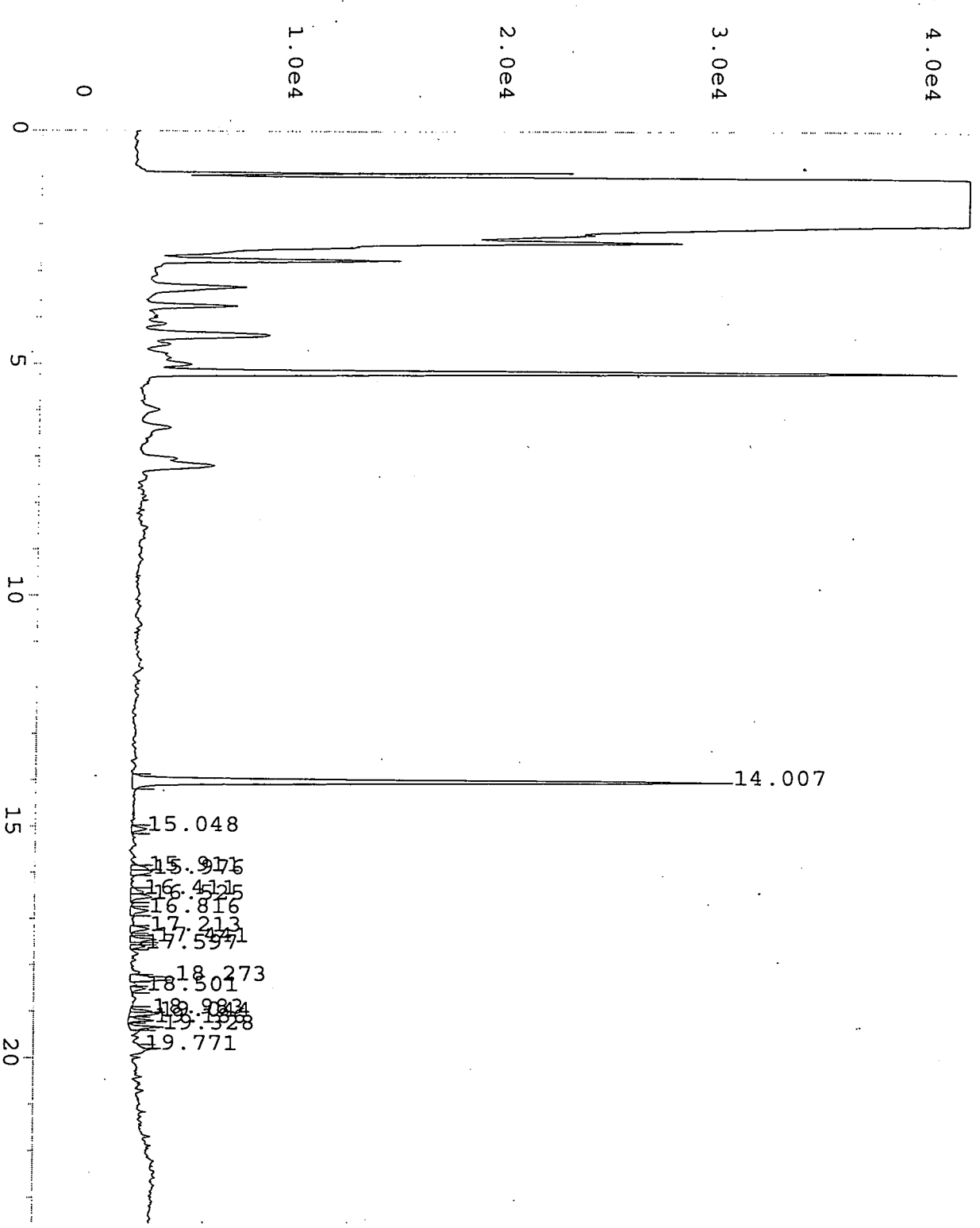



Data File Name : C:\HPCHEM\2\DATA\030997\011F0101.D
Operator : TLC
Instrument : GC #4
Sample Name : b702419-03
Run Time Bar Code:
Acquired on : 09 Mar 97 06:48 PM
Report Created on: 09 Mar 97 07:12 PM
Multiplier : 5
Sample Info : 1 ml

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

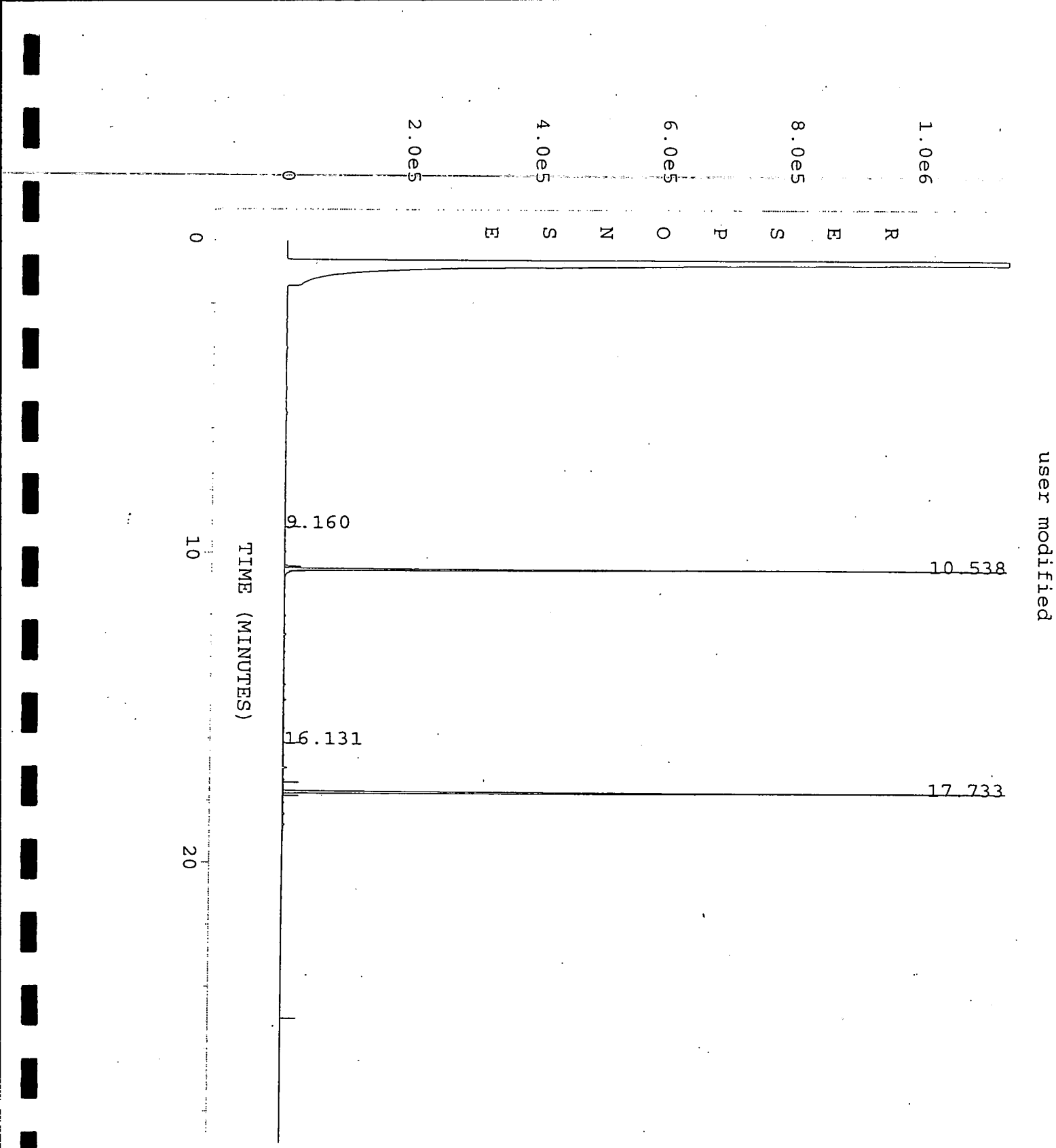



| | | | |
|---|---|---|---|
| Data File Name | : C:\HPCHEM\2\DATA\030997\013F0101.D | | |
| Operator | : TLC | Page Number | : 1 |
| Instrument | : GC #4 | Vial Number | : 13 |
| Sample Name | : b702419-04 | Injection Number | : 1 |
| Run Time Bar Code: | | Sequence Line | : 1 |
| Acquired on | : 09 Mar 97 07:49 PM | Instrument Method | : WA-WATER.MTH |
| Report Created on: | 09 Mar 97 08:12 PM | Analysis Method | : WA-WATER.MTH |
| Sample Info | : 5 ml | | |



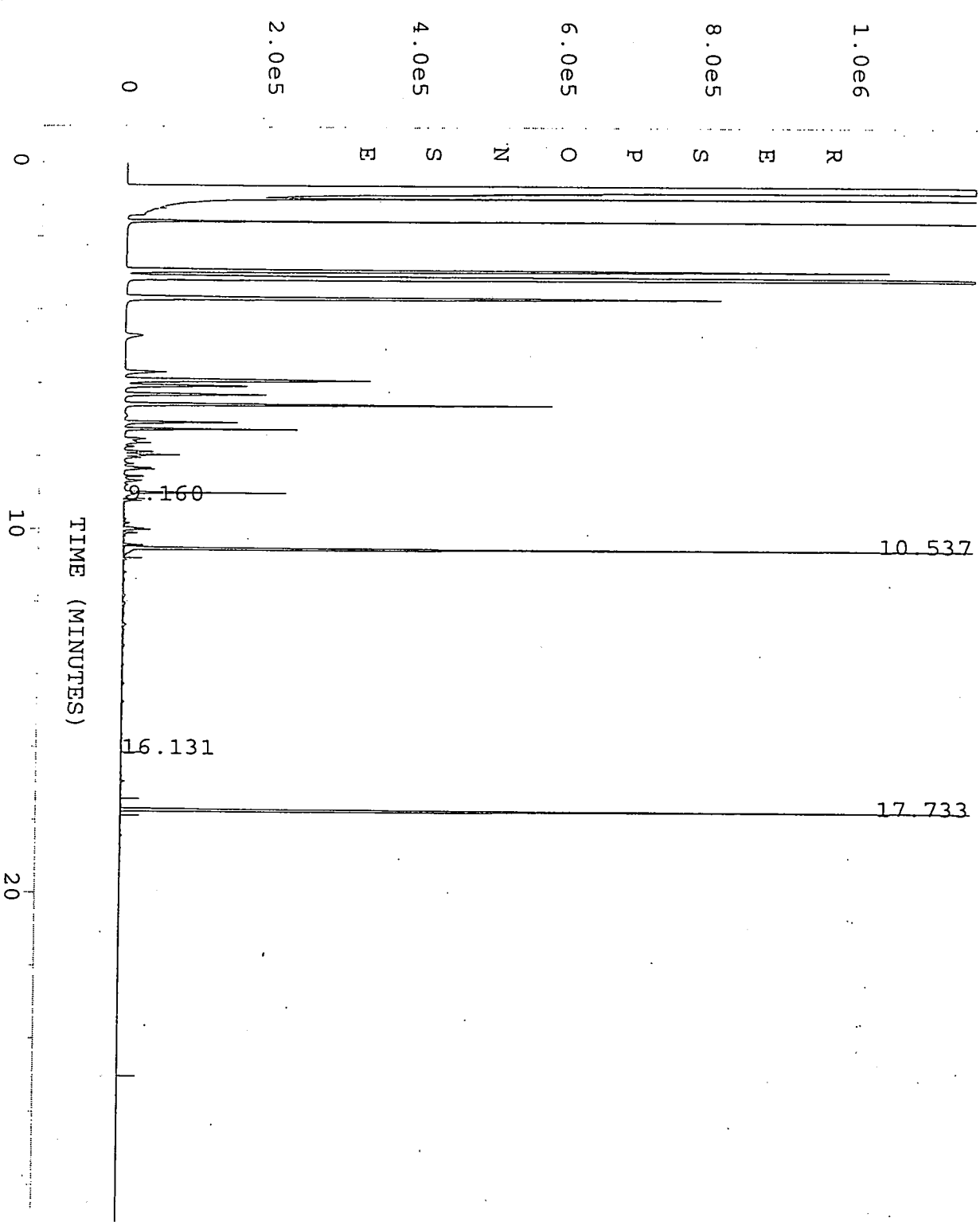

Data File Name : C:\HPCHEM\2\DATA\031097\009F0101.D
Operator : TLC
Instrument : GC #4
Sample Name : b702419-05 r1
Run Time Bar Code:
Acquired on : 10 Mar 97 12:07 PM
Report Created on: 10 Mar 97 12:31 PM
Sample Info : 5 ml

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




Data File Name : C:\HPCHEM\2\DATA\MAR05\055R0501.D
Operator : TF
Instrument : BOB
Sample Name : 702419-01 W
Run Time Bar Code:
Acquired on : 05 Mar 97 03:45 PM
Report Created on: 06 Mar 97 08:46 AM

Page Number : 1
Vial Number : 55
Injection Number : 1
Sequence Line : 5
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH

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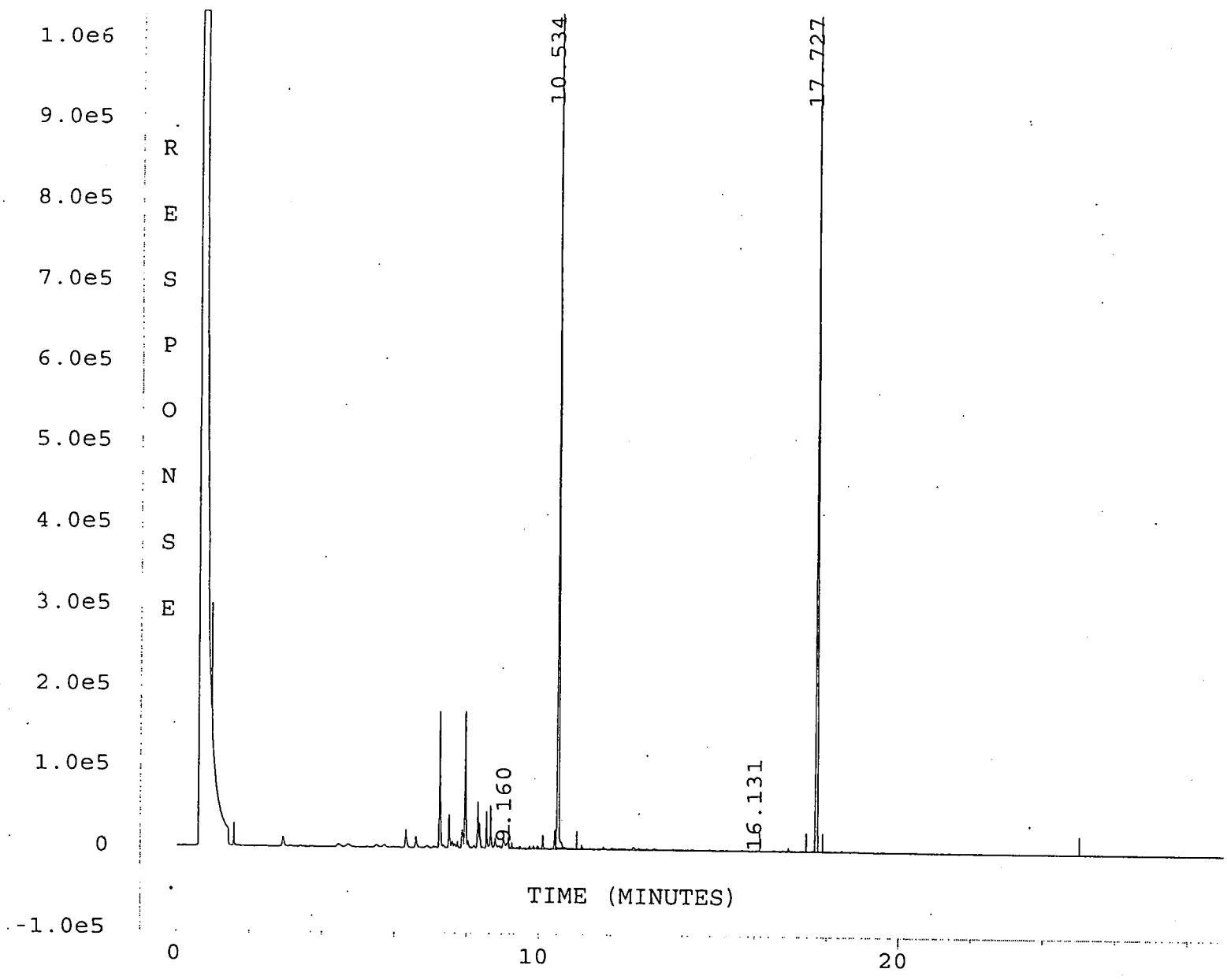
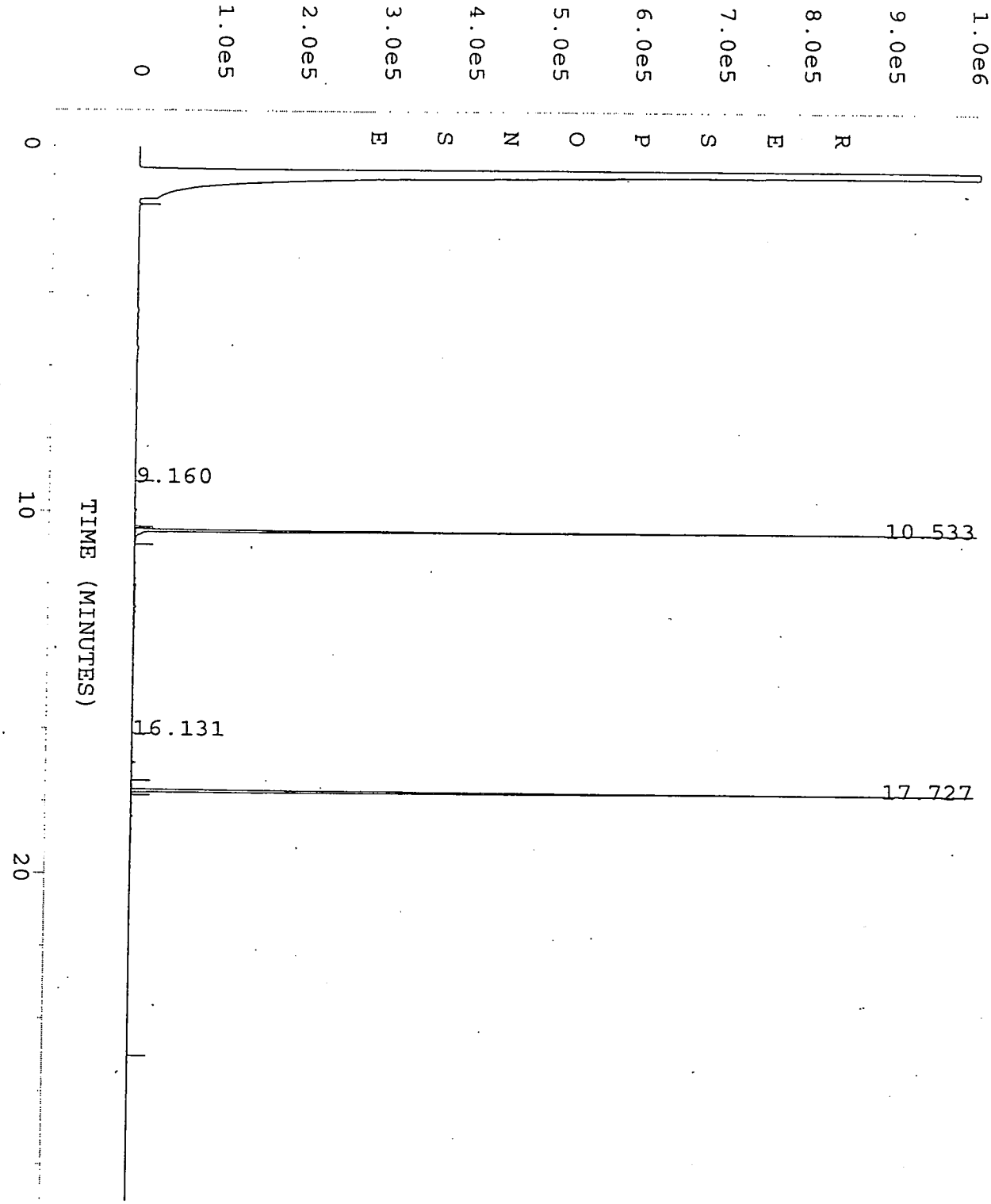
|---|---|---|---|
| Data File Name | : C:\HPCHEM\2\DATA\MAR05\057R0701.D | | |
| Operator | : TF | Page Number | : 1 |
| Instrument | : BOB | Vial Number | : 57 |
| Sample Name | : 702419-02 W | Injection Number | : 1 |
| Run Time Bar Code: | | Sequence Line | : 7 |
| Acquired on | : 05 Mar 97 05:35 PM | Instrument Method | : TPHE.MTH |
| Report Created on: | 06 Mar 97 08:48 AM | Analysis Method | : TPHE.MTH |

user modified




Data File Name : C:\HPCHEM\2\DATA\MAR05\058R0701.D
Operator : TF
Instrument : BOB
Sample Name : 702419-03 W
Run Time Bar Code:
Acquired on : 05 Mar 97 06:13 PM
Report Created on: 06 Mar 97 08:49 AM

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




| | | | |
|---|---|---|---|
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| Operator | : TF | Page Number | : 1 |
| Instrument | : BOB | Vial Number | : 59 |
| Sample Name | : 702419-04 W | Injection Number | : 1 |
| Run Time Bar Code: | | Sequence Line | : 7 |
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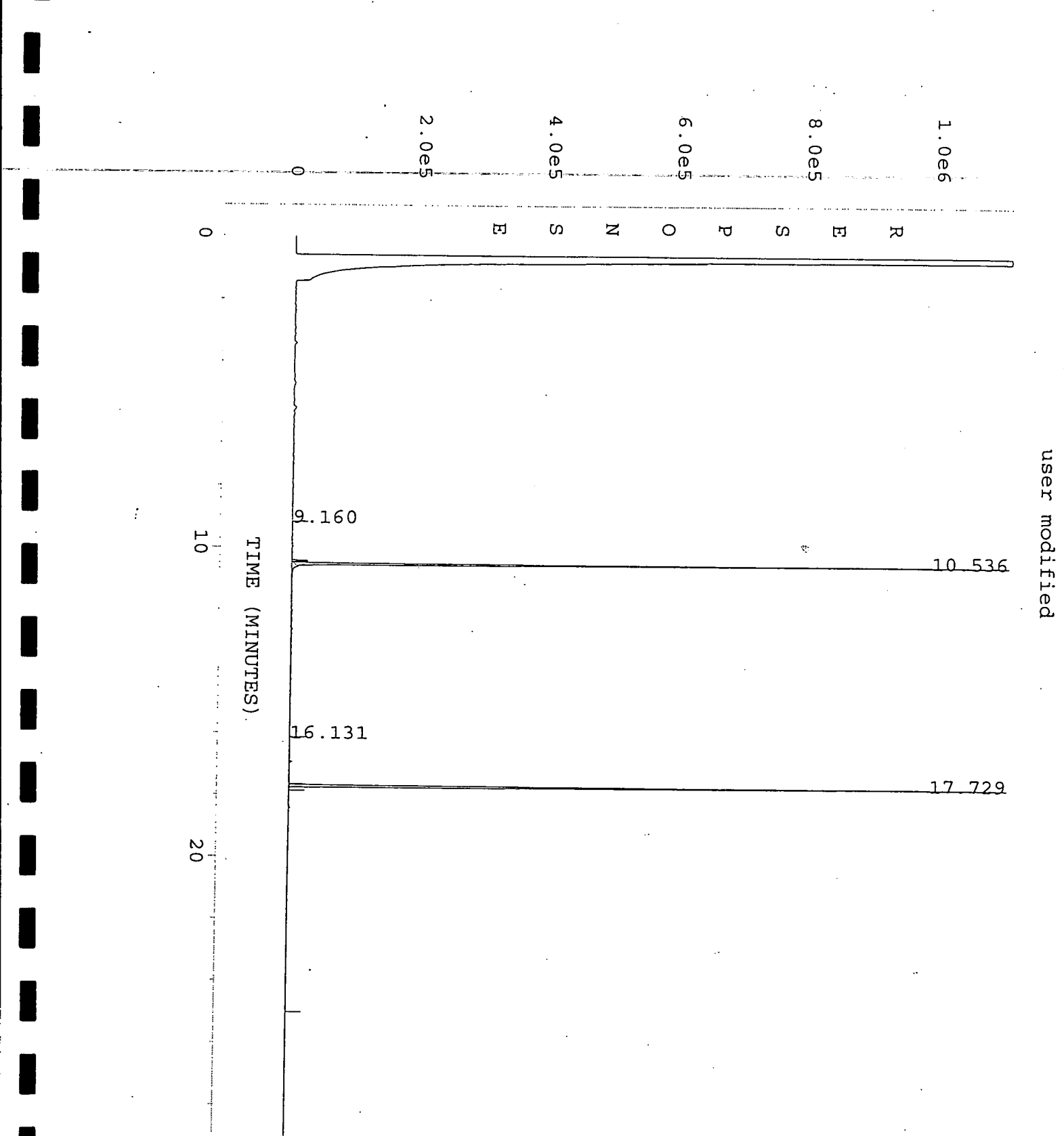
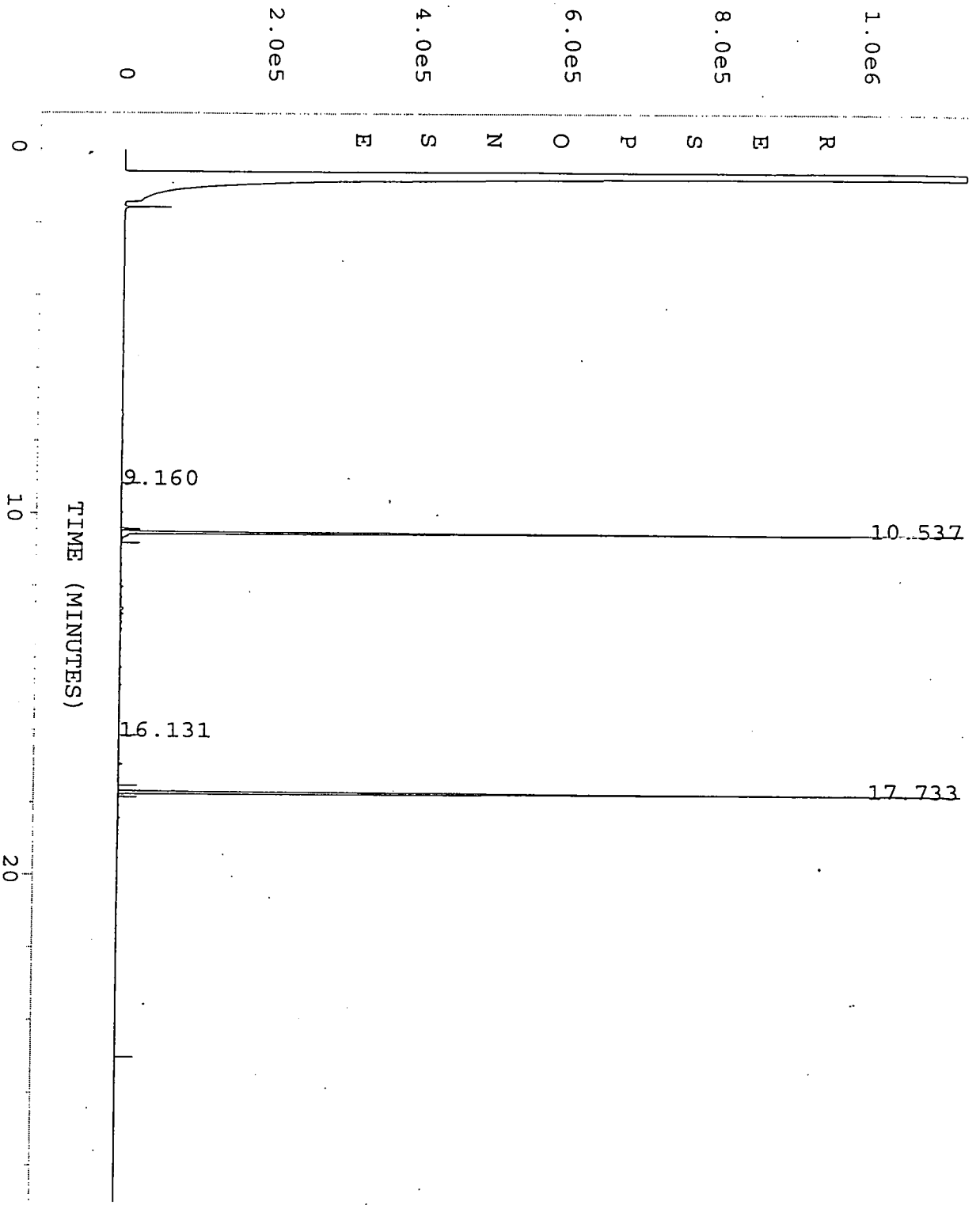
| Report Created on: | 06 Mar 97 08:50 AM | Analysis Method | : TPHE.MTH |




Data File Name : C:\HPCHEM\2\DATA\MAR05\060R0701.D
Operator : TF
Instrument : BOB
Sample Name : 702419-05 W
Run Time Bar Code:
Acquired on : 05 Mar 97 07:30 PM
Report Created on: 06 Mar 97 08:51 AM

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




Data File Name : C:\HPCHEM\2\DATA\MAR05\061R0701.D
Operator : TF
Instrument : BOB
Sample Name : 702419-06 W
Run Time Bar Code:
Acquired on : 05 Mar 97 08:09 PM
Report Created on: 06 Mar 97 08:52 AM

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

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# UNOCAL CHAIN OF CUSTODY REPORT

**UNOCAL INFORMATION**

Facility Number: 5028
Site Address: D Street
City, State, ZIP: Blaine, WA
Site Release Number:
Unocal Manager: Leigh Carlson
CERT INFO: (check one) o Evaluation x Remediation
o Detection o Demolition o Closure o Miscellaneous

**CONSULTANT INFORMATION**

Firm: GeoEngineers Project Number: 9161-349-04
Address: Redmond WA
Phone: 861-6000 Fax: 861-6050
Project Manager: Lisa Bona
Sample Collection by: Sharon Dean

Chain of Custody Record #: 6702419

Quality Assurance Data Level: A1 x
A: Standard Summary
B: Standard + Chromatograms

Laboratory Turnaround Days: x 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 | TRH-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-1 | 02/27/97 1300 | W | 3 | | | | X | | X | | | | | | | | | | B702419-01 |
| 2. MW-2 | 1350 | | 3 | | | | X | | X | | | | | | | | | | 02 |
| 3. MW-3 | 1220 | | 5 | | | | X | | X | | X | | | | | | | | 03 |
| 4. MW-4 | 1240 | | 5 | | | | X | | X | | X | | | | | | | | 04 |
| 5. MW-5 | 1330 | | 3 | | | | X | | X | | | | | | | | | | 05 |
| 6. MW-6 | 1320 | | 3 | | | | X | | X | | | | | | | | | | 06 |
| 7. | | | | | | | | | | | | | | | | | | | |
| 8. | | | | | | | | | | | | | | | | | | | |
| 9. | | | | | | | | | | | | | | | | | | | |
| 10. | | | | | | | | | | | | | | | | | | | |

w/ silica gel cleanup

| Relinquished by: | Firm: | Date & Time | Received by: | Firm: | Date & Time |
|---|---|---|---|---|---|
| 1. Sharon Dean | GEI | 02/27/97 1710 | Dana | NCA-B | 2/27/97 1710 |
| 2. | | | | | |
| 3. | | | | | |

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

Page 1 of 1
Rev. 2.2, 11/94

Comments:

Distribution: White - Laboratory Yellow - Consultant Photocopy - Unocal