

Circle K Station #1461  
Release ID#: 1548  
Seattle



EA Engineering, Science, and Technology, Inc.

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7 November 2006  
61994.01 LN0034

Mr. Roger Nye  
Washington Department of Ecology  
Toxics Cleanup Program  
3190 – 160<sup>th</sup> Avenue Southeast  
Bellevue, Washington 98008-5452

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DEPT OF ECOLOGY

RE: Circle K Station #1461  
Groundwater Monitoring Data Summary for August 2006  
Recommendations for Additional Cleanup Action Tests  
Work Order #17079, Contract Number: 30700

Dear Mr. Nye:

This letter provides a summary of the results from the groundwater sampling event conducted on 3 August 2006 at Circle K Station #1461, in the Montlake area of Seattle.

**1.0 FIELD ACTIVITIES**

On 3 August 2006, EA Engineering, Science, and Technology, Inc. (EA) personnel gauged all monitoring wells at the site for the presence of free product. Free product was measured in four wells at the following thicknesses; 0.12 ft in MW-4, 0.03 ft in MW-13, 0.01 ft in MW-8, and 0.01 ft in MW-9. Free product was not observed in wells MW-6, MW-7, MW-10, MW-11, MW-14, MW-15 or MW-16.

EA collected groundwater samples from MW-6 and MW-15 in accordance with the Sampling and Analysis Plan (SAP)<sup>1</sup>, using a peristaltic pump and low-flow sampling procedures. Wells with measurable free product (MW-4, MW-8, MW-9, and MW-13) were not sampled. (The remaining wells are not included in quarterly sampling, per the SAP.)

In the monitoring wells sampled, the tubing intake was placed three to five feet from the bottom of the wells during sampling. Groundwater was purged at a rate of 300-350 milliliters per minute. Groundwater quality parameters were measured every three minutes during purging until parameters stabilized. Groundwater samples were then collected. A duplicate sample was collected from MW-15 (CK-MW15D). Table 1 summarizes monitoring well construction information, water level measurements, and field parameter measurements obtained after the readings stabilized. A site map showing monitoring well locations is attached as Figure 1.

In accordance with the SAP, groundwater samples were submitted for laboratory analysis of gasoline range organics (GRO); benzene, toluene, ethylbenzene, and xylenes (BTEX); diesel range organics (DRO); and lube oil range organics (LRO). Samples were not analyzed for lead due to historical non-detect or near non-detect concentrations. Groundwater purged during

<sup>1</sup> EA Engineering, Science, and Technology, Inc. 2006. Sampling and Analysis Plan for Amendment No. 2, Revision 1, Work Order #17079, Contract Number: 30700. March 8.

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monitoring well sampling was contained in a 55-gallon drum within the fenced enclosure at the rear of the Jays Cleaners/Mont's Market building.

## 2.0 GROUNDWATER MONITORING RESULTS

Laboratory reports for groundwater samples are attached. Analytical results and are summarized in Table 2, along with prior sampling results. GRO, DRO, and benzene concentrations for the August 2006 sampling event are also shown on Figure 1. Analytical results for the August 2006 sampling event are generally consistent with previous results. Following is a discussion of the findings.

- Results for the sample collected from MW-6 were below the laboratory reporting limits for all analytes.
- In the sample from MW-15, GRO was detected at a concentration of 1,350 micrograms per liter ( $\mu\text{g/L}$ ), exceeding the MTCA Method A cleanup criteria of 800  $\mu\text{g/L}$ . DRO was reported at a concentration of 520  $\mu\text{g/L}$ , slightly exceeding the MTCA Method A cleanup criteria of 500  $\mu\text{g/L}$ . However, the laboratory noted that the sample chromatographic pattern for the DRO analysis did not resemble the fuel standard used for quantitation. (During previous sampling rounds, the laboratory has noted that DRO detections were primarily due to overlap from a gasoline-range product.) All four BTEX constituents were detected in this sample at concentrations below the MTCA criteria.

Quality control (QC) samples were collected and analyzed according to the approved SAP. Results for the field QC samples (field duplicate and trip blank samples) were within acceptance limits. The results of laboratory QC samples (*i.e.*, matrix spikes, blanks, blank spikes, and duplicates) were within the laboratory's acceptance limits. The laboratory noted that the sample temperature upon receipt was 11° C; this exceeds the standard sampling protocol range of 2° to 6° C. This occurred because the samples were delivered to the laboratory immediately after collection and did not have time to cool completely.

## 3.0 GROUNDWATER ELEVATION DATA

Groundwater elevations measured in the site wells on 3 August 2006 had decreased from measurements from May 2006, as expected due to seasonal decreases in rainfall. Groundwater contours for August 2006 are provided on Figure 2. Groundwater flow was generally to the southeast (with some more southerly and easterly components) at a gradient of approximately 0.035 ft/ft.

During previous groundwater sampling events by EA in May 2005, February 2006, and May 2006, no dominant direction of groundwater flow was apparent across the site. Estimated groundwater contours for the February and May 2006 sampling events are shown on Figures 3 and 4. Of the four sampling events performed by EA, the highest groundwater elevations were observed in February 2006 and the lowest elevations were observed in August 2006. This is as expected based on seasonal rainfall variations. (Note that we have not yet completed one full year of quarterly sampling; the final quarterly sampling event for 2006 is scheduled for November.)

Although the seasonal high and low water levels occurred when expected, a review of 2006 water elevation data indicates that the degree of water level fluctuation in the site monitoring wells is not consistent between wells. The maximum water level fluctuation during 2006 was calculated for each site well ("annual water level fluctuation" in Table 3). The average annual water level fluctuation for all monitoring wells during 2006 was 4.46 ft. However, several wells exhibited significantly different annual water level fluctuations, as follows:

- MW-6 had a much smaller fluctuation of only 0.94 ft
- MW-8 also had a significantly smaller fluctuation of 3.05 ft
- MW-11 had a much larger fluctuation of 8.88 ft
- MW-4 also had a significantly larger fluctuation of 5.92 ft.

This difference in water level fluctuations between wells impacts the groundwater flow direction at the site. Wells MW-6 and MW-8, located near the center of the study area, fluctuate little, while wells MW-4 and MW-11, located near the south and north edges of the study area, fluctuate significantly. This causes a shift in groundwater flow direction at the site, with groundwater appearing to flow radially toward MW-6 at times during the year (see Figures 3 and 4) and more southeasterly at other times (see Figure 2).

The reason for the variation in annual water level fluctuations at the site is not known. A review of well logs and site lithology did not reveal any apparent causes. The reported lithology does not differ significantly for those wells with significant variations in fluctuations.

Several corrections and updates can be made to the site information presented in EA's 2005 summary report, based on the 2006 sampling data. The depth to groundwater at the site ranges from at least 2.4 ft bgs (MW-11 in February) to 14.5 ft bgs (MW-4 in August). This is a considerably wider range than that identified previously (9 to 12 ft bgs), based only on information presented in the 1990 GeoEngineers report<sup>2</sup>. Additionally, the groundwater flow directions observed differs from that presented in the GeoEngineers report (identified by them as generally to the northeast).

#### **4.0 DISCUSSION AND CONCLUSIONS**

The primary concern at this site remains the presence of free product. Until the free product is removed, it will continue to act as an ongoing source for groundwater contamination.

On 9 June 2005, a test was conducted at the former Circle K facility to determine the effectiveness of enhanced fluid recovery (EFR<sup>®</sup>). During the 8-hr test, approximately 18 gallons of hydrocarbons were extracted from the subsurface in the vapor and liquid phases. Prior to testing, free product levels were highest in MW-4, and measurable in wells MW-8, MW-9 and MW-13. On 23 June 2006, free product was not present in measurable quantities in any well, though trace quantities were found in MW-4, MW-8 and MW-9. Since the test, free product levels were measured during three quarterly sampling events. Levels of free product have rebounded, though they have not returned to pre-test levels in MW-4. The following table

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<sup>2</sup> GeoEngineers. 1990. Report of Geotechnical Services, Subsurface Contamination Study and Remedial Action Monitoring, Circle K Facility 1461, Seattle, Washington. Report prepared for The Circle K Corporation. March 6.

summarizes free product levels before testing and at current levels. Additional measurements are presented in Table 2.

Monitoring Well	Product Thickness 31 May 2005 (Before EFR Test)	Product Thickness 23 June 2006 (2 weeks after EFR Test)	Product Thickness 3 August 2006
MW-4	0.3	Trace	0.12
MW-8	Trace	Trace	0.01
MW-9	0.02	Trace	0.01
MW-13	0.01	None measured	0.03

During the EFR<sup>®</sup> test conducted last year, a significant quantity of free product was removed, however over the past year, free product levels in the monitoring wells are rebounding. Because of this, gasoline and BTEX constituent concentrations are not decreasing in groundwater. Typically, EFR<sup>®</sup> is used numerous times at a site before free product removal is complete. The addition of a non-toxic, biodegradable, surfactant has been shown to improve free product removal during EFR<sup>®</sup> events. Adding the surfactant alters the properties of organic-water interface. The surfactant mobilizes the free product, allowing easier extraction using EFR<sup>®</sup>. To test if the addition of surfactants will remove free product more rapidly than the traditional EFR<sup>®</sup>, another test is recommended, though this time with the addition of a surfactant. The test will be conducted in 4 phases, as described below.

**Phase 1: EFR<sup>®</sup> Test Event**

The first phase of the test requires an 8-hour EFR<sup>®</sup> test event. This test will remove contaminants by the multi-phase/dual-phase extraction process, reduce the aerial and vertical extent of the plumes, determine if additional EFR<sup>®</sup> events are necessary prior to surfactant injection, determine the surfactant injection volumes/locations/sequence, and determine the duration of the next phase of the test.

Also during Phase 1, the existing product recovery well will be pumped to remove any free product that has accumulated since the system was turned off.

**Phase 2: Surfactant Injection**

During Phase 2, an EFR<sup>®</sup>/surfactant injection event will be conducted. This event will consist of approximately 4 to 6 hours of extraction followed by 2 to 4 hours of surfactant injection.

**Phase 3: Surfactant “Capture”**

Two 8-hour EFR<sup>®</sup>/surfactant capture events will take place on consecutive days as Phase 3, commencing 16 to 48 hours following the completion of Phase 2. The goal of this phase event is to recover approximately at 100 times the volume of the undiluted surfactant injected into the groundwater.

#### **Phase 4: "Polishing" EFR® Event**

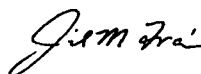
During Phase 4 an 8-hour "polishing" event will take place approximately four weeks following the completion of Phase 3 to remove any remnants of free product or surfactant that may exist remain.

Suggest conducting the test when water levels are high. Based on historical information, this would suggest the best time to conduct the test would be during the winter months, sometime between December and March.

After the test, we recommend conducting an additional quarterly groundwater sampling event including product measurement in all site wells following the EFR event.

Please feel free to contact me at (425) 451-7400 if you have any questions about the enclosed.

Sincerely,  
EA ENGINEERING, SCIENCE,  
AND TECHNOLOGY, INC.

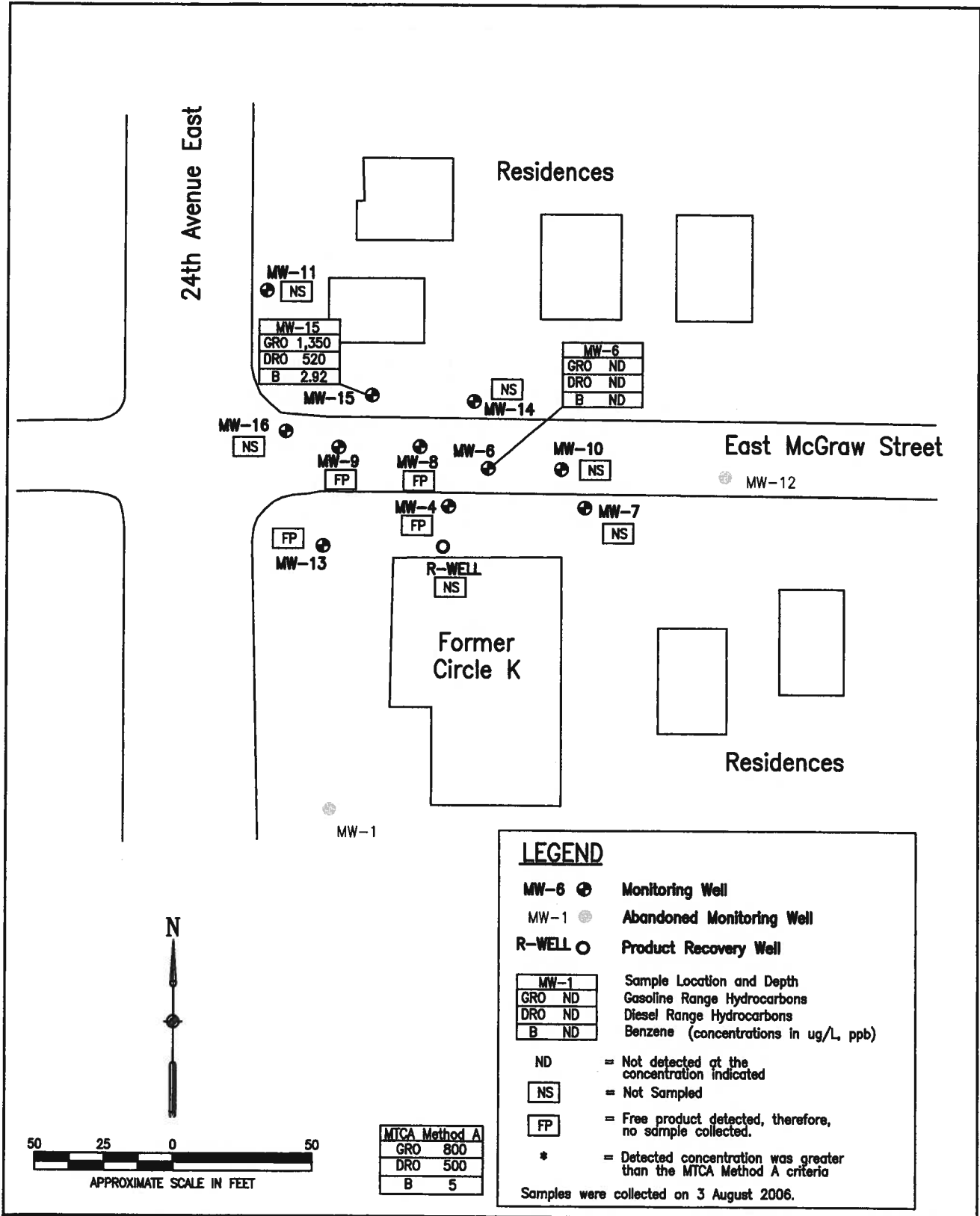


Jil Frain, P.E.  
Project Manager  
[jfrain@eaest.com](mailto:jfrain@eaest.com)

#### **Attachments:**

- Figure 1 – Site Map with Groundwater Monitoring Results – Circle K Station #1461
- Figure 2 – Groundwater Elevations and Contour Lines, 3 August 2006 – Circle K Station #1461
- Figure 3 – Groundwater Elevations and Contour Lines, 18 May 2006 – Circle K Station #1461
- Figure 4 – Groundwater Elevations and Contour Lines, 14 February 2006 – Circle K Station #1461
- Table 1 – Monitoring Well Construction and Field Measurement Data – Circle K Station #1461
- Table 2 – Summary of Groundwater Analytical Data – Circle K Station #1461
- Table 3 – Groundwater Elevation Summary – Circle K Station #1461
- Appendix A – Purge and Sampling Forms
- Appendix B – Laboratory Reports

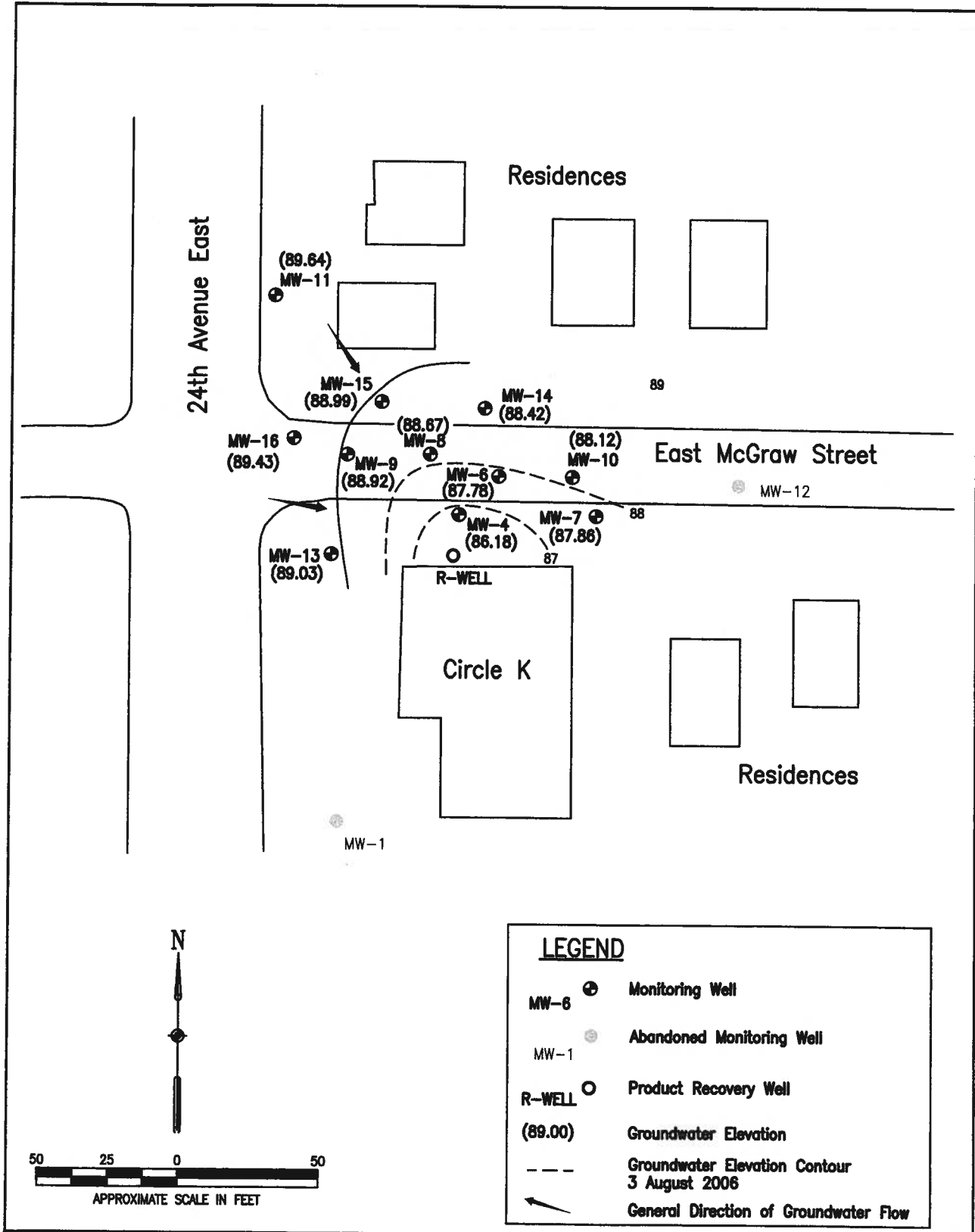
## **Figures**



G:\Projects\61994.01 2006\_2007 Ecology LUST Sites\Circle K\GW report-Aug 2006\Fig.1 GW Results.dwg, Model, 11/6/2006 3:45:48 PM

Figure 1. Site Map with Groundwater Monitoring Results – Circle K Station #1461

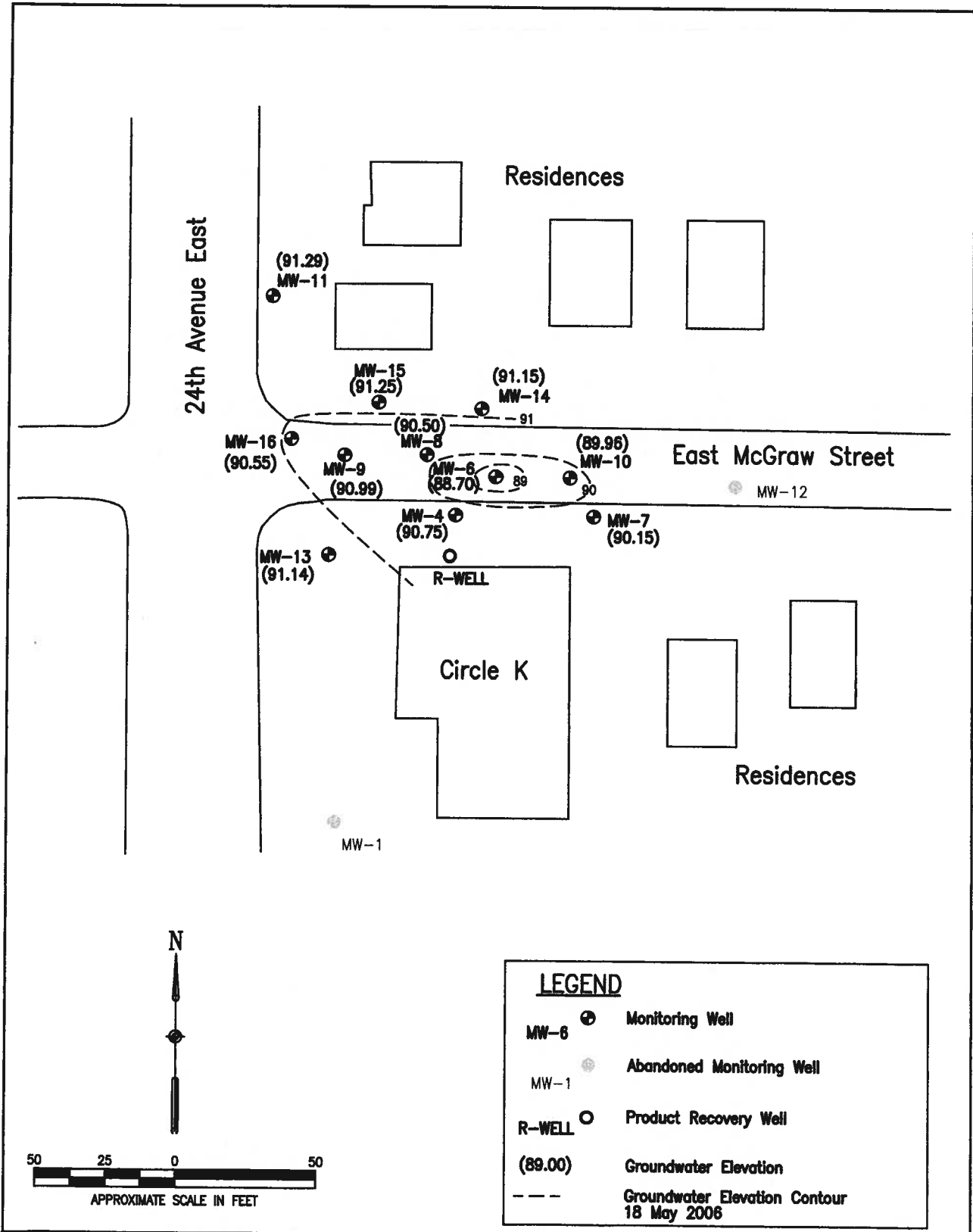




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Figure 2. Groundwater Elevations and Contour Lines, 3 August 2006 – Circle K Station #1461

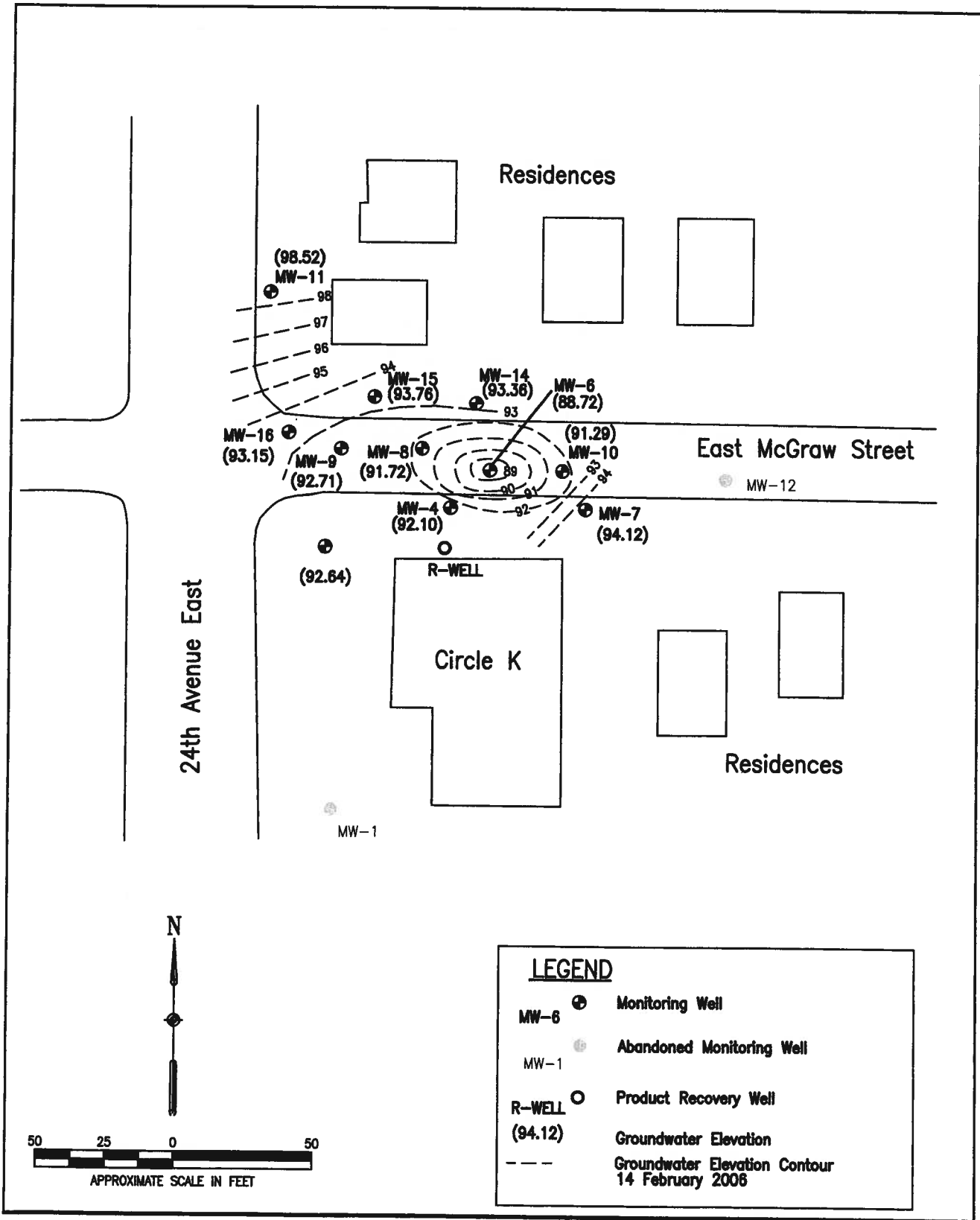




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Figure 3. Groundwater Elevations and Contour Lines, 18 May 2006 -- Circle K Station #1461





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Figure 4. Groundwater Elevations and Contour Lines, 14 February 2006 – Montlake Circle K



## **Tables**

TABLE 1. MONITORING WELL CONSTRUCTION AND FIELD MEASUREMENT DATA - CIRCLE K STATION #1461

Well ID	Date Installed	Well Diameter (inches)	Reported Screen Depth (ft bgs)	Total Depth (ft btoc)	Top of Casing Elevation (ft)	Depth to Water 3-Aug-06 (ft btoc)	Depth to Product 3-Aug-06 (ft btoc)	Free Product Thickness 3-Aug-06 (ft)	Groundwater Elevation 3-Aug-06 (ft)
MW-4	9/12/1989	2	4 - 18.5	17.90	100.73	14.67	14.55	0.12	86.18
MW-6	10/2/1989	2	5 - 20	20.43	100.24	12.46	NA	NA	87.78
MW-7	10/2/1989	2	5 - 20	20.49	99.75	11.89	NA	NA	87.86
MW-8	10/3/1989	2	5 - 20	19.45	100.70	12.04	12.03	0.01	88.67
MW-9	10/3/1989	2	5 - 21	20.35	101.41	12.50	12.49	0.01	88.92
MW-10	10/3/1989	2	5 - 20	20.47	99.96	11.84	NA	NA	88.12
MW-11	10/4/1989	2	5 - 20	20.31	100.89	11.25	NA	NA	89.64
MW-12	10/4/1989	2	5 - 20	abandoned	abandoned	NA	NA	NA	NA
MW-13	12/20/1989	2	4 - 19	18.81	102.19	13.19	13.16	0.03	89.03
MW-14	12/20/1989	2	4 - 19	18.87	100.40	11.98	NA	NA	88.42
MW-15	12/21/1989	2	4 - 18.5	16.81	101.29	12.3	NA	NA	88.99
MW-16	12/21/1989	2	4 - 19	18.94	101.15	11.72	NA	NA	89.43

Water Quality Parameters							
Well ID	Date Measured	pH	Conductivity (mS/cm)	Turbidity (NTUs)	Dissolved Oxygen (mg/L)	Temperature (°C)	Oxidation-Reduction Potential (mV)
MW-6	8/3/2006	7.06	1.67	1.5	0.71	17.6	-42
MW-15	8/3/2006	5.62	2.233	1.3	0.78	15.8	42.4

NOTES:

°C = degrees Celsius.

ft bgs = feet below ground surface.

ft btoc = feet below top of casing.

NA = Not applicable.

NTUs = Nephelometric turbidity units.

mS/cm = millisiemens per centimeter.

mg/L = milligrams per liter.

mV = millivolts

**TABLE 2. SUMMARY OF GROUNDWATER ANALYTICAL DATA  
CIRCLE K STATION #1461**

Well ID	Date Sampled	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (total) (ug/L)	GRO (ug/L)	DRO (ug/L)	LRO (ug/L)	Product Thickness	
CK-MW4	4/11/2001	7,370	28,000	2,680	17,100	117,000	NA	NA	0.03	
	6/16/2003	No sample collected							0.09	
	5/31/2005	No sample collected							0.3	
	6/23/2005	240	3,750	1,640	10,700	65,600	1,870 D-08	500 U	?	
	2/14/2006	Not Sampled - Free product measured in well								0.02
	5/18/2006	Not Sampled - Free product measured in well								0.14
CK-MW6	8/3/2006	Not Sampled - Free product measured in well								0.12
	4/11/2001	0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	NA	NA	ND	
	6/16/2003	0.5 U	0.5 U	0.5 U	1.0 U	1.0 U	NA	NA	ND	
	2/14/2006	0.982	0.500 U	3.84	7.13	67.5	243 U	485 U	ND	
	5/18/2006	0.514	0.500 U	1.48	1.00 U	50.0 U	243 U	485 U	ND	
	5/18/2006*	0.500 U	0.500 U	1.28	1.00 U	50.0 U	240 U	481 U	ND	
CK-MW8	8/3/2006	0.500 U	0.500 U	0.500 U	1.00 U	50.0 U	238 U	476 U	ND	
	4/11/2001	802	9770	1520	7030	46,400	NA	NA	0.01	
	6/16/2003	No sample collected							0.01	
	5/31/2005	No sample collected							?	
	6/23/2005	No sample collected							?	
	2/14/2006	342	143,000	2,670	14,800	102,000	2,390 D-08	472 U	?	
CK-MW9	2/14/2006*	452	14,000	2,770	14,900	89,000	2,230 D-08	472 U	?	
	5/18/2006	Not Sampled - Free product measured in well							0.05	
	8/3/2006	Not Sampled - Free product measured in well							0.01	
	4/11/2001	420	2,310	1,500	7,350	35,400	NA	NA	0.01	
	6/16/2003	No sample collected							0.02	
	5/31/2005	No sample collected							0.02	
CK-MW10	6/23/2005	1,820	6,140	1,820	9,350	71,300	1,810 D-08	500 U	?	
	2/14/2006	Not Sampled - Free product measured in well							0.02	
	5/18/2006	535	2,300	1,730	8,390	52,200	2,530 D-08	485 U	?	
	8/3/2006	Not Sampled - Free product measured in well							0.01	
	5/18/2006	0.5 U	0.5 U	0.5 U	1.0 U	50.0 U	236 U	472 U	ND	
	CK-MW11	4/11/2001	0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	NA	NA	ND
6/16/2003		0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	NA	NA	ND	
2/14/2006		0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	240 U	481 U	ND	
CK-MW13	7/11/2003	No sample collected							0.02	
	5/13/2005	No sample collected							0.01	
	6/23/2005	8,560	16,800	1,920	12,900	115,000	3,720 D-08	500 U	ND	
	6/23/2005*	8,560	16,900	1,880	12,700	121,000	3,010 D-08	500 U	ND	
	2/14/2006	2,270	6,660	1,530	14,100	74,700	3,010 D-08	472 U	?	
	5/18/2006	7,260	14,700	1,810	15,500	109,000	4,650 D-08	481 U	?	
CK-MW14	8/3/2006	Not Sampled - Free product measured in well							0.03	
	4/11/2001	0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	NA	NA	ND	
	6/16/2003	0.5 U	0.5 U	0.5 U	1.0 U	1.0 U	NA	NA	ND	
CK-MW15	2/14/2006	0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	243 U	485 U	?	
	4/11/2001	58.4	310.0	526.0	2,920.0	23,800	NA	NA	ND	
	6/16/2003	6.2	83.3	12.6	199.0	3,150	NA	NA	ND	
	5/31/2005	1.26	0.500 U	2.60 I-06	3.39 I-06	878	NA	NA	ND	
	6/23/2005	2.01	3.18	2.48	6.34	950	749 D-08	500 U	ND	
	2/14/2006	0.5 U	0.5 U	0.5 U	1.0 U	137	552	472 U	ND	
	5/18/2006	0.791	1.69	0.816	5.82	381	236 U	472 U	ND	
	8/3/2006	2.92	6.86	6.03	41.9	1,350	520 D-06	481 U	ND	
	8/3/2006*	3.29	6.60	6.78	45.1	1,580	392 D-06	476 U	ND	
CK-MW16	4/11/2001	0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	NA	NA	ND	
	6/16/2003	0.5 U	0.5 U	0.5 U	1.0 U	0.05 U	NA	NA	ND	
	2/14/2006	0.5 U	0.5 U	0.5 U	1.0 U	50.00 U	236 U	472 U	?	
MTCA Method A		5	1,000	700	1,000	800/1,000	500	500		

**NOTES:**

Sample results from 2001 and 2003 were provided by the Washington Department of Ecology.

Shaded cells indicate the results exceed the cleanup criteria.

\* Duplicate sample.

MTCA Method A cleanup level for gasoline is 800 ug/L instead of 1,000 ug/L when benzene is present.

U = Not detected at or above the specified reporting limit.

D-08 = Results in the diesel organics range are primarily due to overlap from a gasoline range product.

D-06 = The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

I-06 = The analyte concentration may be artificially elevated due to coeluting compounds or components.

DRO = Diesel range organics.

GRO = Gasoline range organics.

LRO = Lube-oil range organics.

ug/L = micrograms per liter.

mg/L = milligrams per liter

NA = not analyzed

? = "trace" product < 0.01 ft free product in well

ND = no free product detected in this well

**TABLE 3. GROUNDWATER ELEVATION SUMMARY - CIRCLE K STATION #1461**

Well ID	Top of Casing Elevation (ft)	Groundwater Elevation 31 May 2005 (ft)	Groundwater Elevation 14 Feb 2006 (ft)	Groundwater Elevation 18 May 2006 (ft)	Groundwater Elevation 3 August 2006 (ft)	Annual Water Level Fluctuation (ft)
MW-4	100.73	91.02	92.10	90.75	86.18	5.92
MW-6	100.24	88.69	88.72	88.70	87.78	0.94
MW-7	99.75	90.63	94.12	90.15	87.86	6.26
MW-8	100.70	90.69	91.72	90.50	88.67	3.05
MW-9	101.41	91.34	92.71	90.99	88.92	3.79
MW-10	99.96	90.13	91.29	89.96	88.12	3.17
MW-11	100.89	92.23	98.52	91.29	89.64	8.88
MW-13	102.19	91.29	92.64	91.14	89.03	3.61
MW-14	100.40	91.62	93.36	91.15	88.42	4.94
MW-15	101.29	91.86	93.76	91.25	88.99	4.77
MW-16	101.15	91.64	93.15	90.55	89.43	3.72
Average =						4.46

**NOTES:**

ft bgs = feet below ground surface.

ft btoc = feet below top of casing.

TOC elevations are per INCA 22 March 2006 survey.

**Appendix A**  
**Purge and Sampling Forms**







# Ground Water Purge and Sampling Form

Well Identification	MW-15									
Well Diameter (inches)	2" ✓									
Well Monument Locked and Good Condition?	yes ✓									
Inside Well Head and Outside Well Casing (D=dry), (WAC=Water above Casing), WBC=Water Below Casing)	D ✓									
Well Casing Plug Locked and Good Condition?	yes ✓									
Initial Depth to Water (ft btoc)	1230									
Well Total Depth (ft btoc)	1654 + .28 = 1682.28									
Time	1158	1201	1204	1207	1210	1213				
Depth to Ground water (ft btoc)	1259	1267	1277	-	1291					
Total Groundwater Purged (gallons)	-	-	-	-	1	1.1				
Purge Rate (gpm, ml/min, other)	300									
pH	5.84	5.70	5.66	5.67	5.63	5.62				
Conductivity (mS/cm)	2.550	2.570	3.040	2.974	2.244	2.233				
Turbidity (NTU)	12	8	7.6	2.1	1.8	1.3				
Dissolved Oxygen (mg/L)	2.31	1.00	0.77	0.70	0.71	0.78				
Temperature (°C)	15.53	15.76	15.62	15.60	15.81	15.81				
ORP/eH (mV)	28.4	31.9	33.0	34.9	40.3	42.4				
Color of Purged Water (gray, brown, red, clear)	clear									
Sample Identification: CK-MW 15 / CK-MW 15 D	Analysis									
Time Sampled: 1220 / 1230	<input checked="" type="checkbox"/> NWTTPH-Gasoline <input checked="" type="checkbox"/> BTEX (8021B) <input checked="" type="checkbox"/> NWTTPH-Dx									
Purge water disposed To: Drum Onsite	# of Bottles: 3 Comments: Tubing pulled up 3' off bottom.									

Site Location: Ecology - Circle K Station # 1461    Date: 8/3/06  
 Project Number: 6199401 6000 B    Personnel: MBB  
 Purge Method:  Low Flow     Conventional     None  
 Purge Equipment:  Peristaltic Pump     Bailer     Grundfos submersible  
 Sampling Equipment:  Peristaltic Pump     Bailer     Grundfos submersible  
 Weather Conditions: clear, sunny ~ 73°F    Blue Angels flying over  
 Well Volume Calculation: 2"=.16, 4"=.64, 6"=1.44 gallons

## **Appendix B**

### **Laboratory Reports**

August 11, 2006

Jill Frain  
EA Engineering, Science and Technology  
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Bellevue, WA/USA 98005

RE: Circle K

Enclosed are the results of analyses for samples received by the laboratory on 08/03/06 13:50.  
The following list is a summary of the Work Orders contained in this report, generated on 08/11/06  
13:27.

If you have any questions concerning this report, please feel free to contact me.

---

<u>Work Order</u>	<u>Project</u>	<u>ProjectNumber</u>
BPH0087	Circle K	61994.01

---

*Sandra Yakamavich*

Sandra Yakamavich For Kortland Orr, PM



## CASE NARRATIVE for Work Order BPH0087

Client: EA Engineering, Science and Technology  
Project Manager: Jill Frain  
Project Name: Circle K  
Project Number: 61994.01

### 1.0 DESCRIPTION OF CASE

Four aqueous samples were received for analysis of:

- Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B
- Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up)

### 2.0 COMMENTS ON SAMPLE RECEIPT

The samples were received on 08/03/06 in good condition. The sample temperature at the time of receipt was 11 °C.

### 3.0 PREPARATIONS AND ANALYSIS

#### *Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B*

There were no anomalies associated with sample preparation and analysis.

Quality Control criteria for the analytical batch were met.

#### *Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up)*

All anomalies associated with sample preparation and analysis were appropriately qualified in the analytical report.

Quality Control criteria for the analytical batch were met.



---

Sandra Yakamavich  
Project Manager  
North Creek Analytical





**EA Engineering, Science and Technology**

12011 NE 1st Street, Suite 100  
 Bellevue, WA/USA 98005

Project Name: **Circle K**

Project Number: 61994.01

Project Manager: Jill Frain

Report Created:

08/11/06 13:27

## ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
CK-MW6	BPH0087-01	Water	08/03/06 11:20	08/03/06 13:50
CK-MW15	BPH0087-02	Water	08/03/06 12:20	08/03/06 13:50
CK-MW15D	BPH0087-03	Water	08/03/06 12:30	08/03/06 13:50
CK-MW-TB	BPH0087-04	Water	08/03/06 12:00	08/03/06 13:50

*Sandra Yakamovich*

Sandra Yakamovich For Kortland Orr, PM



EA Engineering, Science and Technology  
 12011 NE 1st Street, Suite 100  
 Bellevue, WA/USA 98005

Project Name: **Circle K**  
 Project Number: 61994.01  
 Project Manager: Jill Frain

Report Created:  
 08/11/06 13:27

## Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B

TestAmerica - Seattle, WA

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes	
<b>BPH0087-01 (CK-MW6)</b>		<b>Water</b>			<b>Sampled: 08/03/06 11:20</b>						
Gasoline Range Hydrocarbons	NWTPH-Gx/802 1B	ND	---	50.0	ug/l	1x	6H07021	08/07/06 09:58	08/07/06 21:54		
Benzene	"	ND	---	0.500	"	"	"	"	"		
Toluene	"	ND	---	0.500	"	"	"	"	"		
Ethylbenzene	"	ND	---	0.500	"	"	"	"	"		
Xylenes (total)	"	ND	---	1.00	"	"	"	"	"		
Surrogate(s): 4-BFB (FID)			91.8%		58 - 144 %	"				"	
4-BFB (PID)			97.8%		68 - 140 %	"				"	
<b>BPH0087-02 (CK-MW15)</b>		<b>Water</b>			<b>Sampled: 08/03/06 12:20</b>						
Gasoline Range Hydrocarbons	NWTPH-Gx/802 1B	1350	---	50.0	ug/l	1x	6H07021	08/07/06 09:58	08/07/06 22:57		
Benzene	"	2.92	---	0.500	"	"	"	"	"		
Toluene	"	6.86	---	0.500	"	"	"	"	"		
Ethylbenzene	"	6.03	---	0.500	"	"	"	"	"		
Xylenes (total)	"	41.9	---	1.00	"	"	"	"	"		
Surrogate(s): 4-BFB (FID)			119%		58 - 144 %	"				"	
4-BFB (PID)			95.3%		68 - 140 %	"				"	
<b>BPH0087-03 (CK-MW15D)</b>		<b>Water</b>			<b>Sampled: 08/03/06 12:30</b>						
Gasoline Range Hydrocarbons	NWTPH-Gx/802 1B	1580	---	50.0	ug/l	1x	6H07021	08/07/06 09:58	08/08/06 11:07		
Benzene	"	3.29	---	0.500	"	"	"	"	"		
Toluene	"	6.60	---	0.500	"	"	"	"	"		
Ethylbenzene	"	6.78	---	0.500	"	"	"	"	"		
Xylenes (total)	"	45.1	---	1.00	"	"	"	"	"		
Surrogate(s): 4-BFB (FID)			123%		58 - 144 %	"				"	
4-BFB (PID)			94.3%		68 - 140 %	"				"	
<b>BPH0087-04 (CK-MW-TB)</b>		<b>Water</b>			<b>Sampled: 08/03/06 12:00</b>						
Gasoline Range Hydrocarbons	NWTPH-Gx/802 1B	ND	---	50.0	ug/l	1x	6H07021	08/07/06 09:58	08/08/06 10:36		
Benzene	"	ND	---	0.500	"	"	"	"	"		
Toluene	"	ND	---	0.500	"	"	"	"	"		
Ethylbenzene	"	ND	---	0.500	"	"	"	"	"		
Xylenes (total)	"	ND	---	1.00	"	"	"	"	"		
Surrogate(s): 4-BFB (FID)			92.7%		58 - 144 %	"				"	
4-BFB (PID)			98.0%		68 - 140 %	"				"	

TestAmerica - Seattle, WA

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

*Sandra Yakamovich*

Sandra Yakamovich For Kortland Orr, PM



EA Engineering, Science and Technology  
 12011 NE 1st Street, Suite 100  
 Bellevue, WA/USA 98005

Project Name: **Circle K**  
 Project Number: 61994.01  
 Project Manager: Jill Frain

Report Created:  
 08/11/06 13:27

**Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up)**  
 TestAmerica - Seattle, WA

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
<b>BPH0087-01 (CK-MW6)</b>		<b>Water</b>		<b>Sampled: 08/03/06 11:20</b>						
Diesel Range Hydrocarbons	NWTPH-Dx	ND	---	0.238	mg/l	1x	6H04037	08/04/06 14:47	08/08/06 15:29	
Lube Oil Range Hydrocarbons	"	ND	---	0.476	"	"	"	"	"	
<i>Surrogate(s): 2-FBP</i>			85.3%		53 - 125 %	"				"
<i>Octacosane</i>			88.2%		68 - 125 %	"				"
<b>BPH0087-02 (CK-MW15)</b>		<b>Water</b>		<b>Sampled: 08/03/06 12:20</b>						
Diesel Range Hydrocarbons	NWTPH-Dx	0.520	---	0.240	mg/l	1x	6H04037	08/04/06 14:47	08/08/06 15:58	D-06
Lube Oil Range Hydrocarbons	"	ND	---	0.481	"	"	"	"	"	
<i>Surrogate(s): 2-FBP</i>			103%		53 - 125 %	"				"
<i>Octacosane</i>			95.0%		68 - 125 %	"				"
<b>BPH0087-03 (CK-MW15D)</b>		<b>Water</b>		<b>Sampled: 08/03/06 12:30</b>						
Diesel Range Hydrocarbons	NWTPH-Dx	0.392	---	0.238	mg/l	1x	6H04037	08/04/06 14:47	08/08/06 16:28	D-06
Lube Oil Range Hydrocarbons	"	ND	---	0.476	"	"	"	"	"	
<i>Surrogate(s): 2-FBP</i>			104%		53 - 125 %	"				"
<i>Octacosane</i>			92.4%		68 - 125 %	"				"

*Sandra Yakamovich*

Sandra Yakamovich For Kortland Orr, PM





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 Bellevue, WA/USA 98005

Project Name: **Circle K**  
 Project Number: 61994.01  
 Project Manager: Jill Frain

Report Created:  
 08/11/06 13:27

**Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B - Laboratory Quality Control Results**  
 TestAmerica - Seattle, WA

QC Batch: 6H07021 Water Preparation Method: EPA 5030B (P/T)

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
<b>Blank (6H07021-BLK1)</b>													Extracted: 08/07/06 09:58	
Gasoline Range Hydrocarbons	NWTPH-Gx/ 8021B	ND	---	50.0	ug/l	1x	--	--	--	--	--	--	08/07/06 11:05	
Benzene	"	ND	---	0.500	"	"	--	--	--	--	--	--	"	
Toluene	"	ND	---	0.500	"	"	--	--	--	--	--	--	"	
Ethylbenzene	"	ND	---	0.500	"	"	--	--	--	--	--	--	"	
Xylenes (total)	"	ND	---	1.00	"	"	--	--	--	--	--	--	"	
Surrogate(s): 4-BFB (FID)		Recovery: 93.8%	Limits: 58-144%											08/07/06 11:05
4-BFB (PID)		97.8%	68-140%											"

<b>LCS (6H07021-BS1)</b>													Extracted: 08/07/06 09:58	
Gasoline Range Hydrocarbons	NWTPH-Gx/ 8021B	939	---	50.0	ug/l	1x	--	1000	93.9%	(80-120)	--	--	08/07/06 11:42	
Surrogate(s): 4-BFB (FID)		Recovery: 98.8%	Limits: 58-144%											08/07/06 11:42

<b>LCS (6H07021-BS2)</b>													Extracted: 08/07/06 09:58	
Benzene	NWTPH-Gx/ 8021B	31.9	---	0.500	ug/l	1x	--	30.0	106%	(80-120)	--	--	08/07/06 12:13	
Toluene	"	29.9	---	0.500	"	"	--	"	99.7%	"	--	--	"	
Ethylbenzene	"	30.9	---	0.500	"	"	--	"	103%	"	--	--	"	
Xylenes (total)	"	90.7	---	1.00	"	"	--	90.0	101%	"	--	--	"	
Surrogate(s): 4-BFB (PID)		Recovery: 97.8%	Limits: 68-140%											08/07/06 12:13

<b>Duplicate (6H07021-DUP1)</b>													QC Source: BPH0087-01		Extracted: 08/07/06 09:58	
Gasoline Range Hydrocarbons	NWTPH-Gx/ 8021B	ND	---	50.0	ug/l	1x	ND	--	--	--	NR (25)		08/07/06 22:25			
Benzene	"	ND	---	0.500	"	"	ND	--	--	--	NR	"	"			
Toluene	"	ND	---	0.500	"	"	ND	--	--	--	NR	"	"			
Ethylbenzene	"	ND	---	0.500	"	"	ND	--	--	--	NR	"	"			
Xylenes (total)	"	ND	---	1.00	"	"	ND	--	--	--	NR	"	"			
Surrogate(s): 4-BFB (FID)		Recovery: 92.0%	Limits: 58-144%											08/07/06 22:25		
4-BFB (PID)		98.3%	68-140%											"		

<b>Duplicate (6H07021-DUP2)</b>													QC Source: BPH0087-02		Extracted: 08/07/06 09:58	
Gasoline Range Hydrocarbons	NWTPH-Gx/ 8021B	1350	---	50.0	ug/l	1x	1350	--	--	--	0.00% (25)		08/07/06 23:28			
Benzene	"	2.81	---	0.500	"	"	2.92	--	--	--	3.84%	"	"			
Toluene	"	6.79	---	0.500	"	"	6.86	--	--	--	1.03%	"	"			
Ethylbenzene	"	5.97	---	0.500	"	"	6.03	--	--	--	1.00%	"	"			
Xylenes (total)	"	41.5	---	1.00	"	"	41.9	--	--	--	0.959%	"	"			
Surrogate(s): 4-BFB (FID)		Recovery: 120%	Limits: 58-144%											08/07/06 23:28		
4-BFB (PID)		95.3%	68-140%											"		

TestAmerica - Seattle, WA

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*Sandra Yakamovich*

Sandra Yakamovich For Kortland Orr, PM



EA Engineering, Science and Technology  
 12011 NE 1st Street, Suite 100  
 Bellevue, WA/USA 98005

Project Name: **Circle K**  
 Project Number: 61994.01  
 Project Manager: Jill Frain

Report Created:  
 08/11/06 13:27

**Gasoline Hydrocarbons (Benzene to Naphthalene) and BTEX by NWTPH-G and EPA 8021B - Laboratory Quality Control Results**  
 TestAmerica - Seattle, WA

QC Batch: 6H07021 Water Preparation Method: EPA 5030B (P/T)

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
<b>Matrix Spike (6H07021-MS1)</b>		QC Source: BPH0087-01				Extracted: 08/07/06 09:58								
Gasoline Range Hydrocarbons	NWTPH-Gx/ 8021B	1040	---	50.0	ug/l	1x	ND	1000	104%	(75-131)	--	--	08/07/06 23:59	
Surrogate(s): 4-BFB (FID)		Recovery: 98.8%		Limits: 58-144%		"						08/07/06 23:59		
<b>Matrix Spike (6H07021-MS2)</b>		QC Source: BPH0087-02				Extracted: 08/07/06 09:58								
Benzene	NWTPH-Gx/ 8021B	32.0	---	0.500	ug/l	1x	2.92	30.0	96.9%	(46-130)	--	--	08/08/06 00:30	
Toluene	"	32.3	---	0.500	"	"	6.86	"	84.8%	(60-124)	--	--	"	
Ethylbenzene	"	34.3	---	0.500	"	"	6.03	"	94.2%	(56-141)	--	--	"	
Xylenes (total)	"	115	---	1.00	"	"	41.9	90.0	81.2%	(66-132)	--	--	"	
Surrogate(s): 4-BFB (PID)		Recovery: 94.7%		Limits: 68-140%		"						08/08/06 00:30		

*Sandra Yakamovich*

Sandra Yakamovich For Kortland Orr, PM



**EA Engineering, Science and Technology**

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 Bellevue, WA/USA 98005

Project Name: **Circle K**  
 Project Number: 61994.01  
 Project Manager: Jill Frain

Report Created:  
 08/11/06 13:27

**Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up) - Laboratory Quality Control Results**  
 TestAmerica - Seattle, WA

QC Batch: 6H04037 Water Preparation Method: EPA 3520C

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
<b>Blank (6H04037-BLK1)</b>													Extracted: 08/04/06 14:47	
Diesel Range Hydrocarbons	NWTPH-Dx	ND	--	0.250	mg/l	1x	--	--	--	--	--	--	08/08/06 11:32	
Lube Oil Range Hydrocarbons	"	ND	--	0.500	"	"	--	--	--	--	--	--	"	
Surrogate(s): 2-FBP		Recovery: 99.6%		Limits: 53-125%		"						08/08/06 11:32		
Octacosane		89.2%		68-125%		"						"		
<b>LCS (6H04037-BS1)</b>													Extracted: 08/04/06 14:47	
Diesel Range Hydrocarbons	NWTPH-Dx	2.27	--	0.250	mg/l	1x	--	2.00	114%	(61-132)	--	--	08/08/06 12:02	
Surrogate(s): 2-FBP		Recovery: 108%		Limits: 53-125%		"						08/08/06 12:02		
Octacosane		93.6%		68-125%		"						"		
<b>LCS Dup (6H04037-BSD1)</b>													Extracted: 08/04/06 14:47	
Diesel Range Hydrocarbons	NWTPH-Dx	2.28	--	0.250	mg/l	1x	--	2.00	114%	(61-132)	0.440% (40)		08/08/06 14:00	
Surrogate(s): 2-FBP		Recovery: 107%		Limits: 53-125%		"						08/08/06 14:00		
Octacosane		97.6%		68-125%		"						"		

*Sandra Yakamovich*

Sandra Yakamovich For Kortland Orr, PM



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Project Name: **Circle K**

Project Number: 61994.01

Project Manager: Jill Frain

Report Created:

08/11/06 13:27

**Notes and Definitions**

Report Specific Notes:

D-06 - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

Laboratory Reporting Conventions:

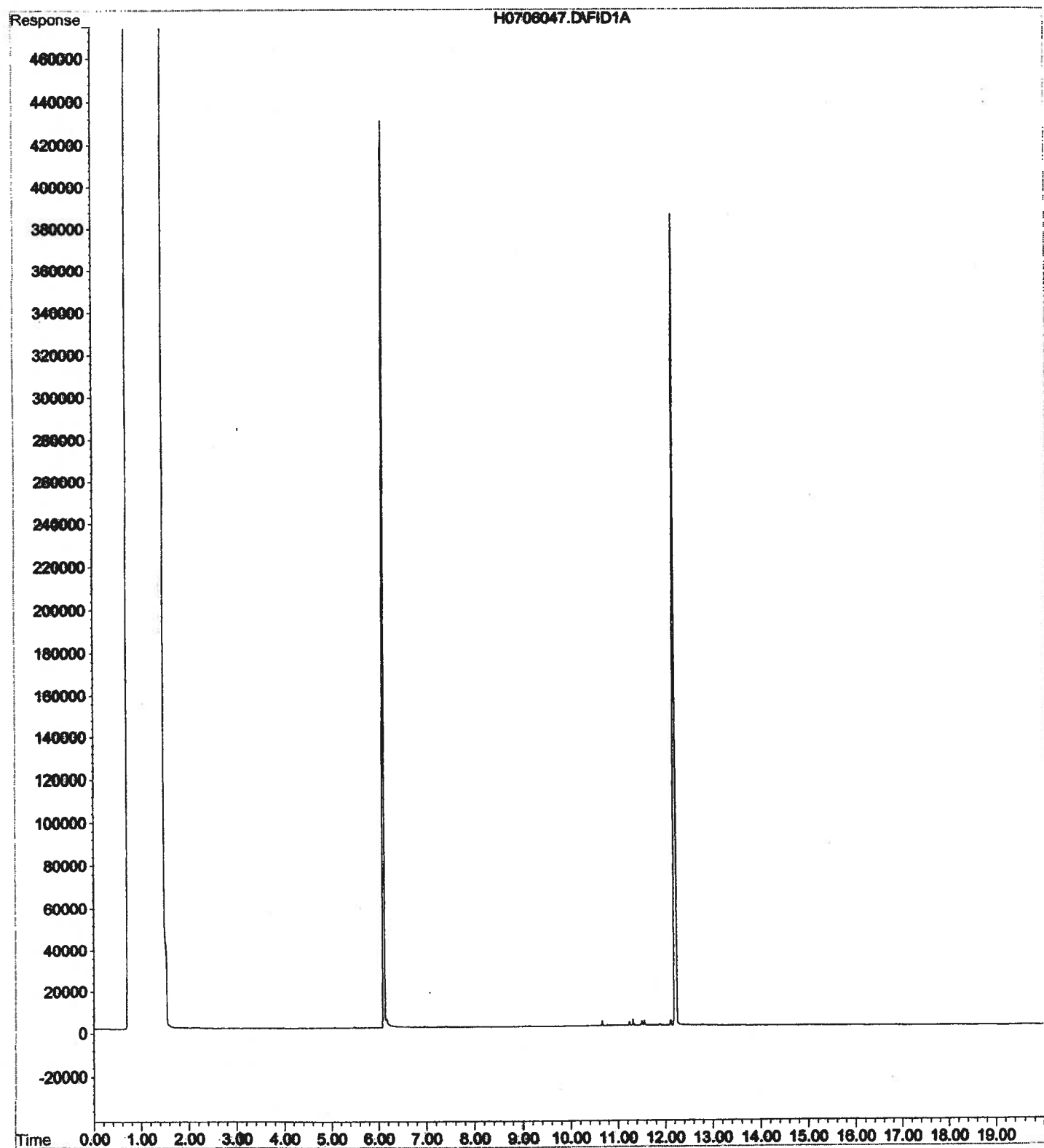
- DET - Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.
- ND - Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).
- NR/NA - Not Reported / Not Available
- dry - Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.
- wet - Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.
- RPD - RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).
- MRL - METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.
- MDL\* - METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. \*MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.
- Dil - Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.
- Reporting Limits - Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.
- Electronic Signature - Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy*. Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

*Sandra Yakamavich*

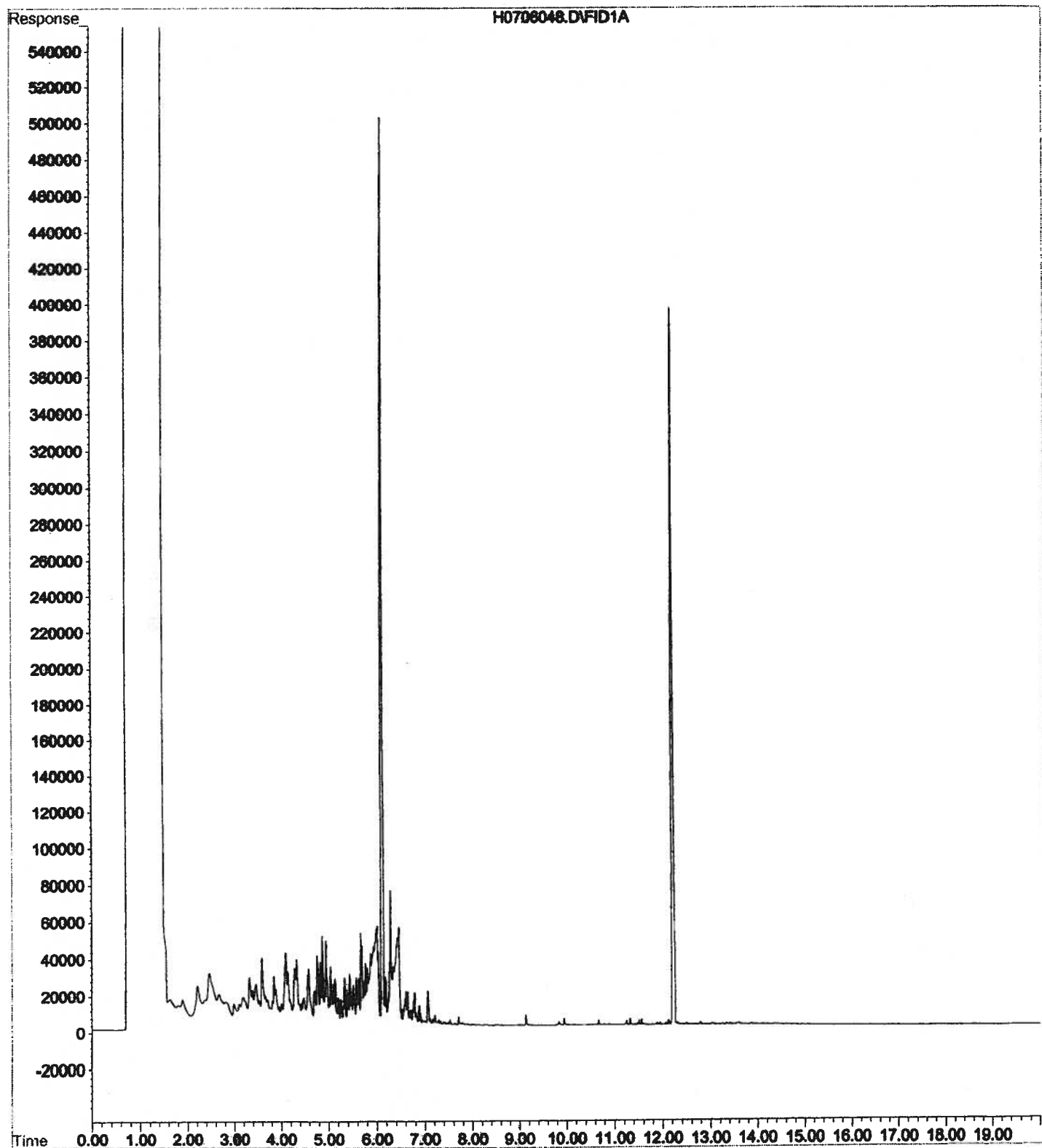
Sandra Yakamavich For Kortland Orr, PM



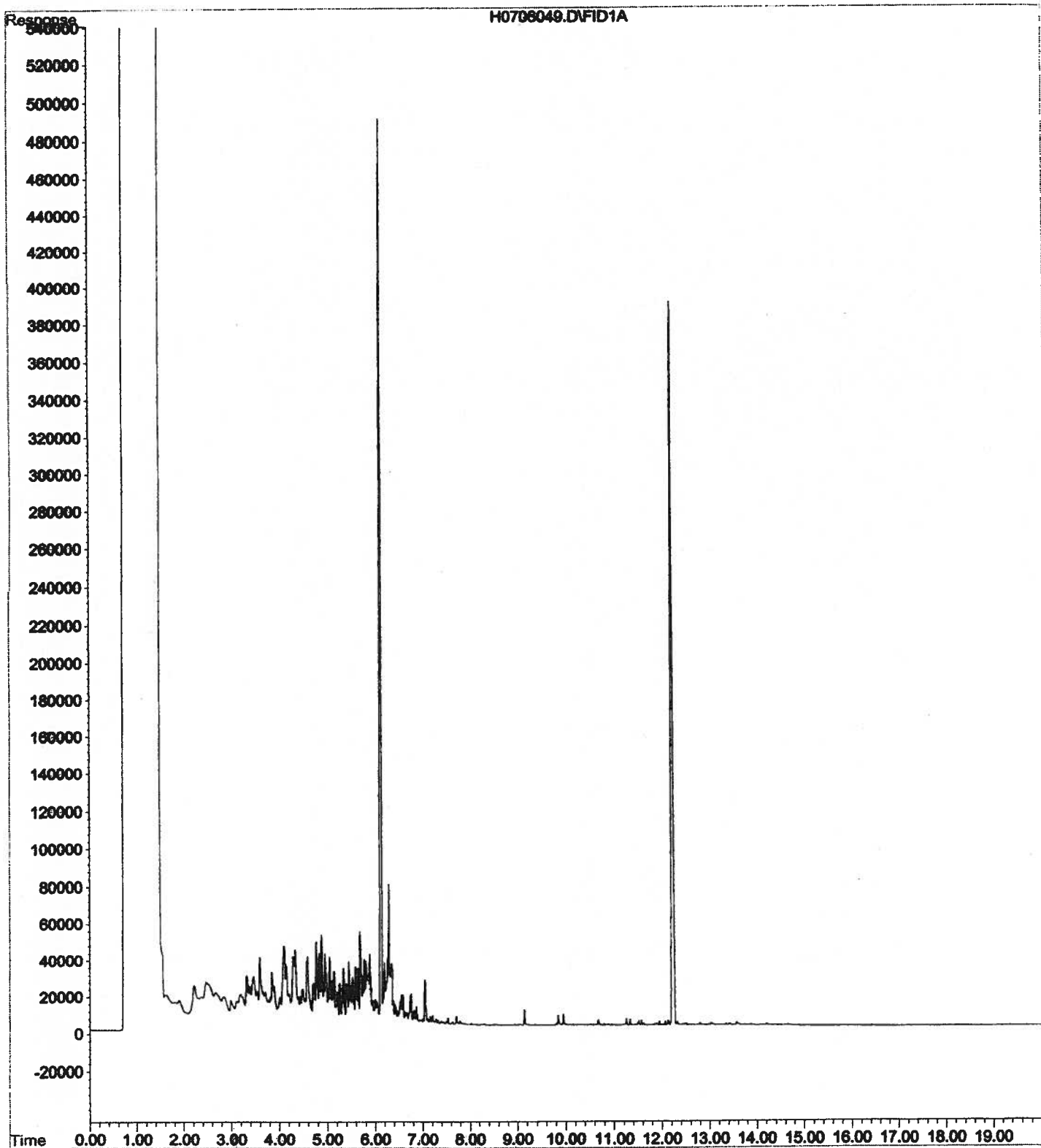
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Operator : DEB  
Acquired : 8 Aug 2006 15:29 using AcqMethod TPHF.M  
Instrument : GC-1  
Sample Name: BPH0087-01  
Misc Info : 1X NWTPH-Dx Water  
Vial Number: 92



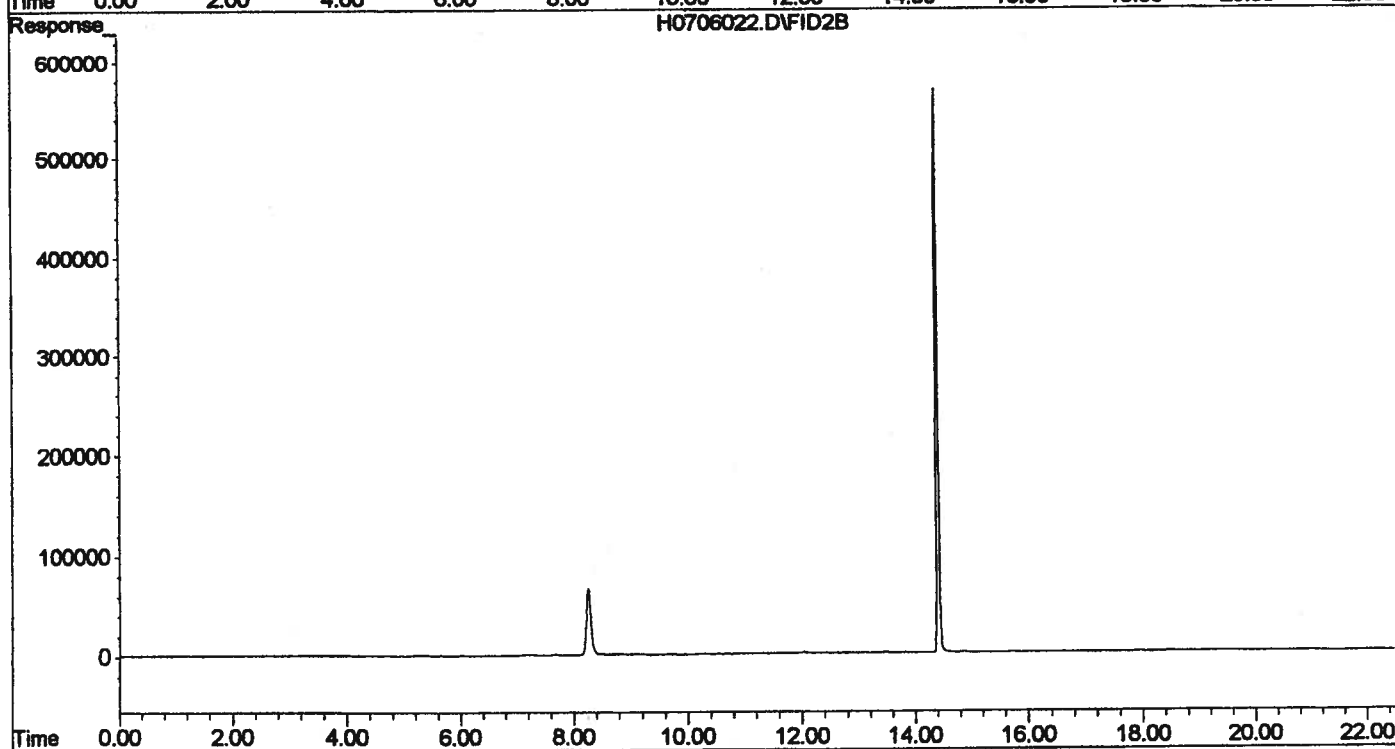
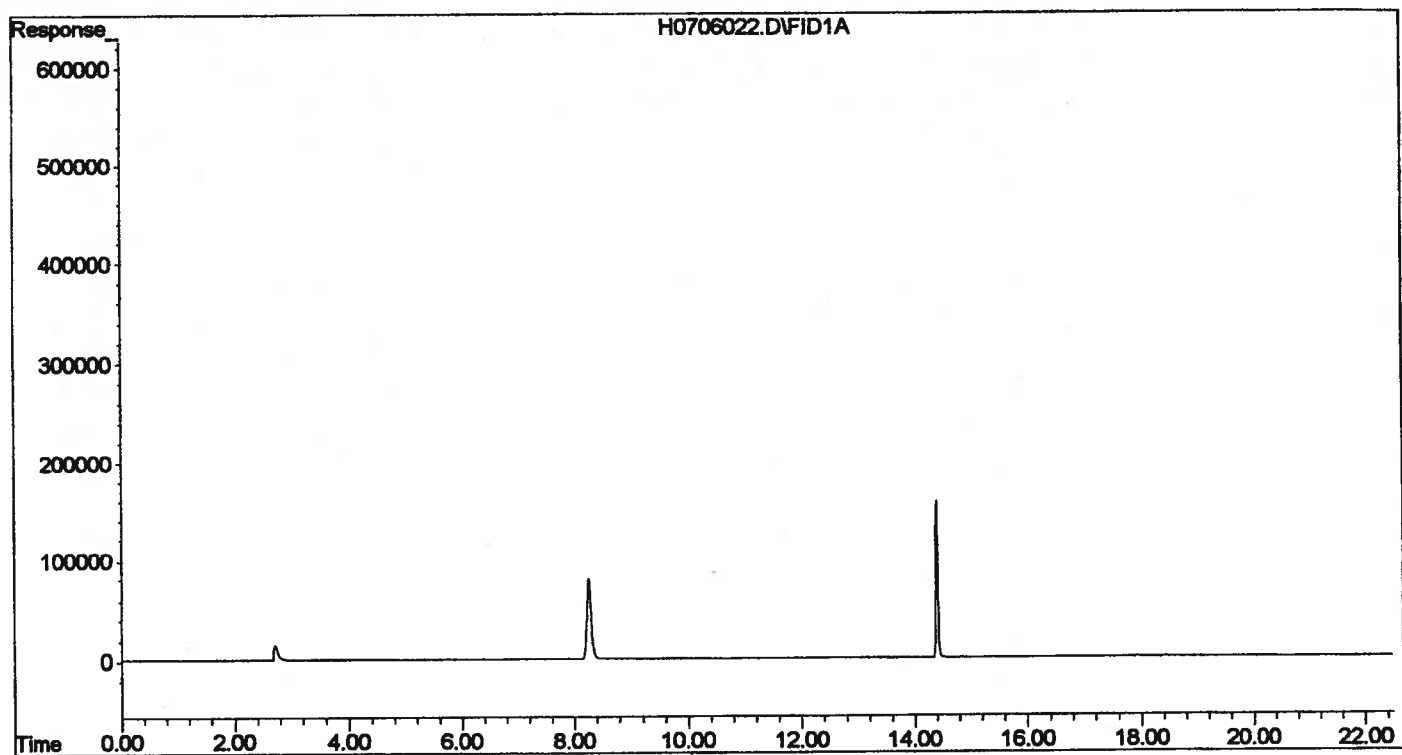
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Operator : DEB  
Acquired : 8 Aug 2006 15:58 using AcqMethod TPHF.M  
Instrument : GC-1  
Sample Name: BPH0087-02  
Misc Info : 1X NPTPH-Dx Water  
Vial Number: 93



File : C:\HPCHEM\4\DATA\080706\H0706049.D  
Operator : DEB  
Acquired : 8 Aug 2006 16:28 using AcqMethod TPHF.M  
Instrument : GC-1  
Sample Name: BPH0087-03  
Misc Info : 1X NWTPH-Dx Water  
Vial Number: 94

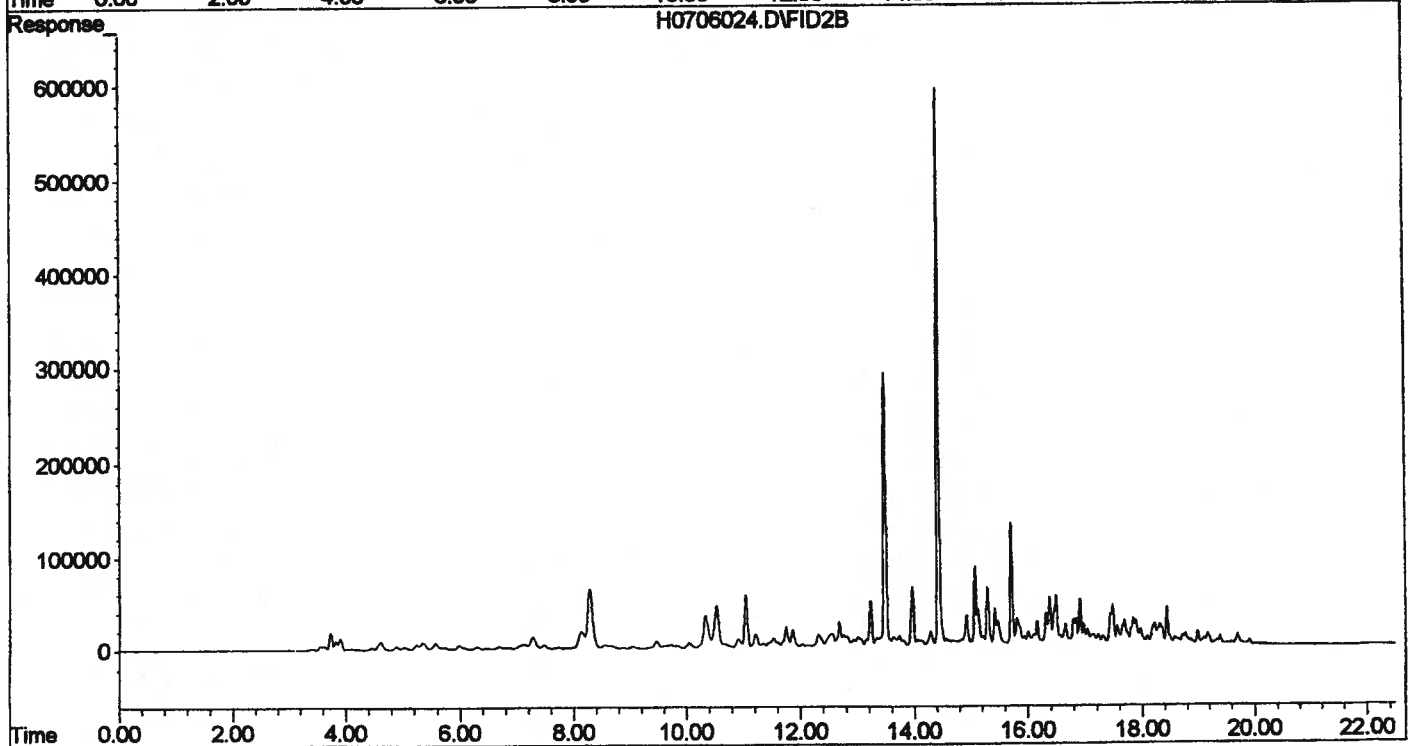
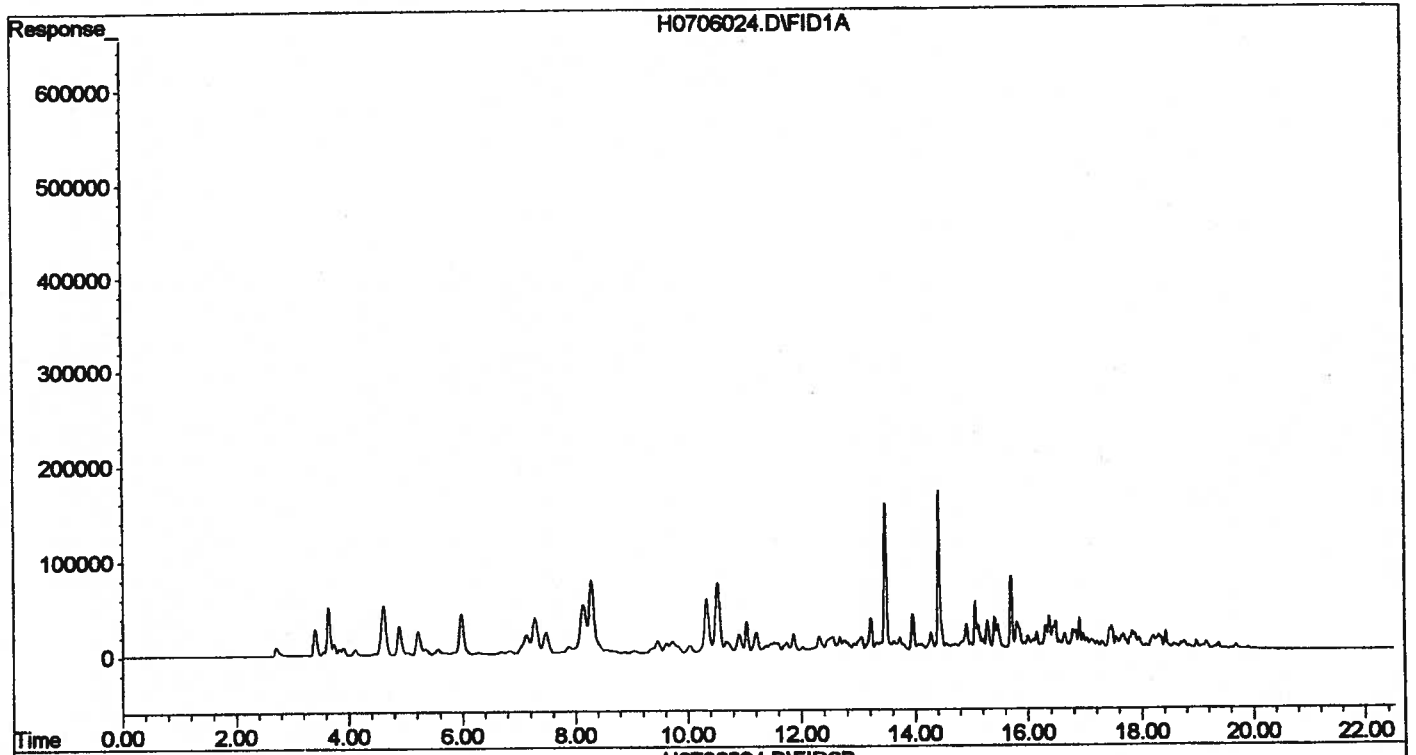


File : D:\HPCHEM\4\DATA\080706\H0706022.D  
Operator : JLH  
Acquired : 7 Aug 2006 21:54 using AcqMethod TGF1606.M  
Instrument : GC #8  
Sample Name: bph0087-01  
Misc Info : 1x 5mL  
Vial Number: 22

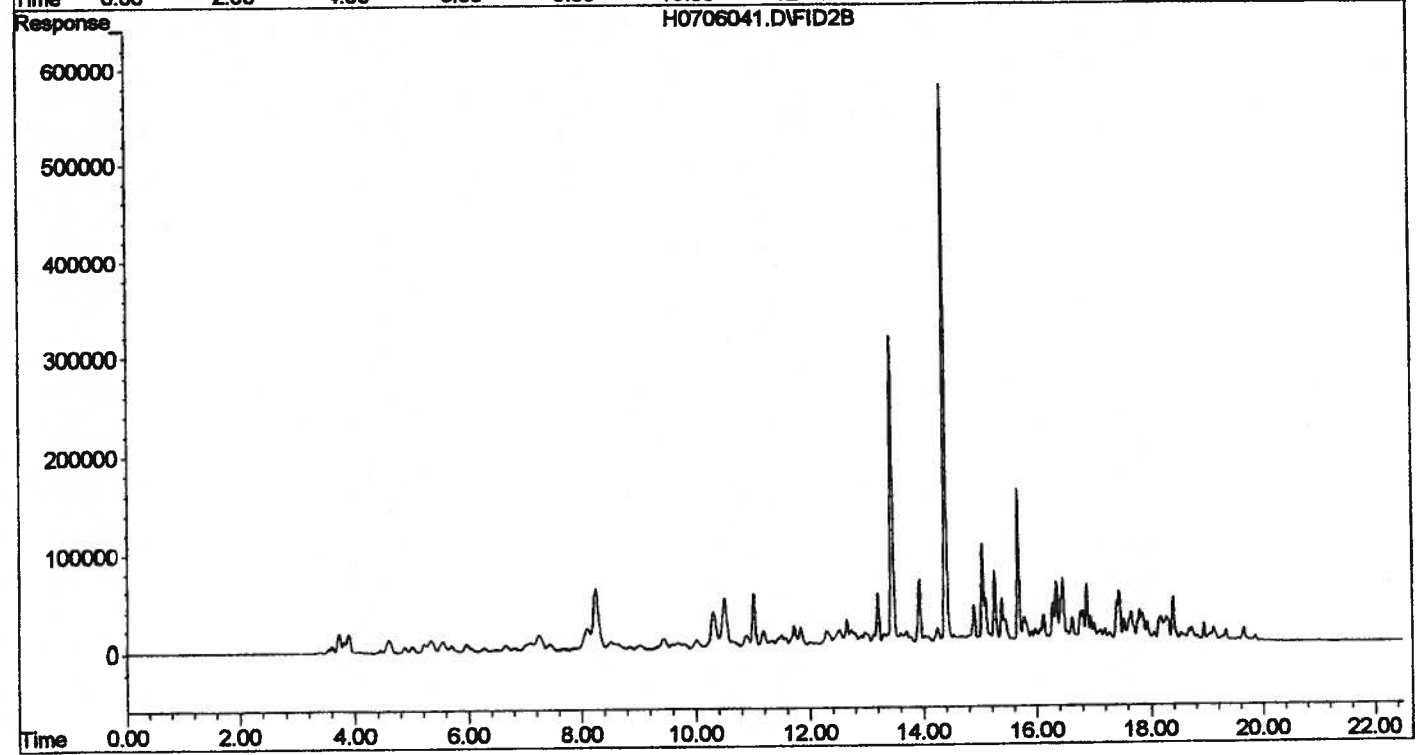
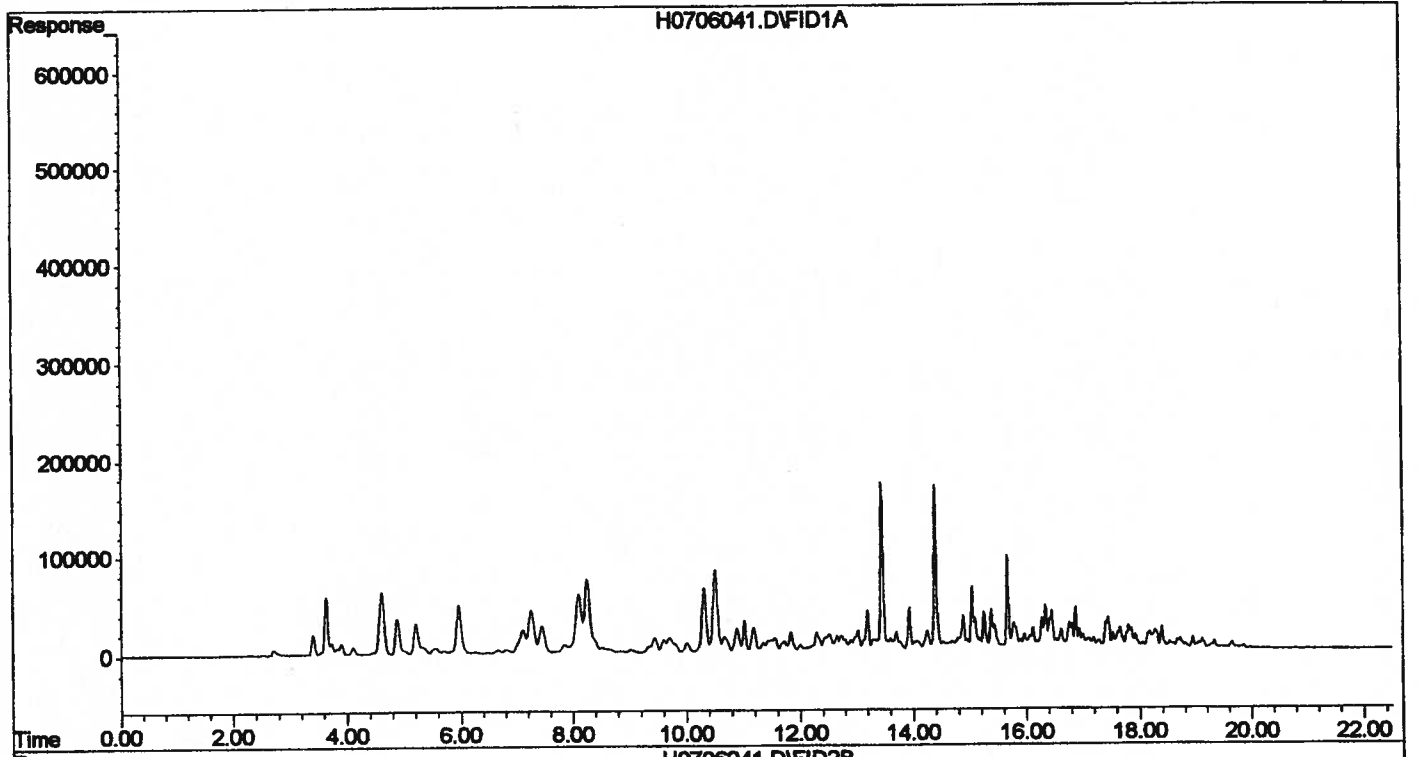




File : D:\HPCHEM\4\DATA\080706\H0706024.D  
Operator : JLH  
Acquired : 7 Aug 2006 22:57 using AcqMethod TGF1606.M  
Instrument : GC #8  
Sample Name: bph0087-02  
Misc Info : 1x 5mL  
Vial Number: 24



File : D:\HPCHEM\4\DATA\080706\H0706041.D  
Operator : JLH  
Acquired : 8 Aug 2006 11:07 using AcqMethod TGF1606.M  
Instrument : GC #8  
Sample Name: bph0087-03 r1  
Misc Info : 1x 5ml  
Vial Number: 41



File : D:\HPCHEM\4\DATA\080706\H0706040.D  
Operator : JLH  
Acquired : 8 Aug 2006 10:36 using AcqMethod TGF1606.M  
Instrument : GC #8  
Sample Name: bph0087-04 r1  
Misc Info : 1x 5ml  
Vial Number: 40

