Frontier Hard Chrome
Event 1 Long-Term Monitoring Report
(February 2004 Results)
Work Assignment Number: 230-RALR-1027

EPA Contract: 68-W7-0026

May 2004

EPA Region V

RAC

Response Action Contract

Weston Solutions, Inc. · 190 Queen Anne Avenue North · Seattle, WA 98109-4926

04-0126/Event 1 Cover.ai

FRONTIER HARD CHROME
LONG-TERM MONTORING REPORT
EVENT 1 – FEBRUARY 2004
VANCOUVER, WASHINGTON

Prepared for

U.S. Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101

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SECTION 1

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

This Long Term Monitoring Report has been prepared as directed by Task 9 "Project Performance" in the Scope of Work for Remedial Action for the Frontier Hard Chrome (FHC) Superfund Site (EPA 2003) located in Vancouver, Washington. This report describes the sampling activities performed and analytical results obtained during "Event 1" of the long-term groundwater monitoring program at the FHC site. Sampling activities for Event 1 were conducted during February 2004.

The FHC site was the subject of a remedial action conducted during the summer of 2003. The purpose of the remedial action (RA) was to treat the site's chromium-contaminated soil and groundwater to cleanup levels specified in the Record of Decision. Long term monitoring is required to track offsite plume concentrations as well as show that the remedy is maintaining its operational functionality.

All Event 1 work was performed in accordance with project work plan titled *Frontier Hard Chrome, Long Term Monitoring Plan* (Weston 2004). No significant deviations from the work plan occurred.

1.2 BACKGROUND AND PROBLEM DEFINITION

1.2.1 Site Background

The FHC site is located in southeastern Vancouver, Washington **(**Figure 1). The facility address is 113 "Y" Street, Vancouver, Washington. The site is located in the Section 25, Township 2 north, Range 1 east, Willamette Meridian in Clark County, Washington. The location in latitude and longitude coordinates is 45 degrees, 37 minutes, 19 seconds north by 122 degrees, 38 minutes 45 seconds east (Degrees, Minutes, Seconds [DMS]). The site was previously occupied by several metals fabricating businesses and was used for storage and as a staging area for a neighboring business. Currently, no buildings exist on the site and the site is vacant.

The FHC site proper covers approximately 0.5 acre and is bordered to the east by Grand Avenue, to the south by Cassidy Manufacturing, and to the west by "Y" Street.

Work began on the remedial design in October 2001. The remedial design was completed in February 2003. The remedial action, consisting of building demolition, treatment of source area soil and groundwater, and installation of an in-situ redox manipulation (ISRM) treatment wall (to treat hexavalent chromium), was completed in September 2003.

1.2.2 Problem Definition

The goal of the remedial action was to treat source area soil and groundwater to reduce hexavalent chromium concentrations such that groundwater downgradient of the site would attenuate to chromium concentrations less than 50 micrograms per liter (ug/L). To demonstrate this, groundwater quality is being monitored in two areas. The first area consists of locations immediately within and down gradient of the ISRM wall. Wells located within and just down gradient of the wall are being monitored to ensure the continued operational functionality of the ISRM Treatment Wall. The second area targeted for monitoring consists of the historical chromium contaminated groundwater plume located down gradient of the ISRM wall. This down gradient plume did not get treated during the remedial action and is being monitored to track the long-term expected reduction in chromium concentration as a result of completing the remedial action and elimination of the source of hexavalent chromium.

Long-term groundwater monitoring is required by the site's Record of Decision.

1.3 PLANNED MONITORING SCHEDULE

Planned sampling events are to be conducted approximately quarterly for the first year. Planned sampling events are scheduled for February, April, August and December 2004. The first three sampling events in 2004 will be completed by EPA. The sampling event scheduled for August will complete monitoring for approximately one year after the remedial action was completed. In September/October 2004, monitoring of the FHC site will be turned over to the Washington State Department of Ecology.

SECTION 2

SAMPLING ACTIVITIES AND RESULTS

2.1 MONITORING WELL SAMPLING PROCEDURES

Sampling activities for Event 1 were conducted on February 2 through February 11, 2004 by EPA's Environmental Services Assistance Team (ESAT) with oversight by Weston Solutions, Inc, (Weston). The monitoring wells in the vicinity of the FHC site are shown on Figure 2. A total of 33 wells in the vicinity of the site were sampled in accordance with the *Long Term Monitoring Plan* (Weston 2004).

Well purging and sampling were performed according to EPA sampling guidelines and Weston standard operating procedures. The wells were sampled with a peristaltic pump equipped with new polyethylene tubing deployed to mid-screen depth at each well. The wells were purged prior to sampling until monitored field parameters (turbidity, conductivity, pH, dissolved oxygen, ORP, and temperature) stabilized. The field parameter readings were recorded on field sampling forms.

Groundwater samples were analyzed for total analyte list (TAL) metals. In cases where groundwater turbidity was greater than 10 nephalometric turbidity units, samples were passed through a 0.45-micron filter in the field and submitted for dissolved TAL metals. Field analysis for hexavalent chromium (using Hach test kits) was also performed on all samples. Selected samples were analyzed for total sulfur and sulfate to provide an assessment of the distribution of byproducts from the reducing agent used during ISRM wall installation.

Groundwater chemical data and field parameters are provided in Table 1 and 2.

2.2 ANALYTICAL RESULTS

2.2.1 Chromium

Chromium was detected in all 33 wells sampled. Chromium concentrations in the "A" zone ranged from a maximum concentration of 180 ug/L in well RA-MW-12A (located within the ISRM Treatment Wall) to a low of 0.41 ug/L in well W99-R5A (the most distant well sampled at approximately 2,200 feet southwest of the Frontier Hard Chrome site). Monitoring well RA-MW-12A was installed in an area where very high (70,000 ug/L) initial chromium concentrations were present in groundwater before the ISRM Treatment Wall was installed. "A" zone chromium concentrations and plume contours are shown in Figure 3.

Onsite chromium concentrations in "B" zone groundwater were slightly lower than in the "A" zone groundwater. However, the "B" zone groundwater had higher concentrations of chromium downgradient of the site than did the "A" zone. Chromium concentrations in "B" zone

groundwater ranged from 136 ug/L onsite to a low of 4 ug/L downgradient of the site. "B" zone chromium concentrations and plume contours are shown in Figure 4.

Hexavalent chromium was generally not detected. Hexavalent chromium was only detected in 3 of 31 wells sampled. The maximum hexavalent chromium concentration detected was 130 ug/L in well RA-MW-15B. The minimum detected concentration was 30 ug/L in well W85-7B.

The data appear to indicate that most all chromium present in groundwater is hexavalent chromium based on the few samples where both hexavalent and total chromium were detected. Hexavalent chromium values were very consistent with total chromium values. Since the hexavalent chromium detection limit was approximately 40 ug/L and most total chromium concentrations were below 40 ug/L, no correlation between total and hexavalent chromium concentrations could be drawn at the lower concentrations.

Figures showing the chromium concentration trends in groundwater over time are included in Appendix A. Data from wells sampled during Operational and Functional monitoring in November and December 2003 are included in these figures where available to assist in determining trends.

Figures 3, 4 and those in Appendix A used dissolved chromium values where turbidity exceeded 10 NTU.

2.2.2 Water Quality

Dissolved oxygen (DO) concentrations ranged from a low of 0.13 mg/L to a high of 4.92 mg/L. DO was generally less than 1 mg/L in samples collected within the ISRM Treatment Wall. This low DO indicates the wall is still reductive which is necessary for treatment of hexavalent chromium. Samples of groundwater collected downgradient of the ISRM Treatment Wall had the highest concentrations of DO which tended to increase with distance from the wall.

The pH ranged from 5.9 to 8.8. The highest pH was located within the treatment zone; this trend is consistent with the high pH of the reagent used to create the ISRM Treatment Wall.

The highest sulfur and sulfate concentrations were located within the treatment wall. Concentrations of sulfur and sulfate were over an order of magnitude lower immediately downgradient of the wall indicating the reagents used in construction of the wall had not migrated downgradient at the time these groundwater samples were taken. Sulfur concentrations in groundwater were less than 1,000 mg/L.

2.3 GROUNDWATER FLOW DIRECTION AND ELEVATION

Groundwater surface elevations were determined using the known elevation of the top of each well casing and the depth to groundwater measured in each long term monitoring well. The depth to groundwater measurements were collected during a single afternoon on the first day of the sampling event by Bernie Zavala of EPA and the Weston Field Leader. The elevation of the Columbia River at the United State Geological Survey (USGS) gauging station 14144700

located at the nearby I-5 bridge was also obtained for use in determining flow direction. The river elevation information was obtained from http://waterdata.usgs.gov/wa/nwis/.

Groundwater surface elevations for each well measured are shown in Table 3.

The groundwater flow direction, as determined using groundwater surface elevations measured just prior to sampling, is heading to the northwest then divides to the northeast when it approaches the FHC site. Groundwater elevation information and gradient figures are provided in Appendix B.

The stage height of the Columbia River had a high of 12.05 feet (AMSL) on January 30, 2004 at 1:45 P.M. A horizontal gradient was calculated for February 2, 2004 with a result of 0.000104 ft/ft with a flow direction from the Columbia river towards the FHC site.

2.4 INVESTIGATION-DERIVED WASTES

Investigation-derived waste (IDW) generated during the sampling event consisted of well purge water, used PPE, and disposable sampling supplies. During sampling, purge water was stored on site in 5-gallon buckets. At the completion of sampling, the water was transported to the City of Vancouver's operations center and disposed of in accordance with the disposal permit issued to Weston by the city. Personnel protective equipment and other solid wastes were disposed of in a dumpster.

2.5 DISCUSSION AND CONCLUSIONS

Chromium concentrations in "A" zone groundwater were generally less than 5 ug/L downgradient of the FHC site during the time period in which the wells were sampled (February 2004). Chromium concentrations in "A" zone groundwater closer to the site near the ISRM Treatment Wall were less than 200 ug/L; significantly less than the concentrations before the remedial action was performed.

Deeper "B" zone groundwater downgradient of the site contains chromium in concentrations greater than the "A" zone. Chromium in "B" zone groundwater downgradient of the site was generally less than 15 ug/L.

Dissolved oxygen data collected from within the ISRM Treatment Wall indicates that an area of reducing conditions still exists indicating the hexavalent chromium treatment zone is still active.

SECTION 3

ANALYTICAL METHODS AND DATA VALIDATION

3.1 ANALYTICAL METHODS REQUIREMENTS AND DATA VALIDATION

Analyses of samples collected during the field event were performed by an EPA CLP laboratory. The Event 1 samples were analyzed by Bonner Analytical Testing Company in Hattiesburg, Mississippi.

Data was reviewed by EPA's CADRE program and reviewed by Weston. A data validation memorandum prepared by Weston is provided in Appendix C.

A laboratory data quality assurance review of 39 water samples was completed. Samples were collected February 5 – 9, 2004 from the Frontier Hard Chrome site. Samples were analyzed for Target Analyte List (TAL) metals, hexavalent chromium (in the field), sulfate, and total sulfur.

A data review was performed on laboratory quality control results summary sheets to ensure they met data quality objectives for the project. All laboratory quality assurance results as applicable (e.g., holding times, blank sample analysis, matrix spike/duplicate analysis, laboratory control sample analysis) supplied to Weston for the analyses met acceptance criteria specified in the work plan (Weston 2004), with the following exceptions:

- Aluminum, copper, magnesium, lead, and zinc were detected in one or more preparation blanks, recovery of silver from one matrix spike sample was less than the lower control limit, and lead recovery from one interference check sample (ICS) was less than the lower control limit.

No other QA/QC exceptions were noted in the data review. These exceedances did not adversely affect the project DQOs.

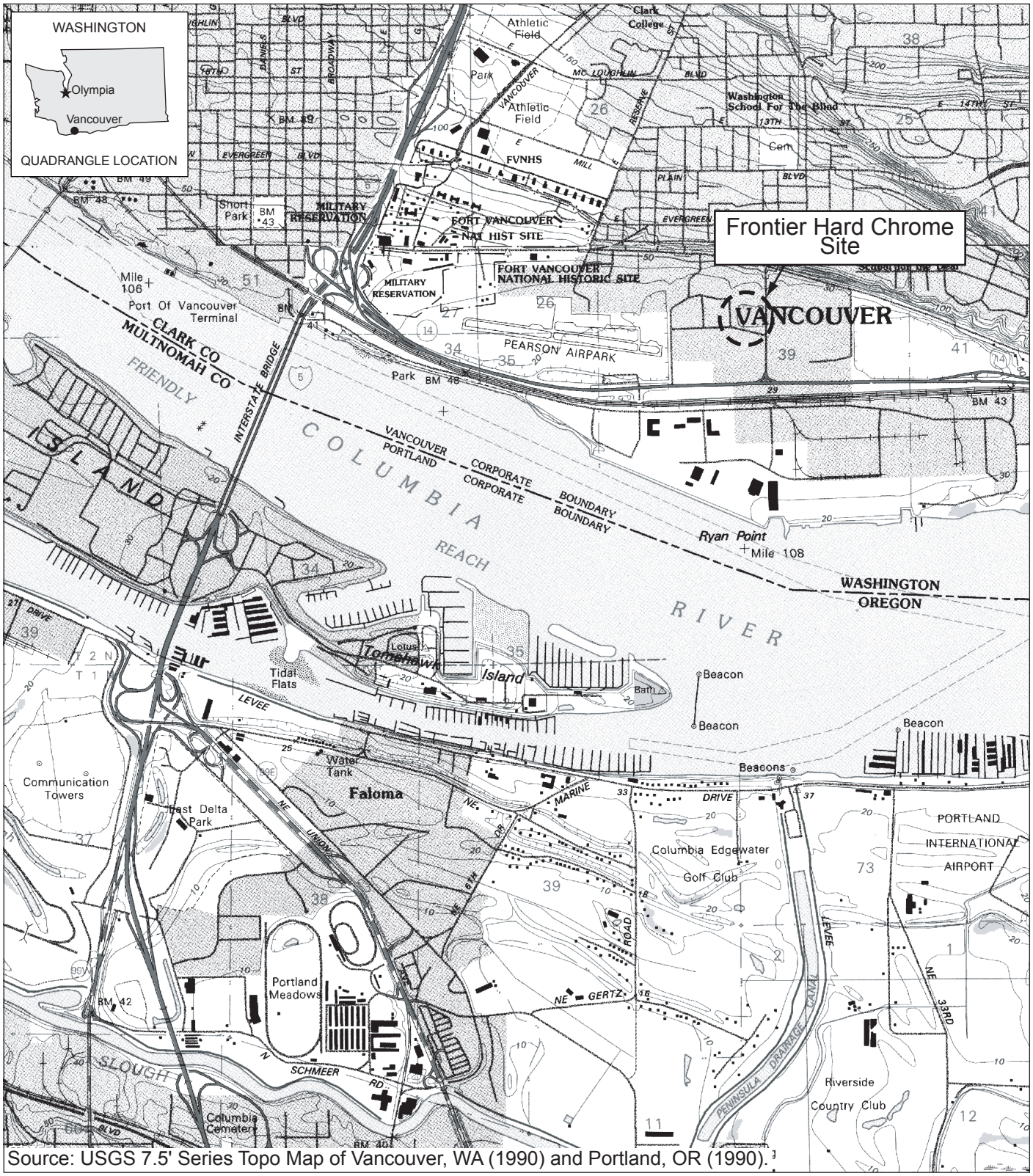
SECTION 4

REFERENCES

EPA (United States Environmental Protection Agency), 2003. Statement of Work for Long Term Response Action. Frontier Hard Chrome, Vancouver, WA. December 30th, 2003.

Weston (Weston Solutions, Inc.), 2004. Frontier Hard Chrome Long Term Monitoring Plan. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington. February.

FIGURES



Source: USGS 7.5' Series Topo Map of Vancouver, WA (1990) and Portland, OR (1990).

0 1000 2000

Scale in Feet

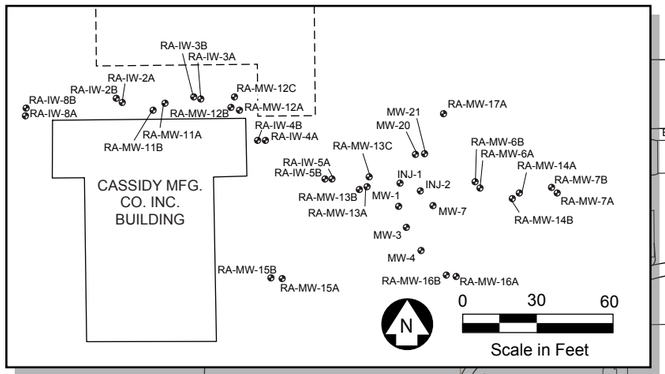
Frontier Hard Chrome
Vancouver, Washington
Vicinity Map

Figure

1

WESTON SOLUTIONS

04-0126/Event 1 Fig1.ai



LEGEND

W85-5B Monitoring Well Location and ID

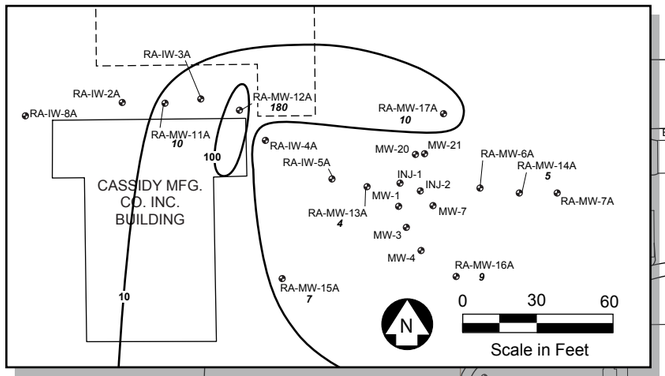
Fence

Frontier Hard Chrome
Vancouver, Washington
Monitoring Well Locations

Figure
2

WESTON SOLUTIONS

04-0126/Event 1 Fig2.ai



LEGEND

- W85-7A — Monitoring Well Location and ID
- 1.7 — Chromium Concentration (µg/L)
- —10— Concentration Contour (µg/L)

N

0 150 300

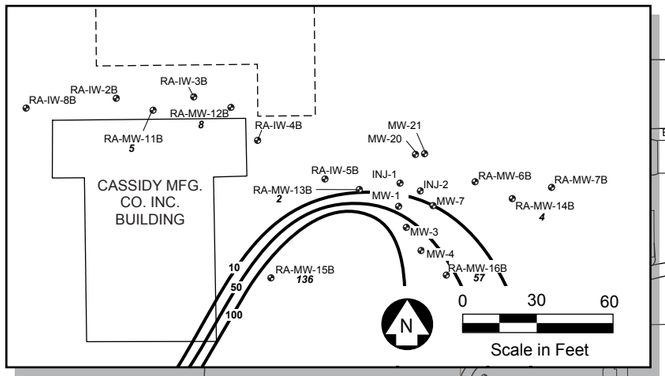
Scale in Feet

Frontier Hard Chrome Vancouver, Washington Chromium Concentrations in Zone A Groundwater February 2004

Figure **3**

WESTON SOLUTIONS

04-0126/Event 1 Fig3.ai



LEGEND

- W85-7B — Monitoring Well Location and ID
- 18 — Chromium Concentration (µg/L)
- —10— Concentration Contour (µg/L)

0 150 300
Scale in Feet

Frontier Hard Chrome Vancouver, Washington Chromium Concentrations in Zone B Groundwater February 2004

Figure
4

WESTON SOLUTIONS

04-0126/Event 1 Fig4.ai

TABLES

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	B85-3 GW-B85-3-0000 02/05/2004	B85-4 GW-B85-4-0000 02/05/2004	B87-8 GW-B87-8-0000 02/04/2004	RA-MW-11A GW-RA-MW-11A-0000 02/03/2004	RA-MW-11B GW-RA-MW-11B-0000 02/03/2004	RA-MW-12A GW-RA-MW-12A-0000 02/02/2004
Inorganics (Total) (ug/l)							
Aluminum		48.1 U	200 U	175 J	38.4 U	57.5 U	591
Antimony		60.0 U	60.0 U	60.0 U	60.0 U	60.0 U	60.0 U
Arsenic		15.0 U	15.0 U	15.0 U	19.1	12.2 J	9.9 J
Barium		105 J	21.3 J	40.0 J	156 J	103 J	710
Beryllium		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Cadmium		0.94 J	5.0 U	0.52 J	0.32 J	0.34 J	0.52 J
Calcium		96800	53400 J	28300	206000	191000	973000
Chromium		5.0 J	37.7	18.2	17.4	15.6	180
Cobalt		6.6 J	1.3 J	0.99 J	15.2 J	15.8 J	7.6 J
Copper		25.0 U	7.5 J	39.1	2.3 U	25.0 U	3.6 U
Hexavalent Chromium		40 U	40	40 U	800 U	800 U	800 U
Iron		12500	21.0 J	221	1090	997	629
Lead		10.0 UJ	10.0 U	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ
Magnesium		32200	13300 J	8970	36300	36800	1300 J
Manganese		15900	845	3840	8240	5530	24.2
Nickel		40.0 U	6.9 J	2.0 J	35.8 J	24.2 J	138
Potassium		10600	3000 J	1460 J	66400	72500	401000
Selenium		35.0 U	35.0 U	35.0 U	35.0 U	35.0 U	35.0 U
Silver		1.6 J	10.0 UJ	10.0 U	1.2 J	0.77 J	0.91 J
Sodium		9810	15000	11400	117000	70100	138000
Thallium		24.4 J	25.0 U	6.6 J	14.0 J	8.5 J	25.0 U
Vanadium		50.0 U	2.6 J	3.0 J	4.9 J	0.92 J	2.8 J
Zinc		4.1 U	2.4 J	22.4 J	21.2 J	18.5 J	387
Inorganics (Dissolved) (ug/l)							
Aluminum					39.2 U	35.9 U	
Antimony					60.0 U	60.0 U	
Arsenic					15.0	11.8 J	

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	B85-3 GW-B85-3-0000 02/05/2004	B85-4 GW-B85-4-0000 02/05/2004	B87-8 GW-B87-8-0000 02/04/2004	RA-MW-11A GW-RA-MW-11A-0000 02/03/2004	RA-MW-11B GW-RA-MW-11B-0000 02/03/2004	RA-MW-12A GW-RA-MW-12A-0000 02/02/2004
Barium					152 J	97.5 J	
Beryllium					5.0 U	5.0 U	
Cadmium					5.0 U	0.54 J	
Calcium					202000	189000	
Chromium					10.2	4.6 J	
Cobalt					11.2 J	11.3 J	
Copper					25.0 U	25.0 U	
Iron					102	56.4 J	
Lead					10.0 UJ	10.0 UJ	
Magnesium					35700	35300	
Manganese					8210	5100	
Nickel					26.8 J	17.0 J	
Potassium					64400	72200	
Selenium					35.0 U	35.0 U	
Silver					1.3 J	0.72 J	
Sodium					111000	66400	
Thallium					17.2 J	8.4 J	
Vanadium					3.8 J	1.4 J	
Zinc					2.8 U	60.0 U	
Conventional Parameters							
Sulfate (SO4) (mg/l)			58.1	20.7	620		
Sulfur (mg/l)			23	9	286		

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	RA-MW-12B GW-RA-MW-12B-0000 02/02/2004	RA-MW-12C GW-RA-MW-12C-0000 02/02/2004	RA-MW-13A GW-RA-MW-13A-0000 02/03/2004	RA-MW-13B GW-RA-MW-13B-0000 02/03/2004	RA-MW-13C GW-RA-MW-13C-0000 02/03/2004	RA-MW-14A GW-RA-MW-14A-0000 02/04/2004
Inorganics (Total) (ug/l)							
Aluminum		14.8 U	9.9 U	64.0 U	26.0 U	86.4 U	37.9 U
Antimony		60.0 U	60.0 U	60.0 U	60.0 U	60.0 U	60.0 U
Arsenic		10.3 J	3.2 J	15.0 U	15.0 U	15.0 U	15.0 U
Barium		120 J	82.0 J	103 J	68.5 J	105 J	103 J
Beryllium		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Cadmium		0.35 J	5.0 U	1.1 J	0.73 J	0.88 J	0.69 J
Calcium		118000	67900	325000	150000	156000	193000
Chromium		7.6 J	2.8 J	4.4 J	2.3 J	3.7 J	5.4 J
Cobalt		28.8 J	34.4 J	41.7 J	27.9 J	37.7 J	11.2 J
Copper		25.0 U	2.0 U	4.7 J	2.2 J	4.5 J	2.4 J
Hexavalent Chromium		40 U	40 U	40 U	40 U	40 U	40 U
Iron		129	455	17300	5460	4910	8570
Lead		10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ
Magnesium		22300	16100	74300	43700	38700	23500
Manganese		1050	764	7770	3410	3670	8270
Nickel		20.0 J	19.9 J	213	114	70.3	18.1 J
Potassium		342000	383000	753000	636000	432000	86100
Selenium		35.0 U	35.0 U	35.0 U	35.0 U	35.0 U	35.0 U
Silver		10.0 U	10.0 U	0.94 J	10.0 U	10.0 U	1.0 J
Sodium		108000	104000	390000	240000	235000	40300
Thallium		25.0 U	25.0 U	13.5 J	25.0 U	7.6 J	14.2 J
Vanadium		1.4 J	50.0 U	1.5 J	50.0 U	50.0 U	50.0 U
Zinc		6.1 U	3.0 U	2.6 U	2.3 U	3.2 U	2.8 U
Inorganics (Dissolved) (ug/l)							
Aluminum							
Antimony							
Arsenic							

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	RA-MW-12B GW-RA-MW-12B-0000 02/02/2004	RA-MW-12C GW-RA-MW-12C-0000 02/02/2004	RA-MW-13A GW-RA-MW-13A-0000 02/03/2004	RA-MW-13B GW-RA-MW-13B-0000 02/03/2004	RA-MW-13C GW-RA-MW-13C-0000 02/03/2004	RA-MW-14A GW-RA-MW-14A-0000 02/04/2004
Barium							
Beryllium							
Cadmium							
Calcium							
Chromium							
Cobalt							
Copper							
Iron							
Lead							
Magnesium							
Manganese							
Nickel							
Potassium							
Selenium							
Silver							
Sodium							
Thallium							
Vanadium							
Zinc							
Conventional Parameters							
Sulfate (SO4) (mg/l)				1960			477
Sulfur (mg/l)				743			189

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	RA-MW-14A GW-RA-MW-14A-1000 02/04/2004	RA-MW-14B GW-RA-MW-14B-0000 02/04/2004	RA-MW-15A GW-RA-MW-15A-0000 02/04/2004	RA-MW-15B GW-RA-MW-15B-0000 02/04/2004	RA-MW-16A GW-RA-MW-16A-0000 02/04/2004	RA-MW-16B GW-RA-MW-16B-0000 02/04/2004
Inorganics (Total) (ug/l)							
Aluminum		38.2 U	51.9 U	49.6 U	75.2 U	66.5 U	66.1 U
Antimony		60.0 U	10.7 J	60.0 U	60.0 U	60.0 U	60.0 U
Arsenic		15.0 U	15.0 U	15.0 U	15.0 U	3.2 J	15.0 U
Barium		103 J	83.8 J	126 J	38.4 J	84.1 J	93.7 J
Beryllium		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Cadmium		0.35 J	0.72 J	0.62 J	0.53 J	0.86 J	0.69 J
Calcium		191000	159000	248000	54500	326000	276000
Chromium		5.6 J	3.5 J	7.2 J	136	9.2 J	57.4
Cobalt		11.4 J	15.2 J	32.0 J	6.8 J	34.1 J	39.1 J
Copper		2.0 J	2.1 J	3.8 J	5.6 J	4.0 J	8.6 J
Hexavalent Chromium		40 U	40 U	40 U	130	40 U	40 U
Iron		8510	10700	2930	428	11700	5540
Lead		10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ
Magnesium		23300	26100	73100	17400	48800	63700
Manganese		8210	7330	9520	1630	13400	6580
Nickel		17.7 J	14.4 J	212	4.7 J	145	65.4
Potassium		85900	122000	20100	4200 J	238000	131000
Selenium		35.0 U	35.0 U	35.0 U	35.0 U	35.0 U	35.0 U
Silver		10.0 U	0.64 J	0.97 J	10.0 U	1.5 J	0.70 J
Sodium		40700	67100	91000	16600	187000	126000
Thallium		12.3 J	11.5 J	13.9 J	4.3 J	19.8 J	11.5 J
Vanadium		50.0 U	50.0 U	50.0 U	0.98 J	1.7 J	50.0 U
Zinc		2.5 U	3.7 U	7.8 U	2.6 U	3.5 U	7.4 U
Inorganics (Dissolved) (ug/l)							
Aluminum							
Antimony							
Arsenic							

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	RA-MW-14A GW-RA-MW-14A-1000 02/04/2004	RA-MW-14B GW-RA-MW-14B-0000 02/04/2004	RA-MW-15A GW-RA-MW-15A-0000 02/04/2004	RA-MW-15B GW-RA-MW-15B-0000 02/04/2004	RA-MW-16A GW-RA-MW-16A-0000 02/04/2004	RA-MW-16B GW-RA-MW-16B-0000 02/04/2004
Barium							
Beryllium							
Cadmium							
Calcium							
Chromium							
Cobalt							
Copper							
Iron							
Lead							
Magnesium							
Manganese							
Nickel							
Potassium							
Selenium							
Silver							
Sodium							
Thallium							
Vanadium							
Zinc							
Conventional Parameters							
Sulfate (SO4) (mg/l)		477					
Sulfur (mg/l)		189					

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	RA-MW-17A GW-RA-MW-17A-0000 02/03/2004	W85-6A GW-W85-6A-0000 02/09/2004	W85-6B GW-W85-6B-0000 02/09/2004	W85-7A GW-W85-7A-0000 02/06/2004	W85-7B GW-W85-7B-0000 02/06/2004	W92-16A GW-W92-16A-0000 02/05/2004
Inorganics (Total) (ug/l)							
Aluminum		63.4 U	18.3 J	200 U	26.0 J	236	16.6 J
Antimony		60.0 U	60.0 U	60.0 U	60.0 U	60.0 U	60.0 U
Arsenic		15.0 U	15.0 U	15.0 U	15.0 U	15.0 U	15.0 U
Barium		115 J	3.4 J	10.6 J	6.7 J	20.9 J	36.6 J
Beryllium		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Cadmium		0.39 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Calcium		262000	10500 J	34400 J	14700 J	31300 J	34900 J
Chromium		10.2	1.4 J	12.9	1.7 J	17.7	4.2 J
Cobalt		23.0 J	50.0 U	2.0 J	50.0 U	2.2 J	0.77
Copper		1.9 J	25.0 U	1.8 U	12.3 J	5.8 U	1.9 U
Hexavalent Chromium		40 U	40 U	40 U	40 U	30 J	40 U
Iron		3680	24.8 J	100 U	63.8 J	494	579
Lead		10.0 UJ	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U
Magnesium		36000	3320 J	10500 J	4540 J	9340 J	14000 J
Manganese		12400	0.46 J	15.0 U	14.0 J	10.1 J	5070
Nickel		75.8	40.0 U	40.0 U	40.0 U	2.1 J	40.0 U
Potassium		91400	1460 J	3760 J	1570 J	3250 J	8100 J
Selenium		35.0 U	35.0 U	35.0 U	35.0 U	35.0 U	35.0 U
Silver		1.7 J	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ
Sodium		92100	3520 J	6770	3570 J	5760	9820
Thallium		18.8 J	25.0 U	25.0 U	25.0 U	25.0 U	6.8 J
Vanadium		50.0 U	3.0 J	6.2 J	2.3 J	6.4 J	50.0 U
Zinc		2.8 U	60.0 U	60.0 U	26.6 J	110	7.3 J
Inorganics (Dissolved) (ug/l)							
Aluminum							
Antimony							
Arsenic							

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	RA-MW-17A GW-RA-MW-17A-0000 02/03/2004	W85-6A GW-W85-6A-0000 02/09/2004	W85-6B GW-W85-6B-0000 02/09/2004	W85-7A GW-W85-7A-0000 02/06/2004	W85-7B GW-W85-7B-0000 02/06/2004	W92-16A GW-W92-16A-0000 02/05/2004
Barium							
Beryllium							
Cadmium							
Calcium							
Chromium							
Cobalt							
Copper							
Iron							
Lead							
Magnesium							
Manganese							
Nickel							
Potassium							
Selenium							
Silver							
Sodium							
Thallium							
Vanadium							
Zinc							
Conventional Parameters							
Sulfate (SO4) (mg/l)			5.09		5.46		
Sulfur (mg/l)			3		3		

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	W92-16B GW-W92-16B-0000 02/05/2004	W97-18A GW-W97-18A-0000 02/05/2004	W97-18B GW-W97-18B-0000 02/06/2004	W97-19A GW-W97-19A-0000 02/06/2004	W97-19B GW-W97-19B-0000 02/06/2004	W98-20A GW-W98-20A-0000 02/07/2004
Inorganics (Total) (ug/l)							
Aluminum		41.0 J	452	38.5 J	651	200 U	30.9 J
Antimony		60.0 U	60.0 U	60.0 U	60.0 U	60.0 U	60.0 U
Arsenic		15.0 U	15.0 U	15.0 U	15.0 U	15.0 U	4.3 J
Barium		323	20.3 J	13.3 J	14.5 J	15.5 J	8.9 J
Beryllium		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Cadmium		0.77 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Calcium		84200 J	10800 J	29000 J	28300 J	31400 J	19100 J
Chromium		2.6 J	0.56 J	0.41 J	2.2 J	12.5	2.0 J
Cobalt		13.2 J	50.0 U	50.0 U	50.0 U	50.0 U	50.0 U
Copper		3.4 U	2.1 U	2.3 U	3.0 U	1.6 U	1.5 U
Hexavalent Chromium		40 U	40 U	40 U	40 U	40 U	40 U
Iron		440	507	60.0 J	667	28.0 J	34.3 J
Lead		4.5 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U
Magnesium		25800 J	2640 J	8860 J	8870 J	9540 J	6080 J
Manganese		2310	35.5	6.9 J	20.6	2.6 J	0.24 J
Nickel		6.4 J	40.0 U	40.0 U	40.0 U	1.5 J	40.0 U
Potassium		122000 J	1970 J	3750 J	3440 J	4450 J	2390 J
Selenium		35.0 U	35.0 U	35.0 U	35.0 U	35.0 U	35.0 U
Silver		10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ
Sodium		28700	3990 J	6640	6610	7250	4740 J
Thallium		4.9 J	25.0 U	25.0 U	25.0 U	25.0 U	25.0 U
Vanadium		1.6 J	2.8 J	4.3 J	6.2 J	4.7 J	3.9 J
Zinc		41.9 J	3.7 J	2.2 J	6.9 J	148	60.0 U
Inorganics (Dissolved) (ug/l)							
Aluminum			116 J				
Antimony			60.0 U				
Arsenic			15.0 U				

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	W92-16B GW-W92-16B-0000 02/05/2004	W97-18A GW-W97-18A-0000 02/05/2004	W97-18B GW-W97-18B-0000 02/06/2004	W97-19A GW-W97-19A-0000 02/06/2004	W97-19B GW-W97-19B-0000 02/06/2004	W98-20A GW-W98-20A-0000 02/07/2004
Barium			15.8 J				
Beryllium			5.0 U				
Cadmium			5.0 U				
Calcium			11300 J				
Chromium			10.0 U				
Cobalt			50.0 U				
Copper			45.7				
Iron			187				
Lead			4.2 U				
Magnesium			2730 J				
Manganese			30.7				
Nickel			23.1 J				
Potassium			2030 J				
Selenium			35.0 U				
Silver			10.0 UJ				
Sodium			4200 J				
Thallium			25.0 U				
Vanadium			1.8 J				
Zinc			5.7 J				
Conventional Parameters							
Sulfate (SO4) (mg/l)							
Sulfur (mg/l)							

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID:	W98-21A	W98-21B	W99-R5A	W99-R5A	W99-R5B
	Sample ID:	GW-W98-21A-0000	GW-W98-21B-0000	GW-W99-R5A-0000	GW-W99-R5A-1000	GW-W99-R5B-0000
	Sample Date:	02/09/2004	02/09/2004	02/07/2004	02/07/2004	02/07/2004
Inorganics (Total) (ug/l)						
Aluminum		53.5 J	17.4 J	200 U	200 U	200 U
Antimony		60.0 U	60.0 U	60.0 U	60.0 U	60.0 U
Arsenic		15.0 U	15.0 U	15.0 U	15.0 U	4.1 J
Barium		7.8 J	9.7 J	14.6 J	15.0 J	9.9 J
Beryllium		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Cadmium		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Calcium		16300 J	25300 J	26000 J	27200 J	29600 J
Chromium		1.7 J	3.6 J	0.41 J	10.0 U	7.5 J
Cobalt		50.0 U	50.0 U	50.0 U	50.0 U	50.0 U
Copper		25.0 U	25.0 U	1.9 U	1.2 U	0.53 U
Hexavalent Chromium		40 U	40 U	40 U	40 U	40 U
Iron		42.5 J	45.9 J	7.5 J	100 U	38.3 J
Lead		10.0 U	10.0 U	10.0 U	5.1 J	10.0 U
Magnesium		5070 J	7930 J	8560 J	8890 J	9210 J
Manganese		0.93 J	1.0 J	15.0 U	15.0 U	15.0 U
Nickel		40.0 U	40.0 U	40.0 U	40.0 U	40.0 U
Potassium		1990 J	2860 J	3330 J	3500 J	3500 J
Selenium		35.0 U	35.0 U	35.0 U	35.0 U	35.0 U
Silver		10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ
Sodium		4620 J	5650	7380	7700	6530
Thallium		25.0 U	25.0 U	25.0 U	25.0 U	25.0 U
Vanadium		2.5 J	4.0 J	3.6 J	3.6 J	6.0 J
Zinc		60.0 U	60.0 U	60.0 U	60.0 U	60.0 U
Inorganics (Dissolved) (ug/l)						
Aluminum						
Antimony						
Arsenic						

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 1 - Frontier Hardchrome Long Term Monitoring, Event 1 Comprehensive Groundwater Data Listing

Constituent	Station ID: / Sample ID: / Sample Date:	W98-21A GW-W98-21A-0000 02/09/2004	W98-21B GW-W98-21B-0000 02/09/2004	W99-R5A GW-W99-R5A-0000 02/07/2004	W99-R5A GW-W99-R5A-1000 02/07/2004	W99-R5B GW-W99-R5B-0000 02/07/2004
Barium						
Beryllium						
Cadmium						
Calcium						
Chromium						
Cobalt						
Copper						
Iron						
Lead						
Magnesium						
Manganese						
Nickel						
Potassium						
Selenium						
Silver						
Sodium						
Thallium						
Vanadium						
Zinc						
Conventional Parameters						
Sulfate (SO4) (mg/l)				11.6	11.6	
Sulfur (mg/l)				5	5	

A blank cell indicates analysis was not performed. U - Analyte not detected. J - Value estimated. R - Data rejected. For additional descriptions see EPA CLP RAS Validation SOP

Table 2—Event 1 (February 2004) Monitoring Field Parameters

Well No.	Temp (C)	Specific Conductance (mS/cm)	D.O. (mg/L)	pH	ORP (mV)	Cr^{+6} (mg/L)
B85-3	14.6	0.99	1.11	6.49	-7.3	<0.04
B85-4	14.1	0.41	0.65	6.14	10	0.04
B87-8	14.5	0.26	0.13	6.55	-8	<0.04
RA-MW-11A	15.7	1.67	0.32	7.51	-384	<0.8
RA-MW-11B	14.9	1.49	0.19	7.66	-394	<0.8
RA-MW-12A	14.9	6.01	0.24	8.86	-468	<0.8
RA-MW-12B	14.4	2.25	0.27	7.77	-363	<0.04
RA-MW-12C	14.4	2.18	0.2	8.13	-282	<0.04
RA-MW-13A	15	5.21	1.63	7.15	-155	<0.04
RA-MW-13B	14.8	3.73	0.73	7.23	-129	<0.04
RA-MW-13C	14.2	3.07	0.22	7.36	-136	<0.04
RA-MW-14A	13.9	1.43	0.89	6.64	-77	<0.04
RA-MW-14B	14	1.56	1.08	6.9	-112	<0.04
RA-MW-15A	14.3	1.88	0.33	6.35	-47	<0.04
RA-MW-15B	13.9	0.47	0.22	6.35	-5	0.13
RA-MW-16A	14.3	2.95	0.73	6.61	-94	<0.04
RA-MW-16B	14.3	2.42	0.75	6.42	-57	<0.04
RA-MW-17A	14.3	1.8	0.6	6.55	-91	<0.04
W85-6A	14.1	0.11	4.92	6.23	17	<0.04
W85-6B	13.6	0.31	3.46	6.4	19	<0.04
W85-7A	11.4	0.13	4.05	6.24	68	<0.04
W85-7B	12.1	0.28	2.78	6.63	59	0.03
W92-16A	14.2	0.33	0.98	6.42	1	<0.04
W92-16B	14.1	1.17	0.14	7.51	-116	<0.04
W97-18A	11.3	0.11	1.27	5.83	32	<0.04
W97-18B	11.4	0.26	2.01	6.57	57	<0.04
W97-19A	12.5	0.25	4.72	6.35	71	<0.04
W97-19B	12.7	0.26	1.81	6.68	56	<0.04
W98-20A	13.8	0.16	4.92	6.01	52	<0.04
W98-21A	13.1	0.16	1.29	5.92	28	<0.04
W98-21B	13.1	0.24	1.24	6.04	33	<0.04
W99-R5A	14.2	0.24	4.72	6.03	58	<0.04
W99-R5B	13.9	0.26	3.97	6.2	58	<0.04

Table 3—Frontier Hard Chrome - Ground Water Elevations February 2, 2004

Well No.	Date/Time	Casing Elevation (feet)	Depth to Water (feet)	Water level Elevation (AMSL)
W85-3A	2-02/ 1505	26.40	17.05	9.35
W85-3B	1503	26.77	17.37	9.40
W97-18A	1513	25.44	16.40	9.04
W97-18B	1515	25.36	15.85	9.51
B87-8	1526	25.95	16.45	9.50
B85-4	1522	25.38	15.85	9.53
W92-16B	1532	25.51	16.05	9.46
W92-16A	1533	25.62	16.15	9.47
W98-21A	1542	25.28[4]	15.70	9.58
W98-21B	1541	25.50[4]	15.90	9.60
W85-6A	1547	25.38	15.80	9.58
W85-6B	1546	25.24	15.70	9.54
W85-7B	1602	23.00	13.50[1]	9.50
W85-7A	NM[2]	22.83	NM[2]	-
W97-19A	1620	22.45[4]	12.95	9.50
W97-19B	1622	21.72[4]	34.10[3]	(-12.38)
W98-20A	1630	23.57[4]	13.95	9.62
W99-R5B	1642	32.33	22.70	9.63
W99-R5A	1644	32.26	22.63	9.63
USGS 14144700 (Stage height of the Columbia River)	1645	-	-	10.24

1- The light and sound didn't work on the water level recorder at this location but visual contact was made for the "b-zone" well only. This was possible because it was a 4-inch casing.

2- NM (not measured) Water level recorder didn't work for this location.

3- Water level measurement was collected at a deeper depth then the rest of the monitoring wells for this zone. It is possible that the well screen is plugged therefore proper contact with the aquifer may not have been made.

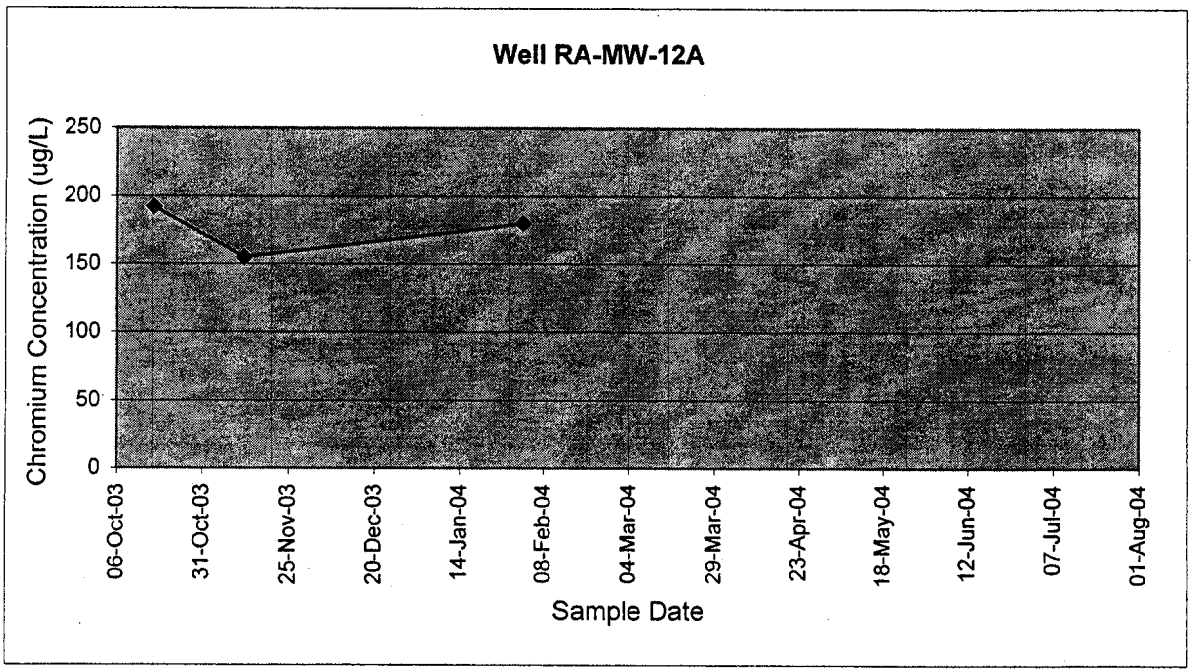
4- Two different elevation datums have been used at Frontier Hard Chrome. Weston (12/03) Long-Term Monitoring plan have applied a correction factor (+3.76 feet) using the City of Vancouver's benchmark #108 located near FHC site.

APPENDIX A

GROUNDWATER CHROMIUM CONCENTRATION TRENDS

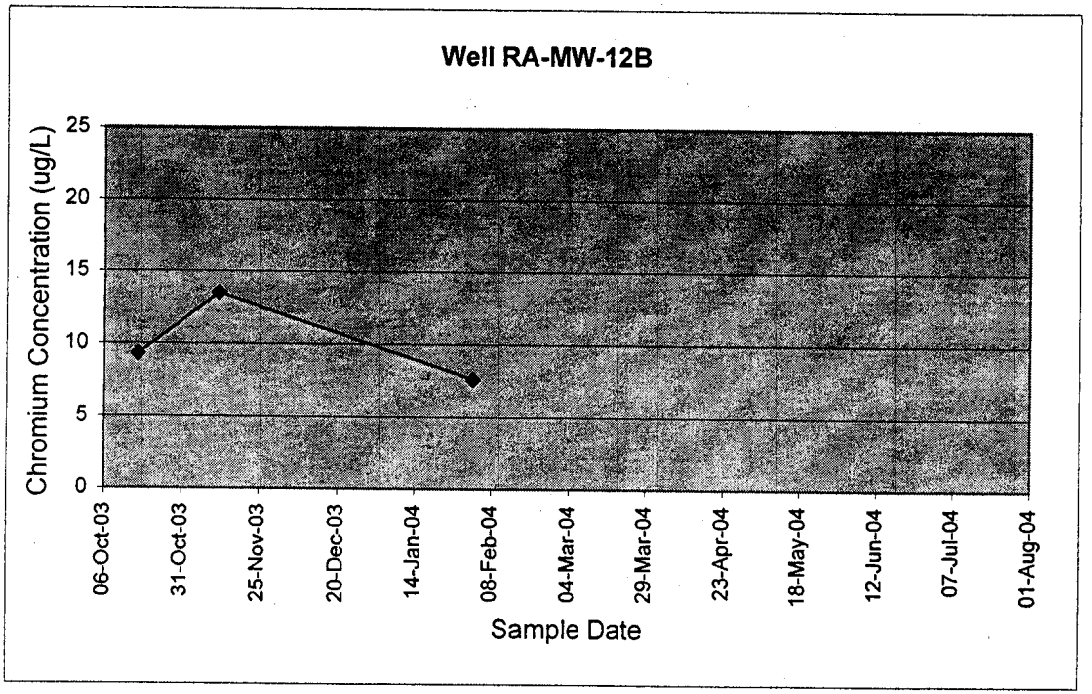
Well RA-MW-12A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2524	Water	17-Oct-03	CHROMIUM	192	UG/L		RA-MW-12A	Dissolved
MJ27F5	Water	12-Nov-03	CHROMIUM	155	UG/L		RA-MW-12A	Dissolved
MJ2AF0	Water	02-Feb-04	CHROMIUM	180	UG/L		RA-MW-12A	Total



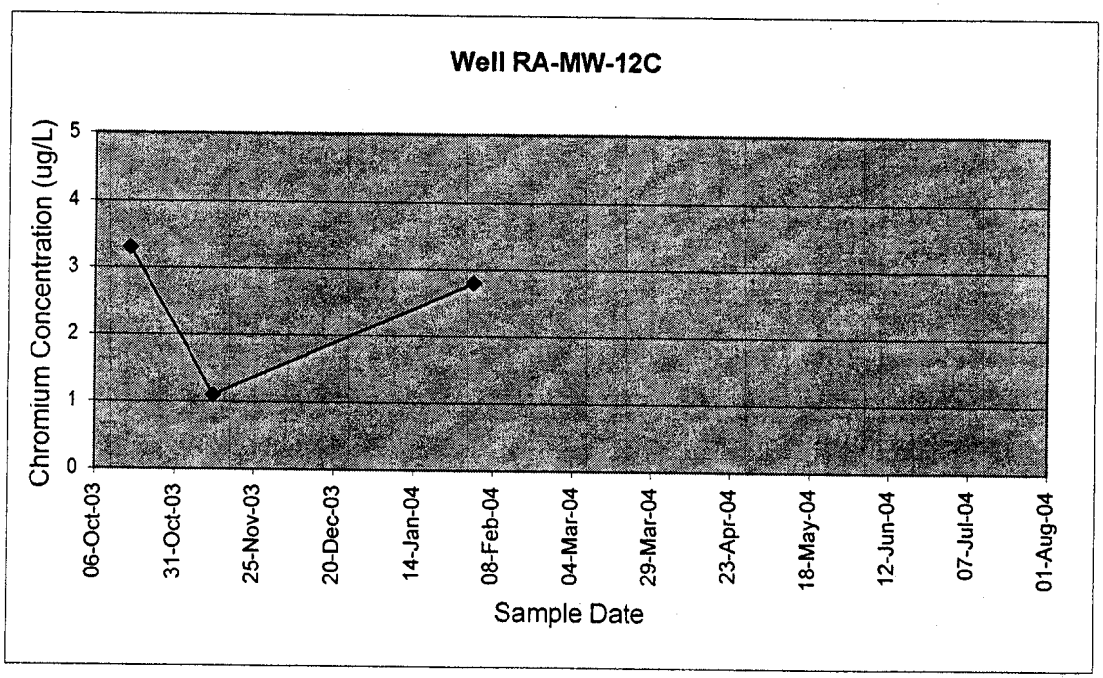
Well RA-MW-12B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2526	Water	17-Oct-03	CHROMIUM	9.3	UG/L	BJ	RA-MW-12B	Dissolved
MJ27F7	Water	12-Nov-03	CHROMIUM	13.5	UG/L		RA-MW-12B	Dissolved
MJ2AF1	Water	02-Feb-04	CHROMIUM	7.6	UG/L	J	RA-MW-12B	Total



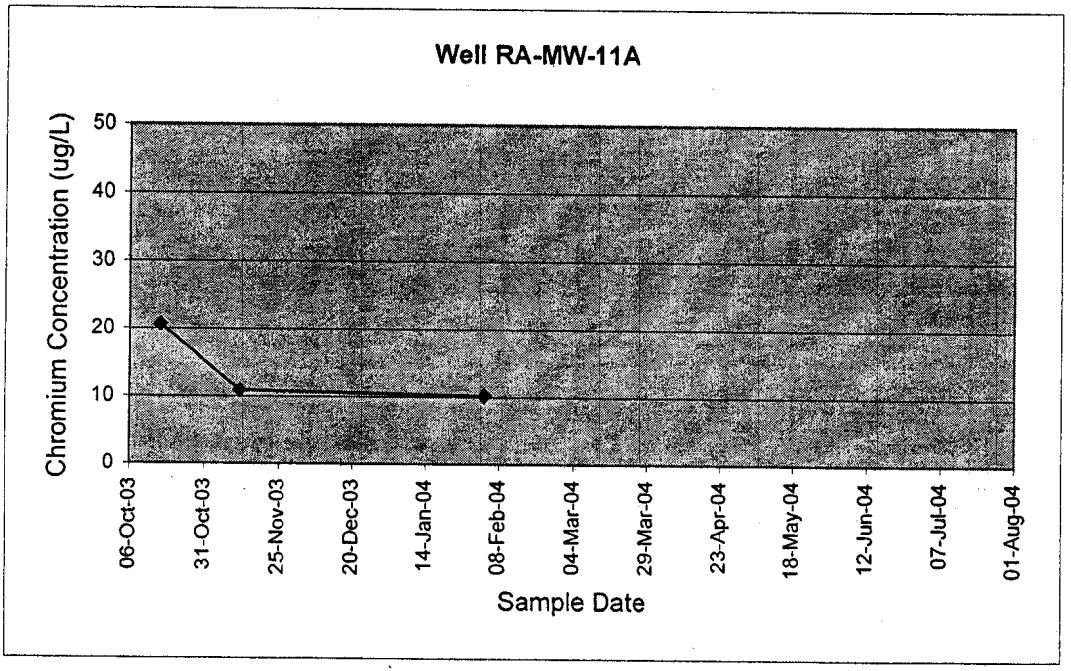
Well RA-MW-12C

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2528	Water	17-Oct-03	CHROMIUM	3.3	UG/L	BJ	RA-MW-12C	Dissolved
MJ27F9	Water	12-Nov-03	CHROMIUM	1.1	UG/L	BJ	RA-MW-12C	Dissolved
MJ2AF2	Water	02-Feb-04	CHROMIUM	2.8	UG/L	J	RA-MW-12C	Total



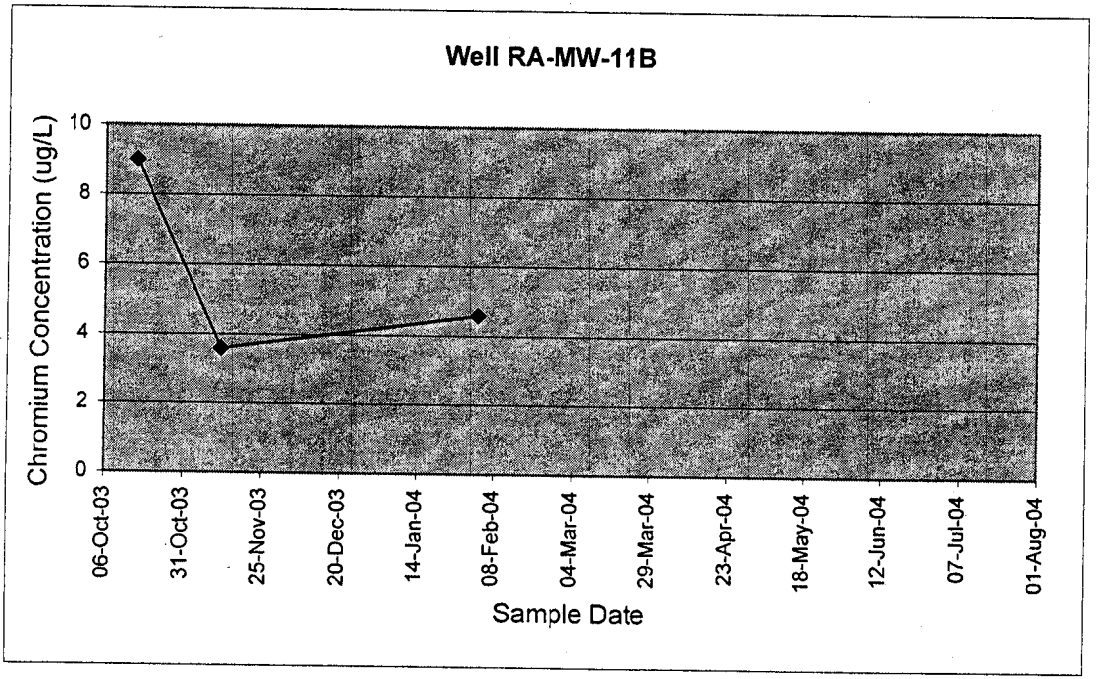
Well RA-MW-11A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2516	Water	16-Oct-03	CHROMIUM	20.7	UG/L		RA-MW-11A	Dissolved
MJ27G1	Water	12-Nov-03	CHROMIUM	10.9	UG/L	J	RA-MW-11A	Dissolved
MJ2AF4	Water	03-Feb-04	CHROMIUM	10.2	UG/L		RA-MW-11A	Dissolved



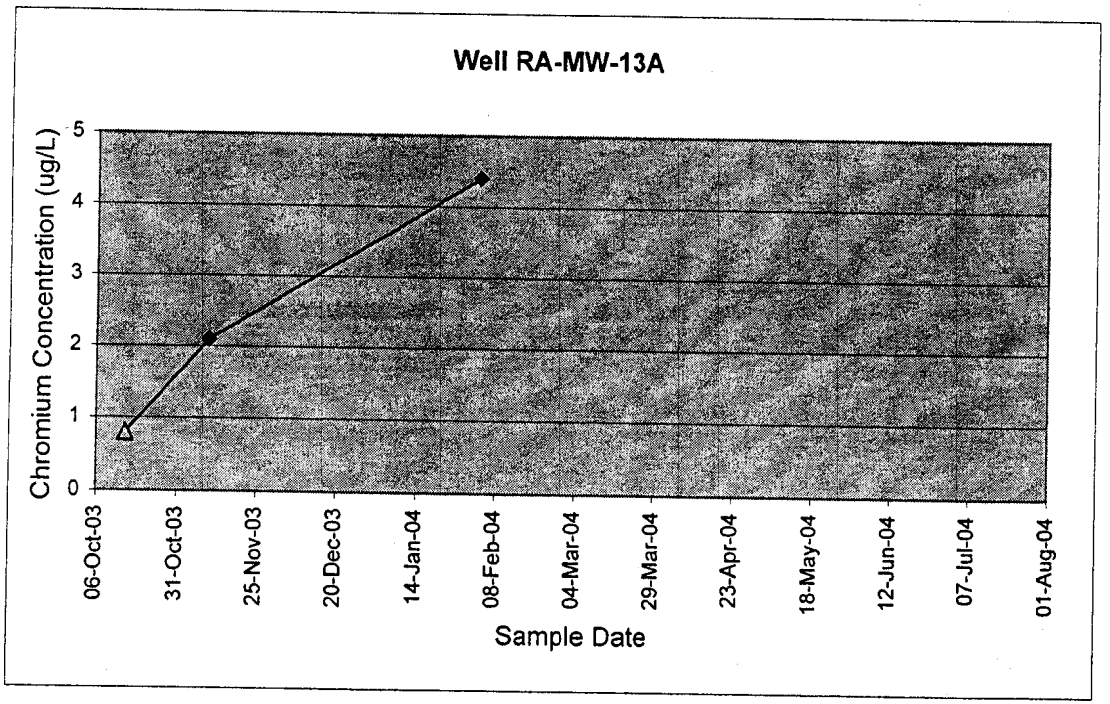
Well RA-MW-11B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2518	Water	16-Oct-03	CHROMIUM	9	UG/L	BJ	RA-MW-11B	Dissolved
MJ27G3	Water	12-Nov-03	CHROMIUM	3.6	UG/L	BJ	RA-MW-11B	Dissolved
MJ2AF6	Water	03-Feb-04	CHROMIUM	4.6	UG/L	J	RA-MW-11B	Dissolved



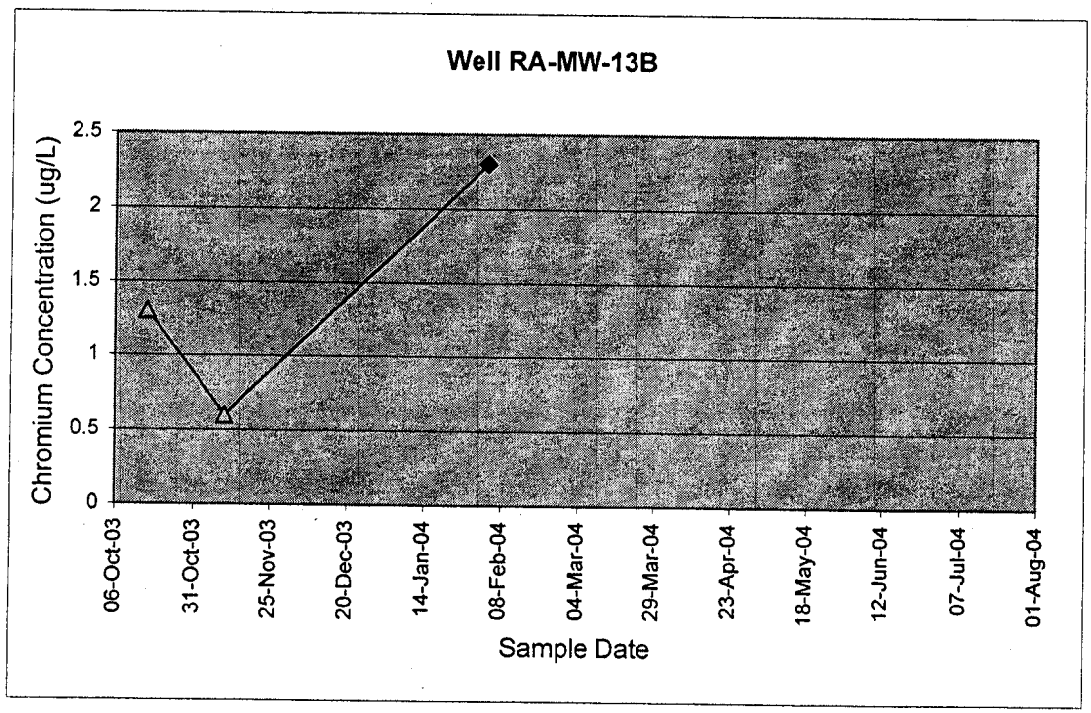
Well RA-MW-13A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2508	Water	15-Oct-03	CHROMIUM	0.8	UG/L	U	RA-MW-13A	Total
MJ27E2	Water	10-Nov-03	CHROMIUM	2.1	UG/L	BJ	RA-MW-13A	Total
MJ2AG1	Water	03-Feb-04	CHROMIUM	4.4	UG/L	J	RA-MW-13A	Total



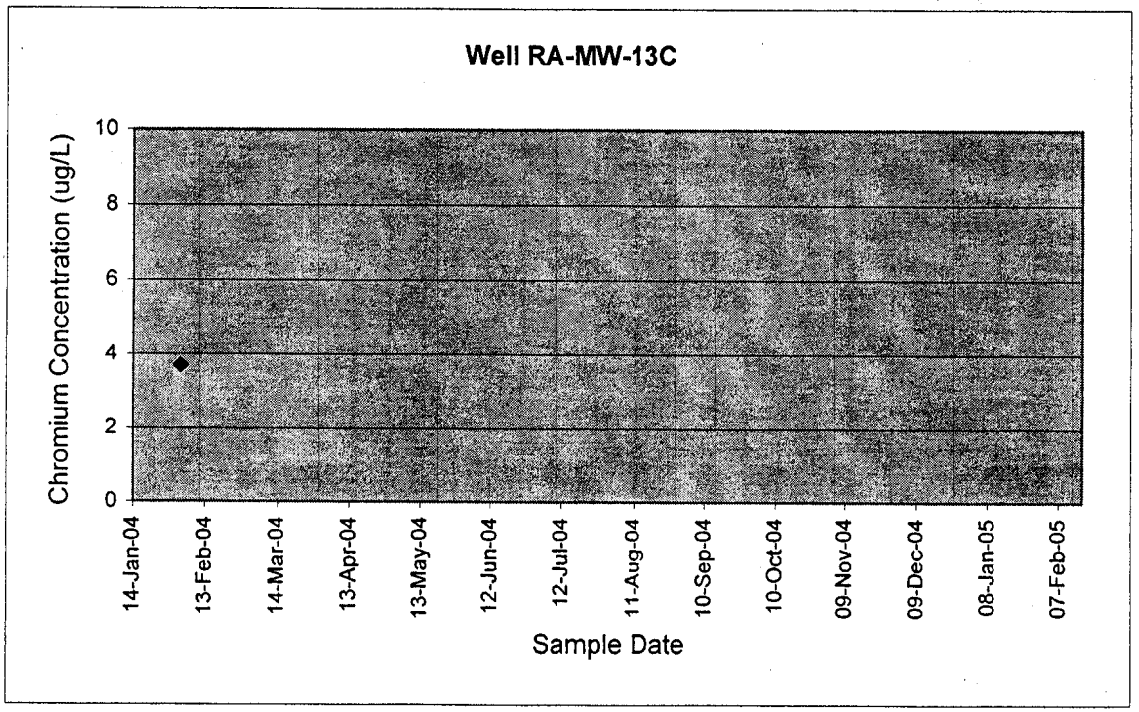
Well RA-MW-13B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2509	Water	16-Oct-03	CHROMIUM	1.3	UG/L	U	RA-MW-13B	Total
MJ27E3	Water	10-Nov-03	CHROMIUM	0.6	UG/L	UJ	RA-MW-13B	Total
MJ2AF8	Water	03-Feb-04	CHROMIUM	2.3	UG/L	J	RA-MW-13B	Total



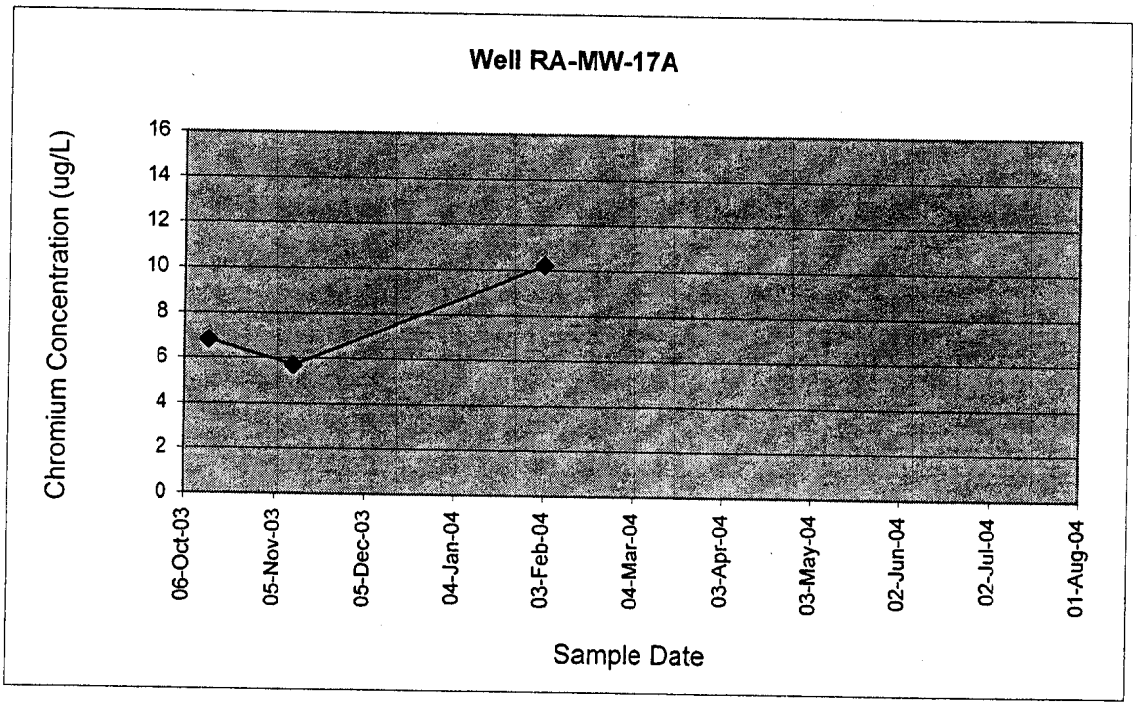
Well RA-MW-13C

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AF9	Water	03-Feb-04	CHROMIUM	3.7	UG/L	J	RA-MW-13C	Total



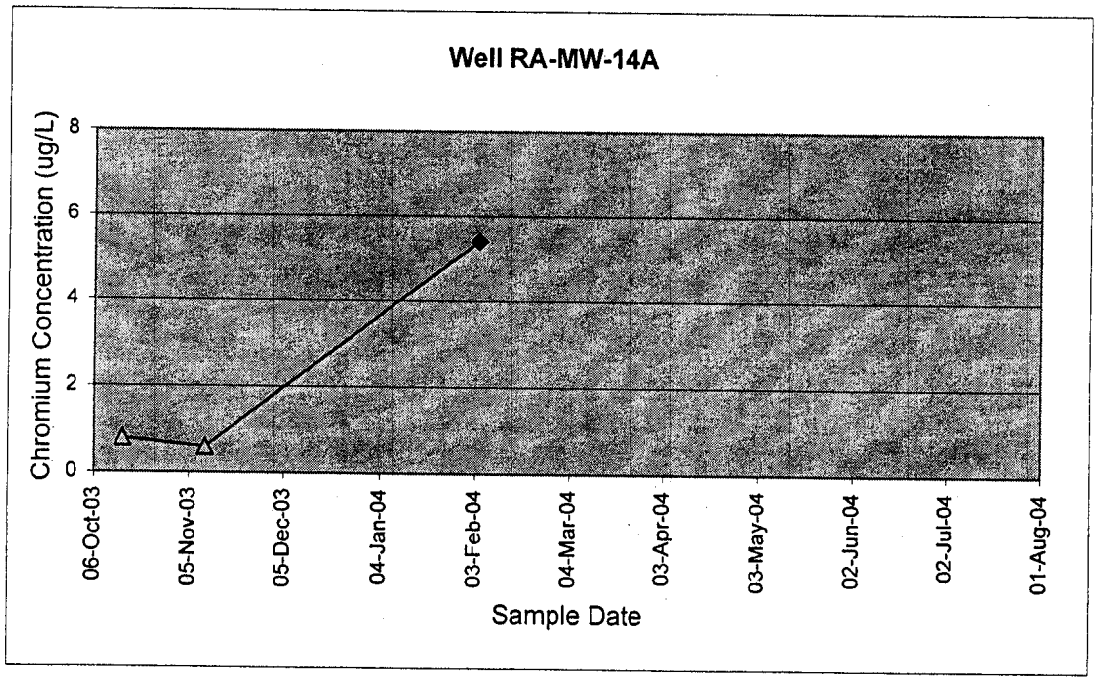
Well RA-MW-17A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2501	Water	14-Oct-03	CHROMIUM	6.8	UG/L	BJ	RA-MW-17A	Total
MJ27E5	Water	11-Nov-03	CHROMIUM	5.7	UG/L	BJ	RA-MW-17A	Total
MJ2AG0	Water	03-Feb-04	CHROMIUM	10.2	UG/L	J	RA-MW-17A	Total



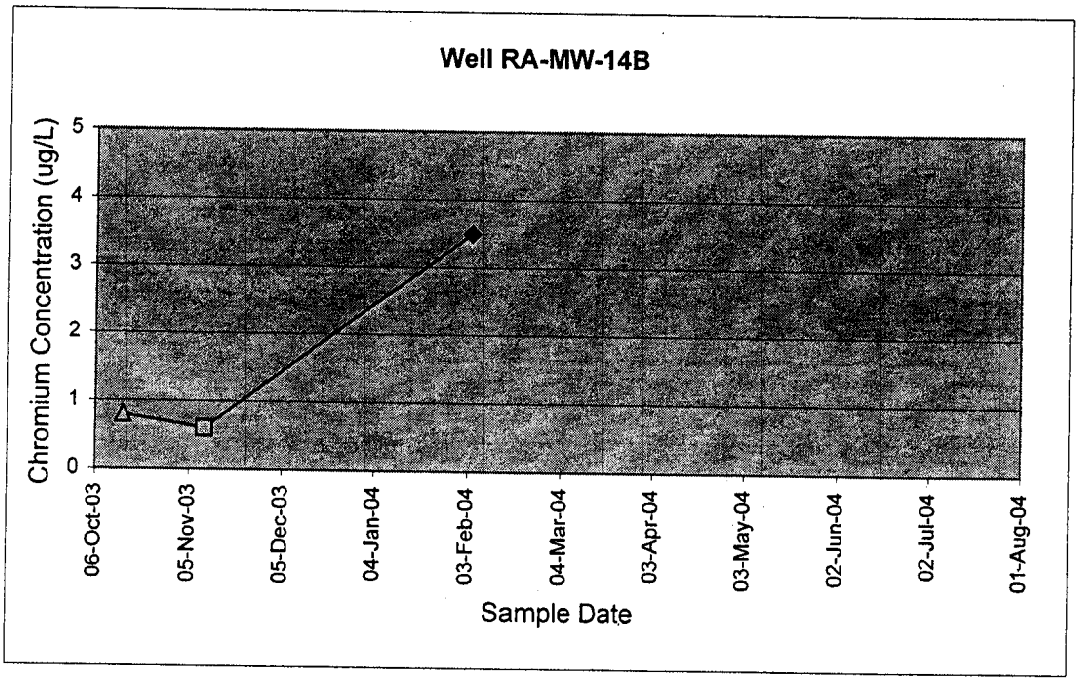
Well RA-MW-14A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2504	Water	15-Oct-03	CHROMIUM	0.8	UG/L	U	RA-MW-14A	Total
MJ27D8	Water	10-Nov-03	CHROMIUM	0.6	UG/L	UJ	RA-MW-14A	Total
MJ2AG2	Water	04-Feb-04	CHROMIUM	5.4	UG/L	J	RA-MW-14A	Total



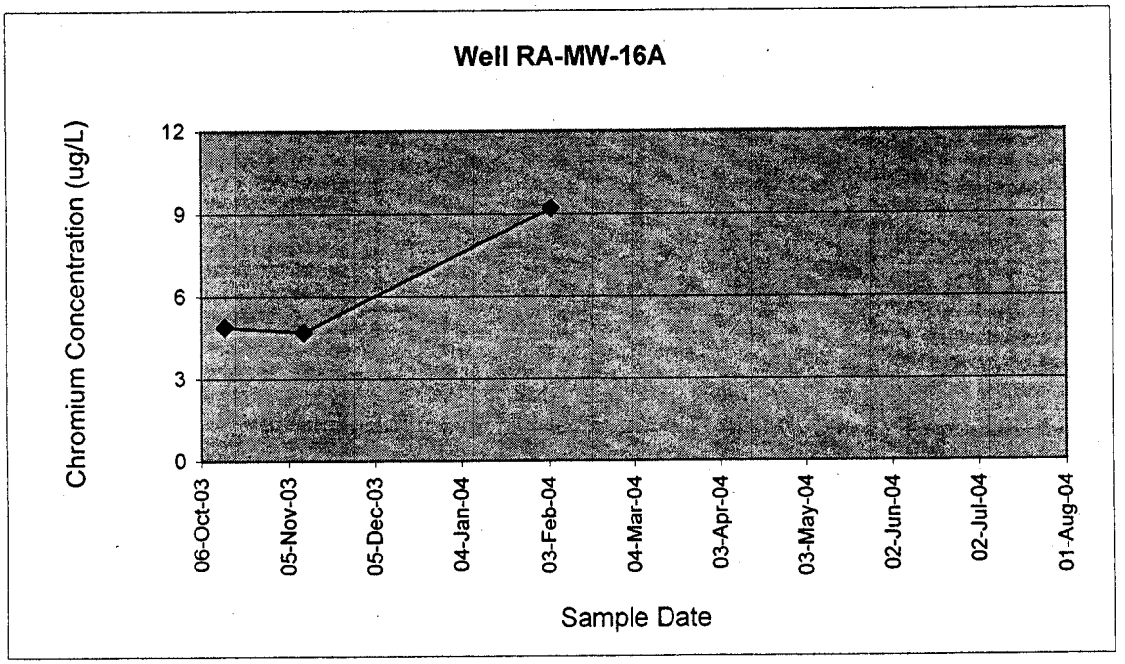
Well RA-MW-14B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2505	Water	15-Oct-03	CHROMIUM	0.8	UG/L	U	RA-MW-14B	Total
MJ27D9	Water	10-Nov-03	CHROMIUM	0.6	UG/L	R	RA-MW-14B	Total
MJ2AG4	Water	04-Feb-04	CHROMIUM	3.5	UG/L	J	RA-MW-14B	Total



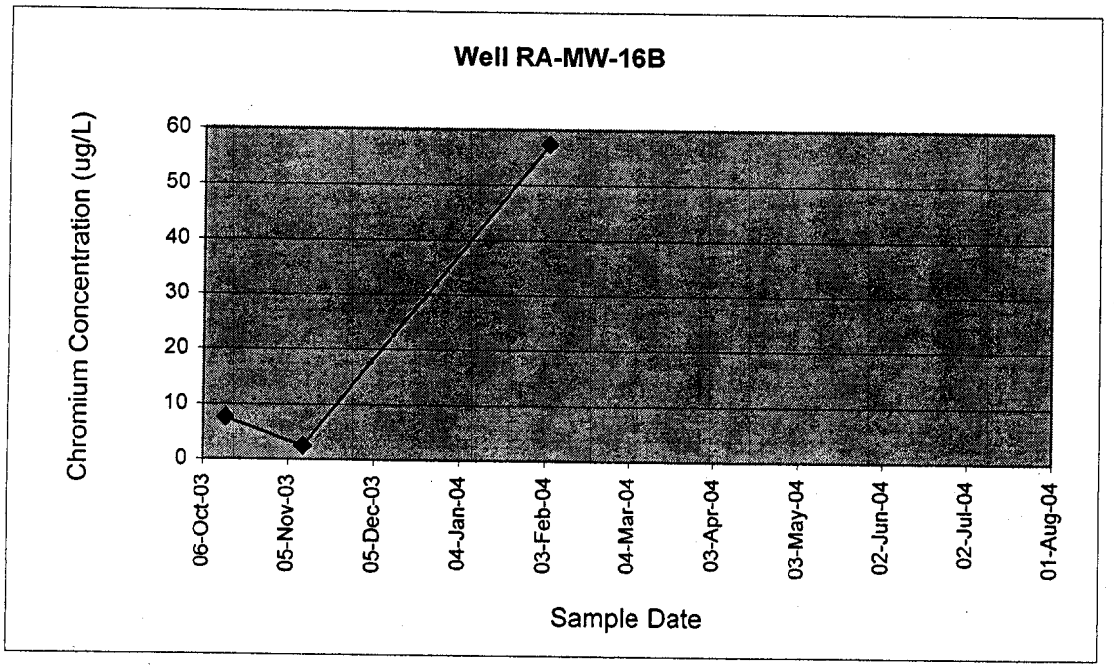
Well RA-MW-16A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2502	Water	14-Oct-03	CHROMIUM	4.9	UG/L	BJ	RA-MW-16A	Total
MJ27E0	Water	10-Nov-03	CHROMIUM	4.7	UG/L	BJ	RA-MW-16A	Total
MJ2AG5	Water	04-Feb-04	CHROMIUM	9.2	UG/L	J	RA-MW-16A	Total



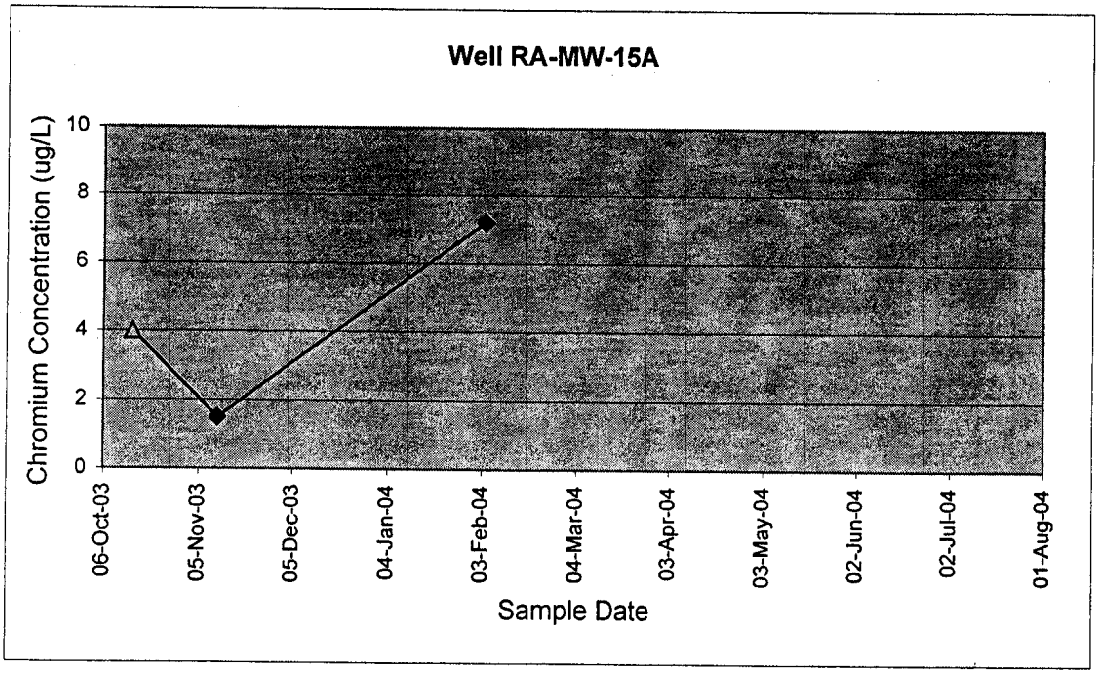
Well RA-MW-16B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2503	Water	14-Oct-03	CHROMIUM	7.6	UG/L	BJ	RA-MW-16B	Total
MJ27E1	Water	10-Nov-03	CHROMIUM	2.5	UG/L	BJ	RA-MW-16B	Total
MJ2AG6	Water	04-Feb-04	CHROMIUM	57.4	UG/L	BJ	RA-MW-16B	Total



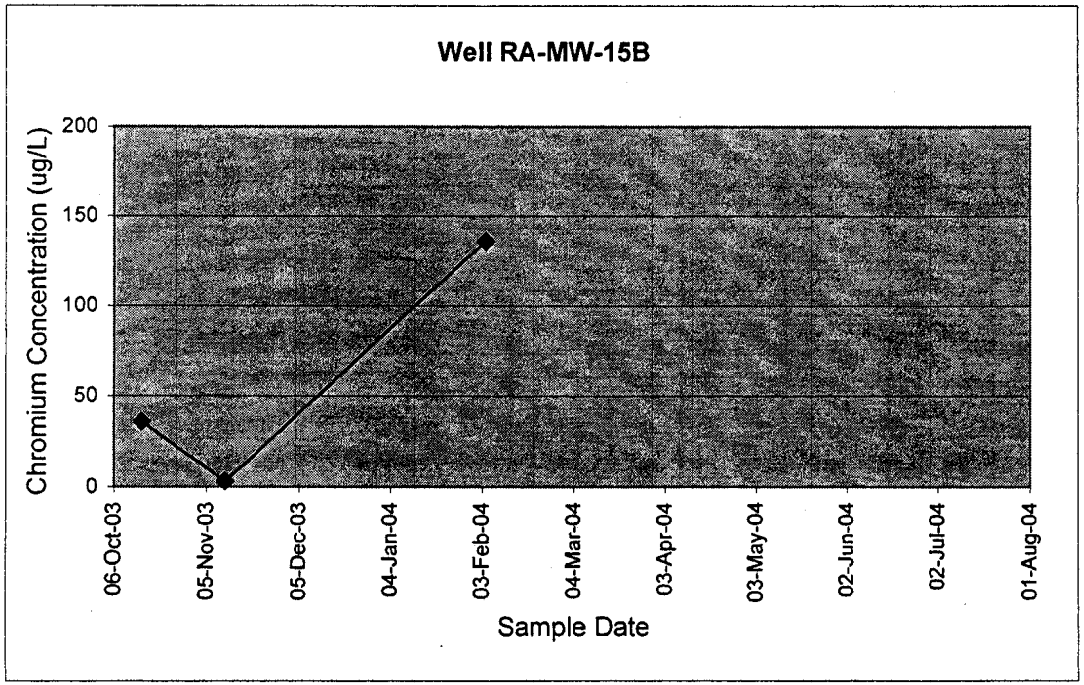
Well RA-MW-15A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2506	Water	15-Oct-03	CHROMIUM	4	UG/L	U	RA-MW-15A	Total
MJ27E8	Water	11-Nov-03	CHROMIUM	1.5	UG/L	BJ	RA-MW-15A	Total
MJ2AG7	Water	04-Feb-04	CHROMIUM	7.2	UG/L	J	RA-MW-15A	Total



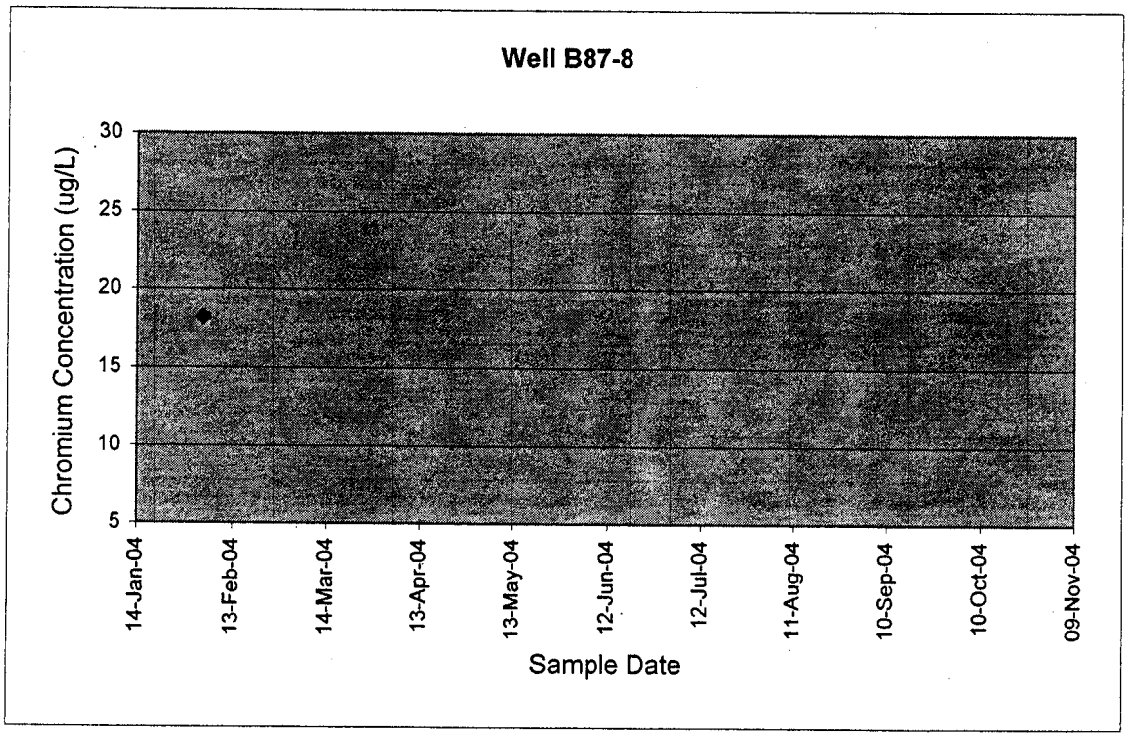
Well RA-MW-15B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2507	Water	15-Oct-03	CHROMIUM	35.8	UG/L		RA-MW-15B	Total
MJ27E9	Water	11-Nov-03	CHROMIUM	3.2	UG/L	BJ	RA-MW-15B	Total
MJ2AG8	Water	04-Feb-04	CHROMIUM	136	UG/L		RA-MW-15B	Total



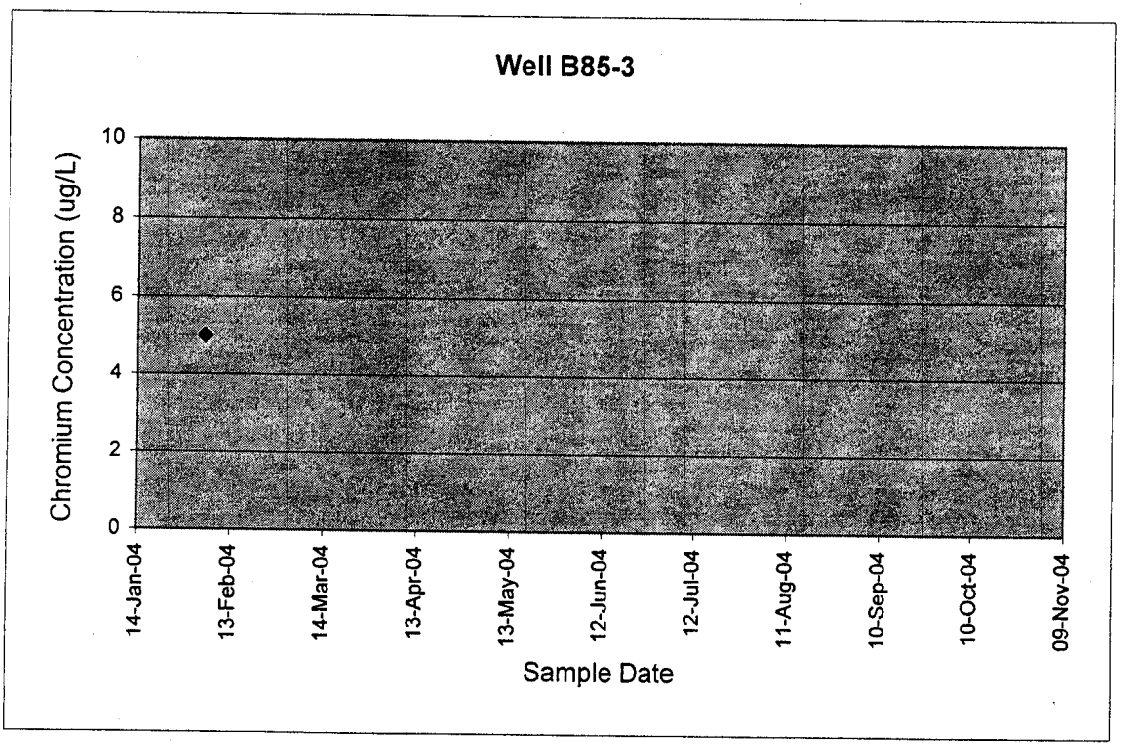
Well B87-8

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AG9	Water	04-Feb-04	CHROMIUM	18.2	UG/L		B87-8	Total



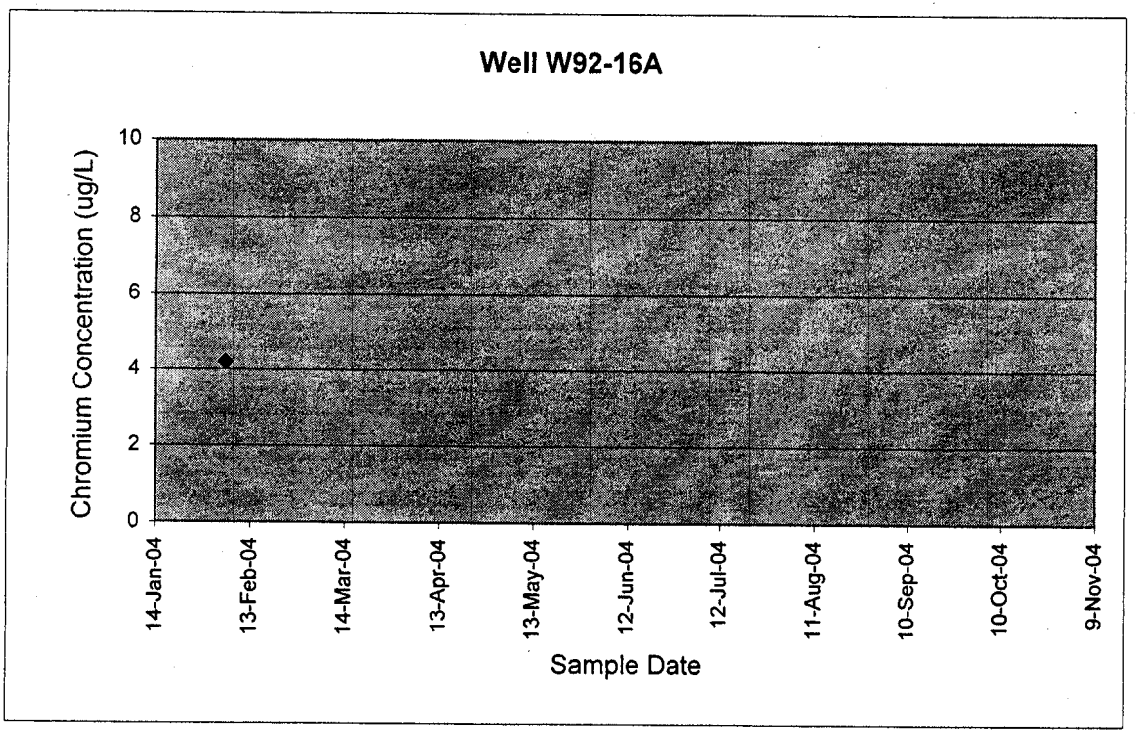
Well B85-3

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH0	Water	05-Feb-04	CHROMIUM	5	UG/L	J	B85-3	Total



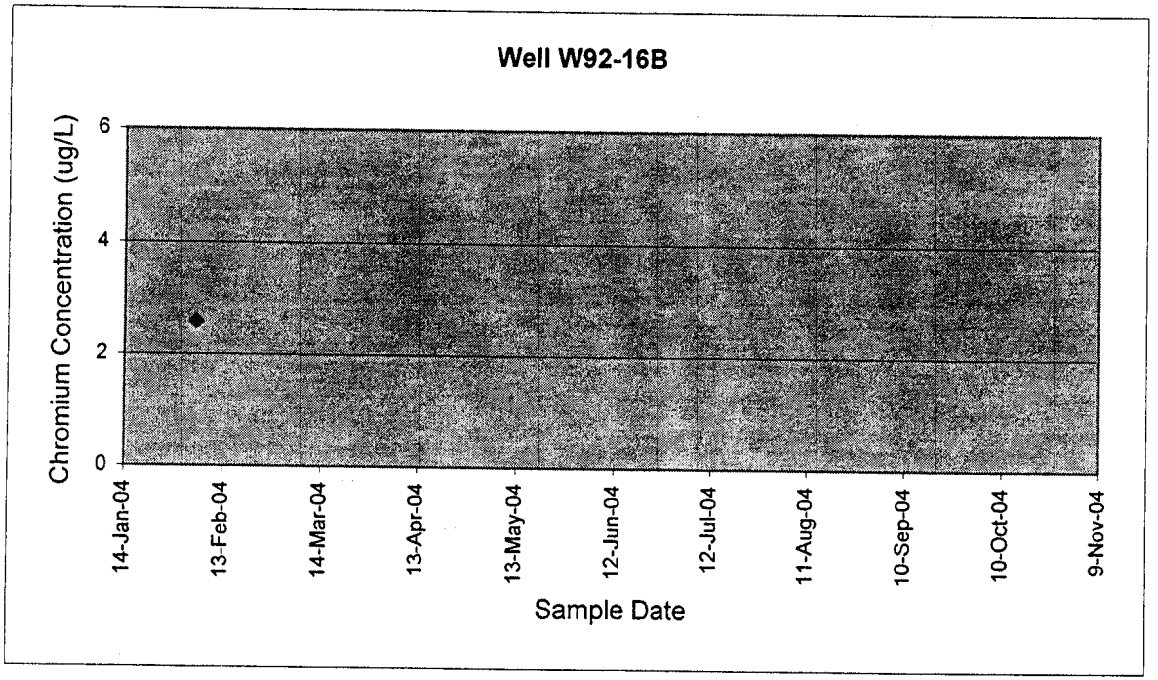
Well W92-16A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH1	Water	05-Feb-04	CHROMIUM	4.2	UG/L	J	W92-16A	Total



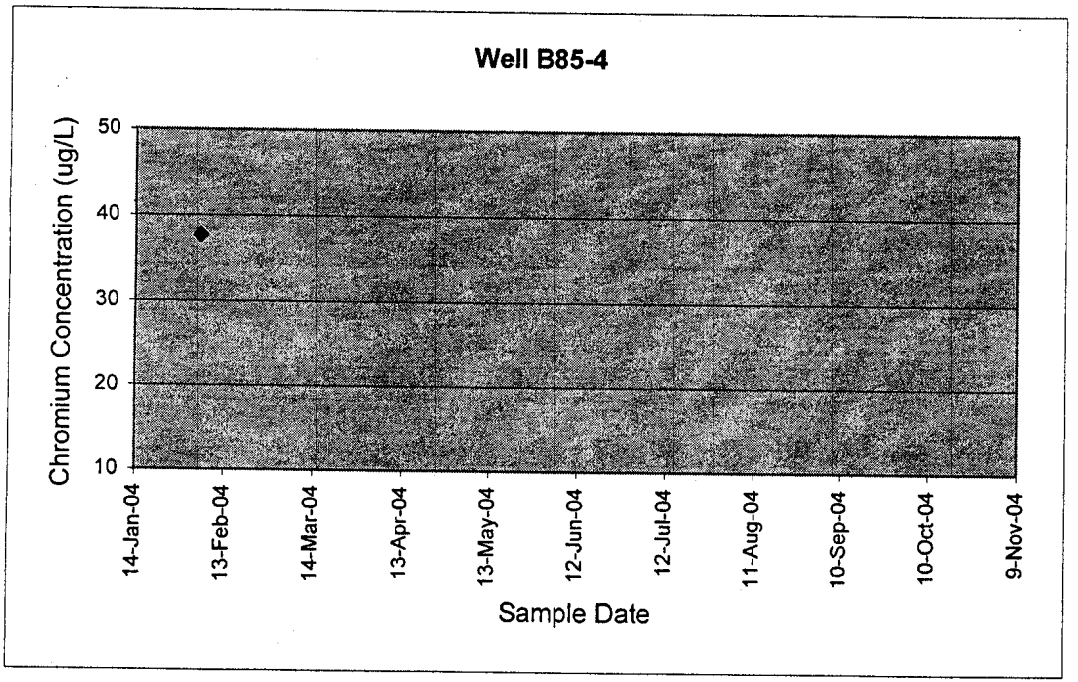
Well W92-16B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH3	Water	05-Feb-04	CHROMIUM	2.6	UG/L	J	W92-16B	Total



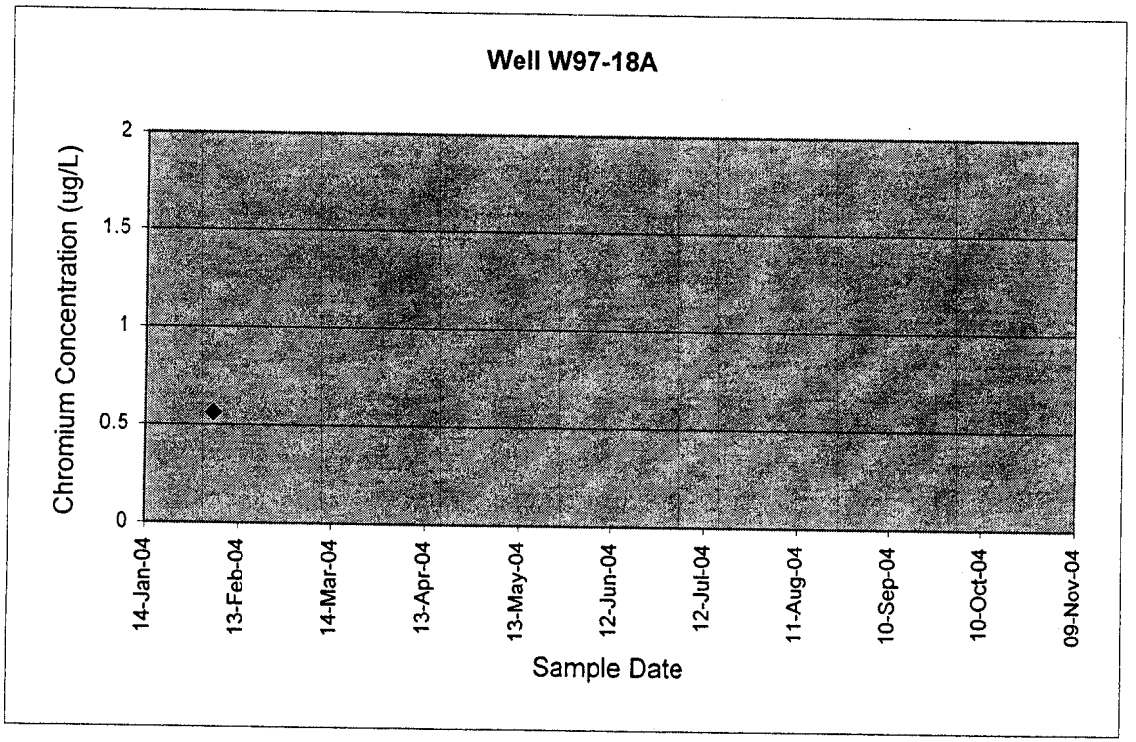
Well B85-4

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH4	Water	05-Feb-04	CHROMIUM	37.7	UG/L		B85-4	Total



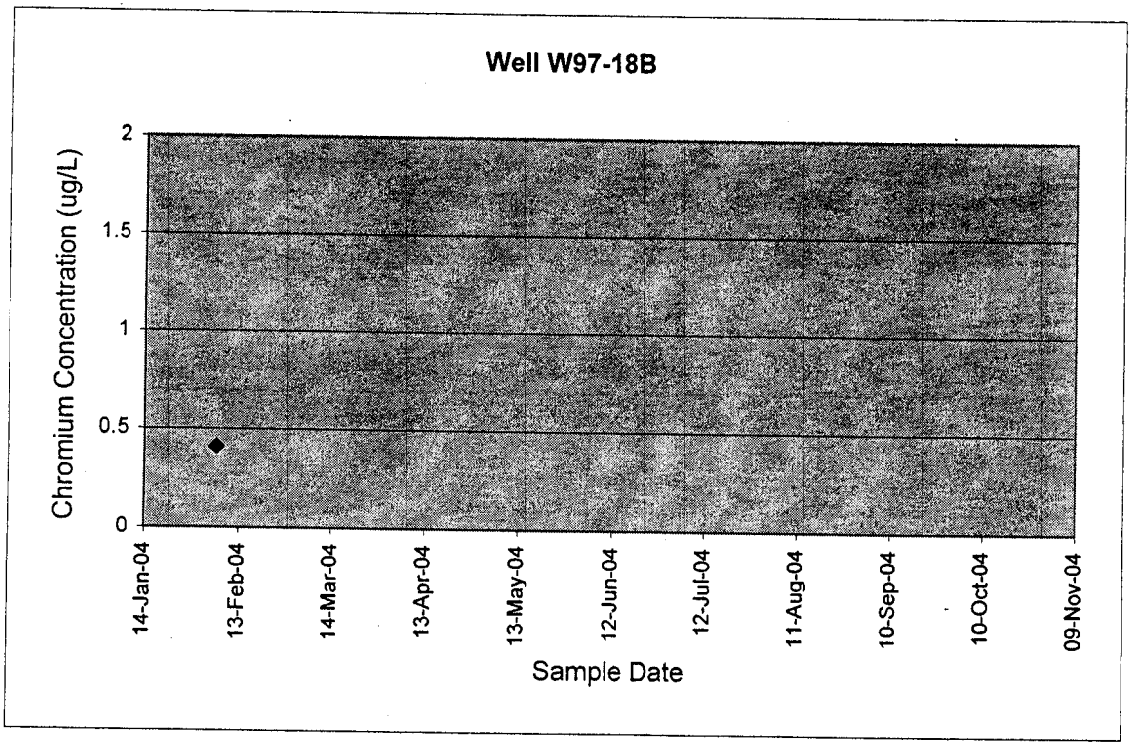
Well W97-18A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH5	Water	05-Feb-04	CHROMIUM	0.56	UG/L	J	W97-18A	Total



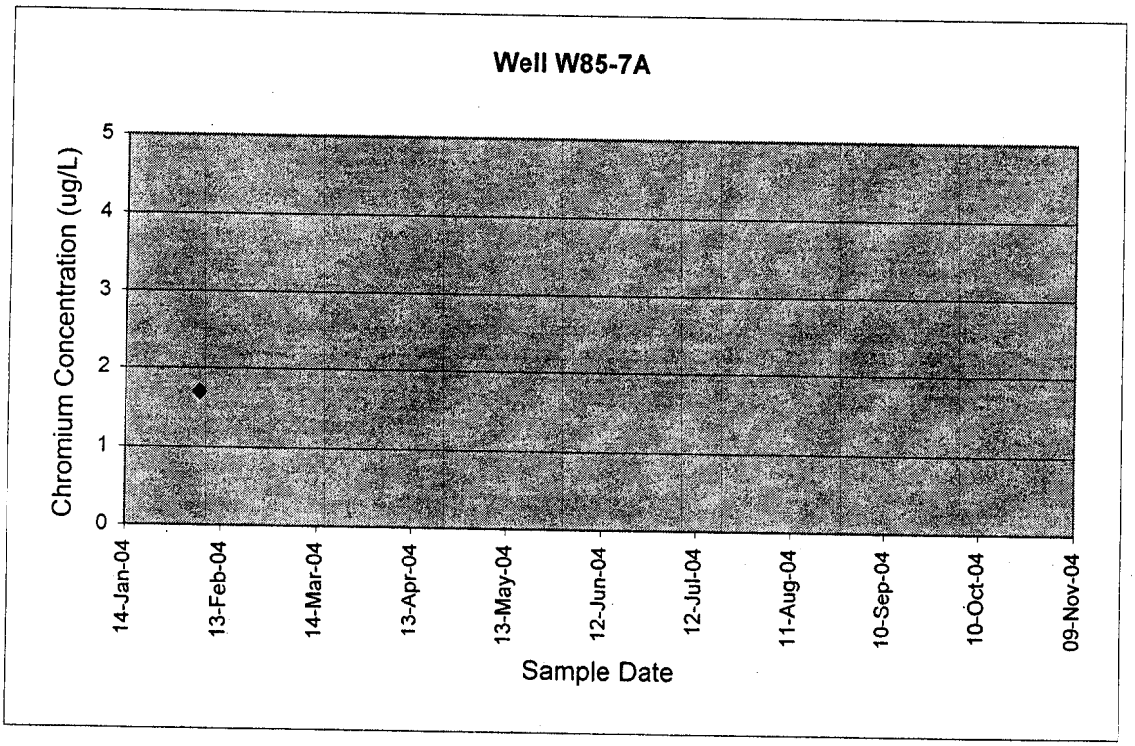
Well W97-18B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH7	Water	06-Feb-04	CHROMIUM	0.41	UG/L	J	W97-18B	Total



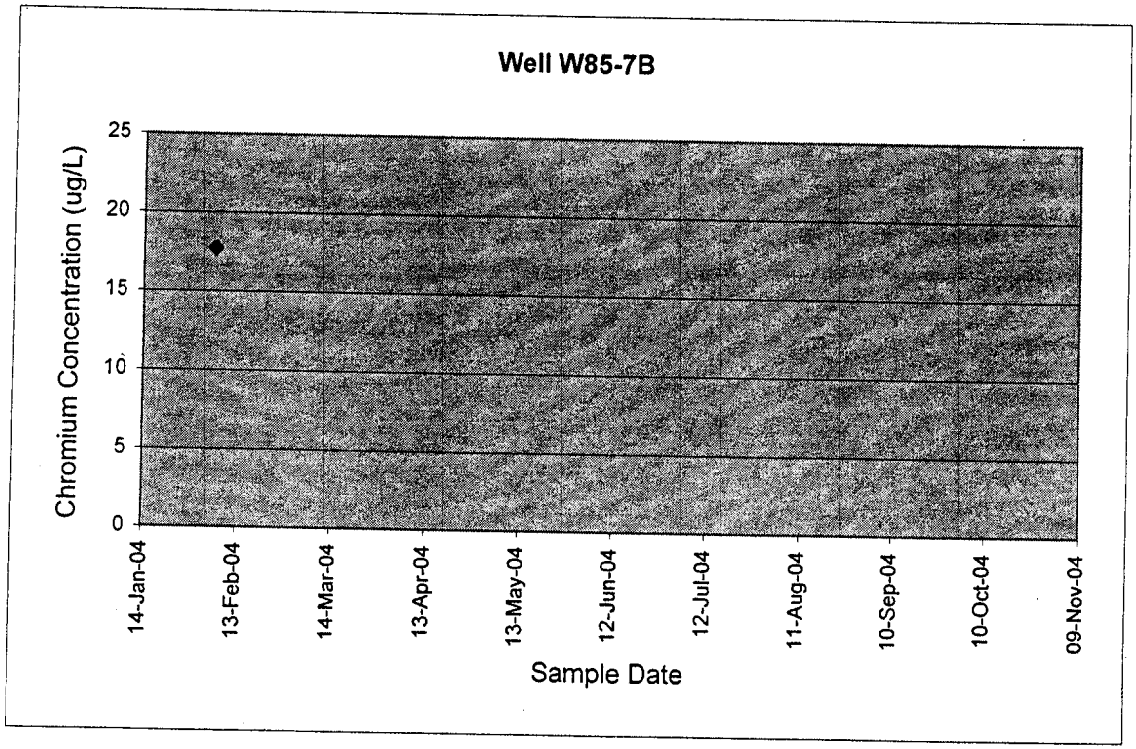
Well W85-7A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH8	Water	06-Feb-04	CHROMIUM	1.7	UG/L	J	W85-7A	Total



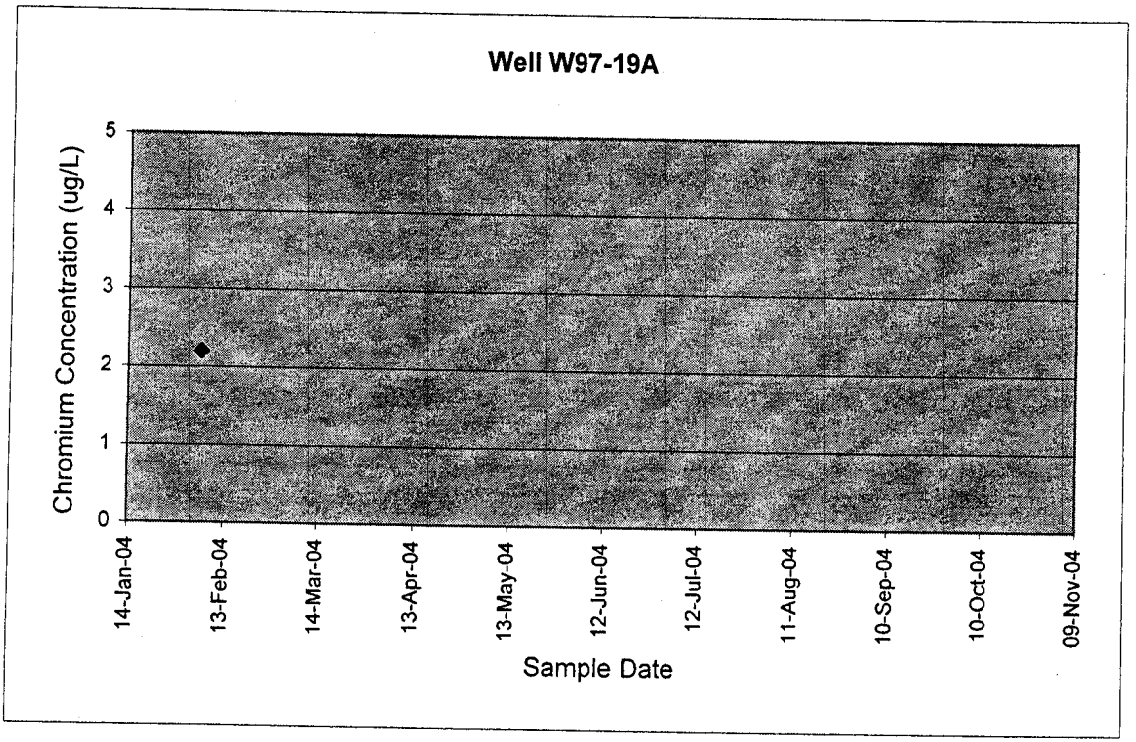
Well W85-7B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AH9	Water	06-Feb-04	CHROMIUM	17.7	UG/L		W85-7B	Total



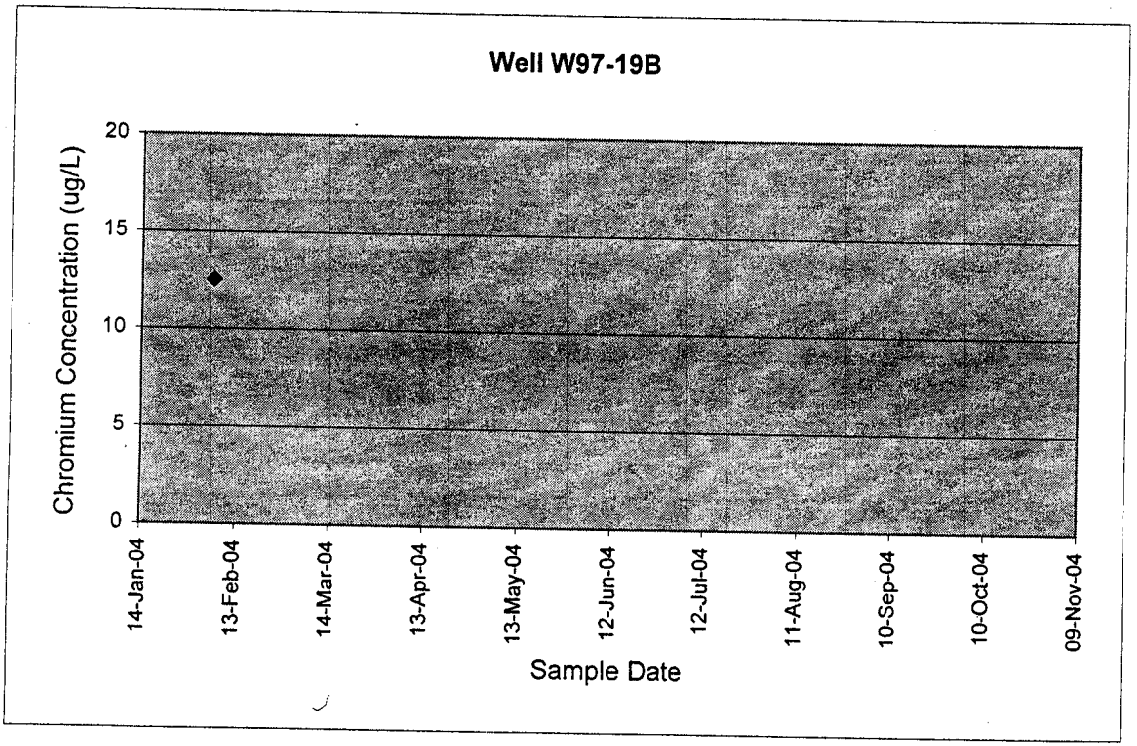
Well W97-19A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ0	Water	06-Feb-04	CHROMIUM	2.2	UG/L	J	W97-19A	Total



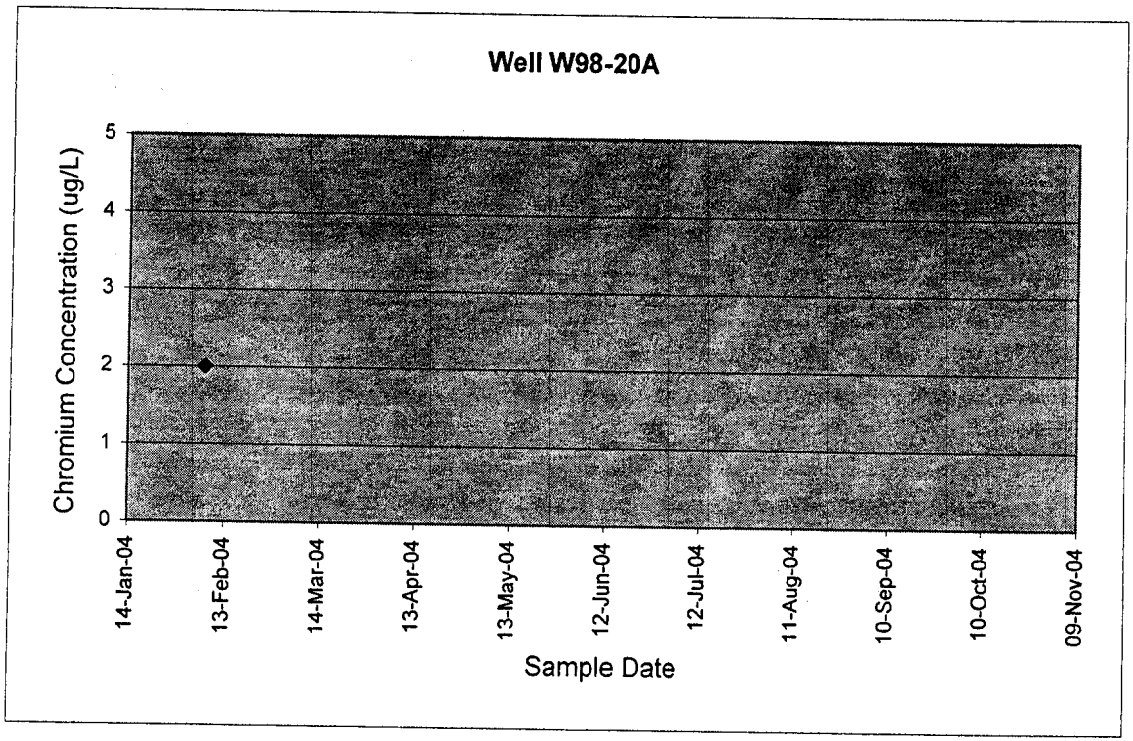
Well W97-19B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ1	Water	06-Feb-04	CHROMIUM	12.5	UG/L	J	W97-19B	Total



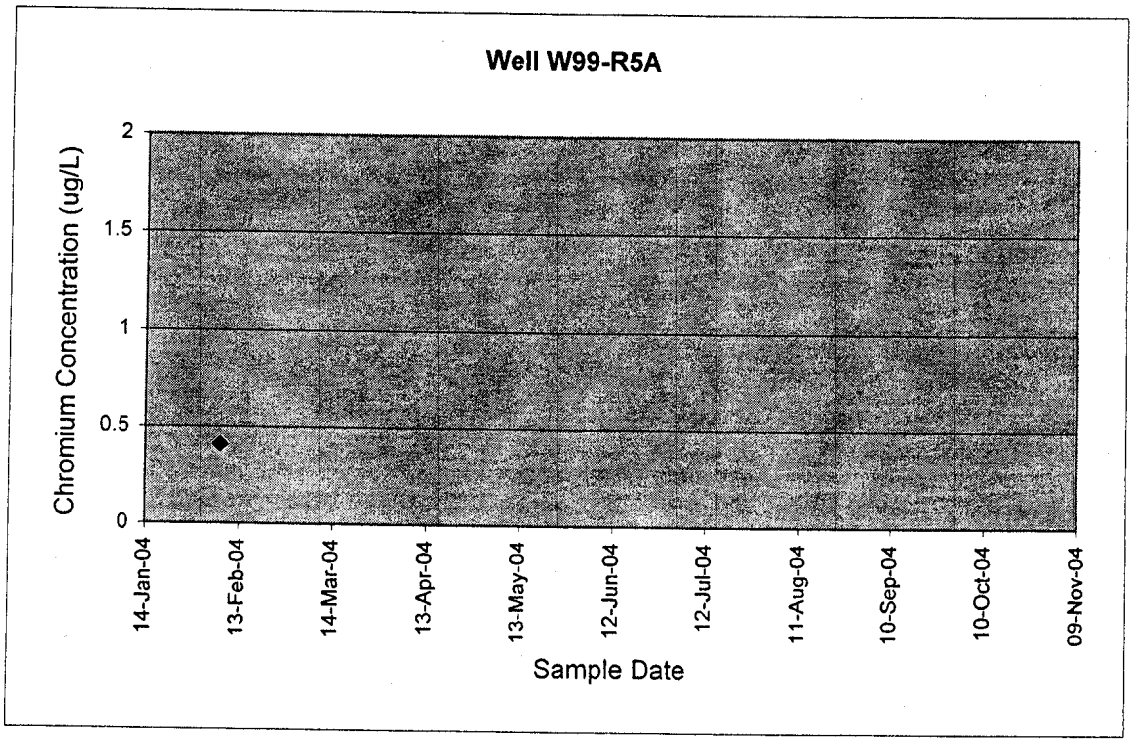
Well W98-20A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ2	Water	07-Feb-04	CHROMIUM	2	UG/L	J	W98-20A	Total



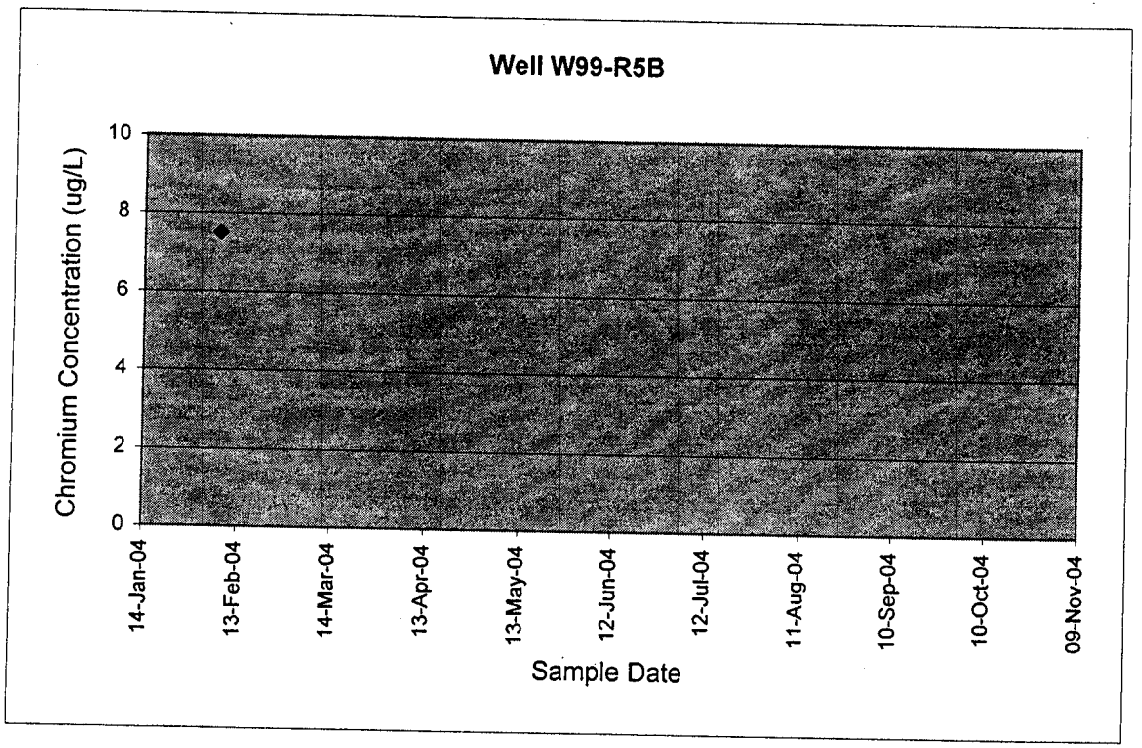
Well W99-R5A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ3	Water	07-Feb-04	CHROMIUM	0.41	UG/L	J	W99-R5A	Total



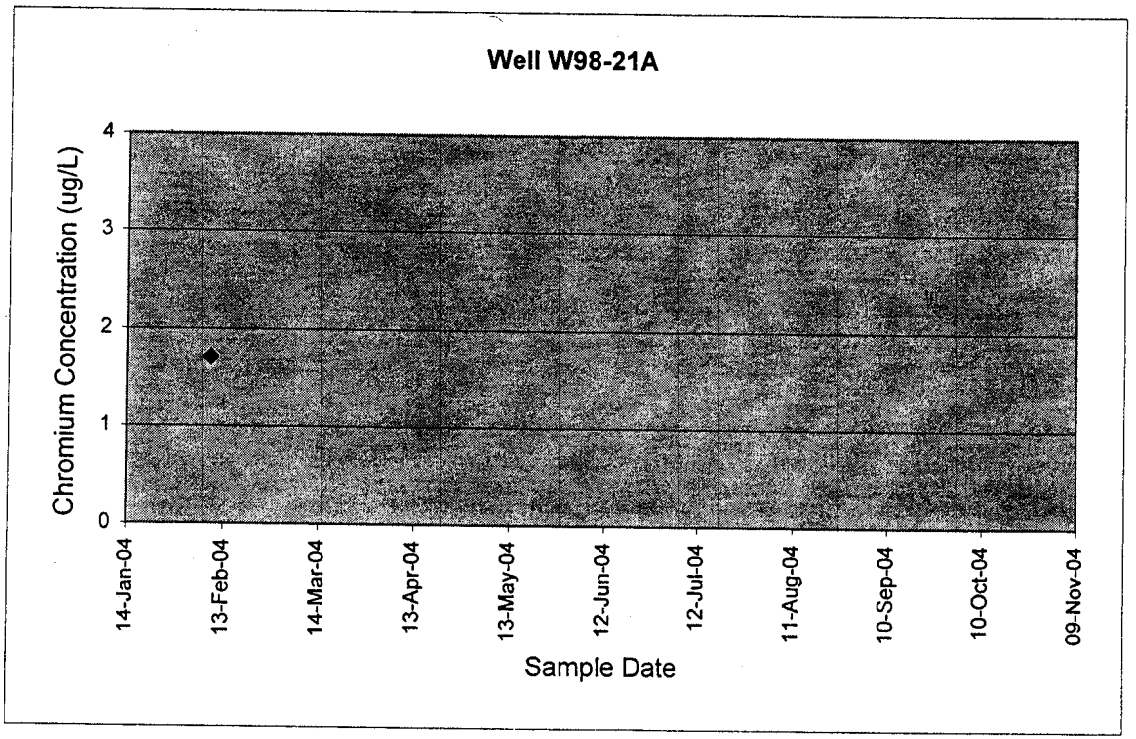
Well W99-R5B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ5	Water	07-Feb-04	CHROMIUM	7.5	UG/L	J	W99-R5B	Total



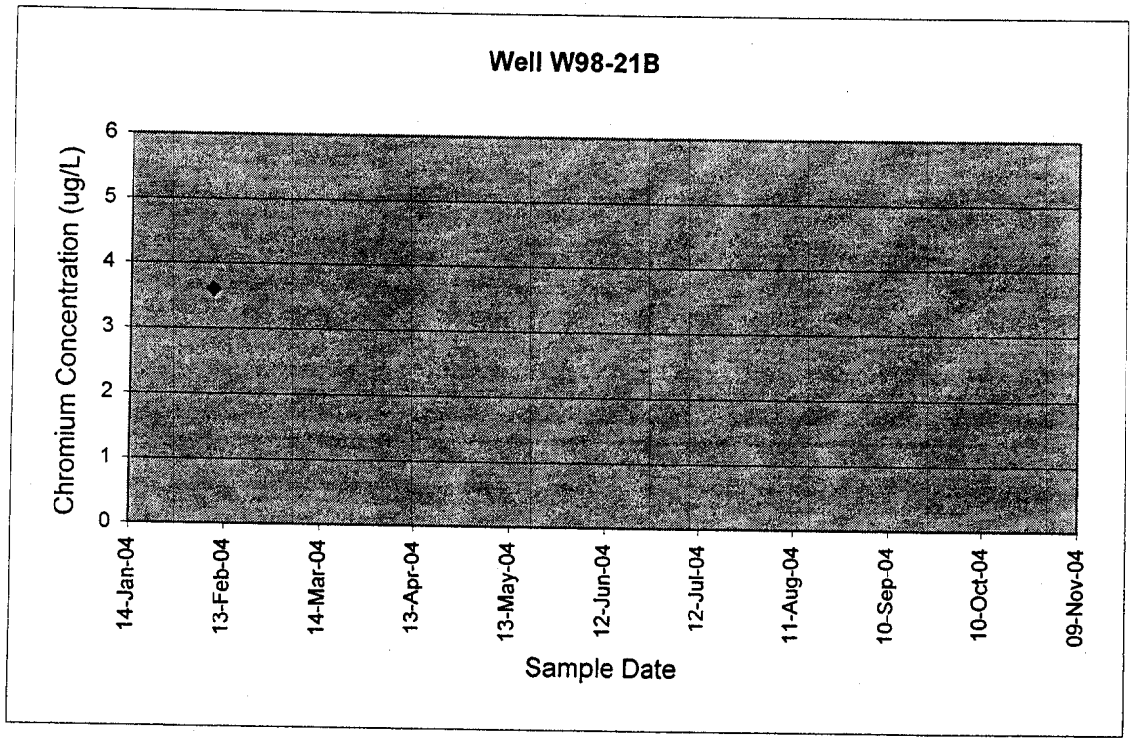
Well W98-21A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ6	Water	09-Feb-04	CHROMIUM	1.7	UG/L	J	W98-21A	Total



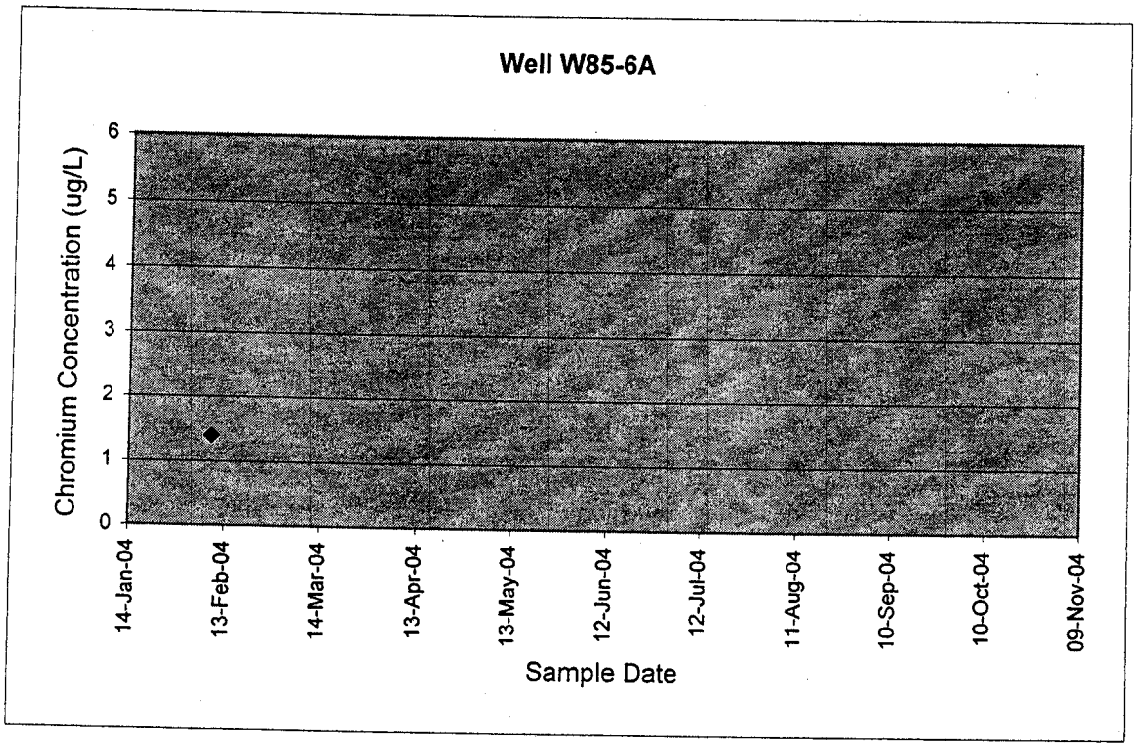
Well W98-21B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ7	Water	09-Feb-04	CHROMIUM	3.6	UG/L	J	W98-21B	Total



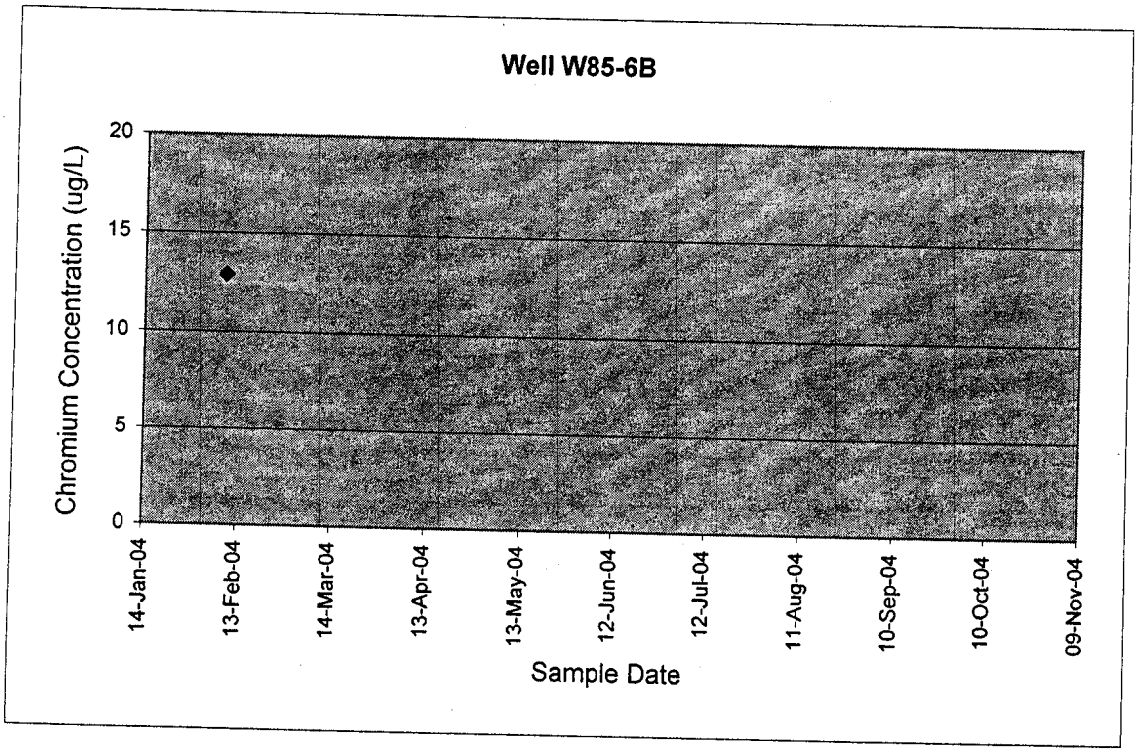
Well W85-6A

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ8	Water	09-Feb-04	CHROMIUM	1.4	UG/L	J	W85-6A	Total



Well W85-6B

EPA Sample No.	Matrix	Sample Date	Analyte	Conc.	Units	Qualifier	Station Location	Notes
MJ2AJ9	Water	09-Feb-04	CHROMIUM	12.9	UG/L		W85-6B	Total



APPENDIX B

GROUNDWATER ELEVATIONS AND FLOW DIRECTION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

Reply To
Attn Of: OEA-095 February 27, 2004

MEMORANDUM

SUBJECT: Trip Report - Frontier Hard Chrome Field oversight of ground water sampling and field data collection, 2/02-04/2004.

FROM: Bernie Zavala
Hydrogeologist

TO: Sean Sheldrake
Remedial Project Manager

The weeks of February 2nd and 9th EPA-Region 10, Weston Solution and ESAT FASP Team began the long-term ground water monitoring program at the Superfund Site Frontier Hard Chrome (FHC). The primary task during this sampling event was the collection of ground water samples from 33-monitoring wells for hexavalent and total chromium, sulfur, sulfate and ground water elevations. An additional task, the collection of GPS readings, was also conducted for horizontal coordinates of the monitoring wells which were never surveyed.

The ESAT team and Weston Solution were responsible for the collection of the ground water samples. These samples were collected by a peristaltic pump using a low flow purging and sampling technique with the stabilization of the water quality field parameters as a determination for ground water sample collection. Ground water elevations were collected by EPA-Region 10 and Weston Solution by measuring the depth to water in 19-monitoring wells. EPA-Region 10 also collected readings with a GPS unit for the horizontal coordinates for 13-monitoring wells.

The ESAT team and Weston Solution followed the sampling procedures in the work plan for the ground water sampling with no problems occurring during sampling for the first three days. The depth-to water measurements for all 19-monitoring

wells took place on 2nd of February, see table 2.0 for the ground water elevations. The results from the GPS survey can also be found on table 2.0 except for the following monitoring wells which can be found on table 1.0 below.

Washington State Plane Coordinates
Table 1.0

Well No.	**Easting**	**Northing**
B85-6	1091705.95	112532.34
B85-3	1091462.16	112605.90
W86-10B	1093365.77	112510.41
W86-13A	1090490.94	112712.34

Additional data was downloaded from the USGS for stage height of the Columbia River. The USGS maintains a gauging station (14144700) which continuously collects stage height of the Columbia River for streamflow. This gauging station is located on the I-5 bridge as it crosses the Columbia River, which is located 1.5 miles downstream of the FHC site. During the time of the ground water sampling the Columbia River had a stage height of 10.24 feet above mean sea level (AMSL). The nearest monitoring well W99-R5A has a ground water elevation of 9.63 feet which was lower then the Columbia River. It appears during this time period the River was discharging into the aquifer with the ground water flow direction moving toward the FHC Superfund site. Figure 1.0 illustrates contours of the existing ground water elevations for February 2, 2004. The ground water flow direction is heading to the northwest then it divides to the northeast when it approaches the FHC site. The stage height of the Columbia River had a high of 12.05 feet (AMSL) on January 30, 2004 at 1:45 P.M.. A horizontal gradient was calculated for February 2, 2004 with a result of 0.000104 ft/ft with a flow direction from the Columbia river to the FHC site.

Frontier Hard Chrome - Ground Water Elevations February 2, 2004
Table 2.0

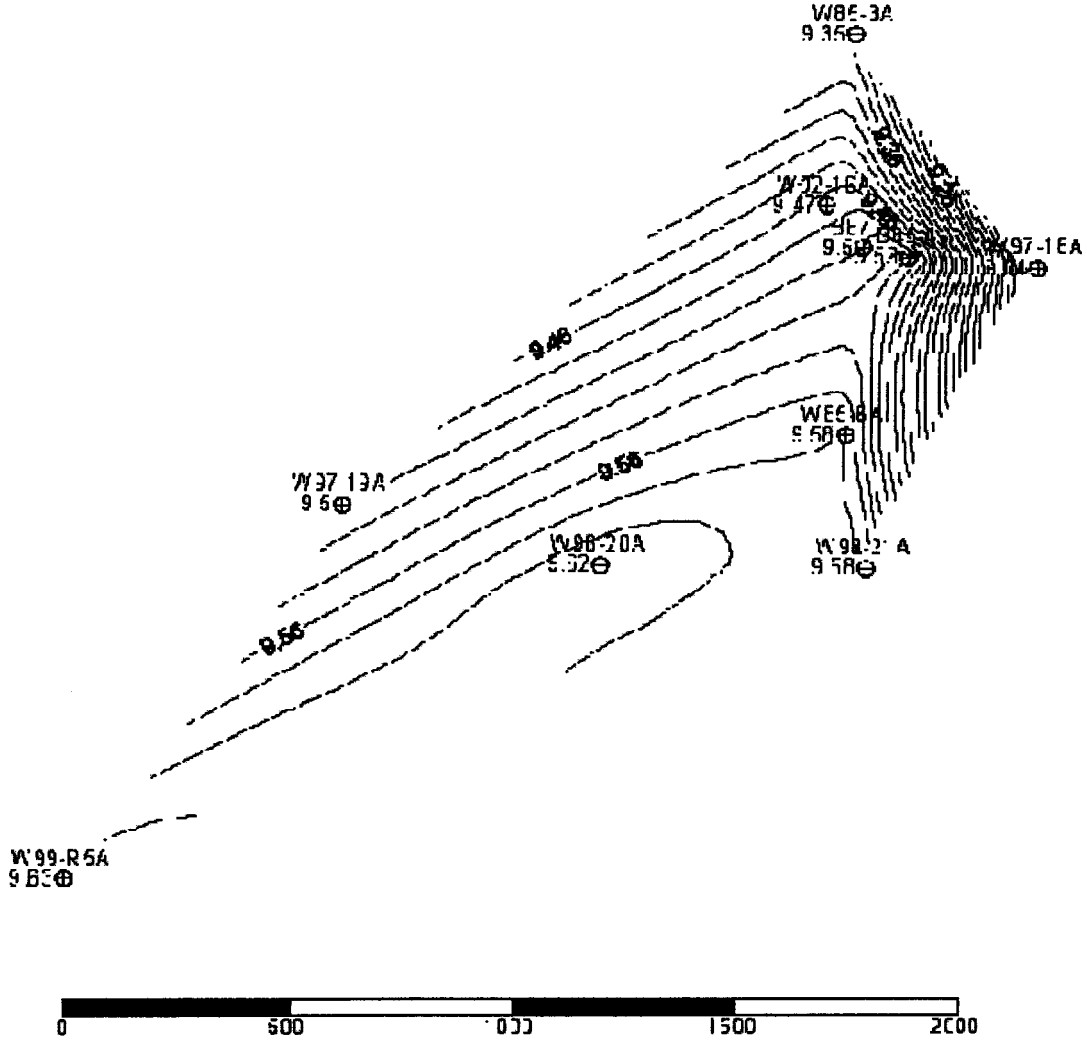
Well No.	Easting	Northing	Date/ Time	Casing Elevation	Depth to Water	Water level Elevation (AMSL)
W85-3A	1091509.69	112824.50	2-02/ 1505	26.40	17.05	9.35
W85-3B	1091514.26	112824.23	1503	26.77	17.37	9.40
W97-18A	1091919.98	112299.62	1513	25.44	16.40	9.04
W97-18B	1091926.64	112299.13	1515	25.36	15.85	9.51
B87-8	1091529.10	112344.00	1526	25.95	16.45	9.50
B85-4	1091631.89	112324.18	1522	25.38	15.85	9.53
W92-16B	1091445.85	112424.30	1532	25.51	16.05	9.46
W92-16A	1091446.66	112438.05	1533	25.62	16.15	9.47
W98-21A[5]	1091536.07	111623.54	1542	25.28[4]	15.70	9.58
W98-21B[5]	1091543.41	111616.84	1541	25.50[4]	15.90	9.60
W85-6A[5]	1091489.91	111924.04	1547	25.38	15.80	9.58
W85-6B[5]	1091495.31	111912.90	1546	25.24	15.70	9.54
W85-7B[5]	1090952.50	111917.15	1602	23.00	13.50[1]	9.50
W85-7A[5]	1090984.92	111916.01	NM[2]	22.83	NM[2]	----
W97-19A[5]	1090360.19	111767.46	1620	22.45[4]	12.95	9.50
W97-19B[5]	1090357.80	111758.69	1622	21.72[4]	34.10[3]	(-12.38)
W98-20A[5]	1090944.00	111631.28	1630	23.57[4]	13.95	9.62
W99-R5B	1089741.49	110927.24	1642	32.33	22.70	9.63
W99-R5A	1089743.59	110929.99	1644	32.26	22.63	9.63
USGS 14144700 (Stage height of the Columbia River)			1645			10.24

1- The light and sound didn't work on the water level recorder at this location but visual contact was made for the "b-zone" well only. This was possible because it was a 4-inch casing.
2- NM (not measured) Water level recorder didn't work for this location.
3- Water level measurement was collected at a deeper depth then the rest of the monitoring wells for this zone. It is possible that the well screen is plugged therefore proper contact with the aquifer may not have been made.
4- Two different elevation datums have been used at Frontier Hard Chrome. Weston (12/03) Long-Term Monitoring plan have applied a correction factor (+3.76 feet) using the City of Vancouver's benchmark #108 located near FHC site.
5- The northing and easting for these monitoring wells were obtained by a GPS unit and then converted into Washington state

Frontier Hard Chrome
Ground Water Elevation - February 2, 2004

plane coordinates .

N



The contouring was performed by Surfer® using the gridding method nearest neighbor

Figure 10

APPENDIX C

DATA VALIDATION MEMORANDUM

EXCEPTION SUMMARY FOR LABORATORY DATA QUALITY ASSURANCE REVIEW

1. DATA SUMMARY

The laboratory data quality assurance review of 39 water samples, laboratory groups MJ2AF0 and MJ2AH1 (CLP), A04-0410 (Activation Laboratories) and TEC-410X (ESAT/MEL) analyzed between 02/02/2004 and 03/02/2004 following collection from the Frontier Hard Chrome site Long-Term Monitoring project, has been completed. Samples were analyzed for:

- Target Analyte List (TAL) metals by Bonner Analytical Testing, Hattiesburg, Mississippi, following EPA CLP SOW ILM05.2,
- Hexavalent chromium by the EPA Region 10 ESAT team on-site, following the ESAT SOP for Hach test kit #26672 (colorimetry),
- Sulfate by the EPA Region 10 Manchester Environmental Laboratory (MEL), following EPA Method 300.0 (ion chromatography/conductivity detection), and
- Total sulfur by Activation Laboratories, Ltd., of British Columbia, Canada, following EPA SW-846 Method 6010B.

Quality assurance/quality control (QA/QC) reviews of laboratory procedures were performed on an ongoing basis by the laboratory. A data review was performed on laboratory quality control results summary sheets to ensure they met data quality objectives for the project. Data review followed the format outlined in the *National Functional Guidelines for Inorganic Data Review* (EPA 1994) modified to include specific criteria of the individual analytical methods. Raw laboratory data including calibrations, sample login forms, sample preparation logs and bench sheets, quantitation reports, mass spectra, and chromatograms are kept on file at the laboratory.

This is an exception summary. All laboratory quality assurance results as applicable (e.g., holding times, blank sample analysis, matrix spike/duplicate analysis, laboratory control sample analysis) supplied to Weston for the analyses met acceptance criteria specified in the *Frontier Hard Chrome Long-Term Monitoring Plan* (Weston 2004), with the following exceptions:

1.1 TAL METALS

1) Aluminum, copper, magnesium, lead, and zinc were detected in one or more preparation blanks. Associated analyte results were qualified as non-detected (U) at an elevated reporting limit.

2) Recovery of silver from one matrix spike sample was less than the lower control limit. All associated silver results were qualified as estimated (J).

3) Lead recovery from one interference check sample (ICS) was less than the lower control limit. Lead was not detected in any samples. All associated results were qualified as non-detected at an estimated concentration (UJ).

No other QA/QC exceptions were noted in the data review. Upon consideration of the data qualifications noted above and the project data quality objectives specified in the QAPP, the data are ACCEPTABLE for use except where flagged with data qualifiers that modify the usefulness of the individual values.

2. DATA QUALIFIERS

Any data qualifiers applied by the laboratory have been removed from the data summary sheets and superceded by data validation qualifiers as follow:

The following qualifiers were used to modify the data quality and usefulness of individual analytical results.

U - The analyte was not detected at the given quantitation limit.

J - The analyte was positively identified and detected; however, the concentration is an estimated value because the result is less than the quantitation limit or quality control criteria were not met.

UJ - The analyte was not detected; the associated quantitation limit is an estimated value.

3. DATA ASSESSMENT

Data review was performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved in the project.

This is to certify that I have examined the analytical data and based on the information provided to me by the laboratory, in my professional judgment the data are acceptable for use except where qualified with qualifiers that modify the usefulness of those individual values.

05/10/04

R. Paul Swift, Ph.D.
Chief Chemist

Date