Response Action Contract
Contract No. 68-W-98-228

EPA United States Environmental Protection Agency

REGION 10

Long-Term Groundwater Monitoring Report for June 2000 Frontier Hard Chrome Superfund Site Vancouver, Washington October 2000

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LONG-TERM GROUNDWATER MONITORING REPORT FOR JUNE 2000 FRONTIER HARD CHROME SUPERFUND SITE VANCOUVER, WASHINGTON

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ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
FHC	Frontier Hard Chrome
FS	feasibility study
MCL	maximum contaminant level
µg/L	microgram per liter
mg/L	milligram per liter
msl	mean sea level
MTCA	Model Toxics Control Act
mV	millivolt
NTU	nephelometric turbidity unit
RAC	Response Action Contract
redox	oxidation-reduction
RI	remedial investigation
URSG	URS Greiner, Inc.

LONG-TERM GROUNDWATER MONITORING REPORT FOR JUNE 2000 FRONTIER HARD CHROME SUPERFUND SITE VANCOUVER, WASHINGTON

This report documents groundwater monitoring and sampling activities associated with the long-term monitoring of groundwater at the Frontier Hard Chrome Company (FHC) Superfund site (FHC) (Figure 1). Monitoring wells and piezometers at the FHC site were installed as part of previously reported remedial investigation and feasibility study (RI/FS) activities. The long-term monitoring program consists of measuring groundwater elevations and sampling groundwater from the existing monitoring wells and piezometers for chromium concentrations on an annual basis. The first round of groundwater sampling at the site was conducted in January 1986. The work presented in this report was performed in accordance with the FHC Quality Assurance Sampling Plan Addendum submitted to the U.S. Environmental Protection Agency (EPA) on June 26, 2000 (URSG 2000a). This monitoring report was prepared by URS Greiner, Inc. (URSG) under EPA Response Action Contract No. 68-W-98-228, as defined by Work Assignment No. 033-RI-CO-1027.

LONG-TERM GROUNDWATER MONITORING ACTIVITIES

During the long-term groundwater monitoring effort from June 26 to June 28, 2000, groundwater samples and water level measurements were collected from 17 wells and 8 wells were measured for water level only. The Quality Assurance Sampling Plan Addendum (URSG 2000a) called for samples or water levels to be collected from 30 monitoring wells or piezometers. Five of the 22 wells to be sampled for chromium analysis and water level measurements could not be located in the field.

The site is underlain by two water-bearing units, a shallow perched zone and a deeper alluvial aquifer. A locally continuous silt unit, approximately 5 feet thick, separates these two units. Of the 17 wells sampled, 12 were screened in the "A" zone portion of the alluvial aquifer. The "A" zone has been identified as the upper portion (15 to 35 feet below ground surface [bgs]) of the alluvial aquifer that underlies the site (URSG 2000a). Of the 17 wells sampled, 5 are screened in the "B" zone, which underlies the "A" zone. The vertical extent of the "B" zone exceeds the depth of exploration at the site (approximately 100 feet bgs). "A" zone and "B" zone sampling locations are shown on Figures 2 and 3, respectively.

On June 27 and 28, 2000, after the water level measurements on June 26, purging and sampling of the wells were conducted. Each monitoring well was purged and sampled using a peristaltic pump and dedicated tubing, according to the low-flow sampling protocols included in the Quality Assurance Sampling Plan Addendum. Because they were not located, monitoring wells B85-6, B86-R2, W92-17P, PW-1A, and PW-1B, were not sampled. Table 1 presents a list of all monitoring wells that were measured for water level and/or sampled. "A" zone monitoring wells W85-3A, W85-7A, and W86-13A and "B" zone monitoring wells W85-3B, W85-6B, W85-7B, W97-18B, and W97-19B were measured for groundwater levels only.

Groundwater levels were measured to the nearest 0.01 foot with an electronic water-level indicator from a surveyed point at the top of each well casing. Except for two wells, this activity was completed in 1 day (June 26) prior to water sampling activities.

Water quality parameters were measured in the field at all sampling locations using a sealed flow-through cell during purging (Table 1). Field water quality parameters measured included pH, specific conductivity, turbidity, dissolved oxygen (DO), temperature, and oxidation-reduction potential (redox); they are presented in Table 2. Groundwater samples were collected directly from the pump discharge after parameters had stabilized.

When turbidity measurements taken during sampling did not decrease to below 20 nephelometric turbidity units (NTUs), groundwater sampling included collection of a sample with a 0.45-micron in-line filter. All samples were submitted to EPA Region 10 Manchester Laboratory for analysis of chromium.

MONITORING RESULTS

A summary of analytical results from the June 2000 long-term groundwater-monitoring event is presented in Table 3. Appendix A contains a summary of chromium analyses conducted on groundwater samples from the site since 1985. Figure 4 is a groundwater contour map generated from the water level data collected during this sampling event. Figures 2 and 3 present distribution maps of chromium concentrations in the "A" zone and "B" zone portion of the alluvial aquifer, respectively. Because fewer "B" zone samples were collected during this sampling activity, the data were not contoured, and only the sampling results are presented on Figure 3.

Groundwater Elevations

Groundwater elevation data collected from the 25 wells measured on June 26 and 27 are presented in Table 4. Groundwater elevations measured in wells screened in the "A" zone ranged from 7.22 to 11.91 feet above mean sea level (msl). Well W92-17P is completed in the perched zone and was not used during groundwater elevation contouring. According to groundwater data from this round of sampling, groundwater flows generally south (Figure 4). This is generally consistent with historical evaluations of groundwater flow at the site.

Analytical Results

Groundwater samples were analyzed for total and dissolved chromium (Table 3). Appendix B contains the quality assurance data evaluation and laboratory results. Analysis for dissolved chromium on filtered samples was applied only to samples that had a turbidity greater than 20 NTUs during purging. Analytical results from all samples were compared to the Safe Drinking Water Act maximum contaminant levels (MCLs) and groundwater remediation goals determined for the FHC site in the Final Focused Feasibility Study (URSG 2000b). This section presents the analytical results and a discussion of historical trends in chromium concentrations.

Chromium

Chromium was detected in 13 of the 17 wells sampled. Concentrations ranged from below the method detection limit (5 µg/L) to 25,400 µg/L in the sample from W92-14A. Note that these comparisons include filtered and unfiltered results. Chromium concentrations were above the Safe Drinking Water Act MCL (50 µg/L) in 9 of the 17 wells.

As observed in previous sampling events, the highest concentrations of chromium appear to occur beneath the former FHC building, in the "A" zone of the aquifer (20 to 40 feet bgs). The highest concentrations detected were in samples from wells W92-14A (25,400 µg/L) and W92-14P (10,600 µg/L), which are in the immediate vicinity of the former FHC building. Note that W92-14P is a perched zone monitoring well. The concentrations appear to decrease sharply south of the Cassidy Building, along the south side of E 1st Street as indicated by chromium concentrations in B85-4 (609 µg/L) and B87-8 (609 µg/L). Sampling results from B87-8 include a field duplicate result of 594 µg/L.

The only well in the "B" zone of the alluvial aquifer with a chromium concentration (78.7 µg/L) above the MTCA Method A MCL was well W85-1B, screened at 44 to 49 feet bgs and located southeast of the former FHC building.

Water Quality

As described previously, pH, conductivity, turbidity, DO, temperature, and redox potential were measured in the field at 17 wells. Only the results of DO and redox measurements are discussed in the following subsections. The groundwater sample log for each sampled well is presented in Appendix C.

Dissolved Oxygen. Field DO concentrations ranged from 0.72 to 8.45 mg/L (Table 2). The highest DO concentration (8.45 mg/L) was measured at W85-1B, a "B" zone well situated on the east edge of the chromium plume southeast of the former FHC building. The mean DO concentration for the June 2000 groundwater sampling activities was 3.19 mg/L. The DO concentrations of 75 percent of the "A" zone wells were less than the mean DO concentration.

Redox Potential. Field redox potential ranged from 27 to 305 mV (Table 2). The median redox value was 205 mV. High variability was observed in redox values obtained while purging. No specific trend was observed regarding redox values and aquifer zone.

Historical Trends

Chromium concentrations in clustered areas beneath the former FHC building, on the south side, in wells W92-14A and W92-14P, have decreased since monitoring began at these wells in July 1992 and May 1994, respectively. A significant decrease in chromium concentration has been observed south of the Cassidy Building along the south side of E 1st Street in wells B85-4 and B87-8. These wells have been monitored since January 1986 and February 1987, respectively. Appendix A presents the results of current and historical chromium analyses of groundwater samples from the site.

Comparison of total chromium concentrations from groundwater sampling in off-site wells from 1987 to 2000 also indicates a notable reduction. Concentrations in most of the off-site wells south and southwest of the former FHC building have decreased. However, chromium concentrations in well W85-6A, located approximately 700 feet south of the site, have increased from 1997 to 2000.

DISCUSSION AND CONCLUSIONS

Concentrations of total chromium appear to have decreased in on-site wells at FHC and at the majority of off-site wells over the course of groundwater monitoring. With a few exceptions,

chromium concentrations in the "A" zone of the aquifer are substantially greater than concentrations in the "B" zone of the aquifer.

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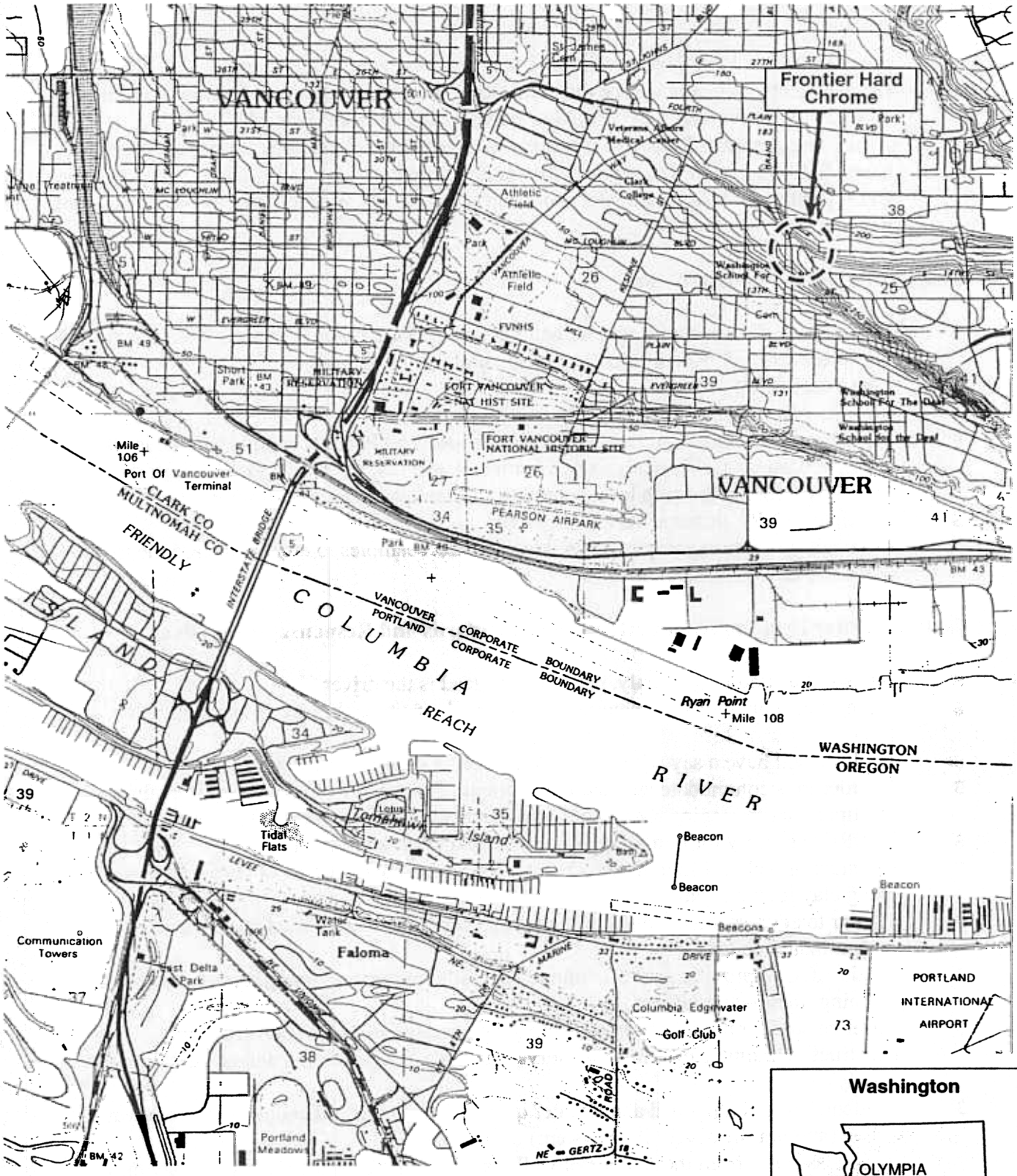

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Figure 1
Frontier Hard Chrome Superfund Site
Vicinity Map

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Frontier Hard Chrome
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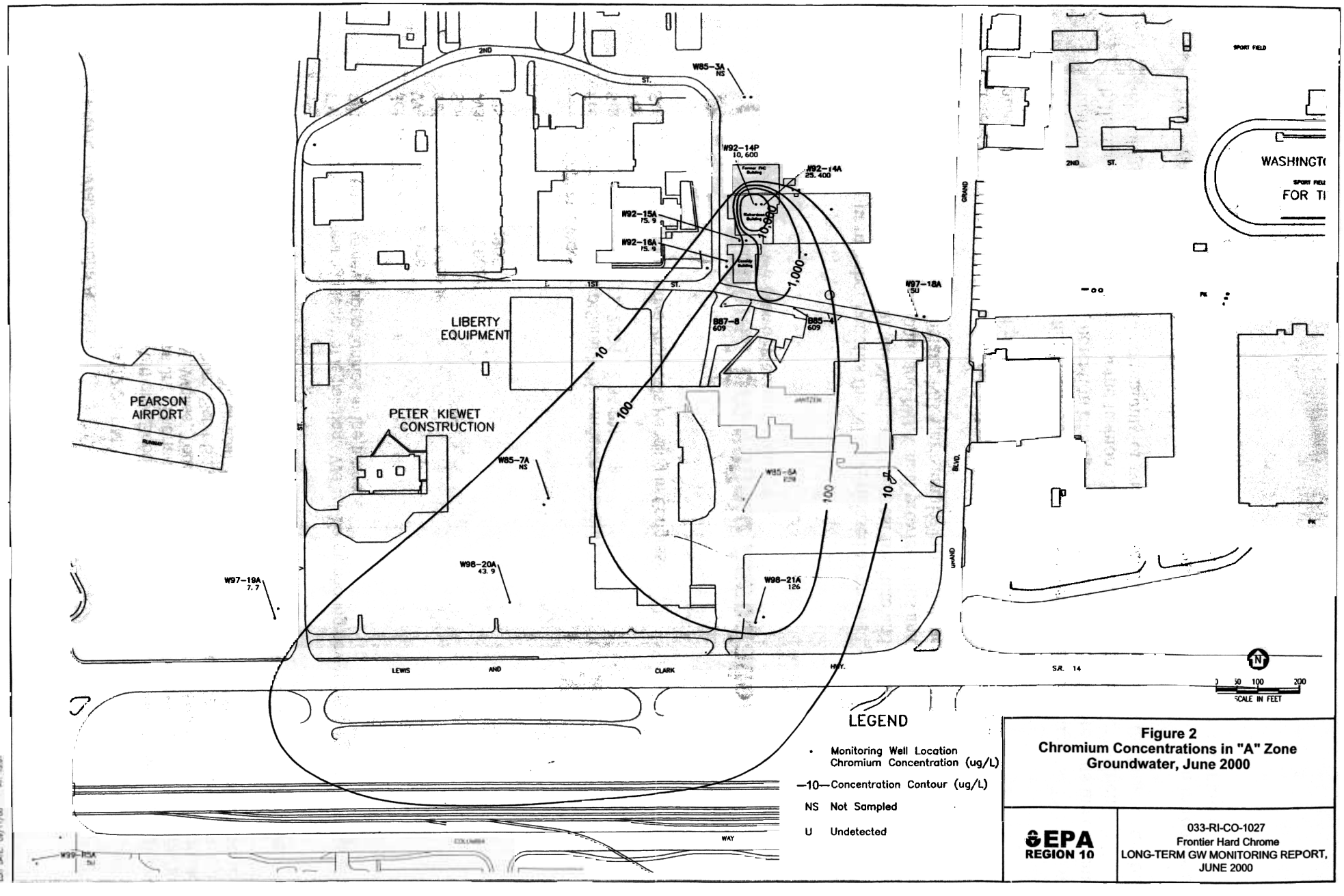
REPORT, JUNE 2000



LEGEND

- • Monitoring Well Location
  Chromium Concentration (ug/L)
- —10— Concentration Contour (ug/L)
- NS Not Sampled
- U Undetected

Figure 2
Chromium Concentrations in "A" Zone Groundwater, June 2000

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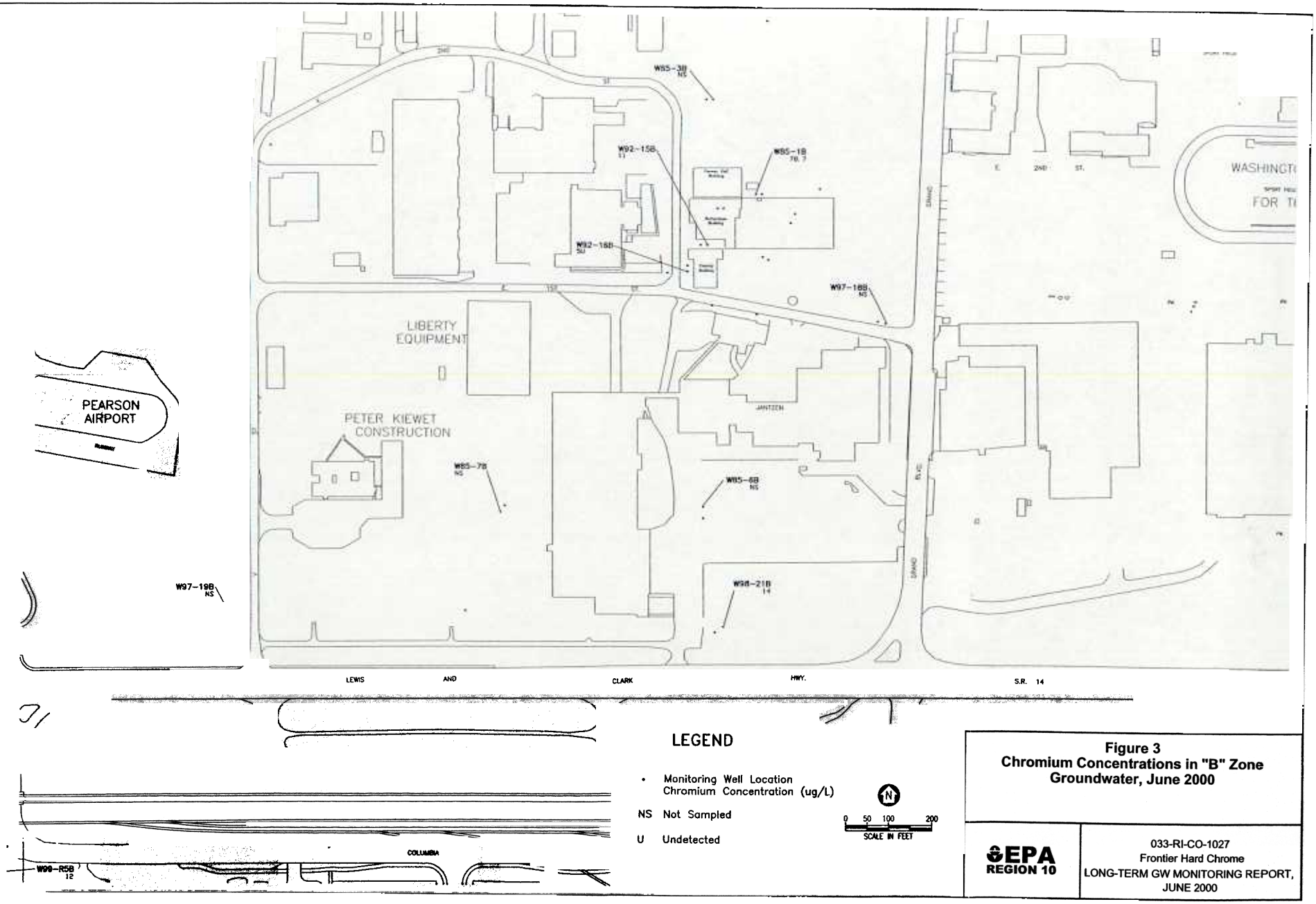

Figure 3
Chromium Concentrations in "B" Zone Groundwater, June 2000

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FILENAME: T:\RAC\Frontier\Sub-Tasks\FFS\GW Monitoring\Fig 3.dwg
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Figure 4
Groundwater Elevation Contour Map
June 26 and 27, 2000

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Table 1
Groundwater Sampling Summary

Station ID	Total Chromium	Water Level Measurement	Field Parameters[a]
Perched Zone Monitoring Well			
W92-14P	X	X	X
"A" Zone Monitoring Wells			
B85-4	X	X	X
B87-8	X	X	X
W85-3A		X	
W85-6A	X	X	X
W85-7A		X	
W86-13A		X	
W92-14A	X	X	X
W92-15A	X	X	X
W92-16A	X	X	X
W97-18A	X	X	X
W97-19A	X	X	X
W98-20A	X	X	X
W98-21A	X	X	X
W99-R5A	X	X	X
"B" Zone Monitoring Wells			
W85-1B	X	X	X
W85-3B		X	
W85-6B		X	
W85-7B		X	
W92-15B	X	X	X
W92-16B	X	X	X
W97-18B		X	
W97-19B		X	
W98-21B	X	X	X
W99-R5B	X	X	X

[a]Water quality parameters include pH, specific conductivity, turbidity, dissolved oxygen, temperature, and oxidation-reduction potential.

Table 2
Water Quality Parameters

Station ID	pH	Specific Conductivity (mS/cm)	Turbidity (NTUs)	Dissolved Oxygen (mg/L)	Temperature (°C)	Redox Potential (mV)
Perched Zone Monitoring Well						
W92-14P	4.35	0.092	0	0.72	15.5	305
"A" Zone Monitoring Wells						
B85-4	6.15	0.418	1	3.39	14.0	174
B87-8	6.36	0.378	8	2.13	13.7	178
W85-6A	6.21	0.382	0	1.71	15.3	215
W92-14A	6.53	0.377	213	0.91	15.6	238
W92-15A	6.79	0.261	36	4.64	15.8	61
W92-16A	6.52	0.300	**	1.25	13.8	183
W97-18A	6.57	0.100	194	1.09	14.1	27
W97-19A	6.31	0.361	4	2.65	13.6	280
W98-20A	6.40	0.273	0	2.99	13.6	282
W98-21A	6.22	0.351	10	1.93	14.5	206
W99-R5A	6.51	0.376	6	3.51	16.6	259
"B" Zone Monitoring Wells						
W85-1B	8.26	0.199	87[a]	8.45	13.0	277
W92-15B	6.74	0.261	25	5.42	15.1	47
W92-16B	6.74	0.263	0	5.72	14.3	298
W98-21B	6.44	0.375	0	3.85	15.5	195
W99-R5B	6.77	0.366	0	3.89	15.4	261

[a]Purge water bubbling as if carbonated; water appeared clear.

Notes:
** Meter malfunction; water visibly clear
°C - degree Celsius
mg/L - milligram per liter
mS/cm - millisiemen per centimeter
mV - millivolt
NTU - nephelometric turbidity unit
redox - oxidation-reduction

Table 3
Groundwater Analytical Data Summary

Sample ID	Station ID	Sampling Date	Total Chromium (µg/L)	Matrix
Perched Zone Monitoring Well				
264256	W92-14P (FD)	6/27/2000	**10,500**	Liquid
264257	W92-14P	6/27/2000	**10,600**	Liquid
"A" Zone Monitoring Wells				
264250	B85-4 (MS/MSD)	6/27/2000	**609**	Liquid
264252	B87-8 (FD)	6/27/2000	**594**	Liquid
264251	B87-8	6/27/2000	**609**	Liquid
264255	W85-6A	6/27/2000	**228**	Liquid
264270	W92-14A	6/27/2000	**25,100**	Liquid
264271	W92-14A (dissolved)	6/27/2000	**25,400**	Filtered liquid
264268	W92-15A	6/27/2000	**75.9**	Liquid
264269	W92-15A (dissolved)	6/27/2000	**57**	Filtered liquid
264272	W92-16A	6/28/2000	**75.9**	Liquid
264264	W92-18A	6/27/2000	5 U	Liquid
264265	W97-18A (dissolved)	6/27/2000	5 U	Filtered liquid
264258	W97-19A	6/28/2000	7.7	Liquid
264259	W98-20A	6/28/2000	43.9	Liquid
264253	W98-21A	6/27/2000	**126**	Liquid
264260	W99-R5A	6/28/2000	5 U	Liquid
"B" Zone Monitoring Wells				
264274	W85-1B	6/28/2000	**78.7**	Liquid
264266	W92-15B	6/27/2000	11	Liquid
264267	W92-15B (dissolved)	6/27/2000	5 U	Filtered liquid
264273	W92-16B	6/28/2000	5 U	Liquid
264254	W98-21B	6/27/2000	14	Liquid
264261	W99-R5B	3/28/2000	12	Liquid
264275	W99-R5B (FD)	6/28/2000	12	Liquid

Notes:
Bold values exceed the Model Toxics Control Act Method A maximum contaminant level of 50 µg/L.

FD - field duplicate
MTCA Method A chromium MCL is 50 µg/L.
µg/L - microgram per liter
MS/MSD - matrix spike/matrix spike duplicate
U - undetected

Table 4
Groundwater Elevation Data

Station ID	Date of Water Level Measurement	Well Casing Elevation (feet msl)	Depth to Water (feet btoc)	Water Table Elevation (feet msl)
Perched Zone Monitoring Wel				
W92-14P	6/27/00	29.61	9.84	19.77
"A" Zone Monitoring Wells				
B85-4	6/26/00	29.95 14	18.04	11.91
B87-8	6/26/00	29.71 DLD	18.54	11.17
W85-3A	6/26/00	30.19 12/2/03	18.84	11.35
W85-6A	6/26/00	29.15	18.08	11.07
W85-7A	6/26/00	26.72	15.53	11.19
W86-13A	6/26/00	30.15	18.88	11.27
W92-14A	6/27/00	29.57	18.33	11.24
W92-15A	6/26/00	29.77	18.59	11.18
W97-18A	6/26/00	29.23	18.10	11.13
W97-19A	6/26/00	26.22	15.20	11.02
W98-20A	6/26/00	27.34	16.26	11.08
W98-21A	6/26/00	29.05	18.02	11.03
W99-R5A	6/26/00	32.26	25.04	7.22
"B" Zone Monitoring Wells				
W85-1B	6/26/00	29.06	17.76	11.30
W85-3B	6/26/00	30.56	19.22	11.34
W85-6B	6/26/00	29.03	17.93	11.10
W85-7B	6/26/00	26.54	15.70	10.84
W92-15B	6/26/00	29.64	18.46	11.18
W92-16B	6/28/00	29.26	18.29	10.97
W97-18B	6/26/00	29.15	18.00	11.15
W97-19B	6/26/00	25.49	14.50	10.99
W98-21B	6/26/00	29.27	18.22	11.05
W99-R5B	6/26/00	32.33	25.10	7.23

Notes:
btoc - below top of casing
msl - mean sea level

APPENDIX A

Chromium Concentrations in Groundwater

Chromium Concentrations in Groundwater

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
B85-1	11/13/85	mg/L	0.13			0.01 U
	1/9/86	mg/L	0.014			0.014
	5/7/86	mg/L	0.005 U			0.005 U
	2/5/87	mg/L	0.32			0.27
B85-2	11/13/85	mg/L	160			160
	1/7/86	mg/L	300			210
	5/1/86	mg/L	130			140
B85-3	11/7/85	mg/L	0.011			0.01
	1/14/86	mg/L	0.002 U			0.006
	5/1/86	mg/L	0.015			0.007
	2/5/87	mg/L	0.005 U			0.073
B85-4	10/23/85	mg/L				5.75
	11/13/85	mg/L	14			14
	1/14/86	mg/L	47			36
	5/2/86	mg/L	27			34
	2/5/87	mg/L	51			19
	7/13/90	mg/L			7.5	
	7/22/92	mg/L	5.96	4.89	3.1 J	2.5 J
	10/28/92	mg/L	4.68	4.37	4.74	4.41
	1/20/93	mg/L	10.2	9.89	2.67	3.1
	4/28/93	mg/L		15.1		16.3
	5/5/94	mg/L		1.57		1.37
	3/1/97	µg/L		5,560		
	2/3/99	µg/L		2,450		
	6/27/00	µg/L		609		
B85-4 (DUP)	11/13/85	mg/L	17			14
	1/14/86	mg/L	47			37
	5/2/86	mg/L	27			32
B85-5	10/23/85	mg/L				27
	11/12/85	mg/L	1.9			0.11
	1/7/86	mg/L	4.2			3.7
	5/5/86	mg/L	1.1			1.2
	2/5/87	mg/L	1.4			1.4
B85-6	11/12/85	mg/L	67			3
	1/7/86	mg/L	18			16
	5/7/86	mg/L	6.1			6.6
	2/5/87	mg/L	21			12
	7/12/90	mg/L	13	16	7.2	9.1
	3/1/97	µg/L		230		
B85-6 (DUP)	1/7/86	mg/L	17			16
	7/12/90	mg/L	14		7	
B86-2R	2/5/87	mg/L	100			59
	7/10/90	mg/L	12		12	
B86-2R (DUP)	2/5/87	mg/L	100			71

Chromium Concentrations in Groundwater (Continued)

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
B87-8	2/5/87	mg/L	41			12
	7/13/90	mg/L	1.4		1.3	
	7/23/92	mg/L	1.98	4.9	0.38 J	0.3 J
	10/28/92	mg/L	2.73	2.56	2.65	2.41
	1/21/93	mg/L	2.02	2.04	0.50	0.66
	4/28/93	mg/L		1.94		1.99
	5/5/94	mg/L		1.15		1.23
	3/1/97	µg/L		1,590		
	06/27/00	µg/L		594		
B87-8 (DUP)	2/5/87	mg/L	34			15
	5/5/94	mg/L		1.15		1.25
	2/3/99	µg/L		321		
	6/27/00	µg/L		609		
PW-1A	2/16/87	mg/L	6.4			6.4
	2/18/87	mg/L	11			9.9
	2/19/87	mg/L	12			16
	10/29/92	mg/L		1.77		
	1/21/93	mg/L		0.9		
PW-1B	2/9/87	mg/L	0.19			
	2/9/87	mg/L		0.294		
	2/9/87	mg/L		0.295		
	2/9/87	mg/L		0.292		
	2/9/87	mg/L				
	2/9/87	mg/L				
	2/9/87	mg/L				
	2/9/87	mg/L				
	2/10/87	mg/L				
	2/10/87	mg/L		0.409		
	2/10/87	mg/L		0.545		
	2/10/87	mg/L				
	2/10/87	mg/L				
	2/10/87	mg/L				
	2/11/87	mg/L	0.6			
	2/11/87	mg/L		0.616		
	2/11/87	mg/L		0.668		
	2/11/87	mg/L				
	2/11/87	mg/L				
	2/11/87	mg/L				
	2/12/87	mg/L		0.685		
	2/12/87	mg/L		0.718		
	2/12/87	mg/L				
	2/12/87	mg/L				
	10/29/92	mg/L		1.18		
PW-1B (DUP)	2/12/87	mg/L		0.77		

Chromium Concentrations in Groundwater (Continued)

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
School For Deaf	6/16/82	mg/L		0.01 U		0.05 U
	6/19/85	mg/L	0.002 U		0.005 U	
	11/14/85	mg/L	0.002 U			0.01 U
	1/15/86	mg/L	0.022			0.005 U
	5/7/86	mg/L	0.005 U			0.005 U
W85-1A	9/30/85	mg/L				140
	10/8/85	mg/L	160			95
W85-1B	11/13/85	mg/L	0.051			0.04
	1/8/86	mg/L	0.033			0.033
	5/7/86	mg/L	0.12			0.21
	2/5/87	mg/L	0.068			0.042
	7/13/90	mg/L	0.12		0.11	
	7/23/92	mg/L	0.0229	0.435	0.015 U	0.01 U
	10/28/92	mg/L	0.0184	0.0735	0.024 B	0.0604 B
	1/20/93	mg/L	0.105	0.116	0.0408	0.0408
	4/28/93	mg/L		0.104		0.1143
	5/4/94	mg/L		0.169		0.169
	3/1/97	µg/L		109		
	2/3/99	µg/L		349		
	6/28/00	µg/L		78.7		
W85-2AA	11/6/85	mg/L	0.034			0.01 U
	1/9/86	mg/L	0.033			0.033
	5/1/86	mg/L	0.055			0.042
W85-2AB	11/6/85	mg/L	1.8			0.092
	1/9/86	mg/L	0.34			0.34
	5/1/86	mg/L	1.4			1.8
W85-2B	11/6/85	mg/L	0.11			0.014
	1/9/86	mg/L	0.23			0.23
	5/6/86	mg/L	1.1			1.2
	2/5/87	mg/L	0.32			0.26
	7/13/90	mg/L	0.003 U		0.64	
W85-3A	11/12/85	mg/L	0.03			0.01 U
	1/8/86	mg/L	0.002 U			0.005 U
	5/5/86	mg/L	0.87			0.97
	2/5/87	mg/L	0.032			0.005 U
	7/16/92	mg/L	0.261	0.28	0.12 J	0.2 J
	10/27/92	mg/L	0.0733	0.065	0.0767	0.0719
	1/20/93	mg/L	0.0418	0.0428	0.0111	0.0458
	4/28/93	mg/L		0.0407		0.0342
	5/3/94	mg/L		0.017 P		0.0164
	3/1/97	µg/L		16		
W85-3B	11/5/85	mg/L	0.002 U			0.01 U
	1/8/86	mg/L	0.096			0.075
	5/6/86	mg/L	0.98			1.1
	2/5/87	mg/L	0.16			0.071

Chromium Concentrations in Groundwater (Continued)

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
W85-3B (Continued)	7/16/92	mg/L	0.81	0.809	0.2 J	0.18 J
	10/27/92	mg/L	0.11	0.106	0.105	0.102
	1/20/93	mg/L	0.342	0.307	0.094	0.1432
	4/28/93	mg/L		0.334		0.4201
	5/3/94	mg/L		0.13		0.138
	3/1/97	µg/L		80.6		
W85-4A	11/6/85	mg/L	0.014			0.01 U
	1/9/86	mg/L	0.004			0.004
W85-4B	11/6/85	mg/L	0.002 U			0.01 U
	1/9/86	mg/L	0.042			0.008
	5/7/86	mg/L	0.005 U			0.005 U
	2/5/87	mg/L	0.026			0.005 U
W85-5A	11/12/85	mg/L	0.084			0.01 U
	1/14/86	mg/L	0.015 B			0.005 U
	5/1/86	mg/L	0.017			0.13
	2/5/87	mg/L	0.044			0.005 U
	3/1/97	µg/L		10		
	2/3/99	µg/L		5 U		
W85-5B	11/8/85	mg/L	0.32			0.24
	1/14/86	mg/L	0.2			0.2
	5/6/86	mg/L	0.12			0.12
	2/5/87	mg/L	0.27			0.23
	3/1/97	µg/L		10		
	2/3/99	µg/L		5 U		
W85-6A	11/7/85	mg/L	0.81			0.81
	1/10/86	mg/L	2.1			2.4
	5/2/86	mg/L	1.4			1.7
	2/5/87	mg/L	0.8			0.084
	7/12/90	mg/L	0.057		0.06	
	7/17/92	mg/L	0.0181	0.142	0.031 UJ	0.053 UJ
	10/27/92	mg/L	0.0928	0.0936	0.0817	0.102
	1/19/93	mg/L	0.0119 U	0.0119 U	0.01	0.01
	4/27/93	mg/L		0.0832		0.0733
	5/3/94	mg/L		0.0254		0.0251
	3/1/97	µg/L		114		
	2/3/99	µg/L		15		
	6/27/00	µg/L		228		
W85-6B	11/7/85	mg/L	0.23			0.21
	1/10/86	mg/L	0.17			0.17
	5/6/86	mg/L	0.62			0.75
	2/5/87	mg/L	0.23			0.45
	7/17/92	mg/L	0.0163	0.0135	0.033 UJ	0.033 UJ
	10/27/92	mg/L	0.03	0.0334	0.0321	0.0323
	1/19/93	mg/L	0.0164 U	0.0167 U	0.01	0.01 U
	4/27/93	mg/L		0.0466		0.0472

Chromium Concentrations in Groundwater (Continued)

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
W85-6B	5/3/94	mg/L		0.021 P		0.021
(Continued)	3/1/97	µg/L		61.1 J		
W85-6B (DUP)	5/3/94	mg/L		0.021 P		0.0212
	3/1/97	µg/L		211 J		
W85-7A	11/7/85	mg/L	2.3			2.3
	1/13/86	mg/L	3.1			3
	5/1/86	mg/L	1			1.2
	2/5/87	mg/L	1.4			1.2
	7/12/90	mg/L	0.1		0.06	
	7/23/92	mg/L	0.0142	0.0218	0.004 U	0.001 U
	10/27/92	mg/L	0.005 U	0.0055 U	0.01 U	0.01 U
	1/19/93	mg/L	0.0095 UB	0.0128 U	0.01	0.01
	4/27/93	mg/L		0.0172		0.0188
	5/3/94	mg/L		0.024 P		0.0229 H
	3/1/97	µg/L	10 U	10	11	
W85-7B	11/5/85	mg/L	0.05			0.01
	1/13/86	mg/L	0.15			0.18
	5/6/86	mg/L	0.25			0.42
	2/5/87	mg/L	0.35			0.2
	7/23/92	mg/L	0.034	0.0379	0.006 U	0.006 U
	10/27/92	mg/L	0.0983	0.0937	0.139 B	0.0891
	1/19/93	mg/L	0.0307 U	0.0298	0.01	0.01
	1/19/93	mg/L	0.0298 U	0.031	0.01	0.01
	4/27/93	mg/L		0.0532		0.0463
	4/27/93	mg/L		0.0466		0.047
	5/3/94	mg/L		0.0354		0.0331 H
	3/1/97	µg/L	27.2	27.3		
W85-7B (DUP)	5/6/86	mg/L	0.33			0.42
W86-10B	2/5/87	mg/L	0.005 U			0.005 U
	3/1/97	µg/L		5 U		
W86-11A	2/5/87	mg/L	0.011			0.005 U
	7/16/92	mg/L	0.0049 U	0.0078 B	0.001 UJ	0.005 UJ
	10/26/92	mg/L	0.005 U	0.0079 P	0.01 U	0.01 U
	1/18/93	mg/L	0.0027 U	0.0074 B	0.01	0.0267
	4/26/93	mg/L		0.003 U		0.003 U
	5/2/94	mg/L		0.005 U		0.01 U
W86-11B	2/5/87	mg/L	0.007			0.005 U
	7/16/92	mg/L	0.0099 B	0.0101	0.001 UJ	0.001 UJ
	10/26/92	mg/L	0.005 U	0.0055 U	0.01 U	0.01 U
	1/18/93	mg/L	0.0027 U	0.0039 B	0.01	0.01
	4/26/93	mg/L		0.003 U		0.003 U
	5/2/94	mg/L		0.005 U		0.01 U
W86-13A	2/5/87	mg/L	0.005 U			0.005 U
	3/1/97	µg/L		5 U		
W87-12A	2/5/87	mg/L	0.24			0.16

Chromium Concentrations in Groundwater (Continued)

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
W87-12A (Continued)	7/16/92	mg/L	0.007 B	0.0425	0.001 UJ	0.13 J
	10/27/92	mg/L	0.005 U	0.0055 U	0.012 B	0.01 U
	1/19/93	mg/L	0.0039 UB	0.0117 U	0.01	0.01
	4/27/93	mg/L		0.003 U		0.003 U
	5/2/94	mg/L		0.005 U		0.01 U
W87-12B	2/5/87	mg/L	0.21			0.13
	7/16/92	mg/L	0.0484	0.0523	0.019 UJ	0.021 UJ
	10/27/92	mg/L	0.114	0.111	0.099	0.104
	1/19/93	mg/L	0.0164 U	0.0146 U	0.01	0.01
	4/27/93	mg/L		0.0404		0.0475
	5/2/94	mg/L		0.017 P		0.017
W87-8A	2/5/87	mg/L	0.027			0.01
	7/15/92	mg/L	0.0049 U	0.0037 U	0.001 UJ	0.001 UJ
	10/26/92	mg/L	0.005 U	0.0055 U	0.01 U	0.01 U
	1/18/93	mg/L	0.0027 U	0.0027 U	0.0136	0.0117
	4/27/93	mg/L		0.0074 B		0.003 U
	5/3/94	mg/L		0.005 U		0.01 UH
W87-8B	2/5/87	mg/L	0.071		0.009	
	7/15/92	mg/L	0.111	0.259	0.027 UJ	0.23 J
	10/26/92	mg/L	0.005 U	0.0056 U	0.01 U	0.01 U
	10/26/92	mg/L	0.005 U	0.0055 U	0.01 U	0.01 U
	1/18/93	mg/L	0.0222	0.0268	0.01	0.01
	4/27/93	mg/L		0.0064 B		0.0066 B
	5/3/94	mg/L		0.014 P		0.0139 H
	3/1/97	µg/L	46.5	48		47.8
W87-8B (DUP)	2/5/87	mg/L	0.062			0.007
	3/1/97	µg/L	49	47.4		45.5
W87-9A	2/5/87	mg/L	0.005 U			0.005 U
	7/22/92	mg/L	0.0049 U	0.0272	0.001 UJ	0.016 UJ
	10/26/92	mg/L	0.005 U	0.0054 U	0.01 U	0.01 U
	1/18/93	mg/L	0.0027 U	0.0042 B	0.01	0.01
	4/26/93	mg/L		0.003 U		0.003 U
	5/2/94	mg/L		0.005 U		0.01 U
W87-9B	2/5/87	mg/L	0.011			0.005 U
	7/22/92	mg/L	0.0049 U	0.005 B	0.003 UJ	0.007 UJ
	10/26/92	mg/L	0.005 U	0.0055 U	0.01 U	0.01 U
	1/18/93	mg/L	0.0027 U	0.0027 U	0.01	0.01
	4/26/93	mg/L		0.003 U		0.003 U
	5/2/94	mg/L		0.005 U		0.01 U
W92-14A	7/22/92	mg/L	2.11	3.68	6 J	5.9 J
	10/29/92	mg/L	29.1	27.5	24.8	28.5
	10/29/92	mg/L	32.6	31	29.1	30.8
	1/21/93	mg/L	36.8	32.1	12.9004	8.2
	4/29/93	mg/L		41.6		44.0064
	5/5/94	mg/L		28.3		28.4

Chromium Concentrations in Groundwater (Continued)

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
W92-14A (Continued)	3/1/97	µg/L	18,500	19,400		18,433 H
	2/3/99	µg/L		19,400		
	6/27/00	µg/L	25,400	25,100		
W92-14P	7/22/92	mg/L	1.23	1.25		
	10/29/92	mg/L	33	32	30	29.9
	1/21/93	mg/L	27.3	27	6.6804	8.84
	4/29/93	mg/L		26.4		29.5053
	5/5/94	mg/L		27.8		27.9
	3/1/97	µg/L	6,530	6,410		6,130 H
	2/3/99	µg/L		10,200		
	6/27/00	µg/L		10,600		
	6/27/00	µg/L	10,500 DUP			
W92-15A	7/22/92	mg/L	5.33	5.65		
	10/28/92	mg/L	7.41	6.76	6.77	6.51
	1/21/93	mg/L	7.47	7.44	1.75	1.92
	4/29/93	mg/L		7.87		8.1923
	5/4/94	mg/L		1.58		1.94
	3/1/97	µg/L		732		
	2/3/99	µg/L		71		
	6/27/00	µg/L	57	75.9		
W92-15B	7/22/92	mg/L	7.69	7.88		
	10/28/92	mg/L	5.85	4.22	5.59	4.87
	1/21/93	mg/L	10	10.5	2.9	31.7
	4/29/93	mg/L		1.77		1.5757
	5/4/94	mg/L		6.67		6.98
	3/1/97	µg/L	669	684		762
	2/3/99	µg/L		1,610		
	6/27/00	µg/L	5	11		
W92-16A	7/22/92	mg/L	19.9	28.8		
	10/28/92	mg/L	0.711	0.649	0.64	0.679
	1/20/93	mg/L	2.59	2.61	0.788	0.824
	4/28/93	mg/L		0.0781		0.4263
	5/4/94	mg/L		0.276		0.284
	3/1/97	µg/L	473	472		463
	6/28/00	µg/L		75.9		
W92-16B	7/22/92	mg/L	27.4	29.2		
	10/28/92	mg/L	1.37	1.31	1.21	1.18
	1/20/93	mg/L	2.13	2.01	0.518	0.572
	4/28/93	mg/L		1.87		2.0346
	5/4/94	mg/L		2.13		2.25
	3/1/97	µg/L	62.9	74		63.7
	6/28/00	µg/L		5		
W92-17P	7/23/92	mg/L	0.0333	10.1		
	7/23/92	mg/L	0.018	16.9		
	10/29/92	mg/L	0.0152	0.116	0.01 U	0.215

Chromium Concentrations in Groundwater (Continued)

Station ID	Sampling Date	Units	Chromium		Chromium VI	
			Dissolved	Total	Dissolved	Total
W92-17P (Continued)	1/21/93	mg/L	**0.0228**	**0.0902**	**0.021**	**0.0212**
	1/21/93	mg/L	**0.0228**	**0.197**	**0.0164**	**0.0171**
	4/29/93	mg/L		**0.92**		**0.0172**
	5/4/94	mg/L		**0.0407**		0.01 U
W97-18A	3/1/97	µg/L		5 U		
	2/3/99	µg/L		5 U		
	6/27/00	µg/L	5	5		
W97-18B	3/1/97	µg/L		5 U		
W97-19A	3/1/97	µg/L		**8.1**		
	2/3/99	µg/L		5 U		
	6/28/00	µg/L		**7.7**		
W97-19B	3/1/97	µg/L		5 U		
WB98-20A	2/3/99	µg/L		**5.6**		
	6/28/00	µg/L		**43.9**		
WB98-21A	2/3/99	µg/L		**6.3**		
	6/27/00	µg/L		**126**		
WB98-21B	2/3/99	µg/L		**17**		
	6/27/00	µg/L		**14**		
W99-R5A	6/28/00	µg/L		**5**		
W99-R5B	3/28/00	µg/L		**12**		
	6/28/00	µg/L		**12**		

Notes:
Bold denotes detected value
B - detected in the blank
DUP - duplicate
H - sample analyzed after suggested holding time limit
J - estimate
µg/L - microgram per liter
mg/L - milligram per liter
P - detected above instrument detection limit, but not quantified within expected limits of precision. The laboratory has established a minimum quantitation limit with a relative standard deviation of no more than 10 percent.
U - undetected

APPENDIX C

Groundwater Sample Logs

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: B85-4
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 25.69
Static Water Level (ft btoc): 18.18
Water Column Height (ft): 7.51
Well Volume (gallons): 1.22

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 21.5-26.5
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 23
Sample Number: 00264250 MS/MSD

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
621	6.06	0.505	33	3.81	15.4	171	18.19	0.5	initial
624	6.13	0.450	14	3.48	14.4	171	18.19	0.5	1.5
627	6.12	0.431	9	3.44	14.1	173	18.19	0.5	3
630	6.12	0.424	3	3.43	14.1	175		0.5	4.5
633	6.13	0.419	1	3.41	14.0	175		0.5	6
636	6.14	0.420	1	3.40	14.0	175	18.18	0.5	7.5
639	6.15	0.418	1	3.39	14.0	174		0.5	9

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 9 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log

Frontier Hard Chrome Monitoring

Well Number: B87-8
Well Type: Monitoring
Well Diameter (inches): 4
Measuring Point: Marked PVC
Total Depth (ft btoc): 29.39
Static Water Level (ft btoc): 18.65
Water Column Height (ft): 10.74
Well Volume (gallons): 7.01

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 24.5-29.5
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 27
Sample Number: 00264251
00264252 (FD)

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
711	6.42	0.384	38	2.87	16.3	195	18.65	0.5	initial
714	6.44	0.379	18	1.87	14.4	188	18.65	0.5	1.5
717	6.41	0.380	16	2.46	13.8	185	18.65	0.5	3
720	6.39	0.378	9	2.21	13.7	182		0.5	4.5
723	6.37	0.378	9	2.18	13.7	180	18.65	0.5	6
726	6.36	0.378	8	2.16	13.7	179		0.5	7.5
729	6.36	0.378	8	2.13	13.7	178		0.5	9

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 9 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log

Frontier Hard Chrome Monitoring

Well Number: W98-21A
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 25.78
Static Water Level (ft btoc): 18.09
Water Column Height (ft): 7.39
Well Volume (gallons): 1.2

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 20.7-25.7
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 23
Sample Number: 00264253

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
823	6.25	0.359	68	3.66	17.6	244	18.10	0.5	initial
826	6.29	0.352	41	3.10	14.8	224	18.10	0.4	1.2
829	6.34	0.352	19	3.06	14.7	216		0.4	2.4
832	6.25	0.352	14	2.12	14.5	210	18.10	0.4	3.6
835	6.24	0.352	12	2.07	14.5	209		0.4	4.8
838	6.21	0.351	10	1.89	14.5	205	18.10	0.4	6
841	6.22	0.351	10	1.93	14.5	206		0.4	7.2

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 7.2 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log

Frontier Hard Chrome Monitoring

Well Number: W98-21B
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 43.73
Static Water Level (ft btoc): 18.32
Water Column Height (ft): 25.41
Well Volume (gallons): 4.14

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 39-44
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 41
Sample Number: 00264254

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
856	6.37	0.355	5	5.45	16.9	214	18.32	0.4	initial
859	6.45	0.360	1	4.89	15.9	206	18.32	0.4	1.2
902	6.45	0.364	0	4.37	15.5	201		0.4	2.4
905	6.45	0.371	0	3.96	15.5	197	18.32	0.4	3.6
908	6.44	0.373	0	3.73	15.4	195		0.4	4.8
911	6.44	0.374	0	3.82	15.4	195		0.4	6
914	6.44	0.375	0	3.85	15.5	195		0.4	7.2

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 7.2 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log

Frontier Hard Chrome Monitoring

Well Number: W85-6A
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 26.27
Static Water Level (ft btoc): 18.17
Water Column Height (ft): 8.1
Well Volume (gallons): 1.32

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 17-27
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 22
Sample Number: 00264255

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
1007	6.28	0.381	0	2.71	17.6	246	18.17	0.4	initial
1010	6.34	0.380	0	1.89	15.7	240	18.17	0.4	1.2
1013	6.29	0.382	0	1.69	15.3	227		0.4	2.4
1016	6.24	0.382	0	1.71	15.3	221	18.17	0.4	3.6
1019	6.20	0.382	0	1.73	15.3	216		0.4	4.8
1022	6.21	0.381	0	1.76	15.3	217	18.17	0.4	6
1025	6.21	0.382	0	1.71	15.3	215		0.4	7.2

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 7.2 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W92-14P
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 16.75
Static Water Level (ft btoc): 9.84
Water Column Height (ft): 6.91
Well Volume (gallons): 1.13

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 12-17
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 13
Sample Number: 00264256
00264257 (FD)

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
1213	4.78	0.106	1	1.09	18.4	323	9.85	0.33	initial
1216	4.61	0.103	1	0.89	16.7	318		0.33	1
1219	4.51	0.097	1	0.85	16.4	313	9.85	0.33	2
1222	4.45	0.096	1	0.79	16.2	311		0.33	3
1225	4.34	0.092	0	0.69	15.8	304	9.84	0.33	4
1228	4.34	0.092	0	0.74	15.5	306		0.33	5
1231	4.35	0.092	0	0.72	15.5	305		0.33	6

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 6 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W97-19A
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 25.01
Static Water Level (ft btoc): 15.48
Water Column Height (ft): 9.53
Well Volume (gallons): 1.55

Date: 6/28/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 22.5-27.5
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 23
Sample Number: 00264258 MS/MSD

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
624	6.06	0.446	82	3.96	16.0	276	15.48	0.4	initial
627	6.27	0.359	19	4.07	14.1	281	15.48	0.4	1.2
630	6.24	0.359	12	3.70	14.0	284		0.4	2.4
633	6.27	0.359	4	3.01	13.8	283	15.48	0.4	3.6
636	6.30	0.360	5	2.71	13.7	282		0.4	4.8
639	6.30	0.360	4	2.68	13.7	280	15.48	0.4	6
642	6.31	0.361	4	2.65	13.6	280		0.4	7.2

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 7.2 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log

Frontier Hard Chrome Monitoring

Well Number: W98-20A
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 26.69
Static Water Level (ft btoc): 16.51
Water Column Height (ft): 10.18
Well Volume (gallons): 1.67

Date: 6/28/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 22-27
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 24
Sample Number: 00264259

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
712	6.52	0.280	2	4.44	14.6	280	16.51	0.4	initial
715	6.50	0.271	0	3.05	14.1	287	16.51	0.4	1.2
718	6.48	0.271	0	2.88	13.9	286		0.4	2.4
721	6.45	0.272	0	3.11	13.8	283	16.51	0.4	3.6
724	6.41	0.272	0	2.98	13.7	283		0.4	4.8
727	6.40	0.273	0	2.93	13.7	283	16.51	0.4	6
730	6.40	0.273	0	2.99	13.6	282		0.4	7.2

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 7.2 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log

Frontier Hard Chrome Monitoring

Well Number: W99-R5A
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 32.24
Static Water Level (ft btoc): 25.24
Water Column Height (ft): 7.0
Well Volume (gallons): 1.14

Date: 6/28/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 22-32
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 28.5
Sample Number: 00264260

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
821	6.46	0.391	36	4.31	17.5	264	25.24	0.4	initial
824	6.50	0.373	6	3.30	16.4	271	25.24	0.4	1.2
835	6.49	0.376	6	3.61	17.7	265		0.4	2.4
838	6.47	0.374	6	3.45	17.9	263	25.24	0.4	3.6
841	6.49	0.375	7	3.60	17.7	259	25.24	0.4	4.8
844	6.50	0.375	7	3.53	16.4	257		0.4	6
847	6.51	0.376	6	3.51	16.6	259		0.4	7.2

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 7.2 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W99-R5B
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 49.05
Static Water Level (ft btoc): 25.3
Water Column Height (ft): 23.75
Well Volume (gallons): 3.78

Date: 6/28/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 44-49
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 47.5
Sample Number: 00264261
00264275 (FD)

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
905	6.78	0.367	1	4.79	17.4	279	25.31	0.4	initial
908	6.81	0.365	0	3.92	16.1	272	25.31	0.4	1.2
911	6.80	0.366	0	3.92	15.7	266		0.4	2.4
914	6.79	0.366	0	3.90	15.6	264	25.30	0.4	3.6
917	6.78	0.366	0	3.79	15.5	263		0.4	4.8
920	6.78	0.367	0	3.85	15.4	262	25.30	0.4	6
923	6.77	0.366	0	3.89	15.4	261		0.4	7.2

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 7.2 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W97-18A
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 27.27
Static Water Level (ft btoc): 18.17
Water Column Height (ft): 9.1
Well Volume (gallons): 1.48

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 22.5-27.5
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 25
Sample Number: 00264264
00264265 (Dissolved)

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
817	7.10	0.115	160	2.64	14.4	126	18.19	0.25	initial
824	6.67	0.106	237	2.07	14.0	100	18.19	0.25	1.75
830	6.57	0.107	249	2.33	14.0	54		0.25	3.25
836	6.57	0.107	193	2.13	13.7	67	18.19	0.25	4.75
841	6.78	0.097	253	4.97	13.8	52		0.25	6
848	6.73	0.097	240	3.97	14.0	33		0.25	6.5
851	6.57	0.100	194	1.09	14.1	27		0.25	6.75

Unstable well
Type of Samples Collected: Total and Dissolved Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 6.75 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W92-15B
Well Type: Monitoring
Well Diameter (inches): 4
Measuring Point: Marked PVC
Total Depth (ft btoc): 43.05
Static Water Level (ft btoc): 18.52
Water Column Height (ft): 24.53
Well Volume (gallons): 16.01

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 33-43
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 38
Sample Number: 00264266
00264267 (Dissolved)

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
1000	7.11	0.254	47	7.11	16.1	117	18.53	0.5	0.5
1004	7.01	0.289	72	5.01	16.3	89	18.53	0.5	2.5
1008	6.98	0.261	63	5.90	15.6	100	18.53	0.5	4.5
1015	5.84	0.260	44	6.32	15.7	50	18.52	0.5	8
1018	6.48	0.259	22	5.77	15.4	47	18.52	0.5	9.5
1021	6.67	0.258	24	5.57	15.2	43	18.52	0.5	11
1024	6.74	0.258	26	5.40	15.2	44	18.52	0.5	12.5
1028	6.74	0.261	25	5.42	15.1	47	18.52	0.5	14

Type of Samples Collected: Total and Dissolved Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 14 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W92-15A
Well Type: Monitoring
Well Diameter (inches): 4
Measuring Point: Marked PVC
Total Depth (ft btoc): 33.49
Static Water Level (ft btoc): 18.66
Water Column Height (ft): 14.83
Well Volume (gallons): 9.68

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 24-34
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 29
Sample Number: 00264268
00264269 (Dissolved)

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
1053	7.26	0.262	44	6.55	16.9	282	18.66	0.5	initial
1059	6.96	0.262	56	7.92	15.8	67	18.67	0.5	3
1102	6.87	0.261	49	4.90	15.9	68	18.67	0.5	4.5
1107	6.83	0.261	38	4.88	15.9	60	18.67	0.5	7
1110	6.81	0.261	36	4.60	15.8	62	18.67	0.5	8.5
1114	6.79	0.261	36	4.64	15.8	61	18.67	0.5	10.5

Type of Samples Collected: Total and Dissolved Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 10.5 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W92-14A
Well Type: Monitoring
Well Diameter (inches): 2
Measuring Point: Marked PVC
Total Depth (ft btoc): 27.05
Static Water Level (ft btoc): 18.33
Water Column Height (ft): 8.72
Well Volume (gallons): 1.42

Date: 6/27/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 23.5-27.5
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 25
Sample Number: 00264270
00264271 (Dissolved)

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
1224	6.77	0.413	325	2.03	16.4	176	20.30	0.15	1.35
1227	6.76	0.387	606	0.39	16.2	211	20.78	0.15	1.8
1230	6.74	0.386	466	0.63	16.6	222	20.98	0.15	2.25
1233	6.71	0.387	408	0.42	16.3	225	21.33	0.15	2.7
1236	6.66	0.387	308	0.67	16.0	230	21.70	0.15	3.15
1239	6.62	0.384	239	7.99	15.8	233	21.98	0.15	3.6
1242	6.59	0.389	234	2.34	15.7	236	22.19	0.15	4.05
1245	6.56	0.383	223	2.15	15.7	240	22.59	0.15	4.5
1248	6.55	0.380	224	1.54	14.6	239	22.73	0.15	4.95
1251	6.53	0.377	213	0.91	15.6	238	22.83	0.15	5.4

Unstable and slow producing well
Type of Samples Collected: Total and Dissolved Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 5.4 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W92-16A
Well Type: Monitoring
Well Diameter (inches): 4
Measuring Point: Marked PVC
Total Depth (ft btoc): 33.40
Static Water Level (ft btoc): 18.4
Water Column Height (ft): 15
Well Volume (gallons): 9.9

Date: 6/28/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 24-34
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 29
Sample Number: 00264272

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
623	6.14	0.344	130	1.30	14.9	161	18.40	0.5	initial
626	6.33	0.322	150	0.77	14.6	157	18.40	0.5	3
629	6.49	0.307	135	0.32	14.3	155	18.40	0.5	4.5
632	6.53	0.292	60	0.55	14.2	153	18.40	0.5	6
636	6.52	0.292	53	0.31	14.1	153	18.40	0.5	8
640	6.51	0.291	45	1.03	13.9	161	18.40	0.5	10
644	6.49	0.292	41	0.57	13.8	159	18.40	0.5	12
648	6.55	0.294	32	2.30	13.8	180	18.40	0.5	14
652	6.50	0.294	29	0.86	13.9	189	18.40	0.5	16
656	6.49	0.297	28	1.00	13.9	189	18.40	0.5	18
702	6.57	0.299	*	1.21	14.0	186	18.40	0.5	21
706	6.52	0.300	*	1.25	13.8	183	18.40	0.5	23

* **Meter malfunction, water is visibly clear**
Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 23 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log
Frontier Hard Chrome Monitoring

Well Number: W85-1B
Well Type: Monitoring
Well Diameter (inches): 4
Measuring Point: Marked PVC
Total Depth (ft btoc): 48.35
Static Water Level (ft btoc): 17.98
Water Column Height (ft): 30.37
Well Volume (gallons): 19.8

Date: 6/28/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 44-49
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 46
Sample Number: 00264274

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
858	8.18	0.225	16	8.13	14.0	342	17.98	0.5	initial
902	8.37	0.211	200*	9.76	13.2	234	17.98	0.5	4
907	8.40	0.198	240*	8.55	13.2	227	17.98	0.5	6.5
909	8.37	0.199	10	10.73	13.1	221	17.98	0.5	7.5
913	8.36	0.198	187*	9.23	13.0	254	17.98	0.5	9.5
917	8.35	0.196	156*	8.97	13.0	266	17.98	0.5	11.5
921	8.32	0.198	70*	8.71	13.0	273	17.98	0.5	13.5
924	8.26	0.199	87*	8.45	13.0	277	17.98	0.5	15.5

*** Purge water bubbling as if carbonated, water apppears clear**
Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 15.5

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV

Groundwater Sample Log

Frontier Hard Chrome Monitoring

Well Number: W92-16B
Well Type: Monitoring
Well Diameter (inches): 4
Measuring Point: Marked PVC
Total Depth (ft btoc): 44.98
Static Water Level (ft btoc): 18.29
Water Column Height (ft): 26.69
Well Volume (gallons): 17.4

Date: 6/28/2000
Sampling Crew: Lillywhite
Hinds
Screen/Casing Material: PVC
Screen Interval (ft bgs): 35-45
Purging/Sampling Device: Peristaltic pump
Pump Intake (ft btoc): 40
Sample Number: 00264273

Time	pH (SU)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	DO (mg/L)	Temperature (Celsius)	eH (mV)	Depth to Water (Feet)	Flow Rate (lpm)	Volume Purged (Liters)
731	6.78	0.265	11	6.63	14.3	276	18.29	0.5	initial
735	6.65	0.269	12	5.87	14.1	308	18.29	0.5	3
739	6.68	0.264	8	5.79	14.0	251	18.29	0.5	5
743	6.69	0.264	4	5.80	14.1	252	18.29	0.5	7
747	6.70	0.264	1	5.77	14.1	253	18.29	0.5	9
751	6.71	0.263	0	5.83	14.2	273	18.29	0.5	1
800	6.73	0.263	0	5.75	14.2	288	18.29	0.5	15.5
804	6.74	0.263	0	5.72	14.3	298	18.29	0.5	17.5

Type of Samples Collected: Total Metals (Chromium only)
Total Volume Purged Prior to Sample Collection: 17.5 liters

Stabilization Criteria	
Parameter	**Criteria**
pH	+/- 0.1 Standard Units
Specific Conductivity	+/- 3% mS/cm
Turbidity	+/- 10% NTUs
Dissolved O_2	+/- 10% mg/L
eH	+/- 10 mV