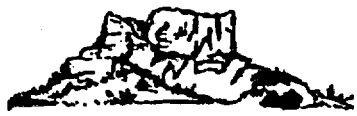
CROW BUTTE RESOURCES, INC.



Mine Unit 1 Restoration Report

Crow Butte Uranium Project

January 10, 2000

United States Nuclear Regulatory Commission
Source Materials License SUA-1534

Submitted To: US Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
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Rockville, Maryland 20850

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Table of Contents

Table of Figures and Tables

1 INTRODUCTION

Crow Butte Resources, Inc. (CBR) operates a uranium solution mine in Dawes County, Nebraska. The permitted area includes approximately 2,800 acres in all or portions of Sections 11, 12, and 13 of Township 31N, Range 52W and Sections 18, 19, 20, 29 and 30 of Township 31N, Range 51W. The process plant is located in Section 19, Township 31 North, Range 51 West. The wellfields for current mining operations are located in Sections 18 and 19.

Solution mining involves the injection of an oxidant- and carbonate-charged solution ("lixiviant") into the production zone aquifer through injection wells. With slight pH adjustments, the reduced uranium is oxidized and dissolved by complexation with the carbonate. The uranium-rich solution ("pregnant" lixiviant) is drawn to recovery wells where it is pumped to the surface and transferred to the process plant. Injection and production flows are carried to and from the process plant through underground pipelines.

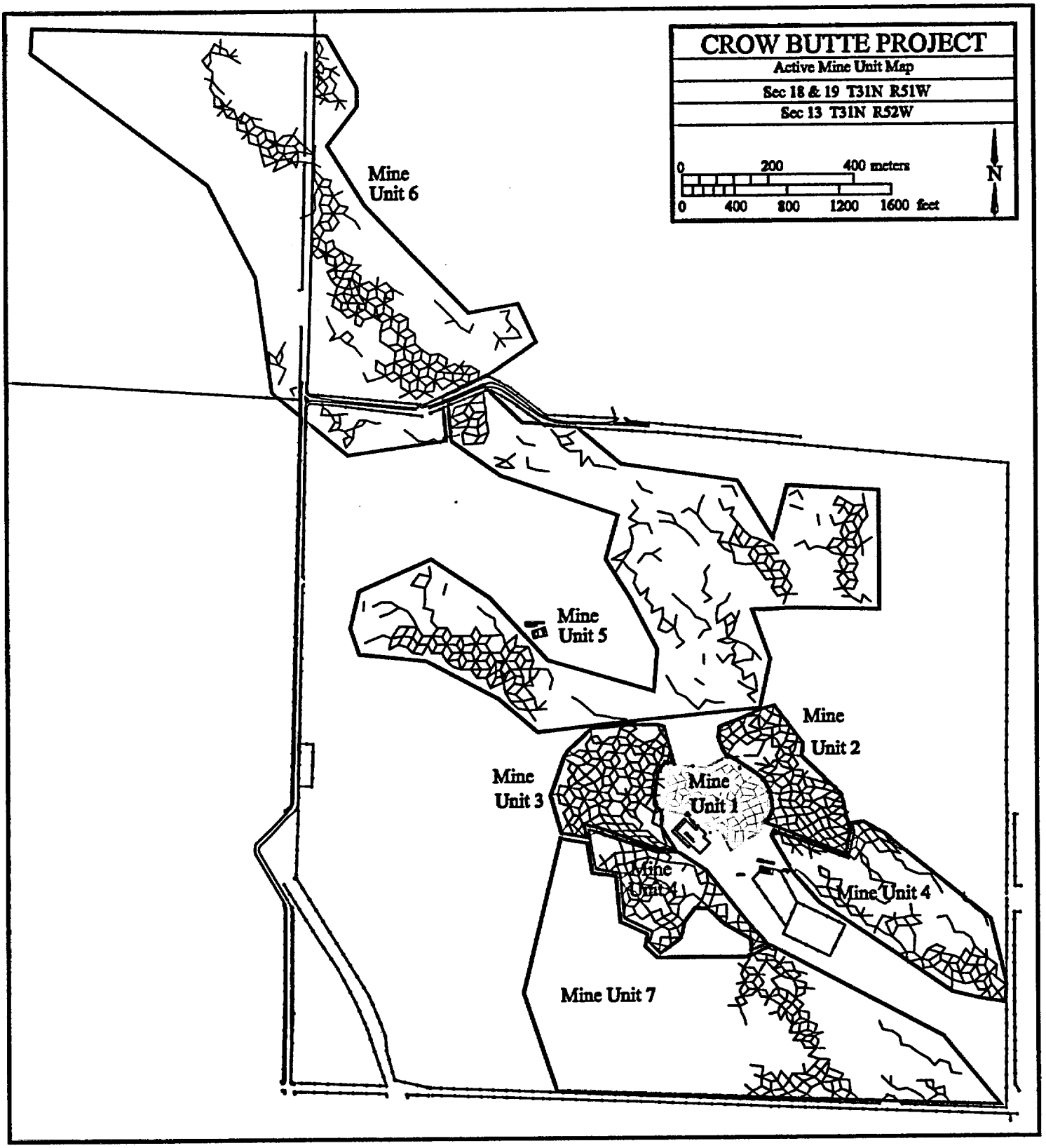
The uranium is removed from the mining solution by adsorption onto ion exchange resin. The now barren lixiviant is recharged with an oxidant and carbonate and is reinjected into the production zone for additional uranium recovery. The production cycle is continued until the ore zone is depleted to the point economic uranium recovery is no longer feasible.

During production, there is a constant movement of lixiviant through the aquifer from outlying injection wells to internal recovery wells. The injection wells and recovery wells are arranged in any of a number of geometric patterns depending upon the configuration of the orebody and the aquifer permeability. Most often, wells are placed in five- or seven-spot patterns. Monitoring wells, which are screened in appropriate stratigraphic horizons, surround the wellfield pattern area to detect any lixiviant that may migrate out of the production zone, either vertically or horizontally.

Following the completion of uranium recovery in a particular mining area, the affected groundwater is restored to appropriate standards, which include preoperational baseline conditions or pre-mining class-of-use limits.

Currently, there are seven mine units, designated as Mine Units 1 through 7, at the Crow Butte project. Of these seven mine units, Mine Units 1, 2 and 3 are in restoration and Mine Units 4 through 7 are in production. Figure 1 shows the general location of the mine units within the permitted area.

FIGURE 1


CROW BUTTE PROJECT
Active Mine Unit Map
Sec 18 & 19 T31N R51W
Sec 13 T31N R52W
0 200 400 meters
0 400 800 1200 1600 feet
N
Mine Unit 6
Mine Unit 5
Mine Unit 2
Mine Unit 3
Mine Unit 1
Mine Unit 4
Mine Unit 4
Mine Unit 7

2 MINE UNIT 1 MINING HISTORY

2.1 Mine Unit 1 Description

Mine Unit 1 encompasses 9.3 acres immediately adjacent to the main process plant. Mine Unit 1 has an average screen thickness of approximately 20 feet and a porosity of 0.29. These parameters result in an estimated pore volume for Mine Unit 1 of 17.2 million gallons.

The mine unit consisted of 38 patterns as designed with an average pattern size of 10,624 square feet. The original design of Mine Unit 1 consisted of 38 production wells, 72 injection wells, 11 production zone monitor wells, and 3 shallow monitor wells. Included in this total were five wells that were originally mined as part of the research and development operation of the pilot plant beginning in 1986. Two additional production wells and four additional injection wells were added to Mine Unit 1 in 1992.

Mine Unit 1 includes two wellhouses (Wellhouse 1 and 2) that serve to connect main trunk lines from the process plant to injection and recovery wells. Figure 2 shows the location of Mine Unit 1 and the associated wells and wellhouses.

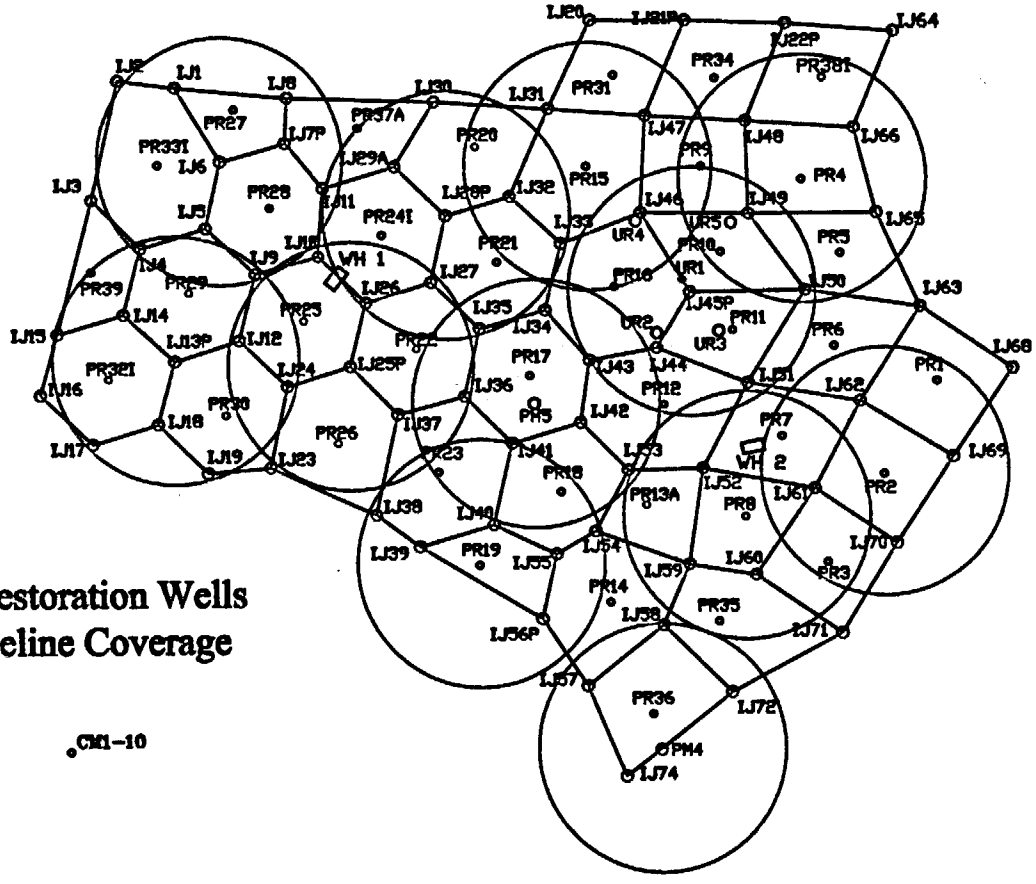
2.2 Determination of Baseline Water Quality

CBR is required to determine pre-operational baseline groundwater quality in a mine unit before mining. For Mine Unit 1, baseline groundwater quality determination was required at a minimum density of one production or injection well per one acre. These selected wells are designated as baseline restoration (BLR) wells. NDEQ requires a minimum of ten BLR wells per mine unit. Figure 2 shows the location of the twelve BLR wells in Mine Unit 1. BLR wells are shown in blue. A red circle depicts the 1-acre area for each well.

In addition to these restoration wells, License Condition 10.4A requires that one shallow monitor well per five acres must be established in the upper aquifer (Brule). Perimeter monitor wells are required in the production zone horizon (i.e., the Basal Chadron) surrounding the mine unit at a distance of 300 feet or less from the mineralized zone and not more than 400 feet apart.

Figure 2

Mine Unit 1
Baseline Restoration Wells



Baseline Restoration Wells
1 Acre Baseline Coverage

CROW BUTTE PROJECT
Mine Unit 1
Baseline Restoration Wells
Sec 19 T31N R51W

0 50 meters
0 50 100 150 200 feet
N

A minimum of three samples are collected at two-week intervals from each of the restoration, shallow monitor, and perimeter monitor wells to determine baseline groundwater quality. Based on the results of the shallow and perimeter monitor wells, upper control limits (UCLs) are established for each mine unit. The results of restoration well sampling are used to establish the restoration goals for that mine unit.

For Mine Unit 1, twelve wells were used to determine baseline restoration goals. These wells are designated PM-1 (PR-4), PM-4, PM-5, PT-5 (PR-2), PT-9 (PR-8), IJ-6, IJ-13, IJ-25, IJ-28, IJ-45, PR-15, and PR-19 and are shown in Figure 2. Many of these wells were completed before 1990 during operation of the pilot plant. Therefore, additional analytical data was available to determine baseline for these wells. Table 1 provides specific information on each well concerning the data that was used for determination of average baseline restoration goals.

Table 1: Wells Used to Establish Mine Unit 1 Baseline Groundwater Quality

Well Number	Formation	Dates Sampled	Number of Analyses
PT-5	Chadron	1985	4
PT-9	Chadron	1982 – 1984	7
PM-1	Chadron	1982 – 1990	25
PM-4	Chadron	1982 – 1990	25
PM-5	Chadron	1985 – 1990	19
IJ-6	Chadron	1990	3
IJ-13	Chadron	1990	3
IJ-25	Chadron	1990	3
IJ-28	Chadron	1990	3
IJ-45	Chadron	1990	3
PR-15	Chadron	1990	3
PR-19	Chadron	1990	3

PM-1 and PT-5 were relabeled later when they were used as mining wells. They became PR-4 and PR-2 respectively. In addition by the end of mining, PT-9 had become non-functional and was unable to be sampled. Therefore, CBR requested and received permission from NDEQ and NRC to replace PT-9 with PR-8. Copies of the letters regarding this matter are attached in Appendix 1.

CBR is required to determine the baseline groundwater quality for a list of 35 water quality parameters. The baseline average for each well is determined for each parameter. These well averages are then used to determine the overall mine unit average for each parameter. Table 2 lists each of the parameters and the average concentration for Mine Unit 1.

Table 2 also lists the standard deviation of the well averages for each parameter. Where a standard deviation is not listed, this is due to analytical results that were less than the reporting level for that parameter. In these cases, the numerical value of the reporting level was used to determine the average. A tabular presentation of the baseline average for each restoration well is contained in Appendix 2. Copies of the laboratory reports were previously submitted to NRC.

Table 2: Baseline Groundwater Quality Data for Mine Unit 1

Parameter	MU-1 Baseline	MU-1 Standard Deviation
Alkalinity (mg/l)	294	20
Ammonium (mg/l)	<0.37	
Arsenic (mg/l)	<0.002	
Barium (mg/l)	<0.1	
Bicarbonate (mg/l)	344	26
Boron (mg/l)	0.93	0.04
Cadmium (mg/l)	<0.006	
Calcium (mg/l)	12.5	3.2
Carbonate (mg/l)	7.2	3.9
Chloride (mg/l)	203.9	38
Chromium (mg/l)	<0.03	
Copper (mg/l)	<0.017	
Fluoride (mg/l)	0.69	0.04
Iron (mg/l)	<0.044	
Lead (mg/l)	<0.031	
Magnesium (mg/l)	3.2	0.8
Manganese (mg/l)	<0.011	
Mercury (mg/l)	<0.001	
Molybdenum (mg/l)	<0.069	
Nickel (mg/l)	<0.034	
Nitrate (mg/l)	<0.05	
Nitrite (mg/l)	<0.01	
pH (Std. Units)	8.46	0.2

Table 2: Baseline Groundwater Quality Data for Mine Unit 1

Parameter	MU-1 Baseline	MU-1 Standard Deviation
Potassium (mg/l)	12.5	1.5
Radium-226 (pCi/L)	229.7	177.1
Selenium (mg/l)	<0.003	
Silica (mg/l)	16.7	3.5
Sodium (mg/l)	412	19.2
Specific Conductivity (µmho/cm)	1947	70
Sulfate (mg/l)	356	9.4
TDS (mg/l)	1170.2	47.6
Uranium (mg/l)	0.092	0.089
Vanadium (mg/l)	<0.066	
Zinc (mg/l)	<0.036	

2.3 Establishment of Restoration Goals

The goal of restoration is to reduce the concentration of mobilized constituents remaining in the groundwater after the completion of mining. CBR is required to return groundwater quality to baseline as a primary goal under SUA-1534.

If baseline concentrations for the monitored parameters cannot be achieved through the reasonable application of best practicable technology, the NRC secondary goal is to return the water quality to levels consistent with pre-mining class-of-use. These secondary restoration goals are based upon standards set by the NDEQ in CBR's UIC permit.

For those parameters that have a numerical groundwater standard established in Title 118 of the NDEQ Rules and Regulations[1] or in other established documents, the UIC Permit requires restoration to successfully return the groundwater to that standard. However, if the baseline preoperational mean for the mine unit exceeds the standard for any parameter, the restoration standard for that parameter is set at the baseline mean plus two standard deviations. For those parameters where no standard is established in Title 118, the UIC restoration standard is calculated from the baseline average. In the case of calcium, potassium, magnesium and sodium, the restoration standard is set at one order of magnitude above the baseline mean due to the ability of some major ions to vary by this amount depending on the pH. Total carbonate is limited to 50 percent of the total dissolved solids (TDS) value. TDS is limited to the baseline mean plus one standard deviation.

If a groundwater parameter cannot be restored to its NRC primary or secondary goal after reasonable restoration efforts, then it must be demonstrated that leaving the parameter at a higher concentration would not be a threat to public health and safety and that, on a parameter-by-parameter basis, water use would not be significantly degraded. Approval of the use of an alternate standard for a parameter would require amendment of SUA-1534.

Table 3 provides the restoration goals for Mine Unit 1. The baseline concentration (NRC primary goal) is listed for each parameter. The wellfield standard deviation is also provided since it is used to calculate some of the UIC standards for which there is no standard in Title 118. The restoration standard from the UIC Permit for each parameter is also listed. Where no UIC Permit standard is listed, these parameters are included in CBR's NRC Source Materials License but are not considered a parameter of concern in the UIC permit.

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1 *Title 118 – Ground Water Quality Standards and Use Classification*, NDEQ July 29, 1996.

Table 3: Mine Unit 1 Restoration Goals

Parameter	Baseline Average (Primary Goal)	Standard Deviation	UIC Permit Standard
Alkalinity	293	20	None
Ammonium (mg/l)	<0.37		10
Arsenic (mg/l)	<0.002		0.05
Barium (mg/l)	<0.1		1.00
Bicarbonate (mg/l)	344	26	None
Boron (mg/l)	0.93	0.04	None
Cadmium (mg/l)	<0.006		0.01
Calcium (mg/l)	12.5	3.2	125
Carbonate (mg/l)	7.2	3.9	None
Chloride (mg/l)	203.9	36.0	250
Chromium (mg/l)	<0.03		None
Copper (mg/l)	<0.017		1.00
Fluoride (mg/l)	0.69	0.04	4.00
Iron (mg/l)	<0.044		0.30
Lead (mg/l)	<0.031		0.05
Magnesium (mg/l)	3.2	0.8	32
Manganese (mg/l)	<0.011		0.05
Mercury (mg/l)	<0.001		0.002
Molybdenum (mg/l)	<0.069		1.00
Nickel (mg/l)	<0.034		0.15
Nitrate (mg/l)	<0.05		10.0
Nitrite (mg/l)	<0.01		None
pH (Std. Units)	8.46	0.2	6.5 – 8.5

Table 3: Mine Unit 1 Restoration Goals

Parameter	Baseline Average (Primary Goal)	Standard Deviation	UIC Permit Standard
Potassium (mg/l)	12.5	1.5	125
Radium-226 (pCi/l)	229.7	177.1	584
Selenium (mg/l)	<0.003		0.01
Silica (mg/l)	16.7	3.5	None
Sodium (mg/l)	412	19.2	4122
Specific Conductivity (µmho/cm)	1947	70	None
Sulfate (mg/l)	356	9.4	375
TDS (mg/l)	1170.2	47.6	1218
Uranium (mg/l)	0.092	0.089	5.0
Vanadium (mg/l)	<0.066		0.2
Zinc (mg/l)	<0.036		5.00

2.4 History of Mining Activities

Commercial operation of Mine Unit 1 began in April 1991. Mining was completed in March 1994 and restoration was begun. During the course of mining and development of adjacent areas, other Mine Units absorbed the original Mine Unit 1 perimeter monitor wells.

2.5 Mine Unit 1 Excursions

Mine Unit 1 did not have any shallow or perimeter monitor wells on excursion status during mining or during restoration. As noted in Section 2.4, all perimeter monitor wells were absorbed into adjacent Mine Units. Consequently, no additional wells need to be added to the BLR well list as required in the UIC permit.

2.6 Determination of Post-Mining Water Quality

Before commencing restoration activities, CBR establishes post mining water quality data for all of the required parameters. For Mine Unit 1, this consisted of sampling the designated wells and having each sample analyzed for the water quality parameters.

Mine Unit 1 was shut in on March 14, 1994. The twelve restoration wells were sampled on March 23, 1994. These samples were split with the NDEQ. Table 4 contains the results of the post-mining water quality for Mine Unit 1. The laboratory reports for these samples are contained in Appendix 3.

Table 4: Post Mining Water Quality for Mine Unit 1 Restoration Well Sampling

	PM-1	PM-4	PM-5	PT-5	IJ-6	IJ-13	IJ-25	IJ-28	IJ-45	PR-8	PR-15	PR-19
Water Quality Parameters												
Calcium (mg/l)	87.9	87.1	80.8	87.9	87.6	93.9	89.4	89.6	89.9	85.4	86.7	98.3
Magnesium (mg/l)	22.6	20.6	22.7	23.8	21.4	23.9	22.5	23.1	24.8	23.2	23.1	23.8
Sodium (mg/l)	1154	942	1054	1144	1054	1174	1177	1182	1126	1144	1172	1083
Potassium (mg/l)	32.7	26.3	30	30	27.2	31.3	30	31.3	32.7	30	30	28.6
Carbonate (mg/l)	0	0	0	0	0	0	0	0	0	0	0	0
Bicarbonate (mg/l)	1099	900	972	981	1057	1086	1111	1207	1104	1170	1170	959
Sulfate (mg/l)	1109	959	1115	1240	1031	1209	1119	1112	1134	1115	1115	1283
Chloride (mg/l)	598	455	586	594	544	598	594	619	607	603	603	590
Ammonium (mg/l)	0.33	0.67	0.14	0.33	0.44	0.07	< 0.05	< 0.05	0.33	0.27	0.15	0.49
Nitrate (mg/l)	1.06	< 0.1	0.97	0.99	1.29	0.74	0.86	1.3	1.25	1.46	1.6	0.46
Fluoride (mg/l)	0.37	0.26	0.54	0.45	0.45	0.37	0.38	0.45	0.43	0.43	0.4	0.35
TDS (mg/l)	3694	3121	3756	3851	3515	3899	3751	3886	3873	3820	3807	3765
Conductivity (µmho/cm)	5843	4841	5590	5964	5445	6012	5807	6025	5916	5819	5940	5819
Alkalinity as $CaCO_3$ (mg/l)	901	738	797	804	866	890	911	989	905	959	959	786
pH (Std. units)	7.65	6.87	6.85	7.28	7.16	7.35	7.65	7.81	7.37	7.46	7.78	6.92

Table 4: Post Mining Water Quality for Mine Unit 1 Restoration Well Sampling

	PM-1	PM-4	PM-5	PT-5	IJ-6	IJ-13	IJ-25	IJ-28	IJ-45	PR-8	PR-15	PR-19
Trace Metals												
Arsenic	0.018	0.007	0.018	0.017	0.031	0.028	0.02	0.028	0.023	0.028	0.024	0.011
Barium (mg/l)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Boron (mg/l)	1.17	1.44	1.09	1.36	1.06	1.26	1.13	1.19	1.15	1.23	1.25	1.17
Cadmium (mg/l)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chromium (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper (mg/l)	< 0.01	< 0.01	0.05	< 0.01	0.02	< 0.01	< 0.01	< 1	< 0.01	< 0.01	< 0.01	< 0.01
Iron (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.38
Lead (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Manganese (mg/l)	0.02	0.11	0.05	0.04	0.14	0.15	0.08	0.06	0.06	0.02	< 0.01	0.16
Mercury (mg/l)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum (mg/l)	0.6	0.2	0.42	0.53	0.47	0.5	0.56	0.54	0.53	0.59	0.53	0.37
Nickel (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.12	0.12	0.12	< 0.05	< 0.05	< 0.05	< 0.05
Selenium (mg/l)	0.139	0.012	0.129	0.24	0.112	0.122	0.1	0.138	0.149	0.154	0.148	0.041
Vanadium (mg/l)	1	0.1	0.38	1.15	1.12	1.18	1.03	1.24	1.29	1.23	1.56	0.28
Zinc (mg/l)	< 0.01	0.14	0.11	0.01	0.11	0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Table 4: Post Mining Water Quality for Mine Unit 1 Restoration Well Sampling

	PM-1	PM-4	PM-5	PT-5	IJ-6	IJ-13	IJ-25	IJ-28	IJ-45	PR-8	PR-15	PR-19
Radionuclides												
Uranium (mg/l)	8.63	6.29	54.52	9.3	13.9	9.31	9.9	2.52	14.83	5.24	5.18	6.78
Ra-226 (pCi/l)	370	126	329	1139	1113	1558	1258	1147	681	417	109	1182

3 MINE UNIT 1 RESTORATION

Restoration activities include four steps that are designed to optimize restoration equipment used in treating groundwater and to minimize the number of pore volumes circulated during the restoration stage. CBR monitors the quality of selected wells during restoration to determine the efficiency of the operations and to determine if additional techniques are necessary.

3.1 Groundwater Transfer

During the groundwater transfer step, water may be transferred between the mine unit commencing restoration and a mine unit commencing operations. Baseline quality water from the mine unit starting production may be pumped and injected into the mine unit in restoration. The higher TDS water from the mine unit in restoration may be recovered and injected into the mine unit commencing production. The direct transfer of water will act to lower the TDS in the mine unit being restored by displacing water affected by mining with baseline quality water.

The goal of groundwater transfer is to blend the water in the two mine units to conserve process chemicals and reduce waste production. The recovered water may be passed through ion exchange columns and filtration during this step if suspended solids are sufficient in concentration to present a problem with blocking the injection well screens. For the groundwater transfer to occur, a newly constructed mine unit must be ready to commence mining.

The ground water transfers took place in five stages. The first two transfers were conducted independent of other restoration activities, while the last three were run concurrent with the groundwater treatment stage. In four of the groundwater transfers, the transfers were in both directions. This means baseline quality water from a new wellfield was pumped into Mine Unit 1, while lixiviant was pumped out of Mine Unit 1 to a newly constructed wellfield. In order to have a direct transfer of baseline quality water to Mine Unit 1, 2-inch high-density polyethylene (HDPE) lines were laid above ground to each new wellfield that was ready for start up. These lines were connected from the individual producers of the new wellfield to the injectors in Mine Unit 1. The producers from Mine Unit 1 were pumped through ion exchange columns to remove residual uranium before pumping the solution to the injectors of the new wellfield. During these operations, Mine Unit 1 flow rates were balanced to prevent the migration of lixiviant from the surrounding mine units. As each producer in the new wellfield showed signs of lixiviant breakthrough, they were shut in and new unaffected wells were brought on line. This continued until all of the producers in the new wellfield had

been affected. A producer was considered affected if it showed higher than baseline conductivity or an increase in headgrade.

The fifth transfer was from one producer in Wellhouse 17. This transfer was a one-way transfer where baseline quality water was pumped into Mine Unit 1. This transfer was used to help balance Mine Unit 1 during a portion of the Reverse Osmosis (RO) phase of groundwater treatment.

During the first transfer, the baseline water was pumped into the injection wells situated along the boundaries between Mine Unit 1 and Mine Units 2 and 3. Successive transfers worked inward towards the center of Mine Unit 1. Figures 3 through 6 show the wells used during each transfer. The quality of the groundwater following each of the first four transfers was tracked using six of the twelve BLR wells for Mine Unit 1. The parameters used were chloride, sulfate, sodium, conductivity, and alkalinity. These parameters were chosen simply because they could be assayed on site. They were used only as a general guide. The benefits of the transfers can be seen in the average water quality data of the selected wells as presented in Appendix 4. The groundwater transfers improved the quality of the water in Mine Unit 1 without sending a large amount of water to the waste disposal system.

As noted, Mine Unit 1 was shut in on March 14, 1994. This corresponded with the approval of mining operations in Mine Unit 4. In April and May 1994 groundwater sweep activities were begun as described in Section 3.2.

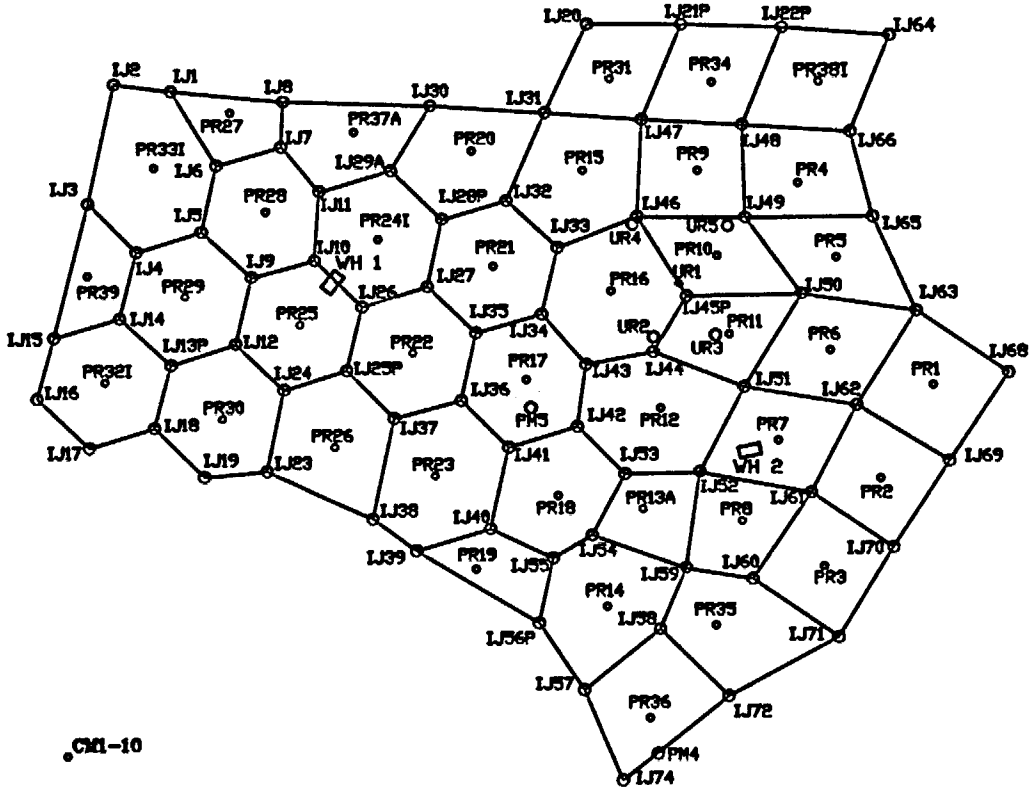
Data for the five steps of groundwater transfer are as follows:

- In late May and June of 1994, 3,640,590 gallons (0.21 pore volumes) were transferred between Mine Unit 1 and Wellhouse 10 in Mine Unit 4.
- In August and September of 1994, 2,942,980 gallons (0.17 pore volume) were transferred between Mine Unit 1 and Wellhouse 11 in Mine Unit 4.
- In November and December of 1994, 3,314,915 gallons (0.19 pore volumes) were transferred between Mine Unit 1 and Wellhouse 12 in Mine Unit 4.
- In April and May 1995, 4,217,689 gallons (0.25 pore volumes) were transferred between Mine Unit 1 and Wellhouse 13 in Mine Unit 4.
- From May 1997 to July 1997, a total of 1,077,530 gallons (0.06 pore volumes) were transferred between Mine Unit 1 and P1100-17.

These separate groundwater transfer steps resulted in a total of 15,193,704 gallons or 0.89 pore volumes transferred from Mine Unit 1 to Mine Unit 4.

Figure 3

Mine Unit 1
Water Transfer Wells
May - June 1994



Production Wells

Injection Wells

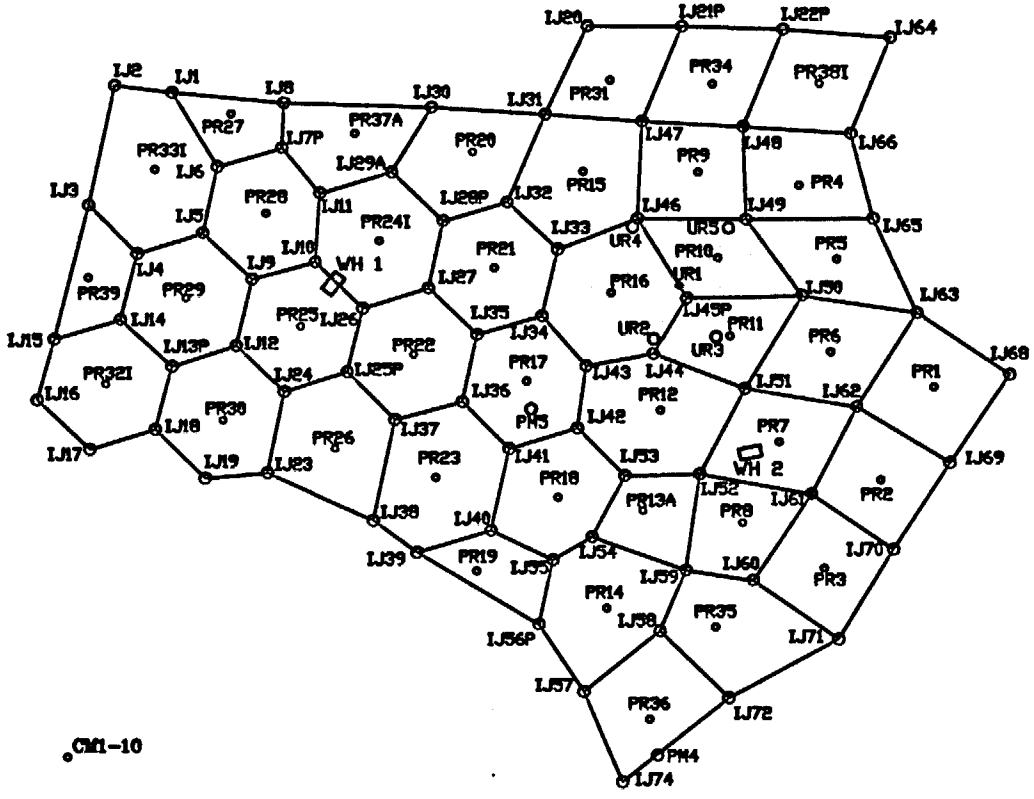
CROW BUTTE PROJECT
Mine Unit 1
Water Transfer #1
Sec 19 T31N R51W

0 50 meters
0 50 100 150 200 feet
N

Figure 4

Mine Unit 1
Water Transfer Wells

August - September 1994



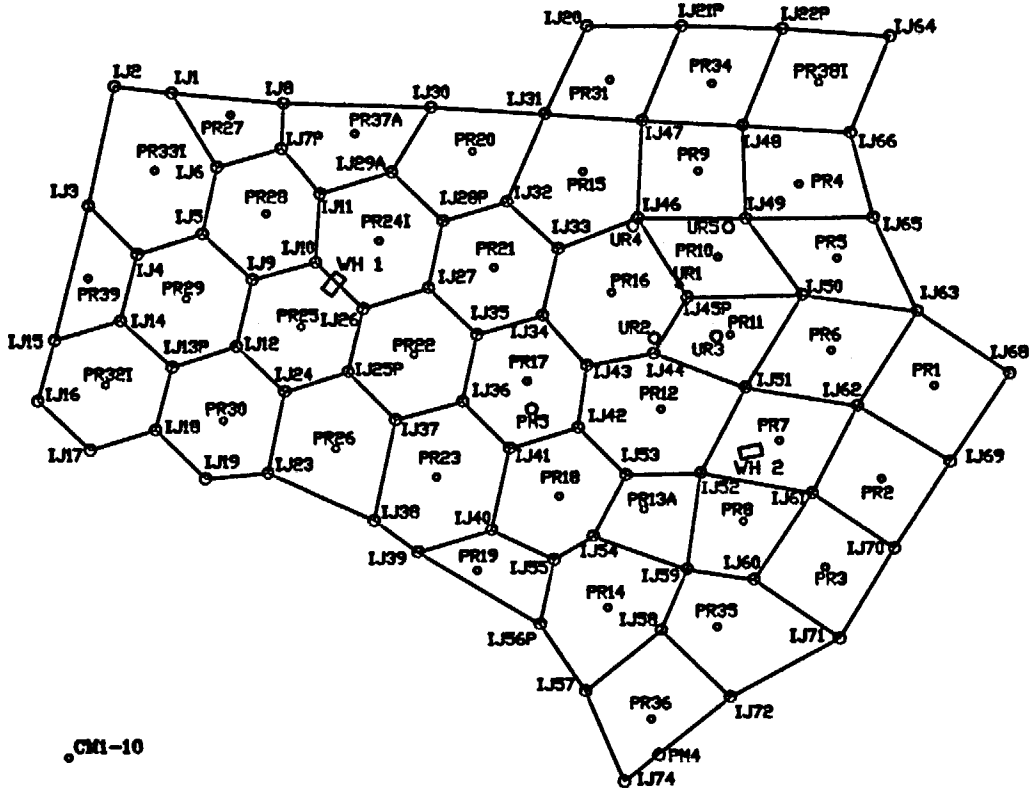
CROW BUTTE PROJECT
Mine Unit 1
Water Transfer #2
Sec 19 T31N R51W

0 50 meters
0 50 100 150 200 feet
N

INT-021A

Figure 5

Mine Unit 1
Water Transfer Wells
November - December 1994



Production Wells

Injection Wells

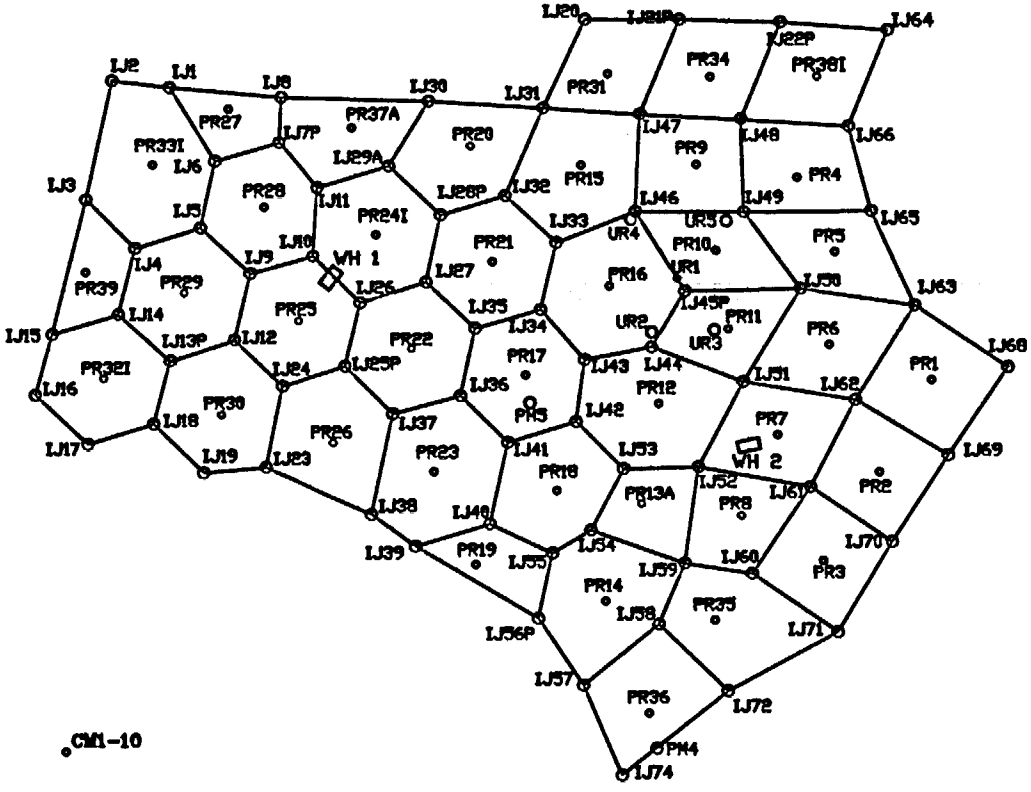
CROW BUTTE PROJECT
Mine Unit 1
Water Transfer #3
Sec 19 T31N R51W

0 50 meters
0 50 100 150 200 feet
N

Figure 6

Mine Unit 1
Water Transfer Wells

May - June 1995



Production Wells

Injection Wells

CROW BUTTE PROJECT
Mine Unit 1
Water Transfer #4
Sec 19 T3IN R51W

0 50 meters
0 50 100 150 200 feet
N

3.2 Groundwater Sweep

During groundwater sweep, water is pumped without injection from the wellfield causing an influx of baseline quality water from the perimeter of the mining unit that sweeps the affected portion of the aquifer. The cleaner baseline water has lower ion concentrations that act to strip off the cations that have attached to the clays during mining. The plume of affected water near the edge patterns of the wellfield is also drawn into the boundaries of the mine unit.

During the groundwater sweep stage, one producer, IJ28P-1, was on line pumping at an average flow rate of 13 gallons per minute (gpm). This well was an injection well, which had been converted to a producer. The well was producing without injection. The main purpose of this well was to control the migration of mining solutions from Mine Unit 1 to the north and south of the mine unit. Ordinarily, groundwater sweep would be used to pull baseline quality water inside the perimeter of the mine unit. This would be the method for restoring any affected groundwater between the monitor wells and the wellfield. However, it is apparent from the location map in Figure 1 that this type of approach would not work for Mine Unit 1. At the time groundwater sweep was performed, Mine Unit 1 was surrounded on three sides by active mine units. Any attempt to do a complete groundwater sweep for Mine Unit 1 would only result in bringing in contaminated water from the other mine units. In addition, all of the Mine Unit 1 monitor wells had been discontinued from service as monitoring wells. They were removed from service as the other wellfields were brought on line. Based on this situation, the groundwater sweep effort for Mine Unit 1 was kept to a minimum.

The open areas to the north and south of Mine Unit 1 will require restoration at some point in time. CBR's future restoration plans include clean up of these areas with the restoration of the mine units surrounding Mine Unit 1.

Active restoration of Mine Unit 1 began with groundwater sweep activities. In April and May 1994, a total of 1,139,299 gallons (0.06 pore volumes) of groundwater sweep was removed from Mine Unit 1 production wells and sent to the plant production circuit. Additional groundwater sweep to main production was also performed in July 1994. The total volume for July 1994 was 569,650 gallons (0.03 pore volumes). These two periods of groundwater sweep resulted in a total of 1,708,949 gallons (0.10 pore volumes) of groundwater sweep during restoration of Mine Unit 1.

3.3 Groundwater Treatment

Following groundwater sweep and the initial groundwater transfers, water is pumped from production wells to treatment equipment and then reinjected into the wellfield. Ion exchange and RO treatment equipment are utilized during this stage as shown in Figure 7. The ion exchange step uses fixed bed downflow ion exchange columns located at the main plant.

Water recovered from restoration containing a significant amount of uranium may be passed through the ion exchange system. The ion exchange columns exchange the majority of the contained soluble uranium for chloride or sulfate. Once the solubilized uranium is removed, a small amount of reductant is metered into the restoration wellfield injection to reduce any pre-oxidized minerals. The concentration and type of trace elements encountered determine the concentration of reductant injected into the formation. The goal of reductant addition is to reduce those minerals that are solubilized by carbonate complexes to prevent build-up of dissolved solids, which would increase the time required to complete restoration.

A portion of the restoration recovery water can be sent to the RO unit. The use of a RO unit has several effects:

- Reduces the total dissolved solids in the contaminated groundwater;
- Reduces the quantity of water that must be removed from the aquifer to meet restoration limits;
- Concentrates the dissolved contaminates in a smaller volume of brine to facilitate waste disposal; and
- Enhances the exchange of ions from the formation due to the large difference in ion concentration.

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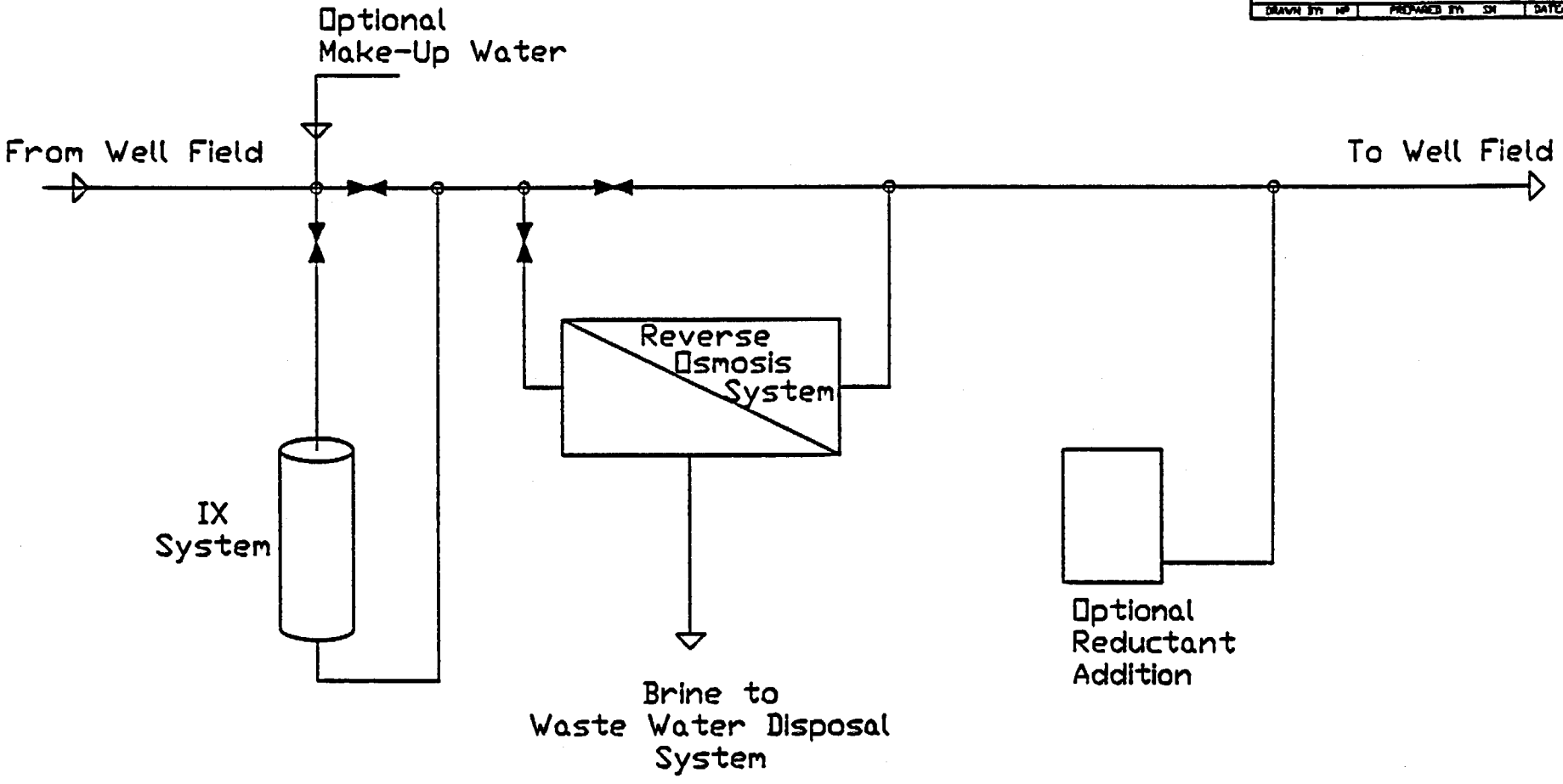
CROW BUTTE PROJECT
Dawes County, Nebraska

REV	DESCRIPTION	BY	DATE

Commercial Process Plant

RESTORATION FLOW SHEET

DRAWN BY: MP | PREPARED BY: SM | DATE: 3/99



Before the RO unit is used to process the water, the soluble uranium is removed by the ion exchange system. The water is then filtered, the pH lowered for decarbonation to prevent calcium carbonate plugging of the membranes (this step is needed for cellulose acetate membranes only), and then pressurized by a pump. The RO unit contains membranes that pass about 60 to 80 percent of the water through, leaving 60 to 90 percent of the dissolved salts in the water that will not pass the membrane. Table 5 shows typical manufacturers specification data for removal of ion constituents. The clean water, called permeate, is reinjected, sent to storage for use in the mining process, or sent to the waste disposal system. The twenty to forty percent of water that is rejected, referred to as the brine, contains the majority of dissolved salts that contaminate the groundwater and is sent for disposal in the wastewater system. The brine stream that is bled to disposal also results in a groundwater sweep that pulls unaffected groundwater into the mine unit. However, because other active mine units border Mine Unit 1 as discussed above, a large groundwater sweep program was precluded. Therefore, Mine Unit 1 was operated as close to balanced as possible during RO operations. Clean water from several different sources was used to make up for the rejected brine.

The sodium sulfide reductant that may be added to the injection stream during this stage will reduce the oxidation-reduction potential (Eh) of the aquifer. During mining operations certain trace elements are oxidized. By adding a reductant, the Eh of the aquifer is lowered thereby decreasing the solubility of these elements.

The number of pore volumes treated and re-injected during the groundwater treatment stage depends on the efficiency of the RO unit in removing total dissolved solids and the reductant in lowering the uranium and trace element concentrations.

The groundwater treatment stage of restoration evolved slowly over time as additional equipment and piping were installed. Initially, groundwater treatment consisted of circulating Mine Unit 1 water through ion exchange columns (IX). The second step was to add treatment of the water with RO. The final step involved the addition of sodium sulfide reductant to the injection stream to Mine Unit 1.

Table 5: Typical Reverse Osmosis Membrane Rejection

NAME	SYMBOL	% REJECTION
	Cations	
Aluminum	Al^{+3}	99+
Ammonium	NH_4^{+1}	88-95
Cadmium	Cd^{+2}	96-98
Calcium	Ca^{+2}	96-98
Copper	Cu^{+2}	98-99
Hardness	Ca and Mg	96-98
Iron	Fe^{+2}	98-99
Magnesium	Mg^{+2}	96-98
Manganese	Mn^{+2}	98-99
Mercury	Hg^{+2}	96-98
Nickel	Ni^{+2}	98-99
Potassium	K^{+1}	94-96
Silver	Ag^{+1}	94-96
Sodium	Na^{+}	94-96
Strontium	Sr^{+2}	96-99
Zinc	Zn^{+2}	98-99
	Anions	
Bicarbonate	HCO_3^{-1}	95-96
Borate	$B_4O_7^{-2}$	35-70
Bromide	Br^{-1}	94-96
Chloride	Cl^{-1}	94-95
Chromate	CrO_4^{-2}	90-98
Cyanide	CN^{-1}	90-95
Ferrocyanide	$Fe(CN)_6^{-3}$	99+
Fluoride	F^{-1}	94-96
Nitrate	NO_3^{-1}	95
Phosphate	PO_4^{-3}	99+
Silicate	SiO_2^{-1}	80-95
Sulfate	SO_4^{-2}	99+
Sulfite	SO_3^{-2}	98-99
Thiosulfate	$S_7O_3^{-2}$	99+

The method employed by CBR during the restoration of Mine Unit 1 was restoration on a pattern-by-pattern basis. In this method, the producer of each pattern in Mine Unit 1 was brought on line to the restoration circuit and then permeate from the RO unit(s) (usually with reductant added) was circulated to every injector in that pattern to recreate the original flowpaths developed during mining. This was to ensure that the mining solutions were displaced or diluted.

Full water quality analyses of seven of the first restored patterns showed that conductivity could be used as a suitable indicator of successful restoration. The results from these analyses are contained in Appendix 5. Therefore, when the conductivity of the producer was reduced to below baseline conductivity, the pattern was considered restored.

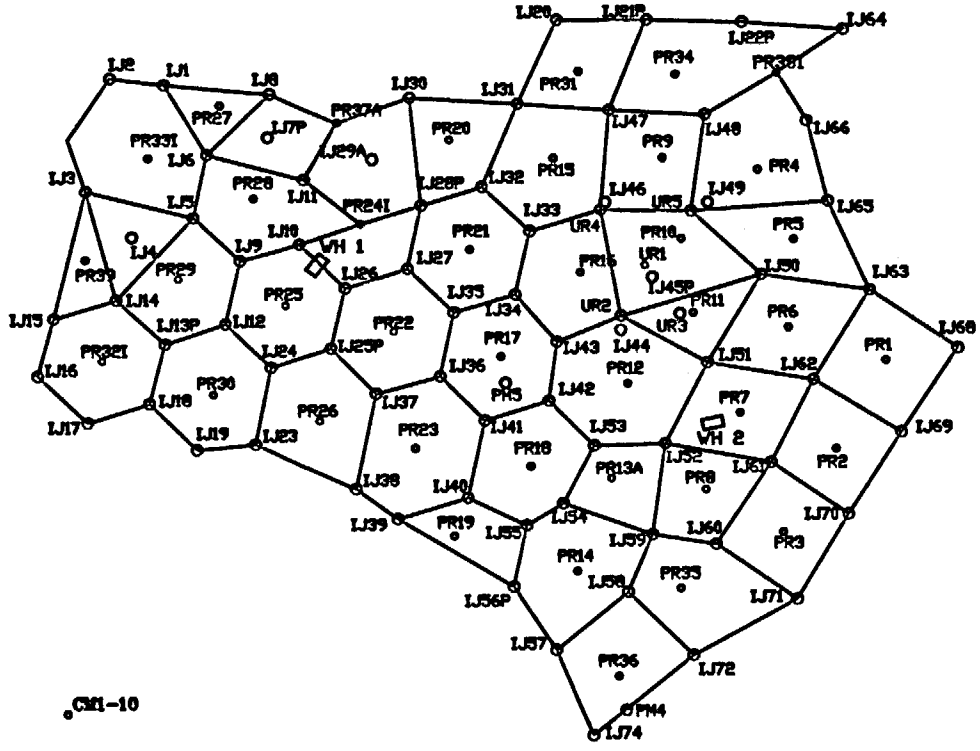
The flowrates during groundwater treatment were balanced to prevent the migration of lixiviant from the surrounding wellfields into Mine Unit 1. There were thirty-nine original patterns in Mine Unit 1. The actual number of patterns restored was thirty-nine. During mining, a few producers became unusable; therefore, injectors were used in their place to restore the pattern.

3.3.1 Ion Exchange Treatment

Groundwater treatment in Mine Unit 1 began on September 12, 1994 with ion exchange operations. Treatment through the ion exchange columns without RO operation was performed through September 1995. After RO treatment was begun, ion exchange treatment was continued for a portion of the restoration flow. During recirculation as discussed in Section 3.4, ion exchange treatment was continued for residual uranium removal. The total volume treated by ion exchange was 456,946,618 gallons (26.62 pore volumes). The average treatment flow rate during this ion exchange phase was 420 gpm.

The purpose for groundwater treatment through the restoration ion exchange columns was to reduce the amount of soluble uranium as much as possible. This was performed before beginning treatment with the RO unit(s). To do this, between 17 and 20 higher headgrade producers were online throughout the wellfield. Figure 8 illustrates which wells were online during the period with the highest flowrate. The results of this operation can be seen in the drop in average headgrade. At the beginning in September of 1994, the average headgrade was approximately 22 ppm. At the end of this phase of groundwater treatment, the average headgrade of the online producers had been lowered to approximately 9 ppm.

Figure 8
Mine Unit 1
Ion Exchange Treatment Wells
April 4, 1995



CROW BUTTE PROJECT
Mine Unit 1
Ion Exchange Treatment Wells
Sec 19 T31N R51W

0 50 100 150 200 feet
0 20 meters
N

3.3.2 Ion Exchange and Reverse Osmosis Treatment

On September 28, 1995, treatment with RO was begun at a flow rate of 45 gpm. Groundwater treatment operations with the ion exchange columns were also continued. From October 1995 through July 1998, treatment with ion exchange and RO was performed. During this period, a total of 103,413,312 gallons (6.02 pore volumes) were treated through the RO units.

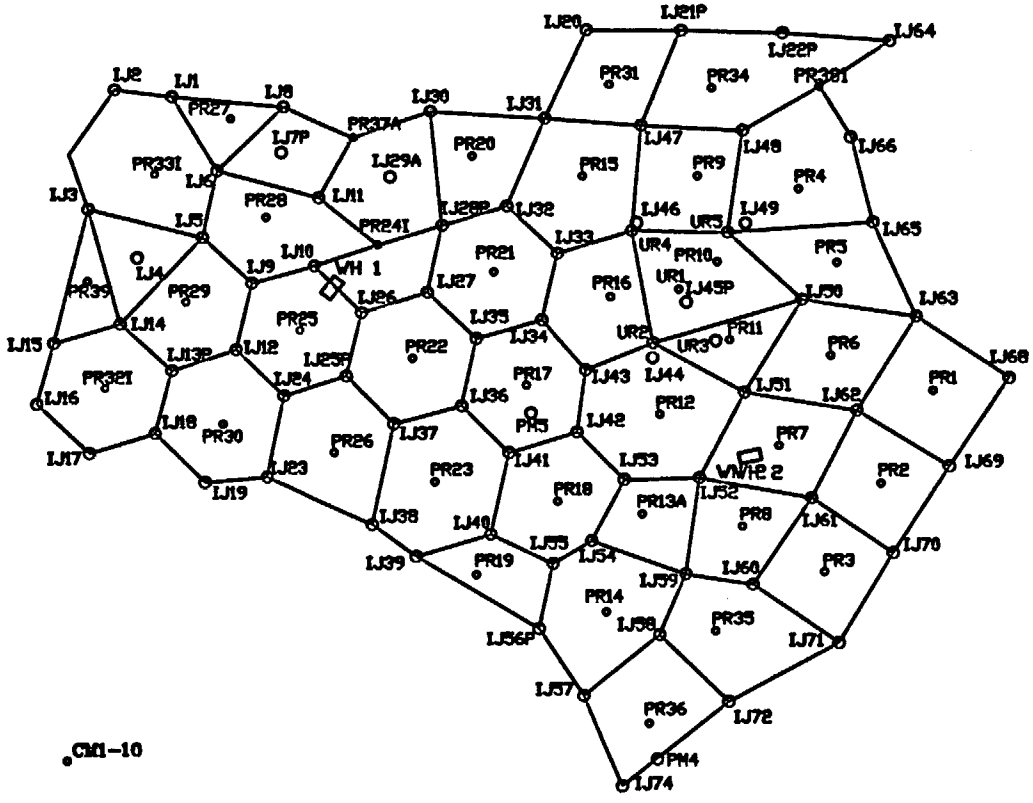
The unit used during the initial stage of restoration was a cellulose acetate membrane RO with a 50-gpm capacity. This RO was designated RO Unit 1. The initial RO capacity determined the method that CBR used to restore Mine Unit 1. Restoration was accomplished on a pattern-by-pattern basis. The method consisted of restoring a pattern and then moving to another pattern. By the end of groundwater treatment, all patterns in Mine Unit 1 had been restored with RO permeate. Figure 9 shows the final Mine Unit 1 wellfield configuration and the patterns restored by RO. Table 6 lists each production well, the total pore volumes of combined RO treatment for the associated pattern, and the final conductivity.

The final configuration of Mine Unit 1 was the result of changes during mining operations such as well reversals. A well reversal occurred when an injection well was converted to a producer and vice versa. This type of reversal was necessary for some patterns in restoration since the producer was no longer operational. Therefore, the pattern was restored using an injector. An example of this is the pattern formed by PR-16. When viewing Figure 9, it appears as if this pattern was not covered during RO restoration. PR-16 developed problems during mining, which prevented it from being used during restoration. IJ-33 was reversed with PR-16 to restore this pattern. Permeate was added to the injectors on the opposite side of the pattern in order to pull the solution across PR-16. This type of operation was used to restore PR-5 (IJ-49 as producer) and PR-14 (IJ-56P as producer).

In other cases, if a reversal had been performed and the producer was still operational, it was used as an injector to enhance restoration. PR-21, PR-32, and PR-38 are examples of patterns restored in this manner.

Figure 9

Mine Unit 1
R O Restoration Patterns



CM1-1
CM1-2
CM1-3
CM1-4
CM1-5
CM1-6
CM1-7
CM1-8
CM1-9
CM1-10
CM1-11

Production Wells

CROW BUTTE PROJECT
Mine Unit 1
R O Restoration Patterns
Sec 19 T31N R51W

0 50 meters
0 50 100 150 200 feet
N

Table 6: Restoration Pattern Final RO Pore Volumes and Conductivity

Well Number	Cumulative Pore Volume	Final Conductivity (µmho/cm)
PR1	2.4	1813
PR2	25.8	1890
PR3	1.9	1803
PR4	5.8	867
PR6	6.6	1852
PR7	1.9	1730
PR8	14.9	712
PR9	2.9	1743
PR11	1.2	1646
PR12	3.9	1582
PR13a	3.9	1624
PR15	7.4	1834
PR17	5.6	1780
PR18	4.8	1871
PR19	34.4	1748
PR20	9.9	1660
PR22	5.2	1858
PR23	1.9	1664
PR26	0.7	1651
PR27	12.9	1625
PR28	11.1	1799
PR29	21.3	1929
PR30	5.4	1842
PR31	1.0	1602
PR33	4.5	1200
PR34	8.4	1938
PR35	4.7	1702
PR36	7.5	1928
PR39	17.4	835
IJ7p	4.0	1373
IJ13p	20.4	2520
IJ25p	5.2	1786
IJ28p	4.5	1685
IJ29p	1.1	1374
IJ33p	2.0	931
IJ45p	10.0	1637
IJ49p	2.9	1738
IJ56p	15.6	2000

The number of patterns in RO restoration at any given time was dependent upon RO flow capacity. Therefore, when RO Unit 1 was brought on line, only two patterns were selected for RO restoration. At the same time, 11 to 13 other patterns were online to ion exchange treatment. As restoration progressed, new RO units were constructed. Eventually RO Unit 1 was shut down and replaced with three thin film membrane RO units. The flow capacity with these three new RO units was 200 gpm, so at the end of groundwater treatment for Mine Unit 1, there were nine patterns in RO restoration.

In addition to newer and better RO units, new restoration pipelines were installed which provided increased flow capacity and more versatile flow arrangements. This allowed for more efficient RO operations. These improvements to the restoration system should significantly reduce the number of pore volumes for the restoration of future mine units.

3.3.3 Reductant Addition

In April 1996 the addition of sodium sulfide as a reductant was begun in Mine Unit 1. Groundwater treatment continued through the ion exchange and RO systems with reductant addition through July 1998.

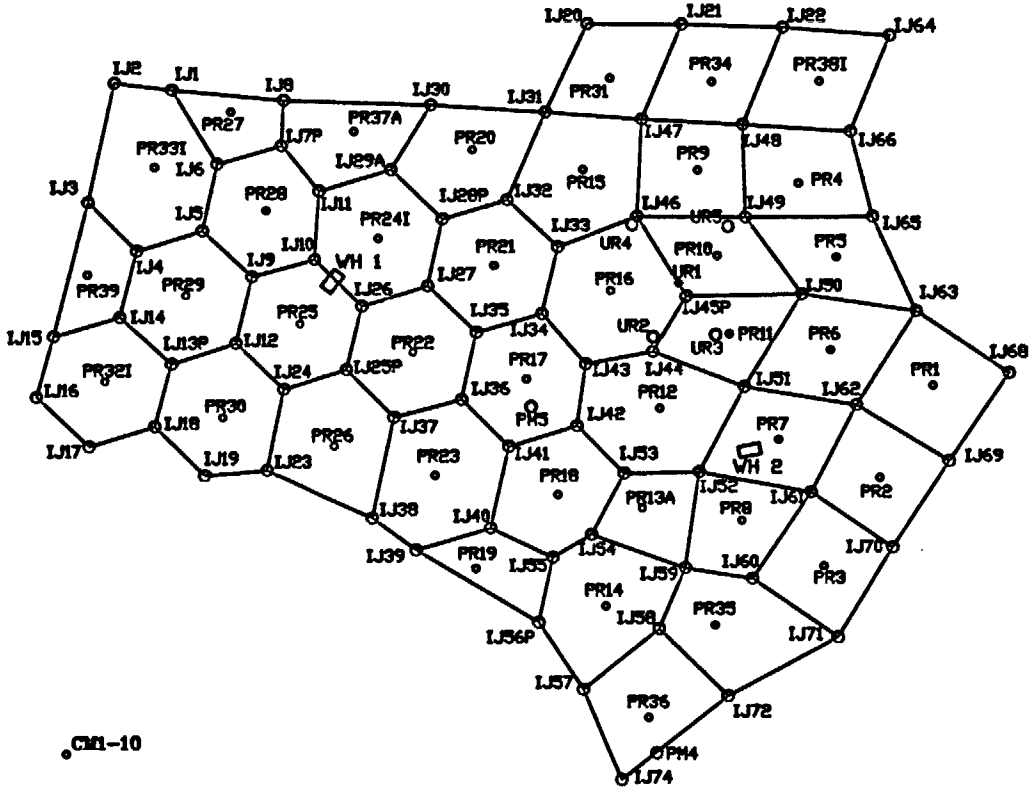
3.4 Wellfield Recirculation

At the completion of the groundwater treatment stages, wellfield recirculation may be initiated. In order to homogenize the aquifer, pumping from the production wells and re-injecting the recovered solution into injection wells can be performed to recirculate solutions.

Mine Unit 1 was placed in recirculation on August 19, 1998. Figure 10 depicts the wells that were used to recirculate the mine unit. Recirculation was conducted until February 18, 1999 when the mine unit was placed in stabilization. A total of 48,946,046 gallons, or 2.85 pore volumes, was recirculated through the ion exchange system to provide final uranium removal.

Figure 10
Mine Unit 1
Recirculation Wells

August 19 - October 22, 1998



Production Wells
Injection Wells

CROW BUTTE PROJECT
Mine Unit 1
Recirculation Wells
Sec 19 T31N R51W

0 50 meters
0 50 100 150 200 feet
N

3.5 Post Restoration Sampling

CBR obtained composite samples from the restoration wells on October 30, 1998. This sampling indicated that, with the exception of vanadium, all parameters met either baseline or UIC Permit restoration standards. CBR continued restoration activities to reduce the vanadium concentrations.

All restoration wells were sampled on January 22, 1999 and analyzed for vanadium. The analytical results indicated that the UIC Permit standard for vanadium had been met.

Table 7 provides the analytical data from the Mine Unit 1 post-restoration sampling. The results for all parameters except vanadium are from the October 1998 composite sampling. The vanadium results are from the January 1999 sampling. The table segregates the parameters into those that were returned to baseline and those that exceeded baseline but met the UIC Permit standards at the end of active restoration.

Based upon the results of the sampling performed in October 1998 and the vanadium sampling performed in January 1999, CBR notified the NDEQ and NRC on February 17, 1999 of the initiation of the stabilization stage.

Table 7: Mine Unit 1 Post-Restoration Analytical Results

Parameter	Baseline Average (Primary Goal)	UIC Permit Standard	Post-Restoration Average Water Quality
Parameters Returned to Baseline			
Ammonium (mg/l)	0.37	10	0.08
Barium (mg/l)	0.1	1.00	<0.1
Boron (mg/l)	0.93	None	0.4
Cadmium (mg/l)	0.006	0.01	<0.005
Carbonate (mg/l)	7.2	None	<1.0
Chloride (mg/l)	204	250	124
Chromium (mg/l)	<0.03	None	<0.05
Copper (mg/l)	0.017	1.00	<0.01
Fluoride (mg/l)	0.69	4.00	0.55
Iron (mg/l)	0.044	0.30	<0.05
Lead (mg/l)	0.031	0.05	<0.05
Manganese (mg/l)	0.11	0.05	0.01
Mercury (mg/l)	0.001	0.002	<0.001
Molybdenum (mg/l)	0.069	1.00	<0.10
Nickel (mg/l)	0.034	0.15	<0.05
Nitrate (mg/l)	0.05	10.0	<0.10
Nitrite (mg/l)	0.01	None	<0.1
pH (Std. Units)	8.5	6.5 – 8.5	7.95
Selenium (mg/l)	0.003	0.01	0.001
Silica (mg/l)	16.7	None	13.6
Sodium (mg/l)	412.2	4122	315
Specific Conductivity (µmho/cm)	1947	None	1620
Sulfate (mg/l)	356.2	375	287
TDS (mg/l)	1170.2	1218	967

Table 7: Mine Unit 1 Post-Restoration Analytical Results

Parameter	Baseline Average (Primary Goal)	UIC Permit Standard	Post-Restoration Average Water Quality
Zinc (mg/l)	0.036	5.00	<0.01
Parameters Above Baseline but Meeting UIC Permit Standards			
Arsenic (mg/l)	0.002	0.05	0.024
Radium-226 (pCi/l)	229.7	584	246.7
Vanadium (mg/l)	0.066	0.2	0.13
Calcium (mg/l)	12.5	125	16.0
Potassium (mg/l)	12.5	125	13.0
Magnesium (mg/l)	3.2	32	4.4
Uranium (mg/l)	0.092	5.0	0.963
Parameters Above Baseline With No UIC Permit Standards			
Alkalinity (mg/l)	293	None	321
Bicarbonate (mg/l)	344	None	392

4 STABILIZATION

Upon completion of restoration, a groundwater stabilization and monitoring program was begun in which the restoration wells were sampled and assayed. Sampling frequency was one sample per month for each well for a period of six months. The initial sample was obtained on February 19, 1999 at the beginning of the stabilization phase. NDEQ obtained split samples at the same time from all restoration wells for submittal to the State of Nebraska Health and Human Services (HHS) Environmental Testing Laboratory.

Following collection of the initial samples at the beginning of the stabilization period, CBR collected samples from each restoration well on a monthly basis. The samples were submitted to Energy Laboratories in Casper, Wyoming for full water quality analysis. Samples were collected on March 18, April 15, May 20, June 17, and July 15, 1999.

The analytical results during the stabilization period indicate that the mine unit average for all parameters is below the baseline concentration or the UIC restoration standard and are stable. Table 8 summarizes the results of each stabilization sample event. The table shows the mine unit average for each parameter for each sample event. The minimum, maximum, and average of the mine unit average data for each parameter are also shown. A comparison of the restoration standards with the maximum of the mine unit average data indicates that at no time during the stabilization period did the mine unit average exceed the UIC Permit standard for any parameter.

Figure 11 depicts the mine unit average for each parameter from each of the six sampling events. The values are shown as a percentage of the UIC Permit restoration standards.

Copies of the stabilization laboratory summary reports for each of the BLR wells is included in Appendix 6.

Table 8: Mine Unit 1 Stabilization Analytical Results

Parameter (mg/l)	MU-1 Baseline Average	UIC Permit Restoration Standard	Six Sampling Periods			Stabilization Sample # 1 2/18/99	Stabilization Sample # 2 3/18/99	Stabilization Sample # 3 4/15/99	Stabilization Sample # 4 5/20/99	Stabilization Sample # 5 6/17/99	Stabilization Sample # 6 7/15/99
			Maximum	Minimum	Average						
Alkalinity	293	None	363	331	347	331	337	342	349	363	360
Ammonium	0.37	10.00	0.18	0.07	0.12	0.07	0.10	0.13	0.08	0.15	0.18
Arsenic	0.002	0.050	0.020	0.016	0.018	0.016	0.020	0.018	0.017	0.018	0.019
Barium	0.2	1.0	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bicarbonate	344	None	403	440	421	403	409	415	423	440	435
Boron	0.93	N/A	0.53	0.33	0.46	0.46	0.47	0.33	0.47	0.48	0.53
Cadmium	0.006	0.01	0.005	0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	12.5	125.0	22.1	16.6	19.9	16.6	19.1	19.8	20.3	22.1	21.2
Carbonate	7.2	None	2.7	1.2	1.9	1.2	1.5	1.6	2.0	2.1	2.7
Chloride	204	250	158	130	139	131	130	141	141	158	136
Chromium	<0.03	None	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	0.017	1.0	0.0	0.0	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	0.69	4.00	0.63	0.51	0.55	0.55	0.52	0.51	0.53	0.53	0.63
Iron	0.044	0.300	0.127	0.049	0.089	0.049	0.070	0.080	0.090	0.118	0.127
Lead	0.031	0.05	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	3.2	32.0	6.1	4.3	5.3	4.3	5.0	5.2	5.3	5.7	6.1

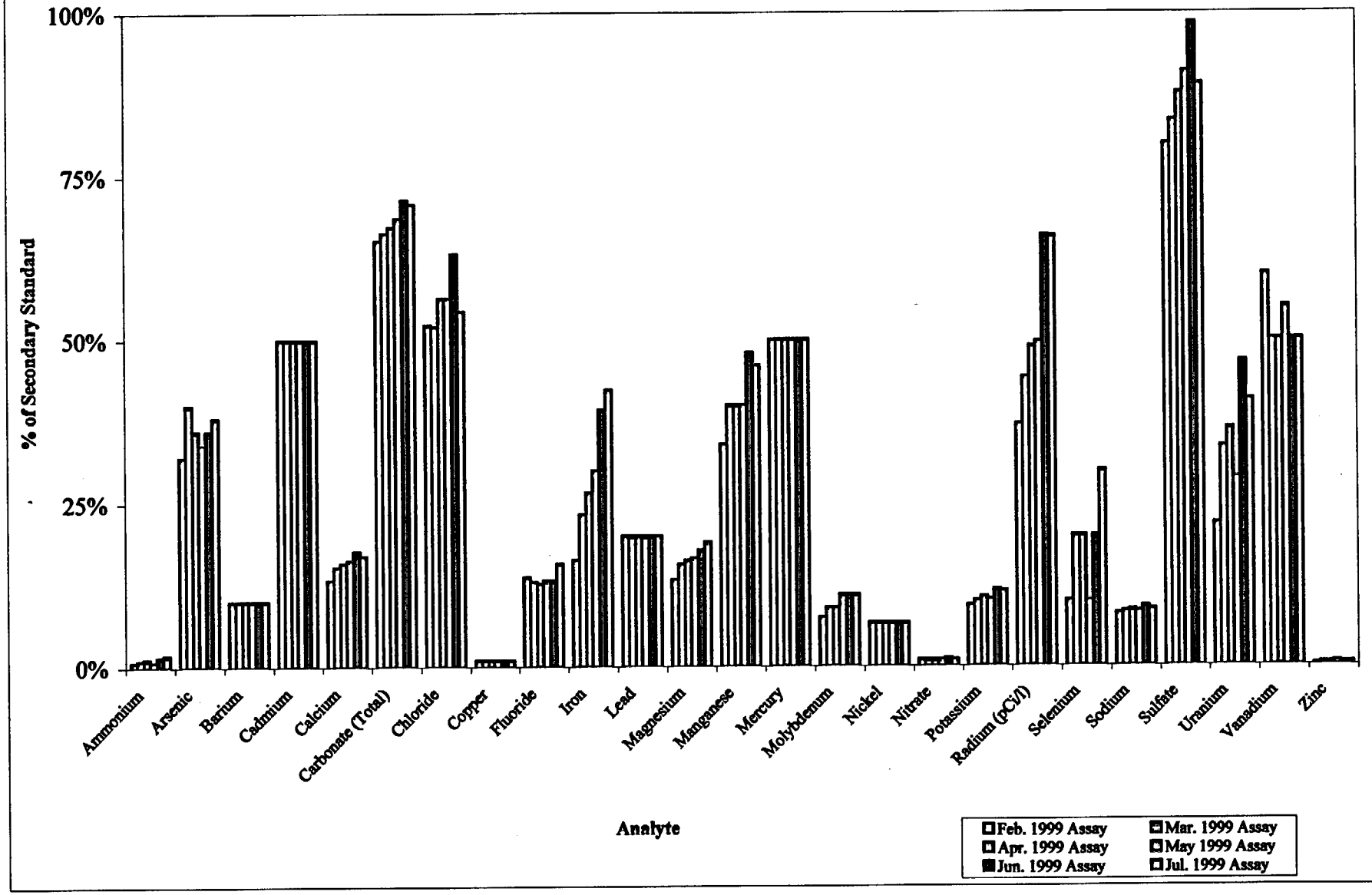
Table 8: Mine Unit 1 Stabilization Analytical Results

Parameter (mg/l)	MU-1 Baseline Average	UIC Permit Restoration Standard	Six Sampling Periods			Stabilization Sample # 1 2/18/99	Stabilization Sample # 2 3/18/99	Stabilization Sample # 3 4/15/99	Stabilization Sample # 4 5/20/99	Stabilization Sample # 5 6/17/99	Stabilization Sample # 6 7/15/99
			Maximum	Minimum	Average						
Manganese	0.011	0.050	0.024	0.017	0.021	0.017	0.020	0.020	0.020	0.024	0.023
Mercury	0.001	0.002	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum	0.069	1.000	0.110	0.075	0.098	0.075	0.090	0.090	0.110	0.110	0.110
Nickel	0.034	0.15	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate	0.05	10.0	0.1	0.1	0.1	<0.1	<0.1	0.1	<0.1	0.12	<0.1
Nitrite	0.01	None	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH (Std. Units)	8.5	6.5-8.5	8.29	8.12	8.18	8.15	8.12	8.20	8.16	8.16	8.29
Potassium	12.5	125.0	14.7	11.7	13.2	11.7	12.6	13.3	12.8	14.7	14.4
Radium-226 (pCi/l)	230	584	385	216	303	216	258	286	290	385	384
Selenium	0.003	0.01	0.003	0.001	0.002	0.001	0.002	0.002	0.001	0.002	0.003
Silica	16.7	None	15.4	13.6	14.4	13.6	15.1	15.4	14.7	13.8	13.7
Sodium	412	4122	376	332	352	332	346	355	345	376	360
Specific Conductivity (µmho/cm)	1947	None	1888	1702	1787	1702	1728	1758	1815	1888	1833
Sulfate	356	375	369	300	331	300	313	329	341	369	334
TDS	1170	1218	1153	1026	1094	1026	1056	1097	1108	1153	1125
Uranium	0.09	5.00	2.33	1.09	1.73	1.09	1.68	1.82	1.44	2.33	2.04

Table 8: Mine Unit 1 Stabilization Analytical Results

Parameter (mg/l)	MU-1 Baseline Average	UIC Permit Restoration Standard	Six Sampling Periods			Stabilization Sample # 1 2/18/99	Stabilization Sample # 2 3/18/99	Stabilization Sample # 3 4/15/99	Stabilization Sample # 4 5/20/99	Stabilization Sample # 5 6/17/99	Stabilization Sample # 6 7/15/99
			Maximum	Minimum	Average						
Vanadium	0.07	0.20	0.12	0.10	0.11	0.12	0.10	0.10	0.11	0.10	0.10
Zinc	0.04	5.00	0.03	0.01	0.02	0.01	0.02	0.02	0.03	0.02	0.02

Figure 11
MU-1 Stabilization Trends and % of Secondary Standard



5 EFFECTIVENESS OF MINE UNIT 1 RESTORATION

5.1 Restoration Summary

Restoration of Mine Unit 1 was conducted in accordance with the Restoration Plan[2] developed by CBR and incorporated by the NRC in SUA-1534. The restoration was accomplished using a combination of each of the restoration steps identified in the plan. A summary of the application of these steps is shown in Table 9.

Table 9: Restoration Summary

Restoration Step	Date Begun	Date Completed	Total Gallons	Total Pore Volumes
Groundwater Transfer	May 1994	July 1997[1]	15,193,704	0.89
Groundwater Sweep	April 1994	July 1994	1,708,949	0.09
Groundwater Ion Exchange Treatment	September 1994	February 1999	456,946,618	26.62
Groundwater Reverse Osmosis Treatment	October 1995	July 1998	103,413,312	6.02
Wellfield Recirculation	August 1998	February 1999	48,946,046	2.85
Stabilization	February 1999	August 1999	N/A	N/A

Notes:

1 Groundwater Transfer was accomplished in five discreet steps during this time period.

2 Crow Butte Resources, Inc., *Groundwater Restoration Plan, Revision 1*, November 26, 1996.

5.2 Restoration Results

The results of the monitoring performed during the stabilization period indicate that CBR has successfully completed restoration of Mine Unit 1 to a stable condition that meets baseline concentrations or UIC Permit standards for all parameters. As shown in Table 10, seventeen of the monitored water quality parameters have been returned to an average concentration that is below the baseline concentrations. All of the remaining monitored parameters are below the UIC restoration standards established by the NDEQ.

The mine unit average for each parameter on each successive sampling event during the stabilization period was below the appropriate standards. There are no important trends in the data for any parameter as shown in Figure 11.

Table 10: Mine Unit 1 Restoration Results

Parameter	Baseline Water Quality	UIC Permit Restoration Standard	Post-Mining Average Water Quality	Post-Restoration Average Water Quality	Stabilization Period Average Water Quality
Alkalinity	293	None	875	321	347
Ammonium	0.37	10	0.277	0.08	0.12
Arsenic	0.002	0.05	0.021	0.024	0.017
Barium	0.1	1.00	<0.10	<0.10	<0.10
Bicarbonate	344	None	1068	392	421
Boron	0.93	N/A	1.22	0.4	0.46
Cadmium	0.006	0.01	<0.01	<0.005	<0.005
Calcium	12.5	125	88.7	16.0	19.9
Carbonate	7.2	None	0	<1.0	1.9
Chloride	204	250	583	124	139
Chromium	<0.03	None	<0.05	<0.05	<0.05
Copper	0.017	1.00	0.035	<0.01	<0.01
Fluoride	0.69	4.00	0.41	0.55	0.54
Iron	0.044	0.30	0.078	<0.05	0.09
Lead	0.031	0.05	<0.05	<0.05	<0.01
Magnesium	3.2	32	23	4.4	5.3
Manganese	0.11	0.05	0.075	0.01	0.02
Mercury	0.001	0.002	<0.001	<0.001	<0.001
Molybdenum	0.069	1.00	0.487	<0.10	0.10

Table 10: Mine Unit 1 Restoration Results

Parameter	Baseline Water Quality	UIC Permit Restoration Standard	Post-Mining Average Water Quality	Post-Restoration Average Water Quality	Stabilization Period Average Water Quality
Nickel	0.034	0.15	0.068	<0.05	<0.01
Nitrate	0.05	10.0	1.01	<0.10	<0.11
Nitrite	0.01	None		<0.10	<0.1
pH (Std. Units)	8.5	6.5 – 8.5	7.35	7.95	8.18
Potassium	12.5	125	30.0	13.0	13.2
Radium-226 (pCi/l)	229.7	584	786	246.7	303
Selenium	0.003	0.01	0.124	0.001	<0.002
Silica	16.7	None		13.6	14.4
Sodium	412.2	4122	1117	315	352
Specific Conductivity (µmho/cm)	1947	None	5752	1620	1787
Sulfate	356.2	375	1128	287	331
TDS	1170.2	1218	3728	967	1094
Uranium	0.092	0.44	12.2	0.963	1.73
Vanadium	0.066	0.2	0.96	0.26	0.11
Zinc	0.036	5.00	0.038	<0.01	<0.02

Appendix 1

Baseline Restoration Well Correspondence

FERRET EXPLORATION COMPANY OF NEBRASKA, INC.

P.O. Box 169
Crawford, Nebraska 69339

Office (308) 665-2215
FAX (308) 665-2341

March 22, 1994

Mr. U. Gale Hutton
Nebraska Department of Environmental Quality
P.O. Box 98922
Lincoln, Nebraska 68509-8922

Dear Gale:

In the Notice of Intent to Operate Mine Unit 1 submittal dated December 17, 1990, FEN designated well PT-9 as a baseline restoration well. FEN has ceased mining activities in Mine Unit 1 and is preparing to establish post-mining water quality by sampling all designated restoration wells in the mine unit. Well PT-9 has become non-functional and FEN is unable to obtain a water sample from the well. FEN proposes to use the nearest well, PR-8 as a replacement for PT-9. Both wells are screened in a similar manner in the Chadron Sandstone.

Discussion with personnel from your office indicated this is an acceptable replacement well. FEN plans to sample all designated restoration wells in Mine Unit 1 this week and split these samples with the Department. FEN also plans to plug PT-9 in accordance with the approved Plugging and Abandonment Plan. Should you have any questions regarding this matter, please do not hesitate to contact me.

Sincerely,

Ralph Knode

Ralph Knode
Vice President

bc: SPC
Frank Mills/NDEQ

FERRET EXPLORATION COMPANY OF NEBRASKA, INC.

216 Sixteenth Street Mall, Suite 810
Denver, Colorado 80202

(303) 825-2266
(303) 825-1544 - FAX

INT-021A

March 21, 1994

Mr. Ramon Hall
U.S. Nuclear Regulatory Commission
Uranium Recovery Field Office
P.O. Box 25325
Denver, Colorado 80225

RE: Docket No. 40-8943
License No. SUA-1534

Dear Mr. Hall:

The cover letter to License Amendment No. 22 asked FEN to propose appropriate revision to License SUA-1534 as a result of revision in 10 CFR Part 20 which became effective January 1, 1994.

The following changes are necessary to correct reference to 10 CFR 20.

	Old 10 CFR 20	New 10 CFR 20
License Condition 17	20.203 (e) (2)	20.1902(e)
License Condition 23	20.103 (a) (2)	20.1201
	20.103 (b) (2)	20.1702
License Condition 30	20.203 (d)	20.1003
License Condition 52	20.103	20.1204

In the Notice of Intent to Operate Mine Unit 1, submittal dated December 17, 1990, FEN designated well PT-9 as a baseline restoration well. FEN has ceased mining activities in Mine Unit 1 and is preparing to establish post mining water quality by sampling all designated restoration wells in the Mine Unit. Well PT-9 has become non-functional and is unable to be sampled. FEN proposes to use the nearest well, PR-8 as a replacement for PT-9. Both wells are screened in a similar manner in the production zone. FEN requests that your agency approve PR-8 as a replacement restoration well for PT-9, and reference to this letter be added to License Condition 44 if necessary.

FEN also requests that License Condition 11 be changed to allow the disposal of waste byproduct material from the Crow Butte facility at any mill tailings or other waste facility that is licensed by USNRC or Agreement State to accept the material. This will allow FEN more flexibility in waste disposal and eliminate the need for a license amendment each time the name of the disposal facility changes.

If you need any further information, please contact me.

Sincerely,

Steve Collings

Stephen P. Collings
President

Appendix 2

Preoperational Baseline Sampling Results

Mine Unit 1

well number / 2nd Well Number			pm-1 pr-4	pm-4	pm-5	pt-5 pr-2	IJ-6	pt-9 pr-8*	IJ-13	pr-15	pr-19	IJ-25	IJ-28	IJ-45	Wellfield Average
Major Ions			bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	bl_avg	
calcium	Ca	mg/l	14.7	15.3	15.5	8.2	12.7	13.0	9.5	13.2	14.0	8.7	17.3	7.6	12.5
magnesium	Mg	mg/l	3.5	3.6	3.9	2.3	3.1	2.1	2.8	3.9	3.8	2.5	4.6	2.2	3.2
sodium	Na	mg/l	402.5	398.6	400.0	464.8	429.7	407.7	401.7	398.7	406.7	402.3	410.7	423.3	412.2
potassium	K	mg/l	12.8	11.6	11.8	15.4	11.3	13.4	10.6	11.1	12.3	12.8	12.1	14.9	12.5
carbonate	CO3	mg/l	6.8	3.4	6.5	17.4	5.6	13.6	5.6	5.9	4.9	5.8	4.2	7.1	7.2
bicarbonate	HCO3	mg/l	370.4	373.3	365.4	305.0	334.7	358.0	314.7	361.7	348.7	306.7	371.7	314.7	344
sulfate	SO4	mg/l	355.7	354.2	355.5	330.5	365.3	351.7	358.3	352.3	361.3	360.3	363.7	365.7	356
chloride	Cl	mg/l	186.8	182.4	186.5	316.5	216.7	186.6	190.3	180.3	186.7	204.3	189.3	218.0	204
ammonium	NH4	mg/l	0.38	0.40	0.38	0.39	0.41	0.44	0.35	0.53	0.28	0.39	0.32	0.19	0.37
nitrite	NO2	mg/l	0.01	0.008	0.01	0.00	0.01	0.01	0.01	0.03	0.01	0.02	0.01	0.01	0.01
nitrate	NO3	mg/l	0.04	0.04	0.03	0.04	0.06	0.10	0.03	0.05	0.03	0.13	0.02	0.02	0.05
fluoride	F	mg/l	0.63	0.63	0.63	0.75	0.74	0.66	0.73	0.69	0.69	0.70	0.68	0.71	0.69
silica	SiO2	mg/l	13.2	13.3	12.0	11.4	18.8	16.1	22.0	16.7	17.2	22.9	17.9	18.5	16.7
Non-Metals															
total dissolved solids	TDS	mg/l	1156	1148	1147	1302	1196	1176	1129	1137	1154	1126	1173	1197	1170.2
conductivity (umho/cm)	Cond	umho/cm	1897	1871	1889	2136	1964	1866	1974	1867	1994	1970	1980	1951	1946.6
alkalinity as CaCO3	Alk	mg/l	310.3	309.5	302.0	279.1	283.7	323.9	267.3	306.7	294.0	261.0	311.7	270.0	293.3
pH (std units)	pH	std. units	8.22	8.16	8.15	8.54	8.56	8.60	8.57	8.55	8.47	8.60	8.43	8.68	8.5
Trace Metals															
aluminum	Al	mg/l	0.10	0.10	0.10	n/a	0.10	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10
arsenic	As	mg/l	0.002	0.002	0.001	0.004	0.001	0.007	0.004	0.001	0.001	0.001	0.001	0.001	0.002
barium	Ba	mg/l	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
boron	B	mg/l	0.93	0.94	0.90	0.89	0.91	0.94	0.94	0.91	0.94	0.93	0.95	0.92	0.92
cadmium	Cd	mg/l	0.001	0.001	0.001	0.001	0.010	0.002	0.010	0.010	0.010	0.010	0.010	0.010	0.006
chromium	Cr	mg/l	0.00	0.00	0.01	0.01	0.05	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.03
copper	Cu	mg/l	0.01	0.01	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.017
iron	Fe	mg/l	0.03	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.044
lead	Pb	mg/l	0.01	0.01	0.01	0.01	0.05	0.01	0.05	0.05	0.05	0.05	0.05	0.05	0.031
manganese	Mn	mg/l	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.011
mercury	Hg	mg/l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.001
molybdenum	Mo	mg/l	0.02	0.02	0.02	0.01	0.10	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.069
nickel	Ni	mg/l	0.01	0.01	0.01	0.01	0.05	0.02	0.05	0.05	0.05	0.05	0.05	0.05	0.034
selenium	Se	mg/l	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.003
vanadium	V	mg/l	0.01	0.01	0.01	0.01	0.10	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.066
zinc	Zn	mg/l	0.10	0.09	0.10	0.03	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.036
Radiometric															
uranium natural (mg/l)	U-nat	mg/l	0.0511	0.0152	0.0378	0.0870	0.1083	0.3040	0.2412	0.0558	0.0361	0.0348	0.0594	0.0727	0.092
radium 226 (pCi/l)	Ra226	pCi/l	129.2	68.9	333.4	467.8	156.7	420.4	566.3	18.5	250.7	148.2	108.3	88.1	229.7
radium 226 precision	Ra226_precis		4.8	3.6	9.0	12.1	4.6	4.7	8.9	1.0	6.4	4.5	3.9	3.4	5.6

* PT9 was replaced by PR8; See letter submitted March 21,1994.

Mine Unit 1

Well Number			pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1	pm-1
2ND Well Number			pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4	pr-4
Date			Jul-90	Dec-82	Jan-83	Apr-83	Jul-83	Oct-83	Jan-84	Apr-84	Dec-85	Jul-86	Oct-86	Jan-87	Apr-87	Jul-87	Oct-87	Jan-88	Apr-88	Jul-88	Oct-88	Feb-89	May-89	Jul-89	Oct-89	Jan-90	Apr-90	Jul-90			
Major Ions			Average	bl1	bl2	bl3	bl4	bl5	bl6	bl7	bl8	bl9	bl10	bl11	bl12	bl13	bl14	bl15	bl16	bl17	bl18	bl19	bl20	bl21	bl22	bl23	bl24	bl25			
calcium	Ca	mg/l	14.7	17.0	13.0	12.0	14.0	12.0	11.0	12.0	14.8	15.4	15.1	16.6	16.5	13.3	13.1	15.4	14.4	15.2	14.7	17.8	16.0	16.0	14.7	15.6	16.6	15.8			
magnesium	Mg	mg/l	3.5	2.9	2.2	1.9	2.2	2.5	2.8	3.0	3.3	4.1	3.3	3.7	4.1	4.2	3.8	4.1	3.9	3.8	3.2	4.3	3.9	4.2	4.3	4.2	4.2	4.2			
sodium	Na	mg/l	402.5	417.0	400.0	440.0	410.0	420.0	420.0	419.0	399.0	397.0	387.0	398.0	398.0	413.0	406.0	397.0	390.0	398.0	398.0	398.0	395.0	396.0	404.0	395.0	396.0	397.0			
potassium	K	mg/l	12.8	13.0	16.0	18.0	17.0	18.0	16.0	15.0	11.7	10.5	9.6	9.8	11.7	11.5	11.8	11.6	11.0	11.6	11.7	11.4	11.0	12.5	15.3	11.6	11.5	12.2			
carbonate	CO3	mg/l	6.8	13.0	12.0	0.0	0.0	12.0	5.0	12.0	3.3	0.0	0.0	0.0	4.2	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
bicarbonate	HCO3	mg/l	370.4	368.0	370.0	376.0	374.0	378.0	387.0	378.0	357.2	371.0	363.0	357.0	339.0	373.0	380.0	380.0	362.0	376.0	361.0	365.0	363.0	376.0	376.0	383.0	387.0	359.0			
sulfate	SO4	mg/l	355.7	358.0	390.0	361.0	365.0	351.0	363.0	330.0	354.0	363.0	332.0	363.0	368.0	348.0	357.0	348.0	358.0	363.0	353.0	363.0	358.0	371.0	350.0	344.0	341.0	351.0			
chloride	Cl	mg/l	186.8	204.0	210.0	215.1	199.0	193.7	188.0	194.0	180.0	176.0	182.0	187.0	173.0	203.0	191.0	195.0	175.0	182.0	181.0	188.0	179.0	176.0	183.0	181.0	180.0	179.0			
ammonium	NH4	mg/l	0.38	0.48	0.28	0.39	0.25	0.10	0.17	0.71	0.20	0.39	0.39	0.42	0.45	0.41	0.43	0.44	0.42	0.42	0.35	0.38	0.42	0.43	0.43	0.39	0.49	0.28			
nitrite	NO2	mg/l	<0.00964	0.02	<.01	0.01	<.01	<.01	<.01	<.01	<.001	<.01	<.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.07	0.00	0.01	<.01			
nitrate	NO3	mg/l	<0.044	<.01	<.01	<.1	<.1	<.1	<.1	<.1	<.01	0.01	0.03	0.01	0.01	0.02	<.01	0.02	<.01	0.01	0.01	0.05	0.01	0.01	0.13	0.01	0.13	<.1			
fluoride	F	mg/l	0.63	0.67	0.60	0.70	0.80	0.50	0.50	0.48	0.57	0.66	0.62	0.65	0.58	0.75	0.75	0.79	0.62	0.63	0.56	0.62	0.56	0.58	0.57	0.80	0.57	0.68			
silica	SiO2	mg/l	13.2	15.0	14.0	14.0	16.0	14.0	15.0	16.5	14.2	13.4	13.1	12.1	12.8	12.8	12.4	12.8	12.8	10.7	9.8	13.1	12.4	12.2	13.1	13.1	12.0	12.7			
Non-Metals																															
total dissolved solids	TDS	mg/l	1156	1260	1200	1226	1199	1223	1300	1168	1154	1196	1134	1178	1146	1176	1180	1124	1128	1136	1102	1082	1086	1097	1142	1116	1089	1166			
conductivity (umhos/cm)	Cond	umhos/cm	1897	1940	1930	1825	1970	2040	2000	1830	1853	1844	1891	1986	1881	1847	1795	1883	1921	1927	1936	1839	1843	1878	1968	1948	1920	1950			
alkalinity as CaCO3	Alk	mg/l	318.3	324.0	330.0	320.0	321.0	339.0	342.0	330.0	298.3	304.0	297.0	292.0	285.0	306.0	312.0	312.0	304.0	308.0	296.0	299.0	298.0	308.0	308.0	314.0	317.0	294.0			
pH (std units)	pH	std. units	8.22	8.61	8.70	8.42	8.25	8.42	8.35	8.20	8.38	8.15	8.17	8.22	8.43	8.13	8.17	8.07	8.40	8.32	7.96	8.00	8.29	7.70	8.16	8.27	7.96	7.96			
Trace Metals																															
aluminum	Al	mg/l	<0.10333	n/a	<.1	<.1	<.1	<.1	<.1	0.170	n/a	<.1	<.1	<.1	<.1	<.1	<.1	<.1	n/a	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
arsenic	As	mg/l	<0.001875	0.001	<.002	<.01	<.005	<.005	n/a	<.004	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
barium	Ba	mg/l	<0.097917	0.005	0.000	0.000	0.000	0.000	n/a	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
boron	B	mg/l	0.928	0.990	0.880	0.960	0.890	1.060	n/a	1.040	1.030	0.900	0.910	0.920	0.960	0.910	0.890	0.910	0.960	0.770	0.870	0.960	0.950	0.920	0.960	0.930	0.900	0.930			
cadmium	Cd	mg/l	<0.001379	<.0001	<.001	<.01	<.001	<.001	n/a	0.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001	<.001	<.001	<.001	<.001			
chromium	Cr	mg/l	<0.064652	<.001	<.001	n/a	<.005	<.005	n/a	0.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005			
copper	Cu	mg/l	<0.009583	0.005	0.005	<.01	<.01	<.01	n/a	0.010	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01			
iron	Fe	mg/l	<0.034167	0.020	<.05	<.05	<.03	<.03	n/a	0.090	<.03	<.03	<.03	<.03	<.03	<.03	<.03	0.040	<.03	<.03	<.03	0.030	<.01	<.01	<.03	<.03	<.03	<.03			
lead	Pb	mg/l	<0.005292	<.001	<.005	<.01	<.005	<.005	n/a	<.005	<.005	<.005	<.005	0.009	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005			
manganese	Mn	mg/l	<0.011958	0.004	<.1	<.01	<.005	<.005	n/a	<.005	0.007	0.007	0.007	0.008	0.008	0.009	<.005	0.009	0.007	0.008	0.009	0.010	0.010	0.010	0.010	0.011	0.011	0.012			
mercury	Hg	mg/l	<0.000212	<.0001	<.0001	<.0003	<.0002	<.0002	n/a	0.000	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	0.001	<.0002	<.0002	<.0002	<.0002			
molybdenum	Mo	mg/l	<0.0235	0.020	0.024	<.1	<.01	<.01	n/a	0.020	0.020	0.020	0.010	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.030	0.040	0.030	<.01	0.020	0.020	0.020			
nickel	Ni	mg/l	<0.011333	<.01	<.002	<.05	<.01	<.01	n/a	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01			
selenium	Se	mg/l	<0.001417	<.001	<.002	<.01	<.001	<.001	n/a	<.001	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001			
vanadium	V	mg/l	<0.013458	<.01	0.005	<.1	<.01	<.01	n/a	0.007	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01			
zinc	Zn	mg/l	<0.100292	0.012	<.005	<.01	<.01	<.01	n/a	0.020	<.01	0.110	0.200	0.180	0.160	0.150	0.130	0.120	0.110	0.120	0.120	0.140	0.130	0.140	0.180	0.160	0.170	<.01			
Radionuclides																															
uranium natural (mg/l)	U-nat	mg/l	0.051	0.035	0.031	0.054	0.033	0.036	0.034	0.041	0.055	0.051	0.020	0.106	0.052	0.039	0.050	0.053	0.038	0.074	0.052	0.043	0.056	0.057	0.048	0.042	0.004	0.068			
radium 226 (pCi/l)	Ra226	pCi/l	129.2	99.0	47.6	43.4	50.7	40.0	45.0	62.0	144.2	144.8	163.5	148.7	152.9	142.6	147.0	170.0	167.0	195.0	196.0	153.0	139.3	162.6	176.0	154.0	148.7	116.0			
radium 226 precision	Ra226 precis		4.8	1.0	1.0	1.4	1.5	1.0	1.0	2.0	3.9	4.4	4.8	3.8	3.6	3.3	2.9	3.5	9.6	19.7	21.4	3.9	7.5	6.0	4.6	4.8	4.3	4.4			

Mine Unit 1

Well Number			ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t	ppm-t
2ND Well Number																													
Date			Jul-90	Dec-92	Jan-93	Apr-93	Jul-93	Oct-93	Jan-94	Apr-94	Dec-95	Jul-96	Oct-96	Jan-97	Apr-97	Jul-97	Oct-97	Jan-98	Apr-98	Jul-98	Oct-98	Feb-99	May-99	Jul-99	Oct-99	Jan-00	Apr-00	Jul-00
Major Ions			Average	bl1	bl2	bl3	bl4	bl5	bl6	bl7	bl8	bl9	bl10	bl11	bl12	bl13	bl14	bl15	bl16	bl17	bl18	bl19	bl20	bl21	bl22	bl23	bl24	bl25
calcium	Ca	mg/l	15.3	16.0	14.0	15.0	14.0	14.0	14.0	14.0	16.1	12.1	15.3	16.6	15.9	16.9	13.6	15.4	14.8	15.3	14.5	16.6	16.0	16.5	15.2	14.8	16.6	17.2
magnesium	Mg	mg/l	3.6	3.5	3.3	3.1	2.9	3.0	3.4	3.0	3.3	3.2	3.1	3.7	4.0	4.4	3.5	3.9	3.5	4.1	3.0	3.5	3.9	4.0	4.4	3.9	3.6	4.2
sodium	Na	mg/l	398.6	408.0	390.0	410.0	390.0	400.0	410.0	408.0	399.0	404.0	399.0	395.0	392.0	395.0	415.0	399.0	393.0	390.0	404.0	396.0	392.0	406.0	390.0	402.0	394.0	391.0
potassium	K	mg/l	11.6	11.0	11.0	10.2	11.0	13.0	14.0	12.0	11.3	10.2	9.2	9.9	12.0	11.5	11.5	11.2	11.0	11.2	11.9	11.4	11.0	12.4	15.2	11.5	11.4	12.8
carbonate	CO3	mg/l	3.4	0.0	14.0	<1	<1	<1	<1	0.0	1.4	0.0	0.0	0.0	3.9	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
bicarbonate	HCO3	mg/l	373.3	386.0	360.0	379.0	370.0	399.0	385.0	390.0	364.9	371.0	361.0	358.0	338.0	376.0	378.0	376.0	383.0	376.0	383.0	371.0	363.0	373.0	379.0	384.0	387.0	362.0
sulfate	SO4	mg/l	354.2	359.0	370.0	358.0	360.0	347.0	362.0	333.0	360.0	344.0	338.0	360.0	362.0	369.0	366.0	360.0	346.0	365.0	356.0	361.0	350.0	371.0	339.0	347.0	331.0	350.0
chloride	Cl	mg/l	182.4	187.0	170.0	170.3	196.0	186.9	187.0	196.0	178.0	182.0	186.0	186.0	173.0	196.0	194.0	196.0	176.0	187.0	186.0	178.0	171.0	180.0	188.0	183.0	177.0	179.0
ammonium	NH4	mg/l	0.40	0.49	0.46	0.37	0.30	0.06	0.19	0.48	0.26	0.43	0.43	0.46	0.47	0.43	0.44	0.46	0.46	0.45	0.43	0.41	0.43	0.48	0.48	0.42	0.49	0.30
nitrite	NO2	mg/l	<0.008	<.01	<.01	0.01	<.01	<.01	<.01	<.01	<.001	<.01	<.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.04	0.00	0.00	<.01
nitrate	NO3	mg/l	<0.037	0.02	<.01	<.1	<.1	<.1	<.1	<.1	<.01	0.01	<.01	0.01	<.01	<.01	<.01	<.01	<.01	<.01	0.01	0.05	0.02	0.01	0.01	0.02	0.09	<.1
fluoride	F	mg/l	0.63	0.66	0.60	0.70	0.40	0.50	0.60	0.56	0.68	0.72	0.68	0.70	0.70	0.42	0.70	0.54	0.64	0.69	0.56	0.66	0.58	0.63	0.60	0.80	0.66	0.70
silica	SiO2	mg/l	13.3	18.0	14.0	16.0	14.0	16.0	16.0	16.3	11.0	13.3	13.0	11.7	12.8	12.8	12.8	12.8	12.8	10.7	9.8	12.8	12.4	12.6	12.6	12.6	11.8	12.5
Non-Metals																													
total dissolved solids	TDS	mg/l	1148	1250	1100	1106	1209	1170	1175	1104	1120	1172	1118	1174	1144	1158	1244	1126	1068	1132	1150	1100	1126	1111	1138	1158	1176	1174
conductivity (unknown)	Cond	umhos/cm	1871	1920	1790	1599	1890	1980	1950	1790	1818	1867	1881	1879	1891	1872	1814	1890	1908	1926	1948	1878	1849	1864	1876	1931	1950	1958
alkalinity as CaCO3	Alk	mg/l	309.5	316.0	320.0	322.0	317.0	337.0	328.0	320.0	301.4	304.0	296.0	293.0	284.0	308.0	310.0	308.0	304.0	308.0	314.0	304.0	297.0	308.0	310.0	315.0	317.0	297.0
pH (std units)	pH	std. units	8.16	8.26	8.60	8.05	8.09	8.30	8.24	8.10	8.32	8.09	8.07	8.20	8.40	8.18	8.08	8.07	8.37	8.30	7.85	8.00	8.28	7.90	8.18	8.26	7.90	8.02
Trace Metals																													
aluminum	Al	mg/l	<0.100952	n/a	<.1	<.1	<.1	<.1		0.120	n/a	<.1	<.1	<.1	<.1	<.1	<.1	n/a	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
arsenic	As	mg/l	<0.001875	0.001	<.001	<.001	<.001	<.001	<.001	<.004	<.001	<.001	<.001	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
barium	Ba	mg/l	<0.097083	0.050	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
boron	B	mg/l	0.935	1.000	0.900	1.000	0.870	1.010		1.040	1.050	0.910	0.930	0.910	0.990	0.950	0.940	0.930	0.980	0.790	0.890	0.980	0.970	0.970	0.950	0.940	0.980	0.970
cadmium	Cd	mg/l	<0.001338	<.0001	<.001	<.01	<.001	<.001		<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
chromium	Cr	mg/l	<0.004652	<.001	<.001	n/a	<.005	<.005		0.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
copper	Cu	mg/l	<0.0095	0.006	0.004	<.01	<.01	<.01		<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	0.010
iron	Fe	mg/l	<0.05225	0.030	<.05	<.05	0.030	0.030		0.044	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03	<.03
lead	Pb	mg/l	<0.005167	<.001	<.005	<.01	<.005	<.005		<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	0.007	0.006	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
manganese	Mn	mg/l	<0.013875	0.014	<.1	<.01	0.010	0.005		0.007	<.012	0.010	0.011	0.010	0.011	0.011	<.005	0.011	0.008	0.009	0.010	0.011	0.011	0.011	0.011	0.011	0.012	0.012
mercury	Hg	mg/l	<0.000212	<.0001	<.0001	<.0008	<.0002	<.0002		0.000	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
molybdenum	Mo	mg/l	<0.022917	0.020	0.023	<.1	<.01	<.01		0.021	0.020	0.020	0.020	0.016	0.020	0.020	<.01	0.020	0.020	0.020	0.020	0.050	0.020	0.050	0.020	0.020	0.020	0.020	0.020
nickel	Ni	mg/l	<0.011333	<.01	<.002	<.05	<.01	<.01		0.010	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
selenium	Se	mg/l	<0.001583	<.001	<.002	<.01	<.001	0.002		<.001	<.001	0.004	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001	<.001	<.001	<.001
vanadium	V	mg/l	<0.01375	0.020	0.005	<.1	<.01	<.01		0.007	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
zinc	Zn	mg/l	0.094	0.019	0.005	<.01	<.01	0.010		0.052	<.01	0.190	0.230	0.230	0.210	0.190	0.140	0.110	0.080	0.090	0.090	0.090	0.090	0.090	0.110	0.100	0.100	<.01
Radiometric																													
uranium natural (mg/l)	U-nat	mg/l	0.002	0.036	0.029	0.012	0.019	0.010	0.023	0.018	0.025	0.019	0.008	0.023	0.013	0.005	0.008	0.013	0.008	0.010	0.014	0.012	0.022	0.008	0.009	0.009	0.011	0.016
radium 226 (pCi/l)	Ra226	pCi/l	68.9	71.0	51.4	35.1	60.0	35.0	44.0	56.0	82.6	70.1	95.9	66.5	70.5	98.5	74.2	80.9	89.6	83.5	120.0	73.5	66.5	73.6	74.4	63.0	57.0	51.8
radium 226 precision	Ra226	precis	3.6	1.0	1.1	1.2	1.4	1.0	1.0	2.0	3.0	3.0	3.7	2.0	2.5	2.6	2.2	2.5	4.7	13.0	18.5	2.2	1.8	4.7	3.3	3.1	2.7	3.0

Mine Unit 1

Well Number			pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5	pm-5
2ND Well Number																								
Date			Jul-96	Nov-85	Nov-85	Nov-85	Dec-85	Jul-86	Oct-86	Jan-87	Apr-87	Jul-87	Oct-87	Jan-88	Apr-88	Jul-88	Oct-88	Feb-89	Apr-89	Jul-89	Oct-89	Jan-90	Apr-90	Jul-90
Major Ions			Average	bl1	bl2	bl3	bl4	bl5	bl6	bl7	bl8	bl9	bl10	bl11	bl12	bl13	bl14	bl15	bl16	bl17	bl18	bl19	bl20	bl21
calcium	Ca	mg/l	15.5	9.8	14.0	14.1	14.4	13.0	15.2	17.0	16.8	17.0	16.0	15.8	17.3	17.8	14.7	18.1	15.2	16.2	13.8	15.4	17.0	17.1
magnesium	Mg	mg/l	3.9	3.9	5.0	3.5	3.4	3.4	3.2	4.0	4.1	4.7	3.8	4.1	3.5	4.2	2.9	4.1	3.9	4.2	4.4	4.1	4.2	4.3
sodium	Na	mg/l	400.0	439.0	408.0	416.0	400.0	409.0	396.0	395.0	391.0	413.0	394.0	398.0	396.0	398.0	390.0	395.0	394.0	407.0	398.0	395.0	393.0	391.0
potassium	K	mg/l	11.8	11.5	13.0	12.7	11.9	10.7	9.5	10.1	12.0	11.8	11.7	11.7	11.4	11.4	12.9	11.5	11.3	12.8	15.4	11.8	11.7	11.6
carbonate	CO3	mg/l	6.5	2.4	19.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0
bicarbonate	HCO3	mg/l	365.4	351.5	312.0	374.0	362.5	367.0	361.0	352.0	340.0	376.0	374.0	378.0	367.0	378.0	365.0	372.0	359.0	376.0	378.0	378.0	387.0	389.0
sulfate	SO4	mg/l	355.5	355.0	294.0	359.0	348.0	367.0	353.0	360.0	371.0	400.0	354.0	360.0	346.0	371.0	345.0	368.0	354.0	377.0	351.0	346.0	341.0	346.0
chloride	Cl	mg/l	186.5	219.0	235.0	205.0	193.0	186.0	182.0	192.0	175.0	191.0	182.0	180.0	179.0	190.0	175.0	173.0	173.0	175.0	180.0	178.0	176.0	177.0
ammonium	NH4	mg/l	<0.381	0.64	<.01	0.62	0.15	0.40	0.40	0.41	0.43	0.40	0.42	0.42	0.38	0.42	0.40	0.39	0.40	0.45	0.46	<.05	0.45	0.27
nitrite	NO2	mg/l	<0.006	<.001	0.00	0.00	<.001	<.01	<.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.02	0.09	0.02	<.01
nitrate	NO3	mg/l	<0.033	<.01	<.05	0.06	<.01	0.07	<.01	<.01	0.01	0.01	<.01	<.01	<.01	<.01	0.11	0.04	0.04	0.01	0.02	0.02	0.07	0.01
fluoride	F	mg/l	0.63	0.62	0.74	0.71	0.65	0.72	0.64	0.70	0.64	0.40	0.67	0.54	0.60	0.69	0.58	0.64	0.54	0.60	0.60	0.60	0.62	0.61
silica	SiO2	mg/l	12.0	11.1	11.5	10.9	11.0	12.7	12.6	11.6	12.8	12.8	12.8	12.8	12.8	10.3	9.8	12.4	12.2	12.2	12.2	12.4	12.4	12.7
Non-Metals																								
total dissolved solids	TDS	mg/l	1147	1192	1236	1210	1104	1196	1104	1128	1162	1174	1156	1134	1112	1130	1190	1092	1120	1126	1148	1122	1123	1158
conductivity (umho/cm)	Cond	umhos/cm	1889	1820	1980	1898	1853	1879	1907	1879	1881	1860	1835	1904	1921	1925	1902	1867	1839	1902	1876	1948	1950	1959
alkalinity as CaCO3	Alk	mg/l	302.0	292.0	258.0	306.5	297.1	301.0	296.0	288.0	285.0	308.0	307.0	310.0	307.0	310.0	299.0	305.0	294.0	308.0	310.0	316.0	317.0	291.0
pH (std units)	pH	std. units	8.15	8.34	8.26	8.30	8.24	8.05	8.06	8.18	8.38	8.07	8.06	8.05	8.32	8.25	7.96	8.00	8.31	7.88	8.16	8.32	7.91	8.04
Trace Metals																								
aluminum	Al	mg/l	<0.1	n/a	n/a	n/a	n/a	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	n/a	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
arsenic	As	mg/l	<0.001146	0.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
barium	Ba	mg/l	<0.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
boron	B	mg/l	0.901	0.890	0.980	0.940	1.020	0.880	0.910	0.910	0.960	0.920	0.940	0.420	0.980	0.770	0.870	0.950	0.930	0.940	0.910	0.920	0.930	0.910
cadmium	Cd	mg/l	<0.00119	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.003	<.001	<.001	<.001	<.001	<.001	<.001	0.003
chromium	Cr	mg/l	<0.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
copper	Cu	mg/l	<0.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
iron	Fe	mg/l	<0.032381	0.080	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3
lead	Pb	mg/l	<0.005476	<.005	<.005	0.009	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	0.006	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005
manganese	Mn	mg/l	<0.006143	0.005	<.005	<.005	<.005	<.005	0.005	0.006	0.006	0.006	0.006	0.006	<.005	<.005	0.005	0.006	0.007	0.007	0.006	0.007	0.007	0.009
mercury	Hg	mg/l	<0.00021	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.000	0.000	0.000	<0.0002	<0.0002	<0.0002
molybdenum	Mo	mg/l	<0.01981	0.020	<.01	<.01	0.020	0.020	0.020	0.016	0.020	0.020	<.01	0.020	0.020	0.030	0.030	0.030	0.010	0.030	0.020	0.020	0.020	0.020
nickel	Ni	mg/l	<0.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
selenium	Se	mg/l	<0.001848	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.002	<.001	<.001	<.001	<.001
vanadium	V	mg/l	<0.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
zinc	Zn	mg/l	<0.095952	<.01	0.115	<.01	<.01	0.160	0.190	0.180	0.160	0.140	0.120	0.090	0.080	0.080	0.080	0.080	0.090	0.090	0.110	0.110	0.090	0.080
Radionuclides																								
uranium natural (mg/l)	U-nat	mg/l	0.038	0.053	0.132	0.051	0.037	0.090	0.120	0.038	0.027	0.015	0.022	0.023	0.022	0.024	0.028	0.026	0.054	0.020	0.018	0.020	0.021	0.033
radium 226 (pCi/l)	Ra226	pCi/l	333.4	301.6	189.0	285.0	299.2	302.4	296.2	329.7	326.7	323.5	348.4	477.0	352.0	412.0	526.0	396.0	348.5	362.0	343.0	339.0	293.5	169.0
radium 226 precision	Ra226	precis	9.0	6.4	17.0	6.7	5.7	6.3	6.3	4.6	5.4	5.0	4.9	5.8	4.0	28.6	38.8	4.9	5.1	9.3	6.9	7.2	5.9	5.4

Mine Unit 1

Well Number			pt-5	pt-5	pt-5	pt-5	pt-5
2ND Well Number			pz-2	pz-2	pz-2	pz-2	pz-2
Date			Dec-85	Nov-85	Nov-85	Nov-85	Dec-85
Major Ions			Average	bl1	bl2	bl3	bl4
calcium	Ca	mg/l	8.2	5.7	7.0	9.4	10.8
magnesium	Mg	mg/l	2.3	1.4	3.0	2.4	2.6
sodium	Na	mg/l	464.8	499.0	492.0	445.0	423.0
potassium	K	mg/l	15.4	14.1	17.0	15.8	14.8
carbonate	CO3	mg/l	17.4	13.6	24.0	9.4	22.6
bicarbonate	HCO3	mg/l	305.0	293.6	268.0	334.8	323.7
sulfate	SO4	mg/l	338.5	343.0	290.0	341.0	348.0
chloride	Cl	mg/l	316.5	371.0	393.0	266.0	234.0
ammonium	NH4	mg/l	0.39	0.38	0.57	0.38	0.22
nitrite	NO2	mg/l	<0.001	<0.001	0.00	<0.001	<0.001
nitrate	NO3	mg/l	0.04	0.03	0.00	0.07	0.00
fluoride	F	mg/l	0.75	0.64	0.99	0.70	0.66
silica	SiO2	mg/l	12.4	10.1	12.1	12.5	11.0
Non-Metals							
total dissolved solids	TDS	mg/l	1302	1398	1420	1226	1172
conductivity (umhos/cm)	Cond	umhos/cm	2136	2249	2400	1992	1905
alkalinity as CaCO3	Alk	mg/l	279.1	263.4	260.0	298.1	303.0
pH (std units)	pH	std. units	8.54	8.72	8.36	8.52	8.54
Trace Metals							
aluminum	Al	mg/l	n/a	n/a	n/a	n/a	n/a
arsenic	As	mg/l	<0.0035	0.002	<0.01	<0.001	<0.001
barium	Ba	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
boron	B	mg/l	0.885	0.720	0.930	0.870	1.020
cadmium	Cd	mg/l	<0.001	<0.001	0.001	<0.001	<0.001
chromium	Cr	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
copper	Cu	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
iron	Fe	mg/l	<0.03	<0.03	<0.03	<0.03	<0.03
lead	Pb	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
manganese	Mn	mg/l	<0.007	<0.005	<0.01	0.008	<0.005
mercury	Hg	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
molybdenum	Mo	mg/l	0.013	0.010	0.000	0.010	0.020
nickel	Ni	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
selenium	Se	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001
vanadium	V	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
zinc	Zn	mg/l	0.033	0.020	0.013	0.020	<0.01
Radiometric							
uranium natural (mg/l)	U-nat	mg/l	0.087	0.091	0.028	0.100	0.079
radium 226 (pCi/l)	Ra226	pCi/l	467.8	408.2	260.0	612.0	591.0
radium 226 precision	Ra226	precis	12.1	7.9	19.0	9.9	11.5

LI-6	LI-6	LI-6	LI-6			
Nov-90	Oct-90	Nov-90	Nov-90			
Average	bl1	bl2	bl3			
12.7	12.0	11.0	15.1			
3.1	2.6	3.0	3.7			
429.7	430.0	430.0	429.0			
11.3	11.0	11.0	11.9			
5.6	4.7	6.5	5.7			
334.7	323.0	336.0	345.0			
365.3	379.0	359.0	358.0			
216.7	227.0	203.0	220.0			
0.41	0.36	0.42	0.45			
<0.01	<0.01	<0.01	<0.01			
<0.06	0.15	<0.01	<0.01			
8.74	8.67	8.76	8.78			
18.8	19.0	20.8	16.7			
1196	1229	1167	1195			
1964	1891	2008	2008			
283.7	273.0	296.0	292.0			
8.56	8.50	8.62	8.55			
<0.1	<0.1	<0.1	<0.1			
<0.001	<0.001	<0.001	<0.001			
<0.1	<0.1	<0.1	<0.1			
0.907	0.910	0.920	0.890			
<0.01	<0.01	<0.01	<0.01			
<0.05	<0.05	<0.05	<0.05			
<0.01	<0.01	<0.01	<0.01			
<0.05	<0.05	<0.05	<0.05			
<0.01	<0.01	<0.01	<0.01			
<0.001	<0.001	<0.001	<0.001			
<0.1	<0.1	<0.1	<0.1			
<0.05	<0.05	<0.05	<0.05			
<0.001	<0.001	<0.001	<0.001			
<0.1	<0.1	<0.1	<0.1			
0.013	0.010	0.010	0.020			
0.108	0.110	0.146	0.069			
156.7	161.0	150.0	159.0			
4.6	4.9	4.7	4.2			

pt-9	pt-9	pt-9	pt-9	pt-9	pt-9	pt-9	pt-9
pz-8	pz-8	pz-8	pz-8	pz-8	pz-8	pz-8	pz-8
Apr-84	Dec-82	Jan-83	Apr-83	Jul-83	Oct-83	Jan-84	Apr-84
Average	bl1	bl2	bl3	bl4	bl5	bl6	bl7
13.8	17.0	13.0	14.0	12.0	12.0	10.0	11.8
2.1	2.8	2.5	2.0	1.6	2.1	1.9	2.0
407.7	408.0	390.0	420.0	400.0	400.0	420.0	416.0
13.4	13.0	13.0	12.0	15.0	15.0	13.0	13.0
13.6	23.0	17.0	<1	<1	16.0	15.0	24.0
358.0	353.0	350.0	379.0	365.0	357.0	361.0	341.0
351.7	355.0	390.0	353.0	367.0	337.0	367.0	333.0
186.6	190.0	190.0	184.8	190.0	184.4	181.0	196.0
0.44	0.82	0.40	0.45	0.41	0.18	0.26	0.58
<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01
<0.1	<0.01	<0.01	<0.1	<0.1	0.10	<0.1	<0.1
0.66	0.69	0.70	0.70	0.60	0.68	0.70	0.60
16.1	13.0	14.0	21.0	17.0	15.0	17.0	16.0
1176	1240	1200	1162	1156	1157	1185	1134
1866	1900	1820	1590	1970	1970	1990	1820
323.9	327.0	320.0	323.0	310.0	331.0	336.0	320.0
8.60	8.92	8.80	8.41	8.29	8.56	8.65	8.70
<0.146	n/a	0.100	<0.1	<0.1	0.300		0.130
<0.007	0.014	0.007	<0.01	<0.005	<0.005		<0.001
<0.1	0.100	<1	<1	<1	<1		<1
0.943	0.990	0.700	0.960	0.860	1.000		1.150
<0.00235	<.0001	<.001	<.01	<.001	<.001		<.001
<0.0034	<.001	<.001	n/a	<.005	<.005		<.005
<0.00933	0.004	0.005	<.01	<.01	<.01		0.017
<0.046167	0.020	<.05	<.05	<.05	0.090		0.037
<0.006833	<.001	<.005	0.020	<.005	<.005		<.005
<0.022333	0.000	<.1	<.01	<.005	0.005		<.005
<0.0002	<.0001	<.0001	<.0005	<.0002	<.0002		0.000
<0.047677	0.050	0.075	<.1	<.01	0.090		0.041
<0.01533	<.01	<.002	<.05	<.01	<.01		<.01
<0.02667	<.001	<.002	<.01	<.001	0.001		<.01
<0.04833	0.030	0.025	<.1	0.030	0.030		0.030
<0.015667	0.008	<.005	0.040	<.01	<.01		0.021
0.304	0.441	0.390	0.305	0.280	0.254	0.229	0.229
428.4	602.0	207.0	491.0	369.0	543.0	267.0	464.0
4.7	2.0	5.0	4.5	3.2	7.0	4.0	7.0

LI-13	LI-13	LI-13	LI-13
Nov-90	Oct-90	Nov-90	Nov-90
Averag	bl1	bl2	bl3
9.5	11.0	7.9	9.5
2.8	3.0	2.2	3.1
401.7	405.0	410.0	390.0
10.6	11.0	11.0	9.7
5.6	4.1	7.4	5.2
314.7	343.0	286.0	315.0
358.3	368.0	364.0	341.0
196.3	189.0	193.0	189.0
0.35	0.37	0.37	0.31
<0.01	<0.01	<0.01	<0.01
<0.83	0.05	0.02	<0.01
0.73	0.59	0.82	0.78
22.0	19.7	23.7	20.7
1129	1149	1118	1120
1974	2014	1905	2006
267.3	258.0	267.0	267.0
8.57	8.48	8.75	8.55
<0.1	<0.1	<0.1	<0.1
0.004	0.004	0.005	0.004
<0.1	<0.1	<0.1	<0.1
0.937	0.920	0.920	0.970
<0.01	<0.01	<0.01	<0.01
<0.05	<0.05	<0.05	<0.05
<0.01	<0.01	<0.01	<0.01
<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05
<0.01	<0.01	<0.01	<0.01
<0.001	<0.001	<0.001	<0.001
<0.1	<0.1	<0.1	<0.1
<0.05	<0.05	<0.05	<0.05
<0.001	<0.001	<0.001	<0.001
<0.1	<0.1	<0.1	<0.1
<0.0133	0.020	<0.01	0.010
0.241	0.199	0.223	0.241
566.3	554.0	443.0	432.0
8.9	12.0	7.8	7.0

Mine Unit 1

Well Number			LJ-13	LJ-13	LJ-13	LJ-13
2ND Well Number						
Date			Nov-90	Oct-90	Nov-90	Nov-90
Major Ions			Average	bl1	bl2	bl3
calcium	Ca	mg/l	9.5	11.0	7.9	9.5
magnesium	Mg	mg/l	2.8	3.0	2.2	3.1
sodium	Na	mg/l	401.7	405.0	410.0	390.0
potassium	K	mg/l	10.6	11.0	11.0	9.7
carbonate	CO3	mg/l	5.6	4.1	7.4	5.2
bicarbonate	HCO3	mg/l	314.7	343.0	286.0	315.0
sulfate	SO4	mg/l	358.3	368.0	366.0	341.0
chloride	Cl	mg/l	190.3	189.0	193.0	189.0
ammonium	NH4	mg/l	0.35	0.37	0.37	0.31
nitrite	NO2	mg/l	<0.01	<0.01	<0.01	<0.01
nitrate	NO3	mg/l	<0.03	0.05	0.02	<0.01
fluoride	F	mg/l	0.73	0.59	0.82	0.78
silica	SiO2	mg/l	22.0	19.7	25.7	20.7
Non-Metals						
total dissolved solids	TDS	mg/l	1129	1149	1118	1120
conductivity (umhos/cm)	Cond	umhos/cm	1974	2014	1903	2006
alkalinity as CaCO3	Alk	mg/l	267.3	281.0	247.0	267.0
pH (std units)	pH	std. units	8.57	8.41	8.75	8.55
Trace Metals						
aluminum	Al	mg/l	<0.1	<0.1	<0.1	<0.1
arsenic	As	mg/l	0.004	0.004	0.005	0.004
barium	Ba	mg/l	<0.1	<0.1	<0.1	<0.1
boron	B	mg/l	0.937	0.920	0.920	0.970
cadmium	Cd	mg/l	<0.01	<0.01	<0.01	<0.01
chromium	Cr	mg/l	<0.05	<0.05	<0.05	<0.05
copper	Cu	mg/l	<0.01	<0.01	<0.01	<0.01
iron	Fe	mg/l	<0.05	<0.05	<0.05	<0.05
lead	Pb	mg/l	<0.05	<0.05	<0.05	<0.05
manganese	Mn	mg/l	<0.01	<0.01	<0.01	<0.01
mercury	Hg	mg/l	<0.001	<0.001	<0.001	<0.001
molybdenum	Mo	mg/l	<0.1	<0.1	<0.1	<0.1
nickel	Ni	mg/l	<0.05	<0.05	<0.05	<0.05
selenium	Se	mg/l	<0.001	<0.001	<0.001	<0.001
vanadium	V	mg/l	<0.1	<0.1	<0.1	<0.1
zinc	Zn	mg/l	<0.0133	0.020	<0.01	0.010
Radiometric						
uranium natural (mg/l)	U-nat	mg/l	0.241	0.199	0.253	0.241
radium 226 (pCi/l)	Ra226	pCi/l	566.3	854.0	413.0	432.0
radium 226 precision	Ra226 prec		8.9	12.0	7.8	7.0

	pz-15	pz-15	pz-15	pz-15
	Nov-90	Oct-90	Nov-90	Nov-90
	Average	bl1	bl2	bl3
	13.2	5.9	16.0	17.8
	3.9	3.0	4.1	4.7
	398.7	405.0	410.0	391.0
	11.1	10.0	11.0	12.3
	5.9	5.0	7.1	5.7
	361.7	360.0	361.0	364.0
	352.3	357.0	352.0	348.0
	180.3	186.0	176.0	179.0
	0.53	0.32	0.94	0.33
	<0.033	<0.01	0.05	0.04
	0.05	0.04	0.09	0.02
	0.69	0.59	0.76	0.72
	16.7	15.0	18.2	16.9
	1137	1139	1130	1143
	1867	1759	1939	1985
	306.7	304.0	308.0	308.0
	8.55	8.48	8.63	8.53
	<0.1	<0.1	<0.1	<0.1
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	0.910	0.840	0.890	1.000
	<0.01	<0.01	<0.01	<0.01
	<0.05	<0.05	<0.05	<0.05
	<0.01	<0.01	<0.01	<0.01
	<0.0533	<0.05	0.060	<0.05
	<0.05	<0.05	<0.05	<0.05
	0.013	0.020	0.010	0.010
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	<0.05	<0.05	<0.05	<0.05
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	<0.02	<0.01	0.040	0.010
	0.056	0.034	0.079	0.054
	18.5	24.7	18.6	18.1
	1.0	1.1	0.9	1.0

	pz-19	pz-19	pz-19	pz-19
	Nov-90	Oct-90	Nov-90	Nov-90
	Average	bl1	bl2	bl3
	14.0	14.0	13.0	14.9
	3.8	3.5	3.7	4.2
	406.7	410.0	410.0	400.0
	12.3	13.0	12.0	12.0
	4.9	3.3	6.6	4.8
	348.7	351.0	349.0	346.0
	361.3	370.0	362.0	352.0
	188.7	191.0	186.0	189.0
	0.28	0.34	0.22	0.28
	<0.01	<0.01	<0.01	<0.01
	0.03	0.02	0.03	0.05
	0.69	0.59	0.73	0.73
	17.2	18.2	18.6	14.7
	1154	1156	1142	1165
	1994	2024	1962	1995
	294.0	293.0	297.0	292.0
	8.47	8.31	8.61	8.48
	<0.1	<0.1	<0.1	<0.1
	<0.001	0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	0.943	0.910	0.930	1.000
	<0.01	<0.01	<0.01	<0.01
	<0.05	<0.05	<0.05	<0.05
	<0.01	<0.01	<0.01	<0.01
	<0.05	<0.05	<0.05	<0.05
	<0.05	<0.05	<0.05	<0.05
	<0.01	<0.01	<0.01	<0.01
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	<0.05	<0.05	<0.05	<0.05
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	<0.01	<0.01	0.010	0.010
	0.036	0.041	0.032	0.036
	250.7	244.0	263.0	245.0
	6.4	6.7	6.3	6.3

	LJ-25	LJ-25	LJ-25	LJ-25
	Nov-90	Oct-90	Nov-90	Nov-90
	Average	bl1	bl2	bl3
	8.7	10.0	5.8	10.4
	2.5	2.9	2.0	2.6
	402.3	408.0	410.0	397.0
	12.8	13.0	13.0	12.3
	5.8	4.0	6.0	7.3
	306.7	321.0	277.0	322.0
	360.3	367.0	371.0	343.0
	204.3	203.0	213.0	197.0
	0.39	0.32	0.55	0.29
	<0.0166	<0.01	<0.01	0.05
	0.13	0.33	0.02	0.05
	0.70	0.61	0.70	0.78
	22.9	21.2	25.7	21.9
	1126	1116	1133	1128
	1970	2016	1961	1933
	261.0	270.0	257.0	256.0
	8.60	8.43	8.67	8.69
	<0.1	<0.1	<0.1	<0.1
	<0.001	<0.001	<0.001	0.001
	<0.1	<0.1	<0.1	<0.1
	0.933	0.900	0.920	0.980
	<0.01	<0.01	<0.01	<0.01
	<0.05	<0.05	<0.05	<0.05
	<0.01	<0.01	<0.01	<0.01
	<0.05	<0.05	<0.05	<0.05
	<0.05	<0.05	<0.05	<0.05
	<0.01	<0.01	<0.01	<0.01
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	<0.05	<0.05	<0.05	<0.05
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	<0.0133	0.020	<0.01	<0.01
	0.035	0.036	0.026	0.043
	148.2	228.0	89.8	127.0
	4.5	6.0	3.7	3.8

	LJ-28	LJ-28	LJ-28	LJ-28
	Nov-90	Oct-90	Nov-90	Nov-90
	Average	bl1	bl2	bl3
	17.3	14.0	14.0	23.8
	4.6	3.9	4.0	5.8
	410.7	410.0	420.0	402.0
	12.1	12.0	12.0	12.3
	4.2	3.0	6.8	3.7
	371.7	381.0	368.0	366.0
	363.7	363.0	371.0	357.0
	189.3	189.0	186.0	193.0
	0.32	0.35	0.25	0.35
	<0.01	<0.01	<0.01	<0.01
	<0.02	0.04	<0.01	<0.01
	0.68	0.54	0.73	0.78
	17.9	16.3	17.1	20.3
	1173	1173	1163	1183
	1980	2044	1982	1913
	311.7	312.0	313.0	310.0
	8.43	8.16	8.60	8.53
	<0.1	<0.1	<0.1	<0.1
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	0.953	0.900	0.905	1.050
	<0.01	<0.01	<0.01	<0.01
	<0.05	<0.05	<0.05	<0.05
	<0.01	<0.01	<0.01	<0.01
	<0.05	<0.05	<0.05	<0.05
	<0.05	<0.05	<0.05	<0.05
	<0.01	<0.01	<0.01	0.010
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	<0.05	<0.05	<0.05	<0.05
	<0.001	<0.001	<0.001	<0.001
	<0.1	<0.1	<0.1	<0.1
	0.017	0.010	0.020	0.020
	0.059	0.061	0.050	0.068
	108.3	110.0	114.0	101.0
	3.9	4.4	4.1	3.1

INT-021

Mine Unit 1

Well Number			LJ-45	LJ-45	LJ-45	LJ-45
2ND Well Number						
Date			Nov-90	Oct-90	Nov-90	Nov-90
Major Ions			Average	bl1	bl2	bl3
calcium	Ca	mg/l	7.6	6.9	4.5	11.5
magnesium	Mg	mg/l	2.2	1.8	1.3	3.5
sodium	Na	mg/l	423.3	420.0	440.0	410.0
potassium	K	mg/l	14.9	13.0	14.0	17.6
carbonate	CO3	mg/l	7.1	6.3	9.4	5.7
bicarbonate	HCO3	mg/l	314.7	299.0	300.0	345.0
sulfate	SO4	mg/l	365.7	364.0	367.0	366.0
chloride	Cl	mg/l	218.0	241.0	227.0	186.0
ammonium	NH4	mg/l	<0.1933	0.28	0.25	<0.05
nitrite	NO2	mg/l	<0.01	<0.01	<0.01	<0.01
nitrate	NO3	mg/l	<0.01667	0.01	0.03	<0.01
fluoride	F	mg/l	0.71	0.62	0.79	0.72
silica	SiO2	mg/l	18.5	18.4	21.4	15.7
Non-Metals						
total dissolved solids	TDS	mg/l	1197	1197	1203	1201
conductivity (umhos/cm)	Cond	umhos/cm	1951	1900	2045	1909
alkalinity as CaCO3	Alk	mg/l	270.0	256.0	262.0	292.0
pH (std units)	pH	std. units	8.68	8.66	8.83	8.55
Trace Metals						
aluminum	Al	mg/l	<0.1	<0.1	<0.1	<0.1
arsenic	As	mg/l	<0.001	<0.001	<0.001	<0.001
barium	Ba	mg/l	<0.1	<0.1	<0.1	<0.1
boron	B	mg/l	0.920	0.870	0.920	0.970
cadmium	Cd	mg/l	<0.01	<0.01	<0.01	<0.01
chromium	Cr	mg/l	<0.05	<0.05	<0.05	<0.05
copper	Cu	mg/l	<0.01	<0.01	<0.01	0.010
iron	Fe	mg/l	<0.05	<0.05	<0.05	<0.05
lead	Pb	mg/l	<0.05	<0.05	<0.05	<0.05
manganese	Mn	mg/l	<0.01	<0.01	<0.01	<0.01
mercury	Hg	mg/l	<0.001	<0.001	<0.001	<0.001
molybdenum	Mo	mg/l	<0.1	<0.1	<0.1	<0.1
nickel	Ni	mg/l	<0.05	<0.05	<0.05	<0.05
selenium	Se	mg/l	<0.001	<0.001	<0.001	<0.001
vanadium	V	mg/l	<0.1	<0.1	<0.1	<0.1
zinc	Zn	mg/l	<0.01	<0.01	<0.01	<0.01
Radionuclides						
uranium natural (mg/l)	U-nat	mg/l	0.073	0.050	0.086	0.082
radium 226 (pCi/l)	Ra226	pCi/l	88.1	92.4	57.0	115.0
radium 226 precision	Ra226	prcnt	3.4	3.7	2.9	3.5

Appendix 3

Mine Unit 1 Post-Mining
Water Quality Sampling Results

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	IJ-25
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8712
MAJOR IONS mg:l	
Ca - Calcium	89.4
Mg - Magnesium	22.5
Na - Sodium	1177
K - Potassium	30.0
CO3 - Carbonate	0
HCO3 - Bicarbonate	1111
SO4 - Sulfate	1119
Cl - Chloride	594
NH4 - Ammonium	<0.05
NO2 - Nitrite	<0.01
NO3 - Nitrate	0.86
F - Fluoride	0.38
SiO2 - Silica	26.4
TDS - Total Dissolved Solids	3751
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5807
Alk - Alkalinity as CaCO3 (CaC03)	911
pH (std units)	7.65
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.020
Ba - Barium	<0.10
B - Boron	1.13
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.08
Hg - Mercury	<0.001
Mo - Molybdenum	0.56
Ni - Nickel	0.12
Se - Selenium	0.100
V - Vanadium	1.03
Zn - Zinc	0.02
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	9.90
Ra226 - Radium 226	1258
Radium 226 Precision	12.3
Quality Assurance Data:	
Anion Milliequivalents	58.35
Cation Milliequivalents	58.31
WDEQ A/C Bal.%	-0.03
Calculated TDS mg/l	3618
TDS Balance A/C %	1.04

Report Approved By: R.A. Starling

kmk 8712fer

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	IJ-6
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8713
MAJOR IONS mg:l	
Ca - Calcium	87.6
Mg - Magnesium	21.4
Na - Sodium	1054
K - Potassium	27.2
CO3 - Carbonate	0
HCO3 - Bicarbonate	1057
SO4 - Sulfate	1031
Cl - Chloride	544
NH4 - Ammonium	0.44
NO2 - Nitrite	0.11
NO3 - Nitrate	1.29
F - Fluoride	0.45
SiO2 - Silica	33.3
TDS - Total Dissolved Solids	3515
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5445
Alk - Alkalinity as CaCO3 (CaCO3)	866
pH (std units)	7.16
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.031
Ba - Barium	<0.10
B - Boron	1.06
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	0.02
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.14
Hg - Mercury	<0.001
Mo - Molybdenum	0.47
Ni - Nickel	<0.05
Se - Selenium	0.112
V - Vanadium	1.12
Zn - Zinc	0.11
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	13.90
Ra226 - Radium 226	1113
Radium 226 Precision	11.4
Quality Assurance Data:	
Anion Milliequivalents	54.25
Cation Milliequivalents	52.74
WDEQ A/C Bal. %	-1.41
Calculated TDS mg/l	3334
TDS Balance A/C %	1.05

Report Approved By: R.A. Gearing

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PROJECT: MU-1 Initial Restoration

Sample Identification:	IJ-13
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8714
MAJOR IONS mg:l	
Ca - Calcium	93.9
Mg - Magnesium	23.6
Na - Sodium	1174
K - Potassium	31.3
CO3 - Carbonate	0
HCO3 - Bicarbonate	1086
SO4 - Sulfate	1209
Cl - Chloride	598
NH4 - Ammonium	0.07
NO2 - Nitrite	<0.01
NO3 - Nitrate	0.74
F - Fluoride	0.37
SiO2 - Silica	34.3
TDS - Total Dissolved Solids	3899
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	6012
Alk - Alkalinity as CaCO3 (CaCO3)	890
pH (std units)	7.35
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.028
Ba - Barium	<0.10
B - Boron	1.26
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.15
Hg - Mercury	<0.001
Mo - Molybdenum	0.50
Ni - Nickel	0.12
Se - Selenium	0.122
V - Vanadium	1.18
Zn - Zinc	0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	9.31
Ra226 - Radium 226	1558
Radium 226 Precision	18.1
Quality Assurance Data:	
Anion Milliequivalents	59.91
Cation Milliequivalents	58.56
WDEQ A/C Bal.%	-1.14
Calculated TDS mg/l	3711
TDS Balance A/C %	1.05

Report Approved By: R.A. Starling

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	IJ-28
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8715
MAJOR IONS mg:l	
Ca - Calcium	89.6
Mg - Magnesium	23.1
Na - Sodium	1182
K - Potassium	31.3
CO3 - Carbonate	0
HCO3 - Bicarbonate	1207
SO4 - Sulfate	1112
Cl - Chloride	619
NH4 - Ammonium	<0.05
NO2 - Nitrite	<0.01
NO3 - Nitrate	1.30
F - Fluoride	0.45
SiO2 - Silica	31.6
TDS - Total Dissolved Solids	3886
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	6025
Alk - Alkalinity as CaCO3 (CaCO3)	989
pH (std units)	7.81
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.028
Ba - Barium	<0.10
B - Boron	1.19
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.06
Hg - Mercury	<0.001
Mo - Molybdenum	0.51
Ni - Nickel	0.12
Se - Selenium	0.138
V - Vanadium	1.24
Zn - Zinc	<0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	2.52
Ra226 - Radium 226	1147
Radium 226 Precision	11.8
Quality Assurance Data:	
Anion Milliequivalents	60.50
Cation Milliequivalents	58.62
WDEQ A/C Bal.%	-1.58
Calculated TDS mg/l	3698
TDS Balance A/C %	1.05

Report Approved By: R.A. Starling

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	PR-15
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8716
MAJOR IONS mg:l	
Ca - Calcium	86.7
Mg - Magnesium	23.1
Na - Sodium	1172
K - Potassium	30.0
CO3 - Carbonate	0
HCO3 - Bicarbonate	1170
SO4 - Sulfate	1115
Cl - Chloride	603
NH4 - Ammonium	0.15
NO2 - Nitrite	<0.01
NO3 - Nitrate	1.60
F - Fluoride	0.40
SiO2 - Silica	30.0
TDS - Total Dissolved Solids	3807
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5940
Alk - Alkalinity as CaCO3 (CaCO3)	959
pH (std units)	7.78
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.024
Ba - Barium	<0.10
B - Boron	1.25
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	<0.01
Hg - Mercury	<0.001
Mo - Molybdenum	0.53
Ni - Nickel	<0.05
Se - Selenium	0.148
V - Vanadium	1.56
Zn - Zinc	<0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	5.18
Ra226 - Radium 226	109
Radium 226 Precision	3.5
Quality Assurance Data:	
Anion Milliequivalents	59.53
Cation Milliequivalents	58.01
WDEQ A/C Bal. %	-1.29
Calculated TDS mg/l	3653
TDS Balance A/C %	1.04

Report Approved By: R.A. Searing

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	PR-19
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8717
MAJOR IONS mg:l	
Ca - Calcium	98.3
Mg - Magnesium	23.8
Na - Sodium	1083
K - Potassium	28.6
CO3 - Carbonate	0
HCO3 - Bicarbonate	959
SO4 - Sulfate	1283
Cl - Chloride	590
NH4 - Ammonium	0.49
NO2 - Nitrite	0.05
NO3 - Nitrate	0.46
F - Fluoride	0.35
SiO2 - Silica	22.2
TDS - Total Dissolved Solids	3765
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5819
Alk - Alkalinity as CaCO3 (CaCO3)	786
pH (std units)	6.92
TRACE METALS mg/l:	
Al - Aluminum	0.29
As - Arsenic	0.011
Ba - Barium	<0.10
B - Boron	1.17
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	0.38
Pb - Lead	<0.05
Mn - Manganese	0.16
Hg - Mercury	<0.001
Mo - Molybdenum	0.37
Ni - Nickel	<0.05
Se - Selenium	0.041
V - Vanadium	0.28
Zn - Zinc	<0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	6.78
Ra226 - Radium 226	1182
Radium 226 Precision	11.8
Quality Assurance Data:	
Anion Milliequivalents	59.12
Cation Milliequivalents	54.82
WDEQ A/C Bal.%	-3.78
Calculated TDS mg/l	3612
TDS Balance A/C %	1.04

Report Approved By: R.A. Starling

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68

INT-021

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	PR-8
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8718
MAJOR IONS mg:l	
Ca - Calcium	85.4
Mg - Magnesium	23.2
Na - Sodium	1144
K - Potassium	30.0
CO3 - Carbonate	0
HCO3 - Bicarbonate	1170
SO4 - Sulfate	1115
Cl - Chloride	603
NH4 - Ammonium	0.27
NO2 - Nitrite	0.05
NO3 - Nitrate	1.46
F - Fluoride	0.43
SiO2 - Silica	33.2
TDS - Total Dissolved Solids	3820
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5819
Alk - Alkalinity as CaCO3 (CaCO3)	959
pH (std units)	7.46
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.028
Ba - Barium	<0.10
B - Boron	1.23
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.02
Hg - Mercury	<0.001
Mo - Molybdenum	0.59
Ni - Nickel	<0.05
Se - Selenium	0.154
V - Vanadium	1.23
Zn - Zinc	<0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	5.24
Ra226 - Radium 226	417
Radium 226 Precision	6.9
Quality Assurance Data:	
Anion Milliequivalents	59.53
Cation Milliequivalents	56.75
WDEQ A/C Bal.%	-2.39
Calculated TDS mg/l	3626
TDS Balance A/C %	1.05

Report Approved By: R.A. Starling

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	PT-5
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8719
MAJOR IONS mg:l	
Ca - Calcium	87.9
Mg - Magnesium	23.6
Na - Sodium	1144
K - Potassium	30.0
CO3 - Carbonate	0
HCO3 - Bicarbonate	981
SO4 - Sulfate	1240
Cl - Chloride	594
NH4 - Ammonium	0.33
NO2 - Nitrite	<0.01
NO3 - Nitrate	0.99
F - Fluoride	0.45
SiO2 - Silica	24.7
TDS - Total Dissolved Solids	3851
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5964
Alk - Alkalinity as CaCO3 (CaCO3)	804
pH (std units)	7.28
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.017
Ba - Barium	<0.10
B - Boron	1.36
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.04
Hg - Mercury	<0.001
Mo - Molybdenum	0.53
Ni - Nickel	<0.05
Se - Selenium	0.240
V - Vanadium	1.15
Zn - Zinc	0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	9.30
Ra226 - Radium 226	1139
Radium 226 Precision	11.3
Quality Assurance Data:	
Anion Milliequivalents	58.74
Cation Milliequivalents	56.93
WDEO A/C Bal.%	-1.57
Calculated TDS mg/l	3640
TDS Balance A/C %	1.06

Report Approved By: R. A. Starling

kmk 8712fer

ENERGY LABORATORIES, INC.
P.O. BOX 3258 • CASPER, WY 82602 • PHONE (307) 235-0515
254 NORTH CENTER, SUITE 100 • CASPER, WY 82601 • FAX (307) 234-1639

FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	IJ-45
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8721
MAJOR IONS mg:l	
Ca - Calcium	89.9
Mg - Magnesium	24.8
Na - Sodium	1126
K - Potassium	32.7
CO3 - Carbonate	0
HCO3 - Bicarbonate	1104
SO4 - Sulfate	1134
Cl - Chloride	607
NH4 - Ammonium	0.33
NO2 - Nitrite	0.04
NO3 - Nitrate	1.25
F - Fluoride	0.43
SiO2 - Silica	28.3
TDS - Total Dissolved Solids	3873
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5916
Alk - Alkalinity as CaCO3 (CaCO3)	905
pH (std units)	7.37
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.023
Ba - Barium	<0.10
B - Boron	1.15
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.06
Hg - Mercury	<0.001
Mo - Molybdenum	0.53
Ni - Nickel	<0.05
Se - Selenium	0.149
V - Vanadium	1.29
Zn - Zinc	<0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	14.83
Ra226 - Radium 226	681
Radium 226 Precision	9.2
Quality Assurance Data:	
Anion Milliequivalents	58.94
Cation Milliequivalents	56.40
WDEQ A/C Bal.%	-2.20
Calculated TDS mg/l	3601
TDS Balance A/C %	1.08

Report Approved By: R.A. Starling

kmk 8712fer

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	PH-5
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8722
MAJOR IONS mg:l	
Ca - Calcium	80.8
Mg - Magnesium	22.7
Na - Sodium	1054
K - Potassium	30.0
CO3 - Carbonate	0
HCO3 - Bicarbonate	972
SO4 - Sulfate	1115
Cl - Chloride	586
NH4 - Ammonium	0.14
NO2 - Nitrite	0.09
NO3 - Nitrate	0.97
F - Fluoride	0.54
SiO2 - Silica	35.3
TDS - Total Dissolved Solids	3756
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5590
Alk - Alkalinity as CaCO3 (CaCO3)	797
pH (std units)	6.85
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.018
Ba - Barium	<0.10
B - Boron	1.09
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	0.05
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.05
Hg - Mercury	<0.001
Mo - Molybdenum	0.42
Ni - Nickel	<0.05
Se - Selenium	0.129
V - Vanadium	0.38
Zn - Zinc	0.11
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	54.52
Ra226 - Radium 226	329
Radium 226 Precision	6.2
Quality Assurance Data:	
Anion Milliequivalents	55.78
Cation Milliequivalents	52.56
WDEQ A/C Bal.%	-2.98
Calculated TDS mg/l	3415
TDS Balance A/C %	1.10

Report Approved By: R.A. Gearing

kmk 8712fer

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	PM-1
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-8720
MAJOR IONS mg:1	
Ca - Calcium	87.9
Mg - Magnesium	22.6
Na - Sodium	1154
K - Potassium	32.7
CO3 - Carbonate	0
HCO3 - Bicarbonate	1099
SO4 - Sulfate	1109
Cl - Chloride	598
NH4 - Ammonium	0.33
NO2 - Nitrite	<0.01
NO3 - Nitrate	1.06
F - Fluoride	0.37
SiO2 - Silica	25.7
TDS - Total Dissolved Solids	3694
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	5843
Alk - Alkalinity as CaCO3 (CaCO3)	901
pH (std units)	7.65
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.018
Ba - Barium	<0.10
B - Boron	1.17
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.02
Hg - Mercury	<0.001
Mo - Molybdenum	0.60
Ni - Nickel	<0.05
Se - Selenium	0.139
V - Vanadium	1.00
Zn - Zinc	<0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	8.63
Ra226 - Radium 226	370
Radium 226 Precision	6.5
Quality Assurance Data:	
Anion Milliequivalents	58.07
Cation Milliequivalents	57.33
WDEQ A/C Bal.%	-0.64
Calculated TDS mg/l	3585
TDS Balance A/C %	1.03

Report Approved By: R.A. Leaking

kmk 8712fer

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration

Sample Identification:	PM-4
Sample Date:	03-23-94
Report Date:	04-13-94
Laboratory I.D. #:	94-6723
MAJOR IONS mg:l	
Ca - Calcium	87.1
Mg - Magnesium	20.6
Na - Sodium	942
K - Potassium	26.3
CO3 - Carbonate	0
HCO3 - Bicarbonate	900
SO4 - Sulfate	659
Cl - Chloride	455
NH4 - Ammonium	0.67
NO2 - Nitrite	0.02
NO3 - Nitrate	<0.10
F - Fluoride	0.26
SiO2 - Silica	18.2
TDS - Total Dissolved Solids	3121
TSS - Total Suspended Solids	
EC - Conductivity (umho/cm)	4841
Alk - Alkalinity as CaCO3 (CaCO3)	738
pH (std units)	6.87
TRACE METALS mg/l:	
Al - Aluminum	<0.10
As - Arsenic	0.007
Ba - Barium	<0.10
B - Boron	1.44
Cd - Cadmium	<0.01
Cr - Chromium	<0.05
Cu - Copper	<0.01
Fe - Iron	<0.05
Pb - Lead	<0.05
Mn - Manganese	0.11
Hg - Mercury	<0.001
Mo - Molybdenum	0.20
Ni - Nickel	<0.05
Se - Selenium	0.012
V - Vanadium	<0.10
Zn - Zinc	0.14
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	6.29
Ra226 - Radium 226	126
Radium 226 Precision	5.0
Quality Assurance Data:	
Anion Milliequivalents	47.58
Cation Milliequivalents	47.77
WDEQ A/C Bal.%	0.21
Calculated TDS mg/l	2960
TDS Balance A/C %	1.05

Report Approved By: R.A. Starling

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FERRET EXPLORATION OF NEBRASKA, INC.

PROJECT: MU-1 Initial Restoration Samples

MAJOR IONS mg:l	Det. Limit
Ca - Calcium	0.10
Mg - Magnesium	0.10
Na - Sodium	0.10
K - Potassium	0.10
CO3 - Carbonate	0.10
HCO3 - Bicarbonate	0.10
SO4 - Sulfate	1.00
Cl - Chloride	0.10
NH4 - Ammonium	0.05
NO2 - Nitrite	0.01
NO3 - Nitrate	0.1
F - Fluoride	0.1
SiO2 - Silica	1.0
TDS - Total Dissolved Solids	1.0
TSS - Total Suspended Solids	1.0
EC - Conductivity (umho/cm)	1.0
Alk - Alkalinity as CaCO3 (CaCO3)	0.1
pH (std units)	1-14
TRACE METALS mg/l:	
Al - Aluminum	0.10
As - Arsenic	0.001
Ba - Barium	0.10
B - Boron	0.10
Cd - Cadmium	0.01
Cr - Chromium	0.05
Cu - Copper	0.01
Fe - Iron	0.05
Pb - Lead	0.05
Mn - Manganese	0.01
Hg - Mercury	0.001
Mo - Molybdenum	0.10
Ni - Nickel	0.05
Se - Selenium	0.001
V - Vanadium	0.10
Zn - Zinc	0.01
RADIOMETRIC pCi/l:	
U-nat - Uranium Natural (mg/l)	0.0003
Ra226 - Radium 226	0.2
Radium 226 Precision	

Quality Assurance Data:	Acceptable Range
Anion Milliequivalents	
Cation Milliequivalents	
WDEQ A/C Bal %	-5 - +5
Calculated TDS mg/l	
TDS Balance A/C %	0.90-1.10

Report Approved By:
kmk 8712fer

ELI

QUALITY ASSURANCE REPORT – Ferret Exploration of Nebraska, Inc.
Report Date: 04-26-94
ELI #(s): 94:8712-8723

MAJOR IONS mg/l:	METHOD	Dup #1 %	Dup #2 %	Spk #1 %	Spk #2 %	ANALYST	DATE SAMPLE ANALYZED
Calcium	EPA-200.7	100	–	100	–	PG	03-31-94
Magnesium	EPA-200.7	100	–	100	–	PG	03-31-94
Sodium	EPA-200.7	104	–	104	–	PG	03-31-94
Potassium	EPA-258.1	100	–	100	–	PG	03-31-94
Carbonate	EPA-310.1	100	–	100	–	RK	03-28-94
Bicarbonate	EPA-310.1	100	–	100	–	RK	03-28-94
Sulfate	EPA-375.3	98	–	98	–	RK	03-29-94
Chloride	EPA-325.3	98	–	101	–	RK	03-30-94
Ammonium	EPA-350.1	92	–	98	–	RK	04-05-94
Nitrite	EPA-354.1	100	–	85	–	RK	04-04-94
Nitrate	EPA-353.2	100	–	97	–	RK	04-01-94
Fluoride	EPA-340.2	105	–	100	–	DC	03-30-94
Silica	EPA-200.7	102	–	104	–	CP	04-01-94
TDS @ 180 C	EPA-160.1	100	–	–	–	RCB	03-31-94
Cond (umho/cm)	EPA-120.1	100	–	–	–	RCB	03-30-94
Alkalinity	EPA-310.1	100	–	100	–	RK	03-28-94
pH (units)	EPA-150.1	100	–	–	–	RK	03-28-94
TRACE METALS mg/l:							
Aluminum	EPA-200.7	100	–	80	–	CP	04-01-94
Arsenic	EPA-206.3	109	–	98	–	PG	04-06-94
Barium	EPA-200.7	100	–	103	–	CP	04-11-94
Boron	EPA-200.7	103	–	100	–	CP	04-11-94
Cadmium	EPA-200.7	100	–	94	–	CP	04-11-94
Chromium	EPA-200.7	100	–	93	–	CP	04-11-94
Copper	EPA-200.7	100	–	95	–	CP	04-11-94
Iron	EPA-200.7	100	–	100	–	CP	04-11-94
Lead	EPA-239.2	100	–	107	–	CP	04-11-94
Manganese	EPA-200.7	100	–	101	–	CP	04-11-94
Mercury	EPA-245.2	100	–	106	–	PG	03-28-94
Molybdenum	EPA-200.7	100	–	98	–	CP	04-01-94
Nickel	EPA-200.7	100	–	92	–	CP	04-01-94
Selenium	EPA-270.3	100	–	110	–	PG	04-07-94
Vanadium	EPA-200.7	99	–	101	–	CP	04-01-94
Zinc	EPA-200.7	100	–	100	–	CP	04-01-94

RADIOMETRIC:	METHOD	Dup #1 %	Dup #2 %	Spk #1 %	Spk #2 %	ANALYST	DATE SAMPLE ANALYZED
Uranium	EPA-908.1	126	–	123	–	DB	03-30-94
Ra226	EPA-903.0	86	–	97	–	DB	04-05-94

USEPA-ESML-LV INTERCOMPARISON STUDY RESULTS

Radiometric	Method	ELI Value	Standard	Difference	Analyst	Date
Uranium	EPA-908.1	20.73	25.30	-4.57	DB	08-13-93
Ra226	EPA-903.1	15.23	14.90	0.33	DB	09-17-93
Ra228	EPA-904.1	16.13	20.40	-4.27	DB	09-17-93
Gross Alpha	EPA-900.0	16.00	20.00	-4.00	DB	10-29-93
Gross Beta	EPA-900.0	19.00	15.00	4.00	DB	10-29-93

Report Approved By: DB

wla 94:8712-8723

Appendix 4

Affect of Groundwater Transfer on Selected Parameters

Periodic Water Analysis of Selected Wells in Mine Unit 1

Chloride Analysis (mg/l)

Sample Date	Well						Average
	IJ 25P-1	IJ 28P-1	IJ 45P-2	PR 6-2	PR 15-1	PR 19-1	
Baseline	204	189	218	187	180	189	195
03/24/94	594	619	607	603	603	590	603
07/06/94	596	596	596	467	524	560	557
10/19/94	506	525	493	519	495	512	508
05/11/95	456	495	440	503	417	468	463

Sulfate Analysis (mg/l)

Sample Date	Well						Average
	IJ 25P-1	IJ 28P-1	IJ 45P-2	PR 6-2	PR 15-1	PR 19-1	
Baseline	360	364	366	352	352	361	359
03/24/94	1,119	1,112	1,134	1,115	1,115	1,283	1,146
07/06/94	1,333	1,191	1,414	1,007	1,117	1,361	1,237
10/19/94	1,139	1,148	1,086	1,118	1,088	1,146	1,121
05/11/95	953	1,042	873	1,055	838	957	953

Sodium Analysis (mg/l)

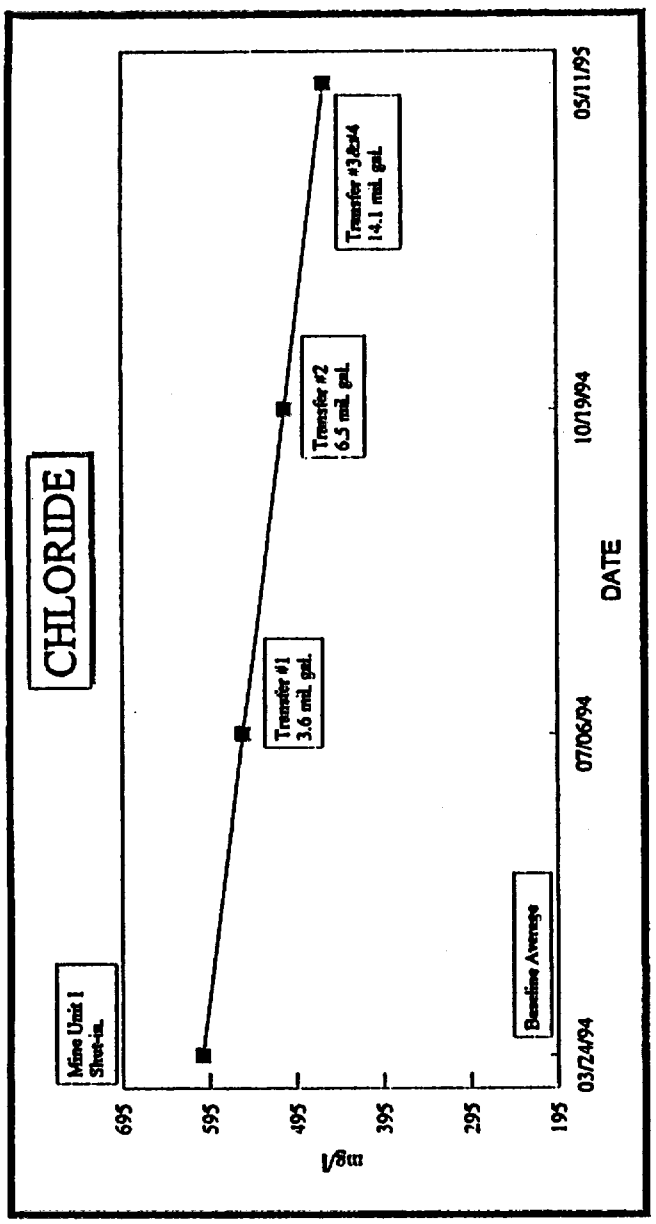
Sample Date	Well						Average
	IJ 25P-1	IJ 28P-1	IJ 45P-2	PR 6-2	PR 15-1	PR 19-1	
Baseline	402	411	423	408	399	407	408
03/24/94	1,177	1,182	1,126	1,144	1,172	1,083	1,147
07/06/94	1,309	1,260	1,276	979	1,199	1,177	1,200
10/19/94	1,133	1,177	1,122	1,133	1,172	1,128	1,144
05/11/95	1,012	1,111	962	1,100	952	1,243	1,063

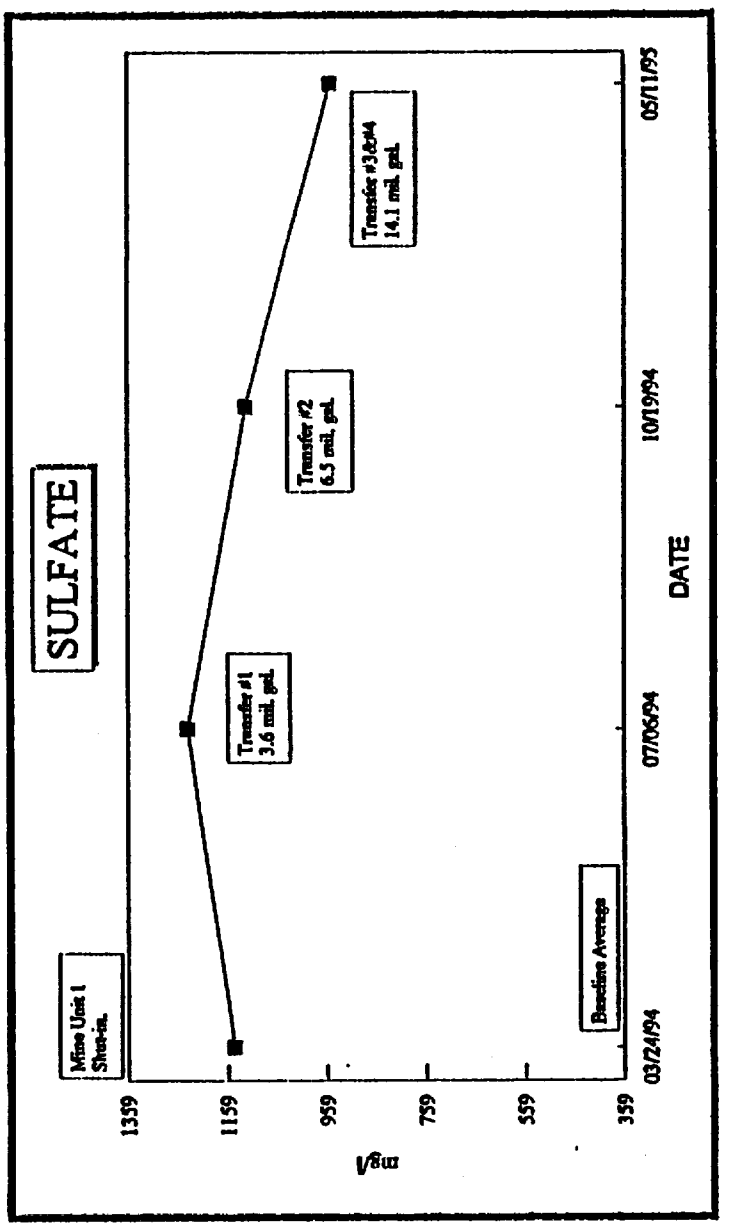
Conductivity Analysis (umhos/cm)

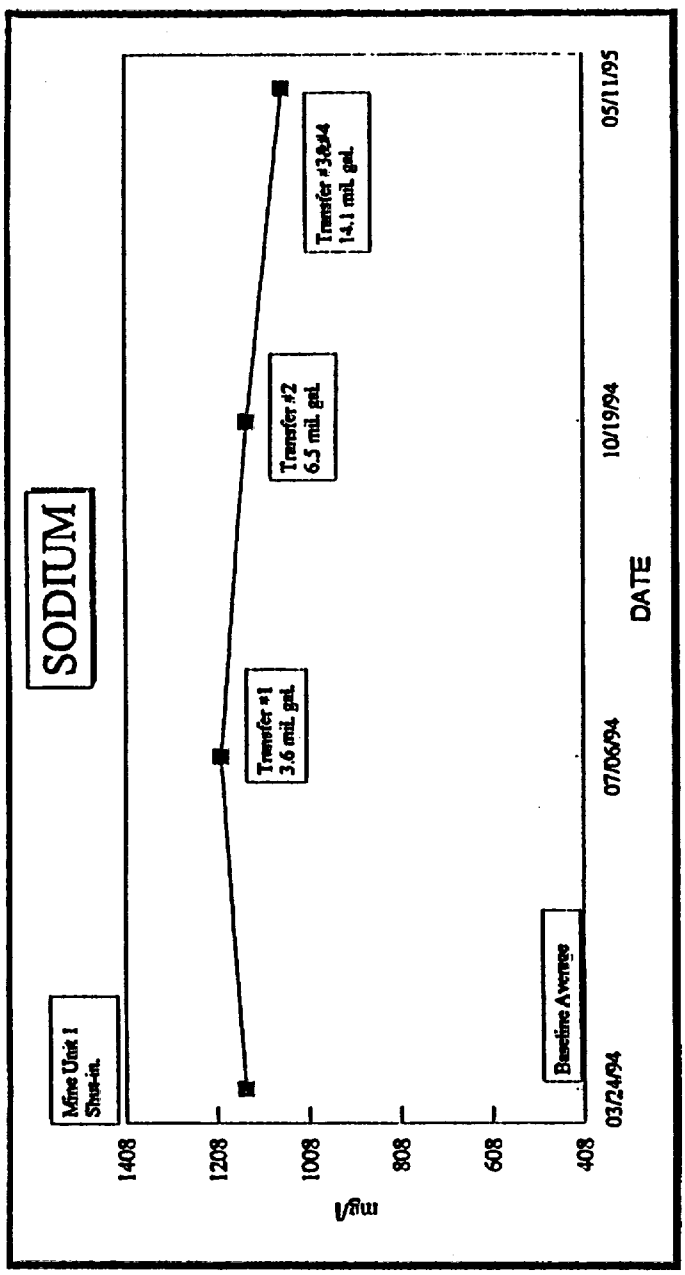
Sample Date	Well						Average
	IJ 25P-1	IJ 28P-1	IJ 45P-2	PR 6-2	PR 15-1	PR 19-1	
Baseline	1,970	1,980	1,951	1,866	1,867	1,994	1,938
03/24/94	5,807	6,025	5,916	5,819	5,940	5,819	5,888
07/06/94	5,600	5,630	5,760	4,750	5,170	5,470	5,430
10/19/94	5,140	5,340	4,980	5,130	5,090	5,110	5,132
05/11/95	4,510	4,900	4,290	4,880	4,160	4,690	4,572

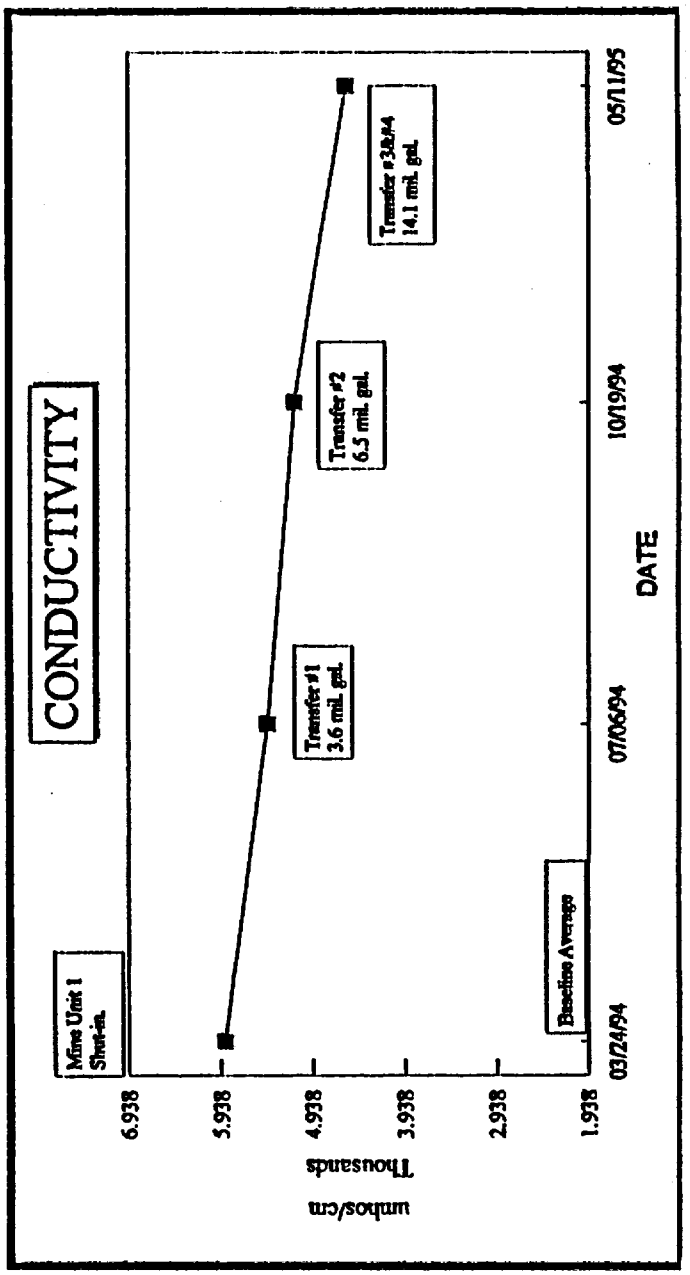
Alkalinity Analysis (mg/l)

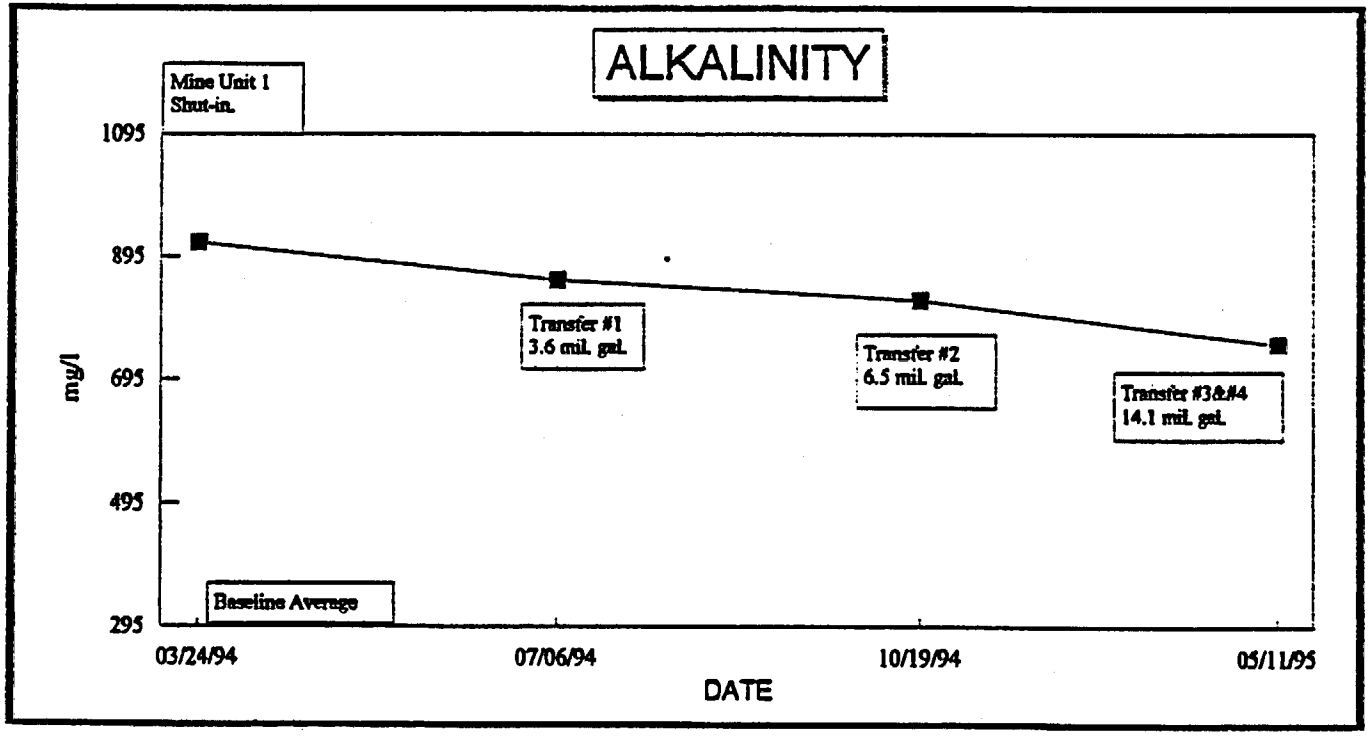
Sample Date	Well						Average
	IJ 25P-1	IJ 28P-1	IJ 45P-2	PR 6-2	PR 15-1	PR 19-1	
Baseline	261	312	270	324	307	294	295
03/24/94	911	989	905	959	959	786	918
07/06/94	920	948	840	780	880	770	856
10/19/94	625	880	800	800	850	788	824
05/11/95	739	810	700	780	700	790	753


CHLORIDE
Mine Unit 1 Shut-in.
Transfer #1 3.6 mil. gal.
Transfer #2 6.5 mil. gal.
Transfer #3&#4 14.1 mil. gal.
Baseline Average
695
595
495
395
295
195
mg/l
03/24/94
07/06/94
10/19/94
05/11/95
DATE


SULFATE
Mine Unit 1 Shut-in.
Transfer #1 3.6 mil. gal.
Transfer #2 6.5 mil. gal.
Transfer #3&#4 14.1 mil. gal.
Baseline Average
1359
1159
959
759
559
359
mg/l
03/24/94
07/06/94
10/19/94
05/11/95
DATE


SODIUM
Mine Unit 1 Shut-in.
Transfer #1 3.6 mil. gal.
Transfer #2 6.5 mil. gal.
Transfer #3&4 14.1 mil. gal.
Baseline Average
mg/l
1408
1208
1008
808
608
408
03/24/94
07/06/94
10/19/94
05/11/95
DATE


CONDUCTIVITY
Mine Unit 1 Shut-in.
Transfer #1 3.6 mil. gal.
Transfer #2 6.5 mil. gal.
Transfer #3&4 14.1 mil. gal.
Baseline Average
umhos/cm
Thousands
6.938
5.938
4.938
3.938
2.938
1.938
03/24/94
07/06/94
10/19/94
05/11/95
DATE


ALKALINITY
Mine Unit 1
Shut-in.
1095
895
695
495
295
mg/l
Transfer #1
3.6 mil. gal.
Transfer #2
6.5 mil. gal.
Transfer #3&#4
14.1 mil. gal.
Baseline Average
03/24/94
07/06/94
10/19/94
05/11/95
DATE

Appendix 5

Conductivity Indicator Data

well number date of sample (end of intial restoration)			NDEQ Standard	pr3 21-Mar-96	pr8 11-Apr-96	pr13a 2-May-96	pr35 7-Feb-96	pr17 19-Sep-96	pr7 4-Dec-96	pr2 22-May-97
Major Ions										
calcium	Ca	mg/l	125	23.7	14.2	16	18.3	19.1	16.5	13.9
magnesium	Mg	mg/l	32	6.7	3.7	4.8	5	5.7	4.6	4.2
sodium	Na	mg/l	4120	402	281	305	352	343	344	306
potassium	K	mg/l	125	14.6	9.5	11.1	12.7	12.4	11.5	9.8
carbonate	CO3	mg/l	0	0	0	0	0	0	0	0
bicarbonate	HCO3	mg/l	585	420	298	331	310	366	383	354
sulfate	SO4	mg/l	375	309	201	247	242	283	274	242
chloride	Cl	mg/l	250	256	163	180	236	200	188	142
ammonium	NH4	mg/l	10	<0.05	<0.05	<0.05	<0.05	0.1	0.09	<0.05
nitrite	NO2	mg/l		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
nitrate	NO3	mg/l	10	0.76	0.93	0.9	0.2	0.46	<0.10	<0.10
fluoride	F	mg/l	4	1.02	0.87	0.93	0.71	0.83	0.9	0.93
silica	SiO2	mg/l		15.5	13.8	17.4	13.6	15.7	17.5	16.2
Non-Metals										
total dissolved solids	TDS	mg/l	1170	1127	844	963	1066	1040	1016	906
conductivity (umho/cm)	Cond	umho/cm	1912	2013	1423	1558	1860	1754	1730	1480
alkalinity as CaCO3	Alk	mg/l		344	244	271	254	300	314	290
pH (std units)	pH	std. units	6.5-8.5	7.87	7.97	7.84	8.18	7.77	7.96	8.01
Trace Metals										
aluminum	Al	mg/l		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
arsenic	As	mg/l	0.05	0.034	0.029	0.046	0.039	0.083	0.066	0.033
barium	Ba	mg/l	1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
boron	B	mg/l		0.69	0.67	0.68	0.84	0.65	0.67	0.57
cadmium	Cd	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
chromium	Cr	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
copper	Cu	mg/l	1	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
iron	Fe	mg/l	0.3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
lead	Pb	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
manganese	Mn	mg/l	0.05	0.01	0.01	0.01	0.01	0.02	0.02	0.01
mercury	Hg	mg/l	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
molybdenum	Mo	mg/l	1	0.16	0.12	0.11	0.15	0.17	0.17	0.12
nickel	Ni	mg/l	0.15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
selenium	Se	mg/l	0.01	0.061	0.014	0.018	0.021	0.022	0.009	0.016
vanadium	V	mg/l	0.2	0.98	0.78	0.66	0.75	0.52	0.54	0.83
zinc	Zn	mg/l	5	0.11	0.05	0.05	0.08	0.01	<0.01	<0.01
Radiometric										
uranium natural (mg/l)	U-nat	mg/l	5	1.433	2.361	1.509	0.923	1.981	4.74	2.58
radium 226 (pCi/l)	Ra-226	pCi/l	584	359	66	70.8	56.3	127	279	265
radium 226 precision	Ra-226 precision			5.4	2.3	3.2	2.2	3.1	5.1	5.2

Appendix 6

Stabilization Water Quality Sampling Results

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INT-021

LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	UJ6P	UJ6	UJ6	UJ6	UJ6	UJ6
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16097	99-20850	99-24859	99-28317	99-30541	99-35537
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:	•	April 15, 1999	•	•	•	•

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	16.7	18.0	18.9	19.0	18.2	18.0
Magnesium	Mg	mg/L	1.0	4.4	4.9	5.0	5.0	4.8	5.4
Sodium	Na	mg/L	1.0	347	354	353	345	352	353
Potassium	K	mg/L	1.0	11.9	12.5	12.7	12.2	13.6	14.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	5.7	5.2	6.4
Bicarbonate	HCO_3	mg/L	1.0	409	423	427	428	432	438
Sulfate	SO_4	mg/L	1.0	325	325	342	331	332	323
Chloride	Cl	mg/L	1.0	131	126	138	129	138	126
Ammonium as N	NH_4	mg/L	0.05	0.05	0.08	0.14	< 0.05	0.13	0.15
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.61	0.64	0.69	0.70	0.71	0.80
Silica	SiO_2	mg/L	1.0	15.5	17.7	16.4	17.0	15.6	14.4

Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1040	1050	1080	1080	1120	1060
Conductivity		µmhos/cm	1.0	1720	1740	1730	1780	1730	1800
Alkalinity	$CaCO_3$	mg/L	1.0	336	347	350	359	362	368
pH		std. units	0.10	8.08	8.25	8.18	8.37	8.33	8.41

Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.003	0.003	0.003	0.002	0.002	0.001
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.44	0.43	0.30	0.45	0.44	0.54
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.01	< 0.01	0.01	< 0.01	0.01	0.01
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	< 0.05*	< 0.01	0.02	0.03	0.03	0.03
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.001	0.001	0.002	0.001	0.002	0.005
Vanadium	V	mg/L	0.01	0.01	0.02	0.02	0.01	0.01	0.01
Zinc	Zn	mg/L	0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01

Radiometrics									
Uranium	^{234}U	mg/L	0.0003	0.208	0.291	0.343	0.269	0.347	0.314
Radium 226	^{226}Ra	pCi/L	0.2	127	115	124	133	130	143
Radium Error Estimate ±				5.0	3.2	3.4	3.6	3.3	3.7

Quality Assurance Data		Target Range						
Anion	meq		17.22	17.30	18.06	17.75	18.09	17.69
Cation	meq		16.61	17.04	17.06	16.70	16.98	17.08
WYDEQ A/C Balance	%	-5 - +5	-1.80	-0.76	-2.84	-3.07	-3.15	-1.75
Calc TDS	mg/L		1058	1071	1101	1078	1096	1080
TDS A/C Balance	dec. %	0.80 - 1.20	0.98	0.98	0.98	1.00	1.02	0.98

*Molybdenum was analyzed at a detection limit of 0.05 for this Round

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INT-021

LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	PR-15	PR-15	PR-15	PR-15	PR-15	PR-15
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16100	99-20839	99-24861	99-28321	99-30543	99-33538
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-19-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:		April 15, 1999	-	-	-	-

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	11.6	13.8	13.6	11.2	10.8	11.2
Magnesium	Mg	mg/L	1.0	2.7	3.2	3.2	2.6	2.6	3.3
Sodium	Na	mg/L	1.0	210	214	214	217	230	221
Potassium	K	mg/L	1.0	10.9	11.5	12.0	11.5	12.9	13.0
Carbonate	CO_3	mg/L	1.0	3.7	3.3	3.4	4.1	5.3	7.5
Bicarbonate	HCO_3	mg/L	1.0	289	289	291	335	354	375
Sulfate	SO_4	mg/L	1.0	160	156	163	152	155	139
Chloride	Cl	mg/L	1.0	87.7	86.2	92.5	81.0	85.8	72.0
Ammonium as N	NH_4	mg/L	0.05	< 0.05	0.06	0.06	< 0.05	0.07	0.13
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.51	0.47	0.49	0.58	0.59	0.68
Silica	SiO_2	mg/L	1.0	13.6	14.1	13.5	13.0	13.0	12.0

Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	606	651	670	675	685	669
Conductivity		umho/c	1.0	1070	1110	1090	1140	1100	1140
Alkalinity	$CaCO_3$	mg/L	1.0	243	242	244	281	298	318
pH		std. unit	0.10	8.35	8.31	8.31	8.34	8.42	8.55

Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.033	0.030	0.034	0.041	0.043	0.045
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.41	0.40	0.25	0.40	0.40	0.49
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.02	0.02	0.02	< 0.01	0.02	0.05
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	0.13	0.14	0.12	0.16	0.15	0.14
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.002	0.002	0.002	0.003	0.003	0.003
Vanadium	V	mg/L	0.01	0.32	0.29	0.33	0.42	0.38	0.38
Zinc	Zn	mg/L	0.01	0.01	< 0.01	< 0.01	0.02	0.01	< 0.01

Radiometrics									
Uranium	^{Nat}U	mg/L	0.0003	0.307	0.420	0.403	0.468	0.808	0.862
Radium 226	^{226}Ra	pCi/L	0.2	12.8	25.0	29.5	30.4	25.5	31.7
Radium Error Estimate ±				0.7	1.5	1.7	1.7	1.5	1.8

Quality Assurance Data			Target Range						
Anion		meq		10.70	10.55	10.91	11.11	11.64	11.33
Cation		meq		10.23	10.57	10.58	10.52	11.11	11.11
WYDEQ A/C Balance		%	-5 - +5	-2.33	0.11	-1.57	-2.70	-2.37	-0.99
Calc TDS		mg/L		646	647	662	661	693	674
TDS A/C Balance		dec. %	0.80 - 1.20	0.94	1.01	1.01	1.02	0.99	0.99

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LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	PR-19	PR-19	PR-19	PR-19	PR-19	PR-19
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16101	99-20858	99-24862	99-28328	99-30542	99-35539
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-28-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:		April 15, 1999	"	"	"	"

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	26.4	27.8	30.7	33.0	51.2	67.0
Magnesium	Mg	mg/L	1.0	6.3	6.9	7.7	8.5	13.2	18.0
Sodium	Na	mg/L	1.0	346	359	381	385	513	616
Potassium	K	mg/L	1.0	11.3	12.0	13.6	14.0	19.5	24.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	406	412	429	444	534	607
Sulfate	SO_4	mg/L	1.0	320	341	391	402	589	696
Chloride	Cl	mg/L	1.0	145	141	172	170	263	313
Ammonium as N	NH_4	mg/L	0.05	0.06	0.15	0.17	0.14	0.28	0.36
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.44	0.42	0.40	0.41	0.37	0.36
Silica	SiO_2	mg/L	1.0	9.8	10.9	10.6	11.0	10.8	10.5
Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1060	1130	1200	1280	1740	2120
Conductivity		µmhos/cm	1.0	1770	1820	1930	2090	2650	3300
Alkalinity	$CaCO_3$	mg/L	1.0	333	338	352	365	438	498
pH		std. units	0.10	8.07	7.93	7.90	7.98	7.90	8.30
Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.016	0.016	0.020	0.018	0.018	0.018
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.50	0.52	0.39	0.55	0.63	0.85
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.09	0.19	0.28	0.40	0.46	0.70
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.03	0.03	0.04	0.04	0.06	0.09
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	< 0.05*	0.08	0.08	0.11	0.14	0.13
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01
Selenium	Se	mg/L	0.001	0.001	0.002	0.002	0.002	0.003	0.004
Vanadium	V	mg/L	0.01	0.09	0.07	0.06	0.06	0.07	0.08
Zinc	Zn	mg/L	0.01	0.01	0.04	0.03	0.07	0.04	0.04
Radiometrics									
Uranium	^{234}U	mg/L	0.0003	1.05	1.34	1.66	1.19	2.70	4.17
Radium 226	^{226}Ra	pCi/L	0.2	439	621	730	711	1600	1910
Radium Error Estimate ±				7.5	7.2	8.3	8.5	11.6	13.3
Quality Assurance Data			**Target Range**						
Anion		meq		17.44	17.87	20.06	20.49	28.47	33.30
Cation		meq		17.20	17.92	19.13	19.60	26.52	32.33
WYDEQ A/C Balance		%	-5 - +5	-0.70	0.14	-2.37	-2.22	-3.33	-1.48
Calc TDS		mg/L		1069	1106	1223	1250	1728	2050
TDS A/C Balance		dec. %	0.80 - 1.20	0.99	1.02	0.98	1.02	1.01	1.03

*Molybdenum was analyzed at a detection limit of 0.05 for this Round.

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LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	13-28 P	13-28-P	13-28-P	13-28-P	13-28-P	13-28-P
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16099	99-20856	99-24864	99-28319	99-30545	99-33546
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 03, 1999
Revised Report Date:		April 15, 1999	•	•	•	•

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	18.5	20.3	19.4	20.0	19.2	18.0
Magnesium	Mg	mg/L	1.0	4.5	5.1	5.0	4.9	4.8	5.2
Sodium	Na	mg/L	1.0	335	348	357	336	357	340
Potassium	K	mg/L	1.0	9.7	10.8	11.3	11.0	12.0	12.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	4.8
Bicarbonate	HCO_3	mg/L	1.0	405	418	428	424	429	416
Sulfate	SO_4	mg/L	1.0	291	307	310	312	332	299
Chloride	Cl	mg/L	1.0	130	131	133	131	140	122
Ammonium as N	NH_4	mg/L	0.05	0.05	0.11	0.11	0.06	0.12	0.14
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	0.27	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.58	0.54	0.53	0.56	0.59	0.68
Silica	SiO_2	mg/L	1.0	14.0	14.8	13.7	14.0	14.0	14.2
Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1010	1050	1080	1050	1060	1020
Conductivity		µmho/cm	1.0	1630	1740	1740	1750	1700	1700
Alkalinity	$CaCO_3$	mg/L	1.0	333	343	351	348	352	348
pH		std. units	0.10	8.17	7.99	8.23	8.12	8.13	8.31
Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.022	0.023	0.026	0.025	0.027	0.025
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.44	0.46	0.31	0.44	0.43	0.53
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.04	0.04	0.05	0.06	0.06	0.06
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.03	0.04	0.03	0.04	0.04	0.03
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	0.08	0.11	0.12	0.10	0.11	0.10
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.002	0.003	0.003	0.003	0.003	0.003
Vanadium	V	mg/L	0.01	0.16	0.16	0.13	0.14	0.14	0.13
Zinc	Zn	mg/L	0.01	< 0.01	0.02	0.01	0.03	0.02	0.01
Radiometrics									
Uranium	^{nat}U	mg/L	0.0003	0.463	0.739	0.734	0.456	0.756	0.710
Radium 226	^{226}Ra	pCi/L	0.2	160	192	212	203	206	183
Radium Error Estimate ±				4.5	4.1	4.4	4.4	4.1	4.1

Quality Assurance Data		Target Range						
Anion	meq		16.43	16.98	17.26	17.19	17.94	16.67
Cation	meq		16.13	16.87	17.23	16.32	17.22	16.43
WYDEQ A/C Balance	%	-5 - +5	-0.93	-0.33	-0.09	-2.58	-2.06	-0.66
Calc TDS	mg/L		1008	1047	1067	1042	1095	1024
TDS A/C Balance	dec. %	0.80 - 1.20	1.00	1.00	1.01	1.01	0.97	1.00

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LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	13-25 P	13-25-P	13-25-P	13-25-P	13-25-P	13-25-P
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-10098	99-20337	99-30363	99-30318	99-30547	99-33541
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	03-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 23, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 25, 1999
Revised Report Date:	-	April 15, 1999	-	-	-	-

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	19.0	18.6	18.2	17.0	16.9	16.0
Magnesium	Mg	mg/L	1.0	4.8	4.8	4.9	4.3	4.2	4.7
Sodium	Na	mg/L	1.0	336	339	333	329	351	341
Potassium	K	mg/L	1.0	13.2	13.2	13.2	12.5	14.3	14.4
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	419	410	409	421	425	430
Sulfate	SO_4	mg/L	1.0	310	304	315	315	331	302
Chloride	Cl	mg/L	1.0	127	120	133	127	138	118
Ammonium as N	NH_4	mg/L	0.05	0.07	0.11	0.11	< 0.05	0.10	0.15
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_2 + NO_3$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.16	< 0.10
Fluoride	F	mg/L	0.10	0.56	0.57	0.58	0.60	0.63	0.69
Silica	SiO_2	mg/L	1.0	13.7	14.3	13.6	14.0	13.3	13.4

Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1030	1050	1030	1040	1070	1030
Conductivity		µmhos/cm	1.0	1690	1680	1670	1720	1670	1710
Alkalinity	$CaCO_3$	mg/L	1.0	344	337	336	346	349	353
pH		std. units	0.10	8.10	7.97	8.06	8.11	8.15	8.21

Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.020	0.020	0.023	0.023	0.025	0.027
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.49	0.51	0.55	0.51	0.50	0.64
Cadmium	Cd	mg/L	0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.04	0.04	0.06	0.05	0.05	0.04
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	0.07	0.10	0.10	0.11	0.11	0.10
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.002	0.002	0.003	0.002	0.002	0.003
Vanadium	V	mg/L	0.01	0.08	0.07	0.07	0.09	0.09	0.10
Zinc	Zn	mg/L	0.01	< 0.01	0.02	0.03	0.04	0.02	0.01

Radiometrics									
Uranium	^{238}U	mg/L	0.0003	0.757	1.04	0.966	0.666	1.12	1.26
Radium 226	^{226}Ra	pCi/L	0.2	253	218	236	225	242	202
Radium Error Estimate ±				5.4	4.4	4.7	4.7	4.5	4.3

Quality Assurance Data		Target Range						
Anion	meq		16.93	16.49	17.07	17.10	17.81	16.72
Cation	meq		16.32	16.46	16.13	15.85	16.85	16.41
WYDEQ A/C Balance	%	-5 - +5	-1.91	-0.13	-2.83	-3.78	-2.78	-0.93
Calc TDS	mg/L		1015	1021	1037	1031	1083	1026
TDS A/C Balance	dec. %	0.80 - 1.20	1.00	1.03	1.01	1.01	0.99	1.00

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INT-021

LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	U-13 P	U-13 P	U-13 P	U-13 P	U-13 P	U-13 P
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16106	99-20860	99-24860	99-28322	99-30546	99-33543
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:	-	April 15, 1999	-	-	-	-

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	16.0	19.7	20.2	21.0	20.9	19.6
Magnesium	Mg	mg/L	1.0	4.2	5.2	5.3	5.3	5.4	5.7
Sodium	Na	mg/L	1.0	332	350	354	339	367	346
Potassium	K	mg/L	1.0	11.3	12.3	12.7	12.0	13.7	13.4
Carbonate	CO_3	mg/L	1.0	< 1.0	5.1	< 1.0	5.0	6.1	6.2
Bicarbonate	HCO_3	mg/L	1.0	402	419	432	424	439	434
Sulfate	SO_4	mg/L	1.0	306	326	335	351	353	319
Chloride	Cl	mg/L	1.0	126	125	139	135	145	123
Ammonium as N	NH_4	mg/L	0.05	0.05	0.15	0.24	0.13	0.26	0.30
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.25	< 0.10
Fluoride	F	mg/L	0.10	0.59	0.64	0.63	0.61	0.62	0.72
Silica	SiO_2	mg/L	1.0	14.0	15.8	14.2	15.0	13.9	14.2

Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1060	1080	1110	1100	1120	1080
Conductivity		µmho/c	1.0	1720	1740	1750	1820	1760	1780
Alkalinity	$CaCO_3$	mg/L	1.0	330	351	354	355	369	365
pH		std. units	0.10	8.18	8.33	8.28	8.32	8.39	8.40

Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.006	0.012	0.017	0.013	0.016	0.016
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.43	0.41	0.28	0.44	0.45	0.54
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.02	0.10	0.13	0.05	0.07	0.06
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	< 0.05*	0.10	0.13	0.21	0.19	0.21
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Vanadium	V	mg/L	0.01	0.05	0.03	0.02	0.02	0.02	0.02
Zinc	Zn	mg/L	0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01

Radiometrics									
Uranium	^{238}U	mg/L	0.0003	0.242	1.27	1.60	1.49	1.75	1.71
Radium 226	^{226}Ra	pCi/L	0.2	376	663	764	770	920	849
Radium Error Estimate ±				6.5	7.6	8.5	8.7	8.7	9.1

Quality Assurance Data			Target Range						
Anion		meq		16.56	17.37	18.01	18.25	18.87	17.46
Cation		meq		15.89	16.98	17.21	16.56	17.84	16.88
WYDEQ A/C Balance		%	-5 - +5	-2.07	-1.15	-2.30	-4.86	-2.81	-1.68
Calc TDS		mg/L		1012	1069	1098	1096	1146	1065
TDS A/C Balance		dec. %	0.80 - 1.20	1.05	1.01	1.01	1.00	0.98	1.01

*Molybdenum was analyzed at a detection limit of 0.05 for this Round.

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LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	PAI-8	PAI-8	PAI-8	PAI-8	PAI-8	PAI-8
Rounds:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID#:	99-16102	99-20855	99-24366	99-28329	99-30548	99-33843
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:	-	April 15, 1999	-	-	-	-

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	13.6	19.3	29.6	38.0	39.4	25.0
Magnesium	Mg	mg/L	1.0	3.8	5.5	8.5	10.1	10.8	7.0
Sodium	Na	mg/L	1.0	349	387	466	477	555	441
Potassium	K	mg/L	1.0	14.4	17.0	19.2	20.0	23.1	19.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	418	436	494	519	560	483
Sulfate	SO_4	mg/L	1.0	306	358	459	514	595	437
Chloride	Cl	mg/L	1.0	132	152	201	226	267	184
Ammonium as N	NH_4	mg/L	0.05	< 0.05	0.07	0.12	0.08	0.17	0.16
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.42	0.39	0.38	0.39	0.39	0.46
Silica	SiO_2	mg/L	1.0	13.3	14.5	16.7	15.0	14.5	14.4
Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1070	1180	1460	1610	1760	1420
Conductivity		umho/c	1.0	1770	1920	2330	2560	2680	2270
Alkalinity	$CaCO_3$	mg/L	1.0	343	357	406	426	459	396
pH		std. unit	0.10	8.21	8.05	8.32	8.08	8.13	8.11
Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.013	0.011	0.013	0.012	0.012	0.013
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.43	0.54	0.46	0.60	0.64	0.65
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01
Iron	Fe	mg/L	0.01	< 0.01	0.01	0.05	0.06	0.06	0.04
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	< 0.01	0.01	0.03	0.03	0.04	0.02
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	< 0.05*	0.08	0.06	0.06	0.09	0.08
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.001	0.002	0.003	0.002	0.003	0.003
Vanadium	V	mg/L	0.01	0.20	0.19	0.15	0.20	0.17	0.14
Zinc	Zn	mg/L	0.01	0.01	0.03	0.02	0.04	0.03	0.02
Radiometrics									
Uranium	$^{total}U$	mg/L	0.0003	3.03	3.65	5.26	5.01	9.35	6.54
Radium 226	^{226}Ra	pCi/L	0.2	35.8	58.5	119	172	202	114
Radium Error Estimate ±				2.2	2.3	3.3	4.0	4.1	3.9
Quality Assurance Data			Target Range						
Anion		meq		16.98	18.91	23.37	25.62	29.11	22.24
Cation		meq		16.56	18.70	22.97	24.02	27.62	21.52
WYDEQ A/C Balance		%	-5 - +5	-1.27	-0.54	-0.88	-3.23	-2.65	-1.64
Calc TDS		mg/L		1042	1172	1449	1561	1786	1370
TDS A/C Balance		dec. %	0.80 - 1.20	1.03	1.01	1.01	1.03	0.99	1.04

*Molybdenum was analyzed at a detection limit of 0.05 for this Round.

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LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	PAI-4	PAI-4	PAI-4	PAI-4	PAI-4	PAI-4
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16107	99-20854	99-24863	99-28324	99-30549	99-33544
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:		April 15, 1999	-	-	-	-

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	16.2	18.2	17.0	15.0	15.3	15.2
Magnesium	Mg	mg/L	1.0	4.4	5.1	4.8	4.4	4.2	4.7
Sodium	Na	mg/L	1.0	334	350	345	319	319	314
Potassium	K	mg/L	1.0	12.0	13.1	13.2	12.0	13.0	13.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	429	421	399	396	393	393
Sulfate	SO_4	mg/L	1.0	300	307	304	306	298	278
Chloride	Cl	mg/L	1.0	144	136	133	125	129	112
Ammonium as N	NH_4	mg/L	0.05	0.10	0.13	0.13	0.09	0.14	0.17
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.50	0.47	0.48	0.50	0.51	0.60
Silica	SiO_2	mg/L	1.0	12.3	13.7	14.4	14.0	12.3	12.7

Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1080	1060	1050	997	982	960
Conductivity		µmho/c	1.0	1790	1750	1710	1670	1570	1600
Alkalinity	$CaCO_3$	mg/L	1.0	352	346	327	325	323	323
pH		std. unit	0.10	8.28	8.23	8.26	8.16	8.16	8.28

Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.49	0.50	0.35	0.49	0.47	0.46
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.05	0.05	0.05	0.06	0.06	0.05
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.02	0.02	0.02	0.02	0.01	0.01
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	0.10	0.12	0.12	0.15	0.16	0.17
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	< 0.001	0.002	0.001	< 0.001	< 0.001	0.001
Vanadium	V	mg/L	0.01	< 0.10*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zinc	Zn	mg/L	0.01	< 0.01	0.02	0.01	< 0.01	0.01	0.01

Radiometrics									
Uranium	^{nat}U	mg/L	0.0003	0.172	0.158	0.122	0.103	0.129	0.130
Radium 226	^{226}Ra	pCi/L	0.2	174	173	184	160	161	157
Radium Error Estimate ±				4.4	3.9	4.2	3.9	3.6	3.9

Quality Assurance Data		Target Range						
Anion	meq		17.38	17.18	16.85	16.43	16.34	15.45
Cation	meq		16.03	16.91	16.61	15.32	15.34	15.16
WYDEQ A/C Balance	%	-5 - +5	-4.04	-0.78	-0.12	-3.51	-3.13	-0.92
Calc TDS	mg/L		1039	1055	1032	995	989	948
TDS A/C Balance	dec. %	0.80 - 1.20	1.04	1.00	1.02	1.00	0.99	1.01

*Vanadium was analyzed at a detection limit of 0.10 for this Round.

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93

LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	PR-8	PR-8	PR-8	PR-8	PR-8	PR-8
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-06103	99-20853	99-34869	99-48327	99-30351	99-35545
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:	-	April 15, 1999	-	-	-	-

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	15.0	16.2	17.5	17.0	18.9	18.0
Magnesium	Mg	mg/L	1.0	3.9	4.8	4.6	4.5	4.7	5.0
Sodium	Na	mg/L	1.0	371	386	375	366	387	371
Potassium	K	mg/L	1.0	10.9	11.9	12.1	12.0	13.6	13.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	431	429	403	421	433	428
Sulfate	SO_4	mg/L	1.0	352	355	343	368	384	348
Chloride	Cl	mg/L	1.0	157	150	143	152	164	138
Ammonium as N	NH_4	mg/L	0.05	0.13	0.12	0.17	0.15	0.18	0.21
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.59	0.53	0.48	0.52	0.51	0.60
Silica	SiO_2	mg/L	1.0	12.6	14.5	15.2	14.0	12.7	13.3
Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1160	1160	1150	1160	1190	1160
Conductivity		µmho/c	1.0	1960	1900	1830	1880	1920	1870
Alkalinity	$CaCO_3$	mg/L	1.0	353	352	331	346	355	351
pH		std. unit	0.10	8.11	8.09	8.20	8.17	8.04	8.23
Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.025	0.021	0.024	0.022	0.023	0.024
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.47	0.50	0.32	0.47	0.47	0.44
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.12	0.17	0.15	0.23	0.25	0.20
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	0.06	0.07	0.08	0.09	0.09	0.09
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.001	0.003	0.003	0.003	0.004	0.004
Vanadium	V	mg/L	0.01	0.07	0.08	0.05	0.05	0.05	0.04
Zinc	Zn	mg/L	0.01	< 0.01	0.04	0.03	0.02	0.03	0.02
Radiometrics									
Uranium	^{238}U	mg/L	0.0003	2.28	2.1	1.62	1.08	1.56	1.58
Radium 226	^{226}Ra	pCi/L	0.2	204	190	184	199	206	192
Radium Error Estimate ±				4.9	4.1	4.1	4.4	4.2	4.3
Quality Assurance Data			**Target Range**						
Anion		meq		18.83	18.70	17.83	18.90	19.75	18.20
Cation		meq		17.51	18.43	17.91	17.48	18.55	17.82
WYDEQ A/C Balance		%	-5 - +5	-3.69	-0.72	0.22	-3.91	-3.14	-1.05
Calc TDS		mg/L		1139	1156	1113	1146	1203	1122
TDS A/C Balance		dec. %	0.80 - 1.20	1.02	1.00	1.03	1.01	0.99	1.03

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LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	U-45 P	U-45 P	U-45 P	U-45 P	U-45 P	U-45 P
Rounds:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16104	99-20851	99-24870	99-28326	99-30544	99-33548
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 13, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:		April 15, 1999				

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	16.6	16.1	17.6	17.0	18.7	18.1
Magnesium	Mg	mg/L	1.0	4.3	4.8	4.7	5.0	4.8	5.2
Sodium	Na	mg/L	1.0	342	349	353	334	355	343
Potassium	K	mg/L	1.0	12.2	12.8	13.1	12.0	13.9	14.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	404	404	402	399	403	412
Sulfate	SO_4	mg/L	1.0	304	312	319	339	347	313
Chloride	Cl	mg/L	1.0	139	136	140	146	149	127
Ammonium as N	NH_4	mg/L	0.05	0.05	0.06	0.06	< 0.05	0.09	0.12
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	0.12	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.58	0.55	0.54	0.55	0.56	0.64
Silica	SiO_2	mg/L	1.0	15.7	17.2	18.1	17.0	15.8	16.0

Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1060	1070	1090	1090	1080	1090
Conductivity		µmhos/c	1.0	1790	1740	1750	1760	1710	1730
Alkalinity	$CaCO_3$	mg/L	1.0	332	332	330	328	330	338
pH		std. unit	0.10	7.98	7.99	8.17	8.00	8.01	8.27

Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.035	0.033	0.037	0.031	0.033	0.035
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.54	0.55	0.59	0.51	0.53	0.51
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.10	0.10	0.10	0.12	0.26	0.20
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.02	0.02	0.02	0.02	0.03	0.02
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	0.16	0.16	0.15	0.16	0.16	0.16
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.002	0.002	0.002	0.001	0.002	0.002
Vanadium	V	mg/L	0.01	0.22	0.22	0.22	0.21	0.18	0.18
Zinc	Zn	mg/L	0.01	< 0.01	0.03	0.03	0.02	0.03	0.02

Radiometrics									
Uranium	^{nat}U	mg/L	0.0003	0.932	1.20	1.18	0.828	1.16	1.22
Radium 226	^{226}Ra	pCi/L	0.2	445	431	447	468	509	487
Radium Error Estimate ±				7.2	6.2	6.2	6.7	6.5	6.7

Quality Assurance Data			Target Range						
Anion		meq		16.93	17.01	17.23	17.77	18.06	16.90
Cation		meq		16.39	16.83	16.98	16.12	17.16	16.64
WYDEQ A/C Balance		%	-5 - +5	-1.60	-0.52	-0.73	-4.88	-2.56	-0.77
Calc TDS		mg/L		1037	1054	1068	1071	1107	1054
TDS A/C Balance		dec. %	0.80 - 1.20	1.02	1.02	1.02	1.02	0.98	1.04

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021

LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	PT-5 FR-2	PT-5 FR-3	PT-5 FR-3	PT-5 FR-3	PT-5 FR-3	PT-5 FR-3
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16105	99-20852	99-24568	99-28328	99-30550	99-33547
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-15-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 8, 1999	August 13, 1999
Revised Report Date:		April 15, 1999				

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	12.9	13.4	14.8	14.0	14.6	14.0
Magnesium	Mg	mg/L	1.0	3.5	4.3	4.2	4.0	4.0	4.4
Sodium	Na	mg/L	1.0	346	355	360	349	355	351
Potassium	K	mg/L	1.0	10.5	11.2	12.0	11.2	12.2	12.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	405	407	421	400	405	401
Sulfate	SO_4	mg/L	1.0	302	325	334	352	356	334
Chloride	Cl	mg/L	1.0	127	127	134	135	141	126
Ammonium as N	NH_4	mg/L	0.05	0.08	0.06	0.09	0.08	0.09	0.14
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.58	0.49	0.51	0.50	0.49	0.58
Silica	SiO_2	mg/L	1.0	14.0	16.2	16.8	15.5	14.2	14.2
Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1070	1060	1080	1100	1090	1050
Conductivity		µmho/c	1.0	1750	1740	1760	1790	1740	1750
Alkalinity	$CaCO_3$	mg/L	1.0	332	334	345	328	332	329
pH		std. unit	0.10	8.06	8.06	8.22	8.13	8.09	8.17
Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.011	0.011	0.014	0.010	0.012	0.011
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.41	0.42	0.27	0.39	0.39	0.39
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.07	0.05	0.04	0.07	0.07	0.07
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.01	0.02	0.01	0.01	0.01	0.01
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	0.05	0.06	0.05	0.07	0.07	0.08
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.001	0.002	0.002	0.001	0.002	0.002
Vanadium	V	mg/L	0.01	0.09	0.08	0.09	0.07	0.07	0.06
Zinc	Zn	mg/L	0.01	< 0.01	0.03	0.02	0.03	0.02	0.02
Radiometrics									
Uranium	^{nat}U	mg/L	0.0003	2.06	2.36	2.22	1.68	2.36	2.40
Radium 226	^{226}Ra	pCi/L	0.2	263	243	248	259	246	233
Radium Error Estimate ±				5.5	4.7	4.8	5.0	4.5	4.7
Quality Assurance Data			**Target Range**						
Anion		meq		16.53	17.06	17.67	17.73	18.06	17.13
Cation		meq		16.27	16.87	17.07	16.52	16.83	16.66
WYDEQ A/C Balance		%	-5 - +5	-0.81	-0.56	-1.72	-3.54	-3.52	-1.37
Calc TDS		mg/L		1020	1059	1087	1082	1101	1057
TDS A/C Balance		dec. %	0.80 - 1.20	1.05	1.00	0.99	1.02	0.99	0.99

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LABORATORY ANALYSIS REPORT - CROW BUTTE RESOURCES

Sample ID:	PR-4	PR-4 (PA1-1)	PR-4 (PA1-1)	PR-4 (PA1-1)	PR-4 (PA1-1)	PR-4 (PA1-1)
Round:	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Laboratory ID:	99-16108	99-20861	99-24867	99-28325	99-30552	99-33548
Sample Matrix:	Water	Water	Water	Water	Water	Water
Sample Date:	02-19-99	03-18-99	04-15-99	05-20-99	06-17-99	07-13-99
Report Date:	March 12, 1999	April 12, 1999	May 6, 1999	June 8, 1999	July 6, 1999	August 13, 1999
Revised Report Date:		April 15, 1999	•	•	•	

Major Ions		Units	Reporting Limit	Results	Results	Results	Results	Results	Results
Calcium	Ca	mg/L	1.0	16.8	21.5	20.4	19.6	21.1	14.0
Magnesium	Mg	mg/L	1.0	4.4	5.6	5.4	5.3	5.4	4.2
Sodium	Na	mg/L	1.0	341	362	369	348	365	271
Potassium	K	mg/L	1.0	11.6	13.2	13.5	13.0	14.6	11.0
Carbonate	CO_3	mg/L	1.0	< 1.0	< 1.0	5.7	< 1.0	< 1.0	< 1.0
Bicarbonate	HCO_3	mg/L	1.0	413	442	444	460	468	399
Sulfate	SO_4	mg/L	1.0	319	345	337	347	354	225
Chloride	Cl	mg/L	1.0	124	130	132	130	134	76.0
Ammonium as N	NH_4	mg/L	0.05	0.07	0.07	0.11	0.08	0.11	0.15
Nitrite as N	NO_2	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nitrate + Nitrite as N	$NO_3 + NO_2$	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoride	F	mg/L	0.10	0.39	0.48	0.42	0.44	0.43	0.79
Silica	SiO_2	mg/L	1.0	14.5	17.9	19.0	17.0	15.9	14.5

Non-Metals									
Total Dissolved Solids @ 180°C	TDS	mg/L	2.0	1040	1130	1140	1120	937	839
Conductivity		µmho/c	1.0	1760	1860	1810	1820	2420	1340
Alkalinity	$CaCO_3$	mg/L	1.0	339	362	372	377	384	327
pH		std. unit	0.10	8.24	8.20	8.36	8.18	8.21	8.28

Trace Metals									
Aluminum	Al	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	As	mg/L	0.001	0.004	0.004	0.003	0.002	0.002	0.002
Barium	Ba	mg/L	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Boron	B	mg/L	0.10	0.42	0.41	0.26	0.37	0.36	0.33
Cadmium	Cd	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Chromium	Cr	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	Cu	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	Fe	mg/L	0.01	0.02	0.03	0.04	< 0.01	0.05	0.04
Lead	Pb	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Manganese	Mn	mg/L	0.01	0.01	0.02	0.02	0.02	0.02	0.01
Mercury	Hg	mg/L	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Molybdenum	Mo	mg/L	0.01	< 0.05*	0.03	0.04	0.08	0.07	0.04
Nickel	Ni	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Selenium	Se	mg/L	0.001	0.001	0.001	0.002	< 0.001	0.001	0.001
Vanadium	V	mg/L	0.01	0.04	0.02	0.01	0.02	0.01	0.01
Zinc	Zn	mg/L	0.01	< 0.01	0.01	0.01	0.02	0.01	< 0.01

Radiometrics									
Uranium	^{238}U	mg/L	0.0003	1.62	3.44	3.74	4.08	3.88	3.56
Radium 226	^{226}Ra	pCi/L	0.2	105	168	155	155	166	99.1
Radium Error Estimate ±				3.7	3.8	3.8	3.8	3.7	3.0

Quality Assurance Data		Target Range						
Anion	meq		16.96	18.12	18.21	18.46	18.86	13.42
Cation	meq		16.35	17.64	17.89	16.90	17.77	13.14
WYDEQ A/C Balance	%	-5 - +5	-1.81	-1.35	-0.88	-4.80	-2.97	-1.05
Calc TDS	mg/L		1039	1117	1124	1111	1145	816
TDS A/C Balance	dec. %	0.80 - 1.20	1.02	1.01	1.01	1.01	0.82	1.03

*Molybdenum was analyzed at a detection limit of 0.05 for this Round.

proj: r:\reports\clients99\crow_butte\baseline_restoration\pr4\33548.xls

Log In No. 54403

COMPLETE ANALYTICAL SERVICES

Appendix 7

NDEQ Acceptance of Mine Unit 1 Restoration

STATE OF NEBRASKA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Suite 400, The Atrium
1200 'N' Street
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186

Mike Johanns
Governor

NOV 1 8 1999

Mr. Steve Collings
Crow Butte Resources, Inc.
1670 Broadway, Suite 3450
Denver, CO 80202

Dear Mr. Collings:

As per the Departments request for a submittal of monitoring well locations for the boundaries of mine units 2 and 3, the locations were presented via telephone on October 22, 1999 by Mr. Michael Griffin of CBR. Three production/injection wells (PR8, IJ13, and PR15) which meet the screened interval requirements were proposed for this purpose. Wells PR8 and PR15 would monitor the boundary of Mine Unit 2 and well IJ13 would monitor the boundary of Mine Unit 3. It was also proposed that sampling of the three monitoring wells would be completed at the time restoration was completed for each Mine Unit.

The Department has reviewed this proposal and determined that the location and construction of the proposed monitoring wells is acceptable. However, sampling of these three monitoring wells should be the same as the current production zone monitoring well schedule (biweekly) for each Mine Unit.

The Department hereby accepts the restoration of Mine Unit 1. All production/injection and monitoring wells associated with Mine Unit 1 may be abandoned according to Title 122, Chapter 36 and Tilte 178, Chapter 12.

If you have any questions concerning this matter, please contact David Miesbach of my staff at (402) 471-0096. Thank-you.

Sincerely,

Michael Linder
Director

ML/ML/dlm
dave/cbr/letter/mu1don2.doc
pc: Dave Carlson, NDEQ
Mike Griffin, CBR

March 29, 2002

Mr. Michael L. Griffin
Manager of Environmental and Regulatory Affairs
Crow Butte Resources, Inc.
86 Crow Butte Road
Post Office Box 169
Crawford, NE 69339-0169

SUBJECT: DENIAL, WELLFIELD UNIT 1 GROUND-WATER RESTORATION APPROVAL, CROW BUTTE RESOURCES *IN SITU* LEACH FACILITY, LICENSE NO. SUA-1534 (TAC No. L52376)

Dear Mr. Griffin:

The U.S. Nuclear Regulatory Commission (NRC) completed its review of your request to approve the completion of the Unit 1, wellfield restoration. Staff concludes that the data in your Restoration Report, submitted by letter dated January 14, 2000, and the additional information submitted by letter dated August 24, 2001, do not demonstrate that the restoration activities in Unit 1, have resulted in constituent levels that will remain below levels protective of human health and the environment, in accordance with 10 CFR 40.31(h) and Criterion 5F, 10 CFR Part 40, Appendix A. As a result, I am denying approval of the Unit 1, restoration request. Staff's Technical Evaluation Report, which provides the technical basis of this denial is provided as an enclosure to this letter.

In addition, you are hereby required to immediately restart stabilization ground-water monitoring in Unit 1, at the monitoring locations described in your January 10, 2000, Restoration Report. The ground-water shall be sampled and analyzed for the constituents listed in License Condition 10.3B, SUA-1534, on a schedule of at least 14 days apart. The wellfield restoration shall be considered stable if four consecutive sampling episodes show no strongly increasing concentration trends for all monitored constituents, on a wellfield average, as described in Section 6.1.3, "Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications," NUREG-1569.

At that time, you shall submit a written report for NRC review and approval, which provides a tabulation of all stability monitoring data for Unit 1, graphics showing time versus concentration of each monitored constituent, and analyses that demonstrate the restored constituent concentrations are within license limits and are stable. Stability monitoring should continue until four consecutive sampling episodes show no strongly increasing concentration trends. Wellfield restoration activities should be immediately re-initiated in Unit 1, if the concentration of any monitored constituent exceeds its license limit. You shall notify NRC in writing, within 30 days of recieving confirmation of any exceedance of the Unit 1 restoration limits. Crow Butte Resources should also revise its ground-water restoration plan to reflect a stability monitoring period which will allow all constituents to reach stability before ceasing the monitoring. This revision should be submitted for NRC review and approval in the form of a license amendment to Condition 10.3C.

M. Griffin 2

A Notice of Denial shall be published in the FEDERAL REGISTER, pursuant to 10 CFR 2.108(b). Upon publication, Crow Butte Resources will have 30 days to file a petition, requesting a hearing before the Atomic Safety Licensing Board Panel on this denial.
In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm.html (the Public Electronic Reading Room).

If you have any questions concerning this letter, please call me directly at (301) 415-7836 or by e-mail mnl@nrc.gov .

Sincerely,

/RA/

Melvyn Leach, Chief
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No. 40-8943
License No. SUA-1534

Enclosure: Technical Evaluation Report

cc w/ enclosures:
Stephen P. Collings, CBR, Denver
Dave Miesbach, Nebraska, UIC, DEQ
cc w/o enclosures:
Dave Carlson Nebraska, UIC, DEQ
Cheryl K. Rogers, Nebraska, RMP, PHA

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If you have any questions concerning this letter, please call me directly at (301) 415-7836 or by e-mail mnl@nrc.gov .

Sincerely,

/RA/

Melvyn Leach, Chief
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No. 40-8943
License No. SUA-1534
Casework No.: L52376 - CLOSED

Enclosure: Technical Evaluation Report

cc w/ enclosures:
Stephen P. Collings, CBR, Denver
Dave Miesbach, Nebraska, UIC, DEQ
cc w/o enclosures:
Dave Carlson Nebraska, UIC, DEQ
Cheryl K. Rogers, Nebraska, RMP, PHA

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OFC	FCLB	FCLB	FCLB	OGC	FCLB
NAME	MLayton*	JMuszkiewicz*	GJanosko*	STreby	MLeach
DATE	03/07/02	03/11/02	03/12/02	03/22/02	03/29/02

* See previous concurrence

OFFICIAL RECORD COPY

Technical Evaluation Report

DATE: March 6, 2002

DOCKET NO.: 40-8943

LICENSE NO.: SUA-1534

FACILITY: Crow Butte Resources *In Situ* Leach Uranium Project, Chadron, Nebraska

PROJECT MANGER: Michael C. Layton

TECHNICAL REVIEWER: Michael C. Layton, Hydrogeologist

SUMMARY AND CONCLUSIONS: Staff concludes the data submitted in the January 10, 2000, Restoration Report (CBR, 2000B) and the additional information submitted by letter dated August 24, 2001 (CBR, 2001), do not demonstrate that restoration activities in Wellfield Unit 1, have resulted in constituent levels that will remain below levels protective of human health and the environment, in accordance with 10 CFR 40.31(h) and Criterion 5F, 10 CFR Part 40, Appendix A.

DESCRIPTION OF AMENDMENT REQUESTS: By letter dated January 14, 2000 (CBR, 2000A), the licensee submitted the results of its Unit 1, ground-water restoration stabilization period in an attached report dated January 10, 2000 (CBR, 2000B), for the purpose of demonstrating that the wellfield had been restored. The licensee's January 10, 2000, submittal was amended by letter dated February 8, 2000 (CBR, 2000C), to include a formal request for approval on the Mine Unit 1 restoration. The request was also amended by an August 24, 2001 (CBR, 2001), submittal, which responded to NRC's Request for Additional Information (NRC, 2001) to support the request for wellfield restoration approval.

The licensee must demonstrate that the proposed request meets the general requirements of 10 CFR Part 40, specifically 10 CFR 40.31(h) and 10 CFR Part 40, Appendix A, Criterion 5F; as described in Section 6.1.3 (5), "Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications" (SRP), NUREG-1569 Rev. 1 (NRC, 2002).

EVALUATION: Staff completed its review of the approval request for the completion of ground-water restoration in Unit 1, as presented in Crow Butte's "Mine Unit 1 Restoration Report," and supplemental documents (CBR, 2000B; CBR, 2000C; and CBR, 2001). The submitted data show that ground-water quality has been restored to the baseline concentrations or the secondary restoration standards established by license condition 10.3C, SUA-1534.

Stability monitoring, after completing ground-water restoration, and demonstrating that the restored ground-water concentrations will remain within license limits, is the final step of the *in situ* leaching process before a wellfield unit is decommissioned and released from the license for the purposes of financial assurance. Guidance to staff for evaluating these measures is provided in Section 6.1.3 of NUREG-1569 (NRC, 2002), and has been included in previous drafts of the SRP since 1997. The SRP directs staff that, "Wellfields may be decommissioned

when all constituents meet the approved standards and show no strong trends in groundwater quality deterioration as a result of ISL activities." Crow Butte Resources committed to conducting stability monitoring at each wellfield for six months in the 1998 license renewal application and the ground-water restoration plan for the Crow Butte facility (CBR, 1996), which is part of the renewal application. The six-month period was based on forecasts for commercial-scale wellfields, using the restoration and stability data from the smaller pilot-scale wellfield demonstration. In the restoration plan, Crow Butte Resources did not commit to assuring that the restored ground-water was stable before ceasing the stability monitoring program.

The only data provided by the licensee for the majority of the constituents of concern were collected during the six-month stability monitoring period. The licensee did not provide additional data for these constituents beyond the stability monitoring period, as requested in the June 26, 2001, Request for Additional Information. The licensee did provide some additional monitoring data and graphical analysis since the close of the stability monitoring period for the selected constituents of alkalinity, conductivity, sulfate, sodium, and chloride; but did not provide additional data or analyses for other restoration constituents, such as: ammonium, arsenic, boron, calcium, fluoride, iron, magnesium, manganese, molybdenum, potassium, radium-226, selenium, total dissolved solids, uranium, vanadium, or zinc. As a result, staff evaluated the stability of the restoration with the data collected during the stability monitoring period. Staff constructed graphical plots of the data provided by the licensee and performed a regression analysis, using a second order polynomial (Microsoft® Excel 97 SR-1), and visually inspected the resulting polynomial curve fitted to the data to determine whether strongly increase concentration trends were evident in the stability data.

1. **Finding:** Staff's analysis indicates that concentrations of ammonium, iron, radium-226, selenium, total dissolved solids, and uranium show strongly increasing concentration trends over the stability monitoring period. These trends indicate a reasonable likelihood that license limits would be exceeded in the near future. Other constituents appear to have reached stability, or exhibit such a weakly increasing trend that stability is not a concern. Figures 1, and 2, provide examples of strongly increasing concentration trends in the monitored data during the stability monitoring period. These increasing trends represent a particular concern when a constituent has been restored to the secondary restoration goal, as these two examples were. The secondary restoration standards are greater than the pre-operational baseline concentrations, but are considered protective of the adjacent aquifer beyond the limits of the U.S. EPA designated aquifer exemption boundary. Increasing trends that indicate a potential future exceedance of baseline limits do not represent an immediate concern, since the secondary limits are higher than the baseline limits and are considered protective. Figures 3, and 4, illustrate two constituents that appear to have stabilized during the stability monitoring period. Although Figure 3, shows an increasing trend, this trend is not significant. Figure 4 shows a strongly increasing trend in the early measurements, but the trend dissipated by the time the later data were collected.

FIGURE 1. Unit 1 Radium-226 Measurements

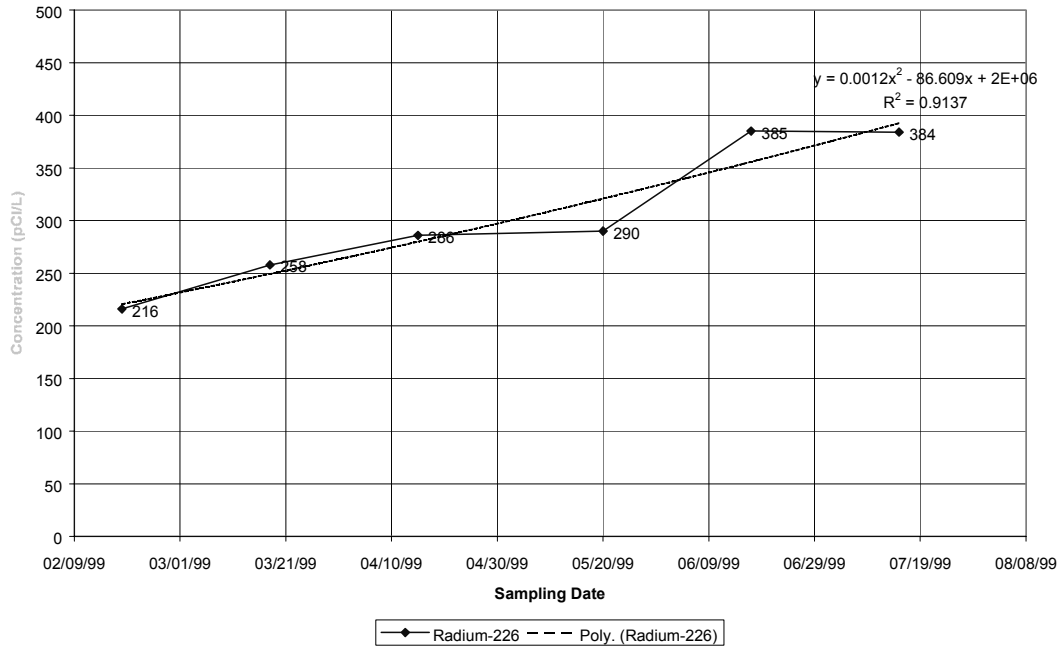


FIGURE 2. Unit 1 Uranium Measurements

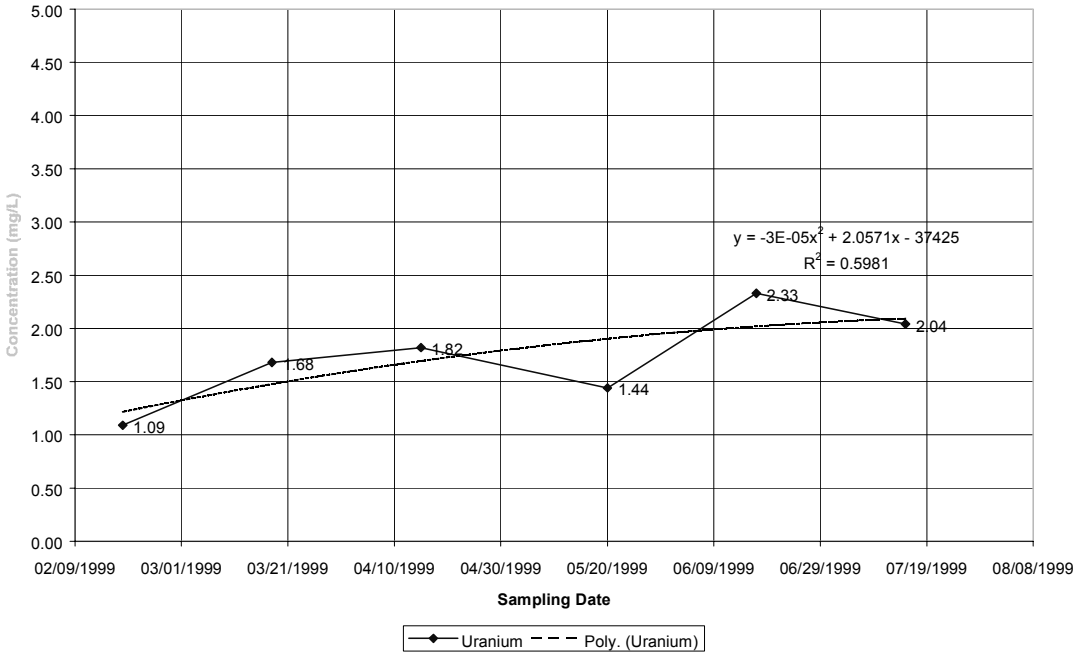


FIGURE 3. Unit 1 Arsenic Measurements

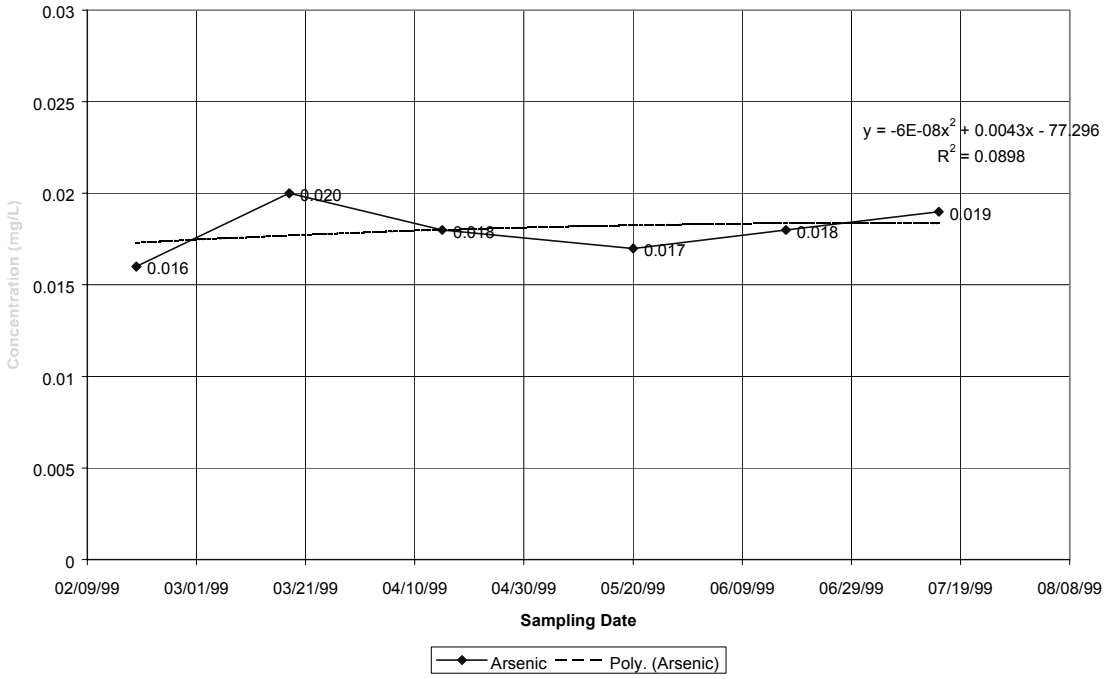
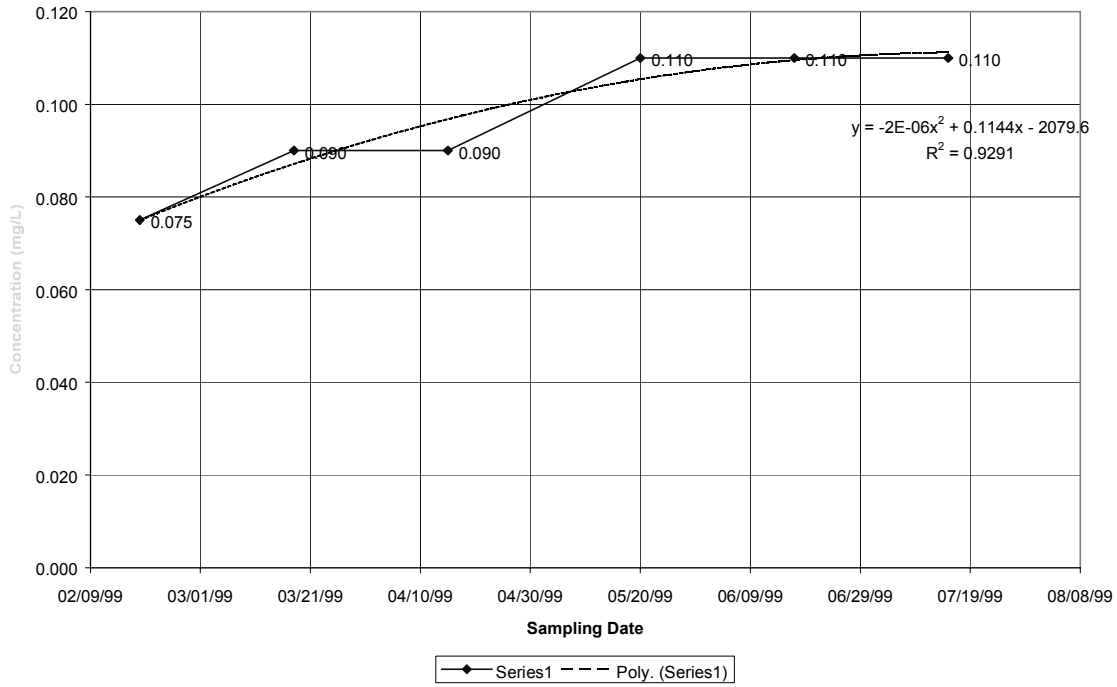


FIGURE 4. Unit 1 Molydenum Measurements



2. **Conclusion:** The data provided by the licensee in the original submittal (CBR, 2000B), and the supplemental data provided in response to NRC's Request for Additional Information (CBR, 2001), has not demonstrated that these concentrations have reached a level of stability that will assure continued compliance with the restoration goals. The Unit 1 restoration does not appear to have stabilized over the six month stabilization period provided by the licensee, and the licensee has not demonstrated that the restored ground-water concentrations in Unit 1 will remain stable and will not exceed the established license limits at some point in the future.

   Staff's analysis and findings strongly indicate that the six-month period for stability monitoring at this site is insufficient to assure stability for all monitored constituents. Many constituents reached stability within a relatively short time; however, increasing concentrations for several constituents persist at the end of, and presumably beyond, the six-month stability period. The stability monitoring data provided by this first commercial-scale wellfield restoration at the site indicates that the originally forecasted stability period was underestimated.

RECOMMENDATIONS:

1. The licensee's request for Unit 1 wellfield restoration approval should be denied.

2. Decommissioning of Unit 1 should not proceed at this time.

3. Stabilization ground-water monitoring in Unit 1 should be restarted immediately at the monitoring locations described in the January 10, 2000, Restoration Report. The ground-water should be sampled and analyzed for the constituents listed in License Condition 10.3B, SUA-1534, on a schedule of at least 14 days apart. The wellfield restoration shall be considered stable if four consecutive sampling episodes show no strongly increasing concentration trends for all monitored constituents, on a wellfield average, as described in Section 6.1.3, "Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications," NUREG-1569.

4. The licensee should submit a written report for NRC review and approval when four consecutive sampling episodes show no strongly increasing concentration trends. The report should provide a tabulation of all stability monitoring data for Unit 1 graphics showing time versus concentration of each monitored constituent, and analyses that demonstrate the restored constituent concentrations are within license limits and are stable.

5. Stability monitoring should continue until four consecutive sampling episodes show no strongly increasing concentration trends.

6. Wellfield restoration activities should be immediately re-initiated in Unit 1 if the concentration of any monitored constituent exceeds its license limit and the NRC should be notified, in writing, within 30 days of this occurrence.

7. The licensee should extend the stability monitoring period for all future wellfields beyond the six-month monitoring period forecasted by the pilot-scale wellfield restoration.

ENVIRONMENTAL REVIEW: Staff determined that the denial of Crow Butte Resources's request regarding the Unit 1 wellfield restoration is purely administrative, therefore an environmental assessment is not required in accordance with 10 CFR 51.22(c)(11).

Staff determined that the following criteria have been met for a categorical exclusion:

- There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite,
- There is no significant increase in individual or cumulative occupational radiation exposure,
- There is no significant construction impact, and
- There is no significant increase in the potential for or consequences from radiological accidents.

Accordingly, pursuant to 10 CFR 51.22(c)(11), neither an environmental assessment nor an environmental impact statement is warranted for this action.

COORDINATION AND CONSULTATION: This technical review and the proposed license amendment were discussed and coordinated with NRC's Region IV Inspection Program, and the Nebraska Department of Environmental Quality, which regulates the Crow Butte Resources facility under its Underground Injection Control Program, delegated from the U.S. Environmental Protection Agency. No unresolved concerns were identified through the course of this coordination.

REFERENCES:

Code of Federal Regulations (CFR), Title 10, Chapter I - Nuclear Regulatory Commission, Parts 2 , 40, and 51, revised as of January 1, 2002.

CBR (Crow Butte Resource, Inc.). 1996, Crow Butte ISL Mine Groundwater Restoration Plan. Letter from Stephen Collings, Crow Butte Resources to Joseph Holonich, Uranium Recovery Branch, NRC, dated November 26, 1996, with attachment. Accession Number 9612040273.

CBR (Crow Butte Resource, Inc.). 2000A. Mine Unit 1 Restoration Report and Request License Amendment, Materials License No. SUA-1534. Letter from Michael Griffin, Crow Butte Resources to John Surmeier, Uranium Recovery Branch, NRC, dated January 14, 2000, with attachments. Accession Number ML003677825.

CBR (Crow Butte Resource, Inc.). 2000B. Mine Unit 1 Restoration Report Crow Butte Uranium Project. Report attached to Letter from Michael Griffin, Crow Butte Resources to John Surmeier, Uranium Recovery Branch, NRC, dated January 10, 2000. Accession Number ML003677938.

CBR (Crow Butte Resource, Inc.). 2000C. Page change for Mine Unit 1 Restoration Report Crow Butte Uranium Project. Report attached to Letter from Michael Griffin, Crow Butte Resources to John Surmeier, Uranium Recovery Branch, NRC, dated February 8, 2000. Accession Number ML003685137.

CBR (Crow Butte Resource, Inc.). 2001. Mine Unit 1 Restoration; Response to Request for Additional Information. Report attached to Letter from Michael Griffin, Crow Butte Resources to Melvyn Leach, Fuel Cycle Licensing Branch, NRC, dated August 24, 2001. Accession Number ML012710072.

NRC (U.S. Nuclear Regulatory Commission). 1998. Environmental Assessment for renewal of Source material License No. SUA-1534. Office of Nuclear Material Safety and Safeguards. Accession Number 9803100003.

NRC (U.S. Nuclear Regulatory Commission). 2001. Request for Additional Information, transmitted by letter from Daniel M. Gillen, acting chief, Fuel Cycle Licensing Branch, NRC, dated June 26, 2001. Accession Number ML011830343.

NRC (U.S. Nuclear Regulatory Commission). 2002. Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications. NUREG-1569 Rev. 1. Office of Nuclear Material Safety and Safeguards. Accession Number ML020320181.

CROW BUTTE RESOURCES, INC.

274 Union Blvd., Suite 310 • Lakewood, Colorado 80228 • (720) 879-5140 • Fax: (720) 879-5141

May 17, 2002

40-8943

VIA FACSIMILE # (301) 415-5370

Mr. Martin J. Virgilio
Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop T8A23
Rockville, MD 20852

Re: Open Meeting Conference Call of May 14, 2002
NRC's March 29, 2002 Denial of Crow Butte's Request for
Approval of Restoration of Mine Unit 1

Dear Mr. Virgilio:

Once again, thank you for taking the time to meet with members of Crow Butte Resources, Inc. (Crow Butte) and NRC Staff via conference call to discuss NRCs decision not to approve restoration of Crow Butte's Mine Unit 1. This letter is intended to confirm the arrangements we agreed upon during our conference call.

NRC agrees to hold in abeyance the immediate effectiveness of the monitoring requirements set forth in its Notice of Denial dated March 20, 2002, and Federal Register notice dated April 22, 2002, for a period of seventy-five (75) days beginning May 14, 2002. During this time period, Crow Butte will develop alternative approaches to demonstrating restoration at Mine Unit 1. These alternative approaches will focus on providing reasonable assurance that restoration at Mine Unit 1 will adequately protect public health and safety and the environment in the State of Nebraska.

If, at the end of this 75-day period, Crow Butte and NRC have been unable to resolve these restoration issues, Crow Butte will have thirty (30) days, beginning on the first day after expiration of the 75-day abeyance period, within which to file a notice of appeal to the March 20th denial before the Atomic Safety and Licensing Board Panel.

NMSS01
Public

Crow Butte will also expect to receive a reply from NRC confirming the matters set forth in this letter. We will be in contact with Mike Layton and John Lusher to schedule our additional meetings over the next 75 days.

Once again, thank you for your time and attention in this matter. We look forward to reaching a mutually acceptable resolution to this issue.

Very truly yours,

Fletcher T. Newton

FTN:sjg

c: Mike Layton
John Lusher
Maria Schwartz, Esq.
Mike Griffin
Steve Collings
Tony Thompson, Esq.
Christopher Pugsley, Esq.

CROW BUTTE RESOURCES, INC.

86 Crow Butte Road
P.O. Box 169
Crawford, Nebraska 69339-0169

(308) 665-2215
(308) 665-2341 – FAX

Via Federal Express

June 28, 2002

Mr. Martin J. Virgilio
Director
Office of Nuclear Material Safety and Safeguards
c/o Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: **Denial, Mine Unit 1 Groundwater Restoration**
Source Materials License SUA-1534
Docket Number 40-8943

Dear Mr. Virgilio:

By letter dated March 29, 2002, the U.S. Nuclear Regulatory Commission (NRC) denied approval of groundwater restoration in Mine Unit 1 at the Crow Butte uranium mine. As the basis for the denial, the NRC cited what it referred to as evidence of "strongly increasing" trends in six parameters during the stabilization monitoring period. The denial also required Crow Butte to immediately resume sampling of all baseline restoration wells in Mine Unit 1 for the full restoration parameter list. During subsequent conversations between the NRC and Crow Butte Resources, Inc. (CBR), NRC granted a seventy-five day period for CBR to provide alternative approaches to demonstrate restoration. This letter proposes an alternate method that CBR believes will provide NRC with adequate assurance that the groundwater quality in Mine Unit 1 is stable, while also taking into account the practical considerations that are involved in order to comply with NRC's original order.

This alternative, however, should not be construed as an alternative to CBR's NRC-approved license conditions for restoration of Mine Unit 1, i.e., CBR is not herein suggesting or proposing an alternative form of restoration. CBR has already fulfilled each of its license conditions for groundwater restoration at Mine Unit 1 and received approval from the Nebraska Department of Environmental Quality (NDEQ) on its restoration efforts--an approval that NDEQ still stands behind. Nevertheless, in an effort to reach a viable compromise, CBR is proposing to provide NRC with additional monitoring data to demonstrate that the restoration of Mine Unit 1 is indeed complete and that no further monitoring or restoration is required.

NMSS01
Public

CROW BUTTE RESOURCES, INC.

Background

CBR completed the stabilization monitoring phase of groundwater restoration in Mine Unit 1 in July 1999. The stabilization was completed in accordance with the NRC-approved CBR Groundwater Restoration Plan[1], which is incorporated by reference in Source Materials License SUA-1534, License Condition 10.3. The results of restoration and stabilization were submitted to the NDEQ in accordance with CBR's Class III Underground Injection Control (UIC) permit. On November 18, 1999, the NDEQ approved the restoration of Mine Unit 1. The approval was based on the successful attainment of baseline or NDEQ water quality standards for all monitored parameters.

In January 2000, CBR submitted the Mine Unit 1 Restoration Report to NRC for review and approval. Over one year later, NRC responded with a Request for Additional Information on June 26, 2001. The request in part referred to what the NRC called "strongly increasing" trends in the stabilization data for fourteen parameters. These trends were based upon the NRC's analysis of the stabilization monitoring performed between February and July 1999. CBR responded in August 2001 and provided additional data from representative baseline restoration wells that had been routinely sampled for selected parameters following the stabilization period.

Seven months later, in March 2002, the NRC denied approval of groundwater restoration in Mine Unit 1. The denial was based upon the NRC's viewpoint that there were "strongly increasing" trends noted in six restoration parameters. Specifically, NRC cited concerns with trends for ammonium, iron, radium-226, selenium, total dissolved solids, and uranium. CBR was ordered to immediately resume stabilization monitoring of all twelve baseline restoration wells for the full restoration parameter list, which consists of 27 water quality constituents. NRC's order required CBR to continue monitoring until four consecutive samples indicated "no strongly increasing trends". Should the results of any sample event indicate an exceedance of the license limits for any parameter, CBR was further required to immediately resume active restoration of the entire Mine Unit 1.

As previously discussed in meetings with NRC staff, CBR believes that the restoration of Mine Unit 1 successfully met the criteria set forth in SUA-1534 and the licensing basis. CBR does not believe that there is any requirement for trend analysis in the licensing basis and that NRC is relying on the staff guidance contained in NUREG-1569[2]. In CBR's opinion, NUREG-1569 is a draft document for comment that is not incorporated

[1] Crow Butte Resources, Inc., *Groundwater Restoration Plan*, Revision 1, November 26, 1996.
[2] U.S. Nuclear Regulatory Commission, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications – Draft Report for Comment*, NUREG-1569, Revision 1, January 2002.

in CBR's licensing basis. However, CBR understands NRC concerns and is willing to provide additional information to allay these concerns.

With the exception of three baseline restoration wells that have been in constant use as perimeter monitor wells, Mine Unit 1 has not been operated since the final stabilization sample in July 1999. The physical condition of the remaining nine baseline restoration wells and associated utilities is not known. With NDEQ and NRC approval, mechanical integrity testing (MIT) was discontinued in Mine Unit 1 wells following NDEQ approval of restoration. Much of the pumping equipment and utilities have been removed from these wells. This action was taken following NDEQ approval of restoration and after allowing a reasonable period for NRC concurrence. In order to comply with the NRC's latest order, CBR has conservatively estimated a minimum cost of $20,000. Many factors could increase this cost significantly, including the potential costs for repair or replacement of wells that fail the MIT.

Additional Information Related to Trends

On May 16, 2002, CBR sampled the three Mine Unit 1 baseline restoration wells (PR-8, PR-15 and IJ-13) that are currently in use as perimeter monitor wells. These wells were selected to serve as monitor wells for Mine Units 2 and 3 with the approval of the NDEQ based on their representative location within the Mine Unit. The samples were analyzed for the six parameters cited in the NRC denial. These results were then compared with the data obtained from these wells during the stabilization period in 1999.

The analytical results from these three wells indicate that, in the three years since the last stabilization samples were taken, concentrations do not indicate increasing trends that would pose a reasonable likelihood that license limits would be exceeded in the near future. The average concentrations for each parameter except iron are stable and well below the NDEQ and NRC standard. The iron concentration in one well (IJ-13) increased substantially, but CBR believes that this indicates successful restoration of reducing conditions in the formation and does not represent a public health and safety concern. A review of the analytical results shows that the redox conditions near Wells IJ-13 and PR-8 have become reducing.[3] Since the groundwater is now reducing, the concentrations of

[3] This is primarily indicated by the increased iron concentrations at these wells. As groundwater becomes more reducing and remains in a pH range of 6 to 9 standard units, the less soluble oxidized Fe^{3+} is reduced to the more soluble Fe^{2+} oxidation state. Although at this time the average iron concentration for the three wells exceeds the NDEQ standard of 0.3 mg/l, the iron concentrations will decrease during the reduction of sulfate and the iron will be precipitated as sulfide minerals. Additionally, the increases in the concentrations of these constituents are related to the reduction of the ferric oxyhydroxides. Ferric oxyhydroxides have extremely high adsorption capacities and high affinities for heavy metals. During the reduction of the ferric oxyhydroxides, any adsorbed metals will be returned to the groundwater, resulting in temporary increasing

redox sensitive elements such as uranium and selenium will decrease as they are reduced to less soluble redox states. The decreased uranium concentration in Well IJ-13 is an example of uranium reduction. Also, the radium-226 and ammonium concentrations will be moderated by the adsorption to clays within the formation. The perceived increasing trends of these six parameters are actually the normal geochemical processes that take place when oxidizing conditions in the formation are exchanged for reducing conditions[4].

CBR presented this additional information to NRC staff on June 10, 2002 during the annual workshop sponsored by the NRC and the National Mining Association (NMA). At that time, NRC staff indicated a desire for still more information and specifically cited the monitoring requirements of the March 29, 2002 order as an acceptable approach.

CBR Proposal

By your letter dated June 11, 2002, NRC concurred with the 75 day period to allow CBR to propose alternative approaches to demonstrate restoration and suggested that the guidance contained in NUREG-1569, Section 6.1.3, Criterion (9) should be followed. CBR does not believe that this standard is applicable to this situation since Criterion (9) states that "(t)he applicant may propose alternatives to restoring an exploited ore zone to primary or secondary ground-water standards..." CBR is not proposing an alternative to restoration to the primary and secondary standards. In fact, CBR has met all applicable requirements contained in the NRC and NDEQ approved restoration plan and has received NDEQ approval based on successfully meeting these standards. NRC agreed with this conclusion in the Technical Evaluation Report (TER) dated March 6, 2002, which states that "(t)he submitted data show that ground-water quality has been restored to the baseline concentrations or the secondary restoration standards established by license condition 10.3C, SUA-1534."

CBR is proposing to provide additional monitoring data to assure NRC that there are no significant trends that indicate "...a reasonable likelihood that license limits would be exceeded in the near future". This additional monitoring is proposed as an alternative to the monitoring that NRC ordered in the denial. CBR does not believe that it is necessary to sample all twelve baseline restoration wells for the full suite of 27 restoration parameters in order to address NRC concerns regarding trends. CBR proposes to monitor the three wells that are currently in operation as monitor wells. In addition, CBR will

trends for these metals. The release of these metals would also increase the total dissolved solids concentration. These concentration increases are temporary, however, and do not represent truly increasing trends.

[4] James I Drever, *The Geochemistry of Natural Waters, Surface and Groundwater Environments*, Third Edition, 1997.

identify three more restoration wells with NRC concurrence that will be monitored in order to provide statistically valid data. This will provide data from a total of six restoration wells, which is significantly more than what is required under the terms of SUA-1534. CBR believes that two samples from each well for the six parameters of concern will adequately address NRC concerns.

The basis for proposing use of the three active restoration wells is CBR's belief that these wells are representative of groundwater conditions in Mine Unit 1 and that the significant costs associated with returning all other restoration wells to operational status are not justified. The Mine Unit 1 baseline restoration wells were maintained in operating condition for a reasonable period following the submittal of the Restoration Report in January 2000. The protracted NRC review, which encompassed a total of 27 months, led CBR to discontinue active maintenance in Mine Unit 1 and remove components for storage or reuse. The identifiable and potential costs to return these wells to operating status in order to obtain the additional samples are significant and, we believe, unnecessary.

CBR wishes to emphasize that it believes the three baseline restoration wells currently in service can be used to adequately address NRC concerns. This belief is based on three factors:

1. The locations of the wells are representative of the entire Mine Unit. The three wells are distributed evenly throughout the mine unit and are located stratigraphically to be representative of hydrogeologic conditions within the ore zone. The attached map of Mine Unit 1 shows the locations of all mining wells, of the nine inactive baseline restoration wells, and of the three active baseline restoration monitor wells. In addition, the map depicts 4-acre circles plotted around each active well. These circles represent the current NRC and NDEQ baseline restoration well density requirement of one baseline well per 4 acres.

2. The water quality of the three monitor wells is representative of the Mine Unit before active mining and during stabilization. The following table summarizes the Mine Unit and monitor well baseline average and the stabilization average for the six parameters of concern.

Parameter	Baseline Average		Stabilization Average	
	Mine Unit 1	Monitor Wells	Mine Unit 1	Monitor Wells
Ammonium	0.37	0.44	0.12	0.14
Iron	<0.044	<0.050	0.089	0.092
Radium-226	230	307	303	315
Selenium	<0.003	0.001	0.002	0.002
Total Dissolved Solids	1170	1147	1094	971
Uranium	<0.37	0.11	1.73	1.21

As noted, CBR does not believe there is sufficient basis to require additional monitoring for all 27 restoration parameters when only six are in question. The finding contained in the TER supports this position when it stated that the "(o)ther constituents appear to have reached stability, or exhibit such weakly increasing trends that stability is not a concern." If these parameters are not a concern, there is no justification for CBR to incur the significant cost associated with contract laboratory analysis. The TER does not provide NRC's rationale for ordering CBR to analyze for all restoration parameters.

CBR wishes to emphasize that the proposal detailed in this letter is not an alternative to CBR's NRC-approved license conditions pertaining to groundwater restoration at Mine Unit 1. As stated above, CBR performed extensive groundwater restoration activities at Mine Unit 1 for a period of over five years and believes that restoration is complete. The only issue now remaining appears to be finding an acceptable method to satisfy NRC concerns that the quality of the groundwater in question has indeed stabilized.

By denying CBR's Mine Unit 1 restoration amendment request and imposing more stringent restoration requirements on CBR than those required by the existing NRC license conditions, NRC staff have unilaterally modified CBR's license conditions. While the NRC certainly has the authority to issue an "immediately effective order" to a licensee, such an order must presumably be based on a present or future threat to public health and safety. To the best of our knowledge, there has been no evidence presented of a present or future threat to public health and safety involving the groundwater from CBR's Mine Unit 1.

CROW BUTTE RESOURCES, INC.

We sincerely appreciate this opportunity to find a mutually agreeable solution to this dilemma and we believe the additional date we are proposing to submit as outlined above will satisfy the NRC staff that constituents in the exempted aquifer do not pose a present or future threat to public health and safety. Should you or the staff have any questions about this proposal, please contact Mike Griffin at Mike Griffin at (308) 665-2215. Assuming our proposal is acceptable, we will follow up with the staff to determine which wells to use to provide the additional date.

Sincerely,
CROW BUTTE RESOURCES, INC.

Fletcher Newton
President

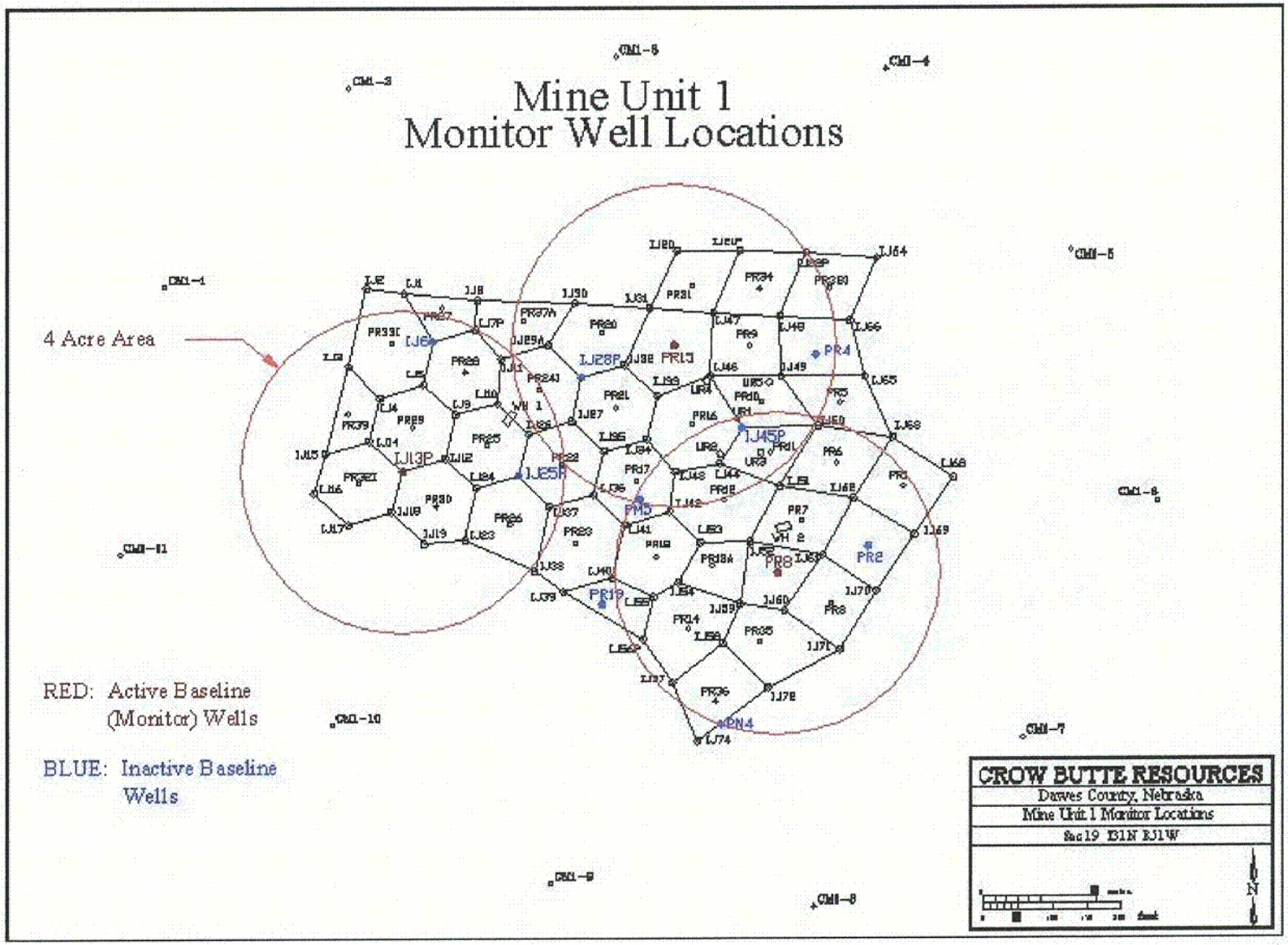
MLG:fn
Attachment

cc: Mr. David Miesbach (w/ attachment)
Underground Injection Control Program Coordinator
Nebraska Department of Environmental Quality,
Lincoln, Nebraska

Anthony Thompson, Esq. (w/ attachment)
Thompson and Associates

C-01

Mine Unit 1
Monitor Well Locations



CROW BUTTE RESOURCES, INC.

86 Crow Butte Road
P.O. Box 169
Crawford, Nebraska 69339-0169

(308) 665-2215
(308) 665-2341 – FAX

October 11, 2002

Mr. Daniel M. Gillen
Branch Chief
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety and Safeguards
c/o Document Control Desk
U.S. Nuclear Regulatory Commission
Washington D.C. 20555

Subject: Mine Unit 1 Groundwater Stability Data
Source Materials License SUA-1534
Docket Number 40-8943

Dear Mr. Gillen:

On June 28, 2002, Crow Butte Resources, Inc. (CBR) submitted a proposed monitoring plan to the U.S. Nuclear Regulatory Commission (NRC) to confirm the stability of restored groundwater in Mine Unit 1. NRC accepted CBR's proposal by letter dated August 2, 2002 and allowed 90 days for completion of the additional monitoring and trend analysis. Attached is a report that summarizes the stability data. Based on the results of the additional monitoring, CBR believes that the stability of the groundwater in the mine unit has been demonstrated and requests that NRC approved restoration for Mine Unit 1.

If you have any questions, please feel free to contact me at (308) 665-2215.

Sincerely,
CROW BUTTE RESOURCES, INC.

Michael L. Griffin
Manager of Health, Safety, and Environmental Affairs

Attachments: As Stated

NMSS01

CROW BUTTE RESOURCES, INC.

cc: U.S. Nuclear Regulatory Commission
Mr. John Lusher - ADDRESSEE ONLY
Fuel Cycle Licensing Branch
Mail Stop T-8A33
Washington, DC 20555

U.S. Nuclear Regulatory Commission
Mr. Mike Layton - ADDRESSEE ONLY – VIA Email
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Washington, DC 20555

Nebraska Department of Environmental Quality
Mr. David Miesbach
UIC Program Coordinator
Lincoln, Nebraska

Nebraska Department of Environmental Quality
Mr. David Carlson
Program Specialist, Northwest Field Office
Chadron, Nebraska

Steve Collings – Crow Butte Resources, Inc.
Denver, Colorado

CROW BUTTE RESOURCES, INC.

Crow Butte Resources, Inc.

Additional Stability Monitoring Data for Mine Unit 1 Groundwater Restoration

Crow Butte Uranium Project

October 11, 2002

United States Nuclear Regulatory Commission
Source Materials License SUA-1534

Submitted To: US Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
11545 Rockville Pike
Rockville, Maryland 20850

Prepared By: Crow Butte Resources, Inc.
P.O. Box 169
Crawford, Nebraska 69339

Table of Contents

1 INTRODUCTION

Crow Butte Resources, Inc. (CBR) operates a uranium solution mine in Dawes County, Nebraska. The permitted area includes approximately 2,800 acres in all or portions of Sections 11, 12, and 13 of Township 31N, Range 52W and Sections 18, 19, 20, 29 and 30 of Township 31N, Range 51W. The process plant is located in Section 19, Township 31 North, Range 51 West. The wellfields for current mining operations are located in Sections 18 and 19. Mining operations are conducted under a Class III Underground Injection Control (UIC) permit issued by the Nebraska Department of Environmental Quality (NDEQ) and source materials license SUA-1534 issued by the U. S. Nuclear Regulatory Commission (NRC).

CBR is required by NDEQ permit and NRC license condition as well as Nebraska State statute to restore groundwater in the affected area following mining operations. On September 3, 1999, CBR submitted the Mine Unit 1 Restoration Report to the NDEQ. NDEQ determined that the groundwater restoration met the requirements of Nebraska statute and regulations and the conditions of the Class III UIC permit. On November 18, 1999, the NDEQ accepted the groundwater restoration of Mine Unit 1.

On January 10, 2000, CBR submitted the Mine Unit 1 Restoration Report[1] to the NRC. The report reviewed the mining history in Mine Unit 1, groundwater restoration efforts including the post-restoration stabilization monitoring, and provided an analysis of the effectiveness of the restoration. CBR requested that NRC amend portions of the source materials license governing groundwater restoration and approve the restoration of groundwater in Mine Unit 1.

On June 26, 2001, NRC sought additional data from CBR in a Request for Additional Information. The Request for Additional Information addressed three areas where NRC required supplementary information before approval of Mine Unit 1 restoration. The areas requiring additional information were a description of the efforts made by CBR to achieve the primary restoration goals and to ensure the restoration of wellfield flare as well as further data supporting the stability of the groundwater restoration. CBR provided the requested information in a report dated August 24, 2001.

On March 29, 2002, NRC denied the restoration of Mine Unit 1 based on concerns related to the stability of six groundwater parameters during the stabilization monitoring period. Specifically, NRC was concerned with increasing trends for uranium, radium-226, ammonium, iron, selenium, and total dissolved solids (TDS). NRC directed that CBR resume restoration stability monitoring and provide the results of this monitoring to NRC.

[1] Crow Butte Resources, Inc., *Mine Unit 1 Restoration Report, Crow Butte Uranium Project*, January 10, 2000.

On June 28, 2002, CBR submitted a proposed monitoring plan that was subsequently approved by NRC. The plan entailed performing supplementary monitoring in six Mine Unit 1 restoration wells. The monitoring was performed for the six parameters of concern to NRC. A minimum of three samples were proposed, with a total period of three months allowed for CBR to collect and interpret the monitoring data.

This report provides the results of the supplementary monitoring. These results indicate that the quality of the groundwater in Mine Unit 1 is stable at concentrations below the restoration standards. The results from monitoring for individual parameters is discussed in Section 2. A summary and requested regulatory action is provided in Section 3.

2 STABILITY OF GROUNDWATER RESTORATION

In the denial of Mine Unit 1 restoration, the NRC staff noted what it referred to as "strongly increasing" trends in six restoration parameters during the six month stabilization period in early 1999. NRC staff believed that these trends indicated "...a reasonable likelihood that license limits would be exceeded in the near future." NRC argued that there were increasing trends in uranium, radium-226, ammonium, iron, selenium, and total dissolved solids.

In response to these concerns, CBR proposed to sample six representative restoration wells (IJ-13, PR-8, PR-15, IJ-28, IJ-45, and IJ-25) in Mine Unit 1 to provide additional stability monitoring data. These wells would be sampled for the six parameters of concern on at least three occasions with a minimum time between samples of fourteen days. The data would be reviewed to determine whether any strongly increasing trend were present that would indicate a future likely exceedance of the approved restoration standards.

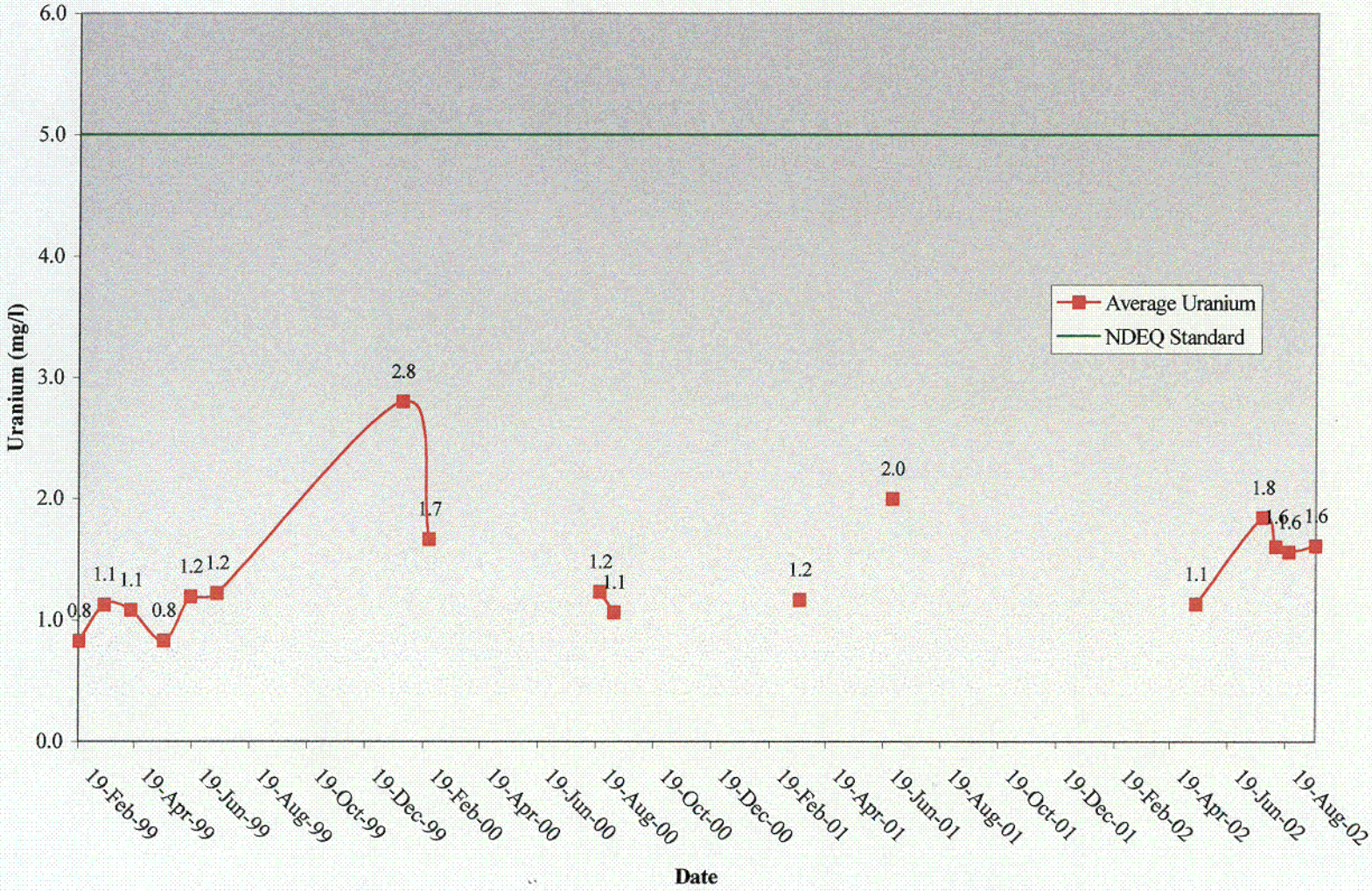
CBR sampled the six representative restoration wells on four occasions on July 25, August 8, August 22, and September 19, 2002. The first three sets of samples were analyzed for uranium, radium-226, ammonium, iron, selenium, and total dissolved solids. The final set of samples was analyzed for uranium, radium-226, iron, and selenium. The samples were sent to Energy Laboratories, Inc. in Casper, Wyoming for analysis. Summary tables and copies of the analytical results are contained in Appendix A. The following sections discuss the monitoring results for each parameter and include figures that compare the results for the six wells from the stabilization period in 1999 and the additional monitoring performed in 2002.

2.1 Uranium

Average Mine Unit 1 concentrations of natural uranium during the stabilization period in 1999 ranged from 1.09 to 2.33 mg/L, with an average concentration of 1.73 mg/L (CBR, 2000). These concentrations compare with the NDEQ restoration standard of 5 mg/L. Figure 1 plots the average uranium concentration for the six representative restoration wells during stabilization monitoring in 1999 and the additional monitoring performed in 2002. The figure also includes additional data obtained by CBR from selected wells beginning in early 2000 through 2002.

As shown in Figure 1, uranium concentrations are stable at concentrations well below the restoration standard of 5 mg/L. The average uranium concentrations for the six representative wells ranged from 1.6 to 1.8 mg/L between June and September 2002, with an average concentration of 1.66 mg/L.

Figure 1
Mine Unit 1 Average Uranium Concentration



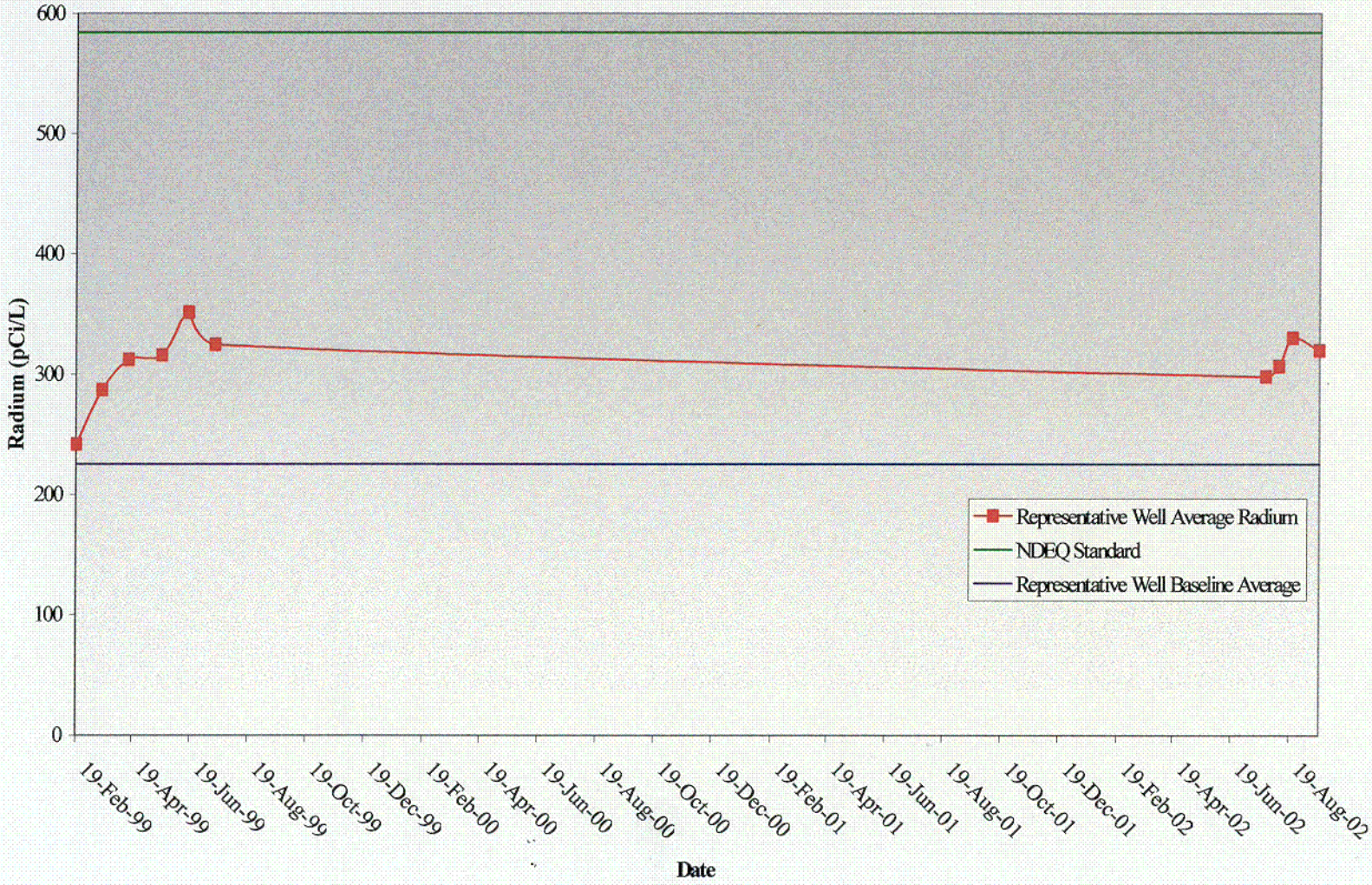
2.2 Radium 226

Average Mine Unit 1 concentrations of radium-226 during the stabilization period in 1999 ranged from 216 to 385 pCi/L, with an average concentration of 303 pCi/L (CBR, 2000). These concentrations compare with the baseline average concentration of 230 pCi/L and the NDEQ restoration standard for Mine Unit 1 of 584 pCi/L[2]. Figure 2 plots the average radium-226 concentration from the six representative restoration wells during stabilization and during the additional monitoring period approved by NRC.

As shown in Figure 2, radium-226 concentrations are stable at concentrations well below the restoration standard of 584 pCi/L. The average radium-226 concentrations ranged from 298 to 330 pCi/L between June and September 2002, with an average concentration of 314 pCi/L.

[2] The NDEQ restoration standard for radium-226 is based upon the drinking water standard of 5 pCi/L from NDEQ Rules and Regulations, Title 118 If the baseline mean for radium-226 exceeds the drinking water standard, the restoration standard is then based upon a statistical determination of the potential range of baseline concentrations, calculated by determining the wellfield mean and adding two standard deviations

Figure 2
Mine Unit 1 Average Radium Concentration



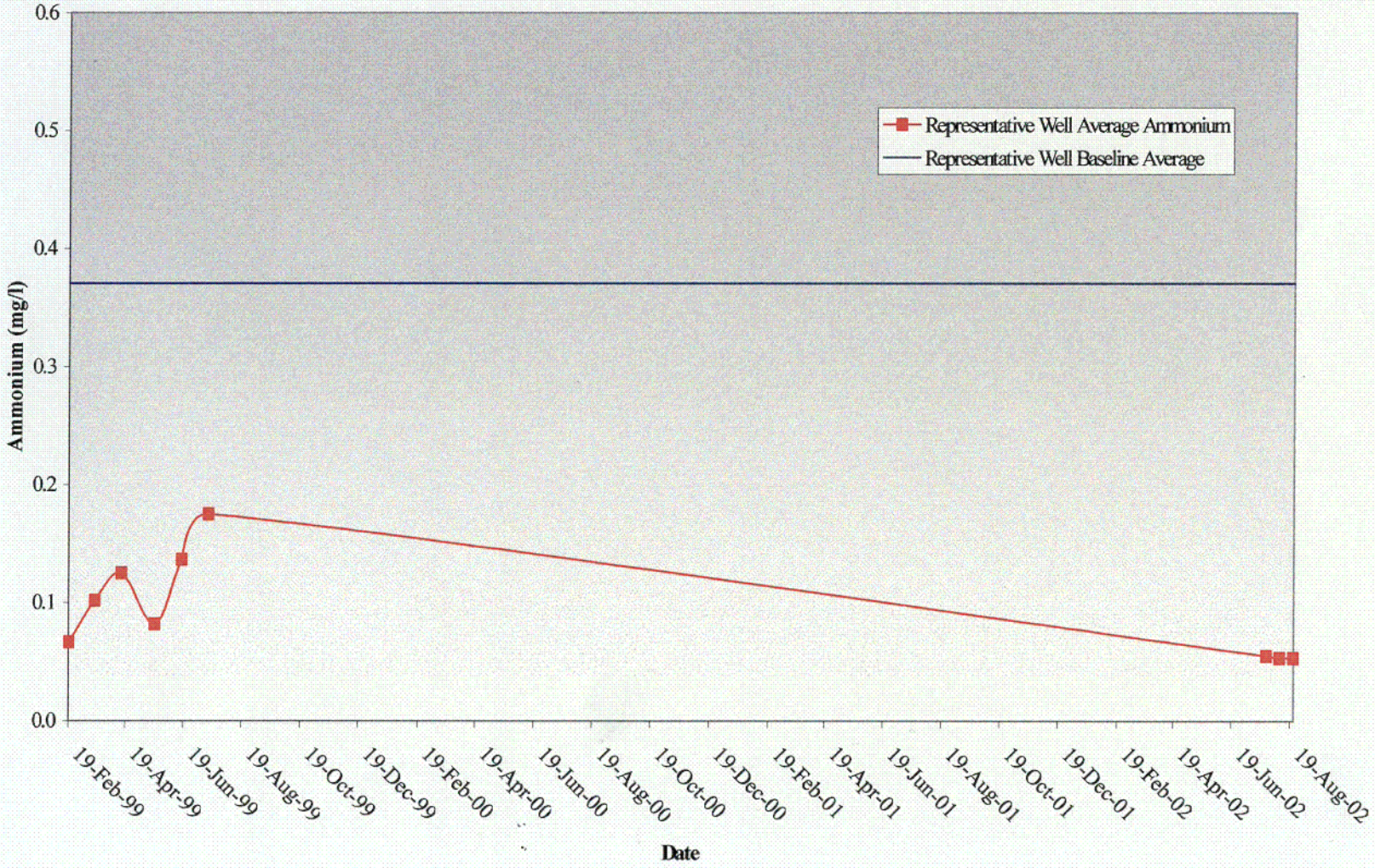
2.3 Ammonium

Average Mine Unit 1 concentrations of ammonium during the stabilization period in 1999 ranged from 0.07 to 0.18 mg/L, with an average concentration of 0.12 mg/L (CBR, 2000). These concentrations compare with the baseline average concentration of 0.37 mg/L and the NDEQ restoration standard for Mine Unit 1 of 10 mg/L[3]. Figure 3 plots the average ammonium concentration from the six representative restoration wells during stabilization and during the additional monitoring period approved by NRC. (Note that the restoration standard of 10 mg/L cannot be plotted due to the useful scale of the graph).

As shown in Figure 3, ammonium concentrations are stable at concentrations well below the premining baseline concentration of 0.37 mg/L. The average ammonium concentrations ranged from 0.05 to 0.06 mg/L between June and September 2002, with an average concentration of 0.05 mg/L. These current concentrations are 0.5 percent of the restoration standard of 10 mg/L.

[3] The NDEQ standard of 10 mg/L is contained in the Class III UIC Permit and is based upon an EPA draft health advisory for a drinking water equivalent level (DWEL). The DWEL is a lifetime exposure concentration protective of adverse, non-cancer health effects assuming all of the exposure is from a drinking water source.

Figure 3
Mine Unit 1 Average Ammonium Concentration



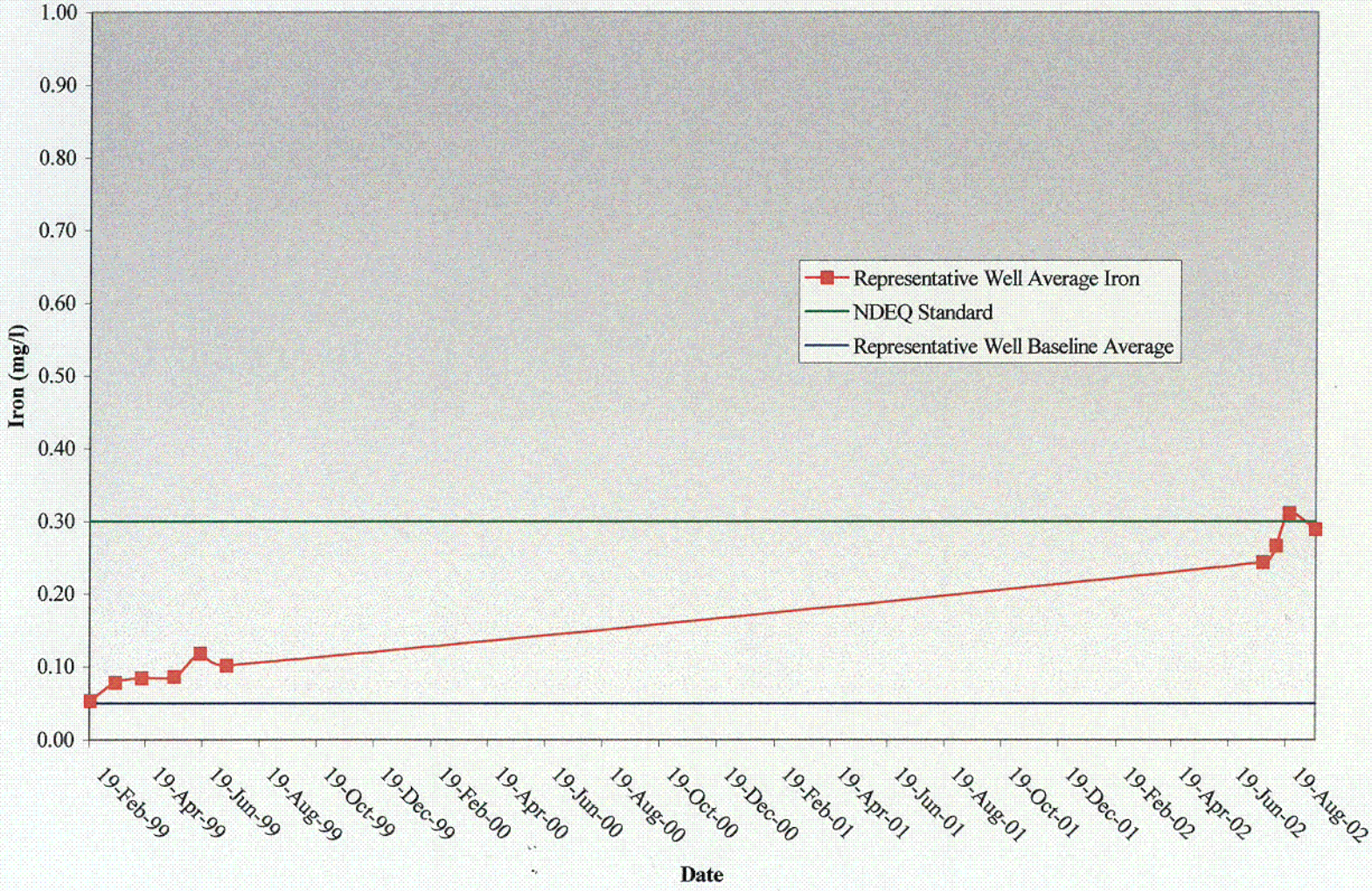
2.4 Iron

Average Mine Unit 1 concentrations of iron during the stabilization period in 1999 ranged from 0.049 to 0.127 mg/L, with an average concentration of 0.089 mg/L (CBR, 2000). These concentrations compare with the baseline average concentration of 0.044 mg/L and the NDEQ restoration standard for Mine Unit 1 of 0.3 mg/L[4]. Figure 4 plots the average iron concentration from the six representative restoration wells during stabilization and during the additional monitoring period approved by NRC. As shown in Figure 4, iron concentrations have increased since the stabilization period to a concentration that is near the restoration standard. The average iron concentrations ranged from 0.24 to 0.31 mg/L between June and September 2002, with an average concentration of 0.278 mg/L.

CBR believes that the elevated iron concentrations are due to the restoration process and will ultimately decrease to concentrations well below the restoration standard. During the in situ mining process, when the groundwater is oxygenated and the Eh is positive, the iron contained in pyrites is oxidized to ferric iron and forms ferric oxyhydroxides. The ferric oxyhydroxides are extremely insoluble, which explains the very low concentrations of iron in solution during mining, indicated by the end of mining values which, with the exception of one restoration well (PR-19), were below the detection limit of 0.05 mg/L. During the active restoration process, however, sodium sulfide is used as a reductant to decrease the Eh of the groundwater. As the Eh drops, the stable solid iron phase is reduced from ferric iron to ferrous iron, which is more soluble. During the transition from ferric to ferrous iron, the iron concentration in the groundwater increases significantly. This increase in the iron concentration is transitory and, as the Eh continues to decrease, iron sulfide minerals will be the dominant iron phase. Because of the relative insolubility of these iron sulfide minerals, this will cause a significant decrease in the iron concentration in solution. Based on these mechanisms, CBR expects that the elevated concentrations of iron at the current time will ultimately decrease.

[4] The NDEQ restoration standard for iron is based upon the drinking water standard of 0.3 mg/L from NDEQ Rules and Regulations, Title 118. This concentration is listed in Title 118 as an "Other Parameter Affecting Use" and is based on an EPA Secondary Maximum Contaminant Level (SMCL). These SCMLs are unenforceable federal guidelines regarding taste, odor, color and certain other non-aesthetic effects of drinking water.

Figure 4
Mine Unit 1 Average Iron Concentration



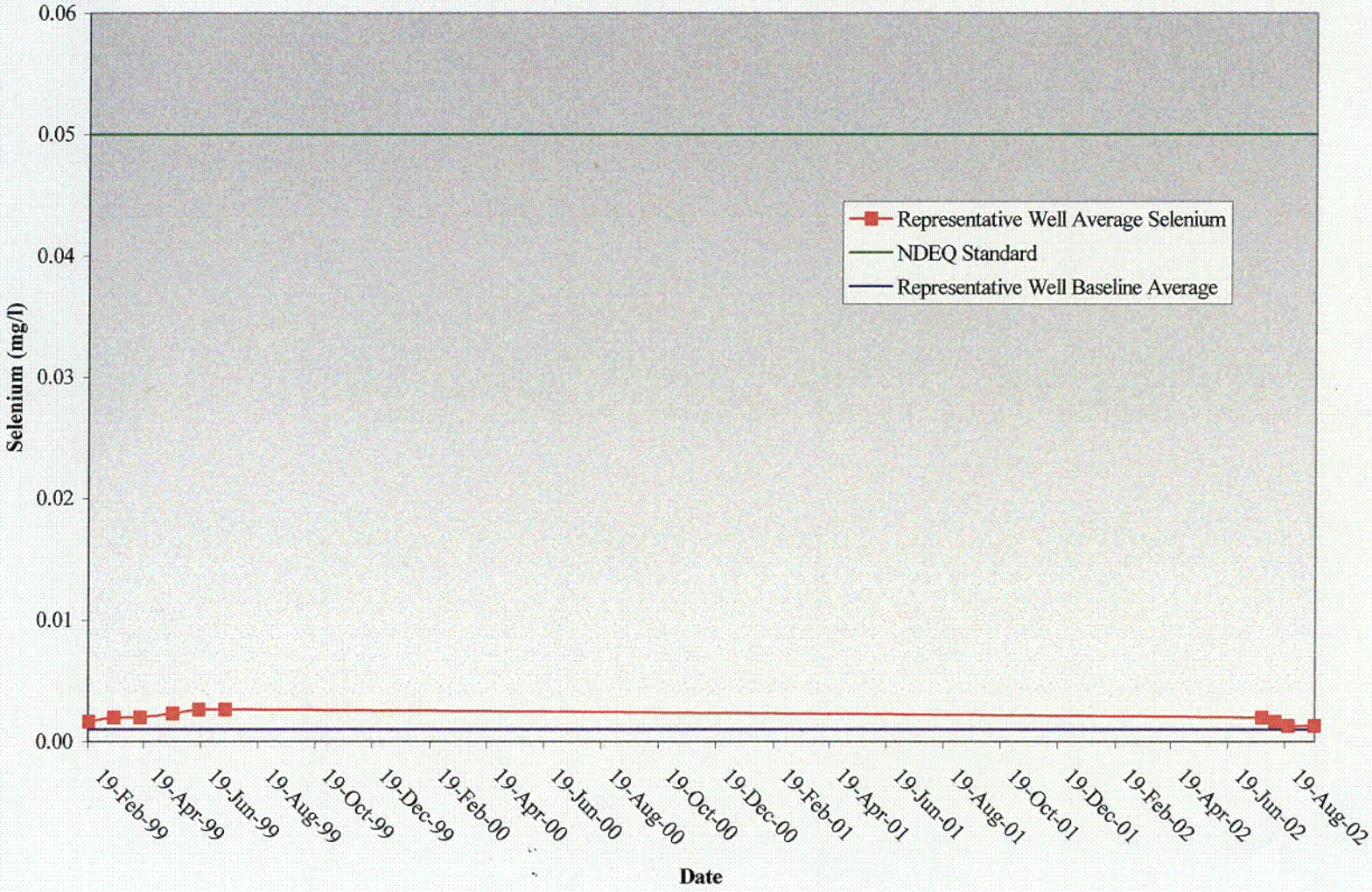
2.5 Selenium

Average Mine Unit 1 concentrations of selenium during the stabilization period in 1999 ranged from 0.001 to 0.003 mg/L, with an average concentration of 0.002 mg/L (CBR, 2000). These concentrations compare with the baseline concentration of 0.003 mg/L and the NDEQ restoration standard for Mine Unit 1 of 0.05 mg/L[5]. Figure 5 plots the average selenium concentration from the six representative restoration wells during stabilization and during the additional monitoring period approved by NRC.

As shown in Figure 5, selenium concentrations are stable at concentrations near baseline and well below the restoration standard of 0.05 mg/L. The average selenium concentrations ranged from 0.0013 to 0.002 mg/L between June and September 2002, with an average concentration of 0.0016 mg/L.

[5] The NDEQ restoration standard for selenium is based upon the drinking water standard of 0.05 mg/L from NDEQ Rules and Regulations, Title 118.

Figure 5
Mine Unit 1 Average Selenium Concentration



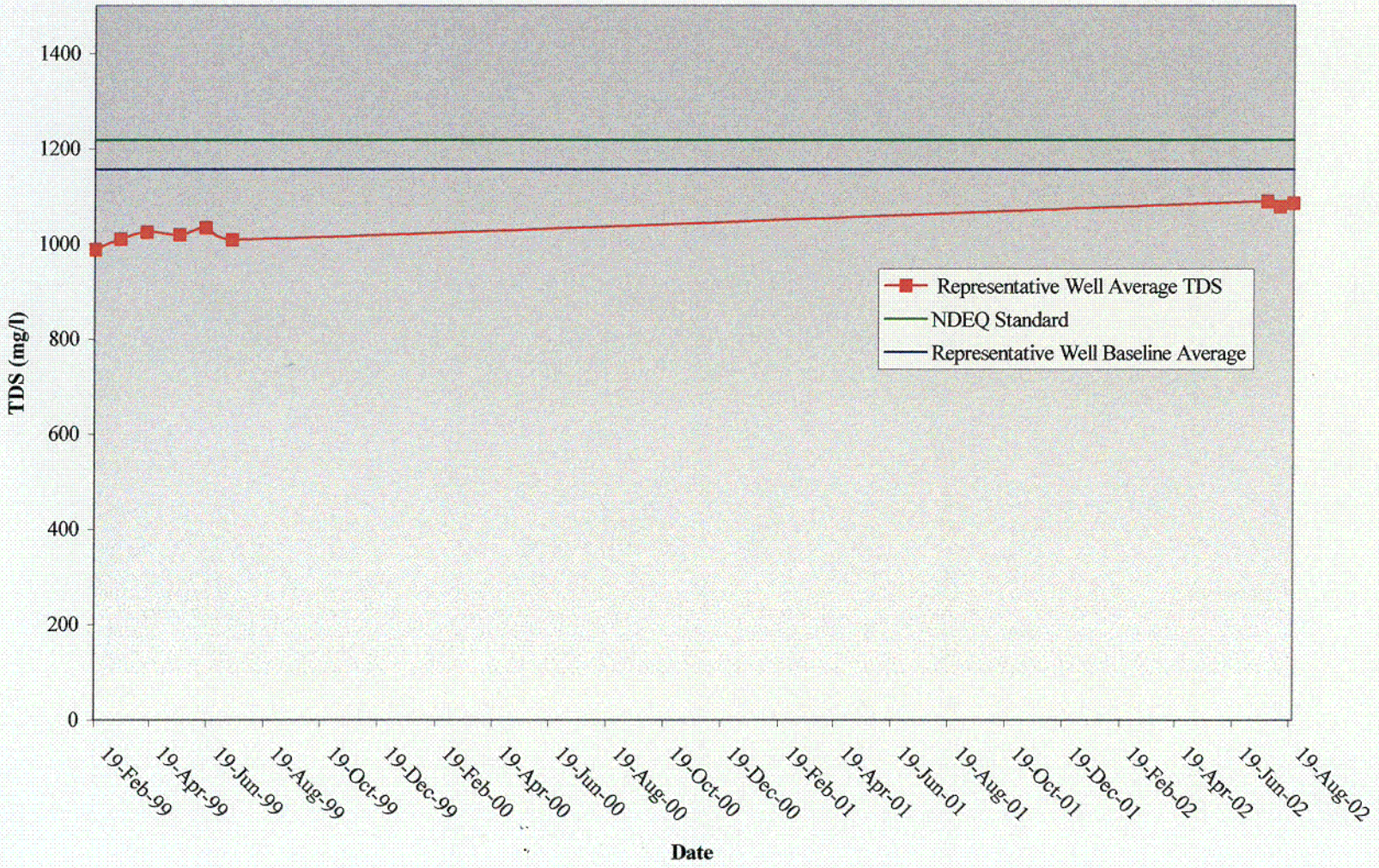
2.6 Total Dissolved Solids

Average Mine Unit 1 Total Dissolved Solids (TDS) concentrations during the stabilization period in 1999 ranged from 1026 to 1153 mg/L, with an average concentration of 1094 mg/L (CBR, 2000). These concentrations compare with the baseline concentration of 1170 mg/L and the NDEQ restoration standard for Mine Unit 1 of 1218 mg/L[6]. Figure 6 plots the average TDS concentration from the six representative restoration wells during stabilization and during the additional monitoring period approved by NRC.

As shown in Figure 6, TDS concentrations are stable at concentrations below baseline and the restoration standard. The average TDS concentrations ranged from 1078 to 1089 mg/L between June and September 2002, with an average concentration of 1084 mg/L.

[6] The NDEQ restoration standard for TDS is contained in the Class III UIC Permit. There is no drinking water standard for TDS contained in the NDEQ Rules and Regulations, Title 118. The restoration standard is based upon a statistical determination of the potential range of baseline concentrations, calculated by determining the wellfield mean and adding one standard deviation.

Figure 6
Mine Unit 1 Average TDS Concentration



3 SUMMARY AND REQUESTED ACTION

CBR has provided additional, updated monitoring data to address NRC questions concerning increasing trends noted in selected restoration parameters during the stabilization monitoring period for Mine Unit 1. This data was provided by sampling six restoration wells that were selected by CBR and approved by NRC as representative of the Mine Unit as a whole. The data has indicated very stable concentrations of these parameters considering the intervening three years since stabilization monitoring was completed. One parameter (i.e., iron) has shown an increase since 1999, with concentrations near the restoration standard. As explained above, this increase is likely a result of the use of a chemical reductant to restore the mining zone and is transitory.

The additional monitoring data collected by CBR clearly demonstrates that the groundwater in Mine Unit 1 has been successfully restored to the NRC-approved standards and is stable. The average concentration during the additional monitoring period for each parameter is below the approved restoration standard. In two cases (i.e., ammonium and TDS), the average concentrations are below premining baseline concentrations. There are no significant increasing trends evident, particularly when the current water quality conditions are compared with those noted during the 1999 stabilization period for the same six wells.

CBR has met the requirements contained in SUA-1534 and the licensing basis. In addition, CBR has provided additional monitoring data that confirms wellfield stability over an extended period. Based on these results, CBR requests that NRC approve the restoration of the groundwater in Mine Unit 1 in an expeditious manner to allow well abandonment and surface reclamation to proceed.

Appendix A

Mine Unit 1 Data Summary Tables and Analytical Results

Mine Unit 1 Monitor Well Uranium Monitoring Data							
Sample Date	PR-15	LJ-13	PR-8	LJ-25	LJ-28	LJ-45	Average Uranium
19-Feb-99	0.3	0 2	2.3	0 8	0 5	0 9	0 8
18-Mar-99	0 4	1 3	2.1	1 0	0 7	1 2	1 1
15-Apr-99	0 4	1 6	1 6	1 0	0 7	1 2	1.1
20-May-99	0 5	1 5	1 1	0 7	0 5	0 8	0.8
17-Jun-99	0 8	1 8	1 6	1 1	0 8	1 2	1.2
15-Jul-99	0 9	1 7	1 6	1 3	0 7	1 2	1.2
27-Jan-00		2 8					2.8
24-Feb-00	0 6	3 1	1.3				1 7
10-Mar-00							
23-Mar-00							
6-Apr-00							
20-Apr-00							
4-May-00							
18-May-00							
1-Jun-00							
15-Jun-00							
29-Jun-00							
13-Jul-00							
27-Jul-00							
10-Aug-00							
23-Aug-00	0 6	2 2	0 9				1.2
7-Sep-00	0 5	0 9	1 8				1.1
21-Sep-00							
5-Oct-00							
19-Oct-00							
2-Nov-00							
16-Nov-00							
30-Nov-00							
14-Dec-00							
28-Dec-00							
11-Jan-01							
25-Jan-01							
8-Feb-01							
22-Feb-01							
8-Mar-01							
22-Mar-01	0 7	2 1	0 7				1.2
5-Apr-01							
19-Apr-01							
3-May-01							
17-May-01							
31-May-01							
14-Jun-01							
28-Jun-01	1.4	2.6	2 0				2.0
12-Jul-01							
26-Jul-01							
9-Aug-01							
23-Aug-01							
6-Sep-01							
20-Sep-01							
4-Oct-01							
18-Oct-01							
1-Nov-01							
15-Nov-01							
29-Nov-01							
13-Dec-01							
27-Dec-01							
10-Jan-02							
24-Jan-02							
7-Feb-02							
21-Feb-02							
7-Mar-02							
21-Mar-02							
4-Apr-02							
18-Apr-02							
2-May-02							
16-May-02	1 5	0 4	1 5				1 1
25-Jul-02	0 5	1 7	1 9	2 2	2.8	2.1	1 8
8-Aug-02	0 4	1 6	1 6	1 8	2.4	1 8	1 6
22-Aug-02	0 4	1 8	1 5	1 6	2.4	1 7	1 6
19-Sep-02	0 3	2 2	1 6	1 5	2.3	1 7	1 6

Mine Unit 1 Monitor Well TDS Monitoring Data									
Sample Date	PR-15	IJ-13	PR-8	IJ-25	IJ-28	IJ-45	Representative Well Average TDS	Representative Well Baseline Average	NDEQ Standard
19-Feb-99	606	1060	1160	1030	1010	1060	988	1156	1218
18-Mar-99	651	1080	1160	1050	1050	1070	1010	1156	1218
15-Apr-99	670	1110	1150	1050	1080	1090	1025	1156	1218
20-May-99	675	1100	1160	1040	1050	1090	1019	1156	1218
17-Jun-99	685	1120	1190	1070	1060	1080	1034	1156	1218
15-Jul-99	669	1080	1160	1030	1020	1090	1008	1156	1218
25-Jul-02	763	1310	1230	1120	1060	1050	1089	1156	1218
8-Aug-02	699	1310	1230	1110	1080	1040	1078	1156	1218
22-Aug-02	720	1320	1210	1110	1110	1040	1085	1156	1218

Mine Unit 1 Monitor Well Radium Monitoring Data									
Sample Date	PR-15	IJ-13	PR-8	IJ-25	IJ-28	IJ-45	Representative Well Average Radium	Representative Well Baseline Average	NDEQ Standard
19-Feb-99	13	376	204	253	160	445	242	225	584
18-Mar-99	25	665	190	218	192	431	287	225	584
15-Apr-99	30	764	184	236	212	447	312	225	584
20-May-99	30	770	199	225	203	468	316	225	584
17-Jun-99	26	920	206	242	206	509	351	225	584
15-Jul-99	32	849	192	202	185	487	324	225	584
25-Jul-02	22	744	218	216	169	418	298	225	584
8-Aug-02	20	778	239	210	188	405	307	225	584
22-Aug-02	17	852	251	203	207	451	330	225	584
19-Sep-02	13	778	310	231	180	407	320	225	584

Mine Unit 1 Monitor Well Selenium Monitoring Data									
Sample Date	PR-15	IJ-13	PR-8	IJ-25	IJ-28	IJ-45	Representative Well Average Selenium	Representative Well Baseline Average	NDEQ Standard
19-Feb-99	0 002	0 001	0 001	0 002	0 002	0 002	0 0017	0 001	0.05
18-Mar-99	0 002	0 001	0 003	0 002	0 003	0 002	0 0020	0 001	0.05
15-Apr-99	0 002	0 001	0 003	0 003	0 003	0 002	0 0020	0 001	0.05
20-May-99	0 003	0 001	0 003	0 002	0 003	0 001	0 0023	0 001	0.05
17-Jun-99	0 003	0 001	0 004	0 002	0 003	0 002	0 0027	0 001	0.05
15-Jul-99	0 003	0 001	0 004	0 003	0 003	0 002	0 0027	0 001	0.05
25-Jul-02	0 002	0 002	0 002	0 004	0 002	0 002	0 0020	0 001	0.05
8-Aug-02	0 001	0 002	0 002	0 003	0 002	0 002	0 0017	0 001	0.05
22-Aug-02	0 001	0 001	0 002	0 003	0 002	0 001	0 0013	0 001	0 05
19-Sep-02	0 001	0 001	0 002	0 002	0 001	0 002	0 0013	0 001	0.05

Mine Unit 1 Monitor Well Iron Monitoring Data									
Sample Date	PR-15	IJ-13	PR-8	IJ-25	IJ-28	IJ-45	Representative Well Average Iron	Representative Well Baseline Average	NDEQ Standard
19-Feb-99	0 02	0 02	0 12	0 04	0 04	0 10	0 05	0 050	0.3
18-Mar-99	0 02	0 10	0 17	0 04	0 04	0 10	0 08	0 050	0.3
15-Apr-99	0 02	0 13	0 15	0 06	0 05	0 10	0 09	0 050	0.3
20-May-99	0 01	0 05	0 23	0 05	0 06	0 12	0 09	0 050	0.3
17-Jun-99	0 02	0 07	0 25	0 05	0 06	0.26	0 12	0 050	0.3
15-Jul-99	0 05	0 06	0 20	0 04	0 06	0 20	0 10	0 050	0.3
25-Jul-02	0 03	0 92	0 30	0 06	0 06	0 09	0 24	0 050	0.3
8-Aug-02	0 03	0 96	0 32	0 07	0 11	0 11	0 27	0 050	0.3
22-Aug-02	0 03	1 06	0 40	0 08	0 14	0 15	0 31	0 050	0.3
19-Sep-02	0 03	1 01	0 40	0 08	0 08	0.14	0 29	0 050	0.3

Mine Unit 1 Monitor Well Ammonium Monitoring Data									
Sample Date	PR-15	IJ-13	PR-8	IJ25	IJ28	IJ45	Representative Well Average Ammonium	Representative Well Baseline Average	NDEQ Standard
19-Feb-99	0 05	0 05	0 13	0 07	0 05	0 05	0 07	0.3705	10 00
18-Mar-99	0 06	0 15	0 12	0 11	0 11	0 06	0 10	0 3705	10 00
15-Apr-99	0 06	0.24	0 17	0 11	0 11	0 06	0 13	0 3705	10 00
20-May-99	0 05	0 13	0 15	0 05	0 06	0 05	0 08	0 3705	10 00
17-Jun-99	0 07	0 26	0 18	0 10	0 12	0 09	0 14	0 3705	10 00
15-Jul-99	0 13	0 30	0.21	0 15	0 14	0 12	0 18	0 3705	10 00
25-Jul-02	0 05	0 05	0 08	0 05	0 05	0 05	0 06	0 3705	10 00
8-Aug-02	0 05	0 06	0 06	0 05	0 05	0 05	0 05	0 3705	10 00
22-Aug-02	0 05	0 07	0 05	0 05	0 05	0 05	0 05	0 3705	10 00

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02070929-001
Client Sample ID: Well PR8

Report Date: 08/06/02
Collection Date: 07/25/02
Date Received: 07/29/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	0.08	mg/L		0 05		A4500-NH3 G	07/29/02 14:56 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1230	mg/L		10		A2540 C	07/29/02 16:22 / es
METALS - DISSOLVED							
Iron	0 300	mg/L		0.030		E200.7	07/31/02 20 06 / cp
Selenium	0 002	mg/L		0.001		E200.8	07/31/02 15:24 / smd
Uranium	1.88	mg/L		0 001		E200.8	07/31/02 15.24 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	218	pCi/L		0 2		E903 0	08/05/02 22:03 / rs
Radium 226 precision	7.8	±				E903.0	08/05/02 22:03 / rs

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit

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70929R00001

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02070929-002
Client Sample ID: Well IJ13P

Report Date: 08/06/02
Collection Date: 07/25/02
Date Received: 07/29/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	0.05	mg/L		0.05		A4500-NH3 G	07/29/02 14:58 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1310	mg/L		10		A2540 C	07/29/02 16:22 / es
METALS - DISSOLVED							
Iron	0.923	mg/L		0 030		E200.7	07/31/02 20.09 / cp
Selenium	0.002	mg/L		0.001		E200.8	07/31/02 15:45 / smd
Uranium	1.67	mg/L		0 001		E200.8	07/31/02 15:45 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	744	pCi/L		0 2		E903.0	08/05/02 22:23 / rs
Radium 226 precision	26.6	±				E903.0	08/05/02 22:23 / rs

Report Definitions:
RL - Analyte reporting limit
QCL - Quality control limit
MCL - Maximum contaminant level
ND - Not detected at the reporting limit

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70929R00002

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02070929-003
Client Sample ID: Well RP15

Report Date: 08/06/02
Collection Date: 07/25/02
Date Received: 07/29/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0 05		A4500-NH3 G	07/29/02 15:00 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	763	mg/L		10		A2540 C	07/29/02 16:23 / es
METALS - DISSOLVED							
Iron	ND	mg/L		0 030		E200.7	07/31/02 20:12 / cp
Selenium	0 002	mg/L		0.001		E200.8	07/31/02 15:50 / smd
Uranium	0 491	mg/L		0 001		E200.8	07/31/02 15:50 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	21.7	pCi/L		0 2		E903.0	08/05/02 23.27 / rs
Radium 226 precision	1.4	±				E903.0	08/05/02 23.27 / rs

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level
ND - Not detected at the reporting limit.

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70929R00003

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02070929-004
Client Sample ID: Well IJ45P

Report Date: 08/06/02
Collection Date: 07/25/02
Date Received: 07/29/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	07/29/02 15:02 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1050	mg/L		10		A2540 C	07/29/02 16:23 / es
METALS - DISSOLVED							
Iron	0 092	mg/L		0.030		E200.7	07/31/02 20.15 / cp
Selenium	0 002	mg/L		0.001		E200 8	07/31/02 15 55 / smd
Uranium	2 05	mg/L		0.001		E200 8	07/31/02 15:55 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	418	pCi/L		0.2		E903.0	08/05/02 23:38 / rs
Radium 226 precision	15.0	±				E903 0	08/05/02 23:38 / rs

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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70929R00004

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02070929-005
Client Sample ID: Well IJ28P

Report Date: 08/06/02
Collection Date: 07/25/02
Date Received: 07/29/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	07/29/02 15:04 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1060	mg/L		10		A2540 C	07/29/02 16:24 / es
METALS - DISSOLVED							
Iron	0.056	mg/L		0.030		E200.7	07/31/02 20:19 / cp
Selenium	0 002	mg/L		0.001		E200.8	07/31/02 16:00 / smd
Uranium	2.83	mg/L		0.001		E200.8	07/31/02 16:00 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	169	pCi/L		0 2		E903 0	08/06/02 00 03 / rs
Radium 226 precision	6 1	±				E903.0	08/06/02 00.03 / rs

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02070929-006
Client Sample ID: Well IJ25P

Report Date: 08/06/02
Collection Date: 07/25/02
Date Received: 07/29/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	07/29/02 15:06 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1120	mg/L		10		A2540 C	07/29/02 16:24 / es
METALS - DISSOLVED							
Iron	0.061	mg/L		0 030		E200.7	07/31/02 20:22 / cp
Selenium	0.004	mg/L		0 001		E200 8	07/31/02 16:05 / smd
Uranium	2.16	mg/L		0 001		E200.8	07/31/02 16:05 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	216	pCi/L		0 2		E903.0	08/06/02 00:23 / rs
Radium 226 precision	7.8	±				E903.0	08/06/02 00:23 / rs

Report Definitions:
RL - Analyte reporting limit
QCL - Quality control limit
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit

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70929R00006

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1 Restoration Round 2

Lab Order: C02080357
Report Date: 08/21/02

Lab ID: C02080357-001
Client Sample ID: Well #IJ 45P
Matrix: AQUEOUS

Collection Date: 08/08/02
DateReceived: 08/12/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	08/12/02 14 37 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1040	mg/L		10		A2540 C	08/13/02 13:44 / es
METALS - DISSOLVED							
Iron	0.107	mg/L		0 030		E200.7	08/13/02 11:04 / cp
Selenium	0 002	mg/L		0 001		E200.8	08/12/02 18 14 / smd
Uranium	1.80	mg/L		0 001		E200 8	08/12/02 18 14 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	405	pCi/L		0 2		E903 0	08/20/02 01.40 / rs
Radium 226 precision	14.5	±				E903 0	08/20/02 01:40 / rs

Lab ID: C02080357-002
Client Sample ID: Well #PR-15
Matrix: AQUEOUS

Collection Date: 08/08/02
DateReceived: 08/12/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	08/12/02 14:40 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	699	mg/L		10		A2540 C	08/13/02 13 45 / es
METALS - DISSOLVED							
Iron	ND	mg/L		0.030		E200 7	08/13/02 11:34 / cp
Selenium	ND	mg/L		0.001		E200 8	08/12/02 18:35 / smd
Uranium	0.381	mg/L		0 001		E200 8	08/12/02 18:35 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	19.6	pCi/L		0.2		E903.0	08/20/02 02:40 / rs
Radium 226 precision	1.3	±				E903.0	08/20/02 02:40 / rs

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1 Restoration Round 2

Lab Order: C02080357
Report Date: 08/21/02

Lab ID: C02080357-003
Client Sample ID: Well #PR-8
Matrix: AQUEOUS

Collection Date: 08/08/02
DateReceived: 08/12/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	0.06	mg/L		0.05		A4500-NH3 G	08/12/02 14 42 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1230	mg/L		10		A2540 C	08/13/02 13 45 / es
METALS - DISSOLVED							
Iron	0.321	mg/L		0.030		E200.7	08/13/02 11:38 / cp
Selenium	0.002	mg/L		0.001		E200.8	08/12/02 18 41 / smd
Uranium	1.63	mg/L		0 001		E200 8	08/12/02 18 41 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	239	pCi/L		0.2		E903.0	08/20/02 02 03 / rs
Radium 226 precision	8.6	±				E903 0	08/20/02 02.03 / rs

Lab ID: C02080357-004
Client Sample ID: Well #IJ-13-P
Matrix: AQUEOUS

Collection Date: 08/08/02
DateReceived: 08/12/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	0 06	mg/L		0.05		A4500-NH3 G	08/12/02 14 51 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1310	mg/L		10		A2540 C	08/13/02 13 46 / es
METALS - DISSOLVED							
Iron	0 962	mg/L		0 030		E200.7	08/13/02 11.55 / cp
Selenium	0.002	mg/L		0 001		E200.8	08/12/02 18 46 / smd
Uranium	1.55	mg/L		0 001		E200.8	08/12/02 18 46 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	778	pCi/L		0.2		E903 0	08/20/02 03 03 / rs
Radium 226 precision	27.8	±				E903 0	08/20/02 03 03 / rs

Report Definitions: RL - Analyte reporting limit.
QCL - Quality control limit
MCL - Maximum contaminant level
ND - Not detected at the reporting limit

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1 Restoration Round 2

Lab Order: C02080357
Report Date: 08/21/02

Lab ID: C02080357-005
Client Sample ID: Well #IJ-28-P
Matrix: AQUEOUS

Collection Date: 08/08/02
DateReceived: 08/12/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0 05		A4500-NH3 G	08/12/02 14:53 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1080	mg/L		10		A2540 C	08/13/02 13 47 / es
METALS - DISSOLVED							
Iron	0.111	mg/L		0 030		E200.7	08/13/02 11:59 / cp
Selenium	0.002	mg/L		0.001		E200.8	08/12/02 18 51 / smd
Uranium	2.44	mg/L		0.001		E200 8	08/12/02 18 51 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	188	pCi/L		0.2		E903 0	08/20/02 03:24 / rs
Radium 226 precision	6.7	±				E903.0	08/20/02 03 24 / rs

Lab ID: C02080357-006
Client Sample ID: Well #IJ-25-P
Matrix: AQUEOUS

Collection Date: 08/08/02
DateReceived: 08/12/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	08/12/02 14:55 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1110	mg/L		10		A2540 C	08/13/02 13:47 / es
METALS - DISSOLVED							
Iron	0.070	mg/L		0.030		E200 7	08/13/02 12 03 / cp
Selenium	0.003	mg/L		0.001		E200.8	08/12/02 18.56 / smd
Uranium	1.84	mg/L		0.001		E200 8	08/12/02 18.56 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	210	pCi/L		0.2		E903 0	08/20/02 03:43 / rs
Radium 226 precision	7.5	±				E903 0	08/20/02 03 43 / rs

Report Definitions: RL - Analyte reporting limit; QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

TRACKING NO. PAGE NO.
80357R00003

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02080856-001
Client Sample ID: Well #PR15

Report Date: 09/05/02
Collection Date: 08/22/02
Date Received: 08/24/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	08/26/02 14.26 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	720	mg/L		10		A2540 C	08/26/02 16 02 / slb
METALS - DISSOLVED							
Iron	ND	mg/L		0.030		E200.7	08/27/02 16.45 / cp
Selenium	0.001	mg/L		0 001		E200.8	08/26/02 18:58 / smd
Uranium	0.363	mg/L		0 001		E200.8	08/26/02 18:58 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	17.1	pCi/L		0.2		E903 0	09/01/02 06:48 / smc
Radium 226 precision	1.3	±				E903.0	09/01/02 06:48 / smc

Report Definitions: RL - Analyte reporting limit
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02080856-002
Client Sample ID: Well #IJ13P

Report Date: 09/05/02
Collection Date: 08/22/02
Date Received: 08/24/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	0 07	mg/L		0.05		A4500-NH3 G	08/26/02 14 29 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1320	mg/L		10		A2540 C	08/26/02 16 03 / slb
METALS - DISSOLVED							
Iron	1.06	mg/L		0.030		E200.7	09/04/02 10.38 / cp
Selenium	0.001	mg/L		0.001		E200 8	08/26/02 19 04 / smd
Uranium	1.83	mg/L		0 001		E200 8	08/26/02 19 04 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	852	pCi/L		0.2		E903.0	09/01/02 06 53 / smc
Radium 226 precision	30.5	±				E903.0	09/01/02 06 53 / smc

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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80856R00002

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02080856-003
Client Sample ID: Well #PR8

Report Date: 09/05/02
Collection Date: 08/22/02
Date Received: 08/24/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0 05		A4500-NH3 G	08/26/02 14 32 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1210	mg/L		10		A2540 C	08/26/02 16 03 / slb
METALS - DISSOLVED							
Iron	0.403	mg/L		0 030		E200.7	09/04/02 10 41 / cp
Selenium	0.002	mg/L		0.001		E200.8	08/26/02 19 09 / smd
Uranium	1.52	mg/L		0.001		E200.8	08/26/02 19 09 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	251	pCi/L		0.2		E903.0	09/01/02 07.10 / smc
Radium 226 precision	9 0	±				E903 0	09/01/02 07.10 / smc

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02080856-004
Client Sample ID: Well #IJ45P

Report Date: 09/05/02
Collection Date: 08/22/02
Date Received: 08/24/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0.05		A4500-NH3 G	08/26/02 14 34 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1040	mg/L		10		A2540 C	08/26/02 16 04 / slb
METALS - DISSOLVED							
Iron	0.150	mg/L		0 030		E200.7	09/04/02 10 43 / cp
Selenium	0.001	mg/L		0.001		E200.8	08/26/02 19 31 / smd
Uranium	1.68	mg/L		0.001		E200 8	08/26/02 19 31 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	451	pCi/L		0.2		E903.0	09/01/02 07.20 / smc
Radium 226 precision	16.1	±				E903 0	09/01/02 07.20 / smc

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02080856-005
Client Sample ID: Well #IJ28P

Report Date: 09/05/02
Collection Date: 08/22/02
Date Received: 08/24/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0 05		A4500-NH3 G	08/26/02 14 36 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1110	mg/L		10		A2540 C	08/26/02 16 04 / slb
METALS - DISSOLVED							
Iron	0.142	mg/L		0.030		E200 7	09/04/02 10 46 / cp
Selenium	0 002	mg/L		0.001		E200 8	08/26/02 19 36 / smd
Uranium	2 35	mg/L		0.001		E200 8	08/26/02 19 36 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	207	pCi/L		0.2		E903.0	09/01/02 07:42 / smc
Radium 226 precision	7.4	±				E903.0	09/01/02 07 42 / smc

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1
Lab ID: C02080856-006
Client Sample ID: Well #IJ25P

Report Date: 09/05/02
Collection Date: 08/22/02
Date Received: 08/24/02
Matrix: AQUEOUS

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
MAJOR IONS							
Nitrogen, Ammonia as N	ND	mg/L		0 05		A4500-NH3 G	08/26/02 14 45 / rwk
PHYSICAL PROPERTIES							
Solids, Total Dissolved TDS @ 180 C	1110	mg/L		10		A2540 C	08/26/02 16 05 / slb
METALS - DISSOLVED							
Iron	0 084	mg/L		0.030		E200.7	09/04/02 10 48 / cp
Selenium	0.003	mg/L		0.001		E200 8	08/26/02 19 41 / smd
Uranium	1.64	mg/L		0.001		E200.8	08/26/02 19 41 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	203	pCi/L		0.2		E903.0	09/01/02 08 02 / smc
Radium 226 precision	7.3	±				E903.0	09/01/02 08 02 / smc

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level
ND - Not detected at the reporting limit

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1 Restoration Round 4

Lab Order: C02090757
Report Date: 10/02/02

Lab ID: C02090757-005
Client Sample ID: IJ25P
Matrix: AQUEOUS

Collection Date: 09/19/02
DateReceived: 09/20/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Iron	0.083	mg/L		0.030		E200.7	09/26/02 13:12 / cp
Selenium	0.002	mg/L		0.001		E200.8	09/30/02 22:22 / smd
Uranium	1.54	mg/L		0.001		E200.8	09/30/02 22:22 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	231	pCi/L		0.2		E903.0	09/30/02 12:33 / rs
Radium 226 precision	5.0	±				E903.0	09/30/02 12:33 / rs

Lab ID: C02090757-006
Client Sample ID: IJ45P
Matrix: AQUEOUS

Collection Date: 09/19/02
DateReceived: 09/20/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Iron	0.139	mg/L		0.030		E200.7	09/26/02 13:15 / cp
Selenium	0.002	mg/L		0.001		E200.8	09/30/02 22:27 / smd
Uranium	1.71	mg/L		0.001		E200.8	09/30/02 22:27 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	407	pCi/L		0.2		E903.0	09/30/02 13:41 / rs
Radium 226 precision	6.6	±				E903.0	09/30/02 13:41 / rs

Report Definitions: RL - Analyte reporting limit. QCL - Quality control limit. MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1 Restoration Round 4

Lab Order: C02090757
Report Date: 10/02/02

Lab ID: C02090757-001
Client Sample ID: PR15
Matrix: AQUEOUS

Collection Date: 09/19/02
DateReceived: 09/20/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Iron	ND	mg/L		0.030		E200.7	09/26/02 12:49 / cp
Selenium	0.001	mg/L		0.001		E200.8	09/30/02 22:01 / smd
Uranium	0.318	mg/L		0.001		E200.8	09/30/02 22:01 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	13.3	pCi/L		0.2		E903.0	09/30/02 12:33 / rs
Radium 226 precision	1.2	±				E903.0	09/30/02 12:33 / rs

Lab ID: C02090757-002
Client Sample ID: PR8
Matrix: AQUEOUS

Collection Date: 09/19/02
DateReceived: 09/20/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Iron	0.399	mg/L		0.030		E200.7	09/26/02 12:52 / cp
Selenium	0.002	mg/L		0.001		E200.8	09/30/02 22:06 / smd
Uranium	1.60	mg/L		0.001		E200.8	09/30/02 22:06 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	310	pCi/L		0.2		E903.0	09/30/02 12:33 / rs
Radium 226 precision	57	±				E903.0	09/30/02 12:33 / rs

Report Definitions: RL - Analyte reporting limit. QCL - Quality control limit. MCL - Maximum contaminant level. ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Crow Butte Resources
Project: MU-1 Restoration Round 4

Lab Order: C02090757
Report Date: 10/02/02

Lab ID: C02090757-003
Client Sample ID: IJ13P
Matrix: AQUEOUS

Collection Date: 09/19/02
DateReceived: 09/20/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Iron	1.01	mg/L		0.030		E200.7	09/26/02 13:06 / cp
Selenium	0.001	mg/L		0.001		E200.8	09/30/02 22:12 / smd
Uranium	2.19	mg/L		0.001		E200.8	09/30/02 22:12 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	778	pCi/L		0.2		E903.0	09/30/02 12:33 / rs
Radium 226 precision	9.1	±				E903.0	09/30/02 12:33 / rs

Lab ID: C02090757-004
Client Sample ID: IJ28P
Matrix: AQUEOUS

Collection Date: 09/19/02
DateReceived: 09/20/02

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS - DISSOLVED							
Iron	0.076	mg/L		0.030		E200.7	09/26/02 13:09 / cp
Selenium	0.002	mg/L		0.001		E200.8	09/30/02 22:17 / smd
Uranium	2.33	mg/L		0.001		E200.8	09/30/02 22:17 / smd
RADIONUCLIDES - DISSOLVED							
Radium 226	180	pCi/L		0.2		E903.0	09/30/02 12:33 / rs
Radium 226 precision	4.5	±				E903.0	09/30/02 12:33 / rs

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

Mr. Michael L. Griffin, Manager
of Health, Safety, and Environmental Affairs
Crow Butte resources, Inc.
86 Crow Butte Road
P.O. Box 169
Crawford, Nebraska 69339-0169

December 4, 2002

SUBJECT: CROW BUTTE RESOURCES, INC. (TAC NO. L52491) ACKNOWLEDGMENT OF WELLFIELD #1 GROUNDWATER STABILITY DATA

Dear Michael:

We have received your information on Mine Unit 1 groundwater stability data of Materials License SUA 1548 transmitted by letter dated October 11, 2002. Your request has been assigned TAC No. L52491. Please reference this number in any future correspondence associated with this request.

We acknowledge our acceptance of your Mine Unit 1 groundwater stability data and have identified no administrative omissions or major technical deficiencies. The Mine Unit 1 groundwater stability data has been accepted for review. Please note that the complete technical review may identify omissions in the submittal information or technical issues that require additional information.

Based on our acknowledgment and projection of current review schedules, we anticipate completing our review by the end of February 2003. This date could change depending on the findings of our technical review, urgent assignments, or other factors. We will promptly communicate any significant changes to this schedule. I can be reached at 301-415-7694 or by e-mail at jhl@nrc.gov.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/NRC/ADAMS/index.html (the Public Electronic Reading Room).

Sincerely,

R/A

John H. Lusher
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

Docket 40-8964
License SUA-1548

Accession No. ML023390193

February 12, 2003

Michael L. Griffin
Manager of Environmental and Regulatory Affairs
Crow Butte Resources, Inc.
86 Crow Butte Road
Post Office Box 169
Crawford, NE 69339-0169

SUBJECT: LICENSE AMENDMENT 15, CROW BUTTE RESOURCES *IN SITU* LEACH FACILITY, LICENSE NO. SUA-1534, WELLFIELD #1 RESTORATION ACCEPTANCE (TAC NO. L52491)

Dear Mr. Griffin:

Staff concludes the data submitted in the October 11, 2002, Additional Stability Monitoring Data (CBR, 2002A) demonstrates that restoration of Wellfield Unit 1 is acceptable and has resulted in constituent levels that will remain below levels protective of human health and the environment, in accordance with 10 CFR 40.31(h) and 10 CFR Part 40, Appendix A, Criterion 5F.

License Condition 10.3C has been changed to reflect the change in the Wellfield Restoration Plan as applied to other Wellfields to comply with the performance based criteria for stabilization, transmitted by letter dated January 30, 2003, which includes stability monitoring beyond the six-month period, as necessary, to continue until no increasing concentration trends are exhibited.

Additionally, the staff is making an administrative change deleting License Condition 9.6 which is more restrictive than the requirements set forth in Reg. Guide 8.31, which is required to be followed in License Condition 9.12.

The staff has concluded that this license amendment meets the requirements in 10 CFR 51.22(c)(11) for a categorical exclusion because (i) there is no significant change in the types or significant increase in the amounts of any effluents; (ii) there is no significant increase in additional or cumulative occupational radiation exposure; (iii) there is no significant construction impact; and (iv) there is no significant increase in the potential for, or consequences from radiological accidents. Therefore, neither an environmental assessment nor an environmental impact statement is required.

These changes to Materials License SUA-1534 were discussed between you and Mr. John Lusher, the NRC Project Manager for the Crow Butte facility, on January 30, 2003. If you have any questions concerning this letter or the enclosure, please contact Mr. Lusher at (301) 415-7694 or by e-mail to JHL@nrc.gov.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the

Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Daniel M. Gillen, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No. 40-8943
License No. SUA-1534

Enclosure: Technical Evaluation Report
Materials License SUA-1534, Amendment 15

cc: Stephen P. Collings, CBR, Denver
Dave Miesbach, Nebraska, UIC, DEQ
Dave Carlson, Nebraska, UIC, DEQ
Sheryl K. Rogers, Nebraska, RMP, PHA

February 12, 2003

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Daniel M. Gillen, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No. 40-8943
License No. SUA-1534

Enclosure: Technical Evaluation Report
Materials License SUA-1534, Amendment 15

DISTRIBUTION (w/encl) **(Closes Tac No. L52491)** Accession No.

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OFC	FCFB	FCFB	OGC	FCFB	FCFB
NAME	JLusher*	BGarrett*	M. Schwartz* via email	GJanosko*	DGillen
DATE	02/04/03	02/05/03	02/11/03	02/12/03	02/12/03

*see previous concurrence **OFFICIAL RECORD COPY**

TECHNICAL EVALUATION REPORT

DATE: January 30, 2003

DOCKET NO.: 40-8943

LICENSE NO.: SUA-1534

FACILITY: Crow Butte Resources *In Situ* Leach Uranium Project, Chadron, Nebraska

PROJECT MANGER: John H. Lusher

TECHNICAL REVIEWER: Michael C. Layton, Hydrogeologist

SUMMARY AND CONCLUSIONS: Staff concludes the data submitted in the October 11, 2002 Additional Stability Monitoring Data (CBR, 2002A) demonstrates that restoration activities in Wellfield Unit 1, have resulted in constituent levels that will remain below levels protective of human health and the environment, in accordance with 10 CFR 40.31(h) and Criterion 5F, 10 CFR Part 40, Appendix A. Staff recommends amending Materials License SUA-1534 to show that restoration of Wellfield Unit 1 is complete. Staff also recommends that the licensee seek a license amendment to make the stability monitoring performance oriented, continuing until no increasing concentration trends are exhibited, rather than restricting the monitoring period to no longer than six months.

DESCRIPTION OF AMENDMENT REQUESTS: By letter dated October 11, 2002, (CBR, 2002A), the licensee submitted supplemental ground-water monitoring data collected in Wellfield Unit 1 to demonstrate the stability of the ground-water restoration efforts. These data were collected and submitted in accordance with the licensee's proposed monitoring plan dated June 28, 2002 (CBR, 2002B), which NRC accepted by letter dated August 2, 2002, (NRC, 2002). The licensee is requesting approval of restoration completion for Unit 1, based on the recently submitted data.

The licensee must demonstrate that the proposed request meets the general requirements of 10 CFR Part 40, specifically 10 CFR 40.31(h) and 10 CFR Part 40, Appendix A, Criterion 5F, as described in Section 6.1.3 (5), "Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications" (SRP), NUREG-1569 Rev. 1 (NRC, 2002B).

EVALUATION: Staff completed its review of the approval request for the completion of ground-water restoration in Unit 1, as presented in Crow Butte's "Mine Unit 1 Restoration Report," and supplemental documents (CBR, 2000B; CBR, 2000C; CBR, 2001; CBR, 2002A, and CBR, 2002B). The submitted data show that ground-water quality has been restored to the baseline concentrations or the secondary restoration standards established by license condition 10.3C, SUA-1534.

Staff previously denied the request for wellfield restoration approval for Unit 1, based on insufficient data to demonstrate stability of the restored concentrations for several constituents. Staff's analysis indicates that concentrations of ammonium, iron, radium-226, selenium, total dissolved solids, and uranium show strongly increasing concentration trends over the stability monitoring period (NRC, 2002A).

The licensee conducted additional confirmatory monitoring in several Unit 1 monitoring wells, in

accordance with the June 28, 2002 (CBR, 2002B) proposed monitoring plan as agreed upon by the NRC by letter dated August 2, 2002 (NRC, 2002B). The data provided by the licensee by letter dated October 11, 2002 (CBR, 2002A) shows that concentrations of ammonium, radium-226, selenium, total dissolved solids, and uranium have remained stable and below regulatory limits during four consecutive sampling episodes collected at least two weeks apart.

Iron concentrations over the same period have shown a continued increase, and at one point, exceeded the State's water quality standard of 0.30 mg/L. Iron is often measured to indicate general quality and aesthetic character of water. It is sometimes used to describe the hardness of ground water and is considered a secondary water quality parameter, which does not impact public health. Staff considers that the increasing iron concentrations exhibited in Unit 1 are likely the result of reducing geochemical conditions continuing to be re-established after restoration completion. The staff does not consider this increasing trend to be an impact to human health or the environment.

As previously concluded, staff's analysis and findings strongly indicate that the six-month period for stability monitoring at this site required by CBR's Underground Injection Control Permit, is insufficient to assure stability for all monitored constituents. Many constituents reached stability within a relatively short time; however, increasing concentrations for several constituents persist at the end of, and presumably beyond, the six-month stability period. Accordingly, CBR has made a commitment in its January 30, 2003 Groundwater Restoration Plan, Revision 2, to continue stability monitoring beyond the six-month period as necessary. Stability monitoring will conclude, instead, when stabilization samples show that restoration goals on a mine unit average for monitored constituents are met and there is an absence of significant increasing trends.

RECOMMENDATIONS:

Staff recommends approval for the completion of Unit 1 ground-water restoration.

Staff also recommends that the licensee seek a license amendment to make the stability monitoring performance oriented, continuing until no increasing concentration trends are exhibited, rather than restricting the monitoring period to no longer than six months.

ENVIRONMENTAL REVIEW:

The staff has determined that the following have been met:

1. The Environmental Assessment for Renewal of Source Material License No. SUA-1534, Crow Butte Resources, Incorporated, Crow Butte Uranium Project, Dawes County Nebraska, February 1998, encompasses this licensing action; additionally,

I. There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite;

II. There is no significant increase in individual or cumulative occupational radiation exposure;

III. There is no significant construction impact; and

IV. There is no significant increase in the potential for or occurrences from radiological accidents.

The staff has concluded that this license amendment meets the requirements in 10 CFR 51.22(c)(11) for a categorical exclusion. Therefore, neither an environmental assessment nor an environmental impact statement is required.

COORDINATION AND CONSULTATION: This technical review and the proposed license amendment were discussed and coordinated with Louis Carson, III, of NRC's Region IV Inspection Program, and David Miesbach, Under Ground Injection Control Program Coordinator, for the Nebraska Department of Environmental Quality, on January 27, 2003, which regulates the Crow Butte Resources facility under its Underground Injection Control Program, delegated from the U.S. Environmental Protection Agency. No unresolved concerns were identified through the course of this coordination.

REFERENCES:

Code of Federal Regulations (CFR), Title 10, Chapter I - Nuclear Regulatory Commission, Parts 2 , 40, and 51, revised as of January 1, 2002.

CBR (Crow Butte Resource, Inc.). 2002A. Additional Stability Monitoring Data for Mine Unit 1 Groundwater Restoration Crow Butte Uranium Project. Report attached to Letter from Michael Griffin, Crow Butte Resources to Daniel M. Gillen, Uranium Recovery Branch, NRC, dated October 11, 2002, Accession Number ML022980095.

CBR (Crow Butte Resource, Inc.). 2002B. Denial, Mine Unit 1 Groundwater restoration Source Materials License SUA-1534 Docket Number 40-8963. Letter and attachments from Fletcher Newton to Martin J. Virgilio, Director NMSS/NRC, dated June 28, 2002. Accession Number ML021990509.

NRC (U.S. Nuclear Regulatory Commission). 2002A. Denial, Wellfield Unit 1 Ground-Water Restoration Approval, Crow Butte Resources In Situ Leach Facility, License No. SUA-1534 (TAC No. L52376). Letter and Attachments from Melvyn Leach to Michael L. Griffin dated March 29, 2002. Accession Number ML020930087.

NRC (U.S. Nuclear Regulatory Commission). 2002B. Crow Butte Resources Proposal for Additional Sampling and Identification of three additional wells. Letter from Martin J. Virgilio to Fletcher Newton, President Crow Butte Resources, dated August 2, 2002. Accession Number ML022140608.

Other Pertinent Documents:

CBR (Crow Butte Resource, Inc.). 1996, Crow Butte ISL Mine Groundwater Restoration Plan. Letter from Stephen Collings, Crow Butte Resources to Joseph Holonich, Uranium Recovery Branch, NRC, dated November 26, 1996, with attachment. Accession Number 9612040273.

CBR (Crow Butte Resource, Inc.). 2000A. Mine Unit 1 Restoration Report and Request License Amendment, Materials License No. SUA-1534. Letter from Michael Griffin, Crow Butte Resources to John Surmeier, Uranium Recovery Branch, NRC, dated January 14, 2000, with attachments. Accession Number ML003677825.

CBR (Crow Butte Resource, Inc.). 2000B. Mine Unit 1 Restoration Report Crow Butte Uranium Project. Report attached to Letter from Michael Griffin, Crow Butte Resources to John Surmeier, Uranium Recovery Branch, NRC, dated January 10, 2000. Accession Number ML003677938.

CBR (Crow Butte Resource, Inc.). 2000C. Page change for Mine Unit 1 Restoration Report Crow Butte Uranium Project. Report attached to Letter from Michael Griffin, Crow Butte Resources to John Surmeier, Uranium Recovery Branch, NRC, dated February 8, 2000. Accession Number ML003685137.

CBR (Crow Butte Resource, Inc.). 2001. Mine Unit 1 Restoration; Response to Request for Additional Information. Report attached to Letter from Michael Griffin, Crow Butte Resources to Melvyn Leach, Fuel Cycle Licensing Branch, NRC, dated August 24, 2001. Accession Number ML012710072.

NRC (U.S. Nuclear Regulatory Commission). 1998. Environmental Assessment for renewal of Source material License No. SUA-1534. Office of Nuclear Material Safety and Safeguards. Accession Number 9803100003.

NRC (U.S. Nuclear Regulatory Commission). 2001. Request for Additional Information, transmitted by letter from Daniel M. Gillen, acting chief, Fuel Cycle Licensing Branch, NRC, dated June 26, 2001. Accession Number ML011830343.

NRC (U.S. Nuclear Regulatory Commission). 2002. Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications. NUREG-1569 Rev. 1. Office of Nuclear Material Safety and Safeguards. Accession Number ML020320181.

NRC FORM 374

U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and the applicable parts of Title 10, Code of Federal Regulations, Chapter I, Parts 19, 20, 30, 31, 32, 33, 34, 35, 36, 39, 40, 51, 70, and 71, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. Crow Butte Resources, Inc.	3. License Number SUA-1534, Amendment 15
2. 274 Union Blvd. Suite 310 Lakewood, Colorado, 80228 [Applicable Amendments: 6, 10]	4. Expiration Date February 28, 2008 5. Docket No. 40-8943 Reference No.

6. Byproduct Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum amount that Licensee May Possess at Any One Time Under This License
a.. Natural Uranium	Any	a. Unlimited
b. Byproduct material as defined in 10 CFR 40.4	Unspecified	b. Quantity generated under Operations authorized by this license

SECTION 9: **Administrative Conditions**

9.1 Authorized place of use shall be the licensee's Crow Butte uranium recovery and processing facilities in Dawes County, Nebraska.

9.2 All written notices and reports to NRC required under this license shall be addressed to the Chief, Fuel Cycle Licensing Branch, c/o Document Control Desk, Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Materials Safety and Safeguards, U. S. Nuclear Regulatory Commission, 11545 Rockville Pike, Two White Flint North, Rockville, MD 20852-2738.

Required telephone notification shall be made to the NRC Operations Center at (301) 816-5100, unless otherwise specified in license conditions.

[Applicable Amendment: 7, 12]

9.3 The licensee shall conduct operations in accordance with the commitments, representations, and statements contained in the license application dated December 1995, as amended by submittals dated April 1, June 25, July 28, October 31, 1997, January 14, 2000, September 12, 2001, April 19, 2002, and September 25, 2002, which are hereby incorporated by reference, except where superseded by license conditions below.

Whenever the word "will" or “shall” is used in the above referenced documents, it shall denote a requirement.

[Applicable Amendment: 11, 12, 14]

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
SUA-1534

Docket or Reference Number
40-8943

Amendment No. 15

9.4 Change, Test and Experiment License Condition

A) The licensee may, without obtaining a license amendment pursuant to §40.44, and subject to conditions specified in (b) of this condition:

I make changes in the facility as described in the license application (as updated),

ii make changes in the procedures as described in the license application (as updated), and

iii conduct test or experiments not described in the license application (as updated).

B) The licensee shall obtain a license amendment pursuant to §40.44 prior to implementing a proposed change, test or experiment if the change, test, or experiment would:

i Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);

ii Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);

iii Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);

iv Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);

v Create a possibility for an accident of a different type than any previously evaluated in the license application (as updated);

vi Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);

vii Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or technical evaluation reports (TERs) or other analysis and evaluations for license amendments.

viii For purposes of this paragraph as applied to this license, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments thereof.

C) Additionally the licensee must obtain a license amendment unless the change, test, or experiment is consistent with the NRC conclusions, or the basis of, or analysis leading to, the conclusions of actions, designs, or design configurations analyzed and selected in the site or facility Safety Evaluation Report, TER, and EIS or EA. This would include all supplements and amendments, and TERs, EAs, EISs issued with amendments to this license.

D) The licensee's determinations concerning (b) and (c) of this condition, shall be made by a Safety and Environmental Review Panel (SERP). The SERP shall consist of a minimum of three individuals. One member of the SERP shall have expertise in management (e.g., Plant Manager) and shall be

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
SUA-1534

Docket or Reference Number
40-8943

Amendment No. 15

responsible for financial approval for changes; one member shall have expertise in operations and/or construction and shall have responsibility for implementing any operational changes; and, one member shall be the radiation safety officer (RSO) or equivalent, with the responsibility of assuring changes conform to radiation safety and environmental requirements. Additional members may be included in the SERP as appropriate, to address technical aspects such as groundwater, hydrology, surface-water hydrology, specific earth sciences, and other technical disciplines. Temporary members or permanent members, other than the three above-specified individuals, may be consultants.

E) The licensee shall maintain records of any changes made pursuant to this condition until license termination. These records shall include written safety and environmental evaluations made by the SERP that provide the basis for determining changes are in compliance with (b) of this condition. The licensee shall furnish, in an annual report to the NRC, a description of such changes, test, or experiments, including a summary of the safety and environmental evaluation of each. In addition, the licensee shall annually submit to the NRC changed pages, which shall include both a change indicator for the area changed, e.g. a bold line vertically drawn in the margin adjacent to the portion actually changed, and a page change identification (date of change or change number or both), to the operations plan and reclamation plan of the approved license application (as updated) to reflect changes made under this condition.

[Applicable Amendment 12]

9.5 The licensee shall maintain an NRC-approved financial surety arrangement, consistent with 10 CFR 40, Appendix A, Criterion 9, adequate to cover the estimated reclamation and closure costs, if accomplished by a third party, for all existing operations and any planned expansions or operational changes for the upcoming year. Reclamation includes all cited activities and groundwater restoration, as well as off-site disposal of all 11e.(2) byproduct material.

Within three months of NRC approval of a revised closure plan and cost estimate, the licensee shall submit for NRC review and approval, a proposed revision to the financial surety arrangement if estimated costs in the newly approved site closure plan exceed the amount covered in the existing financial surety. The revised surety shall then be in effect within three months of written NRC approval.

Annual updates to the surety amount, required by 10 CFR 40, Appendix A, Criterion 9, shall be provided to NRC by October 1 of each year. If NRC has not approved a proposed revision 30 days prior to the expiration date of the existing surety arrangement, the licensee shall extend the existing arrangement, prior to expiration, for one year. Along with each proposed revision or annual update of the surety, the licensee shall submit supporting documentation showing a breakdown of the costs and the basis for the cost estimates with adjustments for inflation, maintenance of a minimum 15 percent contingency, changes in engineering plans, activities performed, and any other conditions affecting estimated costs for site closure.

At least 90 days prior to beginning construction associated with any planned expansion or operational change which was not included in the annual surety update, the licensee shall provide for NRC approval an updated surety to cover the expansion or change.

The licensee shall also provide NRC with copies of surety-related correspondence submitted to the State of Nebraska, a copy of the State's surety review, and the final approved surety arrangement. The licensee also must ensure that the surety, where authorized to be held by the State, identifies the NRC-related portion of the surety and covers the above-ground decommissioning and decontamination, the cost of offsite disposal, soil and water sample analyses, and groundwater restoration associated with the site. The basis for the cost estimate is the NRC-approved site closure plan or the

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
SUA-1534

Docket or Reference Number
40-8943

Amendment No. 15

NRC-approved revisions to the plan. Reclamation/decommissioning plan, cost estimates, and annual updates should follow the outline in Appendix E to NUREG-1569 (NRC, 1997), entitled "Recommended Outline for Site-Specific *In Situ* Leach Facility Reclamation and Stabilization Cost Estimates."

Crow Butte Resources, Inc.'s currently approved surety instrument, an Irrevocable Standby Letter of Credit issued by the Royal Bank Of Canada (New York Branch), in favor of the State of Nebraska, shall be continuously maintained in the sum total amount of no less than $12,816,973.00 for the purpose of complying with 10 CFR 40, Appendix A, Criterion 9, until a replacement is authorized by both the State of Nebraska and NRC.

[Applicable Amendments: 1, 2, 5, 9, 12, 14]

9.6 [Deleted by Amendment No. 15]

9.7 The licensee shall dispose of 11e.(2) byproduct material from the Crow Butte Facility at a site licensed by NRC or an NRC Agreement State to receive 11e.(2) byproduct material. The licensee's approved waste disposal agreement must be maintained on-site. In the event the agreement expires or is terminated, the licensee shall notify NRC in writing, in accordance with License Condition 9.2, within 7 days after the date of expiration or termination. A new agreement shall be submitted for NRC approval within 90 days after expiration or termination unless further delay is justified, or the licensee will be prohibited from further lixiviant injection.

9.8 Release of equipment, materials, or packages from the restricted area shall be in accordance with the NRC guidance document entitled "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated May 1987, or suitable alternative procedures approved by NRC prior to any such release.

9.9 Before engaging in any construction activity not previously assessed by NRC, the licensee shall complete a cultural resource inventory. All construction associated with the proposed development will be completed in compliance with the National Historic Preservation Act of 1966 (as amended) and its implementing regulations (36 CFR Part 800), and the Archaeological Resources Protection Act of 1979 (as amended) and its implementing regulations (43 CFR Part 7).

In order to ensure that no unapproved disturbance of cultural resources occurs, any work resulting in the discovery of previously unknown cultural artifacts shall cease. The artifacts shall be inventoried and evaluated in accordance with 36 CFR Part 800, and no disturbance shall occur until the licensee has received authorization from NRC to proceed.

Prior to any developmental activity in the immediate vicinity of the six "potentially eligible" sites identified in Section 2.4 of the approved license application, the licensee shall provide documentation of its coordination with the Nebraska State Historical Society to NRC.

9.10 The licensee shall conduct operations within the permit area boundaries shown in Figure 1.3-1 of the approved license application, as amended by the submittal dated July 28, 1997.

9.11 The licensee is hereby exempted from the requirements of Section 20.1902(e) of 10 CFR Part 20 for areas within the facility, provided that all entrances to the facility are conspicuously posted in accordance with Section 20.1902(e) and with the words, "**ANY AREA WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL .**"

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number SUA-1534
	Docket or Reference Number 40-8943
	Amendment No. 15

9.12 The licensee shall follow the guidance set forth in U.S. Nuclear Regulatory Commission, Regulatory Guides 8.22, "Bioassay at Uranium Recovery Facilities," 8.30, "Health Physics Surveys in Uranium Recovery Facilities," and 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposure at Uranium Recovery Facilities will be As Low As is Reasonably Achievable (ALARA)," or NRC-approved equivalent.

9.13 [DELETED by Amendment No. 12]

9.14 [DELETED by Amendment No. 4]

SECTION 10: Operations, Controls, Limits, and Restrictions

10.1 The licensee shall use a lixiviant composed of native groundwater, with added sodium carbonate/bicarbonate and oxygen or hydrogen peroxide, as described in the approved license application.

10.2 The licensee shall construct all wells in accordance with methods described in Section 3.1.2 of the approved license application.

Mechanical integrity tests shall be performed on each injection and production well before the wells are utilized and on wells that have been serviced with equipment or procedures that could damage the well casing. Additionally, each well shall be retested at least once each five (5) years it is in use. The integrity test shall pressurize the well to 125 percent of the maximum operating pressure and shall maintain 90 percent of this pressure for 20 minutes to pass the test. A single point resistance test may be used only in conjunction with another approved well integrity testing method. If any well casing failing the integrity test cannot be repaired, the well shall be plugged and abandoned.

10.3 The licensee shall establish pre-operational baseline groundwater quality data for all well field units. Baseline water quality sampling shall provide representative pre-operational groundwater quality data and restoration criteria as described in the approved license application.

The data shall consist, at a minimum, of the following sampling and analyses:

A. Three samples shall be collected from production and injection wells at a minimum density of one production or injection well per 4 acres. These samples shall be collected at least 14 days apart.

B. The samples shall be analyzed for ammonia, arsenic, barium, cadmium, calcium, chloride, copper, fluoride, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, nitrate, pH, potassium, radium-226, selenium, sodium, sulfate, total carbonate, total dissolved solids, uranium, vanadium, and zinc.

C. Groundwater restoration goals shall be established on a parameter-by-parameter basis for the constituents identified in License Condition 10.3B. The primary goal of restoration shall be on a parameter-by-parameter basis to return the average well field unit concentration to baseline conditions. The secondary goal of groundwater restoration shall be on a parameter-by-parameter basis to return the average well field unit concentration to the numerical class-of-use standards established by the Nebraska Department of Environmental Quality, as described in section 6.1.3 of the approved license application. The licensee shall conduct groundwater restoration activities in accordance with the groundwater restoration plan submitted by letter dated January 30, 2003.

[Applicable Amendment: 11, 15]

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
SUA-1534

Docket or Reference Number
40-8943

Amendment No. 15

10.4 The licensee shall establish upper control limits (UCLs) in designated upper aquifer and perimeter monitoring wells before lixiviant is injected in each well field unit. The UCLs shall be established by collecting and analyzing groundwater samples from those designated wells according to the following criteria:

A. Three samples shall be collected from each designated monitoring well at a minimum density of: 1) one upper aquifer monitoring well per 5 acres of well field area, and 2) all perimeter monitoring wells. These samples shall be collected at least 14 days apart. The results of these analyses shall constitute the baseline for each designated well.

B. The samples shall be analyzed for the following indicator parameters: chloride, sodium, sulfate, conductivity, and total alkalinity.

C. The UCLs shall be calculated for each indicator parameter, in each monitoring well, as equal to 20 percent above the maximum concentration measured for that parameter, among the three baseline samples. For those indicator parameters with baseline concentrations that average 50 mg/L or less, the UCL for that parameter may be calculated as equal to 20 percent above the maximum baseline concentration, the baseline average plus 5 standard deviations, or the baseline average plus 15 mg/L.

[Applicable Amendments: 8, 10]

10.5 The plant throughput shall not exceed a maximum flow rate of 5000 gallons per minute, excluding restoration flow. Annual yellowcake production shall not exceed 2 million pounds.

10.6 Each of the R&D evaporation ponds shall have at least 0.9 meters (3 feet) of freeboard. Each of the commercial evaporation ponds shall have at least 1.5 meters (5 feet) of freeboard.

Additionally, the licensee shall maintain, at all times, sufficient reserve capacity in the evaporation pond system to enable transferring the contents of a pond to the other ponds. In the event of a leak and subsequent transfer of liquid, freeboard requirements shall be suspended during the repair period.

10.7 All liquid effluents from process buildings and other process waste streams, with the exception of sanitary wastes, shall be returned to the process circuit; discharged to the solar evaporation ponds; disposed by land irrigation in accordance with the licensee's proposal submitted on August 3, 1988, as modified by its submittal on June 7, 1993; or deep well injected in accordance with the licensee's report submitted on August 24, 1993, as modified by submittals dated December 7, 1995, April 3, 1996, and September 12, 2000.

[Applicable Amendment: 7]

10.8 The licensee shall maintain effluent control systems as specified in Sections 4.1 and 5.7.1.1 of the approved license application, with the following exceptions:

A. If any of the yellowcake emission control equipment fails to operate within specifications set forth in the standard operating procedures, the drying and packaging room shall immediately be closed-in as an airborne radiation area and heating operations shall be switched to cooldown, or packaging operations shall be temporarily suspended. Packaging operations shall not be resumed until the vacuum system is operational to draw air into the system.

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number SUA-1534
	Docket or Reference Number 40-8943
	Amendment No. 15

B. The licensee shall, during all periods of yellowcake drying operations, assure that the negative pressure specified in the standard operating procedures for the dryer heating chamber is maintained. This shall be accomplished by either (1) performing and documenting checks of air pressure differential approximately every four hours during operation, or (2) installing instrumentation which will signal an audible alarm if the water flow or air pressure differential falls below the recommended levels. If an audible alarm is used, its operation shall be checked and documented at the beginning and end of each drying cycle when the differential pressure is lowered.

10.9 [DELETED by Amendment No. 12]

10.10 In-plant radiological monitoring for airborne uranium and radon daughters shall be conducted at the locations shown in Figure 5.7-1 in the approved license application.

10.11 [DELETED by Amendment No. 12]

10.12 [DELETED by Amendment No. 12]

10.13 [DELETED by Amendment No. 12]

10.14 The licensee shall maintain an area within the restricted area boundary for temporary storage of contaminated materials. All contaminated wastes and evaporation pond residues shall be disposed at a radioactive waste disposal site licensed to accept 11e.(2) byproduct material.

10.15 The licensee shall construct evaporation ponds 2 and 5 in accordance with the engineering design report dated April 27, 1988, as modified by the submittals dated May 11, and July 16, 1992. In addition, the ponds shall be constructed as follows:

A. Fill material shall be classified as a silty sand material in accordance with the Unified Soil Classification System.

B. Quality control of the fill shall be performed in accordance with the guidance provided for radon barrier materials in the NRC "Staff Technical Position on Testing and Inspection Plans during Construction of DOE's Remedial Action at Inactive Uranium Mill Tailing Sites" (January 1989).

C. As-built drawings of the constructed ponds shall be submitted to NRC within 3 months of the completion of construction of each pond.

10.16 Production zone monitor wells drilled after April, 1999, shall be spaced no greater than 300 feet from a well field unit and no greater than 400 feet between the wells.

SECTION 11: Monitoring, Recording, and Bookkeeping Requirements

11.1 Flow rates on each injection and recovery well, and manifold pressures on the entire system, shall be measured and recorded daily. During wellfield operations, injection pressures shall not exceed the integrity test pressure at the injection well heads.

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number SUA-1534
	Docket or Reference Number 40-8943
	Amendment No. 15

11.2 All designated perimeter and upper aquifer monitor wells shall be sampled and tested no more than 14 days apart, except in the event of the situations identified in the licensee's submittal dated March 19, 1998. If a designated monitor well is not sampled within 14 days of a previous sampling event, the reasons for the postponement of sampling shall be documented. Sampling shall not be postponed for greater than five days.

If two UCLs are exceeded in a well or if a single UCL is exceeded by 20 percent, the licensee shall take a confirming water sample within 48 hours after the results of the first analyses are received and analyze the sample for the indicator parameters. If the second sample does not indicate an exceedance, a third sample shall be taken and analyzed in a similar manner with 48 hours after the second set of samples was acquired. If neither the second nor the third sample indicate an exceedance, the first sample shall be considered in error.

If either the second or third sample confirms that a UCL(s) has been exceeded, the well in question shall be placed on excursion status. Upon confirmation of an excursion, the licensee shall notify NRC in accordance with License Condition 12.2, implement corrective action, and increase the sampling frequency for the indicator parameters at the excursion well to once every seven (7) days. Corrective actions for confirmed excursions may be, but are not limited to, those described in Section 5.7.8.1 of the approved license application. An excursion is considered concluded when the concentrations of the indicator parameters are below the concentration levels defining an excursion for three (3) consecutive weekly samples.

[Applicable Amendment: 1, 12]

11.3 The licensee shall establish and conduct an effluent and environmental monitoring program in accordance with the program submitted by letter dated March 18, 1999.

[Applicable Amendment: 3]

11.4 The licensee shall perform and document inspections in accordance with the February 5, 1996, revision to its Evaporation Pond Onsite Inspection Program.

Any time 6 inches or more of fluid is detected in a commercial pond standpipe, it shall be analyzed for specific conductance. If the water quality is degraded beyond the action level, the water shall be further sampled and analyzed for chloride, alkalinity, sodium, and sulfate. Any time 6 inches or more of fluid is detected an R&D pond standpipe, it shall be analyzed for specific conductance, chloride, alkalinity, sodium, and sulfate.

Upon verification of a liner leak, the licensee shall notify NRC in accordance with License Condition 12.2, lower the fluid level by transferring the pond's contents to an alternate cell, and undertake repairs, as needed. Water quality in the affected standpipe shall be analyzed for the five parameters listed above once every 7 days during the leak period and once every 7 days for at least 14 days following repairs.

11.5 [DELETED by Amendment No. 12]

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number SUA-1534
	Docket or Reference Number 40-8943
	Amendment No. 15

11.6 The results of the following activities, operations, or actions shall be documented: sampling; analyses; surveys and monitoring; survey/monitoring equipment calibration results; reports on audits and inspections; all meetings and training courses required by this license; and any subsequent reviews, investigations, or corrective actions. Unless otherwise specified in the NRC regulations, all such documentation shall be maintained for a period of at least five (5) years.

11.7 [DELETED by Amendment No. 12]

11.8 Any time uranium in a worker's urine specimen exceeds 15 micrograms per liter (ug/l), the annual ALARA audit will indicating what corrective actions were considered or performed.

11.9 Any time a uranium action level of 35 ug/l for two consecutive urine specimens or 130 ug/l for any one specimen is reached or exceeded, the licensee shall provide documentation within 30 days to the NRC indicating what corrective actions have been performed.

SECTION 12.0 Reporting Requirements

12.1 Effluent and environmental monitoring program results submitted in accordance with 10 CFR 40.65 shall be reported in the format shown Table 3 of Regulatory Guide 4.14, (Rev 1) entitled, "Sample Format for Reporting Monitoring Data." These reports also shall include injection rates, recovery rates, and injection manifold pressures.

12.2 Spills, Pond Leaks, Leaks, Excursions, and Incident/Event Reporting

Until license termination, the licensee shall maintain documentation on unplanned release of source or 11e.(2) by product materials (including extraction solutions) and process chemicals. Documented information shall include, but not be limited to: date, volume, total activity of each radionuclide released, radiological survey results, soil sample results (if taken), corrective actions, results of post remediation surveys (if taken), and a map showing the spill location and the impacted area.

The licensee shall have procedures which will evaluate the consequences of the spill or incident/event against 10 CFR 20, Subpart "M," and 10 CFR 40.60 reporting criteria. If the criteria are met, then report to the NRC Operations Center as required.

If the licensee is required to report any spills, pond leaks, excursions of source, 11e.(2) by product material, and process chemicals that may have an impact on the environment, or any other incidents/events to State or Federal Agencies, a notification shall be made to the NRC Headquarters Project Manager (PM) by telephone or electronic mail (e-mail) within 48 hours of the event. This notification shall be followed, within thirty (30) days of the notification, by submittal of a written report to NRC Headquarters PM as per License Condition 9.2, detailing the conditions leading to the spill, pond leak, excursion or incident/event, corrective actions taken, and results achieved.

[Applicable Amendment 12]

12.3 [DELETED by Amendment No. 12]

12.4 [DELETED by Amendment No. 13]

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number SUA-1534
	Docket or Reference Number 40-8943
	Amendment No. 15

12.5 The licensee shall submit a detailed decommissioning plan to NRC for review and approval at least 12 months prior to the planned final shutdown of well field extraction operations.

12.6 [Deleted by Amendment 12}

12.7 [Deleted by Amendment 12]

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Dated: 2/12/03

Daniel M. Gillen, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

February 18, 2010

Mr. Larry Teahon
Manager of Environmental
Health and Safety
Crow Butte Resources, Inc.
86 Crow Butte Road
P.O. Box 169
Crawford, NE 69339-0169

SUBJECT: REQUEST FOR ALTERNATE DECOMMISSIONING (GROUNDWATER RESTORATION) SCHEDULE, CROW BUTTE RESOURCES, INC., CRAWFORD, NEBRASKA, SOURCE MATERIALS LICENSE SUA-1534

Dear Mr. Teahon:

By letter dated July 24, 2009, Crow Butte Resources, Inc. (CBR) submitted a request for an alternate decommissioning (groundwater restoration) schedule for the Crow Butte facility to the U.S. Nuclear Regulatory Commission (NRC). Subsequently, NRC staff issued a letter on August 20, 2009 (ML092300140) which transmitted the Technical Evaluation Report (TER) that documented our review and approval of this request.

This TER is being reissued for the following reasons:

- An administrative error on the cover letter attributed the licensing action to "surety" changes, but should have read "administrative" changes; 10 CFR 51.22(c)(11) remains the correct citation.

- The TER incorrectly referenced 10 CFR 40.42(h)(2)(i) as the authority for the Commission approving a request for an alternate groundwater restoration schedule; the correct citation is 10 CFR 40.42(i).

- NRC staff is providing a supplemental analysis in the TER to address whether granting approval of this request is in the public interest.

The NRC staff's supplemental review of the request for an alternate decommissioning (groundwater restoration) schedule confirms the prior conclusion that it is acceptable and in the public interest. Therefore, NRC staff is reaffirming its prior approval of the request, subject to its incorporation as noted below, into Source Material License SUA-1534. The enclosed TER documents the staff's review of this request. This licensing action meets the categorical exclusion provision for administrative changes in 10 CFR Part 51.22(c)(11). Therefore, no further environmental review is required for this action.

The alternate decommissioning (groundwater restoration) schedule the staff has approved will be incorporated into Source Material License SUA-1534 as part of NRC staff's response to CBR's license renewal amendment request for this license. Future changes to this schedule will require an amendment to this license. If you have any questions, please contact Mr. Ronald Burrows, Project Manager, at 301-415-6443 or, by email at ronald.burrows@nrc.gov.

L. Teahon 2

In accordance with 10 CFR 2.390 of the NRC's Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders, a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agency-wide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/

Ronald A. Burrows, Project Manager
Uranium Recovery Licensing Branch
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 40-8943

License No.: SUA-1534

Enclosure:
Technical Evaluation Report

cc: Stephen Collings, CBR
Michael Linder, NDEQ

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Sincerely,

Ronald A. Burrows, Project Manager
Uranium Recovery Licensing Branch
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 40-8943

License No.: SUA-1534

Enclosure:
Technical Evaluation Report

cc: Stephen Collings, CBR
Michael Linder, NDEQ

DISTRIBUTION:
JWhitten, IV DOrlando

ML092510030

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DATE	09/22/09	09/22/09	09/22/09	09/22/09	2/05/10	2/18/10

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TECHNICAL EVALUATION REPORT
REQUEST FOR ALTERNATE DECOMMISSIONING (GROUNDWATER RESTORATION) SCHEDULE
CROW BUTTE RESOURCES, INC.
CRAWFORD, NEBRASKA

DATE: December 2009

DOCKET NO.: 40-8943

LICENSEE NO.: SUA-1534

FACILITY LOCATION: Crawford, Nebraska

PROJECT MANAGER: Ron Burrows

TECHNICAL REVIEWERS: Tom Lancaster

INTRODUCTION

By letter dated July 24, 2009, Crow Butte Resources, Inc. (CBR) submitted a request for an alternate decommissioning (groundwater restoration) schedule for the Crow Butte facility to the U.S. Nuclear Regulatory Commission (NRC). In conformance with 10 CFR 40.42, CBR's request seeks NRC approval to extend the period of groundwater restoration beyond the regulatory requirement of 24 months for each of the mine units currently in restoration (i.e., Mine Units 2 to 5).

TECHNICAL REVIEW

NRC staff reviewed CBR's above-referenced submittal with considerations listed in 10 CFR 40.42(i); These considerations are as follows:

(1) Whether it is technically feasible to complete decommissioning within the allotted 24-month period;

(2) Whether sufficient waste disposal capacity is available to allow completion of decommissioning within the allotted 24-month period;

(3) Whether a significant volume reduction in wastes requiring disposal will be achieved by allowing short-lived radionuclides to decay;

(4) Whether a significant reduction in radiation exposure to workers can be achieved by allowing short-lived radionuclides to decay; and

Enclosure

(5) Other site-specific factors which the Commission may consider appropriate on a case-by-case basis, such as the regulatory requirements of other government agencies, lawsuits, groundwater treatment activities, monitored natural groundwater restoration, actions that could result in more environmental harm than deferred cleanup, and other factors beyond the control of the licensee.

In addition, following NRC guidance in NUREG-1757, Section 5.1, staff is evaluating if this request is in the public interest.

Using information provided in CBR's submittal, NRC staff tabulated a historical summary of groundwater restoration at Mine Units 2 to 5 into the table below. NRC staff notes that CBR has continued to pursue increased efficiencies of the groundwater restoration at Mine Units 2 to 5. During the period from August 9, 2007, to April 1, 2009, CBR implemented recirculation at Mine Units 2 to 5 to maintain a hydrologic bleed, while making changes to the restoration system to increase the flow through Ion Exchange (IX) from 750 gallons per minute (gpm) to 1500 gpm and Reverse Osmosis (RO) treatment from 100 gpm to 600 gpm. Further efforts to improve efficiency of groundwater restoration were made with groundwater restoration modeling and sequencing of the mine units by a consultant hired by CBR. On December 17, 2008, CBR started a bioremediation field study using six wells in mine unit 4. At the end of one year of the study, CBR intends to review the study for the effectiveness of bioremediation to enhance restoration efforts.

Historical Summary of Groundwater Restoration at Mine Units 2 to 5

Mine Unit	Initiation of Groundwater Restoration		Period of Groundwater Recirculation during IX/RO Flow Upgrade	Current Phase of Groundwater Restoration
	Treatment	Initiation Date		
2	IX and RO *	January 2, 1996	August 9, 2007 to April 1, 2009	IX and RO
3	IX	July 22, 1999	August 9, 2007 to April 1, 2009	IX
4	IX	October 31, 2003	August 9, 2007 to April 1, 2009	IX **
5	IX	August 6, 2007	August 9, 2007 to April 1, 2009	IX

* IX – Ion Exchange, RO – Reverse Osmosis

** On December 17, 2008, a bioremediation field study was started on six production wells in Well house 9. At the end of a period of one year, the study will be reviewed for the effectiveness of the bioremediation to help restore mine units.

CBR states that the capacity of deep well disposal and the restoration circuit, as well as the need to maintain a hydrologic balance between the production and restoration mine units, make the restoration of each mine unit in a 24-month period technically infeasible. NRC notes that the Crow Butte facility permit from the State of Nebraska (Permit Number NE122611) requires that "no more than five mine units in the mining stage at any given time, no more than five mine units in restoration at any given time, and no more than three mine units constructed in advance of the active mining."

CBR provided an alternate schedule (i.e., in a table) for the completion of various phases of future groundwater restoration for each of the mine units currently in restoration (i.e., Mine Units 2 to 5). According to this schedule, CBR expects to complete groundwater restoration of Mine Units 2 to 5 by July 1, 2012, July 1, 2013, January 1, 2015, and July 1, 2016, respectively. CBR based its alternate schedule on IX and RO circuits' flow capacity, wastewater volume, and mine unit pore volume.

Changes to the restoration circuit have been made to handle increased flow through the IX and RO treatment circuits. Extending the groundwater restoration period will not have any construction impact. The staff also finds that restoration activities are within the parameters previously analyzed by the NRC and thus extending the groundwater restoration period will not significantly increase the potential for or consequences from radiological accidents. For this reason, the staff also finds that extending the groundwater restoration period will not significantly increase the individual or cumulative occupational radiation exposure in the area.

In evaluating whether this request is in the public interest, NRC staff notes that one alternative is to cease restoration activities. Alternatively, allowing the licensee to extend the groundwater restoration period will reduce the overall health risk to the public by bringing the mine units closer to conditions that existed prior to the start of uranium recovery operations in those mine units. Because of this, the staff finds that allowing the licensee to extend the groundwater restoration period will not result in any significant change in the types, or significant increase in the amounts, of any effluents that may be released offsite. Staff also considered the alternative of requiring the licensee to increase restoration capacity and concluded, based on groundwater monitoring and other site data, that this alternative would not significantly reduce the overall health risk to the public. Therefore, NRC staff concludes that approving this request is in the public interest.

CONCLUSION

In accordance with 10 CFR 40.42(i), NRC staff reviewed CBR's request for an alternate schedule to complete decommissioning (groundwater restoration) at the Crow Butte facility and determined that it is acceptable and in the public interest and, therefore, approves CBR's request.

May 21, 2012

Mr. Josh Leftwich
Director of Safety, Health, Environment
and Quality
Cameco Resources
2020 Carey Ave., Suite 600
Cheyenne, WY 82001

SUBJECT: REQUEST FOR ALTERNATE DECOMMISSIONING (GROUNDWATER RESTORATION) SCHEDULE, CROW BUTTE RESOURCES, INC., CRAWFORD, NEBRASKA, SOURCE MATERIALS LICENSE SUA-1534

Dear Mr. Leftwich:

In conformance with 10 CFR 40.42, Cameco Resources, Crow Butte Operations (Cameco) requested U. S. Nuclear Regulatory Commission's (NRC's) approval to extend the period of groundwater restoration beyond the regulatory requirement of 24 months for mine unit (MU) 6 (Cameco, 2010). In a letter dated March 28, 2012 (Cameco, 2012a), Cameco submitted a response to a request for additional information (RAI) from the NRC. The NRC staff has completed its technical review of the subject request for an alternate decommissioning (groundwater restoration) schedule for MU 6. The staff's review of the request for MU 6 also included a review of the progress of restoration for MUs 2 -5 in accordance with schedules previously approved by NRC (NRC, 2010).

Using information submitted by Cameco for MUs 2-6 (Cameco, 2010, 2012a, b), the NRC staff compiled MU restoration completion dates in the table below. The staff observes that the restoration completion dates in Cameco's subject RAI response (Cameco, 2012a) extend beyond NRC approved completion dates (Cameco, 2010, 2012b). Cameco stated that the further modification of the restoration completion dates for MU 2-5 were optimized and periodically calibrated with MODFLOW2000, a groundwater flow model, and the modified restoration date for MU 6 is considered to be more conservative and accounts for increased RO treatment in MU 5.

NRC's approval of the alternate restoration schedule for MU 2-5 was, in part, based on projected restoration efficiencies gained from facility upgrades that were completed in 2009 (Cameco, 2009). However, based on current Cameco projections, it appears that these perceived efficiencies will not result in reduced restoration times. The staff bases its findings on Cameco's further modification of restoration completion dates for MUs 2-6 (Cameco, 2012a). Consequently, Cameco has not provided sufficient information for the staff to make the necessary findings pursuant to 10 CFR 40.42 (i) related to approving Cameco's request for an alternate decommissioning (groundwater restoration) schedule for MU6.

Alternate Groundwater Restoration Completion Dates Submitted by CBR						
	Mine Unit (MU)	MU 2	MU 3	MU 4	MU 5	MU 6
Alternate Groundwater Restoration Completion Dates within	NRC-approved Alternate Restoration Schedule for MU 2-5 (NRC, 2010)	July 1, 2012	July 1, 2013	Jan. 1, 2015	July 1, 2016	-
	Cameco's Alternate Restoration Schedule Request for MU 6 (Cameco, 2010)	-	-	-	-	Dec. 31, 2019
	Cameco's RAI Response for the Alternate Restoration Schedule Request (Cameco, 2012a)	2nd Quarter, 2015	3rd Quarter, 2015	1st Quarter, 2019	2nd Quarter, 2022	3rd Quarter, 2021

The staff further notes that Cameco's current estimates for restoration are not in compliance with approved schedules. Therefore, new requests for alternate restoration schedules for MUs 2-6 should be submitted, in conformance with 10 CFR Part 40.42. Also, pursuant to 10 CFR 40.42 (g)(4)(v), the 2012 financial assurance estimate for the Crow Butte project must be amended to cover estimated costs of the new requests for alternate restoration schedules for MUs 2-6. Please provide the new requests for alternate decommissioning (groundwater restoration) schedules and the amended 2012 financial assurance estimate for the Crow Butte project, or a schedule for submitting these items, within 30 days of receipt of this letter.

References:

Cameco, 2012a. Request for Additional Information for Alternate Decommissioning (Groundwater Restoration) Schedule, Materials License SUA-1534, March 28, 2012, ADAMS Accession No. ML12102A158.

Cameco, 2012b. Annual Report of Changes, Tests, or Experiments, license N0. SUA-1534, January 27, 2012, ADAMS Accession No. ML12032A222.

Cameco, 2010. Notice of Cessation of Mining in Mine Unit #6, Request for Alternate Decommissioning (Groundwater Restoration) Schedule, Source Materials License SUA-1534, December 21, 2010, ADAMS Accession No. ML110040422.

Cameco, 2009. Request for Alternate Decommissioning (Groundwater Restoration) Schedule, Source Materials License SUA-1534, July 24, 2009, ADAMS Accession No. ML092220668.
NRC, 2012. Request for Additional Information for Alternate Decommissioning (Groundwater Restoration) Schedule, Source Materials License SUA-1534, February 22, 2012, ADAMS Accession No. ML120461110.

NRC, 2010. Request for Alternate Decommissioning (Groundwater Restoration) Schedule, Source Materials License SUA-1534, February 18, 2010, ADAMS Accession No. ML092510030.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/
Ronald A. Burrows, Project Manager
Uranium Recovery Licensing Branch
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 40-8943
License No.: SUA-1534

cc: Larry Teahon, Cameco Resources
Crow Butte Operation
Michael Linder, NDEQ

Cameco, 2009. Request for Alternate Decommissioning (Groundwater Restoration) Schedule, Source Materials License SUA-1534, July 24, 2009, ADAMS Accession No. ML092220668.
NRC, 2012. Request for Additional Information for Alternate Decommissioning (Groundwater Restoration) Schedule, Source Materials License SUA-1534, February 22, 2012, ADAMS Accession No. ML120461110.

NRC, 2010. Request for Alternate Decommissioning (Groundwater Restoration) Schedule, Source Materials License SUA-1534, February 18, 2010, ADAMS Accession No. ML092510030.

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Sincerely,

/RA/

Ronald A. Burrows, Project Manager
Uranium Recovery Licensing Branch
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 40-8943
License No.: SUA-1534

cc: Larry Teahon, Cameco Resources
Crow Butte Operation
Michael Linder, NDEQ

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ML12131A421

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DATE	5/ 10 /12	5/10 /12	5/10/12	5/ 17/12	5/ 21 /12

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CAMECO RESOURCES
CROW BUTTE OPERATION

86 Crow Butte Road
P.O. Box 169
Crawford, Nebraska 69339-0169

(308) 665-2215
(308) 665-2341 – FAX

October 26, 2012

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Ronald A. Burrows, Project Manager
Decommissioning and Uranium Recovery Licensing Directorate
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
Mailstop T8-F5
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Request for Additional Information for Alternate Decommissioning (Groundwater Restoration) Schedule, Crow Butte Resources, Inc., Crawford, Nebraska, Source Materials License SUA-1534
Docket No. 40-8943

Dear Mr. Burrows:

By letter dated May 21 (received May 25, 2012), the U.S. Nuclear Regulatory Commission (NRC) staff, upon review of Crow Butte's letter dated March 28, 2012 requesting additional information for an alternate decommissioning (groundwater restoration) schedule for Mine Unit (MU) 6 and requested new alternate decommissioning (groundwater restoration) schedules for Mine Units 2 - 6.

By letter dated April 25, 2012, Crow Butte submitted to the NRC in conformance with 10 CFR Part 40.42(h)(2)(i) a request to revise the approved restoration schedule for Mine Unit 2.

Based on the current restoration infrastructure in place at Crow Butte and the use of a groundwater flow model (MODFLOW2000) the revised estimated timeline for restoration in Mine Units 3 through 6 is summarized as follows:

CAMECO RESOURCES
CROW BUTTE OPERATION

Mine Unit # 3
Current Status:

RO Treatment	Flow
January 1, 2012 through September 30, 2012	130 GPM

Stability Monitoring	Flow
October 1, 2012 through September 30, 2013	None

Regulatory Approval	Flow
October 1, 2013 through September 30, 2015	None

The mine unit was placed into restoration on July 22, 1999

Mine Unit # 4
Current Status:

IX Treatment	Flow
January 1, 2012 through March 31, 2012	250 GPM

RO Treatment	Flow
April 1, 2012 through September 31, 2015	Average 280 GPM

Recirculation	Flow
October 1, 2015 through March 31, 2016	1000 GPM

Stability Monitoring	Flow
April 1, 2016 through March 31, 2017	None

Regulatory Approval	Flow
April 1, 2017 through March 31, 2019	None

The mine unit was placed into restoration on October 31, 2003.

CAMECO RESOURCES
CROW BUTTE OPERATION

Mine Unit #5
Current Status:

RO Treatment	Flow
January 1, 2012 through December 31, 2018	Average 280 GPM

Recirculation	Flow
January 1, 2019 through June 30, 2019	500 GPM

Stability Monitoring	Flow
July 1, 2019 through June 30, 2020	None

Regulatory Approval	Flow
July 1, 2020 through June 30, 2022	None

The mine unit was placed into restoration on August 14, 2007.

Mine Unit # 6
Current Status:

IX Treatment	Flow
January 1, 2012 through September 30, 2015	100 GPM

It should be noted that during the period of November 1, 2010 through December 31, 2011, the mine unit had only three wells operating to maintain a wellfield bleed for excursion control. During this time period, piping changes were made so that the mine unit could be isolated from the commercial circuit and piped into the restoration circuit.

RO Treatment	Flow
October 1, 2015 through March 31, 2018	300 GPM

Recirculation	Flow
February 1, 2018 through September 30, 2018	500 GPM

Stability Monitoring	Flow
October 1, 2018 through September 30, 2019	None

Regulatory Approval	Flow

CAMECO RESOURCES
CROW BUTTE OPERATION

October 1, 2019 through September 30, 2021 None

The mine unit was placed into restoration on October 28, 2010.

Attached is a spreadsheet that summarizes the restoration timeline for each mine unit.

By letter dated May 30, 2012 (received June 4, 2012), the NRC staff determined that Cameco's 2012 surety estimate was not sufficiently completed for them to do a detailed technical review of Cameco's request for an alternate decommissioning (groundwater restoration) schedule for Mine Unit #6. By letter dated August 27, 2012, Crow Butte submitted to the Nebraska Department of Environmental Quality a revised 2012 surety estimate making changes to the reverse osmosis (RO) production rate (400 GPM versus the total RO capacity of 1100 GPM) for each mine unit in restoration.

If you have any questions or require any further information, please do not hesitate to call me at 1-307-316-7588.

Sincerely,
CAMECO RESOURCES
CROW BUTTE OPERATION

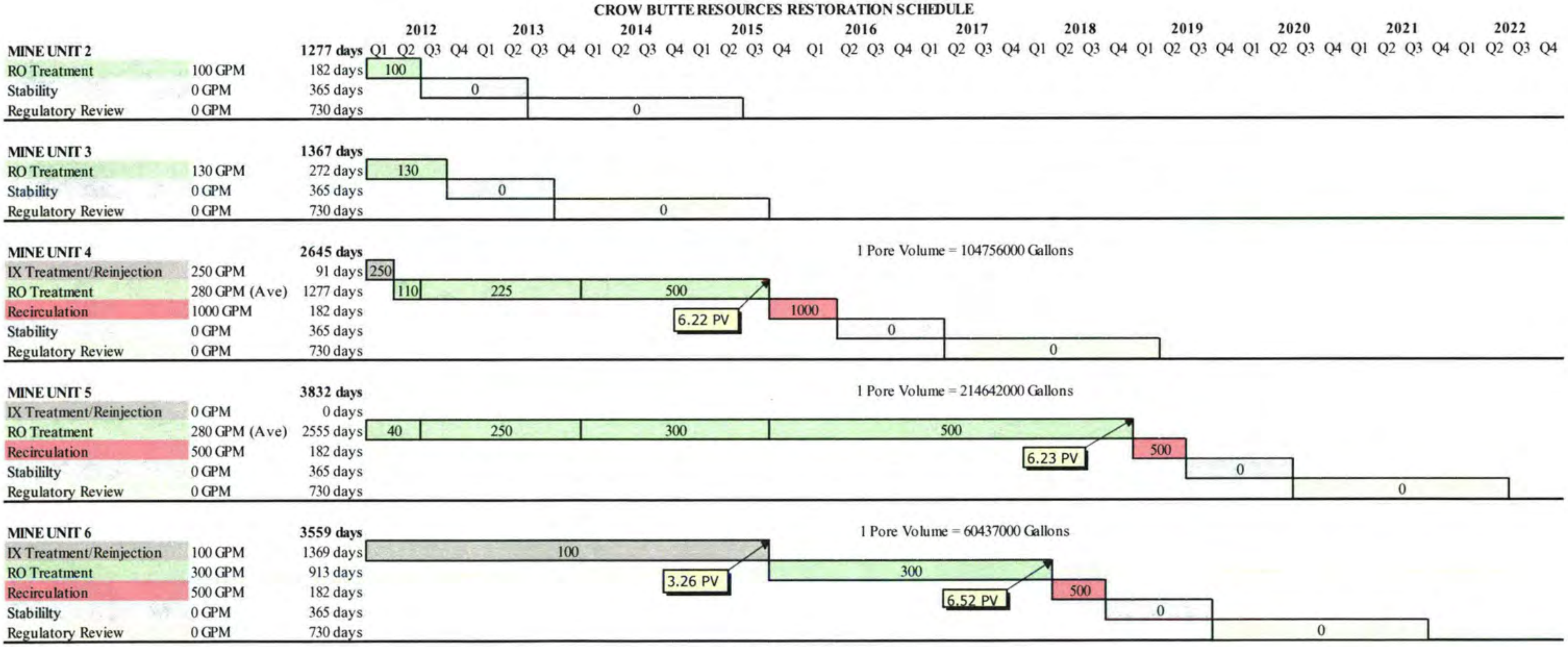
Josh Leftwich
Director of Radiation Safety and Licensing

Enclosures: As Stated

cc: Dave Miesbach – NDEQ
CBO - File
ec: CR – Cheyenne

Attachment

CROW BUTTE RESOURCES RESTORATION SCHEDULE



	2012 Q1	Q2	Q3	Q4	2013 Q1	Q2	Q3	Q4	2014 Q1	Q2	Q3	Q4	2015 Q1	Q2	Q3	Q4	2016 Q1	Q2	Q3	Q4	2017 Q1	Q2	Q3	Q4
IX Flow	350	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0
RO Flow	270	415	380	475	475	475	725	725	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
Recirculation Flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	1000	0	0	0	0	0	0	0

	2018 Q1	Q2	Q3	Q4	2019 Q1	Q2	Q3	Q4	2020 Q1	Q2	Q3	Q4	2021 Q1	Q2	Q3	Q4	2022 Q1	Q2	Q3	Q4
IX Flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RO Flow	800	500	500	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recirculation Flow	0	500	500	0	500	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NRC FORM 253 (9-96) U.S. NUCLEAR REGULATORY COMMISSION

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Cameco Resources	ADM	OWFN	P1-C10

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CAMECO RESOURCES

Cameco Resources,
Corporate Office
2020 Carey Avenue
Suite 600
Cheyenne, WY 82001

TO:
Mr. Ron Burrows, Project Manager
Office of Federal and State Materials and Environmental
Management Programs
Mailstop T8-F5
US Nuclear Regulatory Commission
Washington, DC ~~20555-0001~~ 20852

FIRST • CLASS

CAMECO RESOURCES
CROW BUTTE OPERATION

86 Crow Butte Road
P.O. Box 169
Crawford, Nebraska 69339-0169

(308) 665-2215
(308) 665-2341 – FAX

October 26, 2012

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Ronald A. Burrows, Project Manager
Decommissioning and Uranium Recovery Licensing Directorate
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
Mailstop T8-F5
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Request for Additional Information for Alternate Decommissioning (Groundwater Restoration) Schedule, Crow Butte Resources, Inc., Crawford, Nebraska, Source Materials License SUA-1534
Docket No. 40-8943

Dear Mr. Burrows:

By letter dated May 21 (received May 25, 2012), the U.S. Nuclear Regulatory Commission (NRC) staff, upon review of Crow Butte's letter dated March 28, 2012 requesting additional information for an alternate decommissioning (groundwater restoration) schedule for Mine Unit (MU) 6 and requested new alternate decommissioning (groundwater restoration) schedules for Mine Units 2 - 6.

By letter dated April 25, 2012, Crow Butte submitted to the NRC in conformance with 10 CFR Part 40.42(h)(2)(i) a request to revise the approved restoration schedule for Mine Unit 2.

Based on the current restoration infrastructure in place at Crow Butte and the use of a groundwater flow model (MODFLOW2000) the revised estimated timeline for restoration in Mine Units 3 through 6 is summarized as follows:

CAMECO RESOURCES
CROW BUTTE OPERATION

Mine Unit # 3
Current Status:

RO Treatment	Flow
January 1, 2012 through September 30, 2012	130 GPM

Stability Monitoring	Flow
October 1, 2012 through September 30, 2013	None

Regulatory Approval	Flow
October 1, 2013 through September 30, 2015	None

The mine unit was placed into restoration on July 22, 1999

Mine Unit # 4
Current Status:

IX Treatment	Flow
January 1, 2012 through March 31, 2012	250 GPM

RO Treatment	Flow
April 1, 2012 through September 31, 2015	Average 280 GPM

Recirculation	Flow
October 1, 2015 through March 31, 2016	1000 GPM

Stability Monitoring	Flow
April 1, 2016 through March 31, 2017	None

Regulatory Approval	Flow
April 1, 2017 through March 31, 2019	None

The mine unit was placed into restoration on October 31, 2003.