

CBRNorthTrendPEm Resource

From: Rhonda Grantham [Rhonda_Grantham@cameco.com]
Sent: Monday, September 28, 2009 10:19 AM
To: Burrows, Ronald
Cc: Larry Teahon; Scott Bakken
Subject: NTEA Attachments
Attachments: NT TR attachment 6.1(A) Feb 21, 07.doc; Nt TR attachment 7.3(A) Feb 21, 07.doc; NT ER Attachment 3-5 Ecology attachments.doc; NT ER attachment 4.12.2(A) MILDOS attachments.doc; NT ER attachment 5.3(A) Mar 7, 07.doc

Hi Ron,

Larry mentioned that you had called because you were unable to find Attachment 7.3(A) to the NTEA Technical Report. After we began looking we discovered that five attachments had inadvertently been omitted from the Technical Report and the Environmental Report submittals. The attachments include:

Attachment 6.1(A) Mine Units 1 through 9 Baseline and NDEQ Restoration Goals--Section 6.1.3.1 paragraph 2 of the TR

Attachment 7.3(A) Site Specific Information--Section 7.3.3 paragraph 2 of the TR

Attachment 3.5-A Plant Species List--Section 3.5.2 paragraph 4 of the ER

Attachment 4.12.2(A) Site Specific Information--Section 4.12.4 paragraph 2 of the ER

Attachment 5.3(A) Mine Units 1 through 9 Baseline and NDEQ Restoration Goals--Section 5.4.1.3.1 paragraph 2 of the ER

I have attached all five of the Attachments to this email and we will formally submit hard copies. Please call if you have any questions and sorry for the inconvenience.

Rhonda Grantham

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"Larry Teahon" <lteahon@crowbutte.net>
Tracking Status: None
"Scott Bakken" <Scott_Bakken@cameco.com>
Tracking Status: None
"Burrows, Ronald" <Ronald.Burrows@nrc.gov>
Tracking Status: None

Post Office: US.cameco.com

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NT TR attachment 6.1(A) Feb 21, 07.doc		313920
Nt TR attachment 7.3(A) Feb 21, 07.doc		122432
NT ER Attachment 3-5 Ecology attachments.doc		869952
NT ER attachment 4.12.2(A) MILDOS attachments.doc		122432
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ATTACHMENT 6.1(A)

Crow Butte Commercial License Area

Mine Units 1 through 9

Baseline and NDEQ Restoration Goals

Table 6.1(A)-1: Baseline and Restoration Values for Mine Unit 1

Parameter	Groundwater Standard	MU-1 Baseline (Primary Standard)	MU-1 Standard Deviation	MU-1 NDEQ Restoration Value
Ammonium (mg/l)	10.0	<0.372		10.0
Arsenic (mg/l)	0.05	<0.00214		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.01	<0.00644		0.005 ¹
Chloride (mg/l)	250.0	203.9	38	250.0
Copper (mg/l)	1.0	<0.017		1.0
Fluoride (mg/l)	4.0	0.686	0.04	4.0
Iron (mg/l)	0.3	<0.0441		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.011		0.05
Molybdenum (mg/l)	1.0	<0.0689		1.0
Nickel (mg/l)	0.15	<0.0340		0.15
Nitrate (mg/l)	10.0	<0.050		10.0
Lead (mg/l)	0.05	0.0315		0.05
Radium (pCi/L)	5.0	229.7	177.1	584.0
Selenium (mg/l)	0.01	<0.00323		0.05
Sodium (mg/l)	N/A	412	19.2	4120
Sulfate (mg/l)	250.0	356.2	9.4	375
Uranium (mg/l)	5.0	0.0922	0.089	5.0
Vanadium (mg/l)	0.2	<0.0663		0.2
Zinc (mg/l)	5.0	<0.036		5.0
pH (Std. Units)	6.5 - 8.5	8.46	0.2	6.5 – 8.5
Calcium (mg/l)	N/A	12.5	3.2	125.0
Total Carbonate (mg/l)	N/A	351	31.1	585
Potassium (mg/l)	N/A	12.5	1.5	125.0
Magnesium (mg/l)	N/A	3.2	0.8	32.0
TDS (mg/l)	N/A	1170.2	47.6	1170.2

¹ Standard for Cadmium lowered in modification to UIC permit dated March 9, 2001 following NDEQ approval of Mine Unit 1 restoration.

Table 6.1(A)-2: Baseline and Restoration Values for Mine Unit 2

Parameter	Groundwater Standard	MU-2 Baseline (Primary Standard)	MU-2 Standard Deviation	MU-2 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.37	0.07	10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.007		0.005
Chloride (mg/l)	250.0	208.6	30.8	250.0
Copper (mg/l)	1.0	<0.013		1.0
Fluoride (mg/l)	4.0	0.67	0.04	4.0
Iron (mg/l)	0.3	<0.045		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.073		1.0
Nickel (mg/l)	0.15	<0.037		0.15
Nitrate (mg/l)	10.0	<0.039		10.0
Lead (mg/l)	0.05	<0.035		0.05
Radium (pCi/L)	5.0	234.5	411.8	1058.0
Selenium (mg/l)	0.05	<0.001		0.05
Sodium (mg/l)	N/A	410.8	18.2	4108
Sulfate (mg/l)	250.0	348.2	10.3	369.0
Uranium (mg/l)	5.0	0.046	0.037	5.0
Vanadium (mg/l)	0.2	<0.07		0.2
Zinc (mg/l)	5.0	<0.026		5.0
pH (Std. Units)	6.5 - 8.5	8.32	0.2	6.5 – 8.5
Calcium (mg/l)	N/A	13.4	2.4	134.0
Total Carbonate (mg/l)	N/A	366.9	13.3	585.0
Potassium (mg/l)	N/A	12.6	2.5	126.0
Magnesium (mg/l)	N/A	3.5	0.4	35.0
TDS (mg/l)	N/A	1170.4	41	1170.4

Table 6.1(A)-3: Baseline and Restoration Values for Mine Unit 3

Parameter	Groundwater Standard	MU-3 Baseline (Primary Standard)	MU-3 Standard Deviation	MU-3 NDEQ Restoration Value
Ammonium (mg/l)	10.0	<0.329		10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	197.6	16.7	250.0
Copper (mg/l)	1.0	<0.0108		1.0
Fluoride (mg/l)	4.0	0.719	0.05	4.0
Iron (mg/l)	0.3	<0.05		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.1		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.0728		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	165	222.5	611.0
Selenium (mg/l)	0.05	<0.00115		0.05
Sodium (mg/l)	N/A	428	27.6	4280
Sulfate (mg/l)	250.0	377.0	13.4	404.0
Uranium (mg/l)	5.0	0.115	0.158	5.0
Vanadium (mg/l)	0.2	<0.1		0.2
Zinc (mg/l)	5.0	<0.0131		5.0
pH (Std. Units)	6.5 - 8.5	8.37	0.3	6.5 – 8.5
Calcium (mg/l)	N/A	13.3	3.1	133.0
Total Carbonate (mg/l)	N/A	358.7	24.8	592.0
Potassium (mg/l)	N/A	13.9	4.0	139.0
Magnesium (mg/l)	N/A	3.5	0.9	35.0
TDS (mg/l)	N/A	1183.0	47.4	1183.0

Table 6.1(A)-4: Baseline and Restoration Values for Mine Unit 4

Parameter	Groundwater Standard	MU-4 Baseline (Primary Standard)	MU-4 Standard Deviation	MU-4 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.288	0.08	10.0
Arsenic (mg/l)	0.05	<0.00209		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	217.5	34.9	250.0
Copper (mg/l)	1.0	<0.0114		1.0
Fluoride (mg/l)	4.0	0.745	0.05	4.0
Iron (mg/l)	0.3	<0.0504		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.1		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.114		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	154.3	171.5	496.0
Selenium (mg/l)	0.05	<0.00244		0.05
Sodium (mg/l)	N/A	416.6	27.8	4166
Sulfate (mg/l)	250.0	337.2	19.3	375.0
Uranium (mg/l)	5.0	<0.122		5.0
Vanadium (mg/l)	0.2	<0.0984		0.2
Zinc (mg/l)	5.0	<0.0143		5.0
pH (Std. Units)	6.5 - 8.5	8.68	0.3	6.5 – 9.28
Calcium (mg/l)	N/A	11.2	2.9	112.0
Total Carbonate (mg/l)	N/A	374.4	28	610.0
Potassium (mg/l)	N/A	16.7	4.7	167.0
Magnesium (mg/l)	N/A	2.8	0.8	28.0
TDS (mg/l)	N/A	1221.1	73.5	1221.1

Table 6.1(A)-5: Baseline and Restoration Values for Mine Unit 5

Parameter	Groundwater Standard	MU-5 Baseline (Primary Standard)	MU-5 Standard Deviation	MU-5 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.28	0.05	10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.10		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	191.9	7.9	250.0
Copper (mg/l)	1.0	<0.01		1.0
Fluoride (mg/l)	4.0	0.64	0.07	4.0
Iron (mg/l)	0.3	<0.05		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.10		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.1		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	166.0	184.6	535.0
Selenium (mg/l)	0.05	<0.002		0.05
Sodium (mg/l)	N/A	397.6	14.4	3976
Sulfate (mg/l)	250.0	364.5	10.5	385.0
Uranium (mg/l)	5.0	0.072	0.056	5.0
Vanadium (mg/l)	0.2	<0.10		0.2
Zinc (mg/l)	5.0	<0.02		5.0
pH (Std. Units)	6.5 - 8.5	8.5	0.1	6.5 – 8.5
Calcium (mg/l)	N/A	12.6	1.8	126.0
Total Carbonate (mg/l)	N/A	372	13.0	590.0
Potassium (mg/l)	N/A	11.5	1.2	115.0
Magnesium (mg/l)	N/A	3.4	0.4	34.0
TDS (mg/l)	N/A	1179.5	22.5	1202.0

Table 6.1(A)-6: Baseline and Restoration Values for Mine Unit 6

Parameter	Groundwater Standard	MU-6 Baseline (Primary Standard)	MU-6 Standard Deviation	MU-6 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.32	0.05	10.0
Arsenic (mg/l)	0.05	0.002		0.05
Barium (mg/l)	1.0	0.100		1.0
Cadmium (mg/l)	0.005	0.009		0.005
Chloride (mg/l)	250.0	206	15.4	250.0
Copper (mg/l)	1.0	0.012		1.0
Fluoride (mg/l)	4.0	0.65	0.03	4.0
Iron (mg/l)	0.3	0.050		0.3
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.010		0.05
Molybdenum (mg/l)	1.0	0.102		1.0
Nickel (mg/l)	0.15	0.050		0.15
Nitrate (mg/l)	10.0	0.1		10.0
Lead (mg/l)	0.05	0.050		0.05
Radium (pCi/L)	5.0	80.6	121.9	325
Selenium (mg/l)	0.05	0.001		0.05
Sodium (mg/l)	N/A	400	12.8	4000
Sulfate (mg/l)	250.0	361	14.6	390
Uranium (mg/l)	5.0	0.133	0.212	5.0
Vanadium (mg/l)	0.2	0.098		0.2
Zinc (mg/l)	5.0	0.011		5.0
pH (Std. Units)	6.5 - 8.5	8.6	0.2	6.5 – 9.0
Calcium (mg/l)	N/A	12.8	2.3	128
Total Carbonate (mg/l)	N/A	367.1	22.9	596
Potassium (mg/l)	N/A	11.9	1.7	119
Magnesium (mg/l)	N/A	3.2	0.7	32
TDS (mg/l)	N/A	1192	28.1	1220

Table 6.1(A)-7: Baseline and Restoration Values for Mine Unit 7

Parameter	Groundwater Standard	MU-7 Baseline (Primary Standard)	MU-7 Standard Deviation	MU-7 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.42	0.08	10.0
Arsenic (mg/l)	0.05	0.001		0.05
Barium (mg/l)	1.0	0.10		1.0
Cadmium (mg/l)	0.005	0.007		0.005
Chloride (mg/l)	250.0	198	22.6	250.0
Copper (mg/l)	1.0	0.01		1.0
Fluoride (mg/l)	4.0	0.70	0.05	4.0
Iron (mg/l)	0.30	0.05		0.30
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.01		0.05
Molybdenum (mg/l)	1.00	0.10		1.00
Nickel (mg/l)	0.15	0.05		0.15
Nitrate (mg/l)	10.0	0.1		10.0
Lead (mg/l)	0.05	0.05		0.05
Radium (pCi/L)	5.0	142	148.0	438
Selenium (mg/l)	0.05	0.004		0.05
Sodium (mg/l)	N/A	387	21.6	3,870
Sulfate (mg/l)	250.0	346	20.1	386
Uranium (mg/l)	5.0	0.110	0.138	5.0
Vanadium (mg/l)	0.2	0.10		0.2
Zinc (mg/l)	5.0	0.01		5.0
pH (Std. Units)	6.5 - 8.5	8.6	0.3	6.5 – 9.2
Calcium (mg/l)	N/A	12.2	2.6	122
Total Carbonate (mg/l)	N/A	356		588
Potassium (mg/l)	N/A	12.9	3.0	129
Magnesium (mg/l)	N/A	3.2	0.7	32
TDS (mg/l)	N/A	1,176	40.7	1,217

Table 6.1(A)-8: Baseline and Restoration Values for Mine Unit 8

Parameter	Groundwater Standard	MU-8 Baseline (Primary Standard)	MU-8 Standard Deviation	MU-8 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.682	0.222	10.0
Arsenic (mg/l)	0.05	0.002	0.001	0.05
Barium (mg/l)	1.0	0.099	0.005	1.0
Cadmium (mg/l)	0.005	0.005		0.005
Chloride (mg/l)	250	196	53.8	250
Copper (mg/l)	1.0	0.01		1.0
Fluoride (mg/l)	4.0	0.638	0.048	4.0
Iron (mg/l)	0.30	0.135	0.086	0.30
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.01		0.05
Molybdenum (mg/l)	1.0	0.093	0.023	1.00
Nickel (mg/l)	0.15	0.049	0.003	0.15
Nitrate (mg/l)	10.0	0.2		10.0
Lead (mg/l)	0.05	0.049	0.003	0.05
Radium (pCi/L)	5.0	124.4	151.8	428
Selenium (mg/l)	0.05	0.004		0.05
Sodium (mg/l)	N/A	416.8	41.8	4,168
Sulfate (mg/l)	250	312	33	378
Uranium (mg/l)	5.0	0.188	0.140	5.0
Vanadium (mg/l)	0.2	0.127	0.122	0.2
Zinc (mg/l)	5.0	0.013	0.008	5.0
pH (Std. Units)	6.5 - 8.5	8.67	0.37	6.5 – 9.41
Calcium (mg/l)	N/A	12.3	3.5	123
Total Carbonate (mg/l)	N/A	377	15.6	569
Potassium (mg/l)	N/A	11.8	3.2	117.8
Magnesium (mg/l)	N/A	2.7	0.92	27.1
TDS (mg/l)	N/A	1,137	97.4	1,234

Table 6.1(A)-9: Baseline and Restoration Values for Mine Unit 9

Parameter	Groundwater Standard	MU-9 Baseline (Primary Standard)	MU-9 Standard Deviation	MU-9 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.40	0.05	10.0
Arsenic (mg/l)	0.05	0.001	0.000	0.05
Barium (mg/l)	1.0	0.1	0.0	1.0
Cadmium (mg/l)	0.005	0.005	0.000	0.005
Chloride (mg/l)	250	203	13	250
Copper (mg/l)	1.0	0.01	0.00	1.0
Fluoride (mg/l)	4.0	0.8	0.0	4.0
Iron (mg/l)	0.3	0.04	0.01	0.3
Mercury (mg/l)	0.002	0.001	0.000	0.002
Manganese (mg/l)	0.05	0.01	0.00	0.05
Molybdenum (mg/l)	1.0	0.1	0.0	1.0
Nickel (mg/l)	0.15	0.05	0.00	0.15
Nitrate (mg/l)	10.0	0.06	0.01	10.0
Lead (mg/l)	0.05	0.05	0.00	0.05
Radium (pCi/L)	5.0	164	238	640
Selenium (mg/l)	0.05	0.003	0.001	0.05
Sodium (mg/l)	N/A	380	11	3,800
Sulfate (mg/l)	250	320	15	350
Uranium (mg/l)	5.0	0.1	0.24	5.0
Vanadium (mg/l)	0.2	0.1	0.0	0.2
Zinc (mg/l)	5.0	0.01	0.00	5.0
pH (Std. Units)	6.5 - 8.5	8.35	0.30	6.5 – 9.41
Calcium (mg/l)	N/A	13.6	4.6	136
Total Carbonate (mg/l)	N/A	383	14	595
Potassium (mg/l)	N/A	13.9	3.0	139
Magnesium (mg/l)	N/A	3.5	1.2	35.0
TDS (mg/l)	N/A	1,152	38	1,190

ATTACHMENT 7.3(A)

**Table 7-3(A)- 1: Site Specific Information
Crow Butte Project**

NORTH TREND SATELLITE

PARAMETER	VALUE
Average ore quality, U ₃ O ₈ , in ore body	0.27 percent
Ore radon activity, assuming equilibrium with U-238	761 pCi/g
Operating days per year (plant factor)	365 days
Dimensions of ore body	
Area per year to be mined	20 acres
Average thickness of body	5 ft
Average screened interval	15.1 ft
Average production flow rate	4500 gpm
Formation porosity	29 percent
Process recovery	95 percent
Leaching efficiency	60 percent
Rock density	1.89 g/cm ³
Restoration flow rate	500 gpm
Restoration Residence time	35 days
Production cell parameters	
Residence time	7 days
Type of cell pattern	variable
Average cell area	10,000 ft ²
Average cell flow rate	121 lpm
Source stack description (Main)	
Stack height	15.9 m
Stack diameter	0.30 m
Stack velocity	11 m/sec
Source stack description (Satellite)	
Stack height	10 m
Stack diameter	0.2
Stack velocity	10 m/sec

ft/ft² = feet/square feet
g/cm³ = grams per cubic centimeter
gpm = gallons per minute
lpm = liters per minute
m = meter
m²/sce = meters squared per second
pCi/g = picoCuries per gram

**Table 7-3(A)- 2: Source Coordinates
North Trend Satellite**

Source	East (km)	North (km)	Rn-222 (Curies)
1. Plant Vent	0.00	0.00	4300
2. Satellite Plant Vent	-5.30	9.60	342
3. MU-2-4 (restoration)	-0.30	0.16	350
4. MU-5	0.0	0.74	253
5. MU-6&8	1.92	-1.20	506
6. MU 7&9	0.00	-0.74	506
7. North Trend Wellfield	-5.30	9.60	1320

Sources 2 and 7 are from the proposed North Trend Satellite Facility operating at 4500 gpm using upflow IX columns and 500 gpm restoration flow using downflow IX and reverse osmosis. Resin from the North Trend Satellite is transferred to the Crow Butte processing facility for elution and precipitation.

All other sources are from the existing Crow Butte processing facility operating at 5000 gpm production flow using downflow IX columns and a 1000 gpm restoration flow using downflow IX and reverse osmosis.

Table 7-3(A)- 3: Individual Receptor Location Data

Location	X (km)	Y (km)	Distance (km)
1. R1	-1.21	-0.44	1.29
2. R2	-1.95	1.95	2.76
3. R3	-1.89	2.71	3.30
4. R4	-3.34	2.80	4.36
5. R5	-3.57	3.99	5.35
6. CRAWFORD	-4.39	4.45	6.25
7. R7	-1.99	3.96	4.43
8. R8	-1.99	3.60	4.11
9. R9	-1.57	3.23	3.59
10. R10	-1.16	2.80	3.03
11. R11	-1.78	2.77	3.29
12. R12	-0.30	2.35	2.35
13. R13	0.03	1.49	1.49
14. R14	0.51	0.98	1.10
15. R15	0.52	0.34	0.62
16. R16	1.31	0.30	1.34
17. R17	1.31	-0.34	1.35
18. EHLERS	0.73	-0.06	0.73
19. GIBBONS	0.73	0.73	1.03
20. STETSON	-0.46	1.22	1.30
21. KNODE	-1.89	2.68	3.28
22. BROTT	-1.37	1.34	1.92
23. SP 1	0.73	0.15	0.75
24. SP 2	0.67	0.58	0.89
25. SP 3	0.67	0.91	1.13
26. McDOWELL	-2.16	4.36	4.87
27. TAGGART	-1.89	4.45	4.83
28. FRANEY	-0.98	4.76	4.86
29. BUNCH	1.01	4.27	4.39
30. DYER	-2.44	0.55	2.50
31. NT-1	-3.97	11.33	12.01
32. NT-2	-4.12	8.93	9.83
33. NT-3	-4.75	7.87	9.19
34. NT-4	-5.82	6.69	8.87
35. NT-5	-4.61	6.76	8.18
36. NT-6	-7.20	11.65	13.70
37. NT-7	-8.25	9.86	12.86
38. NT-8	-0.44	2.76	2.79

**Table 7-3(A)- 4: Calculation of Annual Radon Emissions
Crow Butte Project - North Trend Satellite Area**

- 1) To calculate radon release from leaching, assuming that U-238 is in equilibrium with all its decay products:

$$\text{Ci/m}^3 = (761 \text{ pCi/g ore}) \times (1.89 \text{ g/cm}^3) \times 0.2 \times (0.71/0.29) \times 10^{-6} = 7.04 \times 10^{-4} \text{ Ci/m}^3$$

Where: 0.2 = Emanating Power
 0.71 = 1 - Porosity
 0.29 = Porosity
 1.89 = Rock Density

The yearly release is then:

$$7.04 \times 10^{-4} \text{ Ci/m}^3 \times 17034 \text{ lpm} \times (0.72) \times 365 \text{ d/yr} \times 1.44 = 4538 \text{ Ci/yr}$$

Where: 17034 = liters per minute (Production Rate)
 € = $1 - e^{-(\lambda t)}$
 € = $1 - e^{-(0.1812)(7d)}$
 € = $1 - e^{-(0.28)}$
 € = 0.72
 1.44 = constant
 365 = operating time

- 2) The radon release from start-up is given by:

$$7.04 \times 10^{-4} \text{ Ci/m}^3 \times 20 \text{ acres} \times 4074 \text{ m}^2/\text{acre} \times 1.52 \text{ m} \times 0.29 = 25 \text{ Ci/yr}$$

Where: 4074 = m²/acre
 1.52 = Thickness of orebody in meters
 0.29 = Porosity

The total release of radon from the start-up solution and production lixiviant solution is:

Start-up solution	25 Ci/yr
Production	<u>4538</u> Ci/yr
	4563 Ci/yr

- 3) The radon release from restoration is given by:

$$7.04 \times 10^{-4} \text{ Ci/m}^3 \times 1893 \text{ lpm} \times 365 \text{ d/yr} \times (0.99) \times 1.44 = 693 \text{ Ci/yr}$$

$$+ 25 \text{ (start-up)} = 719 \text{ Ci/yr}$$

Where: 1893 = Restoration flow in liters per minute
 € = $1 - e^{-(\lambda t)}$

35	=	Restoration Residence time (t) in days
€	=	$1 - e^{-(0.181)(35)}$
€	=	0.99
1.44	=	constant

The total release from this in-situ satellite mining operation is then:

Production (includes start-up)	4563	
Restoration (Includes Start-up)	719	
		5282 Ci/yr

4) Actual Radon Release to the Environment

The 4500 gpm of production flow at the North Trend Satellite being processed by pressurized downflow ion exchange columns will release only a small fraction of the contained radon to the environment. Approximately 10 percent of the contained radon will be released during resin transfer and venting. It is also expected that 25 percent of the radon will be released in the wellfield. This releases is:

$$\text{Wellfield Release} = 4563 \times 0.25 = 1140 \text{ Ci/yr}$$

The remainder of the radon will go to the process plant where a conservative estimate of 10 percent of the radon is released via the plant vent. The estimated radon released is:

$$4563 \text{ Ci/yr} - 1140 \text{ Ci/yr (Wellfield)} = 3423 \text{ Ci/yr}$$

$$3423 \text{ Ci/yr} \times 0.1 \text{ (plant loss)} = 342 \text{ Ci/yr released from plant vent}$$

The radon released during production is 1140 Ci/yr from the Wellfield and 342 Ci/yr from the plant vent for a total estimated release of 1482 Ci/yr.

During restoration, 500 gpm of recovered water will be processed by pressurized downflow ion exchange (IX) columns. After IX treatment, 200 gpm will be treated by reverse osmosis (RO). Only a small fraction of the contained radon will be released during ion exchange. The estimated release of the source term of 719 Ci of radon/yr (including start-up) is as follows:

- 25 percent of the 719 Ci/yr will be released in the Wellfield = 180 Ci/yr
- Assuming annual release from startup, production, and restoration, the total wellfield release rate is approximately 1140 Ci/yr + 180 Ci/yr = 1320 Ci/yr

Sources for the main plant area were determined in a similar manner.

Table 7-3(A)- 5: Miscellaneous Data

Fraction of year during which cattle graze locally	Est. 67percent
Fraction of cattle feed obtained by grazing	Est. 90 percent
Fraction of stored cattle feed grown locally	Est. 10 percent
Acreage required to graze 1 animal unit (450 kg) for one month (AUM)	3.5 ha
Length of growing season	4 mo/yr
Fraction of locally produced vegetables consumed locally	Est. 100 percent
Fraction of locally produced meat consumed locally	Est. 10 percent
Fraction of locally produced milk consumed locally	Est. 100 percent

Estimates based on personal communication with the Sioux County, Nebraska Agricultural Extension Educator located in Harrison, Nebraska (Ms. Jenny Nixon).

AUM = animal units per month

ha = hectares

kg = kilogram

mo/yr = months per year

CROW BUTTE RESOURCES, INC.

**Environmental Report
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Attachment 3.5-A – Plant Species List



PLANT SPECIES LIST

Scientific Name	Common Name	
<u>EQUISETACEAE</u>		
<i>Equisetum laevigatum</i>	Smooth horsetail	
<u>PINACEAE</u>		
<i>Pinus ponderosa</i>	Ponderosa pine	
<u>RANUNCULACEAE</u>		
<i>Anemone patens</i>	Pasque-flower	
<i>Clematis ligusticifolia</i>	Western clematis	
<i>Ranunculus abortivus</i>	Early wood buttercup	
<i>Thalictrum dasycarpum</i>	Purple meadowrue	
<u>PAPAVERACEAE</u>		
<i>Argemone polyanthemos</i>	Prickle poppy	
<u>FUMARIACEAE</u>		
<i>Corydalis aurea</i>	Golden corydalis	
<u>ULMACEAE</u>		
<i>Ulmus americana</i>	American elm	
<i>Ulmus pumila</i>	Siberian elm	
<u>CANNABACEAE</u>		
<i>Humulus lupulus</i>	Common hop	
<u>URTICACEAE</u>		
<i>Urtica dioica</i>	Stinging nettle	
<u>CACTACEAE</u>		
<i>Coryphantha vivipara</i>	Pincushion cactus	
<i>Opuntia fragilis</i>	Brittle prickly pear	
<u>CARYOPHYLLACEAE</u>		
<i>Arenaria hookeri</i>	Hooker sandwort	
<i>Cerastium arvense</i>	Prairie chickweed	
<i>Paronychia jamesii</i>	James nailwort	
<i>Stellaria media</i>	Common chickweed	
<u>CHENOPODIACEAE</u>		
<i>Chenopodium album</i>	Lamb's-quarters	
<i>Chenopodium fremontii</i>	Fremont goosefoot	
<i>Chenopodium leptophyllum</i>	Maple-leaved goosefoot	
<u>CHENOPODIACEAE</u>		
<i>Kochia scoparia</i>	Kochia	
<i>Salsola iberica</i>	Russian thistle	
<u>AMARANTHACEAE</u>		



PLANT SPECIES LIST

Scientific Name	Common Name	
<i>Amaranthus graecizans</i>	Tumbleweed	
<i>Amaranthus retroflexus</i>	Rough pigweed	
<u>POLYGONACEAE</u>		
<i>Polygonum convolvulus</i>	Wild buckwheat	
<i>Polygonum ramosissimum</i>	Bushy knotweed	
<u>MALVACEAE</u>		
<i>Malva rotundifolia</i>	Common mallow	
<i>Sphaeralcea coccinea</i>	Red false mallow	
<u>VIOLACEAE</u>		
<i>Viola canadensis</i>	Canada violet	
<i>Viola nuttallii</i>	Yellow prairie violet	
<u>SALICACEAE</u>		
<i>Populus deltoids</i>	Plains cottonwood	
<i>Salix exigua</i>	Coyote willow	
<u>CAPPARACEAE</u>		
<i>Cleome serrulata</i>	Rocky mountain beeplant	
<u>BRASSICACEAE</u>		
<i>Arabis holboellii</i>	Rockcress	
<i>Brassica kaber</i>	Charlock	
<i>Capsella bursa-pastoris</i>	Shepherd's purse	
<i>Chorispora tenella</i>	Blue mustard	
<i>Descurainia pinnata</i>	Tansy mustard	
<i>Descurainia sophia</i>	Flixweed	
<i>Draba reptans</i>	Whote whitlowwort	
<i>Erysimum asperum</i>	Western wallflower	
<i>Erysimum repandum</i>	Bushy wallflower	
<i>Lesquerella ludoviciana</i>	Bladderpod	
<i>Sisymbrium altissimum</i>	Tumbling mustard	
<i>Thlaspi arvense</i>	Penny cress	
<u>PRIMULACEAE</u>		
<i>Androsace occidentalis</i>	Western rock jasmine	
<u>SAXIFRAGACEAE</u>		
<i>Ribes odoratum</i>	Buffalo currant	
<u>ROSACEAE</u>		
<i>Prunus americana</i>	Wild plum	
<i>Prunus virginiana</i>	Chokecherry	
<i>Rosa acicularis</i>	Prickly wild rose	



PLANT SPECIES LIST

Scientific Name	Common Name	
<i>Rosa arkansana</i>	Prairie wild rose	
<i>Rosa woodsii</i>	Western wild rose	
<u>FABACEAE</u>		
<i>Astragalus gracilis</i>	Slender milkvetch	
<i>Astragalus missouriensis</i>	Missouri milkvetch	
<i>Lupinus argenteus</i>	Silvery lupine	
<i>Medicago falcata</i>	Yellow lupine	
<i>Medicago sativa</i>	Alfalfa	
<i>Melilotus alba</i>	White sweetclover	
<i>Melilotus officinalis</i>	Yellow sweetclover	
<i>Oxytropis lambertii</i>	Purple locoweed	
<i>Psoralea argophylla</i>	Silver-leaf scurf pea	
<i>Psoralea esculenta</i>	Breadroot scurf pea	
<i>Psoralea lanceolata</i>	Lemon scurf pea	
<i>Vicia americana</i>	American vetch	
<u>ONAGRACEAE</u>		
<i>Gaura coccinea</i>	Velvety gaura	
<i>Oenothera caespitosa</i>	Gumbo lily	
<i>Oenothera nuttallii</i>	White-stemmed evening primrose	
<u>CORNACEAE</u>		
<i>Comandra umbellata</i>	Bastard toadflax	
<u>EUPHORBIACEAE</u>		
<i>Croton texensis</i>		
<i>Euphorbia podperae</i>		
<u>VITACEAE</u>		
<i>Parthenocissus vitacea</i>	Woodbine	
<u>ACERACEAE</u>		
<i>Acer negundo</i>	Box elder	
<u>ANACARDIACEAE</u>		
<i>Rhus aromatica</i>	Aromatic sumac	
<i>Toxicodendron rydbergii</i>	Poison ivy	
<u>ZYGOPHYLLACEAE</u>		
<i>Tribulus terrestris</i>	Puncture vine	
<u>LINACEAE</u>		
<i>Linum perenne</i>	Blue flax	
<i>Linum rigidum</i>	Stiffstem flax	



PLANT SPECIES LIST

Scientific Name	Common Name	
<u>POLYGALACEAE</u>		
<i>Polygala alba</i>	White milkwort	
<u>APIACEAE</u>		
<i>Lomatium nuttallii</i>	Wild parsley	
<u>APOCYNACEAE</u>		
<i>Apocynum cannabinum</i>	Hemp dogbane	
<u>ASCLEPIADACEAE</u>		
<i>Asclepias speciosa</i>	Showy milkweed	
<u>SOLANACEAE</u>		
<i>Solanum rostratum</i>	Buffalo bur	
<u>CONVOLVULACEAE</u>		
<i>Convolvulus arvensis</i>	Field bindweed	
<i>Convolvulus sepium</i>	Hedge bindweed	
<u>POLEMONIACEAE</u>		
<i>Phlox andicola</i>	Moss phlox	
<u>BORAGINACEAE</u>		
<i>Cryptantha jamesii</i>	James' cryptantha	
<i>Lappula redowskii</i>	Low stickseed	
<i>Lithospermum incisum</i>	Narrow-leaved puccoon	
<u>LAMIACEAE</u>		
<i>Mentha arvensis</i>	Field mint	
<i>Monarda pectinata</i>	Spotted beebalm	
<u>PLANTAGINACEAE</u>		
<i>Plantago patagonica</i>	Buckhorn	
<u>OLEACEAE</u>		
<i>Fraxinus pennsylvanica</i>	Green ash	
<u>SCROPHULARIACEAE</u>		
<i>Penstemon albidus</i>	White beardtongue	
<i>Penstemon angustifolius</i>	Narrow beardtongue	
<i>Penstemon glaber</i>	Smooth beardtongue	
<i>Penstemon grandiflorus</i>	Large beardtongue	
<i>Verbascum thapsus</i>	Common mullein	
<u>CAMPANULACEAE</u>		
<i>Campanula rotundifolia</i>	Harebell	
<u>RUBIACEAE</u>		
<i>Galium aparine</i>	Catchweed bedstraw	
<u>CAPRIFOLIACEAE</u>		



PLANT SPECIES LIST

Scientific Name	Common Name	
<i>Symphoricarpos occidentalis</i>	Western snowberry	
<u>ASTERACEAE</u>		
<i>Achillea millefolium</i>	Yarrow	
<i>Agoseris glauca</i>	False dandelion	
<i>Antennaria rosea</i>	Rose pussytoes	
<i>Artemisia campestris</i>	Western sagebrush	
<i>Artemisia frigida</i>	Fringed sagebrush	
<i>Artemisia ludoviciana</i>	White sage	
<i>Chrysopsis villosa</i>	Golden aster	
<i>Cirsium undulatum</i>	Wavyleaf thistle	
<i>Cirsium vulgare</i>	Bull thistle	
<i>Crepis runcinata</i>	Hawk's-beard	
<i>Echinacea angustifolia</i>	Purple coneflower	
<i>Erigeron pumilus</i>	Low fleabane	
<i>Grindelia squarrosa</i>	Curly-top gumweed	
<i>Gutierrezia sarothrae</i>	Broom snakeweed	
<i>Helianthus annuus</i>	Common sunflower	
<i>Helianthus petiolaris</i>	Plains sunflower	
<i>Lygodesmia juncea</i>	Skeleton-weed	
<i>Ratibida columnifera</i>	Prairie coneflower	
<i>Ridbeckia hirta</i>	Black-eyed susan	
<i>Senecio plattensis</i>	Prairie ragwort	
<i>Taraxacum officinale</i>	Dandelion	
<i>Townsendia exscapa</i>	Easter daisy	
<i>Tragopogon dubius</i>	Goatsbeard	
<u>COMMELINACEAE</u>		
<i>Tradescantia occidentalis</i>	Prairie spiderwort	
<u>JUNCACEAE</u>		
<i>Juncus balticus</i>	Baltic rush	
<u>CYPERACEAE</u>		
<i>Carex filifolia</i>	Thread-leaved sedge	
<i>Carex hystericina</i>	Bottlebrush sedge	
<i>Carex lanuginose</i>	Wooly-headed sedge	
<i>Carex nebraskensis</i>	Nebraska sedge	
<i>Carex rossii</i>	Ross' sedge	
<u>POACEAE</u>		



PLANT SPECIES LIST

Scientific Name	Common Name	
<i>Agropyron cristatum</i>	Crested wheatgrass	
<i>Agropyron intermedium</i>	Intermediate wheatgrass	
<i>Agropyron pectiniforme</i>	Smooth crested wheatgrass	
<i>Agropyron smithii</i>	Western wheatgrass	
<i>Agropogon scoparius</i>	Little bluestem	
<i>Aristida longiseta</i>	Red threeawn	
<i>Bouteloua gracilis</i>	Blue grama	
<i>Bromus inermis</i>	Smooth brome	
<i>Bromus japonicus</i>	Japanese brome	
<i>Bromus tectorum</i>	Cheatgrass	
<i>Buchloe dactyloides</i>	Buffalo-grass	
<i>Cenchrus longispinus</i>	Field sandbur	
<i>Elymus canadensis</i>	Canada wild rye	
<i>Festuca octoflora</i>	Six-weeks fescue	
<i>Hordeum jubatum</i>	Foxtail barley	
<i>Hordeum pusillum</i>	Little barley	
<i>Koeleria pyramidata</i>	Junegrass	
<i>Oryzopsis hymenoides</i>	Indian ricegrass	
<i>Panicum capillare</i>	Witchgrass	
<i>Poa compressa</i>	Canada bluegrass	
<i>Poa pratensis</i>	Kentucky bluegrass	
<i>Poa sandbergii</i> = (<i>P. secunda</i>)	Sandberg bluegrass	
<i>Setaria glauca</i>	Yellow foxtail	
<i>Setaria viridis</i>	Green foxtail	
<i>Sitanion hystrix</i>	Squirreltail	
<i>Stipa comata</i>	Needle-and-thread	
<i>Stipa viridula</i>	Green needlegrass	
<i>Triticum aestivum</i>	Wheat	
<u>LILIACEAE</u>		
<i>Allium textile</i>	White wild onion	
<i>Calochortus nuttallii</i>	Mariposa lily	
<i>Leucocrinum montanum</i>	Mountain lily	
<i>Smilacina stellata</i>	Spikenard	
<i>Yucca glauca</i>	Yucca	
<i>Zigadenus venenosus</i>	Death camass	
<u>IRIDACEAE</u>		

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PLANT SPECIES LIST

Scientific Name	Common Name	
<i>Sisyrinchium montanum</i>	Blue-eyed grass	

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Attachment 3.5-B – Mammal Species List



MAMMAL SPECIES LIST		
Order/Common Name	Scientific Name	Documented Status¹
CARNIVORES		
Carnivora		
Raccoon	<i>Procyon lotor</i>	D
Long-tailed weasel	<i>Mustela frenata</i>	D
Mink	<i>Mustela vison</i>	D
Black-footed ferret	<i>Mustela nigripes</i>	E
Badger	<i>Taxidea taxus</i>	D
Spotted skunk	<i>Spilogale putorius</i>	E
Striped skunk	<i>Mephitis mephitis</i>	D
Coyote	<i>Canis latrans</i>	D
Swift fox	<i>Vulpes velox</i>	R
Red fox	<i>Vulpes fulva</i>	D
Bobcat	<i>Lynx rufus</i>	D
Mountain lion	<i>Felis concolor</i>	R
BIG GAME MAMMALS		
Artiodactyla		
Mule deer	<i>Odocoileus hemionus</i>	D
White-tailed deer	<i>Odocoileus virginianus</i>	D
Pronghorn	<i>Antilocapra americana</i>	D
Elk	<i>Cervus elaphus</i>	D
Bighorn sheep	<i>Ovis canadensis</i>	D
Bison	<i>Bison bison</i>	D
Moose	<i>Alces alces</i>	R
Mule deer/White-tailed deer hybrid	<i>O. hemionus x virginianus</i>	D
SMALL MAMMALS		
Chiroptera		
Keen myotis	<i>Myotis keeni</i>	E
Little brown myotis	<i>Myotis lucifugus</i>	E
Fringed myotis	<i>Myotis thysanodes</i>	E
Long-eared myotis	<i>Myotis evotis</i>	E
Long-legged myotis	<i>Myotis volans</i>	E
Small-footed myotis	<i>Myotis subulatus</i>	E



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MAMMAL SPECIES LIST		
Order/Common Name	Scientific Name	Documented Status ¹
Silver-haired bat	<i>Lasionycteris noctivagans</i>	E
Red bat	<i>Lasiurus borealis</i>	E
Big brown bat	<i>Eptesicus fuscus</i>	E
Hoary bat	<i>Lasiurus cinereus</i>	E
Western big-eared bat	<i>Plecotus townsendi</i>	E
Insectivora		
Masked shrew	<i>Sorex cinereus</i>	E
Dwarf shrew	<i>Sorex nanus</i>	E
Merriam shrew	<i>Sorex merriami</i>	E
Least shrew	<i>Cryptotis parva</i>	E
Eastern mole	<i>Scalopus aquaticus</i>	D
Lagomorpha		
White-tailed jackrabbit	<i>Lepus townsendi</i>	D
Black-tailed jackrabbit	<i>Lepus californicus</i>	D
Eastern cottontail	<i>Sylvilagus floridanus</i>	D
Desert cottontail	<i>Sylvilagus auduboni</i>	D
Rodentia		
Black-tailed prairie dog	<i>Cynomys ludovicianus</i>	D
Thirteen-lined ground squirrel	<i>Spermophilus tridecemlineatus</i>	D
Spotted ground squirrel	<i>Citellus spilosoma</i>	D
Least chipmunk	<i>Eutamias minimus</i>	D
Eastern fox squirrel	<i>Sciurus niger</i>	D
Northern pocket squirrel	<i>Thomomys talpoides</i>	D
Plains pocket gopher	<i>Geomys bursarius</i>	E
Wyoming pocket mouse	<i>Perognathus fasciatus</i>	E
Plains pocket mouse	<i>Perognathus flavescens</i>	E
Silky pocket mouse	<i>Perognathus flavus</i>	E
Hispid pocket mouse	<i>Perognathus hispidus</i>	E
Ord kangaroo rat	<i>Dipodomys ordii</i>	D
Beaver	<i>Castor canadensis</i>	D
Plains harvest mouse	<i>Reithrodontomys montanus</i>	E
Western harvest mouse	<i>Reithrodontomys</i>	E



MAMMAL SPECIES LIST		
Order/Common Name	Scientific Name	Documented Status¹
	<i>megalotis</i>	
White-footed mouse	<i>Peromyscus leucopus</i>	D
Deer mouse	<i>Peromyscus maniculatus</i>	D
Northern grasshopper mouse	<i>Onychomys leucogaster</i>	E
Eastern woodrat	<i>Neotoma floridana</i>	E
Bushy-tailed woodrat	<i>Neotoma cinerea</i>	E
Brown rat	<i>Rattus norvegicus</i>	E
House mouse	<i>Mus musculus</i>	D
Meadow vole	<i>Microtus pennsylvanicus</i>	D
Prairie vole	<i>Microtus ochrogaster</i>	D
Muskrat	<i>Ondatra zibethicus</i>	D
Meadow jumping mouse	<i>Zapus hudsonicus</i>	D
Porcupine	<i>Erethizon dorsatum</i>	D

- 1 D Documented in the 1982 baseline study.
 E Expected to occur - historical or recent evidence.
 R Reported by knowledgeable individual(s).

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Attachment 3.5-C – Bird Species List



BIRD SPECIES LIST		
Common Name	Scientific Name	Status¹
GAVIIFORMES		
Common loon	<i>Gavia immer</i>	R
Arctic loon	<i>Gavia arctica</i>	R
PODICIPEDIFORMES		
Red-necked grebe	<i>Podiceps grisegena</i>	R
Horned grebe	<i>Podiceps auritus</i>	D
Eared grebe	<i>Podiceps caspicus</i>	D
Western grebe	<i>Aechmophorus occidentalis</i>	D
Pied-billed grebe	<i>Podilymbus podiceps</i>	
PELECANIFORMES		
White pelican**	<i>Pelicanus erythrorhynchos</i>	D
Double-crested cormorant**	<i>Phalacrocorax auritus</i>	D
CICONIFORMES		
Great blue heron	<i>Ardea herodias</i>	D
Green heron	<i>Butorides virescens</i>	R
Cattle egret	<i>Bubulcus ibis</i>	R
Great egret	<i>Casmerodius albus</i>	R
Snowy egret	<i>Leucophoyx thula</i>	R
Black-crowned night heron**	<i>Nycticorax nycticorax</i>	D
Yellow-crowned night heron	<i>Nyctanassa violacea</i>	R
American bittern**	<i>Botaurus lentiginosus</i>	D
White-faced ibis	<i>Plegadia chihi</i>	R
ANSERIFORMES		
Whistling swan	<i>Olor columbianus</i>	R
Trumpeter swan	<i>Olor buccinator</i>	D
Canada goose	<i>Branta canadensis</i>	D
Brant	<i>Branta bernicla</i>	R
White-fronted goose	<i>Anser albifrons</i>	D
Snow goose	<i>Chen hyperborea</i>	D



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Mallard*	<i>Anas platyrhynchos</i>	D
Black duck	<i>Anas rubripes</i>	R
Gadwall**	<i>Anas strepera</i>	D
Pintail**	<i>Anas acuta</i>	D
Green-winged teal**	<i>Anas carolinensis</i>	D
Blue-winged teal**	<i>Anas discors</i>	D
Cinnamon teal	<i>Anas cyanoptera</i>	D
American wigeon	<i>Mareca americana</i>	D
Northern shoveler	<i>Spatula clypeata</i>	D
Wood duck	<i>Aix sponsa</i>	D
Redhead	<i>Aythya americana</i>	D
Ring-necked duck	<i>Aythya collaris</i>	D
Canvasback	<i>Aythya valisineria</i>	D
Lesser scaup	<i>Aythya affinis</i>	D
Common goldeneye	<i>Bucephala clangula</i>	D
Barrow's goldeneye	<i>Bucephala islandica</i>	R
Bufflehead	<i>Bucephala albeola</i>	D
Oldsquaw	<i>Clangula hyemalis</i>	R
White-winged scoter	<i>Melanitta deglandi</i>	R
Surf scoter	<i>Melanitta perspicillata</i>	R
Black scoter	<i>Oidemia nigra</i>	R
Ruddy duck	<i>Oxyura jamaicensis</i>	D
Hooded merganser	<i>Lophodytes cucullatus</i>	D
Common merganser	<i>Mergus merganser</i>	D
Red-breasted merganser	<i>Mergus serrator</i>	R
FALCONIFORMES		
Turkey vulture	<i>Cathartes aura</i>	D
Goshawk	<i>Accipiter gentilis</i>	D
Sharped-shinned hawk	<i>Accipiter striatis</i>	D
Cooper's hawk	<i>Accipiter cooperi</i>	D
Red-tailed hawk	<i>Buteo jamaicensis</i>	
Red-shouldered hawk	<i>Buteo lineatus</i>	R
Broad-winged hawk	<i>Buteo platypterus</i>	R
Swainson's hawk	<i>Buteo swainsoni</i>	R
Rough-legged hawk	<i>Buteo lagopus</i>	D
Ferruginous hawk	<i>Buteo regalis</i>	D
Golden eagle	<i>Aquila chrysaetos</i>	D



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Bald eagles	<i>Haliaeetus leucocephalus</i>	D
Northern harrier	<i>Circus cyaneus</i>	D
Osprey	<i>Pandion haliaetus</i>	R
Gyr Falcon	<i>Falco rusticolus</i>	D
Prairie falcon	<i>Falco mexicanus</i>	D
Peregrine falcon	<i>Falco peregrinus</i>	R
Merlin	<i>Falco columbarius</i>	D
American kestrel	<i>Falco sparverius</i>	D
GALLIFORMES		
Sharp-tailed grouse*	<i>Pedioecetes phasianellus</i>	D
Bobwhite	<i>Colinus virginianus</i>	R
Ring-necked pheasant*	<i>Phasianus colchicus</i>	D
Turkey*	<i>Meleagris gallopavo</i>	D
Gray partridge**	<i>Perdix perdix</i>	D
GRUIFORMES		
Sandhill crane	<i>Grus canadensis</i>	D
Virginia rail**	<i>Rallus limicola</i>	D
Sora rail**	<i>Porzana carolina</i>	D
American coot**	<i>Fulica americana</i>	D
CHARADRIIFORMES		
Semipalmated plover	<i>Charadrius semipalmatus</i>	R
Mountain plover	<i>Charadrius montainus</i>	E
Piping plover	<i>Charadrius melodus</i>	R
Snowy plover	<i>Charadrius alexandrinus</i>	R
Killdeer*	<i>Charadrius vociferus</i>	D
American golden plover	<i>Pluvialis dominica</i>	R
Black-bellied plover	<i>Squatarola squatarola</i>	D
Marbled godwit	<i>Lemosia fedoa</i>	D
Whimbrel	<i>Numenius phaeopus</i>	R
Long-billed curlew**	<i>Numenius americanus</i>	D
Upland sandpiper**	<i>Bartramia longicauda</i>	D
Greater yellowlegs	<i>Totanus melanoleucus</i>	D
Lesser yellowlegs	<i>Totanus flavipes</i>	D
Solitary sandpiper	<i>Tringa solitaria</i>	D
Willet**	<i>Catoptrophorus semipalmatus</i>	D
Spotted sandpiper**	<i>Actitis macularia</i>	D



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Common snipe*	<i>Capella gallinago</i>	D
Short-billed dowitcher	<i>Limnodromus griseus</i>	R
Long-billed dowitcher	<i>Limnodromus scolopaceus</i>	D
Red knot	<i>Calidris canutus</i>	R
Sanderling	<i>Calidris alba</i>	D
Semipalmated sandpiper	<i>Ereunetes pusillus</i>	D
Western sandpiper	<i>Ereunetes mauri</i>	R
Least sandpiper	<i>Eriola minutilla</i>	D
White-rumped sandpiper	<i>Eriola fuscicollis</i>	R
Baird's sandpiper	<i>Eriola bairdii</i>	D
Pectoral sandpiper	<i>Eriola melanotos</i>	R
Stilt sandpiper	<i>Micropalama himantopus</i>	D
CHARADRIIFORMES		
Buff-breasted sandpiper	<i>Tryngites subrufficollis</i>	R
American avocet**	<i>Recurvirostra americana</i>	D
Wilson's phalarope**	<i>Steganopus tricolor</i>	D
Northern phalarope	<i>Lobipes lobatus</i>	D
Parasitic jaeger	<i>Stercorarius parasiticus</i>	R
Herring gull	<i>Larus argentatus</i>	R
California gull	<i>Larus californicus</i>	R
Ring-billed gull	<i>Larus delawarensis</i>	D
Black-headed gull	<i>Larus ridibundus</i>	R
Franklin's gull	<i>Larus pipixcan</i>	D
Bonaparte's gull	<i>Larus philadelphia</i>	R
Forster's tern	<i>Sterna forsteri</i>	D
Common tern	<i>Sterna hirundo</i>	R
Least (Least interior) tern	<i>Sterna albifrons</i>	R
Black tern**	<i>Chlidonias niger</i>	D
COLUMBIFORMES		
Mourning dove*	<i>Zenaidura macroura</i>	D
Rock dove*	<i>Columba livia</i>	D
CUCULIFORMES		
Yellow-billed cuckoo**	<i>Coccyzus americanus</i>	D
Black-billed cuckoo**	<i>Coccyzus erythrophthalmus</i>	D
STRIGIFORMES		
Barn owl**	<i>Tyto alba</i>	D
Screech owl**	<i>Otus asio</i>	D



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Great horned owl*	<i>Bubo virginianus</i>	D
Snowy owl	<i>Nyctea scandiaca</i>	R
Burrowing owl*	<i>Speotyto cunicularia</i>	D
Barred owl	<i>Strix varia</i>	R
Long-eared owl	<i>Asio otus</i>	R
Short-eared owl**	<i>Asio flammeus</i>	D
Saw-whet owl**	<i>Aegolius acadicus</i>	D
CAPRIMULGIFORMES		
Common poor-will**	<i>Phalaenoptilus nuttallii</i>	D
Common nighthawk**	<i>Chordeiles minor</i>	D
APODIFORMES		
Chimney swift**	<i>Chaetura pelagica</i>	D
White-throated swift**	<i>Aeronautes saxatalis</i>	D
Broad-tailed hummingbird	<i>Selasphorus platycercus</i>	R
Rufous hummingbird	<i>Selasphorus rufus</i>	R
CORACIIFORMES		
Belted kingfisher**	<i>Megaceryle alcyon</i>	D
PICIFORMES		
Common flicker*	<i>Colaptes auratus</i>	D
Red-bellied woodpecker	<i>Centurus carolinus</i>	R
Red-headed woodpecker*	<i>Melanerpes erythrocephalus</i>	D
Lewis' woodpecker**	<i>Asyndesmus lewis</i>	D
Yellow-bellied sapsucker	<i>Sphyrapicus varius</i>	R
Hairy woodpecker**	<i>Dendrocopos villosus</i>	D
Downy woodpecker**	<i>Dendrocopos pubescens</i>	D
PASSERIFORMES		
Eastern kingbird*	<i>Tyrannus tyrannus</i>	D
Western kingbird*	<i>Tyrannus verticalis</i>	D
Cassin's kingbird	<i>Tyrannus vociferans</i>	R
Scissor-tailed flycatcher	<i>Muscivora forfic</i>	R
Great crested flycatcher**	<i>Myiarchus crinitus</i>	D
Eastern phoebe**	<i>Sayornis phoebe</i>	D
Say's phoebe**	<i>Sayornis saya</i>	D



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Black phoebe	<i>Sayornis nigricans</i>	D
Willow flycatcher**	<i>Empidonax traillii</i>	D
Least flycatcher	<i>Empidonax minimus</i>	D
Hammond's flycatcher	<i>Empidonax hammondii</i>	R
Western flycatcher	<i>Empidonax difficilis</i>	R
Eastern pewee**	<i>Contopus virens</i>	D
Western pewee*	<i>Contopus sordidulus</i>	D
Olive-sided flycatcher	<i>Nuttalornis borealis</i>	R
Horned lark*	<i>Eremophila alpestris</i>	D
Violet-green swallow**	<i>Tachycineta thalassina</i>	D
Tree swallow**	<i>Iridoprocne bicolor</i>	D
Bank swallow*	<i>Riparia riparia</i>	D
Rough-winged swallow**	<i>Stelgidopteryx ruficollis</i>	D
Barn swallow*	<i>Hirundo rustica</i>	D
Cliff swallow*	<i>Petrochelidon pyrrhonota</i>	D
Purple martin	<i>Progne subis</i>	R
Gray jay	<i>Perisoreus canadensis</i>	R
Blue jay**	<i>Cyanocitta cristata</i>	R
Stellar's jay	<i>Cyanocitta stelleri</i>	R
Black-billed magpie*	<i>Pica pica</i>	D
American crow*	<i>Corvus branchyrhynchos</i>	D
Pinyon jay**	<i>Gymnorhinus cyanocephalus</i>	D
Clark's nutcracker	<i>Nucifraga columbiana</i>	R
Black-capped chickadee**	<i>Parus atricapillus</i>	D
Tufted titmouse	<i>Parus bicolor</i>	R
White-breasted nuthatch**	<i>Sitta carolinensis</i>	D
Red-breasted nuthatch**	<i>Sitta canadensis</i>	D
Pygmy nuthatch**	<i>Sitta pygmaea</i>	D
Brown creeper**	<i>Certha familiaris</i>	D
Dipper	<i>Cinclus mexicanus</i>	R
Northern house wren**	<i>Troglodytes aedon</i>	D
Winter wren	<i>Troglodytes troglodytes</i>	R
Bewick's wren	<i>Thryomanes bewickii</i>	R



BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Carolina wren	<i>Thryothorus ludovicianus</i>	R
Marsh wren**	<i>Telmatodytes palustris</i>	D
Canyon wren	<i>Catherpes mexicanus</i>	R
Rock wren**	<i>Salpinctes obsoletus</i>	D
Mockingbird	<i>Mimus polyglottos</i>	R
Gray catbird**	<i>Dumetella carolinensis</i>	D
Brown thrasher**	<i>Toxostoma rufum</i>	D
Sage thrasher	<i>Orescoptes montanus</i>	R
American robin*	<i>Turdus migratorius</i>	D
Wood thrush	<i>Hylocichla mustelina</i>	D
Hermit thrush	<i>Hylocichla guttata</i>	D
Swainson's thrush	<i>Hylocichla ustalata</i>	D
Gray-cheeked thrush	<i>Hylocichla ustalata</i>	D
Veery	<i>Hylocichla fuscenscens</i>	D
Eastern bluebird	<i>Sialia sialis</i>	R
Mountain bluebird**	<i>Sialia currucoides</i>	D
Townsend's solitaire**	<i>Myadestes townsendi</i>	D
Blue-gray gnatcatcher	<i>Poliophtila caerulea</i>	R
Golden-crowned kinglet	<i>Rugulus satrapa</i>	R
Ruby-crowned kinglet	<i>Rugulus calendula</i>	D
Water pipit	<i>Anthus spinoletta</i>	D
Bohemian waxwing	<i>Bombycilla garrulus</i>	D
Ceder waxwing**	<i>Bombycilla cedrorum</i>	D
Northern shrike	<i>Lanius excubitor</i>	D
Loggerhead shrike**	<i>Lanius ludovicianus</i>	D
European starling*	<i>Sturnus vulgaris</i>	D
White-eyed vireo	<i>Vireo griseus</i>	R
Bell's vireo**	<i>Vireo bellii</i>	D
Yellow-throated vireo	<i>Vireo flavifrons</i>	R
Solitary vireo	<i>Vireo solitarius</i>	R
Red-eyed vireo**	<i>Vireo olivaceus</i>	D
Philadelphia vireo	<i>Vireo philadelphicus</i>	R
Warbling vireo**	<i>Vireo gilvus</i>	D
Black and white warbler	<i>Mniotilta varia</i>	D
Prothonotary warbler	<i>Protonotaria citrea</i>	R
Tennessee warbler	<i>Vermivora peregrina</i>	D
Orange-crowned warbler	<i>Vermivora celata</i>	D



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Nashville warbler	<i>Vermivora ruficapilla</i>	D
Northern parula	<i>Parula americana</i>	R
Yellow warbler**	<i>Dendroica petechia</i>	D
Magnolia warbler	<i>Dendroica magnolia</i>	R
Cape May warbler	<i>Dendroica tigrina</i>	R
Yellow-rumped warbler	<i>Dendroica coronata</i>	
(Audubon race)**	<i>Dendroica coronata</i>	D
(Myrtle race)	<i>Dendroica coronata</i>	D
Townsend's warbler	<i>Dendroica townsendi</i>	R
Black-throated green warbler	<i>Dendroica virens</i>	R
Cerulean warbler	<i>Dendroica cerulea</i>	R
Blackburnian warbler	<i>Dendroica fusca</i>	R
Chestnut-sided warbler	<i>Dendroica pensylvanica</i>	R
Blackpoll warbler	<i>Dendroica striata</i>	D
Palm warbler	<i>Dendroica palmarum</i>	R
Ovenbird**	<i>Seiurus aurocapillus</i>	D
Northern waterthrush	<i>Seiurus noveboracensis</i>	D
PARULIDAE		
Mourning warbler	<i>Oporornis philadelphia</i>	R
MacCillivray's warbler	<i>Oporornis tolmiei</i>	R
Common yellowthroat**	<i>Geothlypis trichas</i>	D
Yellow-breasted chat**	<i>Icteria virens</i>	D
Hooded warbler	<i>Wilsonia citrina</i>	R
Wilson's warbler	<i>Wilsonia pusilla</i>	D
American redstart**	<i>Setophaga ruticilla</i>	D
House sparrow*	<i>Passer domesticus</i>	D
Bobolink**	<i>Dolichonyx oryzivorus</i>	D
Eastern meadowlark**	<i>Sturnella magna</i>	D
Western meadowlark*	<i>Sturnella neglecta</i>	D
Yellow-headed blackbird**	<i>Xanthocephalus xanthocephalus</i>	D
Red-winged blackbird*	<i>Agelaius phoeniceus</i>	D
Orchard oriole**	<i>Icterus spurius</i>	D
Northern (Bullock) oriole**	<i>Icterus galbula</i>	D
Rusty blackbird	<i>Euphagus carolinus</i>	R



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status ¹
Brewer's blackbird**	<i>Euphagus cyanocephalus</i>	D
Common grackle**	<i>Quiscalus quiscula</i>	D
Brown-headed cowbird**	<i>Molothrus ater</i>	D
Western tanager**	<i>Piranga ludoviciana</i>	D
Scarlet tanager	<i>Piranga olivacea</i>	R
Cardinal	<i>Richmondia cardinalis</i>	R
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>	R
Blue grosbeak**	<i>Guiraca caerulea</i>	D
Indigo bunting**	<i>Passerina cyanea</i>	D
Lazuli bunting**	<i>Passerina amoena</i>	D
Indigo x lazuli hybrid**	<i>P. cyanea x amoena</i>	D
FRINGILLIDAE		
Dickcissel	<i>Spiza americana</i>	R
Evening grosbeak	<i>Herperiphona vespertina</i>	D
Purple finch	<i>Carpodacus purpureus</i>	R
Cassin's finch	<i>Carpodacus cassinii</i>	R
House finch	<i>Carpodacus mexicanus</i>	D
Pine grosbeak	<i>Pinicola enucleator</i>	R
Gray-crowned rosy finch	<i>Leucosticte tephrocotis</i>	R
Common redpoll	<i>Acanthis flammea</i>	R
Pine siskin**	<i>Spinus pinus</i>	D
American goldfinch**	<i>Spinus tristis</i>	D
Red crossbill**	<i>Loxia curvirostra</i>	D
White-winged crossbill	<i>Loxia leucoptera</i>	R
Green-tailed towhee	<i>Chlorura chlorura</i>	R
Rufous-sided towhee**	<i>Pipilo erythrophthalmus</i>	D
Lark bunting**	<i>Calamospiza melanocoryx</i>	D
Savannah sparrow	<i>Passerculus sandwichensis</i>	D
Grasshopper sparrow	<i>Ammodramus savannarum</i>	D
Vesper sparrow**	<i>Pooecetes gramineus</i>	D
Lark sparrow*	<i>Chondestes grammacus</i>	D
Black-throated sparrow	<i>Amphispiza bilineata</i>	R
Dark-eyed junco	<i>Junco hyemalis</i>	



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BIRD SPECIES LIST		
Common Name	Scientific Name	Status¹
(White-winged race)**	<i>Junco hyemalis</i>	D
(Slate-colored race)	<i>Junco hyemalis</i>	D
(Oregon race)	<i>Junco hyemalis</i>	D
(Gray-headed race)	<i>Junco hyemalis</i>	D
Tree sparrow	<i>Spizella arborea</i>	D
Chipping sparrow**	<i>Spizella passerina</i>	D
Clay-colored sparrow**	<i>Spizella pallida</i>	D
Brewer's sparrow**	<i>Spizella breweri</i>	D
Field sparrow	<i>Spizella pusilla</i>	R
Harris' sparrow	<i>Zonotrichia querula</i>	R
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	D
White-throated sparrow	<i>Zonotrichia albicollis</i>	R
Fox sparrow	<i>Passerella iliaca</i>	R
Lincoln's sparrow	<i>Melospiza lincolnii</i>	D
Swamp sparrow	<i>Melospiza georgiana</i>	R
Song sparrow	<i>Melospiza melodia</i>	D
McCown's longspur**	<i>Rhynchophanes mccownii</i>	D
Lapland longspur	<i>Calcarius lapponicus</i>	D
Chestnut-collared longspur**	<i>Calcarius ornatus</i>	D
Snow bunting	<i>Plectyrophenax nivalis</i>	D

¹ Documentation:

- D Documented in the 1982 study.
- E Expected to occur - historical or recent evidence.
- R Reported by knowledgeable individual(s).

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Attachment 3.5-D – Amphibian and Reptile Species List



SIoux/DAWES COUNTY HERP LIST

Common Name	Scientific Name	Status
AMPHIBIANS		
Eastern tiger salamander	<i>Ambystoma tigrinum</i>	
Great plains toad	<i>Bufo cognatus</i>	
Woodhouse's toad	<i>Bufo woodhousii</i>	
Western chorus frog	<i>Pseudacris triseriata</i>	
Plains spadefoot	<i>Spea bombifrons</i>	
Northern leopard frog	<i>Rana pipiens</i>	
Bullfrog	<i>Rana catesbeiana</i>	
REPTILES		
Lesser earless lizard	<i>Holbrookia maculata</i>	
Short-horned lizard	<i>Phrynosoma hernandesi</i>	
Prairie lizard	<i>Sceloporus undulatus</i>	
Many-lined skink	<i>Eumeces multivirgatus</i>	R
Bullsnake	<i>Pituophis catenifer</i>	
Yellow-bellied racer	<i>Coluber constrictor</i>	
Plains garter snake	<i>Thamnophis radix</i>	
Red-sided/Common garter snake	<i>Thamnophis sirtalis</i>	
Plains hognose snake	<i>Heterodon nasicus</i>	
Prairie rattlesnake	<i>Crotalus viridis</i>	
W. terrestrial garter snake	<i>Thamnophis elegans</i>	R
Plains milk snake	<i>Lampropeltis triangulum</i>	R
Northern water snake	<i>Nerodia sipedon</i>	R
Common snapping turtle	<i>Chelydra serpentina</i>	
Painted turtle	<i>Chrysemys picta</i>	

R: RARE but possible

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Attachment 3.5-E – Fish Species List



FISH SPECIES LIST		
Family/Common Name	Scientific Name	Status¹
CATOSTOMIDAE		
River sucker	<i>Carpiodes carpio</i>	R
Longnose sucker	<i>Catostomus catostomus</i>	R
White sucker	<i>Catostomus commersoni</i>	D
CENTRARCHIDAE		
Green sunfish	<i>Lepomis cyanellus</i>	D
Bluegill	<i>Lepomis macrochirus</i>	D
Smallmouth bass	<i>Micropterus dolomieu</i>	R
Largemouth bass	<i>Micropterus salmoides</i>	D
Rock Bass	<i>Amblo plites rupestrinis</i>	D
Black crappie	<i>Pomoxis nigromaculatus</i>	D
CYPRINIDAE		
Carp	<i>Cyprinus carpio</i>	D
Plains minnow	<i>Hybognathus placitus</i>	D
Flathead chub	<i>Hybopsis gracilis</i>	R
Common shiner	<i>Luxilus cornutus</i>	D
Golden shiner	<i>Notemigonus crysoleucas</i>	D
Red shiner	<i>Notropis lutrensis</i>	R
Sand shiner	<i>Notropis stramineus</i>	D
Flathead minnow	<i>Pimephales promelas</i>	D
Longnose dace	<i>Rhinichthys cataractae</i>	D
Creek chub	<i>Semotilus atromaculatus</i>	D
CYPRINODONTIDAE		
Plains topminnow	<i>Fundulus sciadicus</i>	D
ESOCIDAE		
Northern pike	<i>Esox lucius</i>	R
HIODONTIDAE		
Goldeye	<i>Hiodon alosoides</i>	R
ICTALURIDAE		
Black bullhead	<i>Ictalurus melas</i>	D
Channel catfish	<i>Ictalurus punctatus</i>	R
Stonecat	<i>Noturus flavus</i>	R
PERCICHTHYIDAE		
White bass	<i>Morone chrysops</i>	D
PERCIDAE		



Environmental Report
North Trend Expansion Area

FISH SPECIES LIST		
Family/Common Name	Scientific Name	Status ¹
Walleye	<i>Stizostedion vitreum</i>	D
SALMONIDAE		
Rainbow trout	<i>Oncorhynchus mykiss</i>	D
Brown trout	<i>Salmo trutta</i>	D
Brook trout	<i>Salvelinus fontinalis</i>	D

Notes

¹ Documentation:

- D Documented in the course of the present study.
- E Expected to occur - historical or recent evidence.
- R Reported by knowledgeable individual(s).

CROW BUTTE RESOURCES, INC.

**Environmental Report
North Trend Expansion Area**



Attachment 3.5-F – Macroinvertebrate Species and Relative Abundance

CROW BUTTE RESOURCES, INC.

Environmental Report North Trend Expansion Area



BENTHIC MACROINVERTEBRATE COMMUNITY VALUES IN APRIL 1982 AND SEPTEMBER 1996

Sampling Locations Parameter/ Sample Sampling Method**	Streams																Impoundments										
	E-1	E-2	E-3	S-1	S-2	S-2	S-3	S-4	WC-1	WC-2	W-1	W-2	W-1a*	B-1*	C-1*	SL-1*	1	2	3	4	5	6	7	8	9	10*	11*
Density (Org./m ²)	13090	1745	3399	706	5729	897	5896	3062	5435	428	352	5818	786	560	1711	840	15	7237	8972	4792	4731	138	980	276	10242	710	689
Diversity ()	0.49	1.0	1.02	3.18	0.19	1.34	1.15	1.84	1.33	1.16	1.03	1.14	2.10	2.55	3.37	2.95	0	0.93	0.93	1.21	1.06	0	1.60	0	1.69	2.19	2.09
No. of Taxa	11	9	7	22	5	8	16	9	8	4	3	7	10	11	21	19	1	8	8	9	6	1	7	1	13	9	8
Community Structure (% Occurrence)																											
Taxon																											
<i>Chironomidae</i>	0.9	17.5	82.0	10.7	98.1	18.0	14.1	45.5	71.8	42.9	47.8	72.4	9.6	5.8	0.6	0.0	0.0	3.8	19.2	12.3	87.7	48.4	100	37.4	33.6	0.0	3.1
<i>Oligochaeta</i>	0.0	1.8	5.0	3.6	0.8	3.2	0.2	36.0	14.4	50.0	47.8	19.7	1.9	0.0	2.6	0.0	100	89.8	78.3	81.3	3.6	39.1	0.0	39.5	19.1	0.0	0.0
<i>Ephemeroptera</i>	0.0	0.0	0.0	20.3	0.0	65.2	6.8	0.0	0.0	0.0	0.0	7.9	6.8	36.5	10.7	6.4	0.0	0.0	0.0	0.9	0.0	4.7	0.0	16.6	7.0	4.5	1.6
<i>Trichoptera</i>	0.0	0.0	0.5	37.1	0.5	0.4	0.5	0.0	0.0	0.0	4.3	0.5	79.5	5.8	0.6	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0
<i>Ceratopogonidae</i>	94.5	56.1	0.0	0.5	0.0	0.4	0.2	1.0	8.7	7.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.7	0.6	0.0	0.0	0.0	0.0	4.2	14.5	0.0	0.0
<i>Simuliidae</i>	0.0	0.0	0.0	8.6	0.0	11.6	76.8	0.0	0.0	0.0	0.0	0.0	0.0	28.8	1.9	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0

* September 24, 1996 Sample Stations

** P = Ponar Dredge Sample; S = Surber Sample; H = HESS Sample; D = Dip Net Sample

Org./m² Organisms Per Square Meter

ATTACHMENT 4.12.2(A)

**Table 4.12.2(A)- 1: Site Specific Information
Crow Butte Project**

NORTH TREND SATELLITE

PARAMETER	VALUE
Average ore quality, U ₃ O ₈ , in ore body	0.27 percent
Ore radon activity, assuming equilibrium with U-238	761 pCi/g
Operating days per year (plant factor)	365 days
Dimensions of ore body	
Area per year to be mined	20 acres
Average thickness of body	5 ft
Average screened interval	15.1 ft
Average production flow rate	4500 gpm
Formation porosity	29 percent
Process recovery	95 percent
Leaching efficiency	60 percent
Rock density	1.89 g/cm ³
Restoration flow rate	500 gpm
Restoration Residence time	35 days
Production cell parameters	
Residence time	7 days
Type of cell pattern	variable
Average cell area	10,000 ft ²
Average cell flow rate	121 lpm
Source stack description (Main)	
Stack height	15.9 m
Stack diameter	0.30 m
Stack velocity	11 m/sec
Source stack description (Satellite)	
Stack height	10 m
Stack diameter	0.2
Stack velocity	10 m/sec

ft/ft² = feet/square feet
g/cm³ = grams per cubic centimeter
gpm = gallons per minute
lpm = liters per minute
m = meter
m²/sce = meters squared per second
pCi/g = picoCuries per gram

**Table 4.12.2(A)- 2: Source Coordinates
North Trend Satellite**

Source	East (km)	North (km)	Rn-222 (Curies)
1. Plant Vent	0.00	0.00	4300
2. Satellite Plant Vent	-5.30	9.60	342
3. MU-2-4 (restoration)	-0.30	0.16	350
4. MU-5	0.0	0.74	253
5. MU-6&8	1.92	-1.20	506
6. MU 7&9	0.00	-0.74	506
7. North Trend Wellfield	-5.30	9.60	1320

Sources 2 and 7 are from the proposed North Trend Satellite Facility operating at 4500 gpm using upflow IX columns and 500 gpm restoration flow using downflow IX and reverse osmosis. Resin from the North Trend Satellite is transferred to the Crow Butte processing facility for elution and precipitation.

All other sources are from the existing Crow Butte processing facility operating at 5000 gpm production flow using downflow IX columns and a 1000 gpm restoration flow using downflow IX and reverse osmosis.

Table 4.12.2(A)- 3: Individual Receptor Location Data

Location	X (km)	Y (km)	Distance (km)
1. R1	-1.21	-0.44	1.29
2. R2	-1.95	1.95	2.76
3. R3	-1.89	2.71	3.30
4. R4	-3.34	2.80	4.36
5. R5	-3.57	3.99	5.35
6. CRAWFORD	-4.39	4.45	6.25
7. R7	-1.99	3.96	4.43
8. R8	-1.99	3.60	4.11
9. R9	-1.57	3.23	3.59
10. R10	-1.16	2.80	3.03
11. R11	-1.78	2.77	3.29
12. R12	-0.30	2.35	2.35
13. R13	0.03	1.49	1.49
14. R14	0.51	0.98	1.10
15. R15	0.52	0.34	0.62
16. R16	1.31	0.30	1.34
17. R17	1.31	-0.34	1.35
18. EHLERS	0.73	-0.06	0.73
19. GIBBONS	0.73	0.73	1.03
20. STETSON	-0.46	1.22	1.30
21. KNODE	-1.89	2.68	3.28
22. BROTT	-1.37	1.34	1.92
23. SP 1	0.73	0.15	0.75
24. SP 2	0.67	0.58	0.89
25. SP 3	0.67	0.91	1.13
26. McDOWELL	-2.16	4.36	4.87
27. TAGGART	-1.89	4.45	4.83
28. FRANEY	-0.98	4.76	4.86
29. BUNCH	1.01	4.27	4.39
30. DYER	-2.44	0.55	2.50
31. NT-1	-3.97	11.33	12.01
32. NT-2	-4.12	8.93	9.83
33. NT-3	-4.75	7.87	9.19
34. NT-4	-5.82	6.69	8.87
35. NT-5	-4.61	6.76	8.18
36. NT-6	-7.20	11.65	13.70
37. NT-7	-8.25	9.86	12.86
38. NT-8	-0.44	2.76	2.79

**Table 4.12.2(A)- 4: Calculation of Annual Radon Emissions
Crow Butte Project - North Trend Satellite Area**

- 1) To calculate radon release from leaching, assuming that U-238 is in equilibrium with all its decay products:

$$\text{Ci/m}^3 = (761 \text{ pCi/g ore}) \times (1.89 \text{ g/cm}^3) \times 0.2 \times (0.71/0.29) \times 10^{-6} = 7.04 \times 10^{-4} \text{ Ci/m}^3$$

Where: 0.2 = Emanating Power
 0.71 = 1 - Porosity
 0.29 = Porosity
 1.89 = Rock Density

The yearly release is then:

$$7.04 \times 10^{-4} \text{ Ci/m}^3 \times 17034 \text{ lpm} \times (0.72) \times 365 \text{ d/yr} \times 1.44 = 4538 \text{ Ci/yr}$$

Where: 17034 = liters per minute (Production Rate)
 € = $1 - e^{-(\lambda t)}$
 € = $1 - e^{-(0.1812)(7d)}$
 € = $1 - e^{-(0.28)}$
 € = 0.72
 1.44 = constant
 365 = operating time

- 2) The radon release from start-up is given by:

$$7.04 \times 10^{-4} \text{ Ci/m}^3 \times 20 \text{ acres} \times 4074 \text{ m}^2/\text{acre} \times 1.52 \text{ m} \times 0.29 = 25 \text{ Ci/yr}$$

Where: 4074 = m²/acre
 1.52 = Thickness of orebody in meters
 0.29 = Porosity

The total release of radon from the start-up solution and production lixiviant solution is:

Start-up solution	25 Ci/yr
Production	<u>4538</u> Ci/yr
	4563 Ci/yr

- 3) The radon release from restoration is given by:

$$7.04 \times 10^{-4} \text{ Ci/m}^3 \times 1893 \text{ lpm} \times 365 \text{ d/yr} \times (0.99) \times 1.44 = 693 \text{ Ci/yr}$$

$$+ 25 \text{ (start-up)} = 719 \text{ Ci/yr}$$

Where: 1893 = Restoration flow in liters per minute
 € = $1 - e^{-(\lambda t)}$

35	=	Restoration Residence time (t) in days
€	=	$1 - e^{-(0.181)(35)}$
€	=	0.99
1.44	=	constant

The total release from this in-situ satellite mining operation is then:

Production (includes start-up)	4563	
Restoration (Includes Start-up)	719	
		5282 Ci/yr

4) Actual Radon Release to the Environment

The 4500 gpm of production flow at the North Trend Satellite being processed by pressurized downflow ion exchange columns will release only a small fraction of the contained radon to the environment. Approximately 10 percent of the contained radon will be released during resin transfer and venting. It is also expected that 25 percent of the radon will be released in the wellfield. This releases is:

$$\text{Wellfield Release} = 4563 \times 0.25 = 1140 \text{ Ci/yr}$$

The remainder of the radon will go to the process plant where a conservative estimate of 10 percent of the radon is released via the plant vent. The estimated radon released is:

$$4563 \text{ Ci/yr} - 1140 \text{ Ci/yr (Wellfield)} = 3423 \text{ Ci/yr}$$

$$3423 \text{ Ci/yr} \times 0.1 \text{ (plant loss)} = 342 \text{ Ci/yr released from plant vent}$$

The radon released during production is 1140 Ci/yr from the Wellfield and 342 Ci/yr from the plant vent for a total estimated release of 1482 Ci/yr.

During restoration, 500 gpm of recovered water will be processed by pressurized downflow ion exchange (IX) columns. After IX treatment, 200 gpm will be treated by reverse osmosis (RO). Only a small fraction of the contained radon will be released during ion exchange. The estimated release of the source term of 719 Ci of radon/yr (including start-up) is as follows:

- 25 percent of the 719 Ci/yr will be released in the Wellfield = 180 Ci/yr
- Assuming annual release from startup, production, and restoration, the total wellfield release rate is approximately 1140 Ci/yr + 180 Ci/yr = 1320 Ci/yr

Sources for the main plant area were determined in a similar manner.

Table 4.12.2(A)- 5: Miscellaneous Data

Fraction of year during which cattle graze locally	Est. 67percent
Fraction of cattle feed obtained by grazing	Est. 90 percent
Fraction of stored cattle feed grown locally	Est. 10 percent
Acreage required to graze 1 animal unit (450 kg) for one month (AUM)	3.5 ha
Length of growing season	4 mo/yr
Fraction of locally produced vegetables consumed locally	Est. 100 percent
Fraction of locally produced meat consumed locally	Est. 10 percent
Fraction of locally produced milk consumed locally	Est. 100 percent

Estimates based on personal communication with the Sioux County, Nebraska Agricultural Extension Educator located in Harrison, Nebraska (Ms. Jenny Nixon).

AUM = animal units per month

ha = hectares

kg = kilogram

mo/yr = months per year

ATTACHMENT 5.3(A)

Crow Butte Commercial License Area

Mine Units 1 through 9

Baseline and NDEQ Restoration Goals

Table 5.3(A)-1: Baseline and Restoration Values for Mine Unit 1

Parameter	Groundwater Standard	MU-1 Baseline (Primary Standard)	MU-1 Standard Deviation	MU-1 NDEQ Restoration Value
Ammonium (mg/l)	10.0	<0.372		10.0
Arsenic (mg/l)	0.05	<0.00214		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.01	<0.00644		0.005 ¹
Chloride (mg/l)	250.0	203.9	38	250.0
Copper (mg/l)	1.0	<0.017		1.0
Fluoride (mg/l)	4.0	0.686	0.04	4.0
Iron (mg/l)	0.3	<0.0441		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.011		0.05
Molybdenum (mg/l)	1.0	<0.0689		1.0
Nickel (mg/l)	0.15	<0.0340		0.15
Nitrate (mg/l)	10.0	<0.050		10.0
Lead (mg/l)	0.05	0.0315		0.05
Radium (pCi/L)	5.0	229.7	177.1	584.0
Selenium (mg/l)	0.01	<0.00323		0.05
Sodium (mg/l)	N/A	412	19.2	4120
Sulfate (mg/l)	250.0	356.2	9.4	375
Uranium (mg/l)	5.0	0.0922	0.089	5.0
Vanadium (mg/l)	0.2	<0.0663		0.2
Zinc (mg/l)	5.0	<0.036		5.0
pH (Std. Units)	6.5 - 8.5	8.46	0.2	6.5 – 8.5
Calcium (mg/l)	N/A	12.5	3.2	125.0
Total Carbonate (mg/l)	N/A	351	31.1	585
Potassium (mg/l)	N/A	12.5	1.5	125.0
Magnesium (mg/l)	N/A	3.2	0.8	32.0
TDS (mg/l)	N/A	1170.2	47.6	1170.2

¹ Standard for Cadmium lowered in modification to UIC permit dated March 9, 2001 following NDEQ approval of Mine Unit 1 restoration.

Table 5.3(A)-2: Baseline and Restoration Values for Mine Unit 2

Parameter	Groundwater Standard	MU-2 Baseline (Primary Standard)	MU-2 Standard Deviation	MU-2 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.37	0.07	10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.007		0.005
Chloride (mg/l)	250.0	208.6	30.8	250.0
Copper (mg/l)	1.0	<0.013		1.0
Fluoride (mg/l)	4.0	0.67	0.04	4.0
Iron (mg/l)	0.3	<0.045		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.073		1.0
Nickel (mg/l)	0.15	<0.037		0.15
Nitrate (mg/l)	10.0	<0.039		10.0
Lead (mg/l)	0.05	<0.035		0.05
Radium (pCi/L)	5.0	234.5	411.8	1058.0
Selenium (mg/l)	0.05	<0.001		0.05
Sodium (mg/l)	N/A	410.8	18.2	4108
Sulfate (mg/l)	250.0	348.2	10.3	369.0
Uranium (mg/l)	5.0	0.046	0.037	5.0
Vanadium (mg/l)	0.2	<0.07		0.2
Zinc (mg/l)	5.0	<0.026		5.0
pH (Std. Units)	6.5 - 8.5	8.32	0.2	6.5 – 8.5
Calcium (mg/l)	N/A	13.4	2.4	134.0
Total Carbonate (mg/l)	N/A	366.9	13.3	585.0
Potassium (mg/l)	N/A	12.6	2.5	126.0
Magnesium (mg/l)	N/A	3.5	0.4	35.0
TDS (mg/l)	N/A	1170.4	41	1170.4

Table 5.3(A)-3: Baseline and Restoration Values for Mine Unit 3

Parameter	Groundwater Standard	MU-3 Baseline (Primary Standard)	MU-3 Standard Deviation	MU-3 NDEQ Restoration Value
Ammonium (mg/l)	10.0	<0.329		10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	197.6	16.7	250.0
Copper (mg/l)	1.0	<0.0108		1.0
Fluoride (mg/l)	4.0	0.719	0.05	4.0
Iron (mg/l)	0.3	<0.05		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.1		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.0728		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	165	222.5	611.0
Selenium (mg/l)	0.05	<0.00115		0.05
Sodium (mg/l)	N/A	428	27.6	4280
Sulfate (mg/l)	250.0	377.0	13.4	404.0
Uranium (mg/l)	5.0	0.115	0.158	5.0
Vanadium (mg/l)	0.2	<0.1		0.2
Zinc (mg/l)	5.0	<0.0131		5.0
pH (Std. Units)	6.5 - 8.5	8.37	0.3	6.5 – 8.5
Calcium (mg/l)	N/A	13.3	3.1	133.0
Total Carbonate (mg/l)	N/A	358.7	24.8	592.0
Potassium (mg/l)	N/A	13.9	4.0	139.0
Magnesium (mg/l)	N/A	3.5	0.9	35.0
TDS (mg/l)	N/A	1183.0	47.4	1183.0

Table 5.3(A)-4: Baseline and Restoration Values for Mine Unit 4

Parameter	Groundwater Standard	MU-4 Baseline (Primary Standard)	MU-4 Standard Deviation	MU-4 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.288	0.08	10.0
Arsenic (mg/l)	0.05	<0.00209		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	217.5	34.9	250.0
Copper (mg/l)	1.0	<0.0114		1.0
Fluoride (mg/l)	4.0	0.745	0.05	4.0
Iron (mg/l)	0.3	<0.0504		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.1		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.114		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	154.3	171.5	496.0
Selenium (mg/l)	0.05	<0.00244		0.05
Sodium (mg/l)	N/A	416.6	27.8	4166
Sulfate (mg/l)	250.0	337.2	19.3	375.0
Uranium (mg/l)	5.0	<0.122		5.0
Vanadium (mg/l)	0.2	<0.0984		0.2
Zinc (mg/l)	5.0	<0.0143		5.0
pH (Std. Units)	6.5 - 8.5	8.68	0.3	6.5 – 9.28
Calcium (mg/l)	N/A	11.2	2.9	112.0
Total Carbonate (mg/l)	N/A	374.4	28	610.0
Potassium (mg/l)	N/A	16.7	4.7	167.0
Magnesium (mg/l)	N/A	2.8	0.8	28.0
TDS (mg/l)	N/A	1221.1	73.5	1221.1

Table 5.3(A)-5: Baseline and Restoration Values for Mine Unit 5

Parameter	Groundwater Standard	MU-5 Baseline (Primary Standard)	MU-5 Standard Deviation	MU-5 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.28	0.05	10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.10		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	191.9	7.9	250.0
Copper (mg/l)	1.0	<0.01		1.0
Fluoride (mg/l)	4.0	0.64	0.07	4.0
Iron (mg/l)	0.3	<0.05		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.10		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.1		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	166.0	184.6	535.0
Selenium (mg/l)	0.05	<0.002		0.05
Sodium (mg/l)	N/A	397.6	14.4	3976
Sulfate (mg/l)	250.0	364.5	10.5	385.0
Uranium (mg/l)	5.0	0.072	0.056	5.0
Vanadium (mg/l)	0.2	<0.10		0.2
Zinc (mg/l)	5.0	<0.02		5.0
pH (Std. Units)	6.5 - 8.5	8.5	0.1	6.5 – 8.5
Calcium (mg/l)	N/A	12.6	1.8	126.0
Total Carbonate (mg/l)	N/A	372	13.0	590.0
Potassium (mg/l)	N/A	11.5	1.2	115.0
Magnesium (mg/l)	N/A	3.4	0.4	34.0
TDS (mg/l)	N/A	1179.5	22.5	1202.0

Table 5.3(A)-6: Baseline and Restoration Values for Mine Unit 6

Parameter	Groundwater Standard	MU-6 Baseline (Primary Standard)	MU-6 Standard Deviation	MU-6 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.32	0.05	10.0
Arsenic (mg/l)	0.05	0.002		0.05
Barium (mg/l)	1.0	0.100		1.0
Cadmium (mg/l)	0.005	0.009		0.005
Chloride (mg/l)	250.0	206	15.4	250.0
Copper (mg/l)	1.0	0.012		1.0
Fluoride (mg/l)	4.0	0.65	0.03	4.0
Iron (mg/l)	0.3	0.050		0.3
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.010		0.05
Molybdenum (mg/l)	1.0	0.102		1.0
Nickel (mg/l)	0.15	0.050		0.15
Nitrate (mg/l)	10.0	0.1		10.0
Lead (mg/l)	0.05	0.050		0.05
Radium (pCi/L)	5.0	80.6	121.9	325
Selenium (mg/l)	0.05	0.001		0.05
Sodium (mg/l)	N/A	400	12.8	4000
Sulfate (mg/l)	250.0	361	14.6	390
Uranium (mg/l)	5.0	0.133	0.212	5.0
Vanadium (mg/l)	0.2	0.098		0.2
Zinc (mg/l)	5.0	0.011		5.0
pH (Std. Units)	6.5 - 8.5	8.6	0.2	6.5 – 9.0
Calcium (mg/l)	N/A	12.8	2.3	128
Total Carbonate (mg/l)	N/A	367.1	22.9	596
Potassium (mg/l)	N/A	11.9	1.7	119
Magnesium (mg/l)	N/A	3.2	0.7	32
TDS (mg/l)	N/A	1192	28.1	1220

Table 5.3(A)-7: Baseline and Restoration Values for Mine Unit 7

Parameter	Groundwater Standard	MU-7 Baseline (Primary Standard)	MU-7 Standard Deviation	MU-7 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.42	0.08	10.0
Arsenic (mg/l)	0.05	0.001		0.05
Barium (mg/l)	1.0	0.10		1.0
Cadmium (mg/l)	0.005	0.007		0.005
Chloride (mg/l)	250.0	198	22.6	250.0
Copper (mg/l)	1.0	0.01		1.0
Fluoride (mg/l)	4.0	0.70	0.05	4.0
Iron (mg/l)	0.30	0.05		0.30
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.01		0.05
Molybdenum (mg/l)	1.00	0.10		1.00
Nickel (mg/l)	0.15	0.05		0.15
Nitrate (mg/l)	10.0	0.1		10.0
Lead (mg/l)	0.05	0.05		0.05
Radium (pCi/L)	5.0	142	148.0	438
Selenium (mg/l)	0.05	0.004		0.05
Sodium (mg/l)	N/A	387	21.6	3,870
Sulfate (mg/l)	250.0	346	20.1	386
Uranium (mg/l)	5.0	0.110	0.138	5.0
Vanadium (mg/l)	0.2	0.10		0.2
Zinc (mg/l)	5.0	0.01		5.0
pH (Std. Units)	6.5 - 8.5	8.6	0.3	6.5 – 9.2
Calcium (mg/l)	N/A	12.2	2.6	122
Total Carbonate (mg/l)	N/A	356		588
Potassium (mg/l)	N/A	12.9	3.0	129
Magnesium (mg/l)	N/A	3.2	0.7	32
TDS (mg/l)	N/A	1,176	40.7	1,217

Table 5.3(A)-8: Baseline and Restoration Values for Mine Unit 8

Parameter	Groundwater Standard	MU-8 Baseline (Primary Standard)	MU-8 Standard Deviation	MU-8 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.682	0.222	10.0
Arsenic (mg/l)	0.05	0.002	0.001	0.05
Barium (mg/l)	1.0	0.099	0.005	1.0
Cadmium (mg/l)	0.005	0.005		0.005
Chloride (mg/l)	250	196	53.8	250
Copper (mg/l)	1.0	0.01		1.0
Fluoride (mg/l)	4.0	0.638	0.048	4.0
Iron (mg/l)	0.30	0.135	0.086	0.30
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.01		0.05
Molybdenum (mg/l)	1.0	0.093	0.023	1.00
Nickel (mg/l)	0.15	0.049	0.003	0.15
Nitrate (mg/l)	10.0	0.2		10.0
Lead (mg/l)	0.05	0.049	0.003	0.05
Radium (pCi/L)	5.0	124.4	151.8	428
Selenium (mg/l)	0.05	0.004		0.05
Sodium (mg/l)	N/A	416.8	41.8	4,168
Sulfate (mg/l)	250	312	33	378
Uranium (mg/l)	5.0	0.188	0.140	5.0
Vanadium (mg/l)	0.2	0.127	0.122	0.2
Zinc (mg/l)	5.0	0.013	0.008	5.0
pH (Std. Units)	6.5 - 8.5	8.67	0.37	6.5 – 9.41
Calcium (mg/l)	N/A	12.3	3.5	123
Total Carbonate (mg/l)	N/A	377	15.6	569
Potassium (mg/l)	N/A	11.8	3.2	117.8
Magnesium (mg/l)	N/A	2.7	0.92	27.1
TDS (mg/l)	N/A	1,137	97.4	1,234

Table 5.3(A)-9: Baseline and Restoration Values for Mine Unit 9

Parameter	Groundwater Standard	MU-9 Baseline (Primary Standard)	MU-9 Standard Deviation	MU-9 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.40	0.05	10.0
Arsenic (mg/l)	0.05	0.001	0.000	0.05
Barium (mg/l)	1.0	0.1	0.0	1.0
Cadmium (mg/l)	0.005	0.005	0.000	0.005
Chloride (mg/l)	250	203	13	250
Copper (mg/l)	1.0	0.01	0.00	1.0
Fluoride (mg/l)	4.0	0.8	0.0	4.0
Iron (mg/l)	0.3	0.04	0.01	0.3
Mercury (mg/l)	0.002	0.001	0.000	0.002
Manganese (mg/l)	0.05	0.01	0.00	0.05
Molybdenum (mg/l)	1.0	0.1	0.0	1.0
Nickel (mg/l)	0.15	0.05	0.00	0.15
Nitrate (mg/l)	10.0	0.06	0.01	10.0
Lead (mg/l)	0.05	0.05	0.00	0.05
Radium (pCi/L)	5.0	164	238	640
Selenium (mg/l)	0.05	0.003	0.001	0.05
Sodium (mg/l)	N/A	380	11	3,800
Sulfate (mg/l)	250	320	15	350
Uranium (mg/l)	5.0	0.1	0.24	5.0
Vanadium (mg/l)	0.2	0.1	0.0	0.2
Zinc (mg/l)	5.0	0.01	0.00	5.0
pH (Std. Units)	6.5 - 8.5	8.35	0.30	6.5 – 9.41
Calcium (mg/l)	N/A	13.6	4.6	136
Total Carbonate (mg/l)	N/A	383	14	595
Potassium (mg/l)	N/A	13.9	3.0	139
Magnesium (mg/l)	N/A	3.5	1.2	35.0
TDS (mg/l)	N/A	1,152	38	1,190