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MEMORANDUM

TO: Cleveland Cliffs Iron Company, Collins Draw, R&D #3

FROM: Kathy Muller Ogle, Hydrologist WRK for K.O.

DATE: February 24, 1983

SUBJECT: Groundwater restoration and monitor well pumping at the Collins Draw Site

Summary: The groundwater restoration has been found inadequate at this site. It is recommended that Cleveland Cliffs perform additional restoration on selected areas and monitor for stabilization. Additional wells to the south southeast of the site should be drilled and sampled to ascertain if contamination remains outside the permit area.

I. Introduction

The Collins Draw site licensed to Cleveland Cliffs Iron Company under DEQ-LQD R&D #3 is a uranium in situ test site in Campbell County.

Two well feilds, A and B, were injected with an ammonia bicarbonate mining solution into an aquifer, the #1 sand. The solution was injected into the A field from April to November of 1980 with concentrations reaching 10,000 mg/ℓ of ammonia. The B field was mined from December, 1980 to July, 1981.

Restoration on the A field was attempted from November, 1980 to July, 1981. Techniques such as partial groundwater sweep, ion exchange, reverse osmosis and air stripping were used separately for varying periods of time on the A field. Some restoration data is presented for this field.

Restoration on the B field is not clearly documentated. A groundwater sweep was apparently used from July, 1981 to January, 1982 and perhaps longer. It is not clear exactly what restoration technologies were used on the B field nor over what length of time they were applied. Only limited groundwater restoration data can be found for this field.

Cleveland Cliffs is requesting that DEQ-LQD find their groundwater restoration at the site adequate to meet the minimum standards for bond release.

II. Discussion

Four areas of concern are discussed in this memo. Those areas are: the adequacy of restoration, the use of best practicable technology, the stabilization period following restoration, and the pumping of monitor wells.

A. Adequacy of Restoration

Before the adequacy of restoration can be determined the standards must be established. Table 1 summarizes the premining baseline conditions and associated use suitability values.

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TABLE 1
PREMINING BASELINE AND USE
SUITABILITY VALUES

PARAMETER	BASELINE MEAN	BASELINE RANGE LOW	BASELINE RANGE HIGH	USE SUITABILITY VALUE
TDS (cal)	393	329	1011	
TDS (105°C)	414	320	1031	500.0
Cond. 77°F (µmoh/cm) (lab)	606	490	1410	
Cond. (µmoh/cm) (field)	1354	110	3100	
Na (calc)	104	83	242	
Na (obs)	106	82	272	n.s.
K	7	4	14	n.s.
Ca	27	10	61	n.s.
Mg	2.8	1	14	n.s.
SO4	159	114	598	250.0
Cl	14.6	10	32	250.0
CO3	8.1	0	36	n.s.
HCO3	142	85	171	n.s.
pH (lab) s.u.		7.5	8.7	6.5 - 9.0 s.u.
pH (field) s.u.		6.0	8.7	
NH_3 as N	0.18	<0.01	2.10	0.5
NO_3 as N	<0.05	<0.05	2.64	10.0
NO_2 as N	0.03	<0.01	0.13	1.0
Al	<0.05	<0.05	0.47	5.0 (n.s.)
As	<0.01	<0.01	0.02	0.05
Ba	<0.05	<0.05	<0.05	1.0
B	<1.0	<1.0	<1.0	0.75
Cd	<0.002	<0.002	<0.002	0.01
Cr	<0.01	<0.01	<0.01	0.05
Cu	<0.01	<0.01	<0.01	1.0
F	0.17	<0.026	0.30	1.4 - 2.4
Fe	0.73	<0.01	8.3	0.3
Pb	<0.05	<0.05	<0.05	0.05
Mn	0.02	<0.01	0.23	0.05
Hg	<0.001	<0.001	<0.001	0.002
Se	<0.01	<0.01	<0.01	0.01
Ni	<0.04	<0.04	<0.04	0.2 (n.s.)
Zn	<0.01	<0.01	0.11	5.0
Mo	<0.05	<0.05	<0.05	
V	<0.05	<0.05	<0.05	0.1
U	0.05	<0.001	0.79	5.0
Ra-226 (pCi/ℓ)	21.6	0.16	99.0	
T (field) (°C)	14	11.5	16.5	

*All values in mg/ℓ
*n.s. indicates no standard for Class I. If Class standard is listed, it is for either Agriculture or Livestock.

The goal of restoration is stated on p. RP-2.1-2.2 of license as "The target value for groundwater restoration will be baseline conditions." Also, under "Anticipated Restoration Results," on p. RP-2.19, Cleveland Cliffs predicted that, "In general, ammonia levels should be reduced to 200-400 ppm after step 1 of the restoration process; 30-75 ppm at the end of step 2; and approaching baseline conditions at the end of step 3. All other restoration parameters are expected to follow a similar proportioned decline."

The data from the well fields was reviewed to see if baseline conditions or at a minimum quality of use value had been achieved. It should be noted at this point that Cleveland Cliffs has argued that, although the in situ laws and rules and regulations were in place before the granting of their license, they do not have to comply with the quality of use standards since Water Quality's Chapter 8 (which contains the use suitability classes) was not promulgated at the time R&D #3 was issued. However, on p. RP-2.3, Cleveland Cliffs lists USPHS (1962) standards, most of which are at least as stringent as the Water Quality standards. Thus, it appears Cleveland Cliffs was well aware of the quality of use values that would apply to the site.

Each well field is evaluated individually below.

1. A - Well Field

Six wells were sampled for the full Guideline #8 analysis on March 16, 1983. That data was evaluated to see if groundwater restoration was achieved. Baseline or quality of use was achieved for many parameters. However, some parameters remain above the quality of use value and were identified as not meeting minimum restoration criteria. The parameters of concern are identified in table 2.

TABLE 2
PARAMETERS WHICH DO NOT MEET
QUALITY OF USE CRITERIA
FOR A WELL FIELD

PARAMETER (Units) (Quality of use Value)	WELL (Parameter Value)
pH (s.u.) (6.5 - 9.0 s.u.)	246 (9.20), 248 (9.48), 254 (9.33), 297 (9.09)
Ammonia (mg/ℓ) (0.5 mg/ℓ)	242 (28.0), 246 (79.8), 248 (36.4), 252 (26.6), 254 (26.6), 297 (15.4)
Arsenic (mg/ℓ) (0.05 mg/ℓ)	242 (0.143), 246 (0.496), 248 (0.496), 252 (0.160), 254 (0.412), 297 (0.302)
Selenium (mg/ℓ) (0.01 mg/ℓ)	242 (0.560), 246 (1.70), 248 (0.690), 252 (0.260), 254 (0.580), 297 (0.960)
U_3O_8 (mg/ℓ) (5.0 mg/ℓ)	246 (5.508)
V_2O_5 (mg/ℓ) (0.1 mg/ℓ)	246 (1.5)
Ra-226 (pCi/ℓ) (max 100 pCi/ℓ)	242 (237±8), 246 (198±8)

It can be observed from table 2 that as of March 10, 1982, groundwater restoration had not been achieved for some important parameters such as ammonia, arsenic, selenium, uranium, vanadium, and radium-226.

2. B - Well Field

No data of full Guideline #8 Water Quality analysis can be found for the B field which makes any evaluation of the restoration effort impossible. However, some results for a limited number of parameters on ten wells was hand delivered to myself on October 25, 1982. That data was evaluated for restoration of those specific parameters. Table 3 summarizes the results of that evaluation.

TABLE 3
PARAMETERS WHICH DO NOT MEET
QUALITY OF USE CRITERIA
FOR B WELL FIELD

PARAMETER (Units)	(Quality of use Value)	WELL (Parameter Value)
pH (s.u.)	(6.5 - 9.0 s.u.)	276 (9.33)
Ammonia (mg/ℓ)	(0.5 mg/ℓ)	190 (33.46), 232 (29.40), 237 (19.18), 260 (3.42), 276 (62.58), 277 (81.2), 285 (13.80), 231 (2.38), 233 (13.80), 234 (6.50)
Nitrite (mg/ℓ)	(1.0 mg/ℓ)	232 (1.230), 231 (1.150)
Arsenic (mg/ℓ)	(0.05 mg/ℓ)	276 (0.170)
Selenium (mg/ℓ)	(0.01 mg/ℓ)	190 (0.660), 232 (0.430), 237 (0.820), 260 (0.310), 276 (0.820), 277 (0.400), 285 (0.750), 231 (0.180), 233 (0.200), 234 (0.270)
Uranium (mg/ℓ) as U_3O_8	(5.0 mg/ℓ)	190 (7.20), 232 (8.38), 276 (5.50), 277 (5.60), 231 (10.50)
Vanadium (mg/ℓ) as V_2O_5	(0.1 mg/ℓ)	190 (0.59), 232 (0.59), 276 (1.32), 277 (0.40), 285 (0.29), 233 (0.29), 234 (0.44)

Following an October 25, 1982 meeting, Cleveland Cliffs began a program to identify and restore wells with high ammonia and metals.

In the October 25, 1982 meeting it was agreed that Cleveland Cliffs would further restore all wells with ammonia greater than 30 mg/ℓ to 30 mg/ℓ or less. (30 mg/ℓ is the lowest level they feel they can achieve, apparently because that is the approximate efficiency of their air-stripper.) It was also agreed that arsenic and selenium levels would be brought down as low as possible using best practicable technology. Based on this sampling, along with previous submitted data, wells for restoration sampling were to be selected. Each of these issues are discussed below.

3. Ammonia Restoration

Fourteen wells were identified during the inventory sampling as having ammonia levels above 30 mg/ℓ. Following remedial restoration, those wells were all brought below 30 mg/ℓ ammonia. These results are summarized in table 4.

TABLE 4
AMMONIA CONCENTRATIONS (mg/ℓ)

WELL	INITIAL SAMPLING	REMEDIAL RESTORATION SAMPLING	FINAL RESTORATION SAMPLING	WELL FIELD BASELINE RANGE MEAN	LOW	HIGH	QUALITY OF USE VALUE
232	50.3	2.20	1.68				
233	84.9	2.20	5.70				
237	91.0	4.0	2.38				
242	32.2	1.38	0.57				
243	44.8	<0.05	0.20				
246	69.6	5.95	4.50				
254	47.3	<0.05	0.85	0.11	not detected	0.42	0.5
265	47.6	<0.05	<0.05				
275	63.0	<0.05	<0.05				
278	36.4	0.15	<0.05				
282	35.0	<0.05	<0.05				
284	40.6	<0.05	<0.05				
285	77.0	3.3	0.85				
286	47.6	<0.05	<0.05				

It can be seen that all the 14 wells were brought below the agreed limit of 30 mg/ℓ for ammonia; 7 of the wells remain above the quality of use standard and high baseline value.

Of the twenty nine wells which did not require remedial action for ammonia contamination, it should be noted that on the basis of final sampling, seven excede the quality of use standard and the high values. Wells 190, 231, 247, 258, 261, and 262 showed increasing values of NH_3 during this time. Although some of the wells did increase substantially, none reached the 30 mg/ℓ threshold level.

No information on how, or if, Cleveland Cliffs identified wells with high metal values can be found. However, based on the initial sampling, tables 5 and 6 summarize the values for arsenic and selenium.

Table 5 (on following page) summarizes the wells with high arsenic levels.

TABLE 5
ARSENIC LEVELS (mg/ℓ)

WELL	INITIAL SAMPLING	REMEDIAL RESTORATION SAMPLING	FINAL RESTORATION SAMPLING	WELL FIELD BASELINE RANGE MEAN	LOW	HIGH	QUALITY OF USE VALUE
232	0.484	0.008	0.006				
233	0.220	0.008	0.015				
234	0.103	N.R.R.D.	0.006				
237	0.079	0.004	0.009				
242	0.196	0.005	0.012				
246	0.748	0.011	0.008				
248	0.016	N.R.R.D.	0.076				
252	0.064	N.R.R.D.	0.008	<0.01	<0.01	<0.01	0.05
254	0.440	<0.001	0.009				
275	0.016	<0.001	<0.001				
282	0.015	<0.001	0.002				
284	0.017	0.002	0.002				
285	0.297	0.007	0.015				
288	0.015	N.R.R.D.	<0.001				
291	0.016	N.R.R.D.	<0.001				
292	0.015	N.R.R.D.	0.002				
297	0.220	N.R.R.D.	0.096				

*N.R.R.D. indicates that no remedial restoration was apparently done at this well.

Seventeen wells were identified during initial sampling as having values above baseline. Ten of these wells had values greater than 0.05 mg/ℓ. After remedial action was taken on the well field, thirteen of the wells were below the baseline level and an additional two below quality of use value. One well, 297, although a significant reduction was noted, has an arsenic level remaining at 0.096 mg/ℓ. Another well, 248, saw an increase in arsenic to above the 0.05 mg/ℓ level as a result of the remedial action, although during initial sampling it was below the standard.

Table 6 summarizes the status of wells with high selenium values.

TABLE 6
SELENIUM LEVELS (mg/ℓ)

WELL	INITIAL SAMPLING	REMEDIAL RESTORATION SAMPLING	FINAL RESTORATION SAMPLING	WELL FIELD BASELINE RANGE MEAN	LOW	HIGH	QUALITY OF USE VALUE
190	0.026	N.R.R.D.	0.112				
231	0.059	N.R.R.D.	0.126				
232	0.224	0.015	0.010				
233	1.456	0.044	0.058				
234	0.282	N.R.R.D.	0.025				
237	2.110	0.084	0.126				
242	0.130	0.008	0.101				
243	2.430	0.015	0.005				
244	0.022	N.R.R.D.	0.010				
246	2.432	0.156	0.019				
247	0.153	N.R.R.D.	0.004				
248	0.390	N.R.R.D.	0.223				
249	0.510	N.R.R.D.	0.014				
252	0.234	N.R.R.D.	0.166				
253	0.046	N.R.R.D.	0.004				
254	0.221	<0.001	0.018				
255	0.747	N.R.R.D.	0.792				
258	0.396	N.R.R.D.	0.230				
260	0.020	N.R.R.D.	0.021	<0.01	<0.01	<0.01	0.01
261	0.052	N.R.R.D.	0.030				
262	0.029	N.R.R.D.	0.094				
265	1.680	0.002	0.002				
273	0.148	N.R.R.D.	0.002				
275	5.20	<0.001	<0.001				
276	0.042	N.R.R.D.	0.054				
277	0.044	N.R.R.D.	0.030				
278	0.770	<0.001	<0.001				
281	0.080	N.R.R.D.	0.002				
282	0.430	<0.001	<0.001				
284	0.570	<0.001	0.002				
285	2.304	0.170	0.162				
286	1.460	0.027	0.003				
287	0.480	N.R.R.D.	0.007				
288	0.750	N.R.R.D.	0.001				
291	0.106	N.R.R.D.	0.001				
292	0.300	N.R.R.D.	0.001				
293	0.158	N.R.R.D.	0.003				
296	0.144	N.R.R.D.	0.006				
297	2.080	N.R.R.D.	1.220				
303	0.154	N.R.R.D.	<0.001				

*N.R.R.D. denotes no Remedial Restoration Done

As can be seen from table 6, based on initial sampling, forty wells had selenium values above the minimum standard for quality of use. Following remedial restoration, twenty wells were at or below the quality of use standard. Twenty wells remain above the 0.01 mg/ℓ standard for selenium.

Some comments on this data are in order at this point. First, it is not clear that all the initial sampling was done before the remedial restoration was done. However, since all the wells were sampled in the final restoration sampling, it appears to be a moot issue. The groundwater restoration methods and time were not described, therefore, no determination can be made as to the use of "best practicable technology."

However, the most significant comment is that based on the data is that contamination of arsenic and selenium still remain at the site at levels above the minimum quality of use standard.

B. Best Practicable Technology

For any parameters which quality of use value cannot be met, Cleveland Cliffs should demonstrate that best practicable technology was used. It is not necessary for Cleveland Cliffs to make that demonstration for ammonia as such a showing was made for that parameter in the May 21, 1982 restoration report.

C. Stabilization Period

Cleveland Cliffs monitored the A field for stabilization for six months from September, 1981 to March, 1982. They contend that this data shows stabilization and no additional stabilization period is necessary. During this time of monitoring there appeared to be, after an initial drop, increases in ammonia, nitrate, nitrite, arsenic, selenium, uranium and vanadium in some of the wells being monitored for restoration.

But far more important is the question if stabilization was occurring at all, since the B field was undergoing restoration during this time. Therefore, water levels in the monitor wells were examined to determine if in fact the A field had been allowed to stabilize during this period.

TABLE 7
WATER LEVELS DURING
STABILIZATION PERIOD

	WELLS					
DATE	298	241	240	239	238	ABOVE ORE ZONE 230W
9/02/81	72'	72'	56'	45'	77'	79'
9/30/81	50'	31'	75'	28'	57'	79'
10/14/81	58'	44'	82'	36'	75'	79'
10/28/81	63'	31'	72'	32'	68'	81'
11/11/81	86'6"	61'	89'6"	48'6"	101'9"	77'
11/25/81	104'	63'	80'	53'	?	77'
12/09/81	109'2"	61'	78'8"	52'9"	pumped	78'2"
12/23/81	92'5"	55'	77'2"	53'3"	62'4"	79'10"
1/06/82	67'5"	68'4"	82'8"	51'7"	104'6"	77'5"
1/20/82	72'9"	52'6"	71'8"	41'6"	82'8"	77'8"
2/03/82	190'6"	174'6"	171'6"	122'	220'6"	76'
2/17/82	273'6"	?	236'	201'	285'	79'3"
3/03/82	269'6"	239'	236'	196'6"	310'	81'
3/17/82	pumped	232'	234'6"	192'	pumped	82'
3/31/82	pumped	97'	118'	101'	pumped	82'

*(Information from Cleveland Cliffs annual report per Glenn Mooney)

It can be seen from table 7 that in wells 240 and 241 (which are located further from the center of the B field than is the A field) water levels fluxuated from 150 to over 200 feet. This certainly does not reflect a stable period and in fact, the A field may have been undergoing limited groundwater sweep all the time stabilization was being monitored.

Based on this data, no stabilization period appears to have been conducted at this site.

D. Pumping Monitor Wells

Cleveland Cliffs in their reply to Glenn Mooney's inquiry regarding discrepancies in their annual report admitted that they pumped both monitor wells 238 and 298 when they had excursions. Upon investigation it becomes apparent that Cleveland Cliffs did that without either the NRC's nor DEQ-LQD's permission.

It is the general policy to not allow pumping of monitor wells except under extreme conditions. The problem with pumping monitor wells is that it destroys their value as a monitor well since you can no longer track the contamination above their established baseline condition nor monitor the retrival of the contaminate plume. In fact, if the situation is so serious as to warrant pumping a monitor well, additional monitor wells would be needed to identify the extent of contamination and to monitor its clean up.

At the Collins Draw site, we know there was an excursion in the south, southeast direction. What we do not know is how far it went or that it was ever cleaned up. We only know the monitor wells were cleaned up.

III. Recommendations

It is recommended that groundwater restoration be declared inadequate for bond release at this time. Cleveland Cliffs has achieved the agreed on standard of 30 mg/ℓ for ammonia and if those values remain stable, no additional work should be needed on ammonia. However, there are still selenium and arsenic values above quality of use value for this site. Cleveland Cliffs should attempt to bring these levels down to the quality of use using best practicable technology. (It does appear in many of the wells pumped for ammonia, these metals were also reduced). They should clearly document what technology was used, what time span it was used over and what was achieved.

Following the achievement of restoration, Cleveland Cliffs should monitor both of the fields for a stabilization period. The wells 232, 233, 246, 265, 237, 243, 285, 286, and 288 would appear, from the data, to be good wells to monitor for stabilization. This monitoring should include full guideline #8 analysis.

The practice of pumping monitor wells is unacceptable and should not be done unless extraordinary circumstances exist and regulatory agency concurrence has been obtained. Because of the pumping of monitor wells 238 and 298, it is not known how much contamination remains undetected and perhaps off the permit area. It is recommended that Cleveland Cliffs demonstrate that contamination does not exist beyond these two monitor wells. This information should include cross-sections of the geology and possibly additional wells.

KMO:kv

cc: Gary Beach
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