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MEMORANDUM

TO FILE: Cleveland Cliffs Iron Co., Collins Draw In Situ Mining Project, R & D #3

FROM: Kathy Muller Ogle, Hydrologist KMO

DATE: July 19, 1982

SUBJECT: Aquifer Restoration of the A & B Fields

CHECKED BY: WFC

I. INTRODUCTION

Cleveland Cliffs operated an in situ uranium test at the Collins Draw site under DEQ-LQD R & D #3. The Collins Draw project is approximately 6 miles south, southwest of Pumpkin Buttes in Campbell County, Wyoming.

Two well fields, A and B, were tested at this site using an ammonia bicarbonate solution. This solution was injected into the #1 sand in well field A from April to November 1980 and in well field B from December 1980 to July 1981. Above the production zone lie two other sands, the AB sand and the C sand which are separated from each other and the #1 sand by clay layers. Below the production zone is a 10 to 16 foot thick claystone underlain by a sand denoted as the Stray Sand.

The goal of restoration for this license was baseline groundwater quality. On May 24, 1982, DEQ-LQD received a "Groundwater Restoration Report" requesting bond release and stating that Cleveland Cliffs will not seek to use this project as demonstration of restoration for a commercial operation.

The restoration date submitted for well fields A and B was reviewed against the pre-mining baseline to determine if restoration at this site met, at a minimum, the pre-mining quality of use which DEQ-WQD has determined to be Class I - Domestic.

II. DISCUSSION

Restoration techniques such as lixiviant transfer or partial groundwater sweep, ion exchange, reverse osmosis and air stripping were used at the site. Based on the graphs presented, it appears each restoration technology could have been applied for a longer period of time to obtain better restoration.

The adequacy of restoration of well fields A and B to meet the minimum requirements of pre-mining quality of use are summarized in Tables 1 and 2. Additional restoration is needed for 6 parameters (TDS, Sulfate, Ammonia, Arsenic, Selenium and Radium 226) in well field A and 6 parameters (TDS, Uranium, Radium 226, Sulfate, Ammonia, Selenium) in well field B to meet the minimum Water Quality Standards. In addition to the general well field restoration, from the analysis performed on March 16, 1982, it appears that individual wells within well field A have several high parameters. The wells and associated high parameters are listed in Table 3. No similar analysis could be performed on individual wells in the B field as that data was not provided.

RECOMMENDATIONS

It is recommended that the restoration of these two well fields, A and B be found inadequate to meet minimum restoration requirements of quality of use and therefore the bond should be retained.

It also appears that from the review of excursion monitoring data that the areas around monitor wells 238W, 240, 241, and 298 may have been affected. If these areas have been affected, they should also be restored.

KMO:jsk
cc: Gary Beach
Bill Kearney
Dick Lennox - WQD
Jeff Pool - NRC
District IV

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TABLE 1

Groundwater Restoration of Well Field A

Parameter	Mean Baseline	Mean Restoration	W.Q. Standard	Adequate to meet W.Q. Standard
TDS	414	635	500	No
Sodium	106	163		a.b.*
Potassium	7	35		a.b.
Calcium	27	15		
Magnesium	2.8	4.4		a.b.
Sulfate	159	251	250	No
Chloride	14.6	26	250	Yes
Carbonate	8.1	102		a.b.
Bicarbonate	142	43		
Ammonia as N	0.18	31.4	0.5	No
Nitrate as N	<0.05	0.33	10	Yes
Nitrite as N	0.03	0.17	1	Yes
Aluminum	<0.05	0.07	5.0	Yes
Arsenic	<0.01	0.11	0.05	No
Barium	<0.05	0.08	1.0	Yes
Boron	<1.0	0.03	0.75	Yes
Cadmium	<0.002	<0.002	0.01	Yes
Chromium	<0.01	<0.01	0.05	Yes
Copper	<0.01	<0.01	1.0	Yes
Fluoride	0.17	0.34	1.4-2.4	Yes
Iron	0.73	0.03	0.3	Yes
Lead	<0.05	0.03	0.05	Yes
Manganese	0.02	0.01	0.05	Yes
Mercury	<0.001	<0.002	0.002	Yes
Selenium	<0.01	0.76	0.01	No
Nickel	<0.04	0.02		
Zinc	<0.01	0.006		?
Molybdenum	<0.05	0.07		a.b.
Vanadium	<0.05	0.37		a.b.
Uranium	0.05	2.67	5.0	Yes
Radium 226 pCi/ℓ	21.6	162.7	5	No

All values are in mg/ℓ except where noted otherwise.

* a.b. denotes that restoration is above baseline

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TABLE 2

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Groundwater Restoration of Well Field B

Parameter	Mean Baseline	Mean Restoration	W.Q. Standard	Adequate to Meet W.Q. Standard
TDS	414	782	500	No
Sodium	106	91		
Potassium	7	129		a.b. *
Calcium	27	6		
Magnesium	2.8	2		
Sulfate	159	342	250	No
Chloride	14.6	112	250	Yes
Carbonate	8.1	188		a.b.
Bicarbonate	142	0		
Ammonia as N	0.18	119	0.5	No
Nitrate as N	0.05	0.94	10	Yes
Nitrite as N	0.03	0.11	1	Yes
Aluminum	<0.05	<0.10	5.0	Yes
Arsenic	<0.01	0.05	0.05	Yes
Barium	<0.05	<0.10	1.0	Yes
Boron	<1.0	0.14	0.75	Yes
Cadmium	<0.002	<0.002	0.01	Yes
Chromium	<0.01	<0.01	0.05	Yes
Copper	<0.01	<0.01	1.0	Yes
Fluoride	0.17	0.57	1.4-2.4	Yes
Iron	0.73	<0.01	0.3	Yes
Lead	<0.05	<0.05	0.05	Yes
Manganese	0.02	<0.01	0.05	Yes
Mercury	<0.001	<0.0002	0.002	Yes
Selenium	<0.01	0.72	0.01	No
Nickel	<0.04	<0.02		
Zinc	<0.01	<0.005		
Molybdenum	<0.05	<0.10		?
Vanadium	<0.05	1.10		a.b.
Uranium	0.05	8.2	5.0	No
Radium 226 pCi/ℓ	21.6	74	5 pCi/ℓ	No

All values are in mg/ℓ except where noted otherwise.

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* a.b. denotes that restoration is above baseline

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TABLE 3

Individual Wells in Well Field A

Well	Parameters above W.Q. Standards
242	Ammonia Arsenic Selenium Radium
246	TDS Ammonia Arsenic Selenium Uranium Radium
248	TDS Ammonia Arsenic Selenium
252	TDS Sulfate Ammonia Arsenic Selenium
254	TDS Ammonia Arsenic Selenium