Return to: WMUR 461-55
Docket 70-8728

40-8728 PDR
PDR
WMUR r/f
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NMSS r/f
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Mill file
IE & dq (2)
DMartin
HPettengill
JLinehan
FRoss
BFisher
RAScarano
REBrowning
JBMartin

JUL 07 1981

WMUR:FWR
40-8728

MEMORANDUM FOR: Ross A. Scarano. Chief
Uranium Recovery Licensing Branch

THRU: John J. Linehan, Section Leader
Operating Facilities Section I
Uranium Recovery Licensing Branch

FROM: Frederick W. Ross
Operating Facilities Section I
Uranium Recovery Licensing Branch

SUBJECT: GROUNDWATER QUALITY RESTORATION AND POST-RESTORATION MONITORING PLANS AT TETON EXPLORATION DRILLING INC.'S LEUENBERGER SITE R&D IN SITU URANIUM LEACH MINE

BACKGROUND

On June 1, 1980, Teton Exploration began restoration procedures on Test Pattern N-1 in the "N" ore zone. On April 30, 1980, the NRC was informed by letter that restoration would commence within sixty days (Attachment No. 1). The April 30, 1980 transmittal referenced the transmittal of October 23, 1979 for specific plans for groundwater restoration including restoration steps, projected schedules of activity, and plans for post-restoration monitoring (Attachment No. 2). Restoration criteria are also provided in this transmittal.

In November 1980, Teton completed restoration on Test Pattern N-1 and began a four month post-restoration stability monitoring program. In February, 1981, Teton filed a final restoration report with the DEQ demonstrating stability in Test Pattern N-1 at approximately background levels (Attachment No. 3). The four month stabilization period has been voluntarily extended by Teton and further restoration groundwater quality data will be supplied to the DEQ. Also, restoration of the "M" ore zone was initiated in February.

DISCUSSION

License Condition No. 15 requires the licensee to file with the NRC a specific plan for groundwater quality restoration at least sixty days prior to termination of

OFFICE	WMUR						
SURNAME	FRoss	JLinehan					
DATE	7/6/81	7/7/81					

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mining activites. The transmittal must include descriptions of restoration steps, projected schedules of activities and plans for post-restoration monitoring.

The October 23, 1979 transmittal from Teton to the NRC (Attachment No. 2) hardly constitutes specific plans for groundwater quality restoration and post-restoration monitoring as required by License Condition 15. Furthermore, the April 30, 1980 transmittal (Attachment No. 1) notifying the NRC of the imminent restoration of Pattern N-1, did not give the required minimum sixty days notice. Teton is currently in the process of restoring the remaining three Test Patterns and have failed to give the proper notice or file restoration plans and post-restoration monitoring plans.

I have been in contact with Mr. Richard Appel, Teton's coordinator of permits and licensing, concerning Teton's shortcomings in this matter. He agreed to submit groundwater quality restoration plans and post-restoration monitoring plans for the N-2 and "M" ore zone test patterns. Subsequent correspondence between Mr. Appel and myself has not produced all the desired information stipulated by License Condition 15. The final restoration report on Test Pattern N-1 (Attachment No. 3), although submitted after the fact in support of their commercial scale application, does a more than adequate job of detailing restoration and post-restoration monitoring efforts for that pattern only.

In conclusion, I feel that in the past much of this problem was brought about by confusion on the part of Teton in interpreting their license, and by Teton attempting to deal only with the DEQ and ignoring NRC requirements. At present, I feel that Mr. Appel, although more than cooperative, does not fully appreciate the necessity of meeting the exact letter of each license requirement.

PROPOSED COURSE OF ACTION

I propose that a letter be sent to Teton (1) citing the requirements of License Condition No. 15 and listing specific information required to meet those requirements and (2) stressing the importance of meeting all dates or time frames specified in the license.

License Condition No. 15 also holds Teton to the post-restoration monitoring program described on page IV-5 of the Environmental Report calling for a four month post-restoration stability period. It is generally accepted by the NRC staff and the Wyoming DEQ that a four month stability period is not long enough to reasonably insure permanent restoration. Therefore, I propose that Source Material License SUA-1373 be amended changing License Condition 15 to include post-restoration monitoring plans for all test patterns that will meet current standards. In making these changes, the entire license condition should be rewritten cleaning up ambiguous language and terms of the condition.

Original Signed By:

Frederick W. Ross
Operating Facilities Section I
Uranium Recovery Licensing Branch
Division of Waste Management

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DATE ▶							

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Attachment No. 1

SEK
ADO cy
FYI

UNC TETON EXPLORATION DRILLING, INC.

Subsidiary of United Nuclear Corporation
A UNC RESOURCES Company

P.O. Drawer A-1
Casper, Wyoming 82602

Telephone 307/265-4102

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

April 30, 1980

Mr. Ross Scarano
Uranium Recovery Licensing Branch
Division of Waste Management
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Scarano:

RE: Source Material License SUA-1373
Docket Number 040-8726

Pursuant to Stipulation 15 of the referenced License, Teton-Nedco hereby notifies the NRC that ground water restoration may begin within 30 to 60 days in the N Aquifer at the Leuenberger site. As specified in our approved License Application, leach solution injection and mining activities will continue in the M Aquifer while restoration takes place in the N Aquifer.

The specific plan for ground water restoration, restoration steps, the projected schedule of activity and plans for post restoration monitoring are referenced in an October 23, 1979 transmittal to Mr. Ron Kaufman of the US NRC.

Should you have any questions, please do not hesitate to call.

Sincerely,

UNC TETON EXPLORATION DRILLING, INC.

Dan Herlihy

Dan Herlihy
Solution Mining Dept.

DH:fne

DCS # 8006050520

16260

Attachment No. 2

40-8728

Dan Herlihy
Teton Exploration Drilling Co.
P. O. Drawer A-1
Casper, Wyoming 82601

23 October 1979

Mr. Ron Kaufmann
U.S. NRC
Mail Stop 905 SS
Washington, D. C. 20555

Dear Ron:

Re: Docket 40-8728

Attached please find a copy of the TETON-NEDCO application for a Research & Development Testing License submitted to and approved by the Wyoming Department of Environmental Quality (DEQ). The R&D License number for our approved DEQ License is 2 RD. A copy of the License is also attached. This License authorizes TETON-NEDCO to proceed with all phases of the R&D test subject to the conditions listed in the attached license.

The DEQ application is submitted to the NRC as a reference in the review of the TETON-NEDCO application for Source Material License. Section III.3.5 (Leach Solution Excursion) of the DEQ application supercedes Section III.3.5. of the ER submitted to the NRC, Section IV (Reclamation) of the DEQ application supercedes Section IV of the NRC ER. For your immediate reference, I have attached Table IV-1.02 (Ground Water Restoration Goals for R&D Test) of the DEQ application. This Table supercedes Table IV.1.01 of the presently submitted NRC ER and should answer comment 4(h) of the 10/22/79 NRC comments concerning our Source Material License application.

In reference to comment 4(a) of the 10/22/79 NRC comments requesting a schedule for the Testing operation, the proposed testing schedule is as follows:

15045
add'l info

Dcs: 8001310068

Days After Operation Commences	Activity
0	Begin mining in N&M production zones
60	Complete mining in M zone
60	Begin restoration in M zone
90	Complete mining in N zone
90	Begin mining in second pattern in N Zone
100	Complete restoration in M zone
100	If needed begin mining in second pattern in M zone
150	Complete mining in second pattern in N zone
150	Begin restoration of both patters in N zone
160	Complete mining in second pattern of M zone
160	Begin restoration of second pattern of M zone
210	Complete all ground water restoration
210	Implement surface reclamation
365	Complete reclamation

If you have any questions concerning the above, please contact me at your earliest convenience.

Sincerely,

Dan Herlihy

Dan Herlihy
Solution Mining Department

DH:sfs

Attachments

TABLE IV.1.02

Ground Water Restoration Goals for R & D Test
(All units in mg/l except as noted.)

Chemical Parameter	M Aquifer Restoration Goal	N Aquifer Restoration Goal
pH	5.0-9.0	5.0-9.0
Ammonia (NH_3)	.5	.5
NO_2/NO_3 Total	1	1
Bicarbonate	TDS[1]	TDS[1]
Carbonate	TDS	TDS
Calcium	TDS	TDS
Chloride	250	250
Boron	1	1
Fluoride	1.4 to 2.4	1.4 to 2.4
Magnesium	TDS	TDS
Potassium	TDS	TDS
Sodium	TDS	TDS
Sulfate	250	250
Aluminum	.33[2]	.15[2]
Arsenic	.05	.05
Barium	1.0	1.0
Cadmium	.01	.01
Chromium	.05	.05
Copper	1.0	1.0
Iron	.7[3]	.30
Lead	.05	.05
Manganese	.06[3]	.05[3]
Mercury	.001	.01[3]
Molybdenum	.20[2]	.07[2]
Nickel	1.0	1.0
Radium 226	236.5[3]	208.3[3]
Selenium	.01	.01
Uranium	5	5
Vanadium	.34	.21
Zinc	5	5
TDS	500	554[3]

1) The concentration of this parameter shall be at a level such that the restoration concentration for TDS is not exceeded. There is no known recommended Public Water Supply criteria for this parameter.

2) No Public Water Supply Criteria exists. Average values shown are determined from wells PN5-L301, PN5-L306, and PN5-L308 in M Aquifer and wells PN5-L302, PN5-L312, PN5-L317, PN5-572, PN5-L573, PN5-L574 in N Aquifer.

3) Baseline value (Table II.6.04) exceeds Public Water Supply Criteria. Average values shown are determined from wells PN5-L301, PN5-L306, & PN5-L308 in M Aquifer and wells PN5-6302, PN5-L312, PN5-6317, PN5-572, PN5-L573, PN5-L574 in N Aquifer.

Attachment No. 3

APPENDIX D-6.5

GROUND WATER RESTORATION REPORT

The Research and Development Testing plan approved by the DEQ-LQD under the R&D Testing License 2RD calls for a demonstration of ground water restoration after the in situ uranium leaching phase of the Leuenberger operation. Details concerning the R&D operation at the Leuenberger Site can be referenced in the R&D Testing License Application 2RD.

The ground water restoration demonstration effort at the Leuenberger Site was conducted in the Pattern 1 of the N Well Field Area. Pattern 1 consists of well NR-1, four surrounding injection wells, and the process observation well 317. These wells are shown on Figure 1 and are located on the northwest side of the N Well Field Area. During May and June, 1980, additional injection-recovery wells were installed in the southeast portion of the N Well Field Area in keeping with the approved R&D Testing plan. These wells are also shown on Figure 1.

Mining commenced for Pattern 1 in the N Well Field Area on January 22, 1980, and continued through May 31, 1980. The ground water restoration effort commenced on June 1, 1980, and ground water restoration was achieved using five steps. Ground water samples were collected and analyzed at the end of each step. The chemical results for each step are listed in Table 1 along with the volume of ground water recovered, injected and/or discharged to the solar evaporation ponds during each step of the restoration effort. A summary of the procedure used to achieve ground water restoration is provided below.

GROUND WATER RESTORATION PROCEDURE

Step 1 — 6/1/80 through 7/12/80

Ground water circulation with no oxidant or leachant addition. This step was conducted to remove residual UO_2^{++} left in the formation after leaching. The pattern was shut down from 7/13/80 through 8/9/80 so that several pumping tests could be conducted for commercial application purposes.

Step 2 — 8/10/80 through 8/18/80

In an effort to reduce the chemical constituents in the N zone to be restored, water from Pattern 1 of the N Well Field Area was commingled with fresh water from a new pattern installed in the M Well Field Area. The commingled water was continually recycled back to the N & M Well Field Areas. Pumping problems were experienced in the M field and this step was terminated before a fifty (50) percent reduction in chemical constituents from the N zone was realized.

TABLE 1

ANALYTICAL TRENDS FOR N ZONE RESTORATION

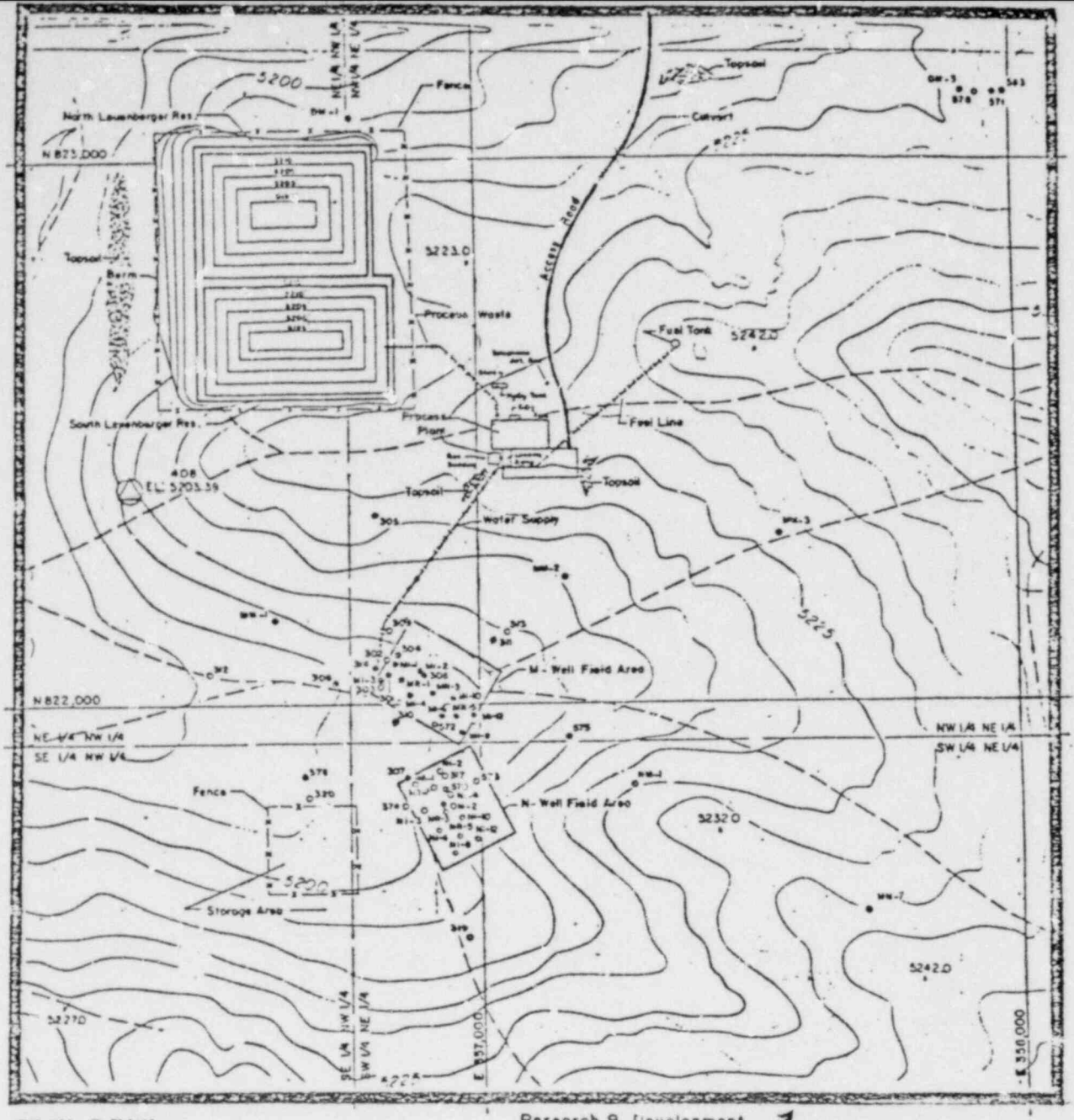
(Units in mg/l except as noted)

Date -- 1980	June 1	Aug. 9	Aug. 18	Sept. 19	Oct. 21	Nov. 6
Step	end of chemical addition	1	2	3	4	5
U_3O_8	28.4	6.8	3.9	3.2	3.0	2.9
Cl^-	52	44	26	15	16	10
HCO_3^-	1,342	936	672	444	432	312
$SO_4^=$	461	391	316	266	286	292
COND (µmhos/cm)	2,010	1,480	1,135	875	1,040	885
TDS	2,500	---	1,066	---	---	585
Gallons Recovery	6,218,640	1,860,927	601,770	1,501,192	862,481	691,699
(pore volume-recovered)*	(47.71)	(14.28)	(4.62)	(11.52)	(6.62)	(5.31)
Gallons Injected	6,045,630	1,785,289	589,200	---	---	---
(pore volume injected)	(46.39)	(13.70)	(4.52)	---	---	---
Gallons bleed	173,100	75,638	12,570	1,501,192	862,481	691,699
(pore volume bleed)	(1.32)	(.58)	(.10)	(11.52)	(6.62)	(5.31)

Total Recovery During Restoration	5,518,069 gal.	= 42.34 pore volumes
Total Injected During Restoration	2,374,489	= 18.22 pore volumes
Net Sweep	3,143,580	= 24.12 pore volumes

Total Recovery During Mining	6,218,640	= 47.71 pore volumes
Total Injected During Mining	6,045,630	= 46.39 pore volumes
Net Bleed 2.78%	173,010	= 1.32 pore volumes

* 1 pore volume = .4 acre-ft = 130,332 gallons
(See page IV-5b of R&D application)



T34N., R.74W.
Within Section 14

Research & Development License Area Boundary

Contour Intervals = 5'

0 100 200 300 500 800 Feet

0 50 100 200 Meters

• THE COORDINATES USED ARE AFTER THE WYOMING STATE COORDINATE SYSTEM.

•• ALL DRILL HOLE NUMBERS ARE PRECEDED BY A 'PNL-L' INDEX NUMBER.

LEGEND

- Upper Idaho Aquifer Well
- Lower Idaho Aquifer Well
- Confining Layer Below Lower Idaho Aquifer Well
- N Aquifer Well
- M Aquifer Well
- Basal Aquifer Well
- Abandoned Well Sealed With Cement
- Pipe Line With Use Noted

SITE FACILITY LAYOUT FOR R&D TEST
Figure 1

Step 3 8/21/80 through 9/17/80

Ground water sweep commenced by pumping NR-1 at approximately 40 gpm and discharging the water directly to the solar evaporation ponds.

Step 4 9/26/80 through 10/21/80

Continue ground water sweep by pumping NI-3.

Step 5 10/21/80 through 11/1/80

Continue ground water sweep by pumping NI-1. Ground water restoration is achieved.

Step 6 11/7/80 through 3/7/81

Stability demonstration period. Samples are collected over a four-month period to demonstrate chemical stability after achieving ground water restoration.

Water samples were collected and analyzed for major and trace elements from five wells within and adjacent to Pattern 1 of the N zone prior to leach solution injection. Table 2 lists the wells sampled and the analytical results. Post-leaching chemical samples have been collected from the same wells at the end of Step 5 and on a monthly basis thereafter. These results are given in Tables 3, 4 and 5. A summary of pre-testing and post-testing analytical data is provided in Table 6 along with the recently promulgated Wyoming DEQ ground water quality standards for livestock.

As illustrated in Table 6, the restoration water is very similar to the pretesting water quality. A less than 10% change in TDS is observed between the restoration water and the pretesting quality. This is attributable to the residual baking soda ($NaHCO_3$) left underground after mining. Baking soda is used to complex with the uranium during the leaching process.

Baking soda or $NaHCO_3$ is not considered toxic, however, the slight increase in TDS is offset by the reduction in Vanadium from above livestock standards in the pretesting water to below livestock standards after ground water restoration. The result is that fewer parameters exceed livestock standards after ground water restoration than before mining commenced.

The results of the ground water restoration effort suggest that restoration of the ground water to a quality of use consistent with the uses for which the ground water was suitable prior to mining can be achieved.

TABLE 2

PRETESTING WATER QUALITY
FOR PATTERN 1 OF
N'ZONE

Wells Number	317	572	573	574	NR-1
pH (Units)	7.56	8.57	7.88	8.01	7.78
Ammonia (NH_3 as N)	.09	.07	.10	.10	1.00
Total NO_2/NO_3 (as N)	.03	.37	.05	.04	1.80
Bicarbonate (HCO_3)	191.20	116	164.50	199	192
Carbonate (CO_3)	0	8.50	0	0	0
Calcium (Ca)	96.60	58.50	77.50	98.33	134
Chloride (Cl)	8	73.33	16	18	4.4
Boron (B)	.01	.01	.01	.01	.05
Fluoride (F)	.47	.42	.57	.56	.30
Magnesium (Mg)	23.60	22.50	21.50	22.33	3.10
Potassium (K)	11.60	95.50	19.50	18.67	9.2
Sodium (Na)	29	45	32	33	29
Sulfate (SO_4)	233	208.67	236	229.33	255
Aluminum (Al)	.11	.01	.05	.07	.1
Arsenic (As)	.01	.01	.01	.01	.01
Barium (Ba)	.03	.08	.04	.03	.05
Cadmium (Cd)	0	.02	0	0	.05
Chromium (Cr)	.01	.06	.01	.01	.05
Copper (Cu)	.02	.03	.01	.01	.05
Iron (Fe)	.22	.07	.02	.10	.58
Lead (Pb)	.01	.01	.01	.01	.05
Manganese (Mn)	.05	.01	.05	.03	.05
Mercury (Hg)	.00163	.0575	.0005	.0005	.001
Molybdenum (Mo)	.05	.08	.05	.05	.1
Nickel (Ni)	.02	.04	.02	.02	.05
Radium 226 (Ra) pCi/l	593.25	61	28.1	23.55	219.2
Selenium (Se)	.01	.01	.01	.01	.01
Uranium (U)	1.78	.77	.03	.01	.1
Vanadium (V)	.05	.05	.05	.05	.05
Zinc (Zn)	.01	.04	.01	.01	.05
TDS	513.4	581.67	529.33	476	548

All data in mg/l except as noted.

TABLE 2

PRETESTING WATER QUALITY
FOR PATTERN 1 OF
N'ZONE

Wells Number	317	572	573	574	NR-1
pH (Units)	7.56	8.57	7.88	8.01	7.78
Ammonia (NH_3 as N)	.09	.07	.10	.10	1.00
Total NO_2/NO_3 (as N)	.03	.37	.05	.04	1.80
Bicarbonate (HCO_3)	191.20	116	164.50	199	192
Carbonate (CO_3)	0	8.50	0	0	0
Calcium (Ca)	96.00	58.50	77.50	98.33	134
Chloride (Cl)	8	73.33	16	18	4.4
Boron (B)	.01	.01	.01	.01	.05
Fluoride (F)	.47	.42	.57	.56	.30
Magnesium (Mg)	23.60	22.50	21.50	22.33	3.10
Potassium (K)	11.60	95.50	19.50	18.67	9.2
Sodium (Na)	29	45	32	33	29
Sulfate (SO_4)	233	208.67	236	229.33	255
Aluminum (Al)	.11	.01	.05	.07	.1
Arsenic (As)	.01	.01	.01	.01	.01
Barium (Ba)	.03	.08	.04	.03	.03
Cadmium (Cd)	0	.02	0	0	.05
Chromium (Cr)	.01	.06	.01	.01	.05
Copper (Cu)	.02	.03	.01	.01	.05
Iron (Fe)	.22	.07	.02	.10	.58
Lead (Pb)	.01	.01	.01	.01	.05
Manganese (Mn)	.05	.01	.05	.03	.05
Mercury (Hg)	.00163	.0575	.0005	.0005	.001
Molybdenum (Mo)	.05	.08	.05	.05	.1
Nickel (Ni)	.02	.04	.02	.02	.05
Radium 226 (Ra) pCi/l	593.25	61	28.1	23.55	219.2
Selenium (Se)	.01	.01	.01	.01	.01
Uranium (U)	1.78	.77	.03	.01	.1
Vanadium (V)	.05	.05	.05	.05	.05
Zinc (Zn)	.01	.04	.01	.01	.05
TDS	513.4	581.67	529.33	476	548

All data in mg/l except as noted.

TABLE 3

NOVEMBER 1980 WATER QUALITY
FOR PATTERN 1 OF
N ZONE

Well	313	572	573	571	NR-1
Lab	Teton	Teton	Teton	Teton	Teton
Job	1946	1964	1965	1978	1945
Date Sampled	11- 7-80	11-11-80	11-11-80	11-12-80	11- 7-80
Date Analyzed	11-10-80	11-12-80	11-12-80	11-13-80	11-10-80
pH (Units)	7.8	8	8	7.90	7.8
Ammonia (NH_3 as N)	<.1	.16	<.1	.11	<.1
Total NO_2/NO_3 (as N)	.16	.15	.16	.20	.23
Bicarbonate (HCO_3)	190	180	193	256	220
Carbonate (CO_3)	0	0	0	0	0
Calcium (Ca)	86	98	94	96	91
Chloride (Cl)	6	3	5	8	8
Boron (B)	<.25	<.25	<.25	<.25	.25
Fluoride (F)	.42	.42	.44	.29	.29
Magnesium (Mg)	28	19	23	29	18
Potassium (K)	12.5	15.7	11.7	13.8	11.7
Sodium (Na)	40	37	31	49	58
Sulfate (SO_4)	257	273	257	275	269
Aluminum (Al)	<.05	<.05	<.05	.07	<.05
Arsenic (As)	<.005	<.005	<.005	<.005	<.005
Barium (Ba)	<.1	<.1	<.1	<.1	<.1
Cadmium (Cd)	<.01	<.01	<.01	<.01	<.01
Chromium (Cr)	<.05	<.05	<.05	<.05	<.05
Copper (Cu)	<.05	<.05	<.05	<.05	<.05
Iron (Fe)	1.5	<.05	.59	.32	.57
Lead (Pb)	<.05	<.05	<.05	<.05	.07
Manganese (Mn)	.07	<.05	<.05	.07	<.05
Mercury (Hg)	<.001	<.001	<.001	<.001	<.001
Molybdenum (Mo)	<.1	<.1	<.1	<.1	<.1
Nickel (Ni)	<.05	<.05	<.05	<.05	<.05
Radium 226 (Ra) pCi/l	775	89	0.10	55	337
Selenium (Se)	<.005	<.005	<.005	<.005	.019
Uranium (U)	1.20	<.1	<.1	.7	1.1
Vanadium (V)	<.1	<.1	<.1	<.1	<.1
Zinc (Zn)	<.05	<.05	<.05	<.05	<.05
TDS	553	565	548	636	585

All data in mg/l except as noted.

TABLE 4

DECEMBER 1980 WATER QUALITY
FOR PATTERN 1 OF
N ZONE

Well Lab Job No. Date Sampled Data Analyzed	317 Teton 2163 12-10-80 12-11-80	572 Teton 2138 12-09-80 12-10-80	573 Teton 2127 12-09-80 12-10-80	574 Teton 2136 12-08-80 12-10-80	NR-1 Teton 2259 12-23-80 12-24-80
pH (Units)	6.80	8.40	7.80	8	6.80
Ammonia (NH_3 as N)	.24	<.1	.13	.15	<.10
Total NO_2/NO_3 (as N)	.14	.17	.24	.19	<.1
Bicarbonate (HCO_3)	205	156	195	276	232
Carbonate (CO_3)	0	24	0	0	0
Calcium (Ca)	88	85	89	95	92
Chloride (Cl)	4	4	4	8	4
Boron (B)	<.25	<.25	<.25	<.25	<.25
Fluoride (F)	.42	.44	.45	.29	.27
Magnesium (Mg)	39	19	20	23	18.60
Potassium (K)	12	14	9.50	11.50	12.90
Sodium (Na)	42	36	35	48	56
Sulfate (SO_4)	251	252	250	241	276
Aluminum (Al)	<.05	<.05	<.05	<.05	<.05
Arsenic (As)	<.005	<.005	<.005	<.005	<.007
Barium (Ba)	<.1	<.1	<.1	<.1	<.1
Cadmium (Cd)	<.01	<.01	<.01	<.01	<.01
Chromium (Cr)	<.05	<.05	<.05	<.05	<.05
Copper (Cu)	<.05	<.05	<.05	<.05	<.05
Iron (Fe)	1.88	.05	.2	<.05	.66
Lead (Pb)	<.05	<.05	<.05	<.05	<.05
Manganese (Mn)	.08	<.05	<.05	<.05	.16
Mercury (Hg)	<.001	<.001	<.001	<.001	<.001
Molybdenum (Mo)	<.1	<.1	<.1	<.1	<.1
Nickel (Ni)	<.05	<.05	<.05	<.05	<.05
Radium 226 (Ra) pCi/l	721	74	7.80	35	
Selenium (Se)	<.005	<.005	<.005	<.005	<.005
Uranium (U)	.80	<.1	<.1	.60	.8
Vanadium (V)	<.1	<.1	<.1	<.1	<.1
Zinc (Zn)	<.05	<.05	<.05	<.05	.01
TDS	572	565	557	626	600

All data in mg/l except as noted.

TABLE 4

DECEMBER 1980 WATER QUALITY
FOR PATTERN 1 OF
N ZONE

Well Lab Job No. Date Sampled Data Analyzed	317 Teton 2163 12-10-80 12-11-80	572 Teton 2138 12-09-80 12-10-80	573 Teton 2137 12-09-80 12-10-80	574 Teton 2136 12-08-80 12-10-80	NR-1 Teton 2259 12-23-80 12-24-80
pH (Units)	6.80	8.40	7.80	8	6.80
Ammonia (NH_3 as N)	.24	< .1	.13	.15	< .10
Total NO_2/NO_3 (as N)	.14	.17	.24	.19	< .1
Bicarbonate (HCO_3)	205	156	195	276	232
Carbonate (CO_3)	0	24	0	0	0
Calcium (Ca)	88	85	89	95	92
Chloride (Cl)	4	4	4	8	4
Boron (B)	< .25	< .25	< .25	< .25	< .25
Fluoride (F)	.42	.44	.45	.29	.27
Magnesium (Mg)	39	19	20	23	18.60
Potassium (K)	12	14	9.50	11.50	12.90
Sodium (Na)	42	36	35	48	56
Sulfate (SO_4)	251	252	250	241	276
Aluminum (Al)	< .05	< .05	< .05	< .05	< .05
Arsenic (As)	< .005	< .005	< .005	< .005	< .007
Barium (Ba)	< .1	< .1	< .1	< .1	< .1
Cadmium (Cd)	< .01	< .01	< .01	< .01	< .01
Chromium (Cr)	< .05	< .05	< .05	< .05	< .05
Copper (Cu)	< .05	< .05	< .05	< .05	< .05
Iron (Fe)	1.88	.05	.2	< .05	.66
Lead (Pb)	< .05	< .05	< .05	< .05	< .05
Manganese (Mn)	.08	< .05	< .05	< .05	.16
Mercury (Hg)	< .001	< .001	< .001	< .001	< .001
Molybdenum (Mo)	< .1	< .1	< .1	< .1	< .1
Nickel (Ni)	< .05	< .05	< .05	< .05	< .05
Radium 226 (Ra) pCi/l	721	74	7.80	35	
Selenium (Se)	< .005	< .005	< .005	< .005	< .005
Uranium (U)	.80	< .1	< .1	.60	.8
Vanadium (V)	< .1	< .1	< .1	< .1	< 1
Zinc (Zn)	< .05	< .05	< .05	< .05	.01
TDS	572	565	557	626	600

All data in mg/l except as noted.

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TABLE 5

JANUARY 1981 WATER QUALITY
FOR PATTERN 1 OF
N ZONE

Well	317	572	573	574	NR-1
Lab	Teton	Teton	Teton	Teton	Teton
Job No.	2344	2355	2356	2342	2422
Date Sampled	1-13-81	1-15-81	1-15-81	1-13-81	1-26-81
Date Analyzed	1-15-81	1-16-81	1-16-81	1-15-81	1-27-81
pH (Units)	6.78	7.37	7.88	7.58	7.36
Ammonia (NH_3 as N)	.28	<.1	<.1	.13	.24
Total NO_2/NO_3 (as N)	.10	<.1	.1	<.1	<.1
Bicarbonate (HCO_3)	200	176	195	254	244
Carbonate (CO_3)	0	0	0	0	0
Calcium (Ca)	95	91	94	95	93
Chloride (Cl)	5	8	6	6	5
Boron (B)	<.25	<.25	<.25	<.25	<.25
Fluoride (F)	.27	.44	.46	.20	.19
Magnesium (Mg)	22.60	19.40	21.90	23.80	21.80
Potassium (K)	11.50	15.50	11	12.30	10
Sodium (Na)	40	35	30	45	66
Sulfate (SO_4)	260	256	264	263	278
Aluminum (Al)	<.05	<.05	<.05	<.05	<.05
Arsenic (As)	<.005	<.005	<.005	<.005	.009
Barium (Ba)	.10	.12	.2	<.1	<.1
Cadmium (Cd)	<.01	<.01	<.01	<.01	<.01
Chromium (Cr)	<.05	<.05	<.05	<.05	<.05
Copper (Cu)	<0.5	<.05	<.05	<.05	<.05
Iron (Fe)	.42	.21	.09	.08	.9
Lead (Pb)	< .05	.06	<.05	<.05	<.05
Manganese (Mn)	.09	<.05	.05	.05	.06
Mercury (Hg)	< .001	<.001	<.001	<.001	<.001
Molybdenum (Mo)	< .1	<.1	<.1	<.1	<.1
Nickel (Ni)	< .05	<.05	<.05	<.05	<.05
Radium 226 (Ra) pCi/l	*	*	*	*	*
Selenium (Se)	< .005	<.005	<.005	<.005	<.00
Uranium (U)	.90	<.1	<.1	.7	.8
Vanadium (V)	<.1	<.1	<.1	<.1	<.1
Zinc (Zn)	<.05	<.05	<.05	<.05	<.05
TDS	586	547	547	613	616

All data in mg/l except as noted.

* Not available at this time.

TABLE 6

WATER QUALITY SUMMARY

N ZONE

PATTERN 1

	PRETESTING WATER QUALITY	WYOMING DEQ LIVESTOCK STANDARDS	POST TESTING WATER QUALITY		
			NOVEMBER '80	DECEMBER '80	JANUARY '81
	Mean STD		Mean STD	Mean STD	Mean STD
pH (Units)	8.0 ± .38		7.9 ± .1	7.6 ± .7	7.4 ± .4
Ammonia (NH_3 as N)	.27 ± .41		.11 ± .03	.14 ± .06	.17 ± .08
Total NO_2/NO_3 (as N)	.46 ± .76	100	.18 ± .03	.17 ± .05	< .1 ± 0
Bicarbonate (HCO_3)	172.5 ± 34.2		207.8 ± 30.7	212.8 ±44.6	213.8 ± 33.5
Carbonate (CO_3)	1.7 ± 3.8		0 ± 0	4.8 ±10.7	0 ± 0
Calcium (Ca)	93 ± 28		93 ± 4.7	90 ± 3.8	94 ± 1.7
Chloride (Cl)	23.9 ± 28.2	2,000	6 ± 2.12	5 ± 2	6 ± 1.2
Boron (B)	.02 ± .02	5	<.25 ± 0	<.25 ± 0	< .25 ± 0
Fluoride (F)	.46 ± .11		.37 ± .08	.37 ± .09	.31 ± .13
Magnesium (Mg)	18.6 ± 8.7		23.4 ± 5.03	23.9 ± 8.6	21.9 ± 1.6
Potassium (K)	30.9 ± 36.4		13.1 ± 1.7	12.0 ± 1.7	12 ± 2.1
Sodium (Na)	33.6 ± 6.6		43.8 ± 9.6	43.4 ± 8.8	43.2 ± 13.9
Sulfate (SO_4)	246.4 ± 33.9	3,000	266.2 ± 8.7	254 ±13	264.2 ± 8.3
Aluminum (Al)	.07 ± .04	5	<.05 ± .01	<.05 ± 0	<.05 ± 0
Arsenic (As)	.01 ± 0	.2	<.005 ± 0	<.005± 0	.006 ± .002
Barium (Ba)	.05 ± .02		<.1 ± 0	<.01 ± 0	.13 ± .05
Cadmium (Cd)	.01 ± .02	.05	<.01 ± 0	<.01 ± 0	<.01 ± 0
Chromium (Cr)	.03 ± .02	.05	<.05 ± 0	<.05 ± 0	<.05 ± 0
Copper (Cu)	.02 ± .02	.5	<.05 ± 0	<.05 ± 0	<.05 ± 0
Iron (Fe)	.20 ± .23		.62 ± .57	.57 ± .77	.48 ± .36
Lead (Pb)	.02 ± .02	.1	.05 ± .01	<.05 ± 0	.05 ± .004
Manganese (Mn)	.04 ± .02		.06 ± .01	.08 ± .05	.21 ± .33
Mercury (Hg)	.01 ± .02	.0005	<.001 ± 0	<.001± 0	<.001 ± 0
Molybdenum (Mo)	.07 ± .02		<.1 ± 0	<.1 ± 0	<.1 ± 0
Nickel (Ni)	.03 ± .01		<.05 ± 0	<.05 ± 0	<.05 ± 0
Radium 226 (Ra) pCi/l	185 ± 242	5	252.42 ±318	309 ±316*	*
Selenium (Se)	.01 ± 0	.05	.008 ± .006	<.005± 0	<.005 ± 0
Uranium (U)	.54 ± .76	*	.64 ± .53	.48 ± .36	.52 ± .39
Vanadium (V)	.14 ± .20	.1	<.1 ± 0	<.1 ± 0	<.1 ± 0
Zinc (Zn)	.02 ± .02	25	<.05 ± 0	.04 ± .02	<.05 ± 0
TDS	530 ± 39	5,000	577 ± 36	584 ±29	582 ± 34

All data in mg/l except as noted.

* All data not available at this time.

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TABLE 6

WATER QUALITY SUMMARY

N ZONE

PATTERN 1

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			NOVEMBER '80	DECEMBER '80	JANUARY '81
	Mean STD		Mean STD	Mean STD	Mean STD
pH (Units)	8.0 ± .38		7.9 ± .1	7.6 ± .7	7.4 ± .4
Ammonia (NH_3 as N)	.27 ± .41		.11 ± .03	.14 ± .06	.17 ± .08
Total NO_2/NO_3 (as N)	.46 ± .76	100	.18 ± .03	.17 ± .05	< .1 ± 0
Bicarbonate (HCO_3)	172.5 ± 34.2		207.8 ± 30.7	212.8 ±44.6	213.8 ± 33.5
Carbonate (CO_3)	1.7 ± 3.8		0 ± 0	4.8 ±10.7	0 ± 0
Calcium (Ca)	93 ± 28		93 ± 4.7	90 ± 3.8	94 ± 1.7
Chloride (Cl)	23.9 ± 28.2	2,000	6 ± 2.12	5 ± 2	6 ± 1.2
Boron (B)	.02 ± .02	5	<.25 ± 0	<.25 ± 0	< .25 ± 0
Fluoride (F)	.46 ± .11		.37 ± .08	.37 ± .09	.31 ± .13
Magnesium (Mg)	18.6 ± 8.7		23.4 ± 5.03	23.9 ± 8.6	21.9 ± 1.6
Potassium (K)	30.9 ± 36.4		13.1 ± 1.7	12.0 ± 1.7	12 ± 2.1
Sodium (Na)	33.6 ± 6.6		43.8 ± 9.6	43.4 ± 8.8	43.2 ± 13.9
Sulfate (SO_4)	246.4 ± 33.9	3,000	266.2 ± 8.7	254 ±13	264.2 ± 8.3
Aluminum (Al)	.07 ± .04	5	<.05 ± .01	<.05 ± 0	<.05 ± 0
Arsenic (As)	.01 ± 0	.2	<.005 ± 0	<.005± 0	.006 ± .002
Barium (Ba)	.05 ± .02		<.1 ± 0	<.01 ± 0	.13 ± .05
Cadmium (Cd)	.01 ± .02	.05	<.01 ± 0	<.01 ± 0	<.01 ± 0
Chromium (Cr)	.03 ± .02	.05	<.05 ± 0	<.05 ± 0	<.05 ± 0
Copper (Cu)	.02 ± .02	.5	<.05 ± 0	<.05 ± 0	<.05 ± 0
Iron (Fe)	.20 ± .23		.62 ± .57	.57 ± .77	.48 ± .36
Lead (Pb)	.02 ± .02	.1	.05 ± .01	<.05 ± 0	.005 ± .004
Manganese (Mn)	.04 ± .02		.06 ± .01	.08 ± .05	.21 ± .33
Mercury (Hg)	.01 ± .02	.0005	<.001 ± 0	<.001± 0	<.001 ± 0
Molybdenum (Mo)	.07 ± .02		<.1 ± 0	<.1 ± 0	<.1 ± 0
Nickel (Ni)	.03 ± .01		<.05 ± 0	<.05 ± 0	<.05 ± 0
Radium 226 (Ra) pCi/l	185 ± 242	5	252.42 ±318	309 ±316*	*
Selenium (Se)	.01 ± 0	.05	.008 ± .006	<.005 0	.005 ± 0
Uranium (U)	.54 ± .76	5	.64 ± .53	.48 ± .36	.52 ± .39
Vanadium (V)	.14 ± .20	.1	<.1 ± 0	<.1 ± 0	<.1 ± 0
Zinc (Zn)	.02 ± .02	25	<.05 ± 0	.04 ± .02	<.05 ± 0
TDS	530 ± 39	5,000	577 ± 36	584 ±29	382 ± 34

All data in mg/l except as noted.

* All data not available at this time.

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