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RAP SITE DESIGN FOR STABILIZATION OF
THE INACTIVE URANIUM MILL TAILINGS S
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SURF000514

Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site At Grand Junction, Colorado

Appendix A to Attachment 3
Volume IV

Final

September 1991

Appendix B of the
Cooperative Agreement
No. DE-FC04-81AL16257

Uranium Mill Tailings Remedial Action Project

um/GRS 9.A.1
(Final)

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JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-03-90-13-01-00c DISCIPLINE Civil/Hydro NO. OF SHEETS 21

PROJECT:

UMTRA

SITE:

GRAND JUNCTION, COLORADO – Cheney Disposal Site

FEATURE:

Summary of Average Gravimetric Water Contents @ the Bedrock Contact for All Boreholes at the Cheney Disposal Site

SOURCES OF DATA:

GRJ-03-90-13-01-00a "Gravimetric Water Contents, Neutron Moisture Meter Logs and Gamma-Gamma Logs for All Boreholes"

SOURCES OF FORMULAE & REFERENCES:

1) Chatfield, C. (1978), Statistics for Technology: A Course in Applied Statistics, 2nd ed., A Halsted Press Book, John Wiley & Sons, New York.

2) NH Analytical Software, "STATISTIX: An Interactive Statistical Analysis Program for Microcomputers", PC DOS Vers. 2.0 Roseville, MN, 1987.

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
00		[illegible]	4/18/90	J Millard	4/18/90	[illegible]	7/10/90

8/86

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DATE 4/18/1990 SUBJECT GWC's @ the Bedrock Contact for All Boreholes @ the Cheney Disp. Site SHEET NO. 1

BY D Dery CHKD. J Millard JOB NO.

I. Purpose

The purpose of this calculation set is to determine the mean gravimetric water contents (gwc's) of the upper three feet of the weathered and unweathered mancos shale layers directly beneath the alluvial contact at the Cheney disposal site, using the gwc measurement data from Calculation Set No. 6RJ-03-90-13-01-00 ("GWC's, Neutron Moisture Meter Logs and Gamma-Gamma Logs for All Boreholes"). Methods found in Statistics for Technology by C. Chatfield (1978) for comparing sample means will be used to determine if there is a significant difference between the mean gwc's of the wet weathered and the dry weathered mancos shale.

II. Methods of Analysis

Two methods of comparison shall be used (taken from C. Chatfield, 1978): the two sample "t"-test for comparing two sample means; and the "F"-test using the One-way Analysis of Variance (AOV). The second method tests the hypothesis that there is no difference between a number of groups. In this case, the total variation of the gwc measurements is partitioned into two components, one measuring the variability between the group means (mean gwc's of the wet weathered and dry weathered shale units) and the other measuring the variation within each group. These two components are compared by means of the F-test (the significance test used for comparing different estimates of variation.

The hypothesis to be tested (using each method) shall be the two-tailed null hypothesis which is written as:

$$H_0 : \mu_1 = \mu_2$$

where μ_1 = population 1 true mean of μ_2 = true mean population of 2

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DATE 4/18 SUBJECT SHEET NO. 2

BY Oley CHKD. J Millard JOB NO.

A statistical analysis computer program called STATISTIX[2] shall be used to compute most values in this calculation set. All other values such as Student's t-distribution and F-distribution shall be obtained from standard tables found in a Statistics text book[1] See Appendix

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III. Data and Assumptions

A. Data

(See Tables 1 – 4 in APPENDIX)

Table 4 was input for running "Two Sample T-Tests" and "One-Way AOV" STATISTIX computer programs referenced in section II.

B. Assumptions

1. Both populations (gwc's of dryweathered and wetweathered units) are normally distributed
2. Both populations have the same variance σ^2
3. The two samples (sample sets) are independent.

IV. Calculations and Analysis

A. Two sample "t"-test (Comparing two sample means)

Null Hypothesis to test –

$$H_0: \mu_1 = \mu_2 \quad \text{(two-tailed test)}$$

where μ_1 = population mean of wetweathered shale gwc's
μ_2 = population mean of dryweathered shale gwc's

Alternative Hypothesis –

$$H_A: \mu_1 \neq \mu_2$$

For σ (standard deviation of the population) unknown, σ is replaced with the sample standard deviation, s to obtain the test statistic (Chatfield, 1978).

$$t_0 = \frac{\bar{X}_1 - \bar{X}_2}{s\sqrt{1/n_1 + 1/n_2}}$$

where t_0 = test statistic
$\bar{X}_1$ = sample mean gwc's for wetweathered shale
$\bar{X}_2$ = " " " " dryweathered "
n_1 = number of samples (value) for wetweath. shale

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BY Valery CHKD. J Millard JOB NO.

n_2 = number of sample (values) for drywreath. shale

$$S = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}$$

where S_1^2 = sample variance for wetwreath. shale
S_2^2 = sample variance for drywreath. shale

Two Sample T-test Output

TWO SAMPLE T TESTS FOR WETW VS DRYW

VARIABLE	MEAN	SAMPLE SIZE	S.D.	S.E.
WETW	1.052E-01	53	2.620E-02	3.599E-03
DRYW	9.498E-02	121	8.067E-02	7.334E-03

	T_0	DF	P
EQUAL VARIANCES	0.90	172	0.3689
UNEQUAL VARIANCES	1.25	162.9	0.2098

	F	NUM DF	DEN DF	P
TESTS FOR EQUALITY OF VARIANCES	9.48	120	52	0.0000

CASES INCLUDED 174 MISSING CASES 68

S.D. = Standard deviation of Sa

T_0 = test statistic

DF = degrees of freedom

From Table below (taken from Chatfield, 1978)

$t_{0.005,172} = 2.576$ (99% critical values)
$t_{0.025,172} = 1.96$ (95% critical value)

The 95 per cent and 99 per cent critical values for the test statistic z can be found from normal tables and are given in Table 11. (See Table 5 in Appendix also)

Table 11

	Two-tailed	One-tailed
95%	1·96	1·64
99%	2·58	2·33

(Chatfield, 1978)

$t_0 < t$

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DATE 4/18 SUBJECT SHEET NO 5

BY Dery CHKD. J Millard JOB NO.

Since test statistic t values for equal and unequal variances are less than the 95 and 99 % critical values, we accept the null hypothesis that there is no significant difference between the sample mean gvc's of the wetweathered vs. dry weathered mancos shale units.

B. One-Way AOV (comparing different components of variation)

One-Way AOV Output

ONE WAY AOV

VARIABLE	MEAN	SAMPLE SIZE	GROUP VARIANCE
WETW	1.052E-01	53 = N_1	6.865E-04
DRYW	9.498E-02	121 = N_2	6.507E-03
TOTAL	9.810E-02	174 = N_T	

SOURCE	DF	SS	MS	F_o	P
BETWEEN (a)	1 (c)	3.853E-03 (e)	3.853E-03 (g)	0.81 (i)	0.3689
WITHIN (b)	172 (d)	8.166E-01 (f)	4.748E-03 (h)		
TOTAL	173	8.204E-01			

Here DF = degrees of freedom
SS = sum of squares
MS = mean square
F_o = ratio of mean squares

Group Variance - same as variance, or s^2

(a) Variation between groups
(b) Variation within groups
(c) Number of groups minus 1; $(c-1)$
(d) $N_T - 2$
(e) $n \sum_{i=1}^{c} (\bar{x}_i - \bar{x})^2$
(f) $\sum_{i=1}^{c} \sum_{j=1}^{n} (x_{ij} - \bar{x}_i)^2$

(g) $S_B^2 = n \sum_{i=1}^{c} \frac{(\bar{x}_i - \bar{x})^2}{c-1}$

(h) $s^2 = \sum_{i=1}^{c} \sum_{j=1}^{n} \frac{(x_{ij} - \bar{x}_i)^2}{c(n-1)}$

(i) $\frac{S_B^2}{s^2}$

[Chatfield, 1978]

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DATE 4/18/90 SUBJECT SHEET NO. 6

BY 4/18 CHKD. JMillard JOB NO.

From Tables 6 & 7 in Appendix (taken from Chatfield, 1978)

The 95% and 99% critical values for F are:

$F_{0.01,1,172} = 6.63$

$F_{0.05,1,172} = 3.84$

$F_o < F$

Since the ratio of mean squares (0.81) is less than the 95 and 99% critical values for F, we accept the null hypothesis that there is no significant variability between the group gwc's.

V. Results and Conclusions

A. Summary of Descriptive Statistics for all Shale Units

DESCRIPTIVE STATISTICS

VARIABLE	MEAN	S.D.	N	MEDIAN	MINIMUM	MAXIMUM
WETW	1.052E-01	2.620E-02	53	1.050E-01	5.600E-02	1.710E-01
DRYW	9.498E-02	8.067E-02	121	8.600E-02	1.300E-02	8.700E-01
DR-U	7.816E-02	2.150E-02	37	8.200E-02	3.000E-02	1.230E-01

Output from Descriptive Statistics/ STATISTIX Computer Program

B. Comparison of the mean gwc's of the wet weathered and dry-weathered shale units (using the standard t and F-tests) shows that there is no significant difference between them.

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Appendix

Table 2, cont

(DRY WEATHERED)

DEPTH INTERVAL (FEET)	912	913	914	916	918	923	926	928	929	930	933	934	936	937	938	940	941	945	946	953
7.5																				
8.5																				
9.5																				
10.5																				
11.5																	0.044			
12.5																	0.072			
13.5																	0.086			
14.5																				
15.5															0.096					
16.5															0.097					
17.5															0.097					
18.5						0.076														
19.5																				
20.5												0.090				0.081				
21.5												0.094				0.080				
22.5										0.113		0.084				0.061				
23.5										0.122										
24.5							0.076			0.123	0.069									0
25.5							0.094		0.075		0.083									0
26.5							0.085		0.082		0.075									0
27.5									0.087											
28.5																		0.040		
29.5													0.067					0.064		
30.5														0.117				0.074		
31.5														0.116						
32.5														0.112						
33.5																				
34.5	0.084							0.043												
35.5	0.089	0.064			0.059			0.056												
36.5	0.088	0.051	0.085		0.036			0.100										0.122		
37.5		0.041	0.086	0.037	0.040													0.105		0.067
38.5			0.050	0.066														0.108		0.042
39.5				0.057																
40.5																				
41.5																				
42.5																				
43.5																				
44.5																				
45.5																				
46.5																				
47.4																				
48.4																				
49.5																				

Table 3

CHENEY DISPOSAL SITE - GROUP: AVERAGE GRAVIMETRIC WATER CONTENT IN DRY HOLES IN UNWEATHERED MANCOS SHALE

DEPTH INTERVAL (FEET)	819	824	826	902	906	915	917	919	920	921	922	944	947	950	955
7.5															
8.5															
9.5															
10.5															
11.5															
12.5															
13.5															
14.5															
15.5															
16.5															
17.5															
18.5															
19.5															
20.5															
21.5															
22.5															
23.5															
24.5															
25.5															
26.5															
27.5															
28.5															
29.5															
30.5													0.088		
31.5													0.090		
32.5													0.094		
33.5															
34.5															
35.5											0.086				
36.5				0.079											
37.5				0.069					0.085						
38.5	0.103			0.073					0.082						
39.5	0.103		0.084		0.091	0.044			0.081						0.081
40.5	0.090		0.114		0.093	0.068	0.080					0.079		0.080	0.081
41.5			0.082		0.085					0.091				0.081	0.095
42.5										0.074				0.044	
43.5															
44.5															
45.5								0.099							
46.5		0.087						0.090							
47.5		0.064						0.082							
48.5		0.056													
49.5															
50.5															

lable 4 Input to STATISTIX Programs

VIEW DATA

CASE	WETW	DRYW	DRYU
1	0.0740	0.0720	0.1220
2	0.1010	0.0810	0.1030
3	0.1260	0.0870	0.0900
4	0.0830	0.1180	0.0570
5	0.1010	0.1040	0.0640
6	0.0890	0.0910	0.0560
7	0.1710	0.1090	0.0840
8	0.0960	0.1170	0.1140
9	0.0990	0.1180	0.0820
10	0.1360	0.1160	0.0790
11	0.1250	0.1120	0.0690
12	0.1040	0.1140	0.0730
13	0.0730	0.0960	0.0910
14	0.0690	0.0930	0.0930
15	0.0810	0.0860	0.0850
16	0.1410	0.1380	0.0440
17	0.1180	0.1130	0.0680
18	0.1260	0.1130	0.0720
19	0.0860	0.0340	0.0990
20	0.0830	0.0440	0.0900
21	0.0890	0.1100	0.0820
22	0.1440	0.1230	0.0850
23	0.0780	0.1380	0.0820
24	0.0650	0.1010	0.0810
25	0.1300	0.1090	0.0910
26	0.1150	0.1090	0.0740
27	0.1080	0.1040	0.0860
28	0.1190	0.0840	0.0790
29	0.1300	0.1020	0.0880
30	0.1720	0.1130	0.0920
31	0.0990	0.0810	0.0940
32	0.1300	0.1060	0.0300
33	0.0590	0.1050	0.0310
34	0.1020	0.1120	0.0440
35	0.1000	0.1010	0.0810
36	0.1060	0.1020	0.0810
37	0.0600	0.1260	0.0950
38	0.1400	0.1230	M
39	0.0810	0.1160	M
40	0.1100	0.0610	M
41	0.1270	0.0450	M
42	0.1210	0.0430	M
43	0.1070	0.0680	M
44	0.1070	0.0660	M
45	0.1330	0.0610	M
46	0.1200	0.0710	M
47	0.1560	0.1020	M
48	0.0560	0.0610	M
49	0.0840	0.2750	M
50	0.0640	0.0800	M
51	0.1150	0.0610	M
52	0.1020	0.0880	M
53	0.1050	0.0130	M
54	M	0.0720	M
55	M	0.1800	M
56	M	0.7100	M
57	M	0.8700	M

60	M	0.1[illegible]	M
61	M	0.0790	M
62	M	0.0880	M
63	M	0.0580	M
64	M	0.0840	M
65	M	0.0890	M
66	M	0.0880	M
67	M	0.0640	M
68	M	0.0510	M
69	M	0.0410	M
70	M	0.0850	M
71	M	0.0860	M
72	M	0.0500	M
73	M	0.0370	M
74	M	0.0660	M
75	M	0.0570	M
76	M	0.0590	M
77	M	0.0360	M
78	M	0.0400	M
79	M	0.0760	M
80	M	0.0760	M
81	M	0.0940	M
82	M	0.0850	M
83	M	0.0430	M
84	M	0.0560	M
85	M	0.1000	M
86	M	0.0750	M
87	M	0.0820	M
88	M	0.0870	M
89	M	0.1130	M
90	M	0.1220	M
91	M	0.1230	M
92	M	0.0690	M
93	M	0.0830	M
94	M	0.0750	M
95	M	0.0900	M
96	M	0.0940	M
97	M	0.0840	M
98	M	0.0670	M
99	M	0.1170	M
100	M	0.1160	M
101	M	0.1120	M
102	M	0.0960	M
103	M	0.0970	M
104	M	0.0970	M
105	M	0.0810	M
106	M	0.0800	M
107	M	0.0610	M
108	M	0.0440	M
109	M	0.0720	M
110	M	0.0860	M
111	M	0.1220	M
112	M	0.1050	M
113	M	0.1080	M
114	M	0.0400	M
115	M	0.0640	M
116	M	0.0740	M
117	M	0.0510	M
118	M	0.0740	M
119	M	0.0820	M
120	M	0.0670	M
121	M	0.0420	M

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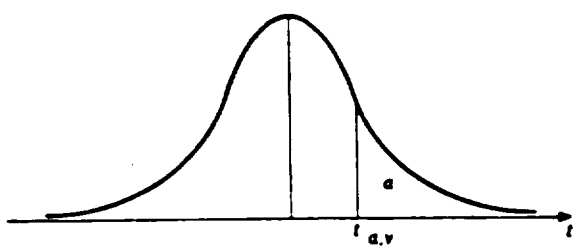
Table 5

Table 2 Percentage points of Student's t-distribution

α	·10	·05	·025	·01	·005	·001
ν						
1	3·078	6·314	12·706	31·821	63·657	318·310
2	1·886	2·920	4·303	6·965	9·925	22·327
3	1·638	2·353	3·182	4·541	5·841	10·215
4	1·533	2·132	2·776	3·747	4·604	7·173
5	1·476	2·015	2·571	3·365	4·032	5·893
6	1·440	1·943	2·447	3·143	3·707	5·208
7	1·415	1·895	2·365	2·998	3·499	4·785
8	1·397	1·860	2·306	2·896	3·355	4·501
9	1·383	1·833	2·262	2·821	3·250	4·297
10	1·372	1·812	2·228	2·764	3·169	4·144
11	1·363	1·796	2·201	2·718	3·106	4·025
12	1·356	1·782	2·179	2·681	3·055	3·930
13	1·350	1·771	2·160	2·650	3·012	3·852
14	1·345	1·761	2·145	2·624	2·977	3·787
15	1·341	1·753	2·131	2·602	2·947	3·733
16	1·337	1·746	2·120	2·583	2·921	3·686
17	1·333	1·740	2·110	2·567	2·898	3·646
18	1·330	1·734	2·101	2·552	2·878	3·610
19	1·328	1·729	2·093	2·539	2·861	3·579
20	1·325	1·725	2·086	2·528	2·845	3·552
21	1·323	1·721	2·080	2·518	2·831	3·527
22	1·321	1·717	2·074	2·508	2·819	3·505
23	1·319	1·714	2·069	2·500	2·807	3·485
24	1·318	1·711	2·064	2·492	2·797	3·467
25	1·316	1·708	2·060	2·485	2·787	3·450
26	1·315	1·706	2·056	2·479	2·779	3·435
27	1·314	1·703	2·052	2·473	2·771	3·421
28	1·313	1·701	2·048	2·467	2·763	3·408
29	1·311	1·699	2·045	2·462	2·756	3·396
30	1·310	1·697	2·042	2·457	2·750	3·385
40	1·303	1·684	2·021	2·423	2·704	3·307
60	1·296	1·671	2·000	2·390	2·660	3·232
120	1·289	1·658	1·980	2·358	2·617	3·160
∞	1·282	1·645	1·960	2·326	2·576	3·090



Taken from Chatfield, 1978.

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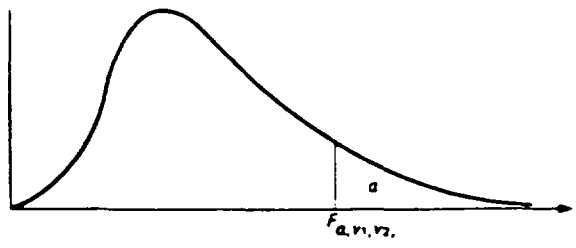
Table 6

Table 4 Upper percentage points of the *F*-distribution

(a) $\alpha = 0{\cdot}01$

ν_2 \ ν_1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30
1	4052·2	4999·5	5403·4	5624·6	5763·6	5859·0	5928·4	5981·1	6022·5	6055·8	6106·3	6157·3	6209·7	6234·6	6260·6
2	98·50	99·00	99·17	99·25	99·30	99·33	99·36	99·37	99·39	99·40	99·42	99·43	99·45	99·46	99·47
3	34·12	30·82	29·46	28·71	28·24	27·91	27·67	27·49	27·35	27·23	27·05	26·87	26·69	26·60	26·50
4	21·20	18·00	16·69	15·98	15·52	15·21	14·98	14·80	14·66	14·55	14·37	14·20	14·02	13·93	13·84
5	16·26	13·27	12·06	11·39	10·97	10·67	10·46	10·29	10·16	10·05	9·89	9·72	9·55	9·47	9·38
6	13·75	10·92	9·78	9·15	8·75	8·47	8·26	8·10	7·98	7·87	7·72	7·56	7·40	7·31	7·23
7	12·25	9·55	8·45	7·85	7·46	7·19	6·99	6·84	6·72	6·62	6·47	6·31	6·16	6·07	5·99
8	11·26	8·65	7·59	7·01	6·63	6·37	6·18	6·03	5·91	5·81	5·67	5·52	5·36	5·28	5·20
9	10·56	8·02	6·99	6·42	6·06	5·80	5·61	5·47	5·35	5·26	5·11	4·96	4·81	4·73	4·65
10	10·04	7·56	6·55	5·99	5·64	5·39	5·20	5·06	4·94	4·85	4·71	4·56	4·41	4·33	4·25
11	9·65	7·21	6·22	5·67	5·32	5·07	4·89	4·74	4·63	4·54	4·40	4·25	4·10	4·02	3·94
12	9·33	6·93	5·95	5·41	5·06	4·82	4·64	4·50	4·39	4·30	4·16	4·01	3·86	3·78	3·70
13	9·07	6·70	5·74	5·21	4·86	4·62	4·44	4·30	4·19	4·10	3·96	3·82	3·66	3·58	3·51
14	8·86	6·51	5·56	5·04	4·69	4·46	4·28	4·14	4·03	3·94	3·80	3·66	3·51	3·43	3·35
15	8·68	6·36	5·42	4·89	4·56	4·32	4·14	4·00	3·89	3·80	3·67	3·52	3·37	3·29	3·21
16	8·53	6·23	5·29	4·77	4·44	4·20	4·03	3·89	3·78	3·69	3·55	3·41	3·26	3·18	3·10
17	8·40	6·11	5·18	4·67	4·34	4·10	3·93	3·79	3·68	3·59	3·46	3·31	3·16	3·08	3·00
18	8·29	6·01	5·09	4·58	4·25	4·01	3·84	3·71	3·60	3·51	3·37	3·23	3·08	3·00	2·92
19	8·18	5·93	5·01	4·50	4·17	3·94	3·77	3·63	3·52	3·43	3·30	3·15	3·00	2·92	2·84
20	8·10	5·85	4·94	4·43	4·10	3·87	3·70	3·56	3·46	3·37	3·23	3·09	2·94	2·86	2·78
21	8·02	5·78	4·87	4·37	4·04	3·81	3·64	3·51	3·40	3·31	3·17	3·03	2·88	2·80	2·72
22	7·95	5·72	4·82	4·31	3·99	3·76	3·59	3·45	3·35	3·26	3·12	2·98	2·83	2·75	2·67
23	7·88	5·66	4·76	4·26	3·94	3·71	3·54	3·41	3·30	3·21	3·07	2·93	2·78	2·70	2·62
24	7·82	5·61	4·72	4·22	3·90	3·67	3·50	3·36	3·26	3·17	3·03	2·89	2·74	2·66	2·58
25	7·77	5·57	4·68	4·18	3·85	3·63	3·46	3·32	3·22	3·13	2·99	2·85	2·70	2·62	2·54
26	7·72	5·53	4·64	4·14	3·82	3·59	3·42	3·29	3·18	3·09	2·96	2·81	2·66	2·58	2·50
27	7·68	5·49	4·60	4·11	3·78	3·56	3·39	3·26	3·15	3·06	2·93	2·78	2·63	2·55	2·47
28	7·64	5·45	4·57	4·07	3·75	3·53	3·36	3·23	3·12	3·03	2·90	2·75	2·60	2·52	2·44
29	7·60	5·42	4·54	4·04	3·73	3·50	3·33	3·20	3·09	3·00	2·87	2·73	2·57	2·49	2·41
30	7·56	5·39	4·51	4·02	3·70	3·47	3·30	3·17	3·07	2·98	2·84	2·70	2·55	2·47	2·39
40	7·31	5·18	4·31	3·83	3·51	3·29	3·12	2·99	2·89	2·80	2·66	2·52	2·37	2·29	2·20
60	7·08	4·98	4·13	3·65	3·34	3·12	2·95	2·82	2·72	2·63	2·50	2·35	2·20	2·12	2·03
120	6·85	4·79	3·95	3·48	3·17	2·96	2·79	2·66	2·56	2·47	2·34	2·19	2·03	1·95	1·86
∞	6·63	4·61	3·78	3·32	3·02	2·80	2·64	2·51	2·41	2·32	2·18	2·04	1·88	1·79	1·70



FORM 91-005-1 (4/81)

SUMMARY OF BOREHOLES AT GRJ-03
1989

HOLE NUMBER	HOLE TYPE	LOCATION EAST COORDINATE	LOCATION NORTH COORDINATE	GS ELEVATION (FT-MSL)	INTERVAL CORED	BOREHOLE DIAM. (IN)	HOLE DEPTH (FT)	DEPTH TO MANCOS (FT)	BEDROCK ELEVATION (FT)
906	BH	93778.4	11423.2	5238.9		6	55	41	5197.9
908	BH	93779.3	10830.4	5232.4		6	44	41	5191.4
909	BH	94006.8	11607.8	5245.4		6	45	40.5	5204.9
910	BH	93869.4	11339.1	5239.9		6	46	42	5197.9
911	BH	93751.1	11536.2	5238.4		6	45	41	5197.4
912	BH	93659.0	11762.6	5239.7		6	38	34.5	5205.2
913	BH	93611.0	11853.0	5241.5		6	40	36	5205.5
914	BH	93685.1	11713.7	5239.2		6	40	37	5202.2
916	BH	93735.3	11396.9	5237.6		6	40	38	5199.6
917	BH	93658.6	10883.8	5230.2		6	42	42	5188.2
918	BH	93765.0	11480.4	5237.7		6	40	36	5201.7
919	BH	93828.5	11382.1	5239.4		6	55	46	5193.4
920	BH	93533.6	10856.7	5227.6		6	48	38.5	5189.1
921	BH	93741.3	10857.5	5232.1		6	45	43.5	5188.6
922	BH	93646.9	10343.1	5224.3	37-47	6	37	36	5188.3
923	BH	93712.8	10215.8	5221.9		6	20	18.5	5203.4
924	BH	93641.3	10727.3	5230.0		6	46	45.5	5184.5
925	BH	93933.9	10825.4	5235.0		6	40	25	5210.0
926	BH	94071.9	10831.2	5237.5		6	27	24	5213.5
928	BH	93479.8	11110.6	5228.9		6	38	35	5193.9
929	BH	93592.4	11941.1	5242.4		6	29	25	5217.4
930	BH	93545.9	12041.5	5242.6		6	25	22	5220.6
932	BH	93915.2	11303.2	5240.5		6	48	45	5195.5
933	BH	92841.9	12670.5	5235.3		6	30	24.5	5210.9
934	BH	92557.4	12625.1	5227.2		6	25	20	5207.2
940	BH	92200.5	12595.1	5221.7		6	23	20	5201.7
941	BH	92205.7	12729.1	5224.0		6	15	11.5	5212.5
942	BH	93272.7	10189.6	5217.9		6	34	32	5185.9
947	BH	92271.2	12250.7	5220.9		6	35	31.5	5189.4
948	BH	92298.8	12438.1	5224.3		6	33	32	5192.3
949	BH	93825.4	10796.1	5233.1		6	30	26.5	5206.6
950	BH	93885.7	10763.9	5234.0		6	27	26	5208.0
953	BH	93847.3	10876.5	5234.0		6	40	38	5196.0
968	BH	94015.1	10748.1	5236.0		6	35	29	5206.0

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-03-90-13-03-01 DISCIPLINE HYDRO NO. OF SHEETS 115

PROJECT:
UMTRA

SITE:
Cheney – Grand Junction, Colorado

FEATURE:
Borehole Water Level Measurements @ Cheney Disposal Site

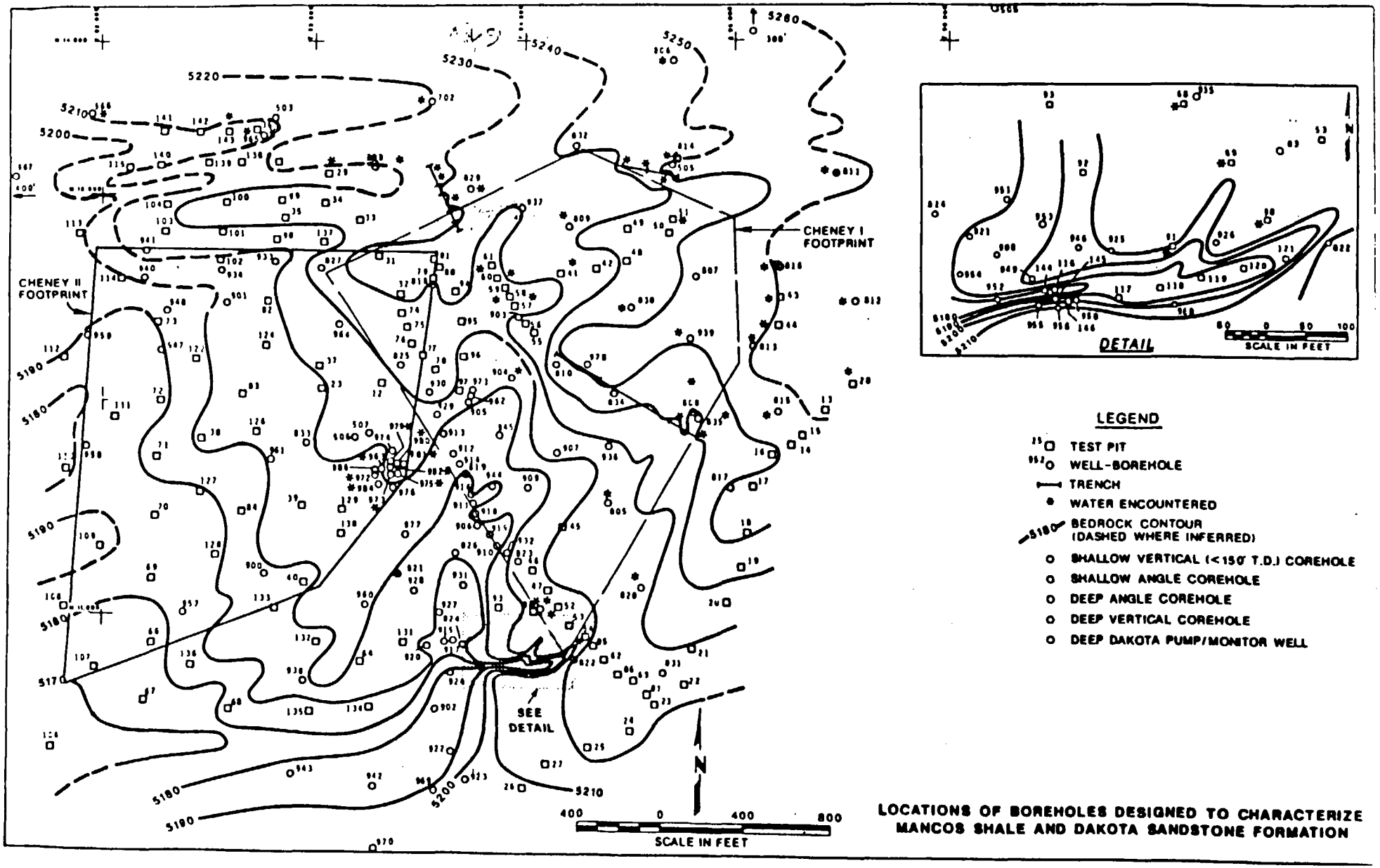
SOURCES OF DATA:
MK-Ferguson Field Data
TEG Field Data

SOURCES OF FORMULAE & REFERENCES:

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		V. Dean	3/29/90	[illegible]	[illegible]/90	T. Coons	7/16/90

8/85



LOCATIONS OF BOREHOLES DESIGNED TO CHARACTERIZE MANCOS SHALE AND DAKOTA SANDSTONE FORMATION

FIGURE 1

Table 1 WATER LEVEL DATA

DATE	507	508	509	701	702	805S	805D	806S	806D	807S	807D	808	809	810	811S	811D
03/05/89 :															25.50	58.40
03/06/89 :															25.50	57.70
03/07/89 :								29.20	DRY						25.40	56.70
03/08/89 :								29.40	DRY						25.50	56.35
03/13/89 :								-	-						25.40	56.00
03/14/89 :								29.35	DRY						25.45	56.20
03/15/89:								29.35	DRY	DRY	DRY				25.45	56.10
03/16/89 :								29.35	DRY	DRY	DRY				25.45	56.10
03/18/89 :								29.35	DRY	DRY	DRY				25.50	56.00
03/20/89 :								-	-	DRY	DRY		29.15		25.50	55.90
03/21/89 :								-	-	DRY	DRY	17.80	DRY	DRY	-	-
03/22/89 :								-	-	-	-	-	-	-	-	-
03/24/89 :						28.14	DRY	27.67	DRY	DRY	DRY	17.57	-	DRY	-	-
03/30/89 :						-	-	29.25	DRY	DRY	-	-	-	-	25.37	-
03/31/89 :						24.84	DRY	27.67	DRY	DRY	DRY	17.53	28.88	DRY	25.43	56.08
04/01/89 :						24.84	DRY	29.15	76.62	DRY	DRY	17.38	28.80	DRY	25.26	56.00
04/04/89 :						-	-	-	-	-	-	-	-	-	-	-
04/05/89 :	DRY	31.87	50.75	-	-	25.49	DRY	29.27	76.65	DRY	DRY	17.51	28.75	DRY	25.45	55.78
04/12/89 :	DRY	31.77	48.83	27.60	25.40	24.15	DRY	29.13	76.62	DRY	DRY	17.36	28.72	DRY	25.25	56.10
04/15/89 :	-	31.75	47.93	27.63	25.31	32.26[a]	39.97[b]	29.07	DRY[a]	DRY	DRY	17.33	28.70	DRY	25.20	56.00
04/18/89 :	DRY	31.70	46.80	27.55	25.27	31.81	39.73[b]	29.03	76.45	DRY	42.94[b]	17.25	28.56	DRY	25.13	55.50
04/26/89 :	DRY	31.76	44.65	27.65	25.25	30.57	38.66[b]	30.70	76.50	DRY	43.57[b]	17.24	28.50	DRY	25.22	55.38
04/28/89 :	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/29/89 :	DRY	31.83	43.85	27.70	25.30	30.31	38.36[b]	31.04	76.50	DRY	43.62[b]	17.28	28.50	DRY	25.25	55.30

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to re[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	507	508	509	701	702	805S	805D	806S	806D	807S	807D	808	809	810	811S	811D
05/03/89	DRY	31.75	42.85	27.75	25.25	29.94	38.19[b]	28.97	76.45[b]	DRY	43.67[b]	17.24	28.50	DRY	25.22	55.16
05/09/89	DRY	31.79	41.32	27.82	25.32	27.39	37.86[b]	29.02	76.39[b]	DRY	43.72[b]	17.27	28.46	DRY	25.29	55.06
05/10/89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/19/89	-	-	-	-	-	28.72	51.63[b]	-	76.45[b]	-	-	-	28.50	-	-	-
05/25/89	DRY	32.03	40.44	28.06	25.39	29.94	34.16[b]	29.14	27.15[b]	DRY	43.01[b]	17.45	28.45	DRY	25.47	54.56
06/02/89	-	32.07	40.47	28.28	25.43	-	-	29.20	28.41[b]	-	-	-	28.57	-	25.54	54.38
06/03/89	DRY	32.16	40.49	28.25	25.38	30.28	33.47[b]	29.21	28.48[b]	DRY	43.40	17.51	28.58	DRY	25.53	54.36
06/05/89	-	32.15	40.49	28.35	25.50	30.06	33.75[b]	29.30	28.78[b]	-	43.50[b]	17.56	28.60	-	25.63	54.13
06/06/89	-	32.06	40.41	28.31	27.48	29.91	33.41[b]	29.20	28.91[b]	-	43.50[b]	17.59	28.66	-	25.58	53.76
06/07/89	-	32.19	40.51	28.43	25.50	30.09	33.24[b]	29.25	29.10[b]	-	43.56[b]	17.79	28.70	-	25.63	53.57
06/08/89	-	32.20	40.49	28.44	25.50	29.82	33.52[b]	29.28	29.20[b]	-	43.58[b]	17.96	28.69	-	25.65	53.38
06/09/89	-	32.25	40.52	28.43	25.50	30.13	32.83[b]	29.31	29.32[b]	-	43.57[b]	18.14	28.72	-	25.68	53.15
06/10/89	-	32.25	40.45	28.40	25.50	30.65	32.47[b]	29.31	29.20[b]	-	43.59[b]	18.27	28.76	-	25.70	52.92
06/12/89	-	32.29	40.49	28.47	25.57	31.12	32.87[b]	29.34	29.69[b]	-	43.65[b]	18.50	28.82	-	25.70	52.52
06/13/89	-	32.29	40.47	28.48	25.59	31.22	33.16[b]	29.37	29.81[b]	-	43.66[b]	18.59	28.87	-	25.77	52.32
06/14/89	-	32.24	40.45	28.49	25.57	31.07	33.56[b]	29.37	29.95[b]	-	43.68[b]	18.64	28.88	-	25.75	52.11
06/16/89	-	-	-	-	-	30.20	34.13[b]	29.28	30.21[b]	-	43.69[b]	18.71	28.93	-	25.83	51.49
06/19/89	-	32.32	40.41	28.56	25.59	29.42	33.94[b]	29.34	30.53[b]	-	43.76[b]	18.78	29.05	-	25.76	51.07
06/20/89	-	32.34	40.45	28.56	25.55	30.30	33.11[b]	29.37	30.65[b]	-	43.78[b]	18.78	29.07	-	25.77	50.90
06/21/89	-	32.38	40.42	28.56	25.63	30.78	33.52[b]	29.46	30.74[b]	-	43.80[b]	18.84	29.10	-	25.85	50.78
06/22/89	-	32.32	40.42	28.59	25.58	30.73	33.99[b]	29.37	30.88[b]	-	43.81[b]	18.86	29.15	-	25.81	50.53
06/26/89	-	32.36	40.38	28.59	25.60	31.23	35.48[b]	29.40	31.30[b]	-	43.88[b]	18.88	29.47	-	25.85	49.86
06/28/89	-	32.39	40.42	28.63	25.61	31.36	36.21[b]	29.43	31.52[b]	-	43.92[b]	18.90	29.95	-	25.88	49.35
06/30/89	-	32.42	40.45	28.69	25.63	32.16	36.43[b]	29.44	31.72[b]	-	43.93[b]	18.91	30.45	-	25.90	49.00

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE :	507	508	509	701	702	805S	805D	806S	806D	807S	807D	808	809	810	811S	811D
07/05/89 :	-	32.47	40.42	28.72	25.70	32.49	38.68	29.49	32.23[b]	-	44.01[b]	18.97	DRY	-	25.96	47.90
07/15/89 :	-	-	-	-	-	32.64	40.96	-	-	-	-	19.21	-	-	-	-
07/19/89 :	-	32.67	89.47	28.91	25.85	32.76	41.92	29.75	33.60[b]	-	44.32[b]	19.14	DRY	-	26.71	55.98
07/22/89 :	-	32.71	86.99	28.93	25.95	DRY	42.14	27.04	61.24[b]	-	44.27[b]	19.10	DRY	-	26.23	55.63
07/31/89 :	-	-	-	-	-	-	-	-	-	-	44.42[b]	19.24	DRY	-	-	-
08/04/89 :	-	32.88	85.05	29.00	25.88	DRY	41.98	29.75	61.10[b]	-	44.45[b]	19.24	DRY	-	26.31	55.23
08/14/89 :	-	33.00	87.15	29.19	26.02	DRY	57.83	30.25	66.33[b]	-	44.75[b]	19.41	DRY	-	26.64	55.23
08/17/89 :	-	33.01	87.14	29.17	26.01	DRY	57.83	30.22	66.34[b]	-	44.75[b]	19.34	DRY	-	26.60	55.21
08/19/89 :	-	33.15	86.68	29.08	26.04	DRY	57.82	30.20	66.33[b]	-	44.75[b]	19.34	DRY	-	26.58	55.21
08/21/89 :	-	33.17	86.22	29.13	26.08	DRY	57.31	30.33	66.37[b]	-	44.29[b]	17.41[f]	DRY	-	26.60	55.11
08/24/89 :	-	33.00	86.18	29.17	26.00	DRY	57.31	30.29	66.08[b]	-	44.33[b]	19.43	DRY	-	26.56	55.13
08/29/89 :	-	33.00	87.15	29.19	26.00	DRY	57.83	30.25	66.33[b]	-	44.76[b]	19.39	DRY	-	26.64	55.21
09/05/89 :	-	33.00	83.05	29.29	26.25	DRY	57.89	30.22	66.49[b]	-	44.79[b]	19.34	DRY	-	26.73	55.30
09/11/89 :	-	33.17	82.80	29.33	26.19	DRY	57.89	30.20	66.45[b]	-	44.72[b]	19.30	DRY	-	30.68	55.23
09/18/89 :	-	33.00	80.18	29.25	26.00	DRY	59.92	30.25	66.45[b]	-	44.91[b]	19.34	DRY	-	26.75	55.30
09/20/89 :	-	33.37	-	29.33	-	DRY	-	30.54	66.03[b]	-	-	-	-	-	26.77	52.88
09/21/89 :	-	33.33	-	29.40	-	DRY	-	-	-	-	-	-	-	-	27.11	52.96
09/22/89 :	-	33.41	-	29.37	-	-	DRY	-	30.55[b]	66.03	-	-	-	-	27.01	53.75
09/25/89 :	-	33.42	79.98	29.33	25.96	DRY	59.02	30.45	65.87[b]	-	45.04[b]	19.34	DRY	-	26.85	54.17
10/02/89 :	-	33.46	77.80	29.33	26.75	DRY	59.00	29.79	66.47[b]	-	44.87[b]	19.34	DRY	-	27.18	52.96
10/09/89 :	-	33.42	77.97	29.33	26.50	DRY	59.03	29.79	66.37[b]	-	44.87[b]	19.43	DRY	-	26.85	52.96
10/17/89 :	-	34.58	85.97	29.50	26.17	DRY	56.48[g]	30.20	66.47[b]	-	45.08[b]	19.43	DRY	-	26.70	55.30
10/27/89 :	-	34.60	85.80	29.33	26.50	DRY	56.50[g]	30.29	66.45[b]	-	45.20[b]	19.51	DRY	-	26.85	55.30
10/30/89 :	-	33.80	74.44	29.43	26.42	DRY	58.23[g]	30.52	66.81[b]	-	45.52[b]	19.64	DRY	-	27.28	47.33

FOOTNOTES:

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k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE :	507	508	509	701	702	805S	805D	806S	806D	807S	807D	808	809	810	811S	811D
11/06/89 :	-	33.71	74.14	29.03	26.40	DRY	58.23[g]	30.48[b]	66.78	-	45.54[b]	19.62	DRY	-	27.26	47.33
11/13/89 :	-	34.13	74.87	29.00	26.51	DRY	57.70[g]	31.39[b]	66.86	-	45.50[b]	20.51	DRY	-	27.47	47.37
11/21/89 :	-	34.10	70.01	29.23	26.57	DRY	56.36[g]	30.78[b]	65.91	-	45.61[b]	19.67	DRY	-	27.52	56.59
12/14/89 :	-	33.62	63.97	29.32	26.29	DRY	56.37[g]	30.62[b]	65.56	-	44.92[b]	19.45	DRY	-	26.87	56.25
12/29/89 :	-	34.31	69.81	29.15	27.46	DRY	56.53[g]	30.67[b]	65.73	-	45.63[b]	19.52	DRY	-	27.21	56.49
01/17/90 :	-	34.37	70.60	29.41	28.12	DRY	54.59[g]	30.67[b]	65.95	-	45.89[b]	19.62	DRY	-	27.73	56.69
02/01/90 :	-	35.30	-	31.27	-	-	-	-	-	-	-	-	-	-	-	-
03/02/90 :	-	31.24	-	31.24	-	-	-	-	-	-	-	-	-	-	-	-

FOOTNOTES:

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k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	812S	812D	813	814	815	816	817	818	819	820	821S	821D	822	823S	823D
03/05/89 :															
03/06/89 :															
03/07/89 :															
03/08/89 :															
03/13/89 :	26.80	DRY													
03/14/89 :	24.85	61.10													
03/15/89 :	23.70	59.50													
03/16/89 :	23.10	58.30	DRY												
03/18/89 :	22.50	55.55	DRY	31.00	19.80	DRY									
03/20/89 :	22.00	-	DRY	-	19.70	DRY									
03/21/89 :	19.90	57.35	DRY	-	19.60	-									
03/22/89 :	-	-	-	-	-	-									
03/24/89 :	19.70	57.09	14.99[c]	-	19.75	19.46									
03/30/89 :	19.82	-	DRY	-	19.68	16.64									
03/31/89 :	19.87	56.88	14.45[c]	30.61	19.73	DRY	DRY	DRY	DRY						
04/01/89 :	19.71	56.77	DRY	30.63	19.69	19.70[d]	DRY	DRY	DRY	21.76					
04/04/89 :	-	-	-	-	-	-	-	-	-	-					
04/05/89 :	25.02[d]	56.62	14.99[c]	30.75	19.74	20.09[d]	15.54[b]	DRY	DRY	21.76					
04/12/89 :	19.66	61.27[a]	14.87	30.61	19.69	16.19	18.14[b]	DRY	DRY	21.66			DRY		
04/15/89 :	19.65	62.20	14.63	30.60	19.69	15.52	18.56[b]	23.31[b]	DRY	21.65			28.44[b]	DRY	DRY
04/18/89 :	19.62	61.77	14.28	30.50	19.59	14.99	18.70[b]	24.11[b]	DRY	18.56[f]			29.29[b]	DRY	-
04/26/89 :	19.67	61.65	13.84	30.50	19.64	14.52	19.22[b]	24.78[b]	DRY	21.51			30.82[b]	DRY	DRY
04/28/89 :	-	-	-	-	-	-	-	-	-	-	DRY	DRY	-	-	48.13[b]
04/29/89 :	19.80	61.62	13.74	30.50	19.79	14.52	19.37[b]	24.91[b]	DRY	21.51	DRY	DRY	31.18[b]	DRY	48.50[b]

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f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
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k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	812S	812D	813	814	815	816	817	818	819	820	821S	821D	822	823S	823D
05/03/89	19.78	61.49	13.60	30.50	19.66	14.48	19.49[b]	DRY	DRY	21.48	30.02[b]	33.04	31.55[b]	DRY	48.54[b]
05/09/89	19.93	61.40	13.51	30.50	19.75	14.56	19.60[b]	DRY	DRY	21.43	30.51[b]	34.97	32.02[b]	DRY	48.87[b]
05/10/89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/19/89	-	61.19	13.52	-	19.85	-	-	-	-	-	-	34.11	32.48[b]	-	-
05/25/89	20.27	18.27[b,c]	15.10[d]	30.87	19.95	-	17.83[b]	DRY	DRY	21.34	DRY	35.02	28.56[b]	DRY	48.43[b]
06/02/89	-	-	-	31.13	-	-	-	-	-	-	-	-	-	-	-
06/03/89	20.45	19.94[b]	14.54	31.12	20.11	15.25	18.63[b]	DRY	DRY	21.39	DRY	37.38	29.88[b]	DRY	48.44[b]
06/05/89	20.57	20.05	14.46	31.29	20.17	15.17	-	-	-	21.43	-	37.85[b]	30.11[b]	-	48.55[b]
06/06/89	20.69	19.97	14.32	31.28	20.15	15.07	-	-	-	21.38	-	38.10[b]	30.23[b]	-	48.46[b]
06/07/89	20.60	20.16	14.39	31.38	20.25	15.14	-	-	-	21.39	-	38.39[b]	30.30[b]	-	48.50[b]
06/08/89	20.62	20.19	14.36	31.39	20.23	15.10	-	-	-	21.40	-	38.56[b]	30.42[b]	-	48.54[b]
06/09/89	20.63	20.19	14.31	31.38	20.27	15.10	-	-	-	21.40	-	38.74[b]	30.56[b]	-	48.54[b]
06/10/89	20.64	20.23	14.29	31.38	20.23	15.10	-	-	-	21.42	-	38.97[b]	30.66[b]	-	48.56[b]
06/12/89	20.70	20.28	14.17	31.41	20.27	15.08	-	-	-	21.44	-	39.38[b]	30.87[b]	-	48.58[b]
06/13/89	20.73	20.31	14.18	31.44	20.29	15.10	-	-	-	21.44	-	39.57[b]	30.95[b]	-	48.54[b]
06/14/89	20.75	20.35	14.19	31.48	20.31	15.11	-	-	-	21.44	-	39.76[b]	31.03[b]	-	48.53[b]
06/16/89	-	-	14.15	-	20.29	15.09	-	-	-	21.42	-	40.18[b]	-	-	-
06/19/89	20.82	20.47	14.09	31.48	20.31	15.12	-	-	-	21.47	-	40.70[b]	31.40[b]	-	48.52[b]
06/20/89	20.84	20.50	14.08	31.49	20.31	15.14	-	-	-	21.51	-	40.90[b]	31.47[b]	-	48.52[b]
06/21/89	20.91	20.54	14.10	31.50	20.32	15.15	-	-	-	21.55	-	41.09[b]	31.58[b]	-	48.54[b]
06/22/89	20.87	20.56	14.09	31.50	20.33	15.14	-	-	-	21.54	-	41.28[b]	31.64[b]	-	48.50[b]
06/26/89	20.97	20.67	14.06	31.52	20.34	15.17	-	-	-	21.63	-	41.98[b]	31.90[b]	-	48.50[b]
06/28/89	21.02	20.70	14.06	31.53	20.32	15.20	-	-	-	21.68	-	42.30[b]	32.02[b]	-	48.83[b]
06/30/89	21.04	20.74	14.07	31.57	20.34	15.22	-	-	-	21.73	-	42.58[b]	32.12[b]	-	48.82[b]

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f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	812S	812D	813	814	815	816	817	818	819	820	821S	821D	822	823S	823D
07/05/89	21.15	20.87	14.13	-	20.36	15.29	-	-	-	21.94	-	43.35[b]	32.42[b]	DRY	47.35[b]
07/15/89	-	-	13.54	-	20.04	-	-	-	-	-	-	44.95[b]	33.02[c]	DRY	40.20[i]
07/19/89	21.44	21.23	DRY	31.71	22.30[c]	20.90[f]	-	-	-	22.30	-	45.42[b]	33.12[c]	DRY	-
07/22/89	21.42	21.24	DRY	-	22.09[c]	18.88[f]	-	-	-	22.41	-	45.73[b]	DRY	DRY	-
07/31/89	21.64	21.51	15.89[f]	-	21.71[c]	16.14	-	-	-	22.66	-	-	33.92[c]	DRY	-
08/04/89	21.75	21.53	DRY	-	21.59[c]	15.90	-	-	-	22.70	-	47.33	DRY	DRY	-
08/14/89	21.79	22.02	DRY	31.85	22.99[c]	17.83	-	-	-	22.93	-	DRY	34.19[c]	DRY	46.54[i]
08/17/89	21.78	22.01	DRY	31.85	22.93[c]	17.83	-	-	-	22.93	-	DRY	34.17[c]	DRY	46.45[i]
08/19/89	21.77	22.01	DRY	31.85	22.99[c]	17.81	-	-	-	22.84	-	DRY	DRY	DRY	45.73[i]
08/21/89	21.85	22.01	DRY	31.91	23.03[c]	17.19	-	-	-	22.92	-	DRY	DRY	DRY	46.62[i]
08/24/89	21.85	21.85	DRY	32.50	23.09[c]	17.23	-	-	-	22.89	-	DRY	DRY	DRY	46.62[i]
08/29/89	21.77	22.01	DRY	31.85	22.97[c]	17.83	-	-	-	22.91	-	DRY	34.19[c]	DRY	46.52[i]
09/05/89	21.79	22.01	DRY	31.92	22.94[c]	17.44	-	-	-	23.51	-	DRY	DRY	DRY	46.56[i]
09/11/89	21.77	21.97	DRY	31.94	23.01[c]	17.42	-	-	-	23.51	-	DRY	DRY	DRY	46.54[i]
09/18/89	21.87	21.93	DRY	32.00	23.26[c]	17.44	-	-	-	22.93	-	DRY	DRY	DRY	46.58[i]
09/20/89	-	-	-	-	-	15.75	-	-	-	23.43	-	-	-	-	-
09/21/89	-	-	-	-	-	15.67	-	-	-	23.43	-	-	DRY	-	-
09/22/89	-	-	-	-		15.79		-	-	23.51	-	-	DRY	-	-
09/25/89	21.94	21.97[b]	18.33[f]	31.50	23.13[c]	15.35	-	-	-	23.43	-	DRY	DRY	DRY	46.60[i]
10/02/89	21.69	21.97[b]	18.00[f]	31.42	23.22[c]	18.02	-	-	-	23.93	-	DRY	DRY	DRY	46.62[i]
10/09/89	21.69	21.59[b]	18.08[f]	31.83	23.17[c]	18.02	-	-	-	23.51	-	DRY	DRY	DRY	46.62[i]
10/17/89	21.77	22.05[b]	16.81[f]	31.83	22.92[c]	17.92	-	-	-	23.64	-	DRY	DRY	-	DRY
10/27/89	21.85	22.10[b]	16.79[f]	32.00	22.84[c]	18.11	-	-	-	23.51	-	DRY	DRY	-	DRY
10/30/89	22.01	22.36[b]	17.64[f]	32.37	23.31[c]	16.17	-	-	-	25.13	-	DRY	DRY	-	DRY

FOOTNOTES:

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e) Water levels affected by water from upper screen.
f) Data i[illegible]pect.
g) Increa[illegible] water level suggests groundwater is beginning to rec[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No [illegible]surement taken.

Table 1 WATER LEVEL DATA

DATE	812S	812D	813	814	815	816	817	818	819	820	821S	821D	822	823S	823D
11/06/89	21.95	22.39[b]	17.55[f]	32.32	23.29[c]	16.21	-	-	-	23.61	-	DRY	DRY	-	DRY
11/13/89	21.93	22.43[b]	17.61[f]	32.30	23.31[c]	16.19	-	-	-	23.65	-	DRY	DRY	-	DRY
11/21/89	22.26	22.54[b]	15.70[f]	32.03	23.13[c]	16.08	-	-	-	27.67[c]	-	DRY	DRY	-	DRY
12/14/89	22.17	22.39[b]	15.38[f]	31.81	22.60[c]	15.53	-	-	-	28.01[c]	-	DRY	DRY	-	DRY
12/29/89	22.32	22.39[b]	14.60[f]	31.90	22.91[c]	15.20	-	-	-	27.73[c]	-	DRY	DRY	-	DRY
01/17/90	22.22	22.83[b]	15.55[f]	32.36	23.50[c]	15.25	-	-	-	28.23[c]	-	DRY	DRY	-	DRY
02/01/90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/02/90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	824	825S	825D	826	827	828	829S	829D	830	831	832	833S	833D	834S	834D	835
03/05/89 :																
03/06/89 :																
03/07/89 :																
03/08/89 :																
03/13/89 :																
03/14/89 :																
03/15/89 :																
03/16/89 :																
03/18/89 :																
03/20/89 :																
03/21/89 :																
03/22/89 :																
03/24/89 :																
03/30/89 :																
03/31/89 :										DRY						
04/01/89 :									DRY	DRY						
04/04/89 :									-	-						
04/05/89 :									DRY	22.90						
04/12/89 :									25.97	23.95						
04/15/89 :		DRY	DRY						24.49	24.14						
04/18/89 :		DRY	DRY	DRY		21.17	27.48	27.61[e]	22.95	24.19	DRY					
04/26/89 :	DRY	DRY	51.02[b]	-	DRY	21.07	27.45	31.85[e]	20.03	24.55	DRY					
04/28/89 :	-	-	-	-	-	-	27.51	28.21[e]	-	-	-					
04/29/89 :	DRY	DRY	51.42[b]	-	DRY	21.12	27.48	28.90[e]	19.29	24.65	DRY					

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k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).

\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	824	825S	825D	826	827	828	829S	829D	830	831	832	833S	833D	834S	834D	835
05/03/89	DRY	DRY	51.54[b]	DRY	DRY	21.04	27.43	27.43[e]	18.52	24.70	DRY	DRY	DRY	26.15[b]	DRY	-
05/09/89	DRY	DRY	51.59[b]	DRY	DRY	21.05	27.44	27.51[e]	18.17	24.88	DRY	DRY	DRY	27.37[b]	DRY	17.62
05/10/89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/19/89	-	DRY	48.98[b]	-	DRY	21.05	-	-	18.05	-	DRY	DRY	DRY	19.96[b]	DRY	-
05/25/89	46.58[b]	DRY	49.42[b]	44.71[b]	14.17[b]	21.12	27.47	30.62[e]	21.86	23.60	25.97[b]	34.60[b]	35.51[b]	21.93[b]	DRY	17.75[j]
06/02/89	-	-	-	-	-	21.13	27.43	30.64[e]	-	-	26.89[b]	-	-	-	-	-
06/03/89	46.68[b]	DRY	50.24[b]	44.67[b]	15.21[b]	21.12	27.43	30.52[e]	19.26	24.05	26.91[b]	34.61[b]	37.64[b]	-	-	17.83
06/05/89	46.78[b]	-	50.40[b]	-	-	21.19	27.58	31.27[e]	18.98	-	-	34.65[b]	38.05[b]	-	-	17.87
06/06/89	46.71[b]	-	50.32[b]	-	-	21.15	27.51	31.43[e]	20.90	-	-	34.68[b]	38.30[b]	-	-	17.91
06/07/89	46.80[b]	-	50.35[b]	-	-	21.19	27.51	31.76[e]	18.76	-	-	34.71[b]	38.55[b]	-	-	17.99
06/08/89	46.81[b]	-	50.40[b]	-	-	21.16	27.56	31.87[e]	18.70	-	-	34.72[b]	38.70[b]	-	-	18.35
06/09/89	46.71[b]	-	50.42[b]	-	-	21.19	27.56	31.90[e]	18.60	-	-	34.69[b]	38.85[b]	-	-	18.49
06/10/89	46.78[b]	-	50.44[b]	-	-	21.18	27.57	31.57[e]	18.52	-	-	34.74[b]	39.07[b]	-	-	18.67
06/12/89	46.80[b]	-	50.57[b]	-	-	21.21	27.63	31.71[e]	18.43	-	-	34.72[b]	39.45[b]	-	-	20.92
06/13/89	46.87[b]	-	50.61[b]	-	-	21.22	27.68	31.91[e]	18.42	-	-	34.75[b]	39.64[b]	-	-	18.95
06/14/89	46.85[b]	-	50.59[b]	-	-	21.21	27.68	32.05[e]	18.38	-	-	34.75[b]	39.83[b]	-	-	19.00
06/16/89	46.88[b]	-	50.52[b]	-	-	-	-	-	18.37	-	-	34.72[b]	40.22[b]	-	-	19.05
06/19/89	46.88[b]	-	50.69[b]	-	-	21.19	27.87	32.45[e]	18.35	-	-	34.74[b]	40.71[b]	-	-	19.08
06/20/89	46.91[b]	-	50.67[b]	-	-	21.19	27.86	32.45[e]	18.32	-	-	34.75[b]	40.87[b]	-	-	19.13
06/21/89	46.88[b]	-	50.66[b]	-	-	21.24	27.96	32.54[e]	18.34	-	-	34.75[b]	41.07[b]	-	-	19.19
06/22/89	46.95[b]	-	50.63[b]	-	-	21.23	27.91	32.59[e]	18.34	-	-	34.77[b]	41.30[b]	-	-	19.18
06/26/89	46.93[b]	-	50.69[b]	-	-	21.22	28.01	32.67[e]	18.35	-	-	34.76[b]	41.89[b]	-	-	19.21
06/28/89	47.01[b]	-	50.79[b]	-	-	21.24	28.04	32.77[e]	18.38	-	-	-	41.31[b]	-	-	19.23
06/30/89	47.03[b]	-	46.54[b]	-	-	21.24	28.08	32.83[e]	18.37	-	-	34.69[i]	41.59[b]	-	-	19.24

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	824	825S	825D	826	827	828	829S	829D	830	831	832	833S	833D	834S	834D	835
07/05/89	47.02[b]	-	49.14[b]	-	-	21.29	28.19	32.96[e]	18.42	-	-	34.62[i]	42.41[i]	-	-	19.30
07/15/89	48.20[b]	-	-	-	-	-	-	18.57[e]	-	-	-	-	-	-	19.22	-
07/19/89	47.43[b]	-	-	-	-	21.63	28.35	42.59[e]	18.52	-	-	-	-	-	-	19.39
07/22/89	47.43[b]	-	-	-	-	21.44	28.51	37.53[e]	18.51	-	-	-	-	-	-	19.44
07/31/89	-	-	-	-	-	-	-	-	18.39	-	-	-	-	-	-	19.54
08/04/89	47.62[b]	-	-	-	-	21.37	28.58	34.53[e]	18.34	-	-	-	-	-	-	19.54
08/14/89	46.87[b]	-	50.93[b]	-	-	21.57	29.06	37.24[e]	22.13	-	-	34.99[i]	40.07[i]	-	-	19.62
08/17/89	46.85[b]	-	50.85[b]	-	-	21.54	29.03	37.22[e]	22.13	-	-	34.86[i]	40.05[i]	-	-	19.62
08/19/89	46.86[b]	-	50.94[b]	-	-	21.54	29.06	37.20[e]	21.28	-	-	34.99[i]	40.05[i]	-	-	19.62
08/21/89	46.93[b]	-	51.02[b]	-	-	21.62	29.10	37.26[e]	19.49	-	-	35.57[i]	40.12[i]	-	-	20.12
08/24/89	47.10[b]	-	51.02[b]	-	-	21.66	29.10	37.28[e]	18.57	-	-	35.57[i]	40.14[i]	-	-	20.12
08/29/89	46.87[b]	-	50.94[b]	-	-	21.58	29.06	37.24[e]	22.11	-	-	34.99[i]	40.05[i]	-	-	19.62
09/05/89	46.85[b]	-	51.02[b]	-	-	21.62	29.08	37.37[e]	22.09	-	-	34.99[i]	40.05[i]	-	-	19.72
09/11/89	46.60[b]	-	50.98[b]	-	-	21.54	29.06	37.37[e]	22.07	-	-	34.99[i]	20.05[f]	-	-	19.87
09/18/89	46.93[b]	-	50.85[b]	-	-	21.54	29.81	37.53[e]	24.07	-	-	34.99[i]	40.22[i]	-	-	20.12
09/20/89	-	-	-	-	-	-	-	-	18.40	-	-	-	-	-	-	-
09/21/89	-	-	-	-	-	21.79	-	-	18.40	-	-	-	-	-	-	-
09/22/89	-	-	-	-	-	21.80	-	-	18.57	-	-	-	-	-	-	-
09/25/89	47.02[b]	-	51.02[b]	-	-	21.79	29.76	37.45[f]	20.58	-	-	30.32[i]	40.22	-	-	20.62
10/02/89	46.85[b]	-	51.35[b]	-	-	21.37	29.12	37.45[f]	22.17	-	-	35.49[i]	39.72	-	-	19.79
10/09/89	47.35[b]	-	51.02[b]	-	-	21.37	29.10	37.37[f]	22.15	-	-	34.99[i]	39.89	-	-	19.62
10/17/89	DRY	-	51.02[b]	-	-	21.54	29.10	37.33[f]	22.15	-	-	34.99[i]	40.14	-	-	19.79
10/27/89	DRY	-	51.19[b]	-	-	21.58	29.26	37.37[f]	22.20	-	-	35.22[i]	40.05	-	-	19.62
10/30/89	DRY	-	51.68[b]	-	-	22.24	38.14[f]	37.62[f]	22.40	-	-	34.82[i]	48.40	-	-	19.83

FOOTNOTES:

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b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data i[illegible]pect.
g) Increa[illegible]water level suggests groundwater is beginning to rec[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	824	825S	825D	826	827	828	829S	829D	830	831	832	833S	833D	834S	834D	835
11/06/89	DRY	-	51.65[b]	-	-	22.25	38.12[f]	37.61[f]	22.37	-	-	34.82[i]	48.36	-	-	19.82
11/13/89	DRY	-	51.68[b]	-	-	22.29	38.09[f]	37.64[f]	22.46	-	-	34.88[i]	48.34	-	-	19.94
11/21/89	DRY	-	51.41[b]	-	-	22.35	30.07	34.67[f]	19.48	-	-	34.85[i]	50.18	-	-	19.77
12/14/89	DRY	-	51.37[b]	-	-	21.71	29.55	33.95[f]	18.06	-	-	34.84[i]	50.59	-	-	19.74
12/29/89	DRY	-	51.51[b]	-	-	22.47	29.96	34.66[f]	19.56	-	-	34.82[i]	50.24	-	-	19.71
01/17/90	DRY	-	51.73[b]	-	-	22.56	30.29	34.82[f]	19.76	-	-	35.52[i]	50.41	-	-	19.94
02/01/90	-	-	-	-	-	23.35	-	-	-	-	-	-	-	-	-	-
03/02/90	-	-	-	-	-	23.36	-	-	-	-	-	-	-	-	-	-

FOOTNOTES:

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b) Dry hole - water in hole added during falling head test.
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d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	936	937	938	939	903	904	906	908	910	911	912	913	914	915	916
03/05/89 :															
03/06/89 :															
03/07/89 :															
03/08/89 :															
03/13/89 :															
03/14/89 :															
03/15/89 :															
03/16/89 :															
03/18/89 :															
03/20/89 :															
03/21/89 :															
03/22/89 :															
03/24/89 :															
03/30/89 :															
03/31/89 :															
04/01/89 :															
04/04/89 :															
04/05/89 :															
04/12/89 :															
04/15/89 :															
04/18/89 :															
04/26/89 :															
04/28/89 :															
04/29/89 :															

FOOTNOTES:

a) Water level recovering from rising head test.
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e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to reach this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	936	937	938	939	903	904	906	908	910	911	912	913	914	915	916
05/03/89	28.13	-	DRY	-											
05/09/89	29.13	DRY	DRY	-											
05/10/89	27.54	-	-	13.95											
05/19/89	-	DRY	DRY	13.97											
05/25/89	26.08	DRY	17.13[b]	14.12											
06/02/89	-	DRY	-	-											
06/03/89	25.96	-	18.71[b]	14.20											
06/05/89	26.05	-	19.00[b]	14.28											
06/06/89	25.94	-	19.15[b]	14.20											
06/07/89	26.26	-	19.30[b]	14.32											
06/08/89	26.00	-	19.36[b]	14.31											
06/09/89	25.95	-	19.47[b]	14.30											
06/10/89	26.00	-	19.57[b]	14.33											
06/12/89	26.01	-	19.81[b]	14.37											
06/13/89	26.01	-	19.89[b]	14.38											
06/14/89	25.98	-	19.97[b]	14.38											
06/16/89	25.89	-	20.21[b]	14.34											
06/19/89	25.89	-	20.42[b]	14.42											
06/20/89	25.86	-	20.52[b]	14.42											
06/21/89	25.99	-	20.59[b]	14.45											
06/22/89	25.91	-	20.69[b]	14.47											
06/26/89	25.80	-	21.05[b]	14.47											
06/28/89	25.87	-	-	14.50											
06/30/89	25.78	-	DRY	14.52											

FOOTNOTES:

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f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	936	937	938	939	903	904	906	908	910	911	912	913	914	915	916
07/05/89	25.79	-	-	14.61											
07/15/89	25.76	-	-	14.75											
07/19/89	26.02	-	-	14.81											
07/22/89	25.73	-	-	14.85											
07/31/89	-	-	-	14.90											
08/04/89	DRY[f]	-	-	14.83											
08/14/89	25.68	-	-	14.96		35.41	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
08/17/89	25.67	-	-	14.95		35.29	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
08/19/89	25.63	-	-	14.95		35.42	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
08/21/89	25.54	-	DRY	15.03		35.58	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
08/24/89	25.46	-	DRY	14.95		35.50	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
08/29/89	25.67	-	DRY	14.95		35.42	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
09/05/89	DRY[f]	-	DRY	14.96		36.00	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
09/11/89	25.71	-	DRY	14.95		36.00	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
09/18/89	25.63	-	DRY	15.03		35.56	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
09/20/89	-	-	-	-		-	-	-	-	-	-	-	-	-	-
09/21/89	-	-	-	-		-	-	-	-	-	-	-	-	DRY	-
09/22/89	-	-	-	-		-	-	-	-	-	-	-	-	DRY	-
09/25/89	25.63	-	DRY	15.12		36.50	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/02/89	25.54	-	DRY	15.16		36.00	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/09/89	26.21	-	DRY	15.12		35.92	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/17/89	25.71	-	DRY	14.95		36.11	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/27/89	25.46	-	DRY	15.14		35.50	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/30/89	26.00	-	DRY	15.34		36.20	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

FOOTNOTES:

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c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is [illegible]ct.
g) Increas[illegible]ater level suggests groundwater is beginning to rech[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No [illegible]rement taken.

Table 1 WATER LEVEL DATA

DATE	936	937	938	939	903	904	906	908	910	911	912	913	914	915	916
11/06/89	25.98	-	DRY	15.32		36.23	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
11/13/89	25.98	-	DRY	15.34		36.29	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
11/21/89	25.47	-	DRY	14.96	32.54[i]	37.86	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
12/14/89	25.08	-	DRY	14.73	32.51[i]	36.43	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
12/29/89	25.69	-	DRY	15.21	32.59[i]	34.38	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
01/17/90	25.83	-	DRY	15.47	32.74[i]	34.39	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
02/01/90	-	-	-	-	35.34	-	-	-	-	-	-	-	-	-	-
03/02/90	-	-	-	-	35.33	-	-	-	-	-	-	-	-	-	-

FOOTNOTES:

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e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	917	918	919	920	921	925	932	831	926	946	950	949	956	955	954
03/05/89 :															
03/06/89 :															
03/07/89 :															
03/08/89 :															
03/13/89 :															
03/14/89 :															
03/15/89 :															
03/16/89 :															
03/18/89 :															
03/20/89 :															
03/21/89 :															
03/22/89 :															
03/24/89 :															
03/30/89 :															
03/31/89 :															
04/01/89 :															
04/04/89 :															
04/05/89 :															
04/12/89 :															
04/15/89 :															
04/18/89 :															
04/26/89 :															
04/28/89 :															
04/29/89 :															

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rech this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	917	918	919	920	921	925	932	831	926	946	950	949	956	955	954
05/03/89 :															
05/09/89 :															
05/10/89 :															
05/19/89 :															
05/25/89 :															
06/02/89 :															
06/03/89 :															
06/05/89 :															
06/06/89 :															
06/07/89 :															
06/08/89 :															
06/09/89 :															
06/10/89 :															
06/12/89 :															
06/13/89 :															
06/14/89 :															
06/16/89 :															
06/19/89 :															
06/20/89 :															
06/21/89 :															
06/22/89 :															
06/26/89 :															
06/28/89 :															
06/30/89 :															

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	917	918	919	920	921	925	932	831	926	946	950	949	56	955	954
07/05/89 :															
07/15/89 :															
07/19/89 :															
07/22/89 :															
07/31/89 :															
08/04/89 :															
08/14/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
08/17/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
08/19/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
08/21/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
08/24/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
08/29/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
09/05/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
09/11/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
09/18/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
09/20/89 :	-	-	-	-	-	-	-								
09/21/89 :	-	-	-	DRY	-	-	-								
09/22/89 :	-	-	-	DRY	-	-	-								
09/25/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
10/02/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
10/09/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY								
10/17/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/27/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
10/30/89 :	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data i pect.
g) Increa water level suggests groundwater is beginning to rech ge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No surement taken.

Table 1 WATER LEVEL DATA

DATE	917	918	919	920	921	925	932	831	926	946	950	949	956	955	954
11/06/89	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
11/13/89	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
11/21/89	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
12/14/89	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
12/29/89	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
01/17/90	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
02/01/90	-	-	-	-	-	-	DRY	-	-	-	-	-	-	-	-
03/02/90	-	-	-	-	-	-	DRY	-	-	-	-	-	-	-	-

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	: 927	X	UNMRKD	951	922	923	943	826	944	909	965	966	972	974	981
03/05/89 :															
03/06/89 :															
03/07/89 :															
03/08/89 :															
03/13/89 :															
03/14/89 :															
03/15/89 :															
03/16/89 :															
03/18/89 :															
03/20/89 :															
03/21/89 :															
03/22/89 :															
03/24/89 :															
03/30/89 :															
03/31/89 :															
04/01/89 :															
04/04/89 :															
04/05/89 :															
04/12/89 :															
04/15/89 :															
04/18/89 :															
04/26/89 :															
04/28/89 :															
04/29/89 :															

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec' this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	927	X	UNMRKD	951	922	923	943	826	944	909	965	966	972	974	981
05/03/89 :															
05/09/89 :															
05/10/89 :															
05/19/89 :															
05/25/89 :															
06/02/89 :															
06/03/89 :															
06/05/89 :															
06/06/89 :															
06/07/89 :															
06/08/89 :															
06/09/89 :															
06/10/89 :															
06/12/89 :															
06/13/89 :															
06/14/89 :															
06/16/89 :															
06/19/89 :															
06/20/89 :															
06/21/89 :															
06/22/89 :															
06/26/89 :															
06/28/89 :															
06/30/89 :															

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	927	X	UNMRKD	951	922	923	943	826	944	909	965	966	972	974	981
07/05/89 :															
07/15/89 :															
07/19/89 :															
07/22/89 :															
07/31/89 :															
08/04/89 :															
08/14/89 :															
08/17/89 :															
08/19/89 :															
08/21/89 :															
08/24/89 :															
08/29/89 :															
09/05/89 :															
09/11/89 :															
09/18/89 :															
09/20/89 :															
09/21/89 :															
09/22/89 :															
09/25/89 :															
10/02/89 :															
10/09/89 :															
10/17/89 :	44.67[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	24.13	-			
10/27/89 :	44.75[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	24.14	-			
10/30/89 :	44.83[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	23.95	26.82	88.97	137.50	78.47

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data [illegible]pect.
g) Incre[illegible] water level suggests groundwater is beginning to rec[illegible]e this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No [illegible]surement taken.

Table 1 WATER LEVEL DATA

DATE	927	X	UNMRKD	951	922	923	943	826	944	909	965	966	972	974	981
11/06/89	44.80[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	23.92	26.84	88.99	137.40	78.46
11/13/89	44.87[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	23.94	26.87	88.93	137.31	78.42
11/21/89	44.92[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	23.96	26.89	88.87	137.34	78.49
12/14/89	44.95[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	23.86	26.69	71.46	114.57	78.92
12/29/89	45.12[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	23.74	26.58	64.96	117.30	74.60
01/17/90	45.21[i]	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	23.76	26.71	64.99	117.37	76.85[k]
02/01/90	-	-	-	-	-	-	-	-	DRY	-	-	26.41	-	-	-
03/02/90	-	-	-	-	-	-	-	-	DRY	-	-	26.39	-	-	-

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	975	980	973	976	970	969	979	982	963	967	905	TP41	TP51	TP43	TP44
03/05/89 :															
03/06/89 :															
03/07/89 :															
03/08/89 :															
03/13/89 :															
03/14/89 :															
03/15/89 :															
03/16/89 :															
03/18/89 :															
03/20/89 :															
03/21/89 :															
03/22/89 :															
03/24/89 :															
03/30/89 :															
03/31/89 :															
04/04/89 :															
04/05/89 :															
04/12/89 :															
04/15/89 :															
04/18/89 :															
04/26/89 :															
04/28/89 :															
04/29/89 :															

FOOTNOTES:

a) Water level recovering from rising head test
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to re[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	975	980	973	976	983	970	969	979	982	963	967	905	TP41	TP51	TP43	TP44
05/03/89 :																
05/09/89 :																
05/10/89 :																
05/19/89 :																
05/25/89 :																
06/02/89 :																
06/03/89 :																
06/05/89 :																
06/06/89 :																
06/07/89 :																
06/08/89 :																
06/09/89 :																
06/10/89 :																
06/12/89 :																
06/13/89 :																
06/14/89 :																
06/16/89 :																
06/19/89 :																
06/20/89 :																
06/21/89 :																
06/22/89 :																
06/26/89 :																
06/28/89 :																
06/30/89 :																

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
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e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	975	980	973	976	983	970	969	979	982	963	967	905	TP41	TP51	TP43	TP44
07/05/89 :																
07/15/89 :																
07/19/89 :																
07/22/89 :																
07/31/89 :																
08/04/89 :																
08/14/89 :													31.00	28.23	19.79	18.10
08/17/89 :													31.02	28.41	19.79	18.08
08/19/89 :													31.00	28.21	19.79	18.08
08/21/89 :													31.00	28.17	20.35	DRY[f]
08/24/89 :													31.00	28.00	20.37	DRY[f]
08/29/89 :													31.00	28.23	19.79	18.08
09/05/89 :													31.17	28.23	20.25	21.19
09/11/89 :													31.13	28.17	20.29	21.19
09/18/89 :													31.00	28.21	20.21	21.10
09/20/89 :																
09/21/89 :																
09/22/89 :													47.98[f]	28.17	20.21	23.33
09/25/89 :																
10/02/89 :													32.17	28.58	20.46	21.33
10/09/89 :													32.00	28.50	20.37	21.42
10/17/89 :													31.17	28.27	21.12	21.50
10/27/89 :													-	-	-	21.41
10/30/89 :	80.40	79.45	DRY	DRY	DRY								31.23	28.34	20.46	21.23

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water le[illegible] affected by water from upper screen.
f) Data is [illegible]t.
g) Increasi[illegible] ater level suggests groundwater is beginning [illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No [illegible]ement taken.

Table 1 WATER LEVEL DATA

DATE	975	980	973	976	983	970	969	979	982	963	967	905	TP41	TP51	TP43	TP44
11/06/89	80.43	79.40	DRY	DRY	DRY	DRY	DRY	-	-	-	-	-	31.31	28.20	19.95	19.65
11/13/89	80.72	79.61	DRY	DRY	DRY	DRY	DRY	82.37	82.34	-	-	-	31.36	28.24	19.92	19.67
11/21/89	80.85	77.74	DRY	DRY	DRY	DRY	DRY	82.36	82.31	83.52	26.70	45.96[d]	31.37	28.25	19.89	19.69
12/14/89	75.65	76.60	DRY	DRY	DRY	DRY	DRY	74.90	74.99	83.56	26.74	45.98[d]	31.39	28.21	20.51	24.99
12/29/89	73.31	73.93	DRY	DRY	DRY	DRY	DRY	72.33	72.42	83.67	25.92	46.13[d]	28.28[f]	22.08[f]	DRY	DRY
01/17/90	77.78[k]	77.34[k]	DRY	DRY	DRY	DRY	DRY	82.77[k]	75.30[c]	83.51	26.02	46.13[d]	31.37	28.61	22.00	DRY
02/01/90	-	-	-	-	-	-	-	-	-	-	26.17	-	-	-	-	-
03/02/90	-	-	-	-	-	-	-	-	-	-	26.15	-	-	-	-	-

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	TP47	TP52	TP53	TP54	TP36	TP29	TP28	TP62	TP57	TP58	TP60	TP116	TP143
03/05/89 :													
03/06/89 :													
03/07/89 :													
03/08/89 :													
03/13/89 :													
03/14/89 :													
03/15/89 :													
03/16/89 :													
03/18/89 :													
03/20/89 :													
03/21/89 :													
03/22/89 :													
03/24/89 :													
03/30/89 :													
03/31/89 :													
04/01/89 :													
04/04/89 :													
04/05/89 :													
04/12/89 :													
04/15/89 :													
04/18/89 :													
04/26/89 :													
04/28/89 :													
04/29/89 :													

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	TP47	TP52	TP53	TP54	TP36	TP29	TP28	TP62	TP57	TP58	TP60	TP116	TP143
05/03/89 :													
05/09/89 :													
05/10/89 :													
05/19/89 :													
05/25/89 :													
06/02/89 :													
06/03/89 :													
06/05/89 :													
06/06/89 :													
06/07/89 :													
06/08/89 :													
06/09/89 :													
06/10/89 :													
06/12/89 :													
06/13/89 :													
06/14/89 :													
06/16/89 :													
06/19/89 :													
06/20/89 :													
06/21/89 :													
06/22/89 :													
06/26/89 :													
06/28/89 :													
06/30/89 :													

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	TP47	TP52	TP53	TP54	TP36	TP29	TP28	TP62	TP57	TP58	TP60	TP116	TP143
07/05/89 :													
07/15/89 :													
07/19/89 :													
07/22/89 :													
07/31/89 :													
08/04/89 :													
08/14/89 :	23.38	DRY	27.33	28.61	22.73	21.04	DRY	24.48					
08/17/89 :	23.35	DRY	27.25	28.55	22.73	20.96	DRY	24.44					
08/19/89 :	23.21	DRY	27.25	28.57	22.71	21.04	DRY	24.42					
08/21/89 :	23.42	DRY	27.50	28.72	22.71	21.21	DRY	-					
08/24/89 :	23.50	DRY	27.25	28.72	22.75	21.79	DRY	-	DRY	29.00	27.08		
08/29/89 :	23.38	DRY	27.31	28.61	22.71	21.02	DRY	24.46	DRY	30.00	27.17		
09/05/89 :	23.50	DRY	27.51	28.65	DRY	21.17	DRY	-	DRY	29.00	27.50		
09/11/89 :	23.42	DRY	DRY	DRY	DRY	21.19	DRY	-	DRY	DRY	27.50		
09/18/89 :	23.42	DRY	DRY	DRY	DRY	21.21	DRY	-	DRY	29.00	27.13	28.50	18.00
09/20/89 :	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/89 :	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/89 :	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/89 :	23.42	DRY	DRY	DRY	DRY	21.17	DRY	-	-	DRY	27.21	28.50	[illegible]
10/02/89 :	23.75	DRY	DRY	DRY	DRY	21.62	DRY	-	DRY	DRY	27.00	DRY[f]	DRY
10/09/89 :	23.50	DRY	DRY	DRY	DRY	21.54	DRY	-	DRY	DRY	27.17	DRY[f]	DRY
10/17/89 :	24.50	24.50[c]	29.42[c]	29.58	22.75	21.19	DRY	-	22.92[f]	DRY	DRY[f]	33.08[f]	DRY
10/27/89 :	24.25	24.49[c]	29.44[c]	29.40	22.90	21.21	DRY	-	23.00[f]	DRY	DRY[f]	33.17	DRY
10/30/89 :	23.56	DRY	DRY	DRY	21.25	21.34	DRY	-	DRY	DRY	27.23	28.62	DRY

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is [illegible]ect.
g) Increas[illegible] water level suggests groundwater is beginning to rech[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No [illegible]urement taken.

Table 1 WATER LEVEL DATA

DATE	TP47	TP52	TP53	TP54	TP36	TP29	TP28	TP62	TP57	TP58	TP60	TP116	TP143
11/06/89	24.92	24.42[c]	28.53[c]	29.66	22.70	21.59	DRY	-	DRY	29.15[c]	DRY	28.63	DRY
11/13/89	24.94	24.43[c]	28.54[c]	29.88	22.71	21.69	DRY	-	DRY	29.16	DRY	28.66	DRY
11/21/89	24.96	24.43[c]	28.55[c]	29.69	22.71	21.69	DRY	-	DRY	29.17	DRY	28.67	DRY
12/14/89	23.60	28.64[f]	32.80[f]	22.17	24.17	DRY	DRY	-	DRY	DRY	DRY	28.69	DRY
12/29/89	DRY	DRY	DRY	21.09	DRY	DRY	DRY	-	DRY	28.64	DRY	29.39	DRY
01/17/90	DRY	DRY	DRY	21.91	DRY	DRY	DRY	DRY	DRY	DRY	DRY	29.67	DRY
02/01/90	-	-	-	-	-	-	-	-	-	-	-	-	-
03/02/90	-	-	-	-	-	-	-	-	-	-	-	-	-

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	TP56	TP88	TP89	TP92	UNK	971	977	978
03/05/89 :								
03/06/89 :								
03/07/89 :								
03/08/89 :								
03/13/89 :								
03/14/89 :								
03/15/89 :								
03/16/89 :								
03/18/89 :								
03/20/89 :								
03/21/89 :								
03/22/89 :								
03/24/89 :								
03/30/89 :								
03/31/89 :								
04/01/89 :								
04/04/89 :								
04/05/89 :								
04/12/89 :								
04/15/89 :								
04/18/89 :								
04/26/89 :								
04/28/89 :								
04/29/89 :								

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to rec' this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	TP56	TP88	TP89	TP92	UNK	971	977	978
05/03/89 :								
05/09/89 :								
05/10/89 :								
05/19/89 :								
05/25/89 :								
06/02/89 :								
06/03/89 :								
06/05/89 :								
06/06/89 :								
06/07/89 :								
06/08/89 :								
06/09/89 :								
06/10/89 :								
06/12/89 :								
06/13/89 :								
06/14/89 :								
06/16/89 :								
06/19/89 :								
06/20/89 :								
06/21/89 :								
06/22/89 :								
06/26/89 :								
06/28/89 :								
06/30/89 :								

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is suspect.
g) Increasing water level suggests groundwater is beginning to recharge this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No measurement taken.

Table 1 WATER LEVEL DATA

DATE	TP56	TP88	TP89	TP92	UNK	971	977	978
07/05/89 :								
07/15/89 :								
07/19/89 :								
07/22/89 :								
07/31/89 :								
08/04/89 :								
08/14/89 :								
08/17/89 :								
08/19/89 :								
08/21/89 :								
08/24/89 :								
08/29/89 :								
09/05/89 :								
09/11/89 :								
09/18/89 :								
09/20/89 :								
09/21/89 :								
09/29/89 :								
09/25/89 :								
10/02/89 :								
10/09/89 :								
10/17/89 :			27.50	28.92				
10/27/89 :			27.54	28.92				
10/30/89 :		22.96	27.65	29.28	30.92			

FOOTNOTES:

a) Water level recovering from rising head test.
b) Dry hole - water in hole added during falling head test.
c) Water in sump; well is actually dry.
d) Bailed water down.
e) Water levels affected by water from upper screen.
f) Data is [illegible]ct.
g) Increas[illegible]ter level suggests groundwater is beginning to rech[illegible] this well screen.
h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
- No m[illegible]rement taken.

Table 1 WATER LEVEL DATA

DATE	TP56	TP88	TP89	TP92	UNK	971	977	978
1/06/89	23.01	30.89	29.31	30.91	-			
1/13/89	23.11	30.90	29.36	30.91	-			
1/21/89	23.11	30.90	29.38	30.92	-			
2/14/89	23.13	DRY	29.40	DRY	-			
2/29/89	-	-	-	-	-			
1/17/90	-	-	-	-	-			
2/01/90	-	-	-	-	-			
3/02/89	-	-	-	-	-			
2/07/90	-	-	-	-	-		363.60	455.30
2/08/90	-	-	-	-	-		365.10	447.40
2/09/90	-	-	-	-	-		363.70	441.20
2/20/90	-	-	-	-	-	327.35	-	417.90
2/21/90	-	-	-	-	-	327.40	-	417.30
2/22/90	-	-	-	-	-	-	-	417.42
2/27/90	-	-	-	-	-	326.90	-	417.30

FOOTNOTES:

Water level recovering from rising head test.
Dry hole - water in hole added during falling head test.
Water in sump; well is actually dry.
Bailed water down.
Water levels affected by water from upper screen.
Data is suspect.
Increasing water level suggests groundwater is beginning to recharge this well screen.

h) Destroyed.
i) Dry hole - water added in hole during constant head test.
j) Blown dry.
k) Water levels may be affected by the long term (1/9/90 - (1/23/90) conducted in a nearby well (MW982).
\- No measurement taken.

JACOBS ENGINEERING

B5
7 of 8

DATE _____ SUBJECT

SHEET NO. _____

BY _____ CHKD. _____

JOB NO. _____

Appendix

(Field Data & Notes)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project _____ Contract No. _____ Sheet _____
Feature Water levels from land surface Designed _____ File No. _____
Item _____ Checked _____ Date _____

Date	507	608	609	701	702
5 March					
6					
7					
8					
13					
14					
15					
16					
18					
20					
21					
22					
24					
30					
31					
1 April					
4					
5	Dry	31.87	50.75	—	—
12	Dry	31.77	48.83	27.6	25.4
15	Dry	31.75	47.93	27.63	25.31
18	Dry	31.70	46.80	27.55	25.27
26	Dry	31.76	44.65	27.65	25.25
28		—	—	—	—
29	Dry	31.83	43.85	27.70	25.30
3 May	Dry	31.75	42.85	27.75	25.25
9	Dry	31.79	41.32	27.82	25.32
10	—	—	—	—	—
12-19	—	—	—	—	—

TOC = Top of casing
LSA = Land Surface

(2)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project ____ Contract No. ____ Sheet ____
Nature ____ Designed ____ File No. ____
Date ____ Checked ____ Date ____

	805S	805D	806S	806D	807S	807D	808	809	810	811S	811D
5 March										25.5	58.4
6										25.5	54.7
7			29.2	Dry						25.4	56.7
8			29.4	Dry						25.5	56.35
13			—	—						25.4	56.0
14			29.35	Dry						25.45	56.2
15			29.35	Dry	Dry	Dry				25.45	56.1
16			29.35	Dry	Dry	Dry				25.45	56.1
18			29.35	Dry	Dry	Dry				25.5	56.0
20			—	—	Dry	Dry		29.15		25.5	55.9
21			—	—	Dry	Dry	17.8	Dry	Dry	—	—
22											
24 (5)	28.14	Dry	27.67	Dry	Dry	Dry	17.57	—	Dry		
30	—	—	29.25	Dry	Dry	—	—	—	—	25.32	—
31	24.84	Dry	27.67	Dry	Dry	Dry	17.53	28.88	Dry	25.43	56.02
1 April	24.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56.0
4											
5	25.49	Dry	29.27	76.65	Dry	Dry	17.57	28.75	Dry	25.45	56.42
12	24.15	Dry (**)	29.13	76.62	Dry	Dry	17.36	28.72	Dry	25.25	56.1
15	32.26 (*)	39.97	29.07	Dry (*)	Dry	Dry	17.33	28.70	Dry	25.20	56.0
18	31.81	39.73	29.03	76.45	Dry	42.94 (**)	17.25	28.56	Dry	25.13	55.50
26	30.57	38.66	[illegible]	76.50	Dry	43.57	17.24	28.50	Dry	25.22	55.39
28	—	—	—	—	—	—	—	—	—	—	—
29	30.31	38.36	31.04	76.50	Dry	43.62	17.22	28.50	Dry	25.25	55.30
3 May	29.94	38.19	28.97	76.45	Dry	43.67	17.24	28.50	Dry	25.22	55.16
9	27.39	37.86	29.02	76.39	Dry	43.72	17.27	28.46	Dry	25.29	55.06
10	—	—	—	—	—	—	—	—	—	—	—
12-19	28.72	57.63		76.45				28.50			

(3)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: Water levels from land surface
Feature:
Item: 12-19

Contract No. ____ Sheet ____
Designed ____ File No. ____
Checked ____ Date ____ Date ____

	812S	812D	813	814	815	816	817	818	819	820	821S	821D
5 March												
6												
7												
8												
13	26.8	Dn										
14	24.85	61.1										
15	23.7	59.5										
16	23.1	58.3	Dn									
18	22.5	55.55	Dn	31.0	19.8	Dn						
20	22.0	—	Dn	—	19.7	Dn						
21	19.9	57.35	Dn	—	19.6	—						
22												
24	19.7	57.09	14.99 (2)	—	19.75	19.46						
30	19.82	—	Dn	—	19.68	16.64						
31	19.37	56.82	14.95	30.61	19.73	24.57 (2)	Dn	Dn	Dn			
1 April	[illegible]	56.75	Dn	30.63	19.69	19.[illegible]	Dn	Dn	Dn			
4												
5	25.02	56.62	14.99 (2)	30.75	19.74	20.09	15.54	Dn	Dn	21.76		
12	19.66	61.27 (*)	14.87	30.61	19.69	16.19	18.14 (2)	Dn	Dn	21.66		
15	19.65	62.20	14.63	30.60	19.69	15.52	18.56 (2)	23.21 (2)	Dn	21.65		
18	19.62	61.77	14.28	30.50	19.59	14.99	18.7 (2)	24.11 (2)	Dn	18.56		
26	19.67	61.65	13.84	30.50	19.64	14.52	19.22 (2)	24.78 (2)	Dn	21.51		
28	—	—	—	—	—	—	—	—	—	—	Dn	[illegible]
29	19.80	61.62	13.74	30.50	19.79	14.52	19.37 (2)	24.91 (2)	Dn	21.57	Dn	Dn
3 May	19.78	61.49	13.60	30.50	19.66	14.48	19.49 (2)	Dn	Dn	21.48	30.02 (**)	33.[illegible]
9	19.93	61.40	13.51	30.50	19.75	14.56	19.60 (2)	Dn	Dn	21.43	30.51	34.[illegible]
10	—	—	—	—	—	—	—	—	—	—	—	—
12-19		61.19	13.52		19.85							34.11

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project Water levels from land surface

Contract No. ____ Sheet ____
Designed ____ File No. ____
Checked ____ Date ____ Date ____

	822	823S	823D	824	825S	825D	826		827	828	829S	829
5 March												
6												
7												
8												
13												
14												
15												
16												
18												
20												
21												
22												
29												
30												
31												
1 April												
4												
5												
12	Dry											
15	28.44	Dry	Dry		Dry	Dry				21.17	27.48	[illegible]
18	29.29	Dry	Dry		Dry	Dry				21.07	27.45	[illegible]
26	30.82	Dry	Dry	Dry	Dry	51.02			Dry	—	27.51	[illegible]
28	—	—	48.13	—	—				—			
29	31.18	Dry	48.50	Dry	Dry	57.42			Dry	21.12	27.48	[illegible]
3 May	31.55	Dry	48.54	Dry	Dry	57.54	Dry		Dry	21.04	27.43	[illegible]
9	32.02	Dry	48.87	Dry	Dry	57.59	Dry		Dry	21.05	27.44	[illegible]
10	—	—	—	—	—	—	—		—	—	—	—
12-19	32.48					48.98			Dry	21.05		

(5)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: Water levels from land surface
Feature:
Item:

Contract No. ____ Sheet ____
Designed ____ File No. ____
Checked ____ Date ____ Date ____

	830	831	832	833S	833D	834S	834D	835	936	937	938	939
5 March												
6												
7												
8												
13												
14												
15												
16												
18												
20												
21												
22												
24												
30												
31		Dry										
1 April	Dry	Dry										
4												
5	Dry	22.9 (2)										
12	25.97	23.95 (2)										
15	24.49	24.14 (2)										
18	22.95	24.19 (2)	Dry									
26	20.03	24.55 (2)	Dry									
28	—	—	—									
29	19.29	24.65 (2)	Dry									
3 May	18.52	24.70 (2)	Dry	Dry	Dry	26.15	Dry		28.13		Dry	
9	18.17	24.88 (2)	Dry	Dry	Dry	27.37	Dry	17.62	29.13 (2)	Dry	Dry	
10	—	—	—	—	—	—	—	—	27.54	—	—	13.9
12-19	18.05		Dry	Dry	Dry	19.96	Dry				Dry	13.9

For Dale ⑥
Hammerman

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____
DESCRIPTION _____
SHEET NO. _____
MADE BY _____ CHECKED BY _____ DATE _____

	507	508	509	701	702
25 May	Dry	32.03	40.44	28.06	25.39
2 June	Dry	32.07	40.47	28.28	25.43
3	Dry	32.16	40.49	28.25	25.38
5	Dry	32.15	40.49	28.35	25.50
7	Dry	[illegible]	[illegible]	28.31	25.48
8	Dry	32.19	40.57	28.43	25.50
9	Dry	32.20	40.49	28.44	25.50
10	Dry	32.25	40.52	28.43	25.50
12	Dry	32.25	40.45	28.40	25.50
13	Dry	32.29	40.49	28.47	25.57
17	Dry	32.29	40.47	28.48	25.59
17	Dry	32.24	40.45	28.49	25.57
6/17	Dry	—	—	—	—
19	Dry	32.32	40.41	28.56	25.59
20	Dry	32.34	40.45	28.56	25.55
21	Dry	32.38	40.42	28.56	25.63
22	Dry	32.32	40.42	28.59	25.58
26	Dry	32.30	40.38	28.55	25.60
28	Dry	32.39	40.42	28.63	25.61
30	Dry	32.42	40.45	28.65	25.63
		-0.39	-0.01	-0.63	-0.24

May 25 - June 30

Summary - ~~water~~ water levels in wells ~~away~~ not adjacent to ~~from~~ trenches upgradient ~~has~~ have decreased .36 feet. Wells adjacent to trenches ~~have~~ upgradient and downgradient Dale note the changes in [illegible] & [illegible] have decreased 1.4 feet (includes 814, ~~808~~, 809, 835. 11N.2055 located around 100' downgradient from Trench 3 has decreased 22 ft. this rise in water must be due to all 605s has appeared to dry up.

the water we put in 8235 + 8255.

They both took a whole 400+ gal

tank of water Sasan.

(7)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

	805S	805D	806S	E D	807S	807D	808	809	810	E	811D
25 May	29.94 (*)	34.16 (*)	29.14 (4)	27.15 (**)	Dry	43.01 (**)	17.45 (4)	28.45 (*)	Dry (*)	25.[illegible] (4)	54.56 (*)
2 June	—	—	29.20	28.41	—	—	—	28.57	—	25.54	54.38
3	30.28	33.47	29.21	28.48	Dry	43.40	17.51	28.58	Dry	25.53	54.36
5	30.06	33.75	29.30	28.78	—	43.50	17.56	28.60	—	25.63	[illegible]
6	29.91	33.41	[illegible]	28.91	—	[illegible]	[illegible]	28.65	—		
7	30.09	33.24	29.25	29.10	—	43.56	17.79	28.70	—	25.63	53.57
8	29.82	33.52	29.28	29.20	—	43.58	17.96	28.69	—	25.65	[illegible]
9	30.13	32.83	29.31	29.32	—	43.57	18.14	28.72	—	25.68	[illegible]
10	30.65	32.47	29.31	29.20	—	43.59	18.27	28.76	—	25.70	52.92
12	31.12	32.87	29.34	29.69	—	43.65	18.50	28.82	—	25.70	52.52
13	31.22	33.16	29.37	29.81	—	43.66	18.59	28.87	—	25.77	52.32
14	31.07	33.56	29.37	29.95	—	[illegible]	[illegible]	28.88	—	25.75	[illegible]
16/17	30.20	34.13	29.28	30.21	—	43.69	18.71	28.93	—	25.83	51.[illegible]
19	29.42	33.94	29.34	30.53	—	43.76	18.78	29.05	—	25.76	51.04
20	30.30	33.11	29.37	30.65	—	43.78	18.78	29.07	—	25.77	50.[illegible]
21	30.78	33.52	29.46	30.74	—	43.80	18.84	29.10	—	25.85	50.[illegible]
22	30.55	33.99	29.37	30.88	—	43.81	18.86	29.15	—	25.81	50.[illegible]
26	31.23	35.48	29.40	31.30	—	43.88	18.88	29.[illegible]	—	[illegible]	[illegible]
28	31.36	36.21	29.43	31.52	—	43.92	18.90	29.95	—	25.88	[illegible]
30	[illegible]	36.43	29.44	31.72	—	43.[illegible]	18.91	30.15	—	[illegible]	[illegible]
	-2.22		-0.30				-1.46	-2.00		-0.43	[illegible]

(8)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

	812S	812D	813	814	815	816	817	818	819	820
25 May	20.27*	18.27**	15.10*(2)	30.87(4)	19.95*	16.93*	17.83**	Dn	Dn	21.34*
2 June	—	—	—	31.13	—	—	—	—	—	—
3	20.45	19.94	14.54	31.12	20.11	15.25	18.63(2)	Dn	Dn	21.39
5	20.57	20.05	14.46	31.29	20.17	15.17	—	—	—	21.43
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.07	—	—	—	[illegible]
7	20.60	20.16	14.39	31.38	20.25	15.14	—	—	—	21.39
8	20.62	20.19	14.36	31.39	20.23	15.10	—	—	—	[illegible]
9	20.63	20.19	14.31	31.38	20.27	15.10	—	—	—	[illegible]
10	20.64	20.23	14.29	31.38	20.23	15.10	—	—	—	[illegible]
12	20.70	20.28	14.17	31.41	20.27	15.08	—	—	—	21.44
13	20.73	20.31	14.18	31.44	20.29	15.10	—	—	—	21.44
14	[illegible]	20.35	14.19	[illegible]	[illegible]	[illegible]	—	—	—	[illegible]
16/17	—	—	14.15	—	20.29	15.09	—	—	—	21.42
19	20.82	20.47	14.09	31.48	20.31	15.12	—	—	—	21.47
20	20.84	20.50	14.08	31.49	20.31	15.14	—	—	—	21.51
21	20.91	20.54	14.10	31.50	20.32	15.15	—	—	—	21.55
22	20.87	20.56	14.09	31.50	20.33	15.14	—	—	—	[illegible]
26	20.97	20.67	14.06	31.52	20.34	15.17	—	—	—	[illegible]
28	21.02	20.70	14.06	31.53	20.32	15.20	—	—	—	[illegible]
30	21.04	20.74	14.07	31.57	20.34	15.22	—	—	—	[illegible]
	-0.77		+1.03	-0.70	-0.39	+0.03				-0.39

(9)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

	821S	821D	822	E	S	823D	824	825S	825D	826	C	828
25 May	Dry	35.02	28.56	Dry		48.43	46.58	Dry	49.42	44.71	14.[illegible]	21.12
2 June	–	–	–	–		–	–	–	–	–	–	21.12
3	Dry	37.38	29.88	Dry		48.44	46.68	Dry	50.24	44.67	15.21	21.12
5	–	37.85	30.11	–		48.55	46.78	–	50.40	–	–	21.13
6	–	38.10	30.22	–		[illegible]	[illegible]	–	[illegible]			15
7	–	38.39	30.38	–		48.50	46.80	–	50.35	–	–	[illegible]
8	–	38.56	30.42	–		48.54	46.81	–	50.40	–	–	[illegible]
9	–	38.74	30.56	–		48.54	46.71	–	50.42	–	–	21 [illegible]
10	–	38.97	30.66	–		[illegible]	[illegible]		[illegible]			
12	–	39.38	30.87	–		48.58	46.80	–	50.57	–	–	21.21
13	–	39.57	30.95	–		48.54	46.87	–	50.61	–	–	[illegible]
14	–	39.76	31.03	–		[illegible]	[illegible]	–	[illegible]	–	–	
16/17	–	40.18	–	–		–	46.88	–	50.52	–	–	–
19	–	40.70	31.40	–		48.52	46.88	–	50.69	–	–	21.19
20	–	40.90	31.47	–		48.52	46.91	–	50.67	–	–	21.1[illegible]
21	–	41.09	31.58	–		48.54	46.88	–	50.66	–	–	[illegible]
22	–	41.22	31.64	–		48.50	46.95	–	50.63	–	–	[illegible]
26	–	41.98	31.90	–		48.50	46.93	–	50.69	–	–	[illegible]
28	–	42.30	32.02	–			47.01	–	50.79	–	–	[illegible]
30	–	42.58	32.12	–		48.82	47.03	–	[illegible]	–	–	[illegible]
						+1.68			+4.25			-0.12

(10)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

	829S	829D	830	831	832	833S	833D	834S	834D	835	936
25 May	27.47+	30.62+	21.86+	23.60 (2)	25.97	34.60	35.57	21.93+	0.00	17.75	26.0
2 June	27.43	30.64	—	—	26.89 (2)	—	—	—	—	—	—
3	27.43	30.52	19.26	24.05	26.91 (2)	34.61	37.64	Destroyed		17.83	25.9
5	27.58	31.27	18.98	—	—	34.65	38.05			17.87	26.0
6	[illegible]	[illegible]	[illegible]90	—	—	34.68	38.30			[illegible]	
7	27.57	31.76	18.76	—	—	34.71	38.55			17.99	26.2
8	27.56	31.87	[illegible]	—	—	34.72	38.70			[illegible]	[illegible]
9	27.56	31.90	18.60	—	—	34.69	38.85			18.49	[illegible]
10	[illegible]	[illegible]	[illegible]	—	—	[illegible]	[illegible]			[illegible]	
12	27.63	31.91	18.43	—	—	34.72	39.45			20.92	[illegible]
13	27.68	31.91	18.42	—	—	34.75	39.64			18.95	26.[illegible]
14	[illegible]	32.05	18.38	—	—	34.75	[illegible]			19.0	25.9
16/17	—	—	18.37	—	—	34.72	40.22			19.05	[illegible]
19	27.87	32.45	18.35	—	—	34.74	40.71			19.08	25
20	27.86	32.45	18.32	—	—	34.75	40.87			19.13	[illegible]
21	27.96	32.54	18.34	—	—	34.75	41.07			19.19	[illegible]
22	27.91	32.59	18.34	—	—	34.77	41.30			19.18	[illegible]
26	28.51	32.67	18.35	—	—	34.76	41.89			[illegible]	[illegible]
28	28.04	32.77	18.38	—	—	5	41.31			[illegible]	[illegible]
30	28.02	32.83	18.3[illegible]	—	—	34.69	41.59			19.24	[illegible]
	−0.61		+.349							1.49	10.

(11)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

	937	938	939
25 May	Dn	17.13**	14.12*
2 June	Dn	—	—
3	Dn	18.71	14.20
5	—	19.00	14.28
6	—	19.15	14.30
7	—	19.30	14.32
8	—	19.36	14.31
9	—	19.47	14.30
10	—	19.57	14.33
12	—	19.81	14.37
13	—	19.89	14.38
14	—	19.97	14.38
16/17	—	20.21	14.34
19	—	20.42	14.42
20	—	20.52	14.42
21	—	20.59	14.45
22	—	20.69	14.47
26	—	21.05	14.47
28	—	(5)	14.50
30	—	0.00	14.52
			-0.40

(12)

JACOBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO ____ JOB NO ____

DATE	507	508	509	701	702		906	911			
JULY 5	–	32.47	40.42	28.72	25.70						
~~15/16~~ 18		32.67	89.47	38.88	25.85						
22		32.71	86.99	28.93	25.95						
31							DRY	DRY			
Aug 3/4		32.88	85.05	29.0	25.88						

(13)

JE JACOBS ENGINEERING

DATE ____ SUBJECT ____ SHEET NO ____

BY ____ CHKD. ____ JOB NO ____

DATE	805 S	805 D	806 S	806 D	807 S	807 D	808	809	810	811 S	811 D
JULY 5	32.49	38.68	29.49	32.23	–	44.01	18.97	DRY	–	25.96	47.90
15/16/18	32.64	40.96	29.75	33.60			19.21			–	55.98
22	DRY	42.14	27.04	61.24	–	44.27	19.10	DRY		26.23	55.63
31						44.42	19.24	DRY			
AUG 3/4	32.88 (DRY?)	41.98	29.75	61.10		44.45	19.24	DRY		26.31	55.23

CONSTANT HEAD PERMEABILITY TESTING

(14)

JE JACOBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO ____ JOB NO ____

DATE	812 S	812 D	813	815	816	820	821 S	821 D	822	823 S	823 D
JULY 5	21.15	20.87	14.13	20.36	15.29	21.94	–	43.35	32.42	DRY	47.35
15/16/18	26.34	–		20.04				44.95	33.02		
22	21.42	21.24	DRY	22.09	18.88	22.41	–	45.73	DRY		
31	21.64	21.51	15.89	21.71	16.14	22.66			33.92		
AUG 3/4	21.75	21.53	DRY	21.59	15.90	22.70		47.33	DRY		

CONSTANT HEAD TEST

(15)

JE JACOBS ENGINEERING

DATE ____ BY ____ CHKD ____ SUBJECT ____ SHEET NO ____ JOB NO ____

DATE	824	825D	828	829S	829D	830	833S	833D	835	936	939
JULY 5	47.02	49.14	21.29	28.19	32.96	18.42	34.62	42.41	19.30	25.79	14.61
15/16/18	48.20		21.36			18.57			19.22	25.76	14.75
22	47.43		21.44	28.51	37.53	18.51			19.44	25.73	14.85
31		CONSTANT HEAD TEST				18.39			19.54		14.90
AUG 3/4	47.62		21.37	28.58	34.53	18.34	CONSTANT HEAD TEST	CONSTANT HEAD TEST	19.54	DRY	14.83

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(16)

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____

Footnotes _____ SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE _____

* Recovery from rising head test
** Recovery from falling head test
(1) Height of pvc casing from surveyors from 24 March, except for 507, 508, 509, 701, 702
(2) Water in sump
(3) Bailed out
(4) Blown dry
(5) Constant head test

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(17)

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____

SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE 7/15 to

	TOC	LSD
508	-1.5	
609	-1.2	
701	-2.0	
702	-1.5	
805S	-1.06	33.7 @ 1:53, 7/15 ✓
805D	-1.11	42.4 @ 1:50, 7/15 ✓
806S	-1.63	
806D	-2.05	
807D	-1.63	
808	-1.19	20.7 @ 11:35, 7/16 ✓
809	-1.10	
811S	-1.15	
811D	-1.62	
812S	-0.98	
812D	-1.53	
813	-1.16	15.0 @ 11:23, 7/16 ✓
814	-1.50	
815	-1.11	21.45 @ 11:17, 7/16 ✓
816 ✓319 ~~deg~~ dry, 21', full depth	-1.58	
820	-1.19	unable to get accurate depth ~26'
821D	-1.65	46.6 @ 10:07, 7/16 ✓
822	-1.58	34.6 @ 10:55, 7/16 ✓
823D	-1.[illegible]	41.58 @ 10:40 7/16 - possible [illegible]
824	-1.10	49.6 @ 10:15, 7/16 ✓
825D	-1.12	constant head test
828	-1.63	
829S	-1.07	
829D	1.[illegible]	
✓830	-1.13	20.0' @ 11:40, 7/16 ✓
833S	-1.18	↑
833D	-1.78	CONSTANT ~~HEAD~~ TEST
835	-1.38	↓ 20.6 @ 11:31, 7/16 ✓
✓936	-1.51	27.3 - 7/15 @ 1:45 ✓
938	-1.19	constant head test

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE FTR

WO NO

DESCRIPTION

SHEET NO

MADE BY O. Holmquist

CHECKED BY

DATE 7/18 & 19/89

		TOC			W.L.
508	7/19	30' + 50"	-	1.5	32.67 ✓
* 509	7/19	90 + 8"	-	1.2	89.47 ✓
701	7/19	30 + 10 7/8"	-	2.0	28.91 ✓
702	7/19	30 - 2' 7 3/4"	-	1.5	~~31.15~~ 25.85
805S	7/20	33.82	-	1.06	32.76 DRY?
805D	7/20	43.36	-	[illegible]	41.92
806S	7/19	31' 4 1/2"	-	[illegible]	29.75
806D	7/19	35' 7 3/4"	-	2.05	33.60
807D	7/20	50 - 4.05'	-	[illegible]	44.32
808	7/20	20.63	-	[illegible]	19.14
809	7/20	DRY	-	[illegible]	DRY
115	7/19 ~~30 - 32 1/8"~~	30 - 32 1/8"	-	[illegible]	26.17
11D	7/19	60 - 2' 4 3/4"	-	[illegible]	55.98
812S	7/20	22.42	-	0.98	21.44
812D	7/20	22.76	-	[illegible]	21.23
813	7/20	DRY	-	[illegible]	DRY
814	7/20	33.21	-	1.50	31.71
815	7/20	23.71	-	1.41	22.30
* 816	7/20	22.48	-	1.58	20.90
820	7/20	30 - 6.21	-	1.19	22.30
821D	7/20	50 - 2.93	-	1.65	45.42
822	7/20	34.7	-	[illegible]	33.12
823D	7/20	———	-	[illegible]	CONSTANT HEAD TEST
824	7/20	50 - 1.17	-	1.10	47.43
825D	7/20	———	-	1.18	CONSTANT HEAD TEST
828	7/19	22' 11 7/8"	-	[illegible]	21.63
829S	7/20	30 - 0.58	-	0.71	28.35
* 829D	7/20	44.14	-	[illegible]	42.59
830	7/20	19.95	-	1.13	18.52
835	7/20	———	-	1.18	CONSTANT HEAD TEST
83D	7/20	———	-	1.78	" " "
835	7/20	20.77	-	1.38	19.39
936	7/20	30 - 2.44	-	1.41	26.02
938	7/20	———	-	[illegible]	CONSTANT HEAD TEST

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W O NO _____

DESCRIPTION _____

SHEET NO. _____

MADE BY O. Hangvist CHECKED BY _____ DATE 7/22/89

	TOC		L.A.D
508	30+50.5"	1.5	32.71
509	40-21.75"	1.2	86.99
701	30+11 1/8"	2.0	28.93
702	30-3[illegible]	1.5	25.92
805S	DRY	1.06 D	DRY
805D	40-4[illegible]	1.1	42.14
806S	[illegible]-19 1/2"	1.3	27.04
*806D	60+34.5	2.05	61.24
807D	50-4[illegible]	1.3	44.27
808	20+[illegible]	1.9	19.10
809	DRY	1.[illegible]	DRY
811S	30-31.5"	1.1	26.23
811D	60-33"	[illegible]	55.63 Sand -
812S	20+28.75	0.98	21.42
812D	20+33.75	1.3	21.24
813	DRY	1.6	DRY
814	30+39"	1.50	31.75
815	20+42"	1.41	27.69
*816	20+5 1/2"	1.58	18.88
820	20+46.75"	1.19	27.41
821D	50-31.5"	1.65	45.73
822	DRY	1.8	DRY [illegible]
823D		1.[illegible]	CONSTANT HEAD TEST
824	50-14"	1.10	47.43
825D		1.18	CONSTANT HEAD TEST
828	20+3.75	1.[illegible]	21.44
829S	30-5"	[illegible].1	28.51
*829D	40-11"	[illegible]	37.53
830	20-8.75"	1.13	18.51
833S		1.18	CONSTANT HEAD TEST
833D		1.18	CONSTANT HEAD TEST
835	20+9 7/8"	1.28	19.44
836	30-32.75	1.[illegible]1	25.73
838	[illegible]	[illegible]	CONSTANT HEAD TEST

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE: Well Testing
DESCRIPTION: testing water wells
WO NO:
SHEET NO:
MADE BY: [illegible] CHECKED BY: [illegible] DATE: 8-14-89

	TOC			
503	1.5		34'6"	34.5
509	1.2		88'4¼"	88.35
701	2.0		31'2¼"	31.19
702	1.5		27'6¼"	27.52
805S	1.06		34'6½"	34.54
805D	1.41		59'3¼"	59.27
806S	2.03		31'10½"	31.88
806D	2.05		68'4⅝"	68.38
807D	1.56		46'4⅝"	46.38
808	1.49	.63	20'10¾"	20.90
809	1.40		Dry	
811S	1.12		27'9½"	27.77
811D	1.52		56'10¼"	56.85
812S	0.98		22'9¼"	22.77
812D	2.0		23'6⅝"	23.55
813	1.46		~~[illegible]~~ 18'7"	18.58
814	1.50		33'4¼"	33.35
815	1.41		24'4¾"	24.40
816	1.58		19'9¾"	19.81
820	1.49		24'5"	24.42
821D	1.65		Dry	
822	1.38		35'9¼"	35.77
823D	1.[illegible]		~~Dry~~ 47'11"	47.92
824	1.[illegible]		48'3¼"	48.27
825D	1.[illegible]		~~Dry~~ 52'5"	52.41
828	1.[illegible]		23'2½"	23.20
829S	1.[illegible]		30'1⅝"	30.13
829D			38'9½"	38.79
830 8-14-89	1.[illegible]		23'6¾"	23.56
833S	1.15		36'2"	36.17
833D	1.78		41'10¼"	41.85
835	1.[illegible]		21'	21.00
936	1.[illegible]		27'2⅝"	27.22
932				Dry
939			16'[illegible]½"	16.51

CHENEY TEST PIT PIEZOMETERS

DATE: 8-14-89 NAME: Ivan D. Miracle

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
	8-14-89		–		
TP 41			–	38'	31.00
TP 51			–	28' 2 3/4"	28.23
TP 43			[illegible]	22'	22.00
TP 44			-3.0	21' 1 1/4"	21.10
TP 47 –			-3.0	24' 4 1/2"	26.38
TP 52 –			2.17	Dry	
TP 53 –			-2.25	29' 7"	29.58
TP 54 –			-3.10	31' 8 1/2"	31.–
TP 36			-2.58	25' 3 3/4"	25.31
TP 29			-2.46	23' 6"	23.5
TP 28			DRY	DRY	
TP 62			~~24~~	24' 5 3/4"	24.48
~~[illegible]~~				~~3[illegible]~~'	

CHENEY MW WATER LEVELS

(22)

DATE: 8-14-89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
	8-14-89	(time PM)	-	
904	" " "	40'	-1.5'	36'11" 36.91
913	" " "	40'	-	Dry
912	" " "	40'	-	Dry
914	" " "	40'	-	Dry
916	" " "	40'	-	Dry
911	" " "	45'	-	Dry
918	" " "	40'	-	Dry
906	" " "	40'	-	Dry
9	" " "	50'	-	Dry
7C	" " "	40'	-	Dry
925	" " "		-	Dry
908	" " "		-	Dry
921	" " "		-	Dry
832	" " "		-	36'1" ~~Dry~~
915	" " "		-	Dry
917	" " "		-	Dry
926	" " "		-	Dry
			-	
			-	
			-	
			-	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(23)

JOB TITLE testing wells

WO NO

DESCRIPTION Testing Water Level

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible]

DATE 8-16-89 8-17-89

	TOC	L.S.D	
508 - 8-16-89	- 1.5	34' 6 5/8"	34.51
509 - 8-17-89	- 1.2	88 4 5/8"	88.34
701 - 8-17-89	- 2.0	31' 2"	31.17
702 - 8-17-89	- 1.5	27' 6 1/8"	27.51
805S - 8-17-89	- 1.06	34' 6 1/2"	34.54
805D - 8-17-89	- 1.11	59' 3 1/4"	59.27
806S - 8-17-89	- 1.03	31' 10 1/4"	31.85
806D - 8-17-89	- 2.05	68' 4 5/8"	68.39
807D - 8-17-89	1.03	46' 4 1/2"	46.38
808 - 8-17-89	1.19	20' 10"	20.83
809 - 8-17-89	- 1.13	DRY	
811S - 8-16-89	- 1.1[illegible]	27' 9"	27.75
811D - 8-17-89	- [illegible]	56' 10"	51' [illegible]
812S - 8-17-89	0.98	22' 9 1/8"	2[illegible].16
812D - 8-17-89	- 1.[illegible]	23' 6 1/2"	23.54
813	1.1[illegible]	18'	18.00
814	- 1.50	33' 4 1/4"	33.35
815	1.41	24' 4 1/8"	24.34
816	- 1.38	19' 9 3/4"	19.81
820	- 1.19	24' 5"	24.42
821D	- 1.65	DRY	
822	- 1.58	35' 9"	35.75
823D	1.[illegible]	47' 10" - (D-1)	47.83
824	1.10	48' 3"	48.25
825D	- 1.12	52' 4" (D-1)	52.33
828	- 1.[illegible]	23' 2"	23.17
829S	1.07	30' 1 1/2"	30.10
829D	1.[illegible]	38' 9 1/4"	38.77
830	- 1.13	23' 6 3/4"	23.56
833S	- 1.18	36' 1"	36.14
833D	- 1.78	41' 10"	[illegible]
835	1.[illegible]	21' 0"	0
936	1.[illegible]	27' 2 1/2"	27.21
938	- 1.[illegible]		
939	[illegible]	16' 6"	16.50

CHENEY TEST PIT PIEZOMETERS

DATE 8-18-89 NAME Ivan D. Miracle

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
			-		
TP 41	8-18-89		-	31 1/4"	31.02
TP 51	8-18-89		-	28 7 3/4"	28.15
TP 43	" " "		-2.21	22'	22.00
TP 44	" " "		-3.0	21' 1"	21.08
TP 47	" " "		-3.0	26' 4 1/4"	26.35
TP 52	" " "		-2.17	Dry	Dry
TP 53	" " "		-2.25	29' 6"	29.50
54	" " "		-3.10	31' 8 1/4"	31.65
P 36	" " "		-2.58	25' 3 3/4"	25.31
TP 29	" " "		-2.16	23' 5"	23.42
TP 28	" " "		DRY	DRY	
TP 62	" " "			24' 5 1/2"	24.44

CHENEY MW W/ 12 LEVELS

(25)

DATE: 8-19-89

MADE BY: Ivan D. Minacle

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	8-19-89		-1.5'	36'9½" 36.79
913	" " "		-	Dry
912	" " "		-	Dry
914	" " "		-	Dry
916	" " "		-	Dry
911	" " "		-	Dry
918	" " "		-	Dry
906	" " "		-	Dry
919	" " "		-	Dry
910	" " "		-	Dry
922	" " "		-	Dry
932	" " "		-	Dry
921	" " "		-	Dry
930	" " "		-	Dry
915	" " "		-	Dry
917	" " "		-	Dry
920	" " "		-	Dry
			-	
			-	
			-	
			-	
			-	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE Well Testing W.O. NO.

DESCRIPTION Water well Depth test

MADE BY [illegible] CHECKED BY [illegible] SHEET NO. DATE 8-19-89

	TOC	D
508	15	34' 7¾"
509	12	88' 10½"
701	20	31' 1"
702	15	27' 6½"
805S	106	34' 6"
805D	111	59' 3¾"
806S	[illegible]	3[illegible] 10"
806D	205	68' 4½"
807D	[illegible]	46' 4½"
808	[illegible]	20' 10"
809	[illegible]	DRY
811S	[illegible]	27' 8¾"
11D	[illegible]	56' 10"
812S	098	22' 9"
812D	[illegible]	23' 6½"
813	[illegible]	18'
814	150	33' 4¼"
815	[illegible]	24' 4¾"
816	158	19' 9½"
820	119	24' 4"
821D	165	Dry
822	[illegible]	DRY
823D	[illegible]	47' 11' (Dry)
824	[illegible]	48' 3¾"
825D	[illegible]	52' 5" (Dry)
828	[illegible]	23' 2"
829S	07	30' 1½"
829D	[illegible]	38' 9"
830	[illegible]	22' 8½"
833S	119	36' 2"
833D	178	41' 10"
835	[illegible]	21'
936	[illegible]	27' 2"
938	[illegible]	
939	[illegible]	16' 1"

(27)

DATE: [redacted]

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	DEPTH TOC	DEPTH BLS
			-	
904	8-19-89		- 1.5'	36'11" 36.1
913	" " "		-	DRY
912	" " "		-	DRY
914	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
910	" " "		-	DRY
125	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
932	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	
			-	

CHENEY TEST PIT PIEZOMETERS

TR: [redacted] NAME: Ivan D. Miracle

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
			-	
TP 41			-	31'
TP 51			-	28' 2½"
TP 43			[illegible]	22'
TP 44			[illegible]	21' 1"
TP 47			[illegible]	26' 4½"
TP 52			2.17	DRY
TP 53			2.25	29' 6"
54			3.10	31' 8
36			2.58	25' 3½"
TP 29			2.46	3" 6"
TP 28			DRY	DRY
TP 62				24' 5"

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(29)

JOB TITLE testing water wells WO NO

DESCRIPTION Check depth of water

SHEET NO

MADE BY [illegible] CHECKED BY [illegible] DATE 8-21-89

	TOC		T.D
508	- 1.5		34' 8"
509	- 1.2		87' 5"
701	- 2.0		31' 2½"
702	- 1.5		27' 7"
805S	- 1.06		34' 8"
805D	- 1.11		58' 9"
806S	- 1.6		31' 11½"
806D	- 2.05		68' 5"
807D	1.53		45' 11"
808	1.19		18' 10¾"
809	- 1.7		DRY
811S	- 1.1		27' 9"
811D	- 1.5		56' 8¾"
812S	0.98		22' 10"
812D	- 1.5		23' 6½"
813	- 1.5		17' 10¾"
814	- 1.50		33' 4⅞"
815	- 1.41		24' 5⅞"
816	- 1.58		19' 2"
820	- 1.19		24' 4⅞"
821D	- 1.65		DRY
822	- 1.58		DRY
823D	1.[illegible]		48' (Dry)
824	1.10		48' 4" (Dry)
825D	1.18		52' 6" (Dry)
828	1.[illegible]		23' 3"
829S	[illegible]		30' 2"
829D	[illegible]		38' 9¾"
830	- 1.13		20' 01"
833S	- 1.18		36' 9"
833D	- 1.18		41' 10¾"
835	- 1.38		21' 6"
936	1.51		27' 1"
938	- 1.3		DRY
939	[illegible]		16' 7"

CHENEY MW & FR LEVELS

(30)

DATE: 8-21-89

MADE BY [illegible]

WELL Number	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	8-21-89		- 1.5'	37'/ "37.08
906	" " "		-	DRY
910	" " "		-	DRY
911	" " "		-	DRY
912	" " "		-	DRY
913	" " "		-	DRY
914	" " "		-	DRY
915	" " "		-	DRY
[illegible]	" " "		-	DRY
917	" " "		-	DRY
918	" " "		-	DRY
919	" " "		-	DRY
920	" " "		-	DRY
921	" " "		-	DRY
921 (Deep)	" " "		-	DRY
922 (Deep)	" " "		-	DRY
923 (Deep)	" " "		-	DRY
943 (Deep)	" " "		-	DRY
			-	
			-	
			-	
			-	

CHENEY TEST PIT PIEZOMETERS

DATE: 8-21-89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
	~~8-21-89~~ 8-22-89		-	
TP 41	" " "		-	31' 31.00
TP 51	" " "		-	28'2" 28.17
TP 43	" " "		-2.21	22'6 3/4" 22.56
TP 44	" " "		-.30	DRY
TP 47	" " "		-.30	26'5" (DRY)
TP 52	" " "		-2.17	DRY
TP 53	" " "		-2.25	29'9" (DRY)
TP 54	" " "	.33'	-3.10	31'9 7/8" (DRY)
TP 36	" " "		-2.58	25'3 1/2" 25.24
TP 29	" " "		-2.46	23'8" 23.67
TP 28	" " "		DRY	DRY
~~[illegible]~~	~~" " "~~			~~[illegible]~~

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

(32)

JOB TITLE Well testing W.O. NO

DESCRIPTION testing for water Depth in wells

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible] DATE 8-24-89

	TOC	LSD	
508	-1.5	34' 6"	34.50
509	-1.2	87' 4½"	87.38
701	-2.0	31' 2"	31.17
702	-1.5	27' 6"	27.50
805S	-1.06	34' 8"	34.67
805D	-1.41	58' 8"	51.75
806S	-1.63	31' 11"	31.92
806D	-2.05	68' 1½"	68.13
807D	-1.63	45' 10½"	45.96
808	-1.19	20' 11"	20.92
809	-1.40	DRY	
811S	-1.16	27' 8½"	27.71
811D	-1.62	56' 8"	56.75
812S	-0.98	22' 10"	22.83
812D	-1.53	23' 4½"	23.38
813	-1.46	17' 11"	[illegible]
814	-1.50	34'	34.00
815	-1.41	24' 6"	24.50
816	-1.58	19' 2½"	19.21
820	-1.19	24' 4½"	24.38
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	48' (DRY)	
824	-1.10	48' 6 (DRY)	
825D	-1.48	52' 6" (DRY)	
828	-1.63	23' 3½"	23.29
829S	-1.07	30' 2"	30.17
829D	-1.55	38' 10"	38.83
830	-1.43	20'	20.00
833S	-1.18	36' 9"	(DRY)
833D	-1.78	41' 11"	41.92
935	-1.38	21' 6"	21.50
936	-1.51	27'	27.00
938	-1.19	DRY	
939	[illegible]	16' 6"	16.50

CHENEY TEST PIT PIEZOMETERS

DATE: 8-24-89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
			-	
TP 41			-	31' 31.00
TP 51			-	28' 28.00
TP 43			-2.21	22'7" 22.58
TP 44			-3.0	DRY
TP 47			-3.0	26'6 (DRY)
TP 52			-2.17	DRY
TP 53			-2.25	29'9" (DRY)
TP 54			-3.10	31'9½" (DRY)
TP 36			-2.58	25'4" [illegible]
TP 29			-2.46	24'3" 24.[illegible]
TP 28			DRY	DRY
TP 57				DRY
TP 58				29' (DRY)
TP 60				27'1" 27.08

CHENEY MW WATER LEVELS

(34)

DATE: 8-24-89

MADE BY: Ivan M.

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904			- 1.5'	37' 37.00
906			-	DRY
910			-	DRY
911			-	DRY
912			-	DRY
913			-	DRY
914			-	DRY
915			-	DRY
916			-	DRY
917			-	DRY
918			-	DRY
919			-	DRY
920			-	DRY
921			-	DRY
926			-	DRY
932			-	DRY
933			-	DRY
943			-	DRY
933			-	DRY
948			-	DRY
			-	
			-	
			-	
			-	
			-	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE testing water wells WO NO

DESCRIPTION test depth of water in test wells

SHEET NO 7

MADE BY Shon CHECKED BY Shon '77 DATE 8-29-89

	TOC	L.S.D.	
508	-1.5	34'6"	34.50
509	-1.2	88'4¼"	88.35
701	-2.0	31'2¼"	31.19
702	-1.5	27'6"	27.50
805S	-1.06	34'6½"	34.54
805D	-1.19	59'3¼"	59.27
806S	-1.03	31'10½"	31.88
806D	-2.05	68'4½"	68.38
807D	-1.63	46'4¾"	46.39
808	-1.19	20'10½"	20.88
809	-1.4[illegible]	DRY	
811S	-1.1[illegible]	27'9½"	27.79
811D	-1.[illegible]	56'10"	56.42
812S	0.98	22'9"	22.[illegible]
812D	-1.5[illegible]	23'6½"	23.54
813	-1.16	18'1"	18.08
814	-1.50	33'4¼"	33.35
815	-1.41	24'4½"	24.38
816	-1.58	19'9¾"	19.81
820	-1.19	24'4¾"	24.40
821D	-1.65	DRY	
822	-1.58	35'9¼"	(DRY)
823D	-1.[illegible]	47'10¾"	47.90
824	1.10	48'3¼"	48.27
825D	-1.12	52'5"	52.42
828	-1.6[illegible]	23'2½"	23.21
829S	[illegible]	30'1½"	30.13
829D	[illegible]	38'9½"	38.79
830	-1.13	23'6½"	[illegible]
833S	-1.18	36'2"	36.17
833D	-1.78	41'10"	41.[illegible]
835	[illegible]	21'[illegible]	[illegible]
936	[illegible]	27'2½"	27.21
938	[illegible]	DRY	
939	[illegible]	16'6"	16.50

CHENEY TEST PIT PIEZOMETERS

DATE 8-29-89 NAME Ivan D. Minnick

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
	8-29-89		-		
TP 41	" " "		-	31'	31.00
TP 51	" " "		-	28' 2 3/4"	28.23
TP 43	" " "		-2.2'	22'	22.00
TP 44	" " "		-3.0	21' 1"	21.08
TP 47	" " "		-3.0	26' 4 1/2"	26.38
TP 52	" " "		2.17	DRY	
TP 53	" " "		-2.25	29' 6 3/4"	29.56
54	" " "		-3.10	31' 8 1/2"	31.71
P 36	" " "		-2.58	25' 3 1/2"	25.29
TP 29	" " "		-2.46	23' 5 3/4"	23.48
TP 28	" " "		DRY	DRY	
Tp 62	" " "			24' 5 1/2"	24.46
TP 57	" " "			DRY	
TP 58	" " "			30' (Dry)	
TP 60	" " "			27' 2"	27.17

CHENEY [illegible] WATER LF.

DATE: 8-29-89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPT BLS
			-	
904	8-29-89		- 1.5'	36'11" 36.92
913	" " "		-	DRY
912	" " "		-	DRY
914	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
10	" " "		-	DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
832	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE Well tester W.O. NO.

DESCRIPTION Testing Depth of water level

SHEET NO. 9-5-89

MADE BY [illegible] CHECKED BY [illegible] DATE ~~[illegible]~~-89

	TOC	LSD	
508	-1.5	34'6"	34.50
509	-1.2	84"3'	84.25
701	-2.0	31' 3¼'	31.29
702	-1.5	27'9"	27.75
805S	-1.06	34'7¼"	34.60
805D	-1.11	59' 4'	59.33
806S	-1.63	31' 10¼"	31.85
806D	-2.05	68' 6½"	68.54
807D	-1.63	46' 5"	46.42
808	-1.19	20' 10"	20.83
809	-1.40	DRY	
11S	-1.15	27' 10½"	27.88
11D	-1.62	56' 11"	56.92
812S	-0.98	22' 9¼"	22.77
812D	-1.53	23' 6½"	23.54
813	-1.16	18' 3"	18.25
814	-1.50	33' 5"	33.42
815	-1.41	24' 4¼"	24.35
816	-1.58	19' 5"	19.42
820	-1.19	25' 0"	25.00
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	47' 11¼"	47.94
824	-1.10	48' 3"	48.25
825D	-1.18	52' 6"	52.50
828	-1.63	23' 3"	[illegible]
829S	-1.07	30' 1¾"	30.15
829D	-1.55	38' 11"	[illegible]
830	-1.13	23' 6¼"	23.52
33S	-1.18	36' 2"	36.17
33D	-1.78	41' 10"	41.83
835	-1.38	21' 1¼"	21.10
936	-1.54	27' 3⅞"	27.26
932	-1.13	DRY	

CHENEY TEST PIT PIEZOMETERS

DATE: 9-5-89 NAME: Dan Minacle

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
	9-5-89		-	
TP 41	" " "		-	31'2" 31.17
TP 51	" " "		-	28'2 3/4" 28.2[illegible]
TP 43	" " "		-2.21	22'5 1/2" 22.46
TP 44	" " "		-3.0	24'2 1/4" 24.19
TP 47	" " "		-3.0	26'6" 26.50
TP 52	" " "		-2.17	DRY
TP 53	" " "		-2.25	29'9 1/8" 29.72 (DRY)
TP 54	" " "		-3.10	30'9" 31.75 (DRY)
TP 36	" " "		-2.58	~~25'4 1/4"~~ (DR[illegible])
TP 29	" " "		-2.46	23'7 1/2" 23.70[illegible]
TP 28	" " "		DRY	DRY
TP 57	" " "			DRY.
TP 58	" " "			29' (DRY)
TP 60	" " "			27'6" 27.50

CHENEY MW WATER LEVELS

DATE: 9-5-89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
	9-5-89		-	
904	" " "		- 1.5'	37'6" 37.50
913	" " "		-	DRY
912	" " "		-	DRY
914	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
[illegible]	" " "		-	DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
832	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	
			-	
			-	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE: testing wells
W.O. NO.:
DESCRIPTION: Depth of water
SHEET NO.:
MADE BY: [illegible]
CHECKED BY:
DATE: 9-11-89

	TOC	LSD	
508	-1.5	34'8"	34.67
509	-1.2	84'0"	84.00
701	-2.0	31'4"	31.33
702	-1.5	27'8 1/4	27.69
805S	-1.06	34'8"	34.67
805D	-1.11	59'4"	59.33
806S	-1.63	31'10"	31.83
806D	-2.05	68'6"	68.5
807D	-1.63	46'4 1/4	46.35
808	-1.49	20'9 1/2"	20.79
809	-1.40	DRY	
811S	-1.15	27'10"	31.83
811D	-1.62	56'10 1/4	56.85
812S	-0.98	22'9"	22.[illegible]
812D	-1.53	23'6"	23.5
813	-1.16	18'3"	18.25
814	-1.50	33'5 1/4	33.44
815	-1.41	24'5"	24.42
816	-1.58	19'4 3/4	19.42
820	-1.49	25'	25.00
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.39	47'11"	47.92
824	-1.10	48'	48.00
825D	-1.48	52'5 1/2"	52.46
828	-1.63	23'2"	23.17
829S	-1.07	30'1 1/2"	30.125
829D	-1.55	38'11"	38.92
830	-1.43	23'6"	23.50
833S	-1.18	36'2"	36.17
833D	-1.78	21'10"	21.8[illegible]
835	-1.38	21'3"	21.[illegible]
936	-1.54	27'3"	27.25
938	-1.43	DRY	
939	-1.[illegible]	16'6"	12.50

CHENEY MW WATER LEVELS

DATE: 9/11/89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	~~12~~ 9/12/89		-1.5'	37'6" 37.5
913	" " "		-	DRY
912	" " "		-	DRY
914	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
0	" " "		-	DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
832	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	
			-	
			-	

CHENEY TEST PIT PIEZOMETERS

DATE: 9/11/89 ~~12~~ NAME: _____

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
	9/12/89		-	
TP 41	" " "		-	31' 1½" 31.125
TP 51	" " "		-	28' 2" 28.17
TP 43	" " "		-2.21	22' 6" 22.5
TP 44	" " "		-3.0	24-24½" 24.19
TP 47	" " "		-3.0	26' 5" 26.42
TP 52	" " "		-2.17	DRY
TP 53	" " "		-2.25	DRY
TP 54	" " "		-3.10	DRY
TP 36	" " "		-2.58	DRY
TP 29	" " "		-2.46	23' 3¾" 23.65
TP 28	" " "		DRY	DRY
TP 57	" " "			DRY
TP 58	" " "			DRY
TP 60	" " "			27' 6" 27.5

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE testing depth of water in wells W.O. NO.

DESCRIPTION Testing water level in wells & Test pits.

SHEET NO. 1 of 3

MADE BY Ivan M CHECKED BY I. D. M. DATE 9/18/89

	TOC	LSD	
508	-1.5	34' 6"	34.5
509	-1.2	81' 4½"	81.38
701	-2.0	31' 3"	31.25
702	-1.5	27' 6"	27.5
805S	-1.06	34' 5"	34.42
805D	-1.19	59' .04"	59.92
806S	-1.63	31' 10½"	31.88
806D	-2.05	68' 6"	68.5
807D	-1.63	46' 6½"	46.54
808	-1.49	20' 10"	20.83
809	-1.40	DRY	
115	-1.15	27' 10¾"	27.90
11D	-1.62	56' 11"	56.92
812S	-0.98	22' 10¼"	22.85
812D	-1.53	23' 5½"	23.46
813	-1.16	18' 4"	18.33
814	-1.50	33' 6"	33.5
815	-1.41	24' 8"	24.67
816	-1.58	19' 5"	19.42
820	-1.49	24' 5"	24.42
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	47' 11½"	47.96
824	-1.10	48' 4"	48.33
825D	-1.48	52' 4"	52.33
828	-1.63	23' 2"	23.17
829S	-1.07	30' 10½"	30.86
829D	-1.55	39' .01"	39.08
830	-1.43	23' 6"	23.5
833S	-1.18	36' 2"	36.17
33D	-1.78	42'	42
835	-1.38	21' 6"	21.5
836	-1.54	24' 2"	24.17
838	-1.43	DRY	

CHENEY MW WATER LEVELS

(45)

DATE: 9/18/89

MADE BY: [illegible]

P.2 of 3

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	9/18/89		-1.5'	31 3/4 E 37.0
913	" " "		-	DRY
912	" " "		-	DRY
919	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
910	" " "		-	DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
932	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	
			-	
			-	

CHENEY TEST PIT PIEZOMETERS

TIME: 9/18/89 NAMES: By Ivan A.3.83

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
	9/18/89		-	
TP 41	" " "		-	31' 31
TP 51	" " "		-	28' 2½" 28.21
TP 43	" " "		-2.21	22' 5" 22.42
TP 44	" " "		-3.0	24' 1¼" 24.10
TP 47	" " "		-3.0	26' 5" 26.42
TP 52	" " "		-2.17	DRY
TP 53	" " "		-2.25	DRY
TP 54	" " "		-3.10	DRY
36'	" " "		-2.58	DRY
TP 29	" " "		-2.46	23' 8" 23.67
TP 28	" " "		DRY	DRY
TP 58	" " "			29 DRY 29
TP 57	" " "			DRY
TP 60	" " "			27' 1½" 27.13
TP 116		30'		28' 6" 28.5
TP 143				18' 18

(Gather more) (47)

9/2/89 # well 828 water depth 21.79
23' 5"

after Night Rain 9/20/89

9-20-89 = well # 830 - water Depth 19' 10" 18.4
9-20-89 = " # 816 - " " 17' 4" 15.75
9-20-89 = " # 811S - " " 27' 11" 26.77
9/20/89 = " # 811D - " " 54' 6" 52.88
9/20/89 = " # 508 - " " 34' 10½" 3.
9/20/89 = " # 701 - " " 31' 4" 29.33
9/20/89 - " # 806D - " " 68' 1" 66.03
9/20/89 - " # 806S - " " 32' 2" 30.54
9/20/89 - " # 820 - " " 24' 11" 23.43
9/21/89 - " # 822 - " " Dry
9/21/89 - " # 920 - " " Dry.
9/21/89 - " # 508 - " " 34' 10" 33.33
9/21/89 - " # 701 - " " 31' 4½" 29.40
9/21/89 - " # 830 - " " 19' 10" 18.4
9/21/89 - " # 816 - " " 17' 3" 15.67
9/21/89 - " # 811D - " " ~~54' 6½"~~ 54' 7 52.46
9/21/89 - " # 811S - " " ~~27' 11"~~ 27' 11" 26.
9/21/89 - " # 820 - " " 24' 11" 13
~~9/21/89 - " # 701 - " " 31' 5"~~
~~9/21/89 - " # 820 - " " 24' 11"~~

							test by [illegible]
1/22/89	# well	#	830	✓	water	Depth	20' 18.5"
9/22/89	#	"	# 816	✓	"	"	17' 4½" 15.7"
9/22/89	=	"	# 811S	✓	"	"	28' 02" 27.0
9/22/89	=	"	# 811D	✓	"	"	56' 04½" 53'
9/22/89	=	"	# 508	✓			34' 11" 33.41
9/22/89	=	"	# 701	✓	"	"	31' 9½" 29.3
9/22/89		"	# 806S	✓	"	"	32' 2¾" 30.5
9/22/89		"	# 806D	✓	"	"	68' 1" 66.03
9/22/89		"	# 820	✓	"	"	25' 23.51
9/22/89		"	# 915	✓	"	"	Dry
9/22/89		"	# 828	✓	"	"	23' 5¼"
[illegible]/89		"	# 822	✓	"	"	Dry
[illegible]/89		"	# 920	✓	"	"	DRY

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE: testing wells
W.O. NO.:
DESCRIPTION: test wells for Depth
SHEET NO.:
MADE BY: [illegible]
CHECKED BY: [illegible]
DATE: 9-25-89

	TOC	LSD	
508	-1.5	34' 11"	34.92
509	-1.2	81' 5½"	81.18
701	-2.0	31' 4"	31.33
702	-1.5	27' 5½"	27.46
805S	-1.06	34' 5¼	34.44
805D	-1.11	59' 02"	59.02
806S	-1.63	32' 1	32.08
806D	-2.05	67' 11"	67.92
807D	-1.63	46' 8"	46.67
808	-1.19	20' 10"	20.83
809	-1.40	DRY	
811S	-1.15	28'	
811D	-1.6[illegible]	55' 9½"	55.[illegible]
812S	-0.98	22' 11"	22.9[illegible]
812D	-1.53	23' 6"	23.5
813	-1.16	18' 4"	18.33
814	-1.50	33' 6½"	33.[illegible]
815	-1.41	24' 9½"	24.54
816	-1.58	17' 4"	17.33
820	-1.19	24' 11"	24.92
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	47' 11¾"	47.98
824	-1.10	48' 5"	48.42
825D	-1.18	52' 6"	52.5
828	-1.63	23' 5"	23.42
829S	-1.07	30' 10"	30.83
829D	-1.55	39'	
830	-1.13	22' 01"	22.01
833S	-1.18	31' 6"	31.5
833D	-1.78	42'	
835	-1.38	22'	
936	-1.54	27' 2"	27.17
938	-1.13	DRY	
[illegible]	[illegible]	[illegible]	1.62

CHENEY MW WATER LEVELS

(50)

DATE: 9-25-89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	38'
904	9/25/89		-1.5'	DRY
913	" " "		-	DRY
912	" " "		-	DRY
914	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
0	" " "		-	DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
932	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	
			-	
			-	

CHENEY TEST PIT PIEZOMETERS

DATE: 9/25/89 NAMES: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
	9/25/89		–	
TP 41	" " "		–	30' 11 3/4" 47.98
TP 51	" " "		–	28' 2" 28.17
TP 43	" " "		-2.21	22' 5" 22.42
TP 44	" " "		-3.0	26' 4" 26.33
TP 47	" " "		-3.0	26' 5" 26.42
TP 52	" " "		-2.17	~~DRY~~ DRY
TP 53	" " "		-2.25	DRY
TP 54	" " "		-3.10	DRY
TP 36	" " "		-2.58	DRY
TP 29	" " "		-2.46	23' 7 1/2" 23.63
TP 28	" " "		DRY	DRY
TP 58	" " "			DRY
TP 57	" " "			DRY
TP 60	" " "			27' 2 1/2" 27.21
TP 116	" " "			28' 6" 28.5
TP 193	" " "			18' 1" 18.08

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION testing water depth in wells

SHEET NO. _____

MADE BY [illegible] CHECKED BY [illegible] DATE 10/2/89

	TOC	LSD	
508	-1.5	37' 11"	34.92
509	-1.2	79' 2"	79.17
701	-2.0	31' 4"	31.33
702	-1.5	28'	
805S	-1.06	34' 11"	34.03
805D	-1.11	59' 07"	59.03
806S	-1.63	31' 5"	31.42
806D	-2.05	68' 4"	68.42
807D	-1.63	46' 6"	46.5
808	-1.19	20' 11"	20.92
809	-1.40	DRY	
11S	-1.15	28'	28
11D	-1.6[illegible]	54' 3"	54.25
812S	-0.98	22' 8"	22.67
812D	-1.53	23' 6"	23.16
813	-1.16	18' 1"	18.08
814	-1.50	33' 4"	33.33
815	-1.41	29' 7"	29.58
816	-1.58	20'	
820	-1.19	25'	
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	48'	
824	-1.10	48' 4"	48.45
825D	-1.18	52' 6"	52.5
828	-1.63	23'	
829S	-1.07	30' 2"	
829D	-1.55	38' 11"	38.92
830	-1.43	23' 7"	23.58
33S	-1.18	36' 2"	36.17
33D	-1.78	41' 8"	41.67
835	-1.38	21'	
936	-1.51	27' 4"	27.35
938	-1.13	DRY	

CHENEY MW WATER LEVELS

DATE: 10/2/89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	10/2/89		- 1.5'	27.5" 37.42
913	" " "		-	DRY
912	" " "		-	DRY
914	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
910	" " "		-	DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
932	" " "		-	DRY
9 5	" " "		-	DRY
9.7	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	
			-	
			-	

CHENEY TEST PIT PIEZOMETERS

DATE: 10/2/89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
	10/2/89		-		
TP 41	" "		-	32'	
TP 51	" "		-	28'6"	28.5
TP 43	" "		[illegible]	22'7"	22.58
TP 44	" "		-3.0	29'5"	24.42
TP 47	" "		-3.0	26'6"	26.5
TP 52	" "		-2.17	DRY	
TP 53	" "		-2.25	DRY	
TP 4	" "		-3.10	DRY	
36	" "		-2.58	DRY	
TP 29	" "		-2.46	23'	
TP 28	" "		DRY	DRY	
TP 57	" "			DRY	
58	" "			DRY	
60	" "			27'2"	27.17
D 116	" "			DRY	
TP 143	" "			DRY	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O NO. _____

DESCRIPTION _____

SHEET NO. _____

MADE BY J.M. CHECKED BY J.M. DATE 10/9/89

	TOC	LSD	
508	-1.5	39' 11½"	34.96
509	-1.2	79'	
701	-2.0	31' 9"	31.33
702	-1.5	28' 3"	28.25
805S	-1.06	39' 9¼"	34.97
805D	-1.19	59'	
806S	-1.63	31' 5"	31.42
806D	-2.05	68' 6¼"	68.52
807D	-1.63	96' 6"	46.51
808	-1.19	20' 10"	20.83
809	-1.40	DRY	
811S	-1.15	28' 8"	28.33
811D	-1.62	59' 7"	
812S	-0.98	22' 8"	22.67
812D	-1.53	23' 6"	23.5
813	-1.16	18'	
814	-1.50	32' 11"	32.92
815	-1.41	29' 7½"	24.63
816	-1.58	20'	
820	-1.49	25' 5"	25.42
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	48'	
824	-1.10	48' 3"	48.25
825D	-1.48	52' 10"	20.83
828	-1.63	23'	
829S	-1.07	30' 9½"	30.19
829D	-1.55	39'	
830	-1.43	23' 7¼"	23.6
833S	-1.18	36' 8"	36.6
833D	-1.78	41' 6"	
835	-1.38	21' 2"	21.17
936	-1.54	27' 1"	27.08
938	-1.43	DRY	
		11' 8½"	

CHENEY TEST PIT PIEZOMETERS

TI 10/2/89 NAME: IVAN

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
			-	
TP 41			-	32' 2" 32.17
TP 51			-	28' 7" 28.58
TP 43			[illegible]	22' 8" 22.67
TP 44			-3.0	24' 9" [illegible]
TP 47			-3.0	26' 9" 26.25
TP 52			-2.17	DRY
TP 53			-2.25	DRY
TP 4			-3.10	DRY
56			-2.58	DRY
TP 29			-2.46	24' 1" 24.08
TP 28			DRY	DRY
TP 57				DRY
TP 58				DRY
TP 60				27'
TP 116				DRY
TP 143				DRY

CHENEY MW WATER LEVELS

(57)

DATE: 10/9/89

MAOR BY: J.M.

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	10/9/89		-1.5'	37' 6' 37.5
913	" " "		-	DRY
912	" " "		-	DRY
919	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
910	" " "		-	DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
932	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
			-	
			-	
			-	
			-	
			-	
			-	
			-	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE test Drain water in wells W.O.

DESCRIPTION

SHEET NO.

MADE BY ch CHECKED BY ch DATE 10/17/89

	TOC	LSD	
508	-1.5	36' 1"	34.58
509	-1.2	87' 2"	85.97
701	-2.0	31' 6"	29.5
702	-1.5	27' 8"	26.17
805S	-1.06	DRY	
805D	-1.11		56.42
806S	-1.63	31' 10"	30.25
806D	-2.05	68' 6 1/4"	66.47
807D	-1.63	46' 8 1/2"	45.08
808	-1.19	20' 11"	19.93
809	-1.40	DRY	
115	-1.15	27' 10 1/4"	26.70
11D	-1.62	56' 11"	55.3
812S	-0.98	22' 9"	21.7
812D	-1.53	23' 7"	22.55
813	-1.16	18' 3 1/4"	16.81
814	-1.50	33' 4"	31.23
815	-1.41	24' 4"	22.92
816	-1.58	19' 6"	17.92
820	-1.49	[illegible]	23.64
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.57	DRY	
824	-1.10	DRY	
825D	-1.18	52' 6"	51.02
828	-1.63	22' 2"	21.54
829S	-1.07	30' 2"	29.10
829D	-1.55	38' 10 1/2"	33.33
830	-1.13	23' 7"	22.15
33S	-1.18	36' 2"	34.99
33D	-1.78	91' 11"	49.14
835	-1.38	21' 2"	19.99
9[illegible]6	[illegible]	27' 3"	25.51
9[illegible]2	[illegible]	DRY	

CHENEY TEST PIT PIEZOMETERS

DATE: 10/17/89 NAME: _____

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
	10/17/89		-		
TP 41			-	31' 2"	31.17
TP 51			-	28' 3¼	28.27
TP 43			-	23' 4	21.12
TP 44			-	24' 6"	21.5
TP 47			-3.0	[illegible]	24.5
TP 52			-2.17	[illegible]	24.5
TP 53			-2.25	[illegible]	29.42
TP 54			-3.10	32' [illegible]	29.48
36			-2.58	25' 4 8	[illegible]
TP 29			-2.46	23' 7¾"	21.19
TP 28			DRY	DRY	
TP 57				22' 11"	22.92
TP 58				DRY	
TP 60				DRY	
TP 116				33' [illegible]	33.08
TP 143				DRY	
TP 89				27' 6	27.5
TP 79				28' [illegible]	28.92

CHENEY MW WATER LEVELS

(60)

DATE: 10/17/89

MADE BY: [illegible]/YM

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
	1017		-	
904 ✓	" " "		-1.5'	[illegible] 35.42
913 ✓	" " "		-	[illegible]
912 ✓	" " "		-	[illegible]
914 ✓	" " "		-	[illegible]
916 ✓	" " "		-	[illegible]
911 ✓	" " "		-	[illegible]
918 ✓	" " "		-	[illegible]
906 ✓	" " "		-	[illegible]
919 ✓	" " "		-	[illegible]
[illegible] ✓	" " "		-	[illegible]
925	" " "		-	[illegible]
908 ✓	" " "		-	[illegible]
921 ✓	" " "		-	[illegible]
932 ✓	" " "		-	[illegible]
915 ✓	" " "		-	[illegible]
917 ✓	" " "		-	[illegible]
920 ✓	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]
[illegible]	" " "		-	[illegible]

10/17/79

#751
#922
#925
#943
#826
#944
#909
#965
#966 not Completed at date

24.13

(62)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE: tester for DATA
W.O. NO.:
DESCRIPTION: test water depth in wells
SHEET NO.:
MADE BY: J.M.
CHECKED BY: [illegible]
DATE: 10/27/89

	TOC	LSD	
508	-1.5	36' 2"	34.6
509	-1.2	87'	85.8
701	-2.0	31' 4"	29.33
702	-1.5	28'	26.5
805S	-1.06	DRY	
805D	-1.41	57' 11 1/4"	56.5
806S	-1.63	31' 11"	30.29
806D	-2.05	68' 6"	66.45
807D	-1.63	46' 10"	45.20
808	-1.49	21'	19.51
809	-1.40	DRY	
11S	-1.15	28'	26.85
11D	-1.62	56' 11"	55.2
812S	-0.98	22' 10"	21.85
812D	-1.53	23' 7 1/2"	22.1
813	-1.46	18' 3"	16.79
814	-1.50	33' 6"	32
815	-1.41	24' 3"	22.84
816	-1.58	19' 8 1/4"	18.11
820	-1.49	25'	23.51
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	DRY	
824	-1.40	DRY	
825D	-1.48	52' 8"	51.19
828	-1.63	23' 2 1/2"	21.58
829S	-1.07	30' 4"	29.26
829D	-1.55	38' 11"	37.27
830	-1.43	23' 7 1/2"	22.20
833S	-1.18	36' 3"	35.22
833D	-1.78	41' 10"	40.05
835	-1.38	21'	19.62
936	-1.54	27'	25.46
938	-1.43	DRY	

CHENEY MW WATER LEVELS

(63)

DATE: 10/27/87

MADE BY: d/m.

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	DEPTH TOC	DEPTH BLS
			-	
904	10/27/89		- 1.5'	37' >5.5
913	" " "		-	DRY
912	" " "		-	DRY
914	" " "		-	DRY
916	" " "		-	DRY
911	" " "		-	DRY
918	" " "		-	DRY
906	" " "		-	DRY
919	" " "		-	DRY
910	" " "			DRY
925	" " "		-	DRY
908	" " "		-	DRY
921	" " "		-	DRY
932	" " "		-	DRY
915	" " "		-	DRY
917	" " "		-	DRY
920	" " "		-	DRY
831	" " "		-	DRY
926	" " "		-	DRY
946	" " "		-	DRY
950	" " "		-	DRY
949	" " "		-	DRY
956	" " "		-	DRY
955	" " "		-	DRY
954	" " "		-	DRY
927				22' 0" 4475

(4)

CHENEY TEST PIT PIEZOMETERS

TIME: 10/27/89 NAME: JM

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
	10/27/89		-		
TP 41			-	3"	
TP 51			-	2' 4½"	
TP 43				2' 6¼	
TP 44			-3.0	24' 5"	21.41
TP 47			-3.0	27' 3"	24.25
TP 52			-2.17	26' 8"	24.49
TP 53			-2.25	31' 8¼"	29.44
-4			-3.10	32' 6"	29.4
36			-2.58	25.48	22.9
TP 29			-2.46	23' 8"	21.21
TP 28			DRY	DRY.	
TP 57				23'	23
TP 58				DRY	
TP 60				DRY	
TP 116				33' 2"	33.17
TP 143				DRY	
TP 88				27' 6½"	27.54
TP 89				28' 11"	28.92

ist by LM.	10/27/89	Depth
Jell X		DRY
Jell not Numbered		DRY
# 951		DRY
# 922		DRY
# 923		DRY
# 943		DRY
# 826		DRY
# 944		DRY
# 909		DRY
# 965		24.14
~~# 966~~	~~Not Complete~~	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE Test Data Water Depth W.O. NO.

DESCRIPTION

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible] DATE 10/20/89

	TOC	LSD	
508	-1.5	35.30	33.8
509	-1.2	75.67	74.41
701	-2.0	31.45	29.43
702	-1.5	27.92	26.42
805S	-1.06	34.73	33.67
805D	-1.11	59.67	58.23
806S	-1.63	32.18	30.52
806D	-2.05	[illegible]	66.81
807D	-1.63	47.15	45.52
808	-1.49	21.15	19.64
809	-1.40	DRY	
11S	-1.15	[illegible]	27.28
811D	-1.62	[illegible]	42.33
812S	-0.98	[illegible]	22.01
812D	-1.53	[illegible]	22.36
813	-1.46	[illegible]	17.64
814	-1.50	[illegible]	32.37
815	-1.41	[illegible]	23.31
816	-1.58	[illegible]	16.17
820	-1.49	25.13	23.64
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	DRY	
824	-1.10		
825D	-1.48	53.16	51.68
828	-1.63	23.87	22.24
829S	-1.07	39.6	38.44
829D	-1.55	39.17	37.62
830	-1.43	23.83	22.4
33S	-1.18	[illegible]	34.82
833D	-1.78	[illegible]	48.4
835	-1.38	[illegible]	19.83
936	-1.51	[illegible]	26.
938	-1.13	[illegible]	

CHENEY MW WATER LEVELS

(67)

DATE: 10/30/89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	10/30/89		-1.5'	37.70 362
913	"		-	DRY
912	"		-	DRY
914	"		-	DRY
916	"		-	DRY
911	"		-	DRY
918	"		-	DRY
906	"		-	DRY
919	"		-	DRY
910	"		-	DRY
925	"		-	DRY
908	"		-	DRY
921	"		-	DRY
932	"		-	DRY
915	"		-	DRY
917	"		-	DRY
920	"		-	DRY
927	"		-	44.83
831	"		-	DRY
926	"		-	DRY
946	"		-	DRY
950	"		-	DRY
949	"		-	DRY
956	"		-	DRY
955	"		-	DRY
954	"			DRY

10/8/79

951
922

74
74
101
975
980
972
976
983

5
131

DRY

CHENEY TEST PIT PIEZOMETERS

DATE: 10/30/89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
			-		
TP 41			-	31.23	
TP 51			-	28.34	
TP 43			[illegible]	22.67	20.46
TP 44			-3.0	24.23	21.23
TP 47			-3.0	26.56	23.56
TP 52			-2.17	DRY	
TP 53			-2.25	DRY	
TP 54			-3.10	DRY	
36			-2.58	23.83	21.25
TP 29			-2.46	23.80 ~~DRY~~	21.34
TP 28			DRY	~~23.~~ DRY	
TP 57				DRY	
TP 58				DRY	
TP 60				27.23	
TP 116				28.62	
TP 143				DRY	
TP 56				22.96 (DRY)	
TP 88				27.65 (DRY)	
TP 89				29.28	
TP 92				30.91 (DRY)	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION _____

SHEET NO. _____

MADE BY _____ CHECKED BY _____ DATE 11/6/89

	TOC	LSD	
508	-1.5	35.21	33.71
509	-1.2	75.34	74.14
701	-2.0	31.03	29.03
702	-1.5	27.90	26.4
805S	-1.06	34.76	33.7
805D	-1.19	59.67	58.23
806S	-1.63	32.11	30.48
806D	-2.05	68.83	66.78
807D	-1.63	47.17	45.54
808	-1.19	21.11	19.62
809	-1.40	DRY	
1S	-1.16	28.41	27.26
811D	-1.62	48.95	47.33
812S	-0.98	22.93	21.95
812D	-1.53	23.92	22.39
813	-1.16	19.01	17.55
814	-1.50	33.82	32.32
815	-1.41	24.70	23.29
816	-1.58	17.79	16.21
820	-1.49	25.10	23.61
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.58	DRY	
824	-1.40	DRY	
825D	-1.48	53.13	51.65
828	-1.63	23.89	22.25
829S	-1.07	39.19	37.12
829D	-1.55	39.16	37.61
830	-1.43	23.80	22.37
833S	-1.18	36.0	34.82
833D	-1.78	50.14	48.36
835	-1.38	21.20	19.82
836	-1.54	27.52	25.98
838	-1.43	DRY	

CHENEY MW WATER LEVELS

(71)

DATE: 11/6/89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904	11/6/89		-1.5'	37.73 36.23
913	"		-	DRY
912	"		-	DRY
914	"		-	DRY
916	"		-	DRY
911	"		-	DRY
918	"		-	DRY
906	"		-	DRY
919	"		-	DRY
910	"		-	DRY
925	"		-	DRY
908	"		-	DRY
921	"		-	DRY
932	"		-	DRY
915	"		-	DRY
917	"		-	DRY
920	"		-	DRY
927	"		-	44.80
831	"		-	DRY
926	"		-	DRY
946	"		-	DRY
950	"		-	DRY
949	"		-	DRY
956	"		-	DRY
955	"		-	DRY
[illegible]	[illegible]			[illegible]

Well No.		Depth
DATE 11/6/89	Test by [illegible]	
not Numbered		DRY
Marked x		DRY
± 951		DRY
922		DRY
923		DRY
943		DRY
826		DRY
± 944		DRY
± 909		DRY
± 965		23.92
± 966		26.84
972		88.99
± 974		137.4
± 981		78.46
975		80.43
± 980		79.40
± 973	56'	DRY
976	130'	DRY
# 983		DRY
# 970	30'6" Depth	DRY
# 969		DRY

CHENEY TEST PIT PIEZOMETERS

DATE: 11/6/89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS	
	11/6/89		-		
TP 41	"		-	[illegible]	
TP 51	"		-	[illegible]	
TP 43	"		[illegible]	[illegible]	19.95
TP 44	"		-[illegible]	[illegible]	19.65
TP 47	"		-[illegible]0	[illegible]	24.92
TP 52	"		-2.17	[illegible]	24.42
TP 53	"		-2.25	[illegible]	28.53
TP 54	"		-3.10	[illegible]	28.66
36	"		-2.58	[illegible]	22.7
TP 29	"		-2.46	[illegible]	21.59
TP 28	"		DRY	DRY	
TP 57	"			[illegible]	
TP 58	"			[illegible]	
TP 60	"			[illegible]	
TP 116	"			[illegible]	
TP 143	"			[illegible]	
TP 89	"			[illegible]	
TP 88	"		[illegible]	30.27	
TP 92	"		[illegible]	30.71	
TP 56	"			23.01	

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE Testing Depth Data W.O. NO.

DESCRIPTION

SHEET NO.

MADE BY CHECKED BY DATE 11/13/89

	TOC	LSD	
508	-1.5	35.63	34.13
509	-1.2	76.07	74.87
701	-2.0	31.0	29
702	-1.5	28.01	26.51
805S	-1.06	34.78	33.72
805D	-1.44	59.74	57.7
806S	-1.63	33.02	31.39
806D	-2.05	68.91	66.86
807D	-1.63	47.13	45.5
808	-1.49	22.0	20.51
809	-1.40	DRY	
11S	-1.15	28.62	27.47
811D	-1.62	48.99	47.37
812S	-0.98	22.91	21.93
812D	-1.53	23.96	22.43
813	-1.46	19.07	17.61
814	-1.50	33.80	32.3
815	-1.41	24.72	23.31
816	-1.58	17.77	16.19
820	-1.49	25.14	23.65
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.38	DRY	
824	-1.40	DRY	
825D	-1.48	53.16	51.68
828	-1.63	23.92	22.29
829S	-1.07	39.16	38.09
829D	-1.55	39.19	37.64
830	-1.43	23.89	22.46
33S	-1.18	36.06	34.88
33D	-1.78	50.12	48.34
835	-1.38	21.32	19.94
936	-1.54	27.52	25.98
938	-1.43	DRY	

CHENEY MW WATER LEVELS

DATE: 11/13/89

MEAS BY: L.M.

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
			-	
904			-1.5'	37.79 36.29
913			-	DRY
912			-	DRY
914			-	DRY
916			-	DRY
911			-	DRY
918			-	DRY
906			-	DRY
919			-	DRY
910			-	DRY
925			-	DRY
908			-	DRY
921			-	DRY
932			-	DRY
915			-	DRY
917			-	DRY
920			-	DRY
927			-	44.87
831			-	DRY
926			-	DRY
946			-	DRY
950			-	DRY
949			-	DRY
956			-	DRY
955			-	DRY
954				DRY

DATE 11/13/89 Test by L.M.

Well No.		Depth
Numbered		DRY
Marked x		DRY
951		DRY
922		DRY
923		DRY
943		DRY
826		DRY
944		DRY
909		DRY
965		23.94
966		26.87
72		88.93
974		137.31
981		78.42
975		80.72
980		79.61
973		DRY
976		DRY
983		DRY
970		DRY
969		DRY
979		82.37
982	(4" PVC)	82.37

CHENEY TEST PIT PIEZOMETERS

DATE: 11/13/89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
			-	
TP 41			-	31.36
TP 51			-	28.24
TP 43			[illegible]	22.13
TP 44			[illegible]	22.67 19.67
TP 47			-3.0	27.94 (DRY)
TP 52			-2.17	26.60 (DRY)
TP 53			-2.25	30.79 (DRY)
TP 54			-3.10	32.78 (DRY)
36			-2.58	25.29 (DRY)
TP 29			-2.46	24.15
TP 28			DRY	DRY
TP 57				DRY
TP 58				29.16 (DRY)
TP 60				DRY
TP 116				28.66
TP 143				DRY
TP 89				29.36
TP 88				30.90 (DRY)
TP 92				30.91 (DRY)
TP 56				23.11

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE: Well Depth, Ex.
W.O. NO.:
DESCRIPTION: DATA Water Levi.
SHEET NO.:
MADE BY: [illegible]
CHECKED BY: [illegible]
DATE: 11/21/89

	TOC	LSD	
508	-1.5	[illegible]	34.10
509	-1.2	71.21	70.01
701	-2.0	[illegible]	29.23
702	-1.5	[illegible]	26.57
805S	-1.06	[illegible]	
805D	-1.11	57.[illegible]	56.36
806S	-1.63	[illegible]	30.78
806D	-2.05	[illegible]	65.91
807D	-1.63	[illegible]	45.61
808	-1.19		19.67
809	-1.40		
11S	-1.15		27.52
11D	-1.62	58.[illegible]	56.59
812S	-0.98	[illegible]	22.26
812D	-1.53	[illegible]	22.5-
813	-1.16		15.7
814	-1.50	[illegible]	32.03
815	-1.41	[illegible]	23.13
816	-1.58		16.08
820	-1.19		27.67
821D	-1.65		
822	-1.58		
823D	-1.38		
824	-1.10		
825D	-1.48	[illegible]	51.41
828	-1.63	[illegible]	22.35
829S	-1.07	[illegible]	32.07
829D	-1.55	[illegible]	30.67
830	-1.43	[illegible]	19.48
833S	-1.18		34.85
33D	-1.78		50.18
835	-1.38		19.77
936	-1.54	[illegible]	25.65
938	-1.43		

CHENEY MW WATER LEVELS

DATE: _____

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED 11/27/89	DEPTH BTOC	TOC	DEPTH BLS
903			-	32.54
904			-1.5'	37.86 37.36
913			-	DRY
912			-	DRY
914			-	DRY
916			-	DRY
911			-	DRY
918			-	DRY
906			-	DRY
919			-	DRY
910			-	DRY
925			-	DRY
908			-	DRY
921			-	DRY
932			-	DRY
915			-	DRY
917			-	DRY
920			-	DRY
927			-	44.92
831			-	DRY
926			-	DRY
946			-	DRY
950			-	DRY
949			-	DRY
956			-	DRY
955			-	DRY
954				DRY

Well No. DATE 11/20/89 Test by [illegible] Depth

Numbered

Marked x

951

922

923

943

826

944

909

965

966

72

974

981

975

980

973

976

983

970

969

979

982

963 Angle Hole (pre 2" 5.65 from ground)

967

905 (49' Depth)

CHENEY TEST PIT PIEZOMETERS

DATE: 11/20/89 NAME: by [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
			-	
TP 91			-	[illegible]
TP 51			-	[illegible]
TP 43			[illegible]	[illegible] 19.87
TP 44			-3.0	[illegible] 19.69
TP 47			-3.0	24.96
TP 52			-2.17	24.4
TP 53			-2.25	[illegible] 21.5
TP 54			-3.10	[illegible]
TP 36			-2.58	[illegible] 22.7
TP 29			-2.46	[illegible] 21.69
TP 28			DRY	
TP 57			—	
TP 58				[illegible]
TP 60				
TP 116				
TP 143				[illegible]
TP 89				[illegible]
TP 88				[illegible]
TP 92				[illegible]
TP 56				[illegible]

Well No. DATE 12/13/89 Test by [illegible] Depth

Numbered

Marked x

951

922

923

943

826

944

909

965

966

72

974

981

975

980

973

976

983

970

969

979

982

963 Angle hole (PVC 2" = 5.65 from ground)

967

905 (49' Depth)

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE Well tester W.O. NO.

DESCRIPTION test wells DATA Depth

SHEET NO.

MADE BY CHECKED BY DATE 12/14/89

	TOC	LSD	
508	-1.5	[illegible]	33.6
509	-1.2	[illegible]	63.97
701	-2.0	[illegible]	29.32
702	-1.5	27.7[illegible]	26.29
805S	-1.06	D[illegible]	
805D	-1.11	57.[illegible]	56.37
806S	-1.63	32.[illegible]	30.62
806D	-2.05	[illegible]	65.57
807D	-1.63	[illegible]	41.[illegible]
808	-1.49	[illegible]	19.45
809	-1.40		
811S	-1.15		26.42
811D	-1.6[illegible]		5[illegible]
812S	-0.98	[illegible]	22.17
812D	-1.53	2[illegible]	22.39
813	-1.16	[illegible]	15.38
814	-1.50	[illegible]	31.81
815	-1.41	[illegible]	22.6
816	-1.58	[illegible]	15.53
820	-1.49	[illegible]	28.01
821D	-1.65		
822	-1.58		
823D	-1.[illegible]8		
824	-1.40		
825D	-1.18		51.37
828	-1.63	23.3[illegible]	21.71
829S	-1.07	[illegible]	29.55
829D	-1.55	35.50	33.95
830	-1.43	[illegible]	18.06
833S	-1.18	[illegible]	37.[illegible]
833D	-1.78	[illegible]	50
835	-1.38	[illegible]	19.74
936	-1.51	[illegible]	25.08
938	-1.43	[illegible]	

CHENEY MW WATER LEVELS

(89)

DATE: 12/14-89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	DEPTH TOC	DEPTH BLS
903	/		-	=
904			- 1.5'	36.[illegible]
913			-	
912			-	
914			-	
916			-	
911			-	
918			-	
906			-	
919			-	
			-	
925			-	
908			-	
921			-	
932			-	
915			-	
917			-	
920			-	
927			-	14.[illegible]
831			-	
926			-	
996			-	
[illegible]0			-	
[illegible]			-	
956			-	
955			-	
954			-	

CHENEY TEST PIT PIEZOMETERS

DATE: 12/14/89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
			-	
TP 41			-	
TP 51			-	
TP 43			-	30.51
TP 44			-3.0	24
TP 47			-3.0	23.6
TP 52			-2.17	28.64
TP 53			-2.25	30.55
TP 54			-3.10	22.17
36			-2.58	
TP 29			-2.46	
TP 28			DRY	
TP 57				
TP 58				
TP 60				
TP 116				
TP 143				
TP 89				
TP 88				
TP 92				
TP 56				

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE _____ W.O. NO. _____

DESCRIPTION test water test wells

SHEET NO. _____

MADE BY [illegible] CHECKED BY [illegible] DATE 12-28-89

	TOC	LSD	
508	-1.5	35.81	34.31
509	-1.2	71.01	[illegible]
701	-2.0	31.15	29.15
702	-1.5	28.96	27.46
805S	-1.06	DRY	
805D	-1.44	57.97	56.53
806S	-1.63	32.30	30.67
806D	-2.05	67.78	65.73
807D	-1.63	47.26	45.63
808	-1.49	21.01	19.52
809	-1.40	DRY	
11S	-1.15	28.36	[illegible]
11D	-1.6[illegible]	58.11	56.[illegible]
812S	-0.98	23.30	22.32
812D	-1.53	23.92	22.39
813	-1.46	16.06	[illegible]
814	-1.50	32.40	31.90
815	-1.41	29.32	27.91
816	-1.58	16.78	15.20
820	-1.49	29.22	27.73
821D	-1.65	DRY	
822	-1.58	DRY	
823D	-1.39	DRY	
824	-1.10	DRY	
825D	-1.48	52.99	51.51
828	-1.63	24.10	22.47
829S	-1.07	31.03	29.96
829D	-1.55	36.21	34.66
830	-1.43	20.94	19.51
833S	-1.18	36.0	34.82
833D	-1.78	52.02	50.24
835	-1.38	21.09	19.71
936	-1.54	27.22	[illegible]
938	-1.43	DRY	

CHENEY MW WATER LEVELS

DATE: 12-28-89

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
903	12-28-89		-	32.59
904	"		-1.5'	35.88
913	"		-	DRY
912	"			DRY
914	"		-	DRY
916	"			DRY
911	"		-	DRY
918	"		-	DRY
906	"			DRY
919	"			DRY
910	"		-	DRY
925	"		-	DRY
908	"		-	DRY
921	"		-	DRY
932	"		-	DRY
915	"		-	DRY
917	"		-	DRY
920	"		-	DRY
927	"		-	45.12
831	"		-	DRY
926	"		-	DRY
946	"		-	DRY
950	"		-	DRY
949	"		-	DRY
956	"		-	DRY
955	"		-	DRY

DATE 12-29-89 Test by [illegible]

NO.	Depth
Numbered	DRY
Marked x	DRY
951	DRY
922	DRY
923	DRY
943	DRY
826	DRY
944	DRY
909	DRY
965	23.74
966	26.58
72	64.96
974	117.30
981	74.60
975	73.31
980	73.93
973	DRY
976	DRY
983	DRY
970	DRY
969	DRY
979	72.33
982	72.42
963	73.67
967	25.92
905	46.13

Angle hole 2" PVC is 5.6[illegible]

CHENEY TEST PIT PIEZOMETERS

DATE: 12-29-89 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
	12-29-89		–	
TP 91	"		–	28.28
TP 51	"		–	22.08
TP 93	"		–	DRY
TP 94	"		– [illegible]	DRY
TP 97	"		– 3.0	DRY
TP 52	"		– 2.17	DRY
TP 53	"		– 2.25	DRY
TP 54	"		– 3.10	24.19
TP 36	"		– 2.58	DRY
TP 29	"		– 2.46	DRY
TP 28	"		DRY	DRY
TP 57	"			DRY
TP 58	"			28.64
TP 60	"			DRY
TP 116	"			29.39
TP 143	"			DRY
				DRY

MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

JOB TITLE DATa on Wells Recovery W.O. NO.

DESCRIPTION Check water levi on well's

SHEET NO.

MADE BY [illegible] CHECKED BY [illegible] DATE Jan 17-90

	TOC	LSD
508	-1.5	35.87
509	-1.2	71.80
701	-2.0	31.41
702	-1.5	29.62
805S	-1.06	DRY
805D	-1.14	56.03
806S	-1.63	32.30
806D	-2.05	68.0
807D	-1.63	47.52
808	-1.19	21.11
809	-1.40	DRY
811S	-1.15	28.88
811D	-1.62	58.31
125	-0.98	23.20
812D	-1.53	29.36
813	-1.16	17.01
814	-1.50	33.86
815	-1.41	29.91
816	-1.58	16.83
820	-1.19	29.72
821D	-1.65	DRY
822	-1.58	DRY
823D	-1.38	DRY
824	-1.10	DRY
825D	-1.48	53.21
828	-1.63	29.19
829S	-1.07	31.36
829D	-1.55	36.37
830	-1.43	21.19
833S	-1.18	36.70
833D	-1.78	52.19
35	-1.38	21.32
936	-1.54	27.37
938	-1.43	DRY
939	-1.56	17.02

DATE: 01-17-90

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
903	01-17-90		-	32.79
904	"		-1.5'	35.87
913	"		-	DRY
912 ✓	" to be abandoned		-	DRY
919 ✓	" " " "		-	DRY
916 ✓	" " " "		-	DRY
911 ✓	" " " "		-	DRY
918 ✓	" " " "		-	DRY
906 ✓	" " " "		-	DRY
919	"		-	DRY
910 ✓	to be abandoned		-	DRY
~~925 ✓~~	~~abandoned well~~			~~DRY~~
908 ✓	" "		-	DRY
921 ✓	" "		-	DRY
932 ✓	to be abandoned		-	DRY
915	"		-	DRY
~~917 ✓~~	~~abandoned well~~		-	~~DRY~~
~~920 ✓~~	~~abandoned well~~			~~DRY~~
927			-	45.21
831			-	DRY
926 ✓	to be abandoned		-	DRY
946			-	DRY
~~950 ✓~~	~~abandoned well~~			~~DRY~~
~~949 ✓~~	~~abandoned well~~		-	~~DRY~~
956			-	DRY
955				DRY
954				DRY

Well No.	DATE. 01-17-90 Test by Tom	Depth
Numbered		DRY
Marked x		DRY
951		DRY
922 ✓	to be Abandoned	DRY
923 ✓	to be Abandoned	DRY
943		DRY
826		DRY
944		DRY
909 ✓	to be Abandoned	DRY
965		23.76
966		26.71
972		64.99
74		117.37
981		76.85
975		77.78
980		77.39
973		DRY
976		DRY
983		DRY
970		DRY
969		DRY
979		82.77
982		75.30
963	Angle Hole	83.51
967		26.02
905	49' Depth	96.13

CHENEY TEST PIT PIEZOMETERS

DATE: 01-18-90 NAME: [illegible]

TEST PIT NO.	DATE	DEPTH BTOC	TOC	DEPTH BLS
	01-18-90		-	31.37
TP 41	"		-	28.61
TP 51	"		-	22.01
TP 43	"			DRY
TP 44	"		-3.0	DRY
TP 47	"		-3.0	DRY
TP 52	"		-2.17	DRY
TP 53	"		-2.25	DRY
TP 54	"		-3.10	28.01 (DRY)
TP 36	"		-2.58	DRY
TP 29	"		-2.46	DRY
TP 28	"		DRY	DRY
TP 57	"			DRY
TP 58	"			DRY
TP 60	"			DRY
TP 116	"			29.67 (DRY)
TP 143	"			DRY
				?

DATE: 02-01-90

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
# 967	2-1-90			26.17
# 966	"			26.41
# 828	"			23.35
# 508	"			35.30
# 701	"			31.27
# 904	"			35.34
# 914	"			DRY
# 931	"			49.09

? Water added during constant head / falling head tests

DW 3/1/90 Record As Dry

DATE: 02-02-10

MADE BY: [illegible]

WELL NUMBER	DATE SAMPLED	DEPTH BTOC	TOC	DEPTH BLS
967				26.15
966				26.39
828				23.36
701				31.24
508				35.33
904				35.31
944				Test DRY
931				49.07

Should read dry. Water added during constant head / falling head tests.

DA 3/16/90

JE JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

2-25

Insitu Hydraulic Conductivity Testing
4/11/89 - 4/21/89

well Data to (b) w/ information on other

Initially Dry (as of 5/4/)

Task I Conducting Falling Head Tests in Competent Moncos Zones in 808D and 807D

1. Sound to make sure wells are still dry
2. Fill wells (PVC pipe) to the ground surface with water using the water truck
3. Continue adding water and maintain water level (near the ground surface) in PVC pipe for at least 0.5 hours. Record rate (gal./min) at which you add water to maintain constant level.
4. Stop addition of water and measure falling head vs. time. Keep recording data until water level has fallen to the level of the sand pack (note that this may take several days - adjust data collection interval accordingly, eg. one measurement/24 hrs). after initial rapid falling head.

Task II. Repeat Rising Head Tests in Wet Competent Moncos Zones in MW 810D and 806D

1. Sound well to obtain static
2. Bail down to level of screen bottom (sump top).
3. Record rising head vs. time. Continue collecting data until water level has recovered (risen) at least ½ of the initial drawdown depth. For example if the initial static is at 57' and you bail the water level down to the bottom of the screen at 63', continue to collect data until the water level has risen to at least 60'.

Task III. Conduct Both Rising Head and Falling Head Tests in wet MW 811D

1. Rising Head Test in MW 811D
   a) After drilling has been completed for the day, ask Mark to move the compressor truck to 811D and blow the hole dry with air. Blow dry in several stages - that is blow dry and then let water flow back into the hole for 1 minute - then repeat blowing and waiting several times.

FORM 91-005-1 (4/81)

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

III b) After blowing dry the final time, quickly run sounder cable down inside of the plastic blow pipe and record rising head data. Do not wait until Mark takes blow pipe out of the hole to start recording data. Be sure and subtract height of blow pipe "stick-up" above the PVC casing from the sounder depth readings to obtain depth from TOC. Again keep collecting data until water has risen at least 0.5 of the initial draw down depth. Help Mark remove blow pipe when you are finished.

2. Falling Head Test Test in wet MW811D
   a). Conduct tests as described in Task I above for holes 805D and 807D.

Task IV. Conduct Falling Head Test in Initially Dry Weathered Mancos screen interval in MW ~~820~~
1. Conduct test following steps described in Task I.

Task V. Conduct Constant Head Tests in Initially Dry Weathered Mancos zones in MW's 818, 819, and 830.
1. Sound wells to make sure wells are still dry.
2. Add water to well until the water level is approximately 1 ft below the weathered Mancos overlying GP or GC contact. Do not raise water level above this contact. Water levels you need to obtain are given below:

gals to reach WL	MW No	GP or GC/Shale Contact Ground Surface	TOC	Water Level Below TOC
2.2	818	20	21.5	22.5
2.7	819	39	40.5	41.5
2.7	830	22	23.5	24.5

3. Maintain this water level for at least 0.5 hours. R rate of addition of water (gallons/min) required to maintain water level.

FORM 01-605-1 (4/81)

(1) 818 location

(2) Response on 818D
806D from Susan

(3) Phase one survey to take place this week.

(4) Resistivity Survey to be done ? MK?

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-03-90-14-09 DISCIPLINE HYDRO NO. OF SHEETS 6

PROJECT: Grand Junction UMTRA Project

SITE: Cheney Site

FEATURE: Demonstration of Class III (Based on Yield) for the Fractured Mancos.

SOURCES OF DATA:

1) Pumping Test data for well GRJ 982 (10/31/89)
2) Calc # GRJ-11-89-14-03 (Pumping Test Analysis)
3) Calc # GRJ-03-90-14-15

SOURCES OF FORMULAE & REFERENCES:

N/A

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
	GRJ-03-90-14-09	TGoering	3/12/90	L Cone	3/12/90	B Ballaban	4/20/90

Tim Goering
3/12/90

Lane
3/12/90

DEMONSTRATION OF LOW YIELD OF THE FRACTURED MANCOS SHALE, CHENEY SITE, GRAND JUNCTION, COLORADO

PURPOSE: To demonstrate that the fractured Mancos shale at the Cheney site (Grand Junction, Colorado) cannot sustain a yield of 150 gallons per day (gpd) to a well.

PROCEDURE: Because of the complex hydrologic characteristics of fractured bedrock, quantitative numerical modeling does not accurately simulate flow in the fractured Mancos shale at the Cheney disposal site. Therefore, to assess whether the fractured Mancos could yield 150 gpd to a well, superposition of pumping test data and daily pumping of monitor well GRJ 982 was conducted to estimate long-term drawdown in the well.

Monitor well GRJ 982 is screened within the fractured Mancos formation at the Cheney site. Analyses of data from two pumping tests conducted on monitor wells GRJ 979 and 982 (Calculation # GRJ 11-89-14-03) indicate that the average transmissivity of the fractured Mancos shale in the vicinity of these wells is 1 ft^2 per day and the storativity is 1 X 10-5.

Actual drawdown and recovery data from these pumping tests were used to predict drawdown over a 10 day period. Two pumping scenarios were simulated using superposition of the pumping and recovery data from the tests. The first scenario consisted of pumping 52.5 gallons from the well each day over a 3.5 hour period, and then allowing the well to recover until the following day. The second scenario consisted of pumping 87.5 gallons over a 11.7 hour period each day, and then allowing the well to recover until the following day. These pumping schedules were simulated for a period of ten days, and the principle of superposition was used to graphically predict the total drawdown at the end of the 10-day period.

Actual field testing of monitor well GRJ 982 was also conducted to provide additional evidence of the low yield of the fractured Mancos shale. The monitor well was pumped twice daily over a 15 day period, with an average withdrawal rate of 45 gpd. The drawdown after each pumping event and the cumulative drawdown was observed, and is tabulated in Table 1. A pumping rate greater than 45 gpd could not be sustained because drawdown became excessive and the pump would not function properly.

ASSUMPTIONS:

1) The rate of recharge in the Mancos shale is independent of the total drawdown in the well. Therefore, the recovery curve is consistent each day, regardless of the water level.

3/12/90
Tim Goering
Jmc 3/12/90

Date	Pump. Test	Time Begin	Time End	Water Level Begin	Water Level End	Volume of Water Pumped (gals)	Rising Head (1) K(d)
1/9/90	morning	0919	0955	79.24	94.35	39	1.3×10^{-5}
	afternoon	1301	1349	84.06	95.31	21	
1/10/90	morning	0810	0856	81.23	95.99	28.5	5.0×10^{-6}
	afternoon	1303	1343	89.61	95.74	20.5	
1/11/90	morning	0815	0951	85.12	95.47	23	5.8×10^{-6}
	afternoon	1514	1621	87.32	95.63	25	
1/12/90	morning	0810	0914	83.59	95.99	26	1.0×10^{-5}
	afternoon	510	1615	83.21	95.42	20.5	
1/13/90	morning	0812	0855	84.97	95.52	20	7.9×10^{-6}
	afternoon	1511	1631	85.93	95.41	21.5	
1/14/90	morning	0901	1005	86.17	95.86	23	9.1×10^{-6}
	afternoon	1550	1631	84.98	95.21	22	
1/15/90	morning	0745	0850	82.51	96.17	25	7.9×10^{-6}
	afternoon	1505	1611	85.96	95.13	21	
1/16/90	morning	0746	0849	83.46	95.30	22	7.1×10^{-6}
	afternoon	1510	1624	85.97	96.38	23	
1/17/90	morning	0745	0856	83.26	96.16	22.5	9.4×10^{-6}
	afternoon	1431	1534	85.31	95.89	24	
1/18/90	morning	0737	0847	86.13	95.63	21.5	7.9×10^{-6}
	afternoon	1440	1538	85.97	95.81	22	
1/19/90	morning	0800	0907	84.70	96.57	22	7.4×10^{-6}
	afternoon	1501	1611	85.03	95.24	21	
1/20/90	morning	0945	1049	83.34	94.86	22	1.1×10^{-5}
	afternoon	1510	1556	85.01	95.72	23	
1/21/90	morning	0807	0911	87.20	95.23	24.5	7.8×10^{-6}
	afternoon	1504	1610	85.67	94.90	22	
1/22/90	morning	0742	0849	83.06	95.67	22	8.8×10^{-6}
	afternoon	1507	1600	84.13	95.03	23	
1/23/90	morning	0831	0940	81.96	96.22	21.5	3.0×10^{-5}
	afternoon	1445	1551	85.66	95.13	23	

NOTE: (1) Reference Calc. No. GRJ-08-89-14-03

Jmc

Table I. Summary of actual drawdown data from pumping period. GRJ 932 over a 15 day

JACOBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO. ____ JOB NO. ____

COBS ENGINEERING

DATE ____ BY ____ CHKD. ____ SUBJECT ____ SHEET NO. ____ JOB NO. ____

3/12/90

2) No boundary conditions occur other than those detected during the one-day pumping tests conducted on monitor well GRJ 982 during October 31, 1989. Hence, the hydrologic characteristics of the fractured Mancos remain relatively constant while the formation is being dewatered.

3) To predict the effects of pumping the well at 150 gpd, the daily decline in water levels is assumed to be a linear function of the pumping rate. (see Figure 3)

DATA SOURCES

1) Pumping Test Analyses on GRJ Monitor Wells 979 and 982 (Calculation # GRJ-11-89-14-03).

CALCULATIONS AND RESULTS:

The drawdown data from the pumping tests conducted on monitor well GRJ 982 (Calc. # GRJ-11-89-14-03) was graphically superimposed over a 10-day time period to predict the total drawdown over 10 days. Figure 1 shows the predicted drawdown when 52.5 gallons is pumped from the well for 3.5 hours each day. Total drawdown after 10 days is 10.3 feet, with an average decline in water level of 1.03 feet per day.

Figure 2 shows the predicted drawdown when 87.5 gallons is pumped from the well over a 11.7 hour period each day. Total drawdown over the 10-day period at this higher pumping rate is 24.1 feet, with an average decline in water level of 2.41 feet per day.

Although a 150 gpd pumping rate could not be simulated using this graphical superposition technique, the cumulative drawdown at the lower pumping rates (52.5 gpd and 87.5 gpd) is significant. The maximum available drawdown for monitor well GRJ 982 is approximately 30 feet (Calc # GRJ 11-89-14-03). Hence, GRJ 982 cannot support these pumping rates for even one month of time.

If cumulative drawdown is assumed to be a linear function of the average daily pumping rate, then the drawdown can be predicted for a pumping rate of 150 gpd. Figure 3 is a graph of average daily decline in pre-pumping water level as a function of the daily pumping rate. The graph indicates that if the well were to be pumped at 150 gpd, water levels would decline an average of 4.8 ft/day. Even if the total depth of the well was 700 feet (thus utilizing the effects of well borehole storage), the well would be pumped dry in less than 150 days. (through the active thickness of the Km)

Table 1 presents actual drawdown data when GRJ 982 is pumped twice daily for 15 days, with an average daily withdrawal of 45 gpd. The cumulative drawdown by the 15th day was 6.7 feet. This is consistent with the graphical simulations described above, except total drawdown is less because the average pumping rate was lower.

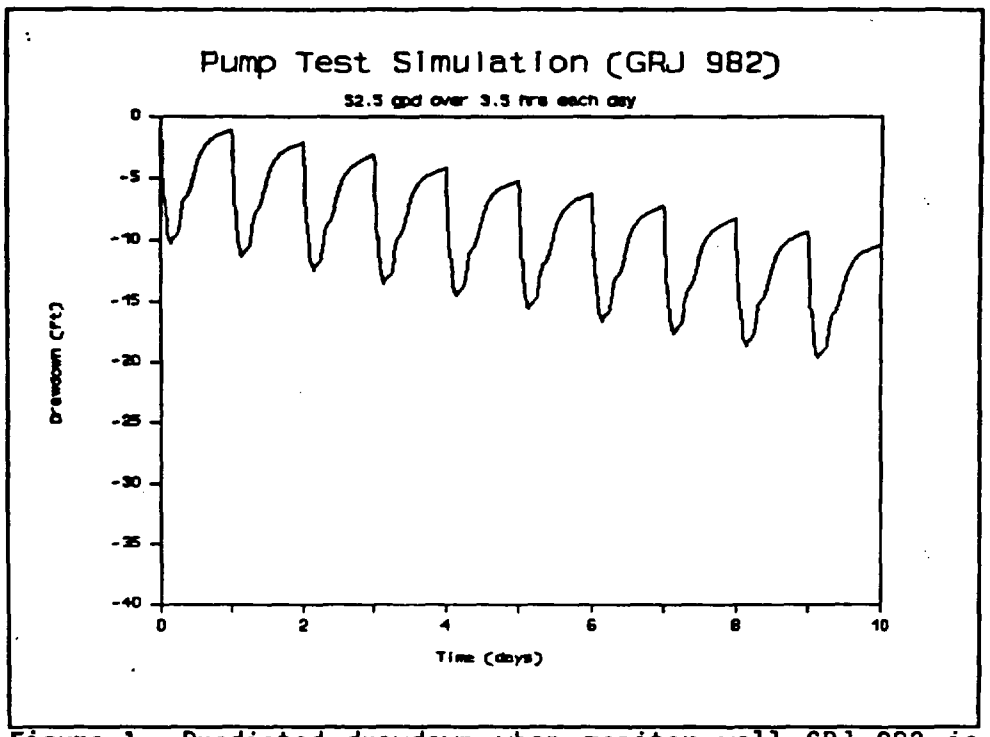

Figure 1 Predicted drawdown when monitor well GRJ 982 is pumped 52.5 gpd for 10 days.

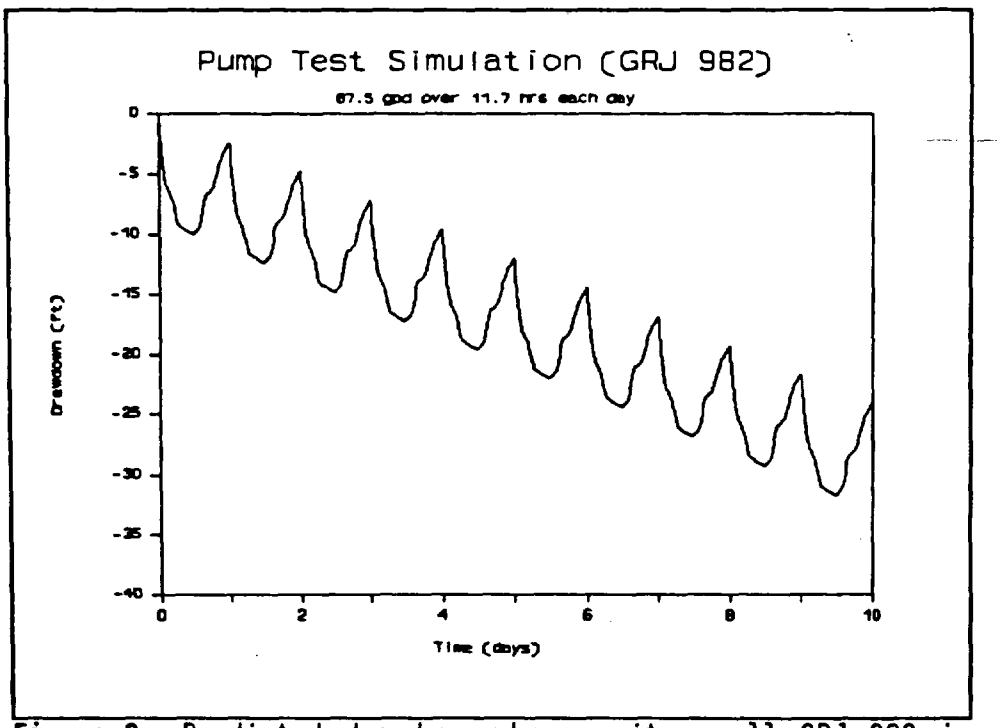

Figure 2 Predicted drawdown when monitor well GRJ 982 is pumped 87.5 gpd for 10 days.

Tim Goeling 3/12/90 5

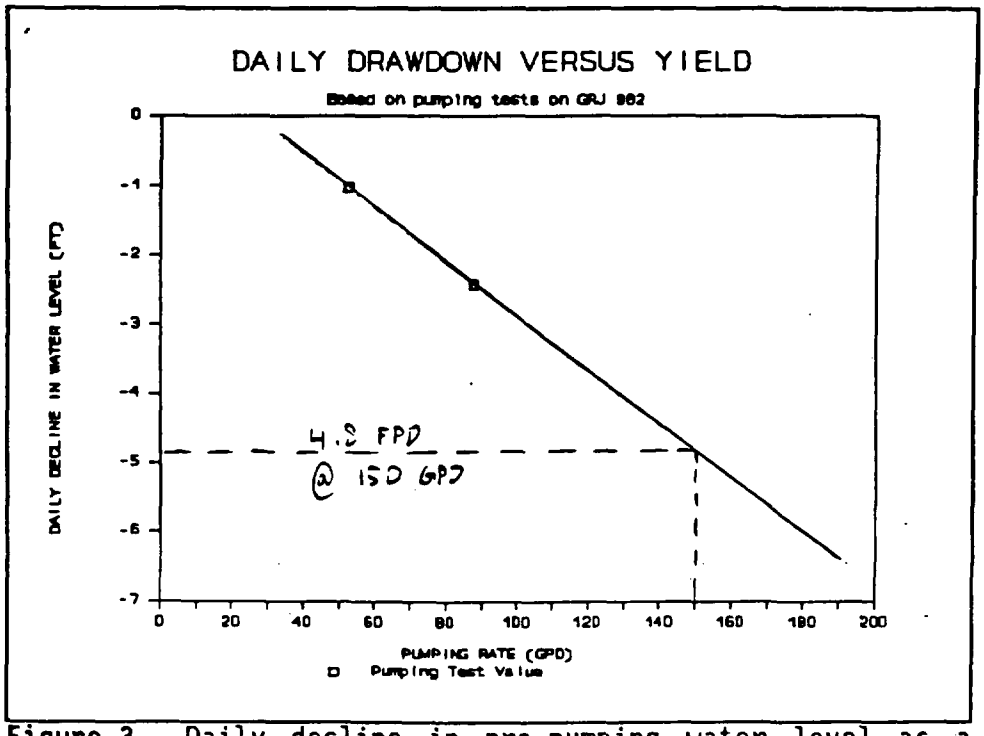

Figure 3 Daily decline in pre-pumping water level as a function of the pumping rate.

CONCLUSIONS AND RECOMMENDATIONS:

Both the graphical simulations and the field pumping exercise indicate that the fractured Mancos formation has a very low yield, and cannot sustain a yield of 150 gpd. Recovery in monitor well GRJ 982 is insufficient for maintaining a constant pumping rate of 150 gpd, and drawdown will be excessive at this rate of pumping. If the daily decline in water level is assumed to be a linear function of the pumping rate, then water levels would decline at a rate of 4.8 ft/day at a pumping rate of 150 gpd. Even if the well were completed throughout the entire 700' thickness of the Mancos shale to utilize borehole storage effects, the well would be pumped dry within 150 days. Therefore, because the fractured Mancos cannot sustain a yield of 150 gpd to a well, it can be classified as Class III (or Limited Use) groundwater.

Additional evidence of the low yield of the formation is available from radiological dating of groundwater from the fractured Mancos and from the overlying alluvium. Radiocarbon dating of groundwater from the fractured Mancos indicates that the groundwater is roughly 30,000 years old (Calculation #GRJ-03-90-14-15). This reflects extremely limited recharge from perched water in the overlying alluvium. Tritium analyses of water from

Tim
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the alluvium (Calc. #GRJ-03-90-14-15) indicates that alluvial groundwater is young (less than 30 years). If substantial recharge were occurring into the fractured Mancos, then the water in the Mancos would be relatively recent. This is additional proof of the low yield potential of the fractured Mancos and the Limited Use (Class III) characteristics of the groundwater in the fractured Mancos.

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-03-90-14-15 DISCIPLINE Hydrology NO. OF SHEETS 6 plus Appendix

PROJECT: UMTRA / DOE

SITE: GRJ-03

FEATURE: Radio Isotope Dating of GRJ-03 Groundwater Including Sample Collection and Processing Procedures, Laboratory Data, and Some Factors Affecting Lab Data Interpretation.

SOURCES OF DATA:

Teledyne Isotope Labs, Ridgewood NJ

Geochron Lab Division Krueger Enterprises, Cambridge MA

(1) Davis et al 1985 An Introduction To Groundwater Tracers Cooperative Agreement CR-810003-01, Robert S Kerr Environmental Research Lab, USEPA, Ada OK 74820

SOURCES OF FORMULAE & REFERENCES:

(1) Gleason, JD; Friedman, I; and Hanshaw, BB. 1969. Extraction of dissolved carbonate species from natural water for carbon isotope analysis: U.S. Geological Prof Paper 650-D, p D248-D250.

(2) Yang, IC, Radiochemist with the U.S. Geological Survey, Denver CO. (Telephone Communication 11/21/89)

(3) Water Sampling for Tritium Analysis UMTRA A16 Operations Manual Section 16.2.2. 8/18/88 3p.

PRELIMINARY CALC. ☒ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		Dale Hainsworth	3/6/90	[illegible]	3/13/90	Bruce Holbrook	5/7/90

8/86

JACOBS ENGINEERING

DATE 3/6/90 SUBJECT SHEET NO. 1 of 6

BY DH CHKD. JOB NO.

1.0 Purpose:

1.1 To document the methods used to collect samples for H^3 and C^{14} age dating of groundwater at GRJ-03

1.2 To describe possible sources of error (in addition to lab error) that affect the interpretation of laboratory analytical results

2.0 Methods and Procedures for Sample Collection

2.1 Tritium: The UMTRA SOP entitled "Water Sampling for Tritium Analysis" (Reference 3) was used for the two sampling episodes for tritium.

2.1.1. UMTRA water samples followed this SOP during the first tritium water sampling episode conducted between 11/14/89 and 11/18/89. at GRJ-03

2.1.1.1. Before collecting tritium samples at least 3 casing volumes were purged from the well by pumping and field parameters of pH, EC, Alkalinity and Temperature were measured on the groundwater samples. Tritium samples were collected after the field parameters stabilized

2.1.1.2. The following wells were sampled: GRJ-03-011, -811 -904, -981 -982, -965, -967, -808.

2.1.2 The same SOP was followed during the second episode of tritium sampling conducted on 2/2/90

2.1.2.1. At least 5 casing volumes were purged from each well by bailing before collecting tritium samples. Field water quality parameters were not measured during this second episode of sampling

2.1.2.1. The following wells were sampled on 2/2/90: GRJ-03-011, -805, and -904.

2.2 Carbon 14 The procedure described by Gleason et al. (Reference 1) for the direct precipitation of dissolved carbon species was used during C^{14} sample collection/preparation 1/31/90 & 2/2/90 (Episode 2). This procedure was modified slightly as per instructions from I.C. Yang

FORM 91-006-1 (4/81)

2.2 cont. (Reference 2). The procedures which were followed are outlined below.

2.2.1 Samples were collected in 15 gallon polyethylene carboys from the following wells: GJT-03-011, 811, 835, 904, 966, 977, 981; and 982. Sampled were pumped from 977 and 982, and were bailed from all other wells. Extreme care was taken when bailing and pumping to minimize any sploshing which would facilitate the dissolution of present-day atmospheric CO_2 into the water sample. Care was also taken to completely fill the carboys so that no head space existed above the samples, again to minimize the introduction of atmospheric CO_2 into the groundwater samples. Prior to the collection of water samples 20 mL of freshly prepared NaOH (see methods described below) to each carboy to help preserve dissolved carbon species.

2.2.2 Samples were transported (the same day they were collected) to a subcontractor's laboratory in Grand Junction (Lincoln Devore) where dissolved species in the ground water were precipitated and collected by the following methods.

2.2.2.1 Preparation of Sodium Hydroxide Reagent

Sodium Hydroxide (NaOH) was required to raise the pH of the groundwater to approximately 10.4 to convert all bicarbonate species to carbonate. The equation is:

$$HCO_3^- + OH^- \longrightarrow CO_3^{-2} + HOH$$

Approximately 6.25 M NaOH was prepared by dissolving 150 g of reagent grade NaOH into 600 mL of demineralized water. The solution was allowed to stand overnight to permit carbonate precipitates to settle. The clear supernatant was stored in an air tight glass container before use.

2.2.2.2 Preparation of Strontium Chloride Solution ($SrCl_2$)

$SrCl_2$ was required to precipitate dissolved carbonate species as $SrCO_3$. Approximately 1.67 M $SrCl_2$ solution was prepared by adding 450 g of $SrCl_2 \cdot 6H_2O$ to 1 liter of demineralized water. The solution was allowed to stand overnight, so that any impurities in solid $SrCl_2 \cdot 6H_2O$ could settle before using the clear supernatant.

2.2.2.3 Groundwater Sample Size - The radiocarbon dating lab (Geochron Labs) requires 2 g of pure carbon. The groundwater sample size required to yield 2g carbon can be calculated from alkalinity data as follows.

(eg) Alkalinity of MW 011 = 286 mg/l $CaCO_3$

$$\text{mg C per liter} = \left(\frac{12\text{ mg C}}{100\text{ mg } CaCO_3}\right) \times \left(\frac{286\text{ mg } CaCO_3}{\text{liter}}\right) = \frac{34.3\text{ mg C}}{\text{liter}}$$

$$\text{liters of groundwater} = \left(\frac{2\text{ gm C}}{1}\right) \times \left(\frac{1\text{ liter}}{.0343}\right) = 58.3 \text{ liters}$$

2.2.2.3 Amount of $SrCl_2$ required to precipitate all dissolved C

Assume all carbon species to be in form CO_3^-. Amount of $SrCl_2$ should be in excess to precipitate both $SrCO_3$ and $SrSO_4$. Moles of CO_3^{-2} determined from alkalinity field titrations and moles of SO_4^{-2} determined water quality lab analysis for SO_4^{-2}.

(eg) Concentration of SO_4^{-2} in MW-011 $= \left(\frac{2.270\text{ g } SO_4^{-2}}{\text{liter}}\right)\left(\frac{1\text{ Mole } SO_4}{96\text{ gm } SO_4}\right) = \frac{2.81 \times 10^{-3}\text{ moles}}{\text{liter}}$

Concentration of CO_3^{-2} in MW-011 $= \left(\frac{0.286\text{ g } CaCO_3}{\text{liter}}\right)\left(\frac{1\text{ Mole } CaCO_3}{100\text{ g } CaCO_3}\right) = \frac{2.86 \times 10^{-3}\text{ moles}}{\text{liter}}$

Moles of SO_4^{-2} in 58.3 liters $= \left(\frac{58.3\text{ liters}}{1}\right)\left(\frac{2.81 \times 10^{-3}\text{ moles}}{\text{liter}}\right) = 1.63 \times 10^{-1}$

Moles of CO_3^{-2} in 58.3 liters $= \left(\frac{58.3\text{ liters}}{1}\right)\left(\frac{2.86\text{ moles}}{\text{liter}}\right) = 1.67 \times 10^{-1}$ moles

Moles of SO_4^{-2} + CO_3^{-2} = 3.3×10^{-1} moles

Moles (Minimum) of $SrCl_2$ solution req'd to completely precipitate SO_4^{-2} + CO_3^{-2} = 3.3×10^{-1} moles

Minimum volume of $SrCl_2$ solution for MW-011 =

$$\left(\frac{.33\text{ moles}}{1}\right)\left(\frac{1\text{ liter } SrCl_2}{1.69\text{ moles } SrCl_2}\right) = .195 \text{ liters } SrCl_2 \text{ solution}$$

22.2.4. Precipitation (Collection Procedure)

- Allow suspended sediment in groundwater sample to settle and siphon (decant) off clear supernatant ground water sample into an empty 5 gallon carboy. Leave small head space for the addition of $SrCl_2$ and NaOH solutions.
- Add excess (2x) 1.69 M $SrCl_2$ solution (see 2.2.23) to the groundwater sample that is free of sediment.
- Slowly add 6.25 M NaOH solution until pH 10.4 is exceeded. The amount of NaOH (moles) to be added can be estimated from the alkalinity (assume all CO_3^{-2} exists as HCO_3^- at field pH; ∴ moles of NaOH required ≅ moles of $CaCO_3$)
- If possible, heat to 40° while stirring for several hours. If this is not possible go on to the next step. The reaction is nearly complete without heating or stirring.
- Allow the precipitate to settle, decant, and discard the high pH supernatant, and collect the precipitate in glass bottles. Half gallon Mason canning jars will serve as glass bottles.
- Label glass bottles, pack carefully in plastic cooler, label cooler as containing fragile contents, and ship to Lab for analysis ASAP.
- Top off carboys with clear supernatant groundwater sample to eliminate head space.

JACOBS ENGINEERING

DATE 3/6/90 SUBJECT SHEET NO. 596

BY DA CHKD. JOB NO.

3.0 Laboratory Data

3.1 Episode 1

As mentioned in Section 2.1-22, radio isotope sample collection and testing was conducted in two episodes. The first episode involved tritium (no carbon 14) sample collection and analysis of shallow alluvial and Mancos Shale groundwater. Analyses were conducted by Teledyne Isotopes, Ridgewood, N.J. Laboratory raw data as well as a summary table of data is presented in Appendix 1

3.2. Episode 2 involved both tritium and carbon-14 sampling and analysis. All laboratory testing was conducted by Geochron Labs, Cambridge MA. Tritium sampling and analysis were conducted on only 3 shallow alluvial groundwater monitor wells to verify the results of Episode 1 testing. Tritium testing was repeated on MW-011 and -904. An attempt was made to repeat analyses on MW-808, however this well was damaged by construction equipment. MW-835 located less than 10 ft away from MW-808 and screened over the same screened interval was substituted as a replacement well.

Episode 2 also involved carbon 14 analyses on all groundwater zones found at GRJ-03 including alluvial, shallow Mancos Shale, and Dakota Sandstone groundwater. Triplicate samples were collected from both shallow Mancos Shale (MW-982) and Dakota (MW-977) groundwater zones to attempt to bound the range of error which results from field sampling procedures (see Section 4.2).

Laboratory raw data from Episode 2 plus a summary data table (including Episode 1 data) is presented in Appendix 1.

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DATE 3/6/90 SUBJECT SHEET NO. 6 of 6

BY DH CHKD. JOB NO.

4.0 Assumptions / Sources of Error which Affect The Interpretation of Laboratory Results.

4.1 Tritium (See Reference 4)

- In general groundwater in the Northern Hemisphere which has more than 5 Tritium Units (1TU = 3.24 pCi / liter) is less than 30 years old. Groundwater recharged prior to thermonuclear bomb testing (mid 1950's) will typically have less than 2.5 TU's.

4.2 Carbon 14 (See Reference 4)

Carbon 14 is in general useful for dating groundwater between 500 and 40,000 years old. The following are some sources of error:

- The age of young groundwater (eg 500 years) can be affected (made to appear older) by the dissolution of carbonate species from minerals as groundwater passes over these mineral surfaces.
- The age of old groundwater (eg 40,000 years) can be affected (made to appear younger) by contamination with present-day atmospheric carbon dioxide. Even though every effort should be made to minimize this error by minimizing the exposure to the atmosphere, it is extremely difficult to eliminate this error entirely.

FORM 91-005-1 (4/81)

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BY DA CHKD. JOB NO.

Appendix 1

Includes Summary Data To 66

Tritium Lab Data From Teledyne Isotopes Lab (Episode 2)

Tritium + Carbon-14 Lab Data From Geochron Lab (Episode 2)

* Appendix is incomplete as of 3/6/90
Laboratory C^{14} analyses to be completed
are MW-835, -904, -966, -981.

FORM 91-005-1 (4/81)

Table Radio Isotope Dating of Groundwater at Cheney (GRT-63)

Borehole No.	Sample No.	Formation	Carbon-14* Age (years)	Tritium Data: Tritium Units**	Tritium Age (yrs)**	Tritium Units**	Tritium Age (yrs)**
011		Arkansan	13,345 ± 75	2.1 ± 0.8	?	3.8 ± 2.0	?
808				10.8 ± 0.1	< 30		
835			405 ± 100			14.0 ± 2.1	< 30
904			2175 ± 75	2.3 ± 0.8	?	4.3 ± 2.0	?
965				< 1.6	> 30		
966			1400 ± 75				
967				< 1.9	> 30		
811	811	Shallow Mancos	26,900 ± 2100	< 0.9	> 30		
981	981		19,565 ± 320	< 0.9	> 30		
982	982-2		30,200 ± 1050	< 0.9	> 30		
982	991		28,580 ± 870				
982	993		30,470 ± 1150				
977	977	Dakota	39,450 +4000/-2700				
977	987		34,170 +1690/-1690				
977	997		> 42,000				

* Geochron Lab Division of Krueger Enterprises Inc (Episode 2)

** Teledyne Isotopes (Episode 1)

JACOBS ENGINEERING

DATE 3/6/90 BY DH CHKD. SUBJECT

SHEET NO. 1 of JOB NO.

FORM B1-005-1 (4/81)

Episo

TELEDYNE ISOTOPES

REPORT OF ANALYSIS

RUN DATE 01/25/90

WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE RECEIVED	DELIVERY DATE	PAGE
3-0127		11/30/89	01/02/90	1

A ARCHULETA
JACOBS ENGINEERING GROUP INC
5301 CENTRAL AVENUE SUITE 1700
ALBUQUERQUE NM 87108

W A T E R

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/LITER)	T.U # ~~NUCL-UNIT-%~~ ~~U/M~~	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
85850	01F-011 GRJ 03		11/16				H-3	6.9 +-2.7 E 00	2.1 ± 0.8	01/10			5
85851	01F-811 GRJ 03		11/16				H-3	L.T. 3. E 00	< 0.9	01/12			5
85852	01F-904 GRJ 03		11/18				H-3	7.4 +-2.5 E 00	2.3 ± 0.8	01/19			5
85853	01F-981 GRJ 03		11/18				H-3	L.T. 3. E 00	< 0.9	01/13			5
85854	01F-982 GRJ 03		11/18				H-3	L.T. 3. E 00	< 0.9	01/20			5
85855	01F-967 GRJ 03		11/16				H-3	L.T. 6. E 00	< 1.9	01/20			5
85856	01F-965 GRJ 03		11/14				H-3	L.T. 5. E 00	< 1.6	01/24			5
85857	01F-808 GRJ 03		11/17				H-3	3.5 +-0.3 E 01	10.8 ± 0.1	01/23			5

LAST PAGE OF REPORT

B Campbell
APPROVED BY B. CAMPBELL 01/25/90

SEND 1 COPIES TO JA040S A ARCHULETA

2 - GAS LAB. 3 - RADIO CHEMISTRY LAB. 4 - GE(LI) GAMMA SPEC LAB. 5 - TRITIUM GAS/L.S. LAB. 6 - ALPHA SPEC LAB.

* 1 Tritium Unit = 1 TU = 3.224 pci/L

3/6/90
DA

Episode 2

3 of

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

Dale Hammerwiester
Jacobs Engineering
5301 Central Ave NE, Suite 1700
Albuquerque, NM 87108

Date Received: 2/5/90
Date Reported: 2/20/90
Reference: Letter

REPORT OF TRITIUM ANALYSES

Our Lab. No.	Your Sample No.	Tritium Units
T-4246	011	3.8 +/- 2.0
T-4247	835	14.0 +/- 2.1
T-4248	904	4.3 +/- 2.0

DA

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GEOCHRON LABORATORIES DIVISION
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RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15615 **PRIORITY BASIS** Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/22/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 011.
Sr salt precipitate.

AGE = 1345 +/- 75 C-14 years BP (C-13 corrected).
(84.6 +/- 0.8)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 6.6 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

DIS

Episode 2

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GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15616 **PRIORITY BASIS** — Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 — Date Reported: 02/26/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 811.
Sr salt precipitate.

AGE = 26,900 +/- 2100 C-14 years BP (C-13 corrected).
(3.5 +/- 0.9)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 3.3 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

DA

Episode 2

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GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15617 **PRIORITY BASIS** Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/22/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 982-2.
Sr salt precipitate.

AGE = 30,200 +/- 1050 C-14 years BP (C-13 corrected).
(2.3 +/- 0.3)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = -10.0 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.
The age is referenced to the year A.D. 1950.

Episode L

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GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15618 **PRIORITY BASIS** Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/22/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 991.
Sr salt precipitate.

AGE = 28,580 +/- 870 C-14 years BP (C-13 corrected).
(2.9 +/- 0.3)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = - 9.3 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

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24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15619 PRIORITY BASIS — Date Received: 02/13/90

Your Reference: PO# 34-6705-P-90-00234 — Date Reported: 02/26/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 993.
Sr salt precipitate.

AGE = 30,470 +/- 1150 C-14 years BP (C-13 corrected).
(2.3 +/- 0.3)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}C_{PDB}$ = -10.2 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

7/17/90
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24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15561 **PRIORITY BASIS** Date Received: 02/05/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/10/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 977.
Sr salt precipitate.

AGE = 39,450 +4000/-2700 C-14 years BP (C-13 corrected).
(0.74 +/- 0.29) % of the modern (1950) C-14 activity.

Description: Sample of sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: Calculated age is significant at 2 sigma (95%).

$\delta^{13}C_{PDB}$ = + 4.5 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

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KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-15562 **PRIORITY BASIS** Date Received: 02/05/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/10/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 987.
Sr salt precipitate.

AGE = 34,170 +/- 1690 C-14 years BP (C-13 corrected).
(1.42 +/- 0.29) % of the modern (1950) C-14 activity.

Description: Sample of sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: Calculated age is significant at 2 sigma (95%).

$\delta^{13}C_{PDB}$ = + 3.5 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.

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GEOCHRON LABORATORIES DIVISION
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RADIOCARBON AGE DETERMINATION REPORT OF ANALYTICAL WORK

Our Sample No. GX-15563 **PRIORITY BASIS** Date Received: 02/05/90

Your Reference: PO# 34-6705-P-90-00234 Date Reported: 02/10/90

Submitted by: Dale Hammermeister
Jacobs Engineering Group Inc.
5301 Central Ave. NE
Suite 1700
Albuquerque, NM 87108

Sample Name: Sample # 997.
Sr salt precipitate.

AGE = Greater than 42,000 C-14 years BP (C-13 corrected).
(<0.54)% of the modern (1950) C-14 activity.

Description: Sample of Sr salts precipitated from groundwater.

Pretreatment: The strontium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum, to recover carbon dioxide from the strontium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: No C-14 activity was detected. The age limit reported is 2 sigma (95% certainty).

$\delta^{13}C_{PDB}$ = + 3.1 ‰

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-07-9014-07 DISCIPLINE Hydro NO. OF SHEETS 9

PROJECT:

DOE UMTRA

SITE:

Grand Junction, Cheney Disposal Site

FEATURE:

Groundwater flow velocities for alluvial paleochannels

SOURCES OF DATA:

Calc Set GRJ-03-90-13-03-00 "Borehole water level measurements at the Cheney disposal site"

Calc Set GRJ-07-89-14-03/09 "Aquifer pumping test analysis of monitor wells GRJ-03-835, GRJ-03-808

SOURCES OF FORMULAE & REFERENCES:

Freeze and Cherry, 1979

TAD (Technical Approach Document) 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		B Gallaher	07-01-90	K Lambert	8/13/90	K Bostick	8/14/90

JEG-AL-ENG-51 (6/87)

JE JACOBS ENGINEERING

(b)

DATE 1 July 1990 SUBJECT

BY BS CHKD. KAL 8/13/90

SHEET NO. 2

JOB NO.

D. Calculations and Analyses

Groundwater flow velocities will be calculated for two separate groundwater flow systems (see attached figure) as delineated by drilling and trenching:

a. Well 811 to well 828
b. Well 815 to 820.

K Hydraulic Conductivity

Hydraulic conductivities used in these calcs. will be those determined from aquifer pumping tests in wells 808 and 835, described in detail w/in Calc Set -07-89-14-03/09. Average K was determined to be = 2.1×10^{-3} cm/sec. It is assumed that this average is representative of all paleochannels elsewhere on the site.

i Hydraulic Gradient

	Well	date	BTOC Depth to H_2O	TOC Elevation	GW Elevation
a.	811	(6/2/89) or	25.54	5292.7	5267.16
	828	"	21.13	5247.5	5226.37

Distance between wells ≅ 2200 ft.

$$i = \frac{5267.2 - 5226.4 \text{ ft.}}{2200 \text{ ft.}} = \frac{40.8}{2200} = 0.019$$

	Well	Date	Below TOC DTW	Elevation TOC	GW Elevation
b.	815	6/3/89	20.11	5274.4	5254.29
	820	"	21.39	5251.2	5229.81

Distance between wells ≅ 1,050 ft.

$$i = \frac{5254.3 - 5229.8}{1,050} = \frac{24.5}{1,050} = 0.023$$

n_e Assumed to be 0.25

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE 1 July 1990 SUBJECT Paleochannel Flow Velocities SHEET NO. 1
BY BJ CHKD. KAL 8/13/90 GRJ-07-90-14-07 JOB NO.

A. Purpose of Calculation

To determine the average linear velocity of groundwater in the alluvial paleochannels, Cheney disposal site, Grand Junction, Colorado.

B. Method of Analysis

Average groundwater velocities were calculated using a modified version of the Darcy equation, as specified in the TAD (1989):

$$\bar{V} = \frac{Ki}{n_e}$$

where $\bar{V}$ = average linear g.w. velocity
K = hydraulic conductivity
i = lateral hydraulic gradient
n_e = effective porosity

C. Material Properties

The alluvial paleochannels are comprised of a highly variable admixture of clays, silts, gravels, cobbles, and boulders. These have filled thin channels that eroded into the top of the underlying Mancos Shale. Typically, the zone of saturation in the paleochannels is limited to less than 10 feet in thickness and 20 feet in width. Water filled paleochannels form thin, discrete groundwater flow systems that may be isolated from ~~and~~ adjacent flow systems by hundreds of feet (see attached figure 2).

FORM 91-005-1 (4/81)

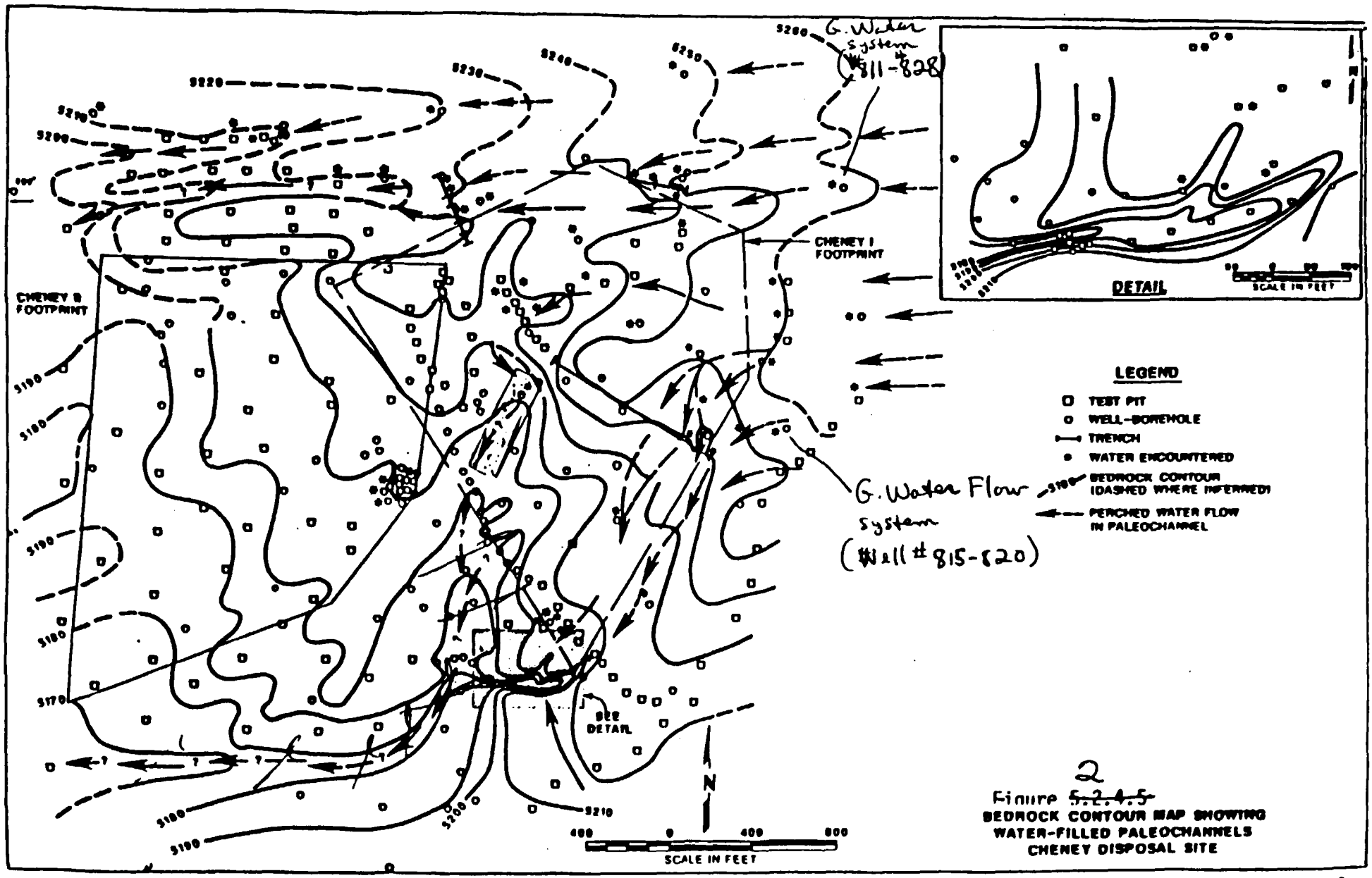

Figure ~~5.2.4.5~~ 2
BEDROCK CONTOUR MAP SHOWING WATER-FILLED PALEOCHANNELS CHENEY DISPOSAL SITE

~~EDDIE BOND IS PRODUCING A PUBLISHABLE FIGURE~~

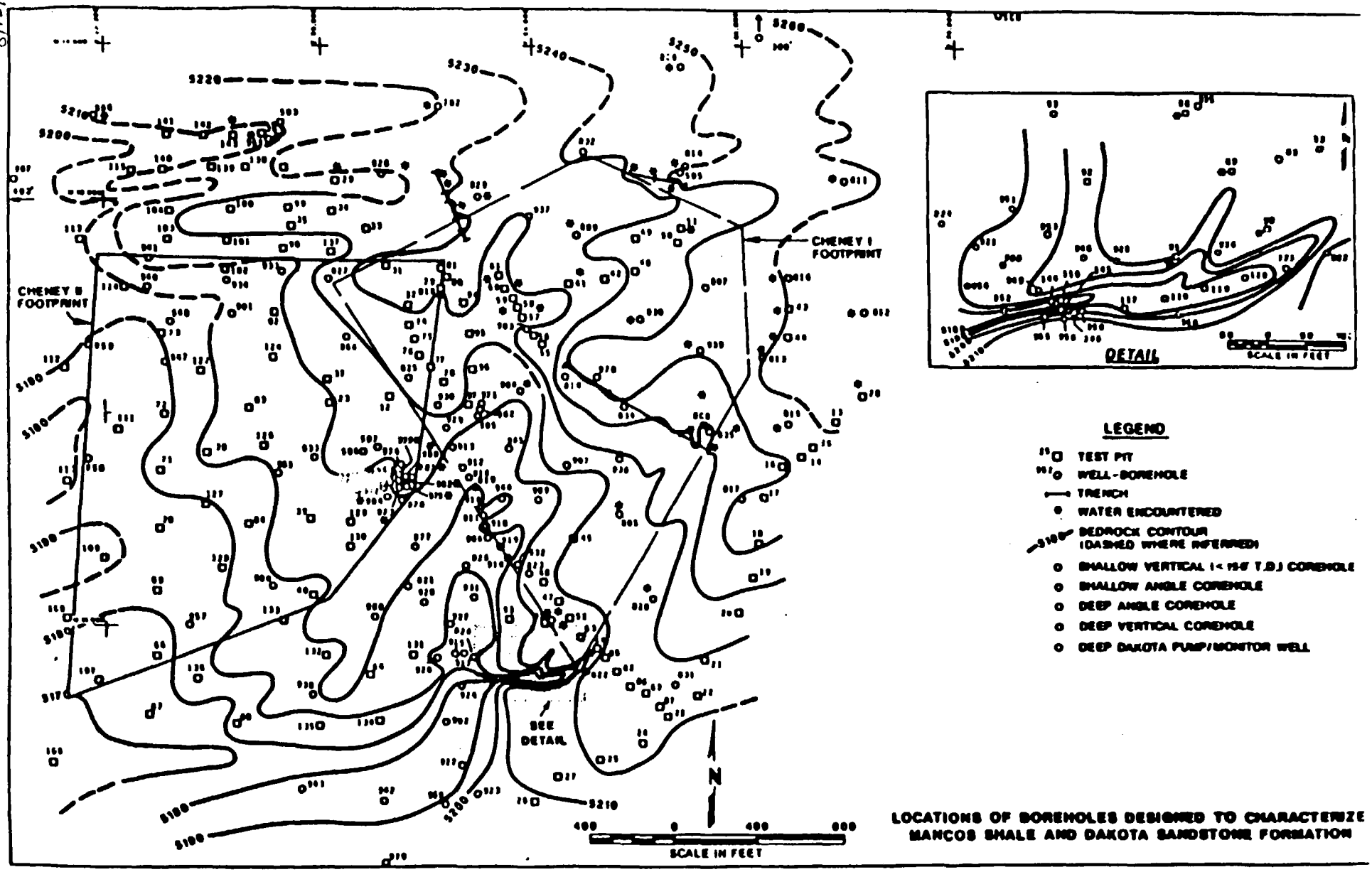

Figure 1. Location of trenches, test pits, and boreholes in relation to Cheney I and Cheney II footprints

A ROBINSON ENVISER COMPANY

JOB TITLE Depth to water level measurements W.O. NO

DESCRIPTION A. below top of casing SHEET NO.

MADE BY DATE

CHECKED BY

From Calc Set
~~GRS-07-89-11-07~~
GRS-03-90-13-03-00

	805S	805D	806S	806D	3075	807D	808	809	810	811S	811D
25 Mar	29.94	34.16	29.14(A)	27.15	P	43.01	17.45(A)	28.45	Dry	25.47	56
2 June	—	—	29.20	28.41	—	—	—	28.57	—	25.59	1.38
3	30.28	33.47	29.21	28.48	Dry	43.40	17.57	28.58	Dry	25.53	54.36
5	30.06	33.75	29.30	28.78	—	43.50	17.56	28.60	—	25.63	[illegible]
6	29.91	33.41	[illegible]	28.91	—	[illegible]	[illegible]	28.66	—	[illegible]	[illegible]
7	30.09	33.24	29.25	29.10	—	43.56	17.79	28.70	—	25.63	53.57
8	29.82	33.52	29.28	29.20	—	43.58	17.96	28.69	—	25.65	53.38
9	30.13	32.83	29.31	29.32	—	43.57	18.14	28.72	—	25.68	53.15
10	30.65	32.47	29.31	29.20	—	43.59	18.27	28.76	—	25.70	52.92
12	31.12	32.87	29.34	29.69	—	43.65	18.50	28.82	—	25.70	52.52
13	31.22	33.16	29.37	29.81	—	43.66	18.59	28.87	—	25.77	52.32
14	31.07	33.56	29.37	29.95	—	43.68	18.64	28.88	—	25.75	[illegible]
16/17	30.20	34.13	29.28	30.21	—	43.69	18.71	28.93	—	25.83	51.49
19	29.42	33.94	29.34	30.53	—	43.76	18.78	29.05	—	25.76	51.07
20	30.30	33.11	29.37	30.65	—	43.78	18.78	29.07	—	25.77	50.90
21	30.78	33.52	29.46	30.74	—	43.80	18.84	29.10	—	25.85	50.78
22	30.73	33.99	29.37	30.88	—	43.81	18.86	29.15	—	25.81	50.53
26	31.23	35.48	29.40	31.30	—	43.88	18.88	29.47	—	25.85	[illegible]
28	31.36	36.21	29.43	31.52	—	43.92	18.90	29.95	—	25.88	49.35
30	32.10	36.43	29.44	31.72	—	43.93	18.91	30.45	—	25.90	[illegible]
	-2.22		-0.30				-1.46	-2.00		-0.43	+5.56

2

2

a. Well 811 to well 828

$$\bar{v} = \frac{ki}{n_e}$$

$$= \frac{(2.1 \times 10^{-3}\ cm/sec)(2834.65\ \frac{ft/d}{cm/sec})(0.019)}{0.25}$$

$$= 0.45\ ft/day$$

b. Well 815 to Well 820

$$\bar{v} = \frac{ki}{n_e}$$

$$= \frac{(2.1 \times 10^{-3}\ cm/sec)(2834.65\ \frac{ft/d}{cm/sec})(0.023)}{0.25}$$

$$= 0.55\ ft/day$$

Conclusions

The calculated average linear groundwater velocities for the alluvial paleochannels ~~6~~ are calculated ~~to~~ be approximately 200 feet per year. Given the inherent uncertainties in the hydraulic conductivity and effective porosity parameters, this velocity may be in error ~~by~~ a factor of 2 ~~to~~ or 3.

JOB TITLE _____ WO NO _____

DESCRIPTION _____ SHEET NO _____

MADE BY _____ CHECKED BY _____ DATE _____

	812S	812D	813	814	815	816	817	818	819	820
25 May	20.27*	18.27**	15.10*(2)	30.87(4)	19.95*	~~16.93~~*	17.83**	Dry	Dry	21.34*
2 June	–	–	–	31.13	–	–	–	–	–	–
3	20.45	19.94	14.54	31.12	20.11	15.25	18.63(2)	Dry	Dry	21.39
5	20.57	20.05	14.46	31.29	20.17	15.17	–	–	–	21.43
6	20.59	20.07	14.38	31.28	20.15	15.07	–	–	–	21.38
7	20.60	20.16	14.39	31.38	20.25	15.14	–	–	–	21.39
8	20.62	20.19	14.36	31.39	20.23	15.10	–	–	–	21.40
9	20.63	20.19	14.31	31.38	20.27	15.10	–	–	–	21.40
10	20.64	20.23	14.29	31.38	20.23	15.10	–	–	–	21.42
12	20.70	20.28	14.17	31.41	20.27	15.08	–	–	–	21.44
13	20.73	20.31	14.18	31.44	20.29	15.10	–	–	–	21.44
14	20.75	20.35	14.19	31.48	20.31	15.11	–	–	–	21.44
16/17	–	–	14.15	–	20.29	15.09	–	–	–	21.42
19	20.82	20.47	14.09	31.48	20.31	15.12	–	–	–	21.47
20	20.84	20.50	14.08	31.49	20.31	15.14	–	–	–	21.51
21	20.91	20.54	14.10	31.50	20.32	15.15	–	–	–	21.55
22	20.87	20.56	14.09	31.50	20.33	15.14	–	–	–	21.54
26	20.97	20.67	14.06	31.52	20.34	15.17	–	–	–	21.63
28	21.02	20.70	14.06	31.53	20.32	15.20	–	–	–	21.68
30	21.04	20.74	14.07	31.57	20.34	15.22	–	–	–	21.73
	-0.77		+1.03	-0.70	-0.39	+0.03				-0.39

MK-FERGUSON COMPANY
A SOMMER SNYDER COMPANY

JOB TITLE _____ W.O. NO. _____
DESCRIPTION _____ SHEET NO. _____
MADE BY _____ CHECKED BY _____ DATE _____

	821S	821D	822	823	823D	824	825S	825D	826	827	828
25 May	Dn	35.02	28.56	Dn	48.43	46.58	Dn	49.42	44.71	14.1	21.12
2 June	—	—	—	—	—	—	—	—	—	—	21.13
3	Dn	37.38	29.88	Dn	48.44	46.68	Dn	50.24	44.67	15.21	21.12
5	—	37.85	30.11	—	48.55	46.78	—	50.40	—	—	21.15
[illegible]	—	38.10	30.23	—	[illegible]	46.71	—	50.32	—	—	15
7	—	38.39	30.38	—	48.50	46.80	—	50.35	—	—	21.19
8	—	38.56	30.42	—	48.54	46.81	—	50.40	—	—	21.16
9	—	38.74	30.56	—	48.54	46.71	—	50.42	—	—	21.19
10	—	38.97	30.66	—	[illegible]	[illegible]	—	[illegible]	—	—	[illegible]
12	—	39.38	30.87	—	48.58	46.80	—	50.57	—	—	21.21
13	—	39.57	30.95	—	48.54	46.87	—	50.61	—	—	21.22
14	—	39.76	31.03	—	[illegible]	46.85	—	50.59	—	—	[illegible]
16/17	—	40.18	—	—	—	46.88	—	50.52	—	—	—
19	—	40.70	31.40	—	48.52	46.88	—	50.69	—	—	21.19
20	—	40.90	31.47	—	48.52	46.91	—	50.67	—	—	21.19
21	—	41.09	31.58	—	48.54	46.88	—	50.66	—	—	21.24
22	—	41.28	31.64	—	48.50	46.95	—	50.63	—	—	[illegible]
26	—	41.98	31.90	—	48.50	46.93	—	50.69	—	—	[illegible]
28	—	42.30	32.02	—		47.01	—	50.79	—	—	21.24
30	—	42.58	32.12	—	48.82	47.03	—	[illegible]	—	—	[illegible]
					+1.68			+4.25			−0.12

KAL 8/13/90

Table 5.2.4.1 Borehole information at GRJ-03

BOREHOLE INFORMATION AT GRJ-03

WELL	HOLE TYPE	LOCATION EAST COORDINATE	LOCATION NORTH COORDINATE	ELEVATION TOC* (FT-MSL)	ELEVATION GS (FT-MSL)	BEDROCK ELEVAT. (FT)	TOTAL DEPTH (FT)	SCREENING INTERVAL (DEPTH-FT)	HYDROSTRATIGRAPHIC UNIT SCREENED
203	MW	94389.2	11531.4	5255.3	5254.3	5225.8	35	15-35	ALLUVIUM,WEATHERED SHALE
205 D	MW	94389.2	11531.4	5255.7	5254.3	5225.8	65	40-65	WEATHERED-UNWEATHERED SHALE
206 S	MW	94629.0	13610.2	5292.7	5291.1	5247.1	39	20-39	ALLUVIUM,WEATHERED SHALE
206 D	MW	94629.0	13610.2	5283.1	5281.1	5247.1	80	53-80	WEATHERED-UNWEATHERED SHALE
207 S	MW	94794.4	12598.6	5271.0	5270.0	5251.0	18	8-18	ALLUVIUM
207 D	MW	94794.4	12598.6	5271.6	5270.0	5251.0	65	33-65	WEATHERED-UNWEATHERED SHALE
208	MW	94793.3	11947.7	5264.7	5263.3	5240.8	25	10-25	ALLUVIUM,WEATHERED SHALE
209	MW	94198.3	12834.4	5267.6	5266.2	5236.7	31.5	15-31.5	ALLUVIUM,WEATHERED SHALE
210	MW	94142.1	12180.9	5253.5	5252.1	5245.1	35	18-35	WEATHERED MANCOS SHALE
211 S	MW	95470.1	13087.9	5292.7	5291.6	5257.6	36.5	20-36.5	ALLUVIUM,WEATHERED SHALE
211 D	MW	95470.1	13087.9	5293.2	5291.6	5257.6	62	45-62	UNWEATHERED MANCOS SHALE
212 S	MW	95562.7	12469.0	5293.6	5292.7	5265.7	39	17-39	ALLUVIUM,WEATHERED SHALE
212 D	MW	95562.7	12469.0	5294.2	5292.7	5265.7	65	46-65	WEATHERED MANCOS SHALE
213	MW	95089.4	12268.0	5277.8	5276.4	5255.4	40	8-17	ALLUVIUM
214	MW	94715.0	13162.4	5281.7	5280.2	5243.2	40	23-40	ALLUVIUM,WEATHERED SHALE
215	MW	95193.4	11962.5	5274.4	5273.0	5251.5	25	13-23.5	ALLUVIUM,WEATHERED SHALE
216	MW	95205.6	12650.5	5282.6	5281.1	5261.6	25	12-24	ALLUVIUM,WEATHERED SHALE
217	MW	94981.9	11694.4	5265.1	5263.7	5253.7	20	11-20	WEATHERED MANCOS SHALE
218	MW	93561.2	12554.2	5251.6	5250.2	5230.2	25	10-25	ALLUVIUM,WEATHERED SHALE
219	MW	93714.8	11661.3	5239.1	5237.7	5196.7	50	18-45	ALLUVIUM,WEATHERED SHALE
220	MW	94543.0	11141.7	5251.2	5249.8	5226.8	30	10-30	ALLUVIUM,WEATHERED SHALE
221 S	MW	93409.5	11204.9	5230.0	5228.8	5197.8	31	18-31	ALLUVIUM,WEATHERED SHALE
221 D	MW	93409.5	11204.9	5230.4	5228.8	5197.8	65	49-65	UNWEATHERED MANCOS SHALE
222	MW	94304.8	10758.4	5241.6	5240.1	5215.1	35	26-35	WEATHERED MANCOS SHALE
[illegible]	MW	93957.9	11244.3	5241.8	5241.0	5214.5	38	28-38	WEATHERED MANCOS SHALE
[illegible]	MW	93957.9	11244.3	5242.3	5241.0	5214.5	60	43-60	UNWEATHERED MANCOS SHALE
224	MW	93765.2	10834.4	5232.6	5231.2	5182.7	50	19-50	ALLUVIUM,UNWEATHERED SHALE
225 S	MW	93356.4	12179.2	5240.9	5239.5	5219.5	43	26-43	WEATHERED MANCOS SHALE
225 D	MW	93356.4	12179.2	5240.4	5239.5	5219.5	60	50-60	UNWEATHERED MANCOS SHALE
226	MW	93677.0	11291.4	5236.0	5234.6	5194.6	45	24-45	ALLUVIUM-UNWEATHERED SHALE
227	MW	93937.2	12636.8	5225.9	5225.1	5225.6	16	6-16	ALLUVIUM,WEATHERED SHALE
228	MW	93286.7	13125.6	5247.5	5245.9	5219.9	30	13-30	ALLUVIUM,WEATHERED SHALE
229 S	MW	93744.3	13016.5	5259.1	5258.1	5225.1	35	10-35	ALLUVIUM,WEATHERED SHALE
229 D	MW	93744.3	13016.5	5259.6	5258.1	5225.1	60	42-60	WEATHERED-UNWEATHERED SHALE
230	MW	94488.0	12457.7	5265.4	5264.0	5243.0	30	11-29	ALLUVIUM,WEATHERED SHALE
231	MW	94644.0	10731.7	5241.2	5239.8	5226.8	25	15-25	WEATHERED MANCOS SHALE
232	MW	94234.7	13236.9	5268.4	5266.9	5243.9	28.5	11-28.5	ALLUVIUM,WEATHERED SHALE
233 S	MW	92960.1	11804.3	5229.3	5228.2	5208.2	37	22-37	WEATHERED MANCOS SHALE
233 D	MW	92960.1	11804.3	5229.9	5228.2	5208.2	65	48-65	UNWEATHERED MANCOS SHALE
234 S	MW	94414.2	12041.9	5256.1	5255.1	5246.1	30	13-30	WEATHERED MANCOS SHALE
234 D	MW	94414.2	12041.9	5256.9	5255.1	5246.1	65	39-65	UNWEATHERED MANCOS SHALE
235	MW	94790.5	11940.2	5264.6	5263.3	5240.3	25	10-25	ALLUVIUM,WEATHERED SHALE
236	CH	92785.8	11206.9	5218.3	5216.4	5200.4	152.5		
237	CH	92593.5	12486.9	5229.5	5230.8	5202.3	157.85		
238	CH	93562.9	10568.9	5228.5	5226.6	5189.1	122.7		
239	MW	93972.3	12410.2	5257.0	5255.5	5234.5	34	24-34	WEATHERED MANCOS SHALE
240	MW	93935.8	12120.0	5252.5	5251.0	5213.0	40	30-40	ALLUVIUM,WEATHERED SHALE
241	MW	93735.0	12007.1	5247.5	5246.1	5211.1	48	38-48	WEATHERED-UNWEATHERED SHALE
242	BH	93776.4	11423.2	5240.2	5238.9	5197.9	55		
[illegible]	CH	94146.6	11773.8	5248.9	5247.8	5226.8	68		

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-07-90-15-01 DISCIPLINE HYDRO NO. OF SHEETS 22 + 1 Attachment (4p

PROJECT:

UMTRA/DOE

SITE:

Grand Junction Processing Site

FEATURE: Hazardous constituents in the tailings pore water exceeding the laboratory method detection limits.

SOURCES OF DATA:

DART 07/03/90 pp 3-22

SOURCES OF FORMULAE & REFERENCES:

TAD, Revised 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		B. Gallaher	07-03-90	D. Metzler	09/12/90	[illegible]	9/90

JEG-AL-ENG-51 (6/87)

JACOBS ENGINEERING

DATE 07-03-90 SUBJECT GRJ-01 Haz Constituents SHEET NO. 1/22

BY BJ CHKD. [illegible] 8/90 JOB NO. GRJ-01

Comparison of results of DART all-parm. retrieval for the processing site lysimeters with 40CFR192 list of hazardous constituents yields the following.

HAZARDOUS CONSTITUENTS IN THE TAILINGS PORE ~~FLUID~~ WATER EXCEEDING THE LABORATOR METHOD DETECTION LIMITS:

1) Aluminum * ✓
2) Antimony * ✓
3) Arsenic ✓
4) Barium ✓
5) Beryllium * ✓
6) Cadmium ✓
7) Chromium ✓
8) Cobalt * ✓
9) Copper * ✓
10) Cyanide * ✓
11) Fluoride * ✓
12) (Net) Gross Alpha ✓
13) Lead ✓
14) Mercury ✓
15) Molybdenum ✓
16) Nickel * ✓
17) Nitrate ✓
18) Radium -226 +228 combined ✓
19) Selenium ✓
20) Strontium * ✓ 26) Silver ✓
21) Sulfide * ✓
22) Tin * ✓ (barely yes)
23) Uranium ✓
24) Vanadium * ✓
25) Zinc * ✓

* = Detected elements of potentially hazardous compounds

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE 07-03-90 SUBJECT GRJ-01 Haz Constituents SHEET NO. 2/22

BY BJ CHKD. [illegible] 8/9

JOB NO. GRJ-01

[None of the potentially hazardous Appendix IX organic compounds ~~have~~ were detected in ground water samples collected from three monitoring wells at the processing site.].

Although vicinity property materials will make up ~ 40% of the total volume of waste material, water quality records are available for only one VP lysimeter (556). These data have been pooled with the much larger data set available for the M-K tailings pile, and thus, the VP ~~proper~~ materials are underweighted in the statistical analyses with respect to the M-K tailings. Because VP materials are almost certainly to be less contaminated than the MK tailings, the calculated statistics (Attachment A) probably represent worst case concentrations.

Note: Upon visual inspection of the V.P. lysimeter analysis (556), the concentration of constituents in this sample are within the range of concentrations in the tailings lysimeter samples.

J Cox

FORM 91-005-1 (4/81)

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

y 9/4

(40 CFR 192)
= Hazardous Constituent
Yes = Constituent Detected

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ALKALINITY	0550	01/09/90	0001	TA	O	MG/L CACO3		668.	-
	0551	01/09/90	0001	TA	O			163.	-
	0554	01/12/90	0001	TA	O			402.	-
	0555	01/15/90	0001	TA	O			181.	-
	0556	01/15/90	0001	TA	O			175.	-
	0600	01/11/90	0001	TA	O			140.	-
	0602	01/10/90	0001	TA	O			7.	-
	0603	01/10/90	0001	TA	O			123.	-
	0604	01/10/90	0001	TA	O			75.	-
	0643	01/12/90	0001	SM	O			679.	-
	0645	01/12/90	0001	CH	O			502.	-
ALUMINUM Yes	0550	08/17/89	0001	TA	O	MG/L		0.05	-
	0550	10/01/89	0002	TA	O		<	0.50	-
	0550	01/09/90	0001	TA	O			0.09	-
	0551	08/17/89	0001	TA	O			0.16	-
	0551	10/01/89	0002	TA	O		<	0.50	-
	0551	01/09/90	0001	TA	O			0.08	-
	0552	08/17/89	0001	TA	O			98.	-
	0552	10/01/89	0002	TA	O			82.9	-
	0552	01/09/90	0001	TA	O			56.	-
	0553	08/17/89	0001	TA	O			28.6	-
	0553	10/01/89	0002	TA	O			25.3	-
	0553	01/09/90	0001	TA	O			28.	-
	0554	08/17/89	0001	TA	O			0.11	-
	0554	10/01/89	0002	TA	O		<	0.50	-
	0554	01/12/90	0001	TA	O			0.17	-
	0556	08/17/89	0001	TA	O			0.07	-
	0556	01/15/90	0001	TA	O		<	0.05	-
	0600	10/01/89	0001	TA	O			4.60	-
	0600	01/11/90	0001	TA	O			0.61	-
	0601	01/10/90	0001	TA	O			0.36	-
	0602	10/01/89	0001	TA	O			1.90	-
	0602	01/10/90	0001	TA	O			9.50	-
	0603	10/01/89	0001	TA	O			0.50	-
	0603	01/10/90	0001	TA	O			1.05	-
	0604	01/10/90	0001	TA	O			0.05	-
	0643	01/12/90	0001	SM	O		<	0.05	-
	0645	01/12/90	0001	CH	O		<	0.05	-
	0646	01/12/90	0001	SP	O		<	0.05	-
AMMONIUM	0550	08/17/89	0001	TA	O	MG/L		868.	-
	0550	10/01/89	0002	TA	O			897.	-
	0550	01/09/90	0001	TA	O			912.	-
	0551	10/01/89	0002	TA	O			143.	-
	0551	01/09/90	0001	TA	O			1.5	-
	0552	01/09/90	0001	TA	O			471.	-
	0553	10/01/89	0002	TA	O			780.	-
	0553	01/09/90	0001	TA	O			773.	-
	0554	01/12/90	0001	TA	O			207.	-
	0556	08/17/89	0001	TA	O			131.	-
	0556	01/15/90	0001	TA	O			4.9	-
	0600	10/01/89	0001	TA	O			325.	-
	0600	01/11/90	0001	TA	O			286.	-
	0602	01/10/90	0001	TA	O			644.	-
	0603	10/01/89	0001	TA	O			112.	-

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

1/22

DMM 07/13/

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
AMMONIUM	0603	01/10/90	0001	TA	O	MG/L		167.	-
	0604	01/10/90	0001	TA	O			491.	-
	0643	01/12/90	0001	SM	O			336.	-
	0645	01/12/90	0001	CH	O			27.	-
	0646	01/12/90	0001	SP	O			267.	-
ANTIMONY Yes	0550	08/17/89	0001	TA	O	MG/L	<	0.010	-
	0550	10/01/89	0002	TA	O			0.020	-
	0550	01/09/90	0001	TA	O			0.007	-
	0551	08/17/89	0001	TA	O		<	0.010	-
	0551	10/01/89	0002	TA	O			0.016	-
	0551	01/09/90	0001	TA	O		<	0.006	-
	0552	08/17/89	0001	TA	O		<	0.010	-
	0552	10/01/89	0002	TA	O		<	0.010	-
	0552	01/09/90	0001	TA	O			0.010	-
	0553	08/17/89	0001	TA	O		<	0.010	-
	0553	10/01/89	0002	TA	O			0.013	-
	0553	01/09/90	0001	TA	O		<	0.006	-
	0554	08/17/89	0001	TA	O			0.010	-
	0554	10/01/89	0002	TA	O			0.027	-
	0554	01/12/90	0001	TA	O			0.015	-
	0556	08/17/89	0001	TA	O		<	0.010	-
	0556	01/15/90	0001	TA	O		<	0.006	-
	0600	10/01/89	0001	TA	O		<	0.010	-
	0600	01/11/90	0001	TA	O		<	0.006	-
	0601	01/10/90	0001	TA	O			0.007	-
	0602	10/01/89	0001	TA	O			0.013	-
	0602	01/10/90	0001	TA	O			0.010	-
	0603	10/01/89	0001	TA	O			0.013	-
	0603	01/10/90	0001	TA	O		<	0.006	-
	0604	01/10/90	0001	TA	O			0.006	-
	0643	01/12/90	0001	SM	O			0.008	-
	0645	01/12/90	0001	CH	O		<	0.006	-
	0646	01/12/90	0001	SP	O			0.006	-
ARSENIC Yes	0550	08/17/89	0001	TA	O	MG/L		0.14	-
	0550	10/01/89	0002	TA	O			0.090	-
	0550	01/09/90	0001	TA	O			0.21	-
	0551	08/17/89	0001	TA	O			0.03	-
	0551	10/01/89	0002	TA	O			0.020	-
	0551	01/09/90	0001	TA	O			0.03	-
	0552	08/17/89	0001	TA	O			0.08	-
	0552	10/01/89	0002	TA	O			0.050	-
	0552	01/09/90	0001	TA	O			0.08	-
	0553	08/17/89	0001	TA	O			0.90	-
	0553	10/01/89	0002	TA	O			0.640	-
	0553	01/09/90	0001	TA	O			0.74	-
	0554	08/17/89	0001	TA	O			0.13	-
	0554	10/01/89	0002	TA	O			0.100	-
	0554	01/12/90	0001	TA	O			0.20	-
	0556	08/17/89	0001	TA	O			0.04	-
	0556	01/15/90	0001	TA	O			0.03	-
	0600	10/01/89	0001	TA	O			0.380	-
	0600	01/11/90	0001	TA	O			0.66	-
	0601	01/10/90	0001	TA	O			0.49	-
	0602	10/01/89	0001	TA	O			0.080	-

FORMATION OF COMPLETION CODE:
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CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ARSENIC	0602	01/10/90	0001	TA	O	MG/L		0.35	-
	0603	10/01/89	0001	TA	O			0.925	-
	0603	01/10/90	0001	TA	O			1.70	-
	0604	01/10/90	0001	TA	O			0.02	-
	0643	01/12/90	0001	SM	O			0.01	-
	0645	01/12/90	0001	CH	O		<	0.01	-
	0646	01/12/90	0001	SP	O			0.04	-
BARIUM	0550	08/17/89	0001	TA	O	MG/L		0.02	-
	0550	10/01/89	0002	TA	O		<	0.10	-
	0550	01/09/90	0001	TA	O			0.03	-
	0551	08/17/89	0001	TA	O			0.05	-
	0551	10/01/89	0002	TA	O		<	0.10	-
	0551	01/09/90	0001	TA	O			0.04	-
	0552	08/17/89	0001	TA	O			0.15	-
	0552	10/01/89	0002	TA	O		<	0.10	-
	0552	01/09/90	0001	TA	O			0.02	-
	0553	08/17/89	0001	TA	O			0.01	-
	0553	10/01/89	0002	TA	O		<	0.10	-
	0553	01/09/90	0001	TA	O			0.01	-
	0554	08/17/89	0001	TA	O			0.06	-
	0554	10/01/89	0002	TA	O			0.10	-
	0554	01/12/90	0001	TA	O			0.04	-
	0556	08/17/89	0001	TA	O			0.03	-
	0556	01/15/90	0001	TA	O			0.02	-
	0600	10/01/89	0001	TA	O		<	0.10	-
	0600	01/11/90	0001	TA	O		<	0.01	-
	0601	01/10/90	0001	TA	O		<	0.01	-
	0602	10/01/89	0001	TA	O		<	0.10	-
	0602	01/10/90	0001	TA	O			0.02	-
	0603	10/01/89	0001	TA	O		<	0.10	-
	0603	01/10/90	0001	TA	O			0.01	-
	0604	01/10/90	0001	TA	O			0.01	-
	0643	01/12/90	0001	SM	O			0.04	-
	0645	01/12/90	0001	CH	O			0.02	-
	0646	01/12/90	0001	SP	O			0.03	-
BERYLLIUM	0550	08/17/89	0001	TA	O	MG/L	<	0.005	-
	0550	01/09/90	0001	TA	O			0.005	-
	0551	08/17/89	0001	TA	O			0.007	-
	0551	01/09/90	0001	TA	O			0.015	-
	0552	08/17/89	0001	TA	O			0.017	-
	0552	01/09/90	0001	TA	O			0.008	-
	0553	08/17/89	0001	TA	O			0.228	-
	0553	01/09/90	0001	TA	O			0.118	-
	0554	08/17/89	0001	TA	O			0.007	-
	0554	01/12/90	0001	TA	O		<	0.005	-
	0556	08/17/89	0001	TA	O			0.006	-
	0556	01/15/90	0001	TA	O		<	0.005	-
	0600	01/11/90	0001	TA	O		<	0.005	-
	0601	01/10/90	0001	TA	O		<	0.005	-
	0602	01/10/90	0001	TA	O			0.023	-
	0603	01/10/90	0001	TA	O		<	0.005	-
	0604	01/10/90	0001	TA	O		<	0.005	-
	0643	01/12/90	0001	SM	O		<	0.005	-
	0645	01/12/90	0001	CH	O		<	0.005	-

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CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BD 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
BERYLLIUM	0646	01/12/90	0001	SP	O	MG/L	<	0.005	-
BORON	0550	08/17/89	0001	TA	O	MG/L		0.85	-
	0550	10/01/89	0002	TA	O			0.60	-
	0550	01/09/90	0001	TA	O			0.64	-
	0551	10/01/89	0002	TA	O			0.45	-
	0551	01/09/90	0001	TA	O			0.62	-
	0552	01/09/90	0001	TA	O			0.85	-
	0553	10/01/89	0002	TA	O			1.00	-
	0553	01/09/90	0001	TA	O			0.84	-
	0554	01/12/90	0001	TA	O			2.04	-
	0556	08/17/89	0001	TA	O			0.70	-
	0556	01/15/90	0001	TA	O			0.26	-
	0600	10/01/89	0001	TA	O			0.80	-
	0600	01/11/90	0001	TA	O			0.60	-
	0602	01/10/90	0001	TA	O			0.88	-
	0603	10/01/89	0001	TA	O			0.55	-
	0603	01/10/90	0001	TA	O			0.58	-
	0604	01/10/90	0001	TA	O			0.26	-
	0643	01/12/90	0001	SM	O			0.45	-
	0645	01/12/90	0001	CH	O			0.66	-
	0646	01/12/90	0001	SP	O			0.28	-
CADMIUM Yes	0550	08/17/89	0001	TA	O	MG/L		0.005	-
	0550	10/01/89	0002	TA	O			0.0071	-
	0550	01/09/90	0001	TA	O			0.002	-
	0551	08/17/89	0001	TA	O			0.071	-
	0551	10/01/89	0002	TA	O			0.0907	-
	0551	01/09/90	0001	TA	O			0.258	-
	0552	08/17/89	0001	TA	O			0.274	-
	0552	10/01/89	0002	TA	O			0.3500	-
	0552	01/09/90	0001	TA	O			0.238	-
	0553	08/17/89	0001	TA	O			0.211	-
	0553	10/01/89	0002	TA	O			0.2700	-
	0553	01/09/90	0001	TA	O			0.123	-
	0554	08/17/89	0001	TA	O		<	0.005	-
	0554	10/01/89	0002	TA	O			0.0026	-
	0554	01/12/90	0001	TA	O			0.011	-
	0556	08/17/89	0001	TA	O			0.023	-
	0556	01/15/90	0001	TA	O			0.015	-
	0600	10/01/89	0001	TA	O			0.1500	-
	0600	01/11/90	0001	TA	O			0.007	-
	0601	01/10/90	0001	TA	O		<	0.001	-
	0602	10/01/89	0001	TA	O			0.1500	-
	0602	01/10/90	0001	TA	O			0.197	-
	0603	10/01/89	0001	TA	O			0.0007	-
	0603	01/10/90	0001	TA	O		<	0.001	-
	0604	01/10/90	0001	TA	O			0.060	-
	0643	01/12/90	0001	SM	O			0.001	-
	0645	01/12/90	0001	CH	O			0.001	-
	0646	01/12/90	0001	SP	O		<	0.001	-
CALCIUM	0550	08/17/89	0001	TA	O	MG/L		510.	-
	0550	10/01/89	0002	TA	O			470.	-
	0550	01/09/90	0001	TA	O			470.	-
	0551	08/17/89	0001	TA	O			535.	-

FORMATION OF COMPLETION CODE:
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CH - FAT CLAYS

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

fnl 8/4/

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CALCIUM	0551	10/01/89	0002	TA	O	MG/L		1180.	-
	0551	01/09/90	0001	TA	O			1300.	-
	0552	08/17/89	0001	TA	O			455.	-
	0552	01/09/90	0001	TA	O			436.	-
	0553	08/17/89	0001	TA	O			455.	-
	0553	10/01/89	0002	TA	O			670.	-
	0553	01/09/90	0001	TA	O			456.	-
	0554	08/17/89	0001	TA	O			655.	-
	0554	01/12/90	0001	TA	O			825.	-
	0556	08/17/89	0001	TA	O			695.	-
	0556	01/15/90	0001	TA	O			535.	-
	0600	10/01/89	0001	TA	O			485.	-
	0600	01/11/90	0001	TA	O			431.	-
	0601	01/10/90	0001	TA	O			482.	-
	0602	01/10/90	0001	TA	O			520.	-
	0603	10/01/89	0001	TA	O			500.	-
	0603	01/10/90	0001	TA	O			489.	-
	0604	01/10/90	0001	TA	O			447.	-
	0643	01/12/90	0001	SM	O			540.	-
	0645	01/12/90	0001	CH	O			560.	-
	0646	01/12/90	0001	SP	O			540.	-
CHLORIDE	0550	08/17/89	0001	TA	O	MG/L		1460.	-
	0550	10/01/89	0002	TA	O			1450.	-
	0550	01/09/90	0001	TA	O			1550.	-
	0551	10/01/89	0002	TA	O			1000.	-
	0551	01/09/90	0001	TA	O			1030.	-
	0552	01/09/90	0001	TA	O			1290.	-
	0553	10/01/89	0002	TA	O			1100.	-
	0553	01/09/90	0001	TA	O			1160.	-
	0554	01/12/90	0001	TA	O			1830.	-
	0556	08/17/89	0001	TA	O			1150.	-
	0556	01/15/90	0001	TA	O			999.	-
	0600	10/01/89	0001	TA	O			900.	-
	0600	01/11/90	0001	TA	O			745.0	-
	0602	01/10/90	0001	TA	O			1340.	-
	0603	10/01/89	0001	TA	O			320.	-
	0603	01/10/90	0001	TA	O			273.5	-
	0604	01/10/90	0001	TA	O			492.5	-
	0643	01/12/90	0001	SM	O			809.	-
	0646	01/12/90	0001	SP	O			705.	-
CHROMIUM Yes	0550	08/17/89	0001	TA	O	MG/L	<	0.01	-
	0550	10/01/89	0002	TA	O			0.10	-
	0550	01/09/90	0001	TA	O		<	0.01	-
	0551	08/17/89	0001	TA	O		<	0.01	-
	0551	10/01/89	0002	TA	O		<	0.10	-
	0551	01/09/90	0001	TA	O		<	0.01	-
	0552	08/17/89	0001	TA	O			0.02	-
	0552	10/01/89	0002	TA	O			0.10	-
	0552	01/09/90	0001	TA	O		<	0.01	-
	0553	08/17/89	0001	TA	O		<	0.01	-
	0553	10/01/89	0002	TA	O			0.10	-
	0553	01/09/90	0001	TA	O		<	0.01	-
	0554	08/17/89	0001	TA	O		<	0.01	-
	0554	10/01/89	0002	TA	O		<	0.10	-

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

8/22

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
[redacted]ONIUM Yes	0554	01/12/90	0001	TA	O	MG/L	<	0.01	-
	0556	08/17/89	0001	TA	O		<	0.02	-
	0556	01/15/90	0001	TA	O		<	0.01	-
	0600	10/01/89	0001	TA	O		<	0.10	-
	0600	01/11/90	0001	TA	O		<	0.01	-
	0601	01/10/90	0001	TA	O		<	0.01	-
	0602	10/01/89	0001	TA	O		<	0.10	-
	0602	01/10/90	0001	TA	O		<	0.01	-
	0603	10/01/89	0001	TA	O			0.10	-
	0603	01/10/90	0001	TA	O		<	0.01	-
	0604	01/10/90	0001	TA	O		<	0.01	-
	0643	01/12/90	0001	SM	O		<	0.01	-
	0645	01/12/90	0001	CH	O		<	0.01	-
	0646	01/12/90	0001	SP	O		<	0.01	-
COBALT Yes	0550	08/17/89	0001	TA	O	MG/L		0.10	-
	0550	10/01/89	0002	TA	O			0.20	-
	0550	01/09/90	0001	TA	O			0.09	-
	0551	08/17/89	0001	TA	O			0.20	-
	0551	10/01/89	0002	TA	O			0.20	-
	0551	01/09/90	0001	TA	O			0.41	-
	0552	08/17/89	0001	TA	O			0.70	-
	0552	10/01/89	0002	TA	O			0.70	-
	0552	01/09/90	0001	TA	O			0.49	-
	0553	08/17/89	0001	TA	O			0.35	-
	0553	10/01/89	0002	TA	O			0.60	-
	0553	01/09/90	0001	TA	O			0.45	-
	0554	08/17/89	0001	TA	O		<	0.05	-
	0554	10/01/89	0002	TA	O		<	0.10	-
	0554	01/12/90	0001	TA	O		<	0.05	-
	0556	08/17/89	0001	TA	O		<	0.05	-
	0556	01/15/90	0001	TA	O		<	0.03	-
	0600	10/01/89	0001	TA	O			0.20	-
	0600	01/11/90	0001	TA	O			0.09	-
	0601	01/10/90	0001	TA	O		<	0.05	-
	0602	10/01/89	0001	TA	O			0.40	-
	0602	01/10/90	0001	TA	O			0.36	-
	0603	10/01/89	0001	TA	O			0.20	-
	0603	01/10/90	0001	TA	O			0.47	-
	0604	01/10/90	0001	TA	O			0.05	-
	0643	01/12/90	0001	SM	O		<	0.05	-
	0645	01/12/90	0001	CH	O		<	0.05	-
	0646	01/12/90	0001	SP	O		<	0.05	-
COPPER Yes	0550	08/17/89	0001	TA	O	MG/L		0.01	-
	0550	10/01/89	0002	TA	O			0.10	-
	0550	01/09/90	0001	TA	O			0.02	-
	0551	08/17/89	0001	TA	O			0.17	-
	0551	10/01/89	0002	TA	O			0.20	-
	0551	01/09/90	0001	TA	O			0.10	-
	0552	08/17/89	0001	TA	O			2.95	-
	0552	10/01/89	0002	TA	O			2.70	-
	0552	01/09/90	0001	TA	O			2.94	-
	0553	08/17/89	0001	TA	O			3.70	-
	0553	10/01/89	0002	TA	O			2.90	-
	0553	01/09/90	0001	TA	O			2.50	-

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
COPPER	0554	08/17/89	0001	TA	O	MG/L		0.04	-
	0554	10/01/89	0002	TA	O			0.20	-
	0554	01/12/90	0001	TA	O			0.08	-
	0556	08/17/89	0001	TA	O			0.05	-
	0556	01/15/90	0001	TA	O			0.06	-
	0600	10/01/89	0001	TA	O		<	0.10	-
	0600	01/11/90	0001	TA	O		<	0.01	-
	0601	01/10/90	0001	TA	O		<	0.01	-
	0602	10/01/89	0001	TA	O			1.00	-
	0602	01/10/90	0001	TA	O			4.21	-
	0603	10/01/89	0001	TA	O			0.10	-
	0603	01/10/90	0001	TA	O		<	0.01	-
	0604	01/10/90	0001	TA	O		<	0.01	-
	0643	01/12/90	0001	SM	O			0.01	-
	0645	01/12/90	0001	CH	O			0.02	-
	0646	01/12/90	0001	SP	O			0.01	-
CYANIDE	0550	08/17/89	0001	TA	O	MG/L	<	0.002	-
	0550	01/09/90	0001	TA	O			0.08	-
	0551	08/17/89	0001	TA	O			0.043	-
	0551	01/09/90	0001	TA	O			0.12	-
	0552	01/09/90	0001	TA	O			0.08	-
	0553	08/17/89	0001	TA	O			0.006	-
	0553	01/09/90	0001	TA	O			0.08	-
	0554	08/17/89	0001	TA	O			0.023	-
	0554	10/01/89	0002	TA	O			0.093	-
	0554	01/12/90	0001	TA	O			0.36	-
	0555	01/15/90	0001	TA	O			0.16	-
	0556	01/15/90	0001	TA	O			0.12	-
	0600	10/01/89	0001	TA	O			0.006	-
	0600	01/11/90	0001	TA	O			0.08	-
	0602	01/10/90	0001	TA	O			0.04	-
	0603	10/01/89	0001	TA	O			0.006	-
	0603	01/10/90	0001	TA	O			0.08	-
	0604	01/10/90	0001	TA	O			0.08	-
	0643	01/12/90	0001	SM	O			0.08	-
	0645	01/12/90	0001	CH	O			0.12	-
	0646	01/12/90	0001	SP	O			0.04	-
FLUORIDE	0550	08/17/89	0001	TA	O	MG/L		3.9	-
	0550	10/01/89	0002	TA	O			4.1	-
	0550	01/09/90	0001	TA	O			4.2	-
	0551	10/01/89	0002	TA	O			1.9	-
	0551	01/09/90	0001	TA	O			1.0	-
	0552	01/09/90	0001	TA	O			15.2	-
	0553	10/01/89	0002	TA	O			12.8	-
	0553	01/09/90	0001	TA	O			14.4	-
	0554	01/12/90	0001	TA	O			4.8	-
	0555	01/15/90	0001	TA	O			4.8	-
	0556	08/17/89	0001	TA	O			1.8	-
	0556	01/15/90	0001	TA	O			1.2	-
	0600	10/01/89	0001	TA	O			5.7	-
	0600	01/11/90	0001	TA	O			3.5	-
	0602	01/10/90	0001	TA	O			8.0	-
	0603	10/01/89	0001	TA	O			8.0	-
	0603	01/10/90	0001	TA	O			19.2	-

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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

10/22

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM CONP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
FLUORIDE	0604	01/10/90	0001	TA	O	MG/L		0.7	-
	0643	01/12/90	0001	SM	O			12.0	-
	0645	01/12/90	0001	CH	O			1.6	-
	0646	01/12/90	0001	SP	O			4.4	-
GROSS ALPHA	0550	01/09/90	0001	TA	O	PCI/L		2151.	237.
	0551	01/09/90	0001	TA	O			302.	89.
	0553	01/09/90	0001	TA	O			8020.	387.
	0554	01/12/90	0001	TA	O			558.	122.
	0556	01/15/90	0001	TA	O			113.	56.
	0600	01/11/90	0001	TA	O			2170.	161.
	0602	01/10/90	0001	TA	O			5471.	300.
	0603	01/10/90	0001	TA	O			133.	38.
	0604	01/10/90	0001	TA	O			244.	64.
GROSS BETA	0550	01/09/90	0001	TA	O	PCI/L		1553.	114.
	0551	01/09/90	0001	TA	O			191.	48.
	0553	01/09/90	0001	TA	O			2675.	108.
	0554	01/12/90	0001	TA	O			666.	77.
	0556	01/15/90	0001	TA	O			109.	36.
	0600	01/11/90	0001	TA	O			1404.	67.
	0602	01/10/90	0001	TA	O			2404.	110.
	0603	01/10/90	0001	TA	O			205.	26.
	0604	01/10/90	0001	TA	O			203.	35.
IRON	0550	08/17/89	0001	TA	O	MG/L		9.2	-
	0550	10/01/89	0002	TA	O			7.60	-
	0550	01/09/90	0001	TA	O			9.60	-
	0551	08/17/89	0001	TA	O			0.18	-
	0551	10/01/89	0002	TA	O			1.60	-
	0551	01/09/90	0001	TA	O		<	0.03	-
	0552	08/17/89	0001	TA	O			3.7	-
	0552	10/01/89	0002	TA	O			1.50	-
	0552	01/09/90	0001	TA	O			0.40	-
	0553	08/17/89	0001	TA	O			58.	-
	0553	10/01/89	0002	TA	O			53.0	-
	0553	01/09/90	0001	TA	O			69.	-
	0554	08/17/89	0001	TA	O			0.70	-
	0554	10/01/89	0002	TA	O			0.40	-
	0554	01/12/90	0001	TA	O			0.13	-
	0556	08/17/89	0001	TA	O		<	0.02	-
	0556	01/15/90	0001	TA	O		<	0.03	-
	0600	10/01/89	0001	TA	O			60.	-
	0600	01/11/90	0001	TA	O			52.	-
	0601	01/10/90	0001	TA	O			7.80	-
	0602	10/01/89	0001	TA	O			58.0	-
	0602	01/10/90	0001	TA	O			56.	-
	0603	10/01/89	0001	TA	O			370.	-
	0603	01/10/90	0001	TA	O			57.	-
	0604	01/10/90	0001	TA	O			21.	-
	0643	01/12/90	0001	SM	O			3.45	-
	0645	01/12/90	0001	CH	O		<	0.03	-
	0646	01/12/90	0001	SP	O			54.	-
LEAD	0550	08/17/89	0001	TA	O	MG/L		0.18	-
	0550	10/01/89	0002	TA	O			0.016	-

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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
LEAD	0550	01/09/90	0001	TA	O	MG/L	<	0.01	-
	0551	08/17/89	0001	TA	O		<	0.02	-
	0551	10/01/89	0002	TA	O			0.016	-
	0551	01/09/90	0001	TA	O		<	0.01	-
	0552	08/17/89	0001	TA	O			0.09	-
	0552	10/01/89	0002	TA	O			0.080	-
	0552	01/09/90	0001	TA	O			0.03	-
	0553	08/17/89	0001	TA	O			0.05	-
	0553	10/01/89	0002	TA	O			0.033	-
	0553	01/09/90	0001	TA	O		<	0.01	-
	0554	08/17/89	0001	TA	O			0.12	-
	0554	10/01/89	0002	TA	O			0.011	-
	0554	01/12/90	0001	TA	O		<	0.01	-
	0556	08/17/89	0001	TA	O		<	0.02	-
	0556	01/15/90	0001	TA	O		<	0.01	-
	0600	10/01/89	0001	TA	O			0.021	-
	0600	01/11/90	0001	TA	O		<	0.01	-
	0601	01/10/90	0001	TA	O		<	0.01	-
	0602	10/01/89	0001	TA	O			0.004	-
	0602	01/10/90	0001	TA	O		<	0.01	-
	0603	10/01/89	0001	TA	O			0.003	-
	0603	01/10/90	0001	TA	O		<	0.01	-
	0604	01/10/90	0001	TA	O		<	0.01	-
	0643	01/12/90	0001	SM	O		<	0.01	-
	0645	01/12/90	0001	CH	O		<	0.01	-
	0646	01/12/90	0001	SP	O		<	0.01	-
MAGNESIUM	0550	08/17/89	0001	TA	O	MG/L		455.	-
	0550	10/01/89	0002	TA	O			410.	-
	0550	01/09/90	0001	TA	O			430.	-
	0551	08/17/89	0001	TA	O			360.	-
	0551	10/01/89	0002	TA	O			415.	-
	0551	01/09/90	0001	TA	O			380.	-
	0552	08/17/89	0001	TA	O			4.	-
	0552	01/09/90	0001	TA	O			330.	-
	0553	08/17/89	0001	TA	O			290.	-
	0553	10/01/89	0002	TA	O			275.	-
	0553	01/09/90	0001	TA	O			296.	-
	0554	08/17/89	0001	TA	O			495.	-
	0554	01/12/90	0001	TA	O			530.	-
	0556	08/17/89	0001	TA	O			385.	-
	0556	01/15/90	0001	TA	O			310.	-
	0600	10/01/89	0001	TA	O			264.	-
	0600	01/11/90	0001	TA	O			125.	-
	0601	01/10/90	0001	TA	O			170.	-
	0602	01/10/90	0001	TA	O			261.	-
	0603	10/01/89	0001	TA	O			245.	-
	0603	01/10/90	0001	TA	O			197.	-
	0604	01/10/90	0001	TA	O			158.	-
	0643	01/12/90	0001	SM	O			204.	-
	0645	01/12/90	0001	CH	O			435.	-
	0646	01/12/90	0001	SP	O			232.	-
MANGANESE	0550	08/17/89	0001	TA	O	MG/L		6.9	-
	0550	10/01/89	0002	TA	O			7.50	-
	0550	01/09/90	0001	TA	O			6.80	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS / 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

12/22

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MANGANESE	0551	08/17/89	0001	TA	O	MG/L		5.1	-
	0551	10/01/89	0002	TA	O			5.20	-
	0551	01/09/90	0001	TA	O			14.7	-
	0552	08/17/89	0001	TA	O			8.3	-
	0552	10/01/89	0002	TA	O			8.90	-
	0552	01/09/90	0001	TA	O			6.22	-
	0553	08/17/89	0001	TA	O			7.9	-
	0553	10/01/89	0002	TA	O			7.60	-
	0553	01/09/90	0001	TA	O			7.48	-
	0554	08/17/89	0001	TA	O			2.79	-
	0554	10/01/89	0002	TA	O			2.60	-
	0554	01/12/90	0001	TA	O			2.00	-
	0556	08/17/89	0001	TA	O			2.05	-
	0556	01/15/90	0001	TA	O			2.34	-
	0600	10/01/89	0001	TA	O			5.20	-
	0600	01/11/90	0001	TA	O			3.59	-
	0601	01/10/90	0001	TA	O			1.93	-
	0602	10/01/89	0001	TA	O			8.10	-
	0602	01/10/90	0001	TA	O			6.60	-
	0603	10/01/89	0001	TA	O			5.50	-
	0603	01/10/90	0001	TA	O			6.74	-
	0604	01/10/90	0001	TA	O			3.95	-
	0643	01/12/90	0001	SM	O			5.00	-
	0645	01/12/90	0001	CH	O			3.45	-
	0646	01/12/90	0001	SP	O			3.94	-
MERCURY Yes	0550	08/17/89	0001	TA	O	MG/L	<	0.0001	-
	0550	10/01/89	0002	TA	O		<	0.0001	-
	0551	08/17/89	0001	TA	O		<	0.0001	-
	0551	10/01/89	0002	TA	O		<	0.0001	-
	0552	08/17/89	0001	TA	O		<	0.0001	-
	0552	10/01/89	0002	TA	O		<	0.0001	-
	0553	08/17/89	0001	TA	O		<	0.0001	-
	0553	10/01/89	0002	TA	O		<	0.0001	-
	0554	08/17/89	0001	TA	O		<	0.0001	-
	0554	10/01/89	0002	TA	O			0.0002	-
	0556	08/17/89	0001	TA	O		<	0.0001	-
	0600	10/01/89	0001	TA	O		<	0.0001	-
	0602	10/01/89	0001	TA	O			0.0003	-
	0603	10/01/89	0001	TA	O		<	0.0001	-
MOLYBDENUM Yes	0550	08/17/89	0001	TA	O	MG/L		1.00	-
	0550	10/01/89	0002	TA	O			0.90	-
	0550	01/09/90	0001	TA	O			0.67	-
	0551	08/17/89	0001	TA	O			0.47	-
	0551	10/01/89	0002	TA	O		<	0.50	-
	0551	01/09/90	0001	TA	O			0.29	-
	0552	08/17/89	0001	TA	O			0.08	-
	0552	10/01/89	0002	TA	O		<	0.50	-
	0552	01/09/90	0001	TA	O			0.10	-
	0553	08/17/89	0001	TA	O			0.15	-
	0553	10/01/89	0002	TA	O		<	0.50	-
	0553	01/09/90	0001	TA	O			0.13	-
	0554	08/17/89	0001	TA	O			0.47	-
	0554	10/01/89	0002	TA	O		<	0.50	-
	0554	01/12/90	0001	TA	O			0.45	-

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MOLYBDENUM	0556	08/17/89	0001	TA	O	MG/L		0.26	-
	0556	01/15/90	0001	TA	O			0.08	-
	0600	10/01/89	0001	TA	O		<	0.50	-
Yes	0600	01/11/90	0001	TA	O			0.20	-
	0601	01/10/90	0001	TA	O			4.35	-
	0602	10/01/89	0001	TA	O		<	0.50	-
	0602	01/10/90	0001	TA	O			0.47	-
	0603	10/01/89	0001	TA	O			1.4	-
	0603	01/10/90	0001	TA	O			0.83	-
	0604	01/10/90	0001	TA	O			0.66	-
	0643	01/12/90	0001	SM	O			0.40	-
	0645	01/12/90	0001	CH	O			0.08	-
	0646	01/12/90	0001	SP	O			0.10	-
NICKEL	0550	08/17/89	0001	TA	O	MG/L		0.76	-
	0550	10/01/89	0002	TA	O			0.80	-
	0550	01/09/90	0001	TA	O			0.69	-
Yes	0551	08/17/89	0001	TA	O			0.44	-
	0551	10/01/89	0002	TA	O			0.60	-
	0551	01/09/90	0001	TA	O			0.68	-
	0552	08/17/89	0001	TA	O			3.82	-
	0552	10/01/89	0002	TA	O			4.20	-
	0552	01/09/90	0001	TA	O			3.12	-
	0553	08/17/89	0001	TA	O			1.67	-
	0553	10/01/89	0002	TA	O			1.80	-
	0553	01/09/90	0001	TA	O			1.46	-
	0554	08/17/89	0001	TA	O			0.62	-
	0554	10/01/89	0002	TA	O			0.50	-
	0554	01/12/90	0001	TA	O			0.50	-
	0556	08/17/89	0001	TA	O			0.12	-
	0556	01/15/90	0001	TA	O			0.09	-
	0600	10/01/89	0001	TA	O			0.70	-
	0600	01/11/90	0001	TA	O			0.38	-
	0601	01/10/90	0001	TA	O		<	0.04	-
	0602	10/01/89	0001	TA	O			1.90	-
	0602	01/10/90	0001	TA	O			1.86	-
	0603	10/01/89	0001	TA	O			1.40	-
	0603	01/10/90	0001	TA	O			2.27	-
	0604	01/10/90	0001	TA	O			0.12	-
	0643	01/12/90	0001	SM	O			0.25	-
	0645	01/12/90	0001	CH	O		<	0.04	-
	0646	01/12/90	0001	SP	O			0.09	-
NITRATE	0550	08/17/89	0001	TA	O	MG/L		3.5	-
	0550	10/01/89	0002	TA	O		<	0.1	-
Yes	0550	01/09/90	0001	TA	O			1.3	-
	0551	10/01/89	0002	TA	O			2330.	-
	0551	01/09/90	0001	TA	O			4600.	-
	0552	01/09/90	0001	TA	O			32.8	-
	0553	10/01/89	0002	TA	O			0.2	-
	0553	01/09/90	0001	TA	O		<	1.	-
	0554	01/12/90	0001	TA	O			1420.	-
	0556	08/17/89	0001	TA	O			246.	-
	0556	01/15/90	0001	TA	O			567.	-
	0600	10/01/89	0001	TA	O			0.3	-
	0600	01/11/90	0001	TA	O		<	1.	-

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

14/22

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
NITRATE	0602	01/10/90	0001	TA	O	MG/L	<	1.	-
	0603	10/01/89	0001	TA	O			17.9	-
	0603	01/10/90	0001	TA	O		<	1.	-
	0604	01/10/90	0001	TA	O		<	1.	-
	0643	01/12/90	0001	SM	O		<	0.1	-
	0646	01/12/90	0001	SP	O		<	1.	-
PH	0550	01/09/90	0001	TA	O	SU		7.03	-
	0551	01/09/90	0001	TA	O			6.25	-
	0552	01/09/90	0001	TA	O			3.92	-
	0553	01/09/90	0001	TA	O			3.73	-
	0554	01/12/90	0001	TA	O			6.57	-
	0555	01/15/90	0001	TA	O			6.91	-
	0556	01/15/90	0001	TA	O			7.01	-
	0600	01/11/90	0001	TA	O			6.10	-
	0601	01/10/90	0001	TA	O			7.55	-
	0602	01/10/90	0001	TA	O			4.88	-
	0603	01/10/90	0001	TA	O			6.22	-
	0604	01/10/90	0001	TA	O			5.91	-
	0643	01/12/90	0001	SM	O			7.29	-
	0645	01/12/90	0001	CH	O			7.60	-
	0646	01/12/90	0001	SP	O			6.95	-
PHOSPHATE	0550	08/17/89	0001	TA	O	MG/L		0.1	-
	0550	10/01/89	0002	TA	O			0.1	-
	0550	01/09/90	0001	TA	O			0.8	-
	0551	10/01/89	0002	TA	O			0.2	-
	0551	01/09/90	0001	TA	O			0.5	-
	0552	01/09/90	0001	TA	O			4.0	-
	0553	10/01/89	0002	TA	O			0.3	-
	0553	01/09/90	0001	TA	O			1.5	-
	0554	01/12/90	0001	TA	O			3.1	-
	0556	08/17/89	0001	TA	O			0.1	-
	0556	01/15/90	0001	TA	O			0.3	-
	0600	10/01/89	0001	TA	O			0.4	-
	0600	01/11/90	0001	TA	O			1.2	-
	0602	01/10/90	0001	TA	O			1.2	-
	0603	10/01/89	0001	TA	O		<	0.1	-
	0603	01/10/90	0001	TA	O			2.8	-
	0604	01/10/90	0001	TA	O			0.3	-
	0643	01/12/90	0001	SM	O			1.7	-
	0645	01/12/90	0001	CH	O			0.3	-
	0646	01/12/90	0001	SP	O			3.0	-
POTASSIUM	0550	08/17/89	0001	TA	O	MG/L		195.	-
	0550	10/01/89	0002	TA	O			180.	-
	0550	01/09/90	0001	TA	O			155.	-
	0551	08/17/89	0001	TA	O			110.	-
	0551	10/01/89	0002	TA	O			90.	-
	0551	01/09/90	0001	TA	O			32.	-
	0552	08/17/89	0001	TA	O			110.	-
	0552	01/09/90	0001	TA	O			96.	-
	0553	08/17/89	0001	TA	O			130.	-
	0553	10/01/89	0002	TA	O			140.	-
	0553	01/09/90	0001	TA	O			100.	-
	0554	08/17/89	0001	TA	O			285.	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

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PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
POTASSIUM	0554	01/12/90	0001	TA	O	MG/L		182.	-
	0556	08/17/89	0001	TA	O			65.	-
	0556	01/15/90	0001	TA	O			30.	-
	0600	10/01/89	0001	TA	O			60.	-
	0600	01/11/90	0001	TA	O			47.	-
	0601	01/10/90	0001	TA	O			33.	-
	0602	01/10/90	0001	TA	O			113.	-
	0603	10/01/89	0001	TA	O			35.	-
	0603	01/10/90	0001	TA	O			37.	-
	0604	01/10/90	0001	TA	O			64.	-
	0643	01/12/90	0001	SM	O			71.	-
	0645	01/12/90	0001	CH	O			21.	-
	0646	01/12/90	0001	SP	O			60.	-
RADIUM-226 Yes	0550	08/17/89	0001	TA	O	PCI/L		33.9	0.931
	0550	10/01/89	0002	TA	O			1.45	0.631
	0550	01/09/90	0001	TA	O			35.4	2.3
	0551	01/09/90	0001	TA	O			12.4	1.6
	0553	08/17/89	0001	TA	O			10.2	0.693
	0553	01/09/90	0001	TA	O			815.9	13.6
	0554	08/17/89	0001	TA	O			11.3	1.27
	0554	01/12/90	0001	TA	O			17.4	2.9
	0556	08/17/89	0001	TA	O			0.313	0.157
	0556	01/15/90	0001	TA	O			1.8	0.7
	0600	10/01/89	0001	TA	O			1.12	0.624
	0600	01/11/90	0001	TA	O			74.9	4.1
	0602	01/10/90	0001	TA	O			668.9	12.3
	0603	10/01/89	0001	TA	O			0.955	0.559
	0603	01/10/90	0001	TA	O			4.4	0.8
	0604	01/10/90	0001	TA	O			33.7	2.3
	0645	01/12/90	0001	CH	O			0.0	0.2
RADIUM-228	0550	01/09/90	0001	TA	O	PCI/L		0.8	1.5
	0551	01/09/90	0001	TA	O			3.8	2.3
	0553	01/09/90	0001	TA	O			2.9	1.7
	0554	01/12/90	0001	TA	O			0.0	2.3
	0556	01/15/90	0001	TA	O			2.0	2.3
	0600	01/11/90	0001	TA	O			0.6	2.2
	0602	01/10/90	0001	TA	O			0.0	2.1
	0603	01/10/90	0001	TA	O			0.0	1.5
	0604	01/10/90	0001	TA	O			0.5	1.9
	0645	01/12/90	0001	CH	O			0.1	0.5
SELENIUM Yes	0550	08/17/89	0001	TA	O	MG/L		0.28	-
	0550	10/01/89	0002	TA	O			0.21	-
	0550	01/09/90	0001	TA	O		<	0.02	-
	0551	08/17/89	0001	TA	O			0.71	-
	0551	10/01/89	0002	TA	O			0.5	-
	0551	01/09/90	0001	TA	O			0.170	-
	0552	08/17/89	0001	TA	O			0.91	-
	0552	10/01/89	0002	TA	O			0.8	-
	0552	01/09/90	0001	TA	O			0.900	-
	0553	08/17/89	0001	TA	O			0.060	-
	0553	10/01/89	0002	TA	O			0.08	-
	0553	01/09/90	0001	TA	O			0.032	-
	0554	08/17/89	0001	TA	O			0.060	-

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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

16/22

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SELENIUM	0554	10/01/89	0002	TA	O	MG/L		0.08	-
Yes	0554	01/12/90	0001	TA	O			0.080	-
	0556	08/17/89	0001	TA	O			0.25	-
	0556	01/15/90	0001	TA	O			0.026	-
	0600	10/01/89	0001	TA	O			0.11	-
	0600	01/11/90	0001	TA	O			0.036	-
	0601	01/10/90	0001	TA	O		<	0.05	-
	0602	10/01/89	0001	TA	O			0.8	-
	0602	01/10/90	0001	TA	O			0.180	-
	0603	10/01/89	0001	TA	O			0.35	-
	0603	01/10/90	0001	TA	O		<	0.01	-
	0604	01/10/90	0001	TA	O		<	0.01	-
	0643	01/12/90	0001	SM	O		<	0.01	-
	0645	01/12/90	0001	CH	O		<	0.01	-
	0646	01/12/90	0001	SP	O		<	0.02	-
SILICA - SIO2	0550	08/17/89	0001	TA	O	MG/L		27.5	-
	0550	10/01/89	0002	TA	O			27.5	-
	0550	01/09/90	0001	TA	O			30.	-
	0551	10/01/89	0002	TA	O			48.5	-
	0551	01/09/90	0001	TA	O			37.	-
	0552	01/09/90	0001	TA	O			83.	-
	0553	10/01/89	0002	TA	O			82.5	-
	0553	01/09/90	0001	TA	O			64.	-
	0554	01/12/90	0001	TA	O			45.	-
	0556	08/17/89	0001	TA	O			25.5	-
	0556	01/15/90	0001	TA	O			12.8	-
	0600	10/01/89	0001	TA	O			70.	-
	0600	01/11/90	0001	TA	O			26.	-
	0602	01/10/90	0001	TA	O			40.	-
	0603	10/01/89	0001	TA	O			44.5	-
	0603	01/10/90	0001	TA	O			35.	-
	0604	01/10/90	0001	TA	O			32.	-
	0643	01/12/90	0001	SM	O			32.	-
	0645	01/12/90	0001	CH	O			17.1	-
	0646	01/12/90	0001	SP	O			17.5	-
SILVER	0550	08/17/89	0001	TA	O	MG/L		0.05	-
Yes B	0550	10/01/89	0002	TA	O		<	0.0001	-
	0550	01/09/90	0001	TA	O		<	0.01	-
	0551	08/17/89	0001	TA	O			0.05	-
	0551	10/01/89	0002	TA	O			0.0073	-
	0551	01/09/90	0001	TA	O		<	0.01	-
	0552	08/17/89	0001	TA	O			0.05	-
	0552	10/01/89	0002	TA	O			0.0016	-
	0552	01/09/90	0001	TA	O		<	0.01	-
	0553	08/17/89	0001	TA	O		<	0.05	-
	0553	10/01/89	0002	TA	O			0.0004	-
	0553	01/09/90	0001	TA	O		<	0.01	-
	0554	08/17/89	0001	TA	O		<	0.05	-
	0554	10/01/89	0002	TA	O		<	0.0001	-
	0554	01/12/90	0001	TA	O		<	0.01	-
	0556	08/17/89	0001	TA	O		<	0.05	-
	0556	01/15/90	0001	TA	O		<	0.01	-
	0600	10/01/89	0001	TA	O		<	0.0001	-
	0600	01/11/90	0001	TA	O		<	0.01	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BS/ 7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SILVER	0601	01/10/90	0001	TA	O	MG/L	<	0.01	-
	0602	10/01/89	0001	TA	O			0.0011	-
	0602	01/10/90	0001	TA	O		<	0.01	-
	0603	10/01/89	0001	TA	O			0.0002	-
	0603	01/10/90	0001	TA	O		<	0.01	-
	0604	01/10/90	0001	TA	O		<	0.01	-
	0643	01/12/90	0001	SM	O		<	0.01	-
	0645	01/12/90	0001	CH	O		<	0.01	-
	0646	01/12/90	0001	SP	O		<	0.01	-
SODIUM	0550	08/17/89	0001	TA	O	MG/L		1200.	-
	0550	10/01/89	0002	TA	O			1145.	-
	0550	01/09/90	0001	TA	O			1150.	-
	0551	08/17/89	0001	TA	O			865.	-
	0551	10/01/89	0002	TA	O			835.	-
	0551	01/09/90	0001	TA	O			810.	-
	0552	08/17/89	0001	TA	O			830.	-
	0552	01/09/90	0001	TA	O			790.	-
	0553	08/17/89	0001	TA	O			700.	-
	0553	10/01/89	0002	TA	O			670.	-
	0553	01/09/90	0001	TA	O			710.	-
	0554	08/17/89	0001	TA	O			1180.	-
	0554	01/12/90	0001	TA	O			1230.	-
	0556	08/17/89	0001	TA	O			1020.	-
	0556	01/15/90	0001	TA	O			870.	-
	0600	10/01/89	0001	TA	O			530.	-
	0600	01/11/90	0001	TA	O			439.	-
	0601	01/10/90	0001	TA	O			498.	-
	0602	01/10/90	0001	TA	O			830.	-
	0603	10/01/89	0001	TA	O			380.	-
	0603	01/10/90	0001	TA	O			401.	-
	0604	01/10/90	0001	TA	O			560.	-
	0643	01/12/90	0001	SM	O			740.	-
	0645	01/12/90	0001	CH	O			1000.	-
	0646	01/12/90	0001	SP	O			740.	-
SPECIFIC CONDUCTANCE	0550	01/09/90	0001	TA	O	UMHO/CM		15880.	-
	0551	01/09/90	0001	TA	O			14400.	-
	0552	01/09/90	0001	TA	O			13000.	-
	0553	01/09/90	0001	TA	O			12150.	-
	0554	01/12/90	0001	TA	O			14550.	-
	0555	01/15/90	0001	TA	O			11370.	-
	0556	01/15/90	0001	TA	O			9110.	-
	0600	01/11/90	0001	TA	O			7800.	-
	0601	01/10/90	0001	TA	O			6680.	-
	0602	01/10/90	0001	TA	O			12180.	-
	0603	01/10/90	0001	TA	O			6200.	-
	0604	01/10/90	0001	TA	O			8520.	-
	0643	01/12/90	0001	SM	O			9180.	-
	0645	01/12/90	0001	CH	O			8580.	-
	0646	01/12/90	0001	SP	O			8660.	-
STRONTIUM-90	0550	08/17/89	0001	TA	O	MG/L		4.35	-
	0550	10/01/89	0002	TA	O			4.20	-
	0550	01/09/90	0001	TA	O			3.19	-
	0551	08/17/89	0001	TA	O			4.80	-

FORMATION OF COMPLETION CODE:
TA - URANIUM MILL TAILINGS
SM - SILTY SAND OR SILTY GRAVELLY SAND
CH - FAT CLAYS
SP - SAND OR GRAVELLY SAND, POORLY GRADED

FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 1-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

10/22

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
STRONTIUM Yes	0551	10/01/89	0002	TA	O	MG/L		4.90	-
	0551	01/09/90	0001	TA	O			7.30	-
	0552	08/17/89	0001	TA	O			5.25	-
	0552	10/01/89	0002	TA	O			5.50	-
	0552	01/09/90	0001	TA	O			4.91	-
	0553	08/17/89	0001	TA	O			3.55	-
	0553	10/01/89	0002	TA	O			4.80	-
	0553	01/09/90	0001	TA	O			3.59	-
	0554	08/17/89	0001	TA	O			5.25	-
	0554	10/01/89	0002	TA	O			5.40	-
	0554	01/12/90	0001	TA	O			5.70	-
	0556	08/17/89	0001	TA	O			6.30	-
	0556	01/15/90	0001	TA	O			4.53	-
	0600	10/01/89	0001	TA	O			5.20	-
	0600	01/11/90	0001	TA	O			3.55	-
	0601	01/10/90	0001	TA	O			3.97	-
	0602	10/01/89	0001	TA	O			6.10	-
	0602	01/10/90	0001	TA	O			4.97	-
	0603	10/01/89	0001	TA	O			5.40	-
	0603	01/10/90	0001	TA	O			5.88	-
	0604	01/10/90	0001	TA	O			5.13	-
	0643	01/12/90	0001	SM	O			5.92	-
	0645	01/12/90	0001	CH	O			5.82	-
	0646	01/12/90	0001	SP	O			5.48	-
SULFATE	0550	08/17/89	0001	TA	O	MG/L		6034.	-
	0550	10/01/89	0002	TA	O			2307.	-
	0550	01/09/90	0001	TA	O			5120.	-
	0551	10/01/89	0002	TA	O			2747.	-
	0551	01/09/90	0001	TA	O			1650.	-
	0552	01/09/90	0001	TA	O			4450.	-
	0553	10/01/89	0002	TA	O			2540.	-
	0553	01/09/90	0001	TA	O			4130.	-
	0554	01/12/90	0001	TA	O			3780.	-
	0556	08/17/89	0001	TA	O			3713.	-
	0556	01/15/90	0001	TA	O			2440.	-
	0600	10/01/89	0001	TA	O			3190.	-
	0600	01/11/90	0001	TA	O			1940.	-
	0602	01/10/90	0001	TA	O			4390.	-
	0603	10/01/89	0001	TA	O			3081.	-
	0603	01/10/90	0001	TA	O			2750.	-
	0604	01/10/90	0001	TA	O			3770.	-
	0643	01/12/90	0001	SM	O			3160.	-
	0646	01/12/90	0001	SP	O			3320.	-
SULFIDE Yes	0550	08/17/89	0001	TA	O	MG/L	<	0.01	-
	0550	01/09/90	0001	TA	O		<	1.	-
	0551	01/09/90	0001	TA	O		<	1.	-
	0552	01/09/90	0001	TA	O		<	1.	-
	0553	01/09/90	0001	TA	O		<	1.	-
	0554	01/12/90	0001	TA	O		<	1.	-
	0555	01/15/90	0001	TA	O		<	1.	-
	0556	01/15/90	0001	TA	O		<	1.	-
	0600	10/01/89	0001	TA	O		<	0.01	-
	0600	01/11/90	0001	TA	O		<	1.	-
	0602	01/10/90	0001	TA	O		<	1.	-

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FLOW RELATIONSHIP CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BD 7/3/90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

19/22

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SULFIDE Yes	0603	10/01/89	0001	TA	O	MG/L		0.01	-
	0603	01/10/90	0001	TA	O		<	1.	-
	0604	01/10/90	0001	TA	O		<	1.	-
	0643	01/12/90	0001	SM	O		<	1.	-
	0645	01/12/90	0001	CH	O			42.	-
	0646	01/12/90	0001	SP	O			60.	-
TEMPERATURE	0550	01/09/90	0001	TA	O	C - DEGREE		12.5	-
	0551	01/09/90	0001	TA	O			16.7	-
	0552	01/09/90	0001	TA	O			13.1	-
	0553	01/09/90	0001	TA	O			13.7	-
	0554	01/12/90	0001	TA	O			11.8	-
	0555	01/15/90	0001	TA	O			9.8	-
	0556	01/15/90	0001	TA	O			6.3	-
	0600	01/11/90	0001	TA	O			12.1	-
	0601	01/10/90	0001	TA	O			12.4	-
	0602	01/10/90	0001	TA	O			15.8	-
	0603	01/10/90	0001	TA	O			14.2	-
	0604	01/10/90	0001	TA	O			13.3	-
	0643	01/12/90	0001	SM	O			12.4	-
	0645	01/12/90	0001	CH	O			10.9	-
	0646	01/12/90	0001	SP	O			12.9	-
THALLIUM No	0550	01/09/90	0001	TA	O	MG/L	<	0.1	-
	0551	01/09/90	0001	TA	O		<	0.1	-
	0552	01/09/90	0001	TA	O		<	0.1	-
	0553	01/09/90	0001	TA	O		<	0.2	-
	0554	01/12/90	0001	TA	O		<	0.1	-
	0556	01/15/90	0001	TA	O		<	0.1	-
	0600	01/11/90	0001	TA	O		<	0.1	-
	0601	01/10/90	0001	TA	O		<	0.1	-
	0602	01/10/90	0001	TA	O		<	0.2	-
	0603	01/10/90	0001	TA	O		<	0.1	-
	0604	01/10/90	0001	TA	O		<	0.1	-
	0643	01/12/90	0001	SM	O		<	0.1	-
	0645	01/12/90	0001	CH	O		<	0.1	-
	0646	01/12/90	0001	SP	O		<	0.1	-
THORIUM-230	0550	08/17/89	0001	TA	O	PCI/L		1.76	1.33
	0550	10/01/89	0002	TA	O			36.0	2.22
	0553	08/17/89	0001	TA	O			3.59	0.763
	0556	08/17/89	0001	TA	O			6.28	0.817
	0600	10/01/89	0001	TA	O			29.6	1.25
	0603	10/01/89	0001	TA	O			29.1	1.76
TIN Yes	0550	10/01/89	0002	TA	O	MG/L		0.010	-
	0551	10/01/89	0002	TA	O		<	0.010	-
	0552	10/01/89	0002	TA	O		<	0.010	-
	0553	10/01/89	0002	TA	O		<	0.010	-
	0554	10/01/89	0002	TA	O		<	0.010	-
	0600	10/01/89	0001	TA	O		<	0.010	-
	0602	10/01/89	0001	TA	O			0.017	-
	0603	10/01/89	0001	TA	O		<	0.010	-
TOTAL DISSOLVED SOLIDS	0550	08/17/89	0001	TA	O	MG/L		9432.	-
	0550	10/01/89	0002	TA	O			10156.	-

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BJ 7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

Done 8/6/90

-/22

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TOTAL DISSOLVED SOLIDS	0550	01/09/90	0001	TA	O	MG/L		8670.	-
	0551	10/01/89	0002	TA	O			11420.	-
	0551	01/09/90	0001	TA	O			9270.	-
	0552	01/09/90	0001	TA	O			7570.	-
	0553	10/01/89	0002	TA	O			8274.	-
	0553	01/09/90	0001	TA	O			6640.	-
	0554	01/12/90	0001	TA	O			8620.	-
	0556	08/17/89	0001	TA	O			6924.	-
	0556	01/15/90	0001	TA	O			5990.	-
	0600	10/01/89	0001	TA	O			5682.	-
	0600	01/11/90	0001	TA	O			4400.	-
	0602	01/10/90	0001	TA	O			6330.	-
	0603	10/01/89	0001	TA	O			4836.	-
	0603	01/10/90	0001	TA	O			4290.	-
	0604	01/10/90	0001	TA	O			5050.	-
	0643	01/12/90	0001	SM	O			5240.	-
	0645	01/12/90	0001	CH	O			7130.	-
	0646	01/12/90	0001	SP	O			5460.	-
TOTAL KJELDAHL NITROGEN	0550	01/09/90	0001	TA	O	MG/L		731.	-
	0551	01/09/90	0001	TA	O		<	1.	-
	0552	01/09/90	0001	TA	O			384.	-
	0553	01/09/90	0001	TA	O			607.	-
	0554	01/12/90	0001	TA	O			123.	-
	0556	01/15/90	0001	TA	O			2.	-
	0600	01/11/90	0001	TA	O			223.	-
	0602	01/10/90	0001	TA	O			520.	-
	0603	01/10/90	0001	TA	O			127.	-
	0604	01/10/90	0001	TA	O			398.	-
	0643	01/12/90	0001	SM	O			269.	-
	0645	01/12/90	0001	CH	O			22.	-
	0646	01/12/90	0001	SP	O			209.	-
URANIUM - Yes	0550	08/17/89	0001	TA	O	MG/L		2.47	0.050
	0550	10/01/89	0002	TA	O			2.897	0.238
	0550	01/09/90	0001	TA	O			3.18	-
	0551	08/17/89	0001	TA	O			0.910	0.030
	0551	10/01/89	0002	TA	O			1.020	0.100
	0551	01/09/90	0001	TA	O			0.356	-
	0552	08/17/89	0001	TA	O			3.95	0.110
	0552	10/01/89	0002	TA	O			3.050	0.530
	0552	01/09/90	0001	TA	O			1.87	-
	0553	08/17/89	0001	TA	O			0.180	0.050
	0553	10/01/89	0002	TA	O			0.180	0.013
	0553	01/09/90	0001	TA	O			0.144	-
	0554	08/17/89	0001	TA	O			2.88	0.080
	0554	10/01/89	0002	TA	O			3.861	0.198
	0554	01/12/90	0001	TA	O			0.81	-
	0556	08/17/89	0001	TA	O			0.090	0.020
	0600	10/01/89	0001	TA	O			0.079	0.008
	0600	01/11/90	0001	TA	O			2.29	-
	0601	01/10/90	0001	TA	O			29.7	-
	0602	10/01/89	0001	TA	O			0.127	0.014
	0602	01/10/90	0001	TA	O			0.051	-
	0603	10/01/89	0001	TA	O			1.680	0.116
	0603	01/10/90	0001	TA	O			0.220	-

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

BJ 7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/03/90

Jue 8/90

-1/22

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETE UNCERTAIN
URANIUM	0604	01/10/90	0001	TA	O	MG/L		0.075	-
Yes	0643	01/12/90	0001	SM	O			1.44	-
	0645	01/12/90	0001	CH	O			0.37	-
	0646	01/12/90	0001	SP	O			1.02	-
VANADIUM	0550	08/17/89	0001	TA	O	MG/L		1.12	-
Yes	0550	10/01/89	0002	TA	O			1.00	-
	0550	01/09/90	0001	TA	O			1.14	-
	0551	08/17/89	0001	TA	O			2.30	-
	0551	10/01/89	0002	TA	O			2.30	-
	0551	01/09/90	0001	TA	O			3.52	-
	0552	08/17/89	0001	TA	O			0.54	-
	0552	10/01/89	0002	TA	O			0.40	-
	0552	01/09/90	0001	TA	O			0.61	-
	0553	08/17/89	0001	TA	O			41.	-
	0553	10/01/89	0002	TA	O			2.90	-
	0553	01/09/90	0001	TA	O			39.	-
	0554	08/17/89	0001	TA	O			2.30	-
	0554	10/01/89	0002	TA	O			3.00	-
	0554	01/12/90	0001	TA	O			7.7	-
	0556	08/17/89	0001	TA	O			1.93	-
	0556	01/15/90	0001	TA	O			1.12	-
	0600	10/01/89	0001	TA	O			6.90	-
	0600	01/11/90	0001	TA	O			1.29	-
	0601	01/10/90	0001	TA	O		<	0.01	-
	0602	10/01/89	0001	TA	O			7.50	-
	0602	01/10/90	0001	TA	O			31.	-
	0603	10/01/89	0001	TA	O			2.60	-
	0603	01/10/90	0001	TA	O			0.68	-
	0604	01/10/90	0001	TA	O			0.18	-
	0643	01/12/90	0001	SM	O			0.12	-
	0645	01/12/90	0001	CH	O			0.13	-
	0646	01/12/90	0001	SP	O		<	0.01	-
ZINC	0550	08/17/89	0001	TA	O	MG/L		0.39	-
Yes	0550	10/01/89	0002	TA	O			0.50	-
	0550	01/09/90	0001	TA	O			0.322	-
	0551	08/17/89	0001	TA	O			2.03	-
	0551	10/01/89	0002	TA	O			2.10	-
	0551	01/09/90	0001	TA	O			6.15	-
	0552	08/17/89	0001	TA	O			7.50	-
	0552	10/01/89	0002	TA	O			6.70	-
	0552	01/09/90	0001	TA	O			5.64	-
	0553	08/17/89	0001	TA	O			7.20	-
	0553	10/01/89	0002	TA	O			7.00	-
	0553	01/09/90	0001	TA	O			6.96	-
	0554	08/17/89	0001	TA	O			0.11	-
	0554	10/01/89	0002	TA	O			0.10	-
	0554	01/12/90	0001	TA	O			0.237	-
	0556	08/17/89	0001	TA	O			0.34	-
	0556	01/15/90	0001	TA	O			0.186	-
	0600	10/01/89	0001	TA	O			3.00	-
	0600	01/11/90	0001	TA	O			0.993	-
	0601	01/10/90	0001	TA	O		<	0.005	-
	0602	10/01/89	0001	TA	O			4.40	-
	0602	01/10/90	0001	TA	O			6.92	-

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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B5/7-3-90

TAILINGS PORE WATER
LYSIMETERS 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 15/90
REPORT DATE: /03/90

fax 9/40

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ZINC	0603	10/01/89	0001	TA	O	MG/L		0.40	-
	0603	01/10/90	0001	TA	O			0.165	-
Yes	0604	01/10/90	0001	TA	O			0.277	-
	0643	01/12/90	0001	SM	O			0.017	-
	0645	01/12/90	0001	CH	O		<	0.005	-
	0646	01/12/90	0001	SP	O			0.020	-

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FLOW RELATIONSHIP CODE:
O - ON-SITE

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT

DATA FILE NAME: J:\DART\GRJ01\GW010005.DAT

JE JACOBS ENGINEERING

DATE 8-8-90 SUBJECT Tailings Pore Water Quality SHEET NO. ____

BY BJ CHKD. JMR 8/8/90 JOB NO. ____

Attachment A

Tailings Pore Water Quality Statistics by Parameter

FORM 91-005-1 (4/81)

A1

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
11	7.0000	679.0000	175.0000	283.1818	238.5623	0.8424	0.0	84.3694	481.9942	NORMAL	
ALUMINUM			MG/L								
28	0.0500	98.0000	0.1650	NA	NA	NA	25.0	0.0500	4.6000	NONPARAMETRIC	2
AMMONIUM			MG/L								
20	1.5000	912.0000	305.5000	392.1700	315.4505	0.8044	0.0	213.0769	571.2631	NORMAL	
ANTIMONY			MG/L								
28	0.0015	0.0270	0.0060	NA	NA	NA	46.4	0.0015	0.0100	NONPARAMETRIC	2
ARSENIC			MG/L								
28	0.0050	1.7000	0.0950	0.1145	4.5245	NA	3.6	0.0565	0.2318	LOGNORMAL	7,8
BARIUM			MG/L								
28	0.0100	0.1500	0.0400	NA	NA	NA	32.1	0.0200	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
20	0.0025	0.2280	0.0037	NA	NA	NA	50.0	0.0025	0.0150	NONPARAMETRIC	2
BORON			MG/L								
20	0.2600	2.0400	0.6300	0.6955	0.3804	0.5469	0.0	0.4795	0.9115	NORMAL	
CADMIUM			MG/L								
28	0.0005	0.3500	0.0190	0.0166	11.2760	NA	14.3	0.0054	0.0516	LOGNORMAL	7,8
CALCIUM			MG/L								
25	431.0000	1300.0000	510.0000	585.6400	218.4693	0.3730	0.0	476.7549	694.5251	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

BS DMY
A-2

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHLORIDE			MG/L								
19	273.5000	1830.0000	1030.0000	1031.7895	414.4132	0.4016	0.0	789.1634	1274.4155	NORMAL	
CHROMIUM			MG/L								
28	0.0050	0.1000	0.0050	NA	NA	NA	82.1	0.0050	0.0050	NONPARAMETRIC	2
COBALT			MG/L								
28	0.0250	0.7000	0.2000	NA	NA	NA	32.1	0.0250	0.4000	NONPARAMETRIC	2
COPPER			MG/L								
28	0.0100	4.2100	0.0900	NA	NA	NA	17.9	0.0100	1.0000	NONPARAMETRIC	2
CYANIDE			MG/L								
21	0.0050	0.3600	0.0800	0.0810	0.0773	0.9542	4.8	0.0384	0.1237	NORMAL	
FLUORIDE			MG/L								
21	0.7000	19.2000	4.4000	6.3429	5.3394	0.8418	0.0	3.3973	9.2884	NORMAL	
GROSS ALPHA			PCI/L								
9	113.0000	8020.0000	558.0000	794.7962	4.9612	NA	0.0	169.3478	3730.1988	LOGNORMAL	7,8
GROSS BETA			PCI/L								
9	109.0000	2675.0000	666.0000	1045.5556	1003.3905	0.9597	0.0	76.9492	2014.1619	NORMAL	
IRON			MG/L								
28	0.0150	370.0000	7.7000	3.4444	21.0144	NA	14.3	0.8299	14.2952	LOGNORMAL	7,8
LEAD			MG/L								
28	0.0030	0.1800	0.0050	NA	NA	NA	53.6	0.0050	0.0210	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

A-3

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MAGNESIUM	MG/L	25	4.0000	530.0000	296.0000	306.2400	125.6630	0.4103	0.0	243.6096	368.8704	NORMAL	
MANGANESE	MG/L	28	1.9300	14.7000	5.3500	5.6564	2.7957	0.4943	0.0	4.3498	6.9630	NORMAL	
MERCURY	MG/L	14	0.0001	0.0003	0.0001	NA	NA	NA	85.7	0.0001	0.0001	NONPARAMETRIC	2
MOLYBDENUM	MG/L	28	0.0050	4.3500	0.2300	NA	NA	NA	21.4	0.0800	0.4700	NONPARAMETRIC	2
NICKEL	MG/L	28	0.0200	4.2000	0.6850	0.5601	4.1560	NA	7.1	0.2878	1.0899	LOGNORMAL	7,8
NITRATE	MG/L	19	0.2000	4600.0000	0.5000	NA	NA	NA	42.1	0.5000	567.0000	NONPARAMETRIC	2
PHOSPHATE	MG/L	20	0.0500	4.0000	0.4500	0.5430	3.7475	NA	5.0	0.2565	1.1495	LOGNORMAL	7,8
POTASSIUM	MG/L	25	21.0000	285.0000	90.0000	97.6400	64.5703	0.6613	0.0	65.4582	129.8218	NORMAL	
RADIUM-226	PCI/L	17	0.0000	815.9000	11.3000	NA	NA	NA	0.0	1.1200	35.4000	NONPARAMETRIC	9
RADIUM-228	PCI/L	10	0.0000	3.8000	0.5500	NA	NA	NA	30.0	0.0000	2.9000	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

By DMY

A-3

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SELENIUM			MG/L								
28	0.0025	0.9100	0.0800	NA	NA	NA	25.0	0.0260	0.2800	NONPARAMETRIC	2
SILICA - SIO2			MG/L								
20	12.8000	83.0000	33.5000	39.8700	20.5191	0.5147	0.0	28.2205	51.5195	NORMAL	
SILVER			MG/L								
28	0.0002	0.0500	0.0050	NA	NA	NA	71.4	0.0050	0.0050	NONPARAMETRIC	2
SODIUM			MG/L								
25	380.0000	1230.0000	810.0000	804.9200	255.0160	0.3168	0.0	677.8200	932.0200	NORMAL	
SPECIFIC CONDUCTANCE			UMHO/CM								
15	6200.0000	15880.0000	9180.0000	10550.6667	3025.0088	0.2867	0.0	8501.1813	12600.1521	NORMAL	
STRONTIUM			MG/L								
28	3.1900	7.3000	5.1650	5.0336	0.9396	0.1867	0.0	4.5945	5.4727	NORMAL	
SULFATE			MG/L								
19	1650.0000	6034.0000	3190.0000	3395.3684	1105.5274	0.3256	0.0	2748.1165	4042.6204	NORMAL	
SULFIDE			MG/L								
17	0.0100	60.0000	0.0500	NA	NA	NA	82.4	0.0500	0.0500	NONPARAMETRIC	2
TEMPERATURE			C - DEGREE								
15	6.3000	16.7000	12.5000	12.5267	2.4344	0.1943	0.0	10.8773	14.1760	NORMAL	
THALLIUM			MG/L								
14	0.0500	0.0500	0.0500	NA	NA	NA	100.0	0.0500	0.0500	NONPARAMETRIC	2
THORIUM-230			PCI/L								
6	1.7600	36.0000	17.6900	17.7217	15.4276	0.8705	0.0	-3.4720	38.9154	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

A-9
BD

DMW

Tailings pore water quality statistics by parameter
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 08/08/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TIN			MG/L								
8	0.0025	0.0170	0.0025	NA	NA	NA	75.0	0.0025	0.0170	NONPARAMETRIC	2
TOTAL DISSOLVED SOLIDS			MG/L								
20	4290.0000	11420.0000	6782.0000	7069.2000	2042.2750	0.2889	0.0	5909.7236	8228.6764	NORMAL	
TOTAL KJELDAHL NITROGEN			MG/L								
13	0.5000	731.0000	223.0000	278.1154	236.4778	0.8503	7.7	102.2762	453.9545	NORMAL	
URANIUM			MG/L								
27	0.0510	29.7000	1.0200	0.7436	4.9243	NA	0.0	0.3476	1.5909	LOGNORMAL	7,8
VANADIUM			MG/L								
28	0.0050	41.0000	1.6100	1.2416	8.7078	NA	7.1	0.4516	3.4140	LOGNORMAL	7,8
ZINC			MG/L								
28	0.0025	7.5000	0.4500	0.5613	10.7767	NA	7.1	0.1848	1.7051	LOGNORMAL	7,8

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

INPUT DATA FILENAME: J:\DART\GRJ01\GWQ10005.DAT

Final
11/21

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-08-90-12-02-00 DISCIPLINE Geotech/Hydro NO. OF SHEETS 20

PROJECT:
UMTRA

SITE:
GRAND JUNCTION - CHENEY DISPOSAL CELL

FEATURE: 'Determination of Unsaturated Hydraulic Properties, Tailings and Vicinity Property Materials'

SOURCES OF DATA:
Daniel B. Stevens & Assoc., Inc. W/O #5, May 1990

SOURCES OF FORMULAE & REFERENCES:
USDA, 1987., Users Guide: RETC.
Van Genuchten, R., 1980, "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

		G. SMITH	8/90	MSK	8/15/90	[illegible]	8/30/90
Y. O.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

B/85

PURPOSE:

The purpose of this calculation is to determine unsaturated hydraulic properties for contaminated materials that will be disposed in the Grand Junction disposal cell at the Cheney site. These materials consist of main pile tailings and vicinity property materials. The hydraulic properties will be used as input to the UNSAT2 computer code to analyze effects of transient drainage. The RETC computer program solves a closed-form equation suggested by Mualem relating soil moisture to hydraulic conductivity. The RETC model was written by Van Genuchten and is utilized in this analysis.

METHOD:

Determination of unsaturated hydraulic properties suggested by Mualem requires input of moisture-pressure capillary data. This data is obtained from laboratory testing. The RETC model computes the volumetric saturated and residual moisture contents in addition to curve fitting parameters, denoted the Mualem parameters, alpha and N. When determining the above parameters for vicinity property materials, they were assumed unknown. The porosity, or saturated volumetric moisture content, was calculated from placement specifications and was not allowed to vary for tailings materials. The Mualem based restriction of $M = 1-1/N$ is used to provide an approximation to the empirically derived capillary curves. This restriction is also necessary for input to the UNSAT2 computer code.

DATA:

The data used in the model were obtained from Daniel B. Stevens & Associates, delivery order #5, May 1990. Copies of the data are reproduced on pages 4 to 6. Samples selected were determined to most closely model expected overall condition of placed contaminated materials in terms of percent minus 200 material contained and placement densities.

REFERENCES:

1) United States Department of Agriculture, 1987. Users Guide: RETC.

2) Van Genuchten, R. Th., 1980. "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

ANALYSIS:

The RETC computer code was run on TAC micro-computers. Data presented on pages 4 to 6 were input to the program to produce the output given on pages 7 to 12.

RESULTS:

Plots of pressure in centimeters of water versus volumetric moisture content (cm^3/cm^3) and pressure versus saturation in percent are illustrated on Figures #1 to #4. Hydraulic conductivity versus volumetric moisture content and saturation for each material are presented on Figures #5 to #8. The use of the restricted model, where M = 1-1/N, appears to be valid for both main pile tailings and vicinity property materials. The coefficient of regression, r^2 for both data sets was above 0.98 indicating a good correlation of the fitted curve to the observed data. Additionally, both determined values of N were above 1.25, which according to Van Genuchten is necessary for the restrictive model to be applicable. The values of saturated and residual moisture contents along with the Mualem parameters generated from the RETC analysis are listed in Table 1.

Table 1

Material	theta(sat), vol/vol	theta(res) vol/vol	alpha, 1/cm	N
vicinity property	0.4025	0.2103	0.0330	1.35
main pile tailings	0.4670	0.2211	0.0034	1.71

CONCLUSIONS:

The above unsaturated hydraulic parameters are reasonable and can be included in transient drainage analyses.

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-1	0.0	45.66
	112.2	16.49
	305.9	1.98
	1019.8	6.89
	3059.4	5.19
	7138.6	4.38
	15399.0	3.77
5-2	0.0	45.17
	112.2	20.15
	305.9	8.70
	1019.8	7.04
	3059.4	5.30
	7138.6	4.60
	15399.0	3.66
5-3 S5-3 Tailings	0.0	50.36
	112.2	46.27
	305.9	38.91
	1019.8	33.22
	3059.4	25.65
	7138.6	24.33
	15399.0	24.16
5-4	0.0	51.35
	112.2	47.28
	305.9	41.07
	1019.8	34.69
	3059.4	26.20
	7138.6	23.88
	15399.0	17.87
5-5	0.0	47.19
	112.2	30.62
	305.9	25.49
	1019.8	22.00
	3059.4	17.36
	7138.6	16.54
	15399.0	14.28

* measurement error

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-11	0.0	48.34
	112.2	34.35
	305.9	32.49
	1019.8	29.72
	3059.4	22.13
	7138.6	20.60
	15399.0	19.38
5-12	0.0	45.27
	112.2	35.60
	305.9	33.56
	1019.8	31.14
	3059.4	25.80
	7138.6	24.46
	15399.0	24.76
5-13	0.0	46.48
	112.2	37.49
	305.9	35.57
	1019.8	32.68
	3059.4	27.95
	7138.6	26.69
	15399.0	25.77
5-14	0.0	47.39
	112.2	39.10
	305.9	35.24
	1019.8	32.05
	3059.4	26.64
	7138.6	24.20
	15399.0	19.45
5-15 ½ RS-3 Vicinity Property	0.0	40.69
	102.0	33.11
	305.9	29.70
	1019.8	26.71
	3059.4	26.09
	7138.6	23.80
	15297.0	23.25

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

Sample No.	Pressure Head (-cm of water)	Moisture Content (cm^3/cm^3)
5-16	0.0	39.78
Vicinity	102.0	33.16
Property	305.9	29.04
	1019.8	25.60
	3059.4	25.50
	7138.6	23.25
½ RS-3	15297.0	22.85
5-17	0.0	37.53
	102.0	33.79
	305.9	31.82
	1019.8	29.36
	3059.4	29.17
	7138.6	27.96
	15297.0	28.00
5-18	0.0	39.84
	102.0	34.27
	305.9	31.93
	1019.8	29.16
	3059.4	28.39
	7138.6	27.35
	15297.0	25.85
5-19	0.0	39.85
	102.0	36.29
	305.9	33.62
	1019.8	30.22
	3059.4	29.38
	7138.6	28.46
	15297.0	27.53
5-20	0.0	39.41
	102.0	36.36
	305.9	33.67
	1019.8	30.29
	3059.4	28.47
	7138.6	26.90
	15297.0	26.50

```
*****************************************************************
*                                                               *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                      *
*                                                               *
*GRJ, VICINITY PROPERTY MATERIALS, (RS-3/ 05-15 & 05-16)        *
*                                                               *
*    MUALEM-BASED RESTRICTION, M=1-1/N                          *
*    ANALYSIS OF RETENTION DATA ONLY                            *
*    MTYPE= 3     METHOD= 2                                     *
*                                                               *
*****************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.2285	1
2	WCS	.4069	1
3	ALPHA	.0500	1
4	N	2.0000	1
5	M	.5000	0
6	EXPO	.5000	0
7	CONDS	1.09E-04	0

OBSERVED DATA

OBS. NO.	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	.100	.4069	1.0000
2	.100	.3978	1.0000
3	102.000	.3311	1.0000
4	102.000	.3316	1.0000
5	305.900	.2970	1.0000
6	305.900	.2904	1.0000
7	1019.800	.2671	1.0000
8	1019.800	.2560	1.0000
9	3059.400	.2609	1.0000
10	3059.400	.2550	1.0000
11	7138.600	.2380	1.0000
12	7138.600	.2325	1.0000
13	15297.000	.2325	1.0000
14	15297.000	.2285	1.0000

NIT	SSQ	WCR	WCS	ALPHA	N
0	.01877	.2285	.4069	.0500	2.0000
10	.00042	.2103	.4025	.0330	1.3504

CORRELATION MATRIX

	1	2	3	4
1	1.0000			
2	-.0354	1.0000		
3	-.8130	.2576	1.0000	
4	.9671	-.0485	-.9117	1.0000

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .99070334

VARIABLE	VALUE	S.E.COEFF.	T-VALUE	LOWER	UPPER
WCR	.21025	.01530	13.74	.1762	.2444
WCS	.40246	.00460	87.44	.3922	.4127
ALPHA	.03297	.01231	2.68	.0055	.0604
N	1.35042	.09971	13.54	1.1283	1.5726

OBSERVED AND FITTED DATA

NO	P	LOG-P	WC-OBS	WC-FIT	WC-DIF
1	.10000+00	-1.0000	.4069	.4024	.0045
2	.10000+00	-1.0000	.3978	.4024	-.0046
3	.10200+03	2.0086	.3311	.3302	.0009
4	.10200+03	2.0086	.3316	.3302	.0014
5	.30590+03	2.4856	.2970	.2948	.0022
6	.30590+03	2.4856	.2904	.2948	-.0044
7	.10200+04	3.0085	.2671	.2662	.0009
8	.10200+04	3.0085	.2560	.2662	-.0102
9	.30590+04	3.4856	.2609	.2484	.0125
10	.30590+04	3.4856	.2550	.2484	.0066
11	.71390+04	3.8536	.2380	.2386	-.0006
12	.71390+04	3.8536	.2325	.2386	-.0061
13	.15300+05	4.1846	.2325	.2320	.0005
14	.15300+05	4.1846	.2285	.2320	-.0035

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

	UNWEIGHTED	WEIGHTED
RETENTION DATA	.00042	.00042
COND/DIFF DATA	.00000	.00000
ALL DATA	.00042	.00042

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)

WC	P	LOGP	COND	LOGK	DIF	LOGD
.2115	.59120+08	7.772	.59650-23	-23.224	.83770-12	-12.077
.2127	.81790+07	6.913	.17630-20	-20.754	.17130-10	-10.766
.2151	.11310+07	6.054	.52110-18	-18.283	.35020-09	-9.456
.2199	.15650+06	5.195	.15400-15	-15.812	.71590-08	-8.145
.2247	.49210+05	4.692	.42940-14	-14.367	.41830-07	-7.378
.2295	.21650+05	4.335	.45530-13	-13.342	.14640-06	-6.834
.2343	.11450+05	4.059	.28430-12	-12.546	.38680-06	-6.412
.2391	.68050+04	3.833	.12700-11	-11.896	.85580-06	-6.068
.2439	.43810+04	3.642	.45020-11	-11.347	.16750-05	-5.776
.2487	.29910+04	3.476	.13480-10	-10.870	.29990-05	-5.523
.2535	.21350+04	3.329	.35460-10	-10.450	.50130-05	-5.300
.2583	.15790+04	3.198	.84310-10	-10.074	.79440-05	-5.100
.2631	.12010+04	3.080	.18460-09	-9.734	.12060-04	-4.919
.2679	.93510+03	2.971	.37780-09	-9.423	.17660-04	-4.753
.2727	.74220+03	2.871	.73070-09	-9.136	.25110-04	-4.600
.2775	.59870+03	2.777	.13470-08	-8.871	.34820-04	-4.458
.2823	.48980+03	2.690	.23820-08	-8.623	.47270-04	-4.325
.2871	.40540+03	2.608	.40660-08	-8.391	.63020-04	-4.200
.2919	.33900+03	2.530	.67260-08	-8.172	.82710-04	-4.082
.2967	.28590+03	2.456	.10830-07	-7.965	.10710-03	-3.970
.3015	.24300+03	2.386	.17020-07	-7.769	.13700-03	-3.863
.3064	.20790+03	2.318	.26170-07	-7.582	.17360-03	-3.760
.3112	.17880+03	2.252	.39510-07	-7.403	.21800-03	-3.662
.3160	.15450+03	2.189	.58640-07	-7.232	.27170-03	-3.566
.3208	.13400+03	2.127	.85740-07	-7.067	.33660-03	-3.473

.3400	.77460+02	1.889	.34870-06	-6.458	.76160-03	-3.118
.3448	.67620+02	1.830	.48450-06	-6.315	.93010-03	-3.031
.3496	.58940+02	1.770	.66900-06	-6.175	.11370-02	-2.944
.3544	.51240+02	1.710	.91970-06	-6.036	.13920-02	-2.856
.3592	.44350+02	1.647	.12610-05	-5.899	.17120-02	-2.766
.3640	.38140+02	1.581	.17260-05	-5.763	.21180-02	-2.674
.3688	.32520+02	1.512	.23660-05	-5.626	.26450-02	-2.578
.3736	.27370+02	1.437	.32560-05	-5.487	.33450-02	-2.476
.3784	.22620+02	1.354	.45160-05	-5.345	.43090-02	-2.366
.3832	.18170+02	1.259	.63510-05	-5.197	.57060-02	-2.244
.3880	.13950+02	1.145	.91440-05	-5.039	.78910-02	-2.103
.3928	.98350+01	.993	.13750-04	-4.862	.11780-01	-1.929
.3977	.56130+01	.749	.22790-04	-4.642	.20950-01	-1.679
.4001	.32830+01	.516	.32400-04	-4.489	.33800-01	-1.471
.4025	.00000+00		.10900-03	-3.963		

END OF PROBLEM

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```
*****************************************************************
*                                                               *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                      *
*                                                               *
*GRJ, MAIN PILE TAILINGS, 23.1% -200 (55-3)                      *
*                                                               *
*    MUALEM-BASED RESTRICTION, M=1-1/N                          *
*    ANALYSIS OF RETENTION DATA ONLY                            *
*    MTYPE= 3     METHOD= 2                                     *
*                                                               *
*****************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.2420	1
2	WCS	.4670	0
3	ALPHA	.0500	1
4	N	2.0000	1
5	M	.5000	0
6	EXPO	.5000	0
7	CONDS	1.50E-05	0

OBSERVED DATA

OBS NO	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	112.200	.4627	1.0000
2	305.900	.3891	1.0000
3	1019.800	.3322	1.0000
4	3059.400	.2565	1.0000
5	7138.600	.2433	1.0000
6	15399.000	.2416	1.0000

NIT	SSQ	WCR	ALPHA	N
0	05790	.2420	.0500	2.0000
10	.00072	.2211	.0034	1.7099

CORRELATION MATRIX

	1	2	3
1	1.0000		
2	-.4337	1.0000	
3	.8882	-.7179	1.0000

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .98372571

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS

VARIABLE	VALUE	S.E.COEFF.	T-VALUE	95% CONFIDENCE LIMITS LOWER	UPPER
WCR	.27115	.07618	8.45	.1378	.3045
ALPHA	.00347	.00097	3.53	.0003	.0065
N	1.70993	.29152	5.87	.7822	2.6376

OBSERVED AND FITTED DATA

NO	P	LOG-P	WC-OBS	WC-FIT	WC-DIF
1	.11770+03	2.0500	.4627	.4495	.0132
2	.30590+03	2.4856	.3891	.4025	-.0134
3	.10200+04	3.0085	.3327	.3178	.0144
4	.30590+04	3.4856	.2565	.2672	-.0107
5	.71390+04	3.8536	.2433	.2465	-.0032
6	.15400+05	4.1875	.2416	.2359	.0057

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

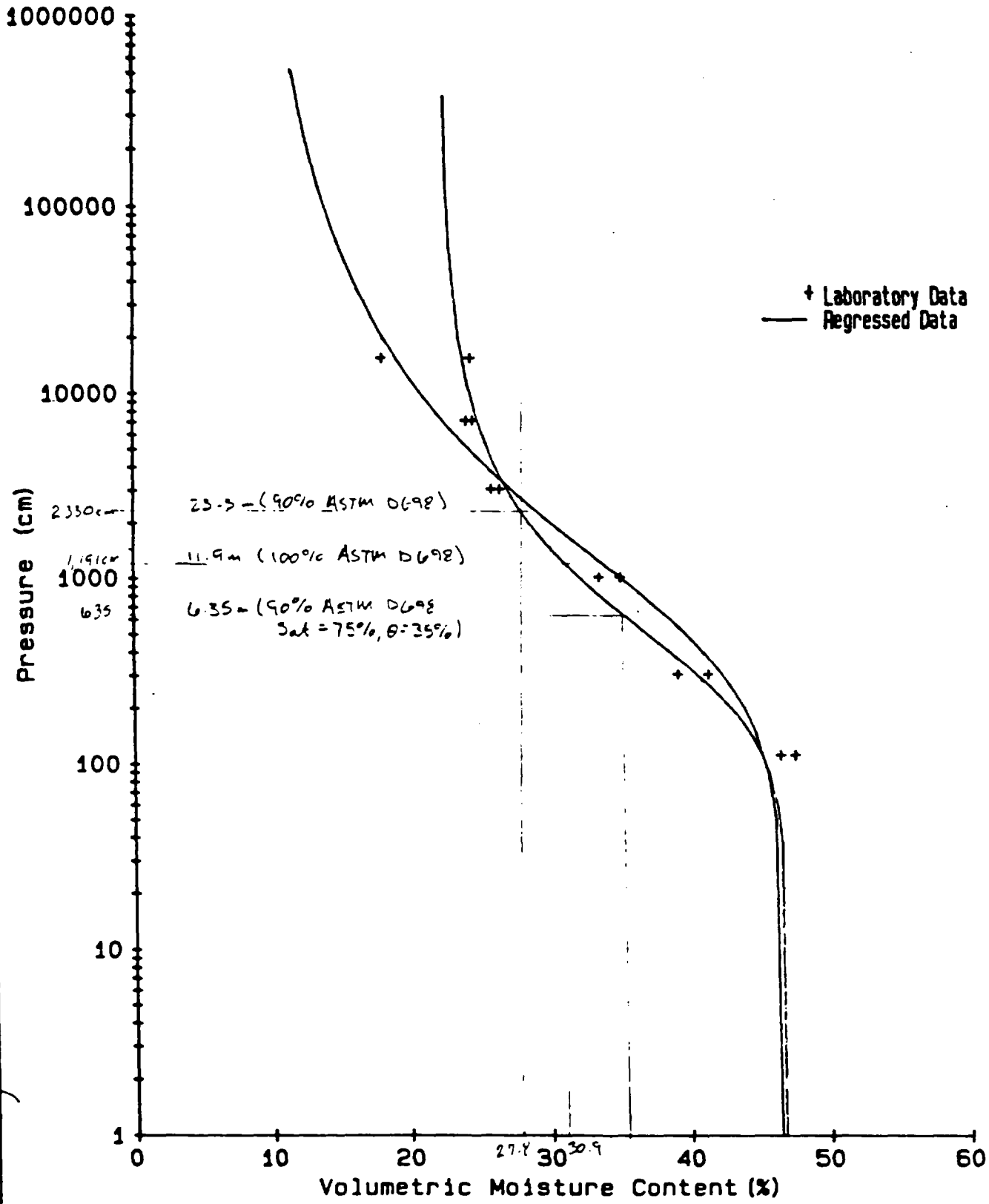
	UNWEIGHTED	WEIGHTED
RETENTION DATA	.00072	.00072
COND/DIFF DATA	.00000	.00000
ALL DATA	.00072	.00072

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)

WC	P	LOGP	COND	LOGK	DIF	LOGD
.2227	.37170+06	5.570	.49300-17	-17.307	.16800-08	-8.775
.2242	.14000+06	5.146	.19660-15	-15.706	.12610-07	-7.899
.2273	.52730+05	4.722	.78370-14	-14.106	.94720-07	-7.024
.2334	.19860+05	4.296	.31260-12	-12.505	.71170-06	-6.148
.2396	.11210+05	4.050	.27010-11	-11.568	.23170-05	-5.635
.2457	.74650+04	3.873	.12480-10	-10.904	.53610-05	-5.271
.2519	.54430+04	3.736	.40960-10	-10.388	.10290-04	-4.988
.2580	.42010+04	3.623	.10820-09	-9.966	.17550-04	-4.756
.2642	.33720+04	3.528	.24630-09	-9.608	.27610-04	-4.559
.2703	.27840+04	3.445	.50270-09	-9.299	.40940-04	-4.388
.2765	.23490+04	3.371	.94420-09	-9.025	.58080-04	-4.236
.2826	.20150+04	3.304	.16610-08	-8.780	.79550-04	-4.099
.2888	.17520+04	3.244	.27730-08	-8.557	.10600-03	-3.975
.2949	.15400+04	3.188	.44320-08	-8.353	.13800-03	-3.860
.3011	.13660+04	3.135	.68320-08	-8.165	.17630-03	-3.754
.3072	.12210+04	3.087	.10210-07	-7.991	.22180-03	-3.654
.3133	.10970+04	3.040	.14870-07	-7.828	.27530-03	-3.560
.3195	.99170+03	2.996	.21180-07	-7.674	.33800-03	-3.471
.3256	.90010+03	2.954	.29560-07	-7.529	.41100-03	-3.386
.3318	.82000+03	2.914	.40550-07	-7.392	.49580-03	-3.305
.3379	.74920+03	2.875	.54790-07	-7.261	.59410-03	-3.226
.3441	.68620+03	2.836	.73050-07	-7.136	.70780-03	-3.150
.3502	.62980+03	2.799	.96240-07	-7.017	.83920-03	-3.076
.3564	.57850+03	2.762	.12550-06	-6.901	.99130-03	-3.004
.3625	.53240+03	2.726	.16200-06	-6.790	.11670-02	-2.933
.3687	.49000+03	2.690	.20760-06	-6.683	.13720-02	-2.863
.3748	.45100+03	2.654	.26400-06	-6.578	.16100-02	-2.793
.3810	.41480+03	2.618	.33360-06	-6.477	.18890-02	-2.724
.3871	.38120+03	2.581	.41920-06	-6.378	.22170-02	-2.654
.3932	.34970+03	2.544	.52450-06	-6.280	.26050-02	-2.584
.3994	.32010+03	2.505	.65390-06	-6.185	.30680-02	-2.513

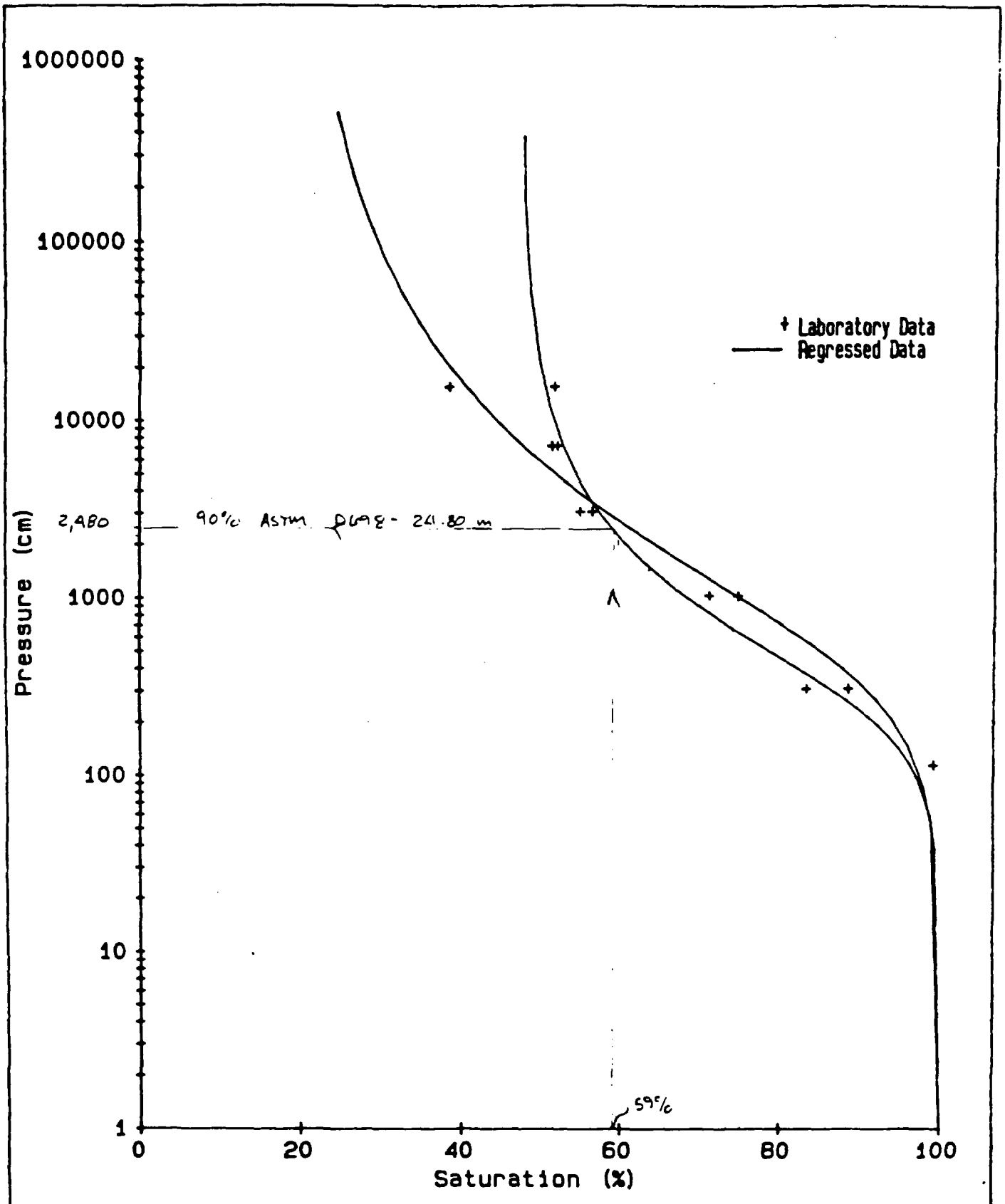
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.4363	.16570+03	2.219	.24150-05	-5.617	.95270-02	-2.021
.4424	.14130+03	2.150	.30450-05	-5.516	.12770-01	-1.913
.4484	.11610+03	2.065	.38920-05	-5.410	.16350-01	-1.786
.4547	.8916D+02	1.950	.51030-05	-5.292	.23410-01	-1.627
.4609	.5791D+02	1.763	.70690-05	-5.151	.40670-01	-1.391
.4639	.3817D+02	1.581	.87760-05	-5.057	.65050-01	-1.187
.4670	.00000+00		.15000-04	-4.824		

END OF PROBLEM



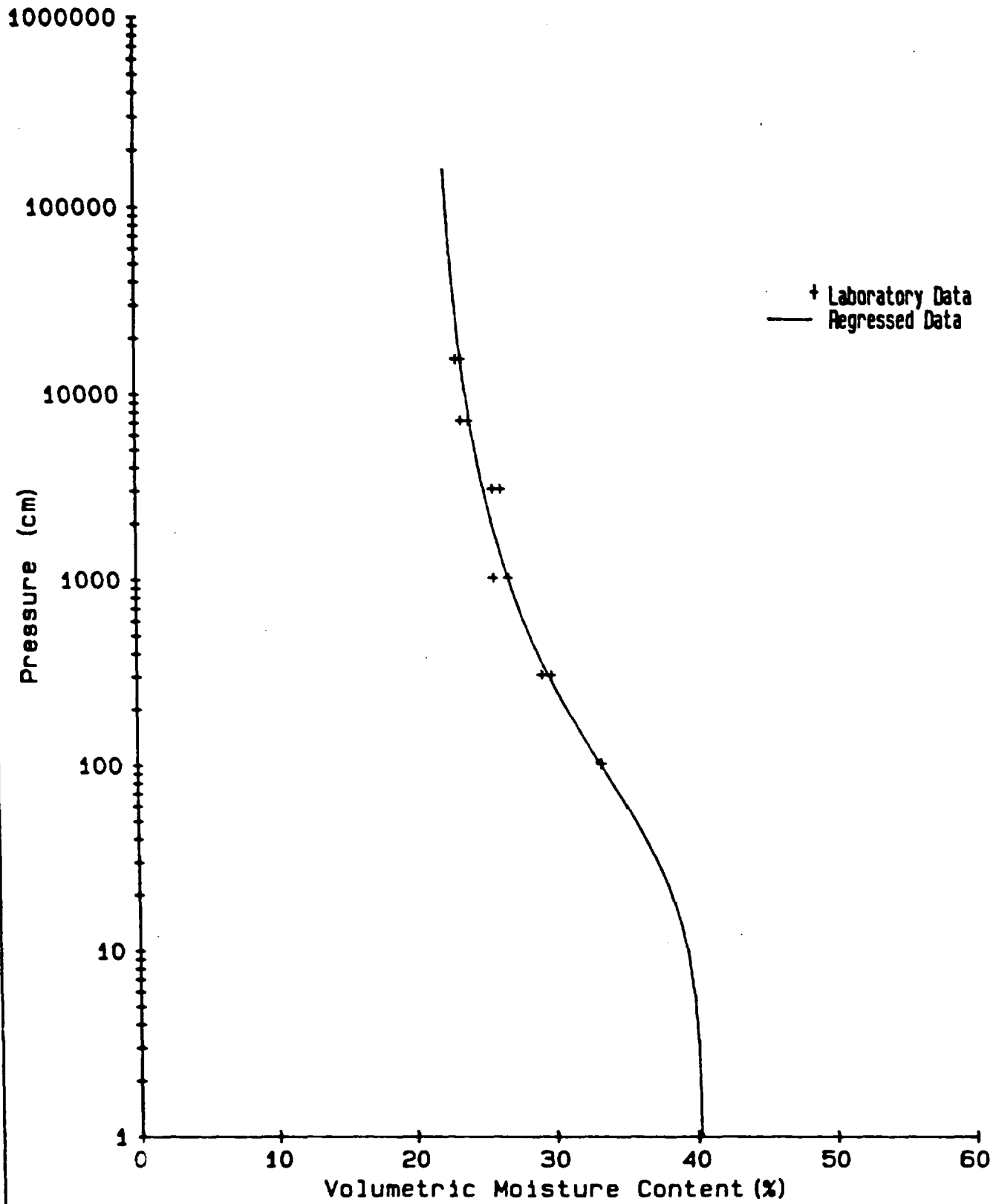
GRJ. MAIN PILE TAILINGS. 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS. 17.7% -200 (S5-4)

FIGURE #1



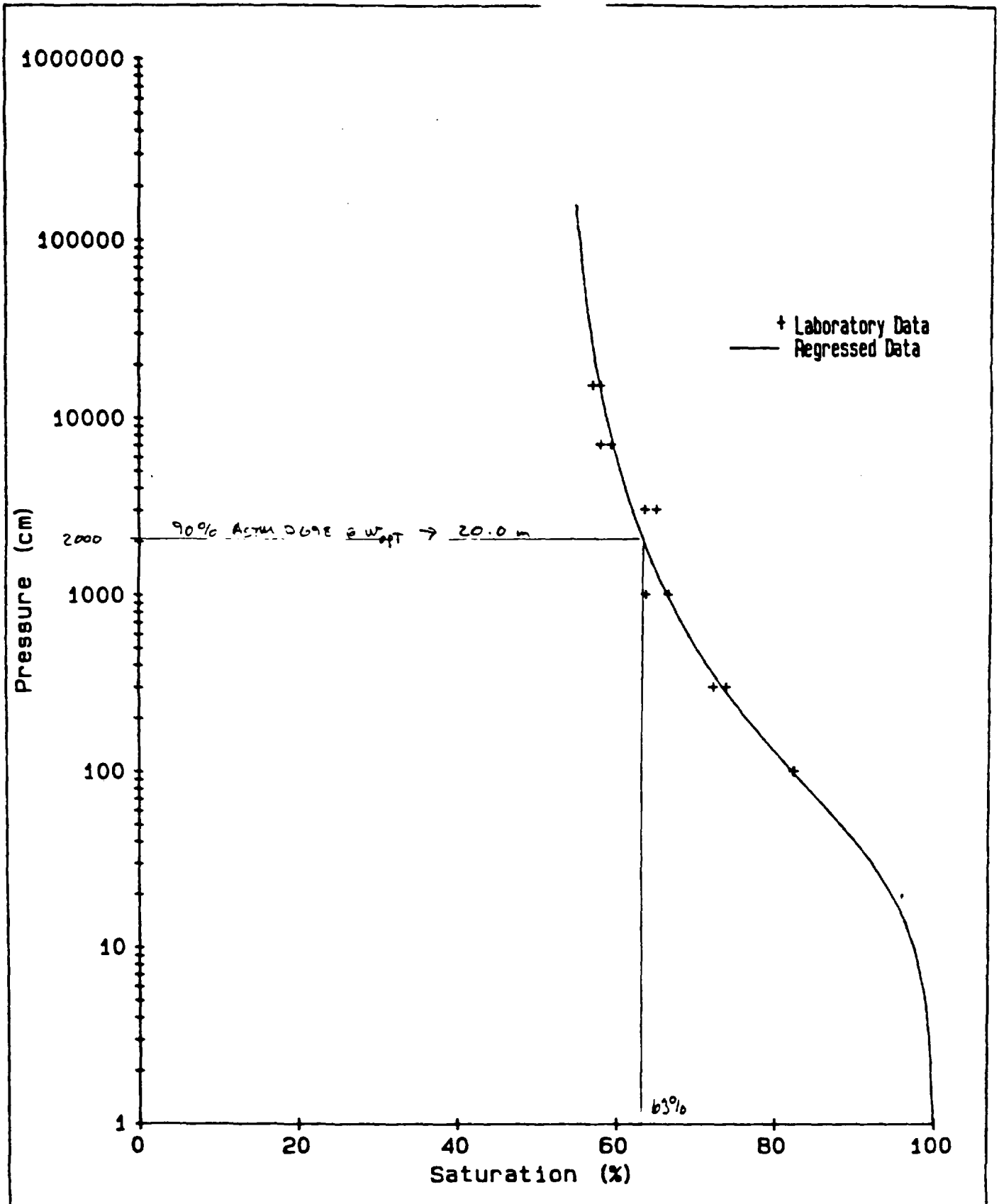
GRJ. MAIN PILE TAILINGS, 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS, 17.7% -200 (S5-4)

FIGURE #2



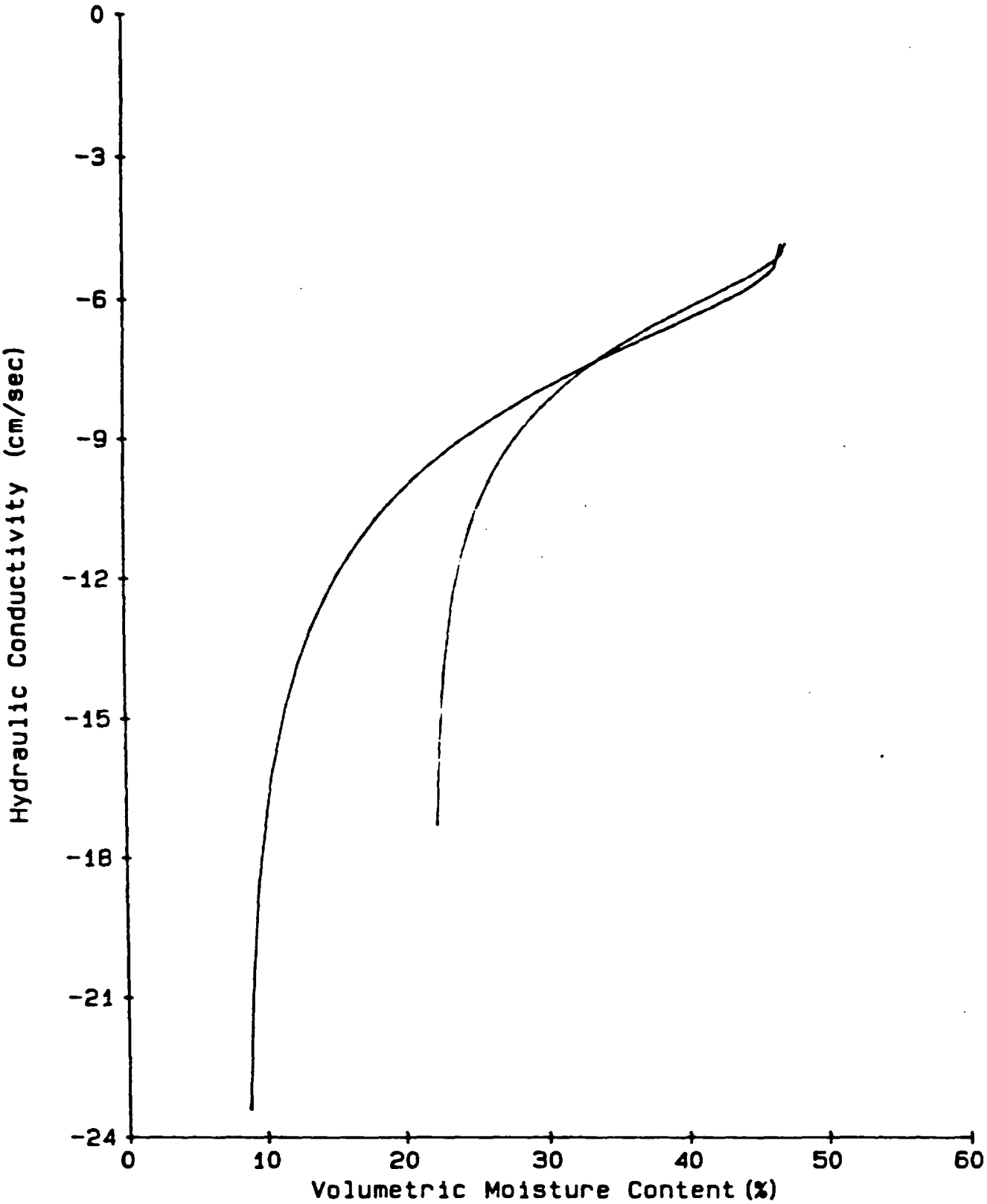
GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE #3



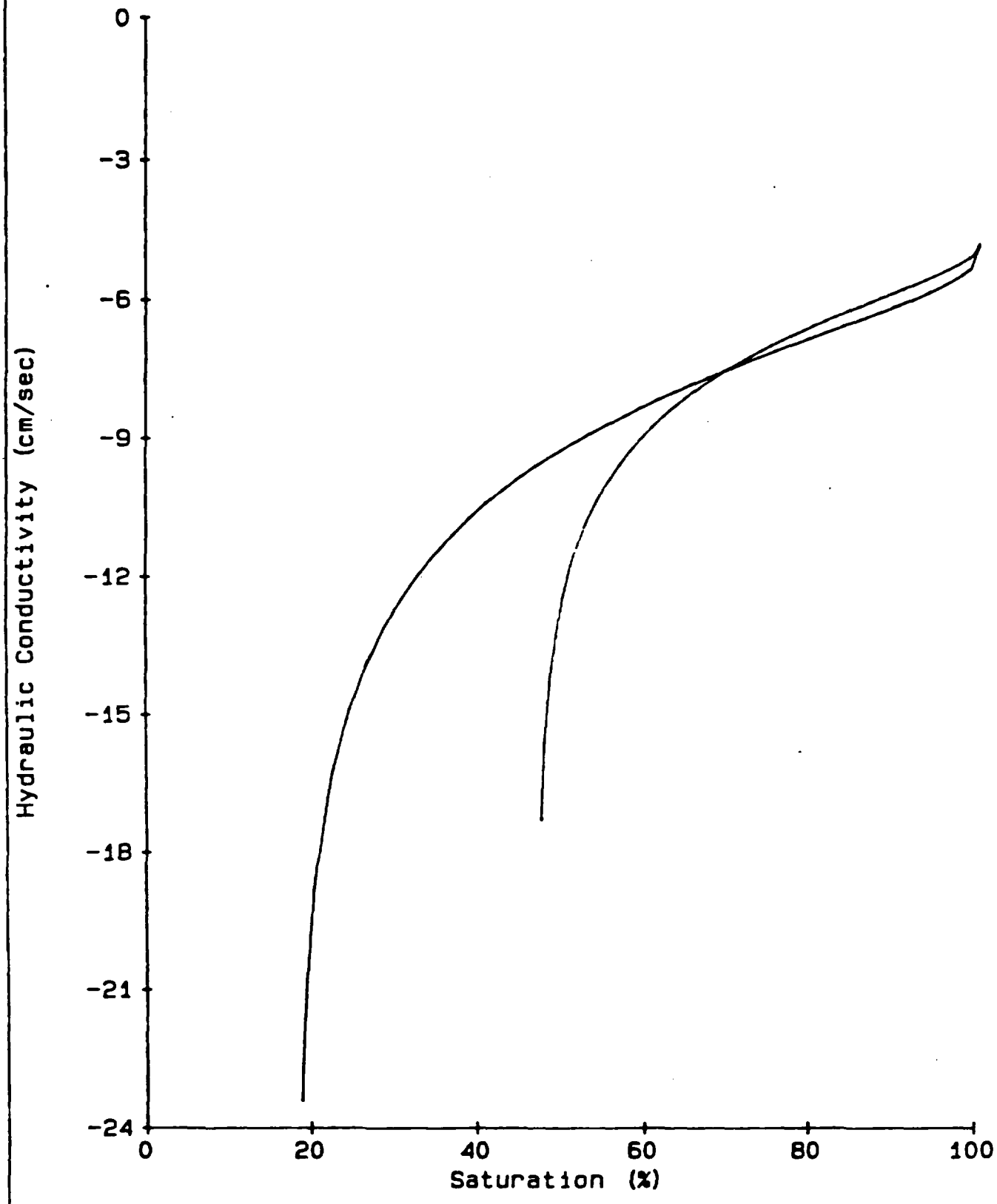
GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE #4



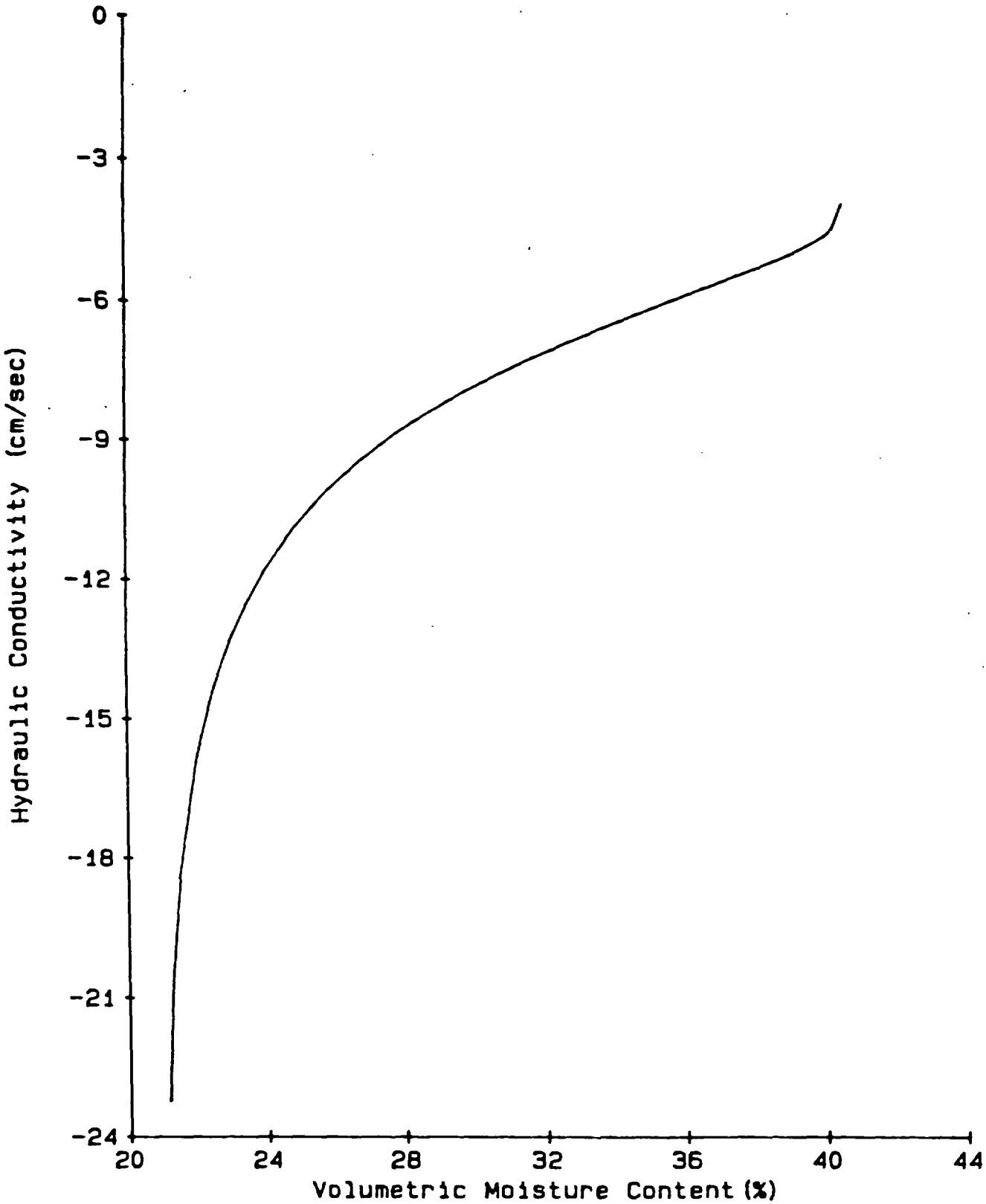
GRJ. MAIN PILE TAILINGS, 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS, 17.7% -200 (S5-4)

FIGURE #5



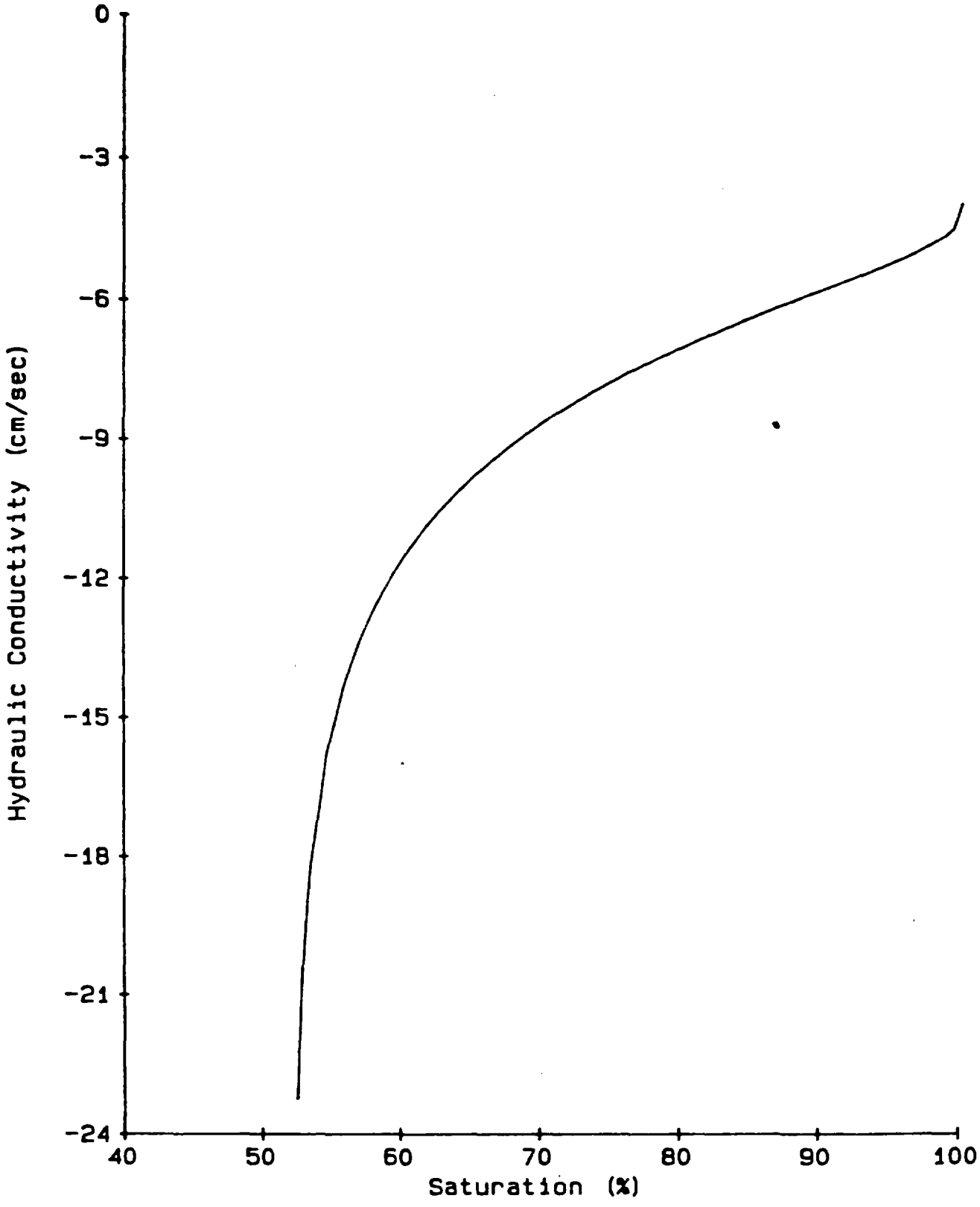
GRJ, MAIN PILE TAILINGS, 23.1% -200 (S5-3)
GRJ, MAIN PILE TAILINGS, 17.7% -200 (S5-4)

FIGURE # 6



GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE # 7



GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE #8

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-08-90-12-05-00 DISCIPLINE Geotech/Hydro NO. OF SHEETS 25

PROJECT:
UMTRA

SITE:
GRAND JUNCTION

FEATURE:
TRANSIENT DRAINAGE AND STEADY STATE SEEPAGE FROM CHENEY DISPOSAL CELL

SOURCES OF DATA:
Daniel B. Stevens & Associates
~~Shan Northern Consulting Geotechnical Engineers~~
MKE-5, Final Grading Plans & Embankment Area Excavations

SOURCES OF FORMULAE & REFERENCES:

SEE PG 3

PRELIMINARY CALC. [X] FINAL CALC. [ ] SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		G. SMITH	8/90	[illegible]	8/9/90	[illegible]	9/6/90

8/85

PURPOSE:

To evaluate effects of transient drainage of construction water from placed contaminated materials on overall cell performance. To determine if any ponding and the resulting depth that water is expected to reach within the cell. Compare the resulting water level to the location of the nearest paleochannel and evaluate the possibility of contaminate water leaching from the cell into the channel.

METHOD:

Utilize finite element method (FEM) analysis provided by the UNSAT2 computer code to evaluate the time-drainage effects of transient drainage. Use Maulem's parameters determined from Van Gneuthen's RETC analyses in conjunction with moisture/pressure test data obtained from laboratory analyses performed on the various materials to be used in the final cell construction. Test data were selected from samples that have materials properties and were prepared closest to expected final field conditions. Tailings materials possess any overall slime or fines content (% material passing a #200 mesh sieve) of around 25% (see reference 4). The vicinity property materials have over 60% slimes according to laboratory test results. Samples chosen contain percentage of fine material which are closest to design specifications and were remolded to design densities and water contents.

Two separate analyses are performed to bound the range of estimated material moisture/pressure relationships. Flux rates determined through previous infiltration studies will be applied to the surface of the contaminated materials. These earlier analyses are listed in the reference section. The cover is not included in the model. The condition imposed is the flux through the cover will be governed by the flux rate as determined by the UNSAT-H calculation of 1.78 cm/year (5.68E-08 cm/sec). This rate is conservatively modeled as the design saturated permeability of the radon/infiltration barrier of 1.0E-07 cm/sec.

ASSUMPTIONS:

- laboratory test methods utilized accurately reproduce expected field behavior of placed materials.

- transient drainage of construction waters do not begin until all cell components have been constructed.

- densities and moisture contents of placed materials precisely meet construction specifications.

- all materials are homogenous and isotropic except where specified anisotropity exists.

REFERENCES:

1) Crain, J., March 1990., TAC calculation GRJ-03-90-11-01-00, "Infiltration Through Cover System and Vicinity Properties Material".

2) Crain, J. & Smith, G., Jan. 1990., TAC calculation GRJ-01-90-02-03-00, "Grand Junction, Cheney Disposal Site, Transient Drainage".

3) Davis, L. and Neuman, 1983. Documentation and User's Guide: UNSAT-2 Variably Saturated Flow Model, NRC.

4) Merritt, R.C., 1971., "The Extractive Metallurgy of Uranium", Colorado School of Mines Research Institute.

5) Smith, G., August 1990., TAC calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

6) United States Department of Agriculture, 1987. User's Guide: RETC.

7) Van Genuchten, R., 1980. "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

DATA SOURCE:

Daniel B. Stevens and Associates

University of Arizona Hydrology Laboratory

MKE preliminary drawings GRJ-DS-10-0220 rev.1 & GRJ-DS-10-0134 rev.2 of Final Gradings Plans & Tailing Embankment Area Excavation Plan.

DATA:

Copies of laboratory determined moisture/pressure relationship test results from the firm of Daniel B. Stevens & Assoc.(DBS&A) are presented on pages 5 to 7. Computer results of the RETC analyses (see references 6 & 7) of these data are presented in the Appendix with the resulting best fit curves shown on Figures #1 to #2. This data is reproduced from calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

Capillarity moisture tests were not successfully performed on the Mancos Formation shale material. Therefore, test results for a similar substitute material were used. Data were obtained from testing performed by the University of Arizona Hydrology Laboratory on Wasatch Formation shale. This material was taken from the UMTRA disposal site in Rifle, Colorado at Estes Gulch. Plots of the unsaturated moisture/pressure relationships are presented on Figures #3 to #4 on pages 10 and 11 . A justification for this substitution is presented in the discussion section of this calculation set.

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-1	0.0	45.66
	112.2	16.49
	305.9	1.98*
	1019.8	6.89
	3059.4	5.19
	7138.6	4.38
	15399.0	3.77
5-2	0.0	45.17
	112.2	20.15
	305.9	8.70
	1019.8	7.04
	3059.4	5.30
	7138.6	4.60
	15399.0	3.66
5-3 S5-3 Tailings	0.0	50.36
	112.2	46.27
	305.9	38.91
	1019.8	33.22
	3059.4	25.65
	7138.6	24.33
	15399.0	24.16
5-4	0.0	51.35
	112.2	47.28
	305.9	41.07
	1019.8	34.69
	3059.4	26.20
	7138.6	23.88
	15399.0	17.87
5-5	0.0	47.19
	112.2	30.62
	305.9	25.49
	1019.8	22.00
	3059.4	17.36
	7138.6	16.54
	15399.0	14.28

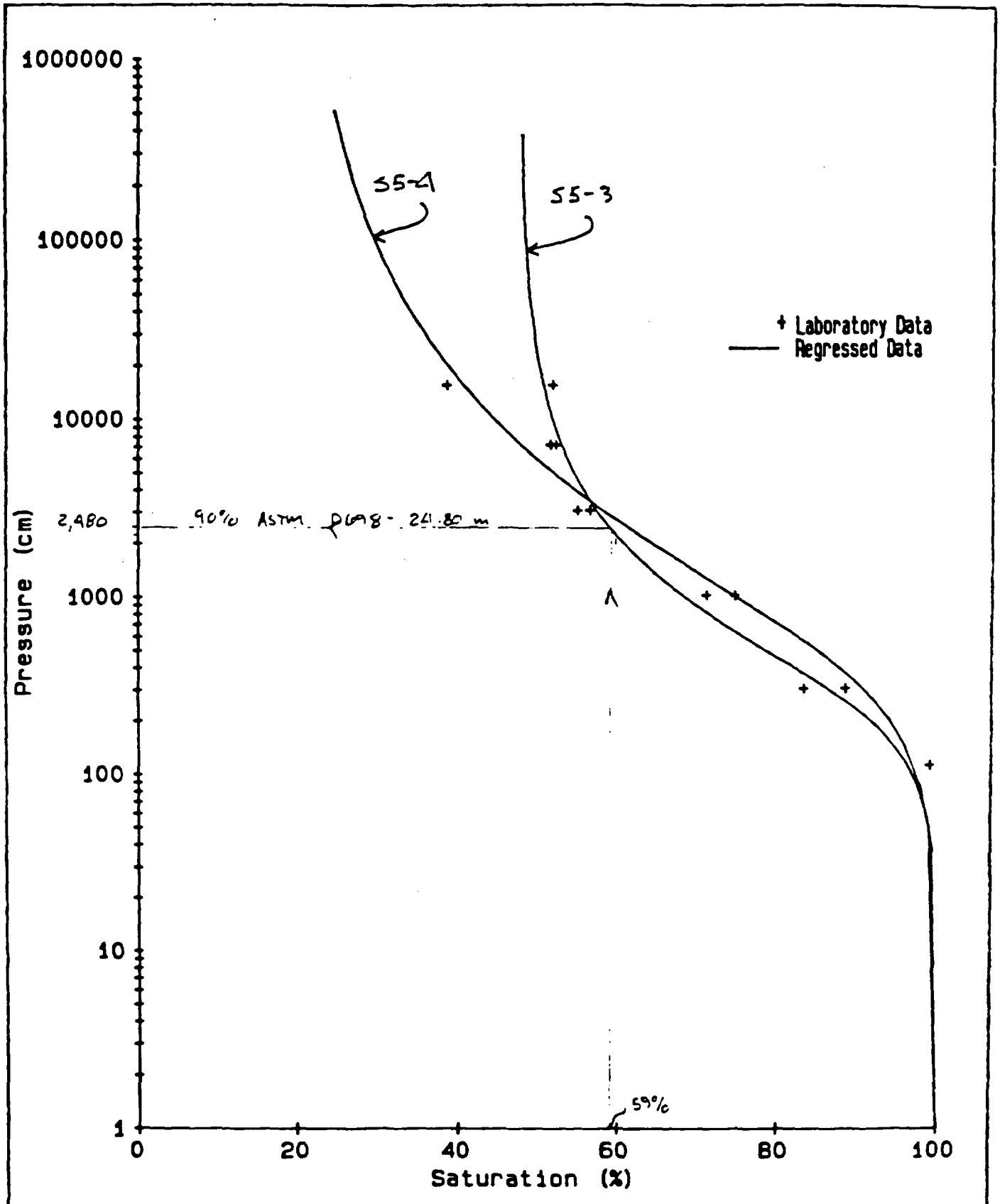
* measurement error

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-11	0.0	48.34
	112.2	34.35
	305.9	32.49
	1019.8	29.72
	3059.4	22.13
	7138.6	20.60
	15399.0	19.38
5-12	0.0	45.27
	112.2	35.60
	305.9	33.56
	1019.8	31.14
	3059.4	25.80
	7138.6	24.46
	15399.0	24.76
5-13	0.0	46.48
	112.2	37.49
	305.9	35.57
	1019.8	32.68
	3059.4	27.95
	7138.6	26.69
	15399.0	25.77
5-14	0.0	47.39
	112.2	39.10
	305.9	35.24
	1019.8	32.05
	3059.4	26.64
	7138.6	24.20
	15399.0	19.45
5-15 ½ RS-3	0.0	40.69
	102.0	33.11
	305.9	29.70
	1019.8	26.71
Vicinity Property	3059.4	26.09
	7138.6	23.80
	15297.0	23.25

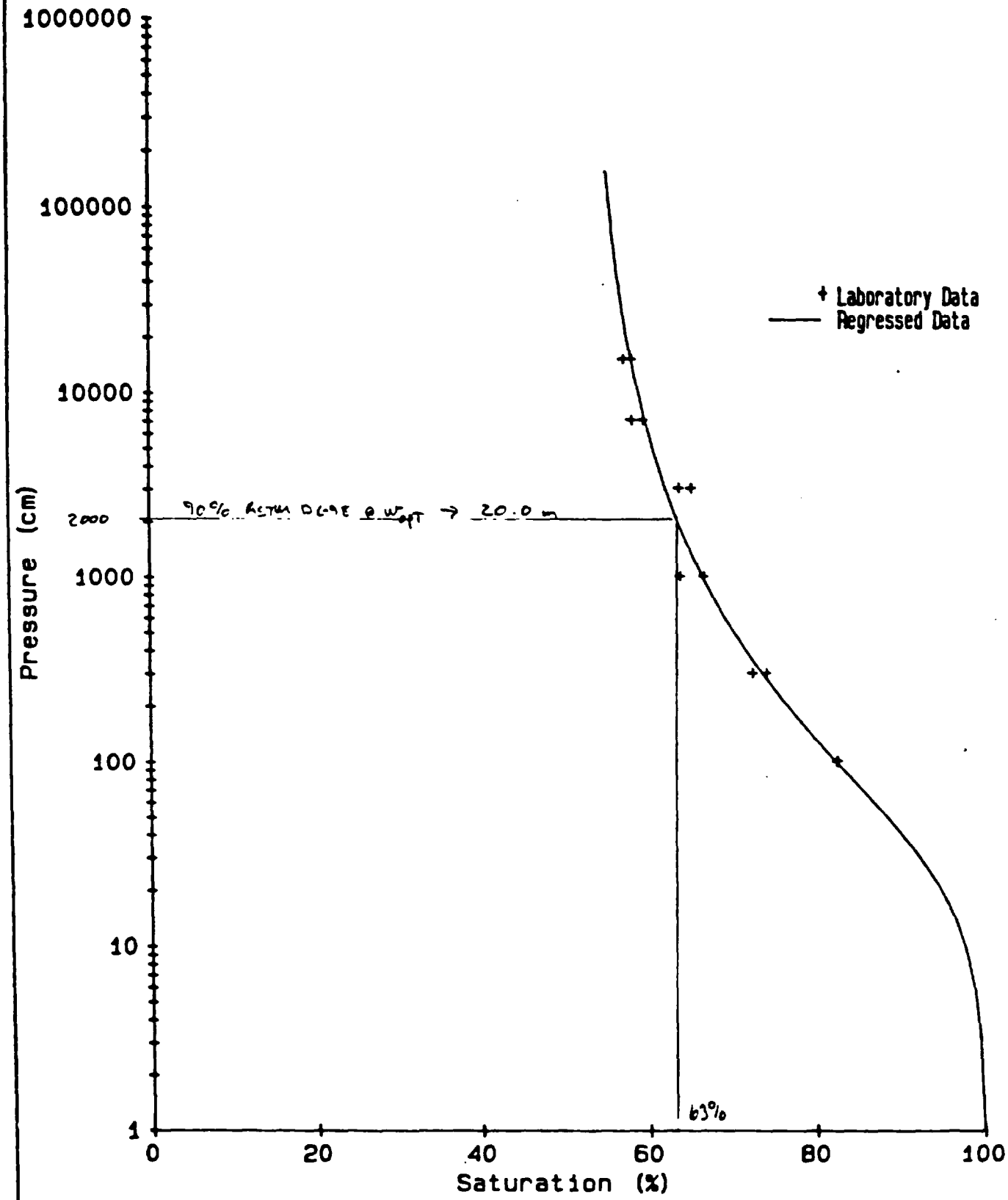
Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-16	0.0	39.78
Vicinity	102.0	33.16
	305.9	29.04
Property	1019.8	25.60
	3059.4	25.50
	7138.6	23.25
½ RS-3	15297.0	22.85
5-17	0.0	37.53
	102.0	33.79
	305.9	31.82
	1019.8	29.36
	3059.4	29.17
	7138.6	27.96
	15297.0	28.00
5-18	0.0	39.84
	102.0	34.27
	305.9	31.93
	1019.8	29.16
	3059.4	28.39
	7138.6	27.35
	15297.0	25.85
5-19	0.0	39.85
	102.0	36.29
	305.9	33.62
	1019.8	30.22
	3059.4	29.38
	7138.6	28.46
	15297.0	27.53
5-20	0.0	39.41
	102.0	36.36
	305.9	33.67
	1019.8	30.29
	3059.4	28.47
	7138.6	26.90
	15297.0	26.50



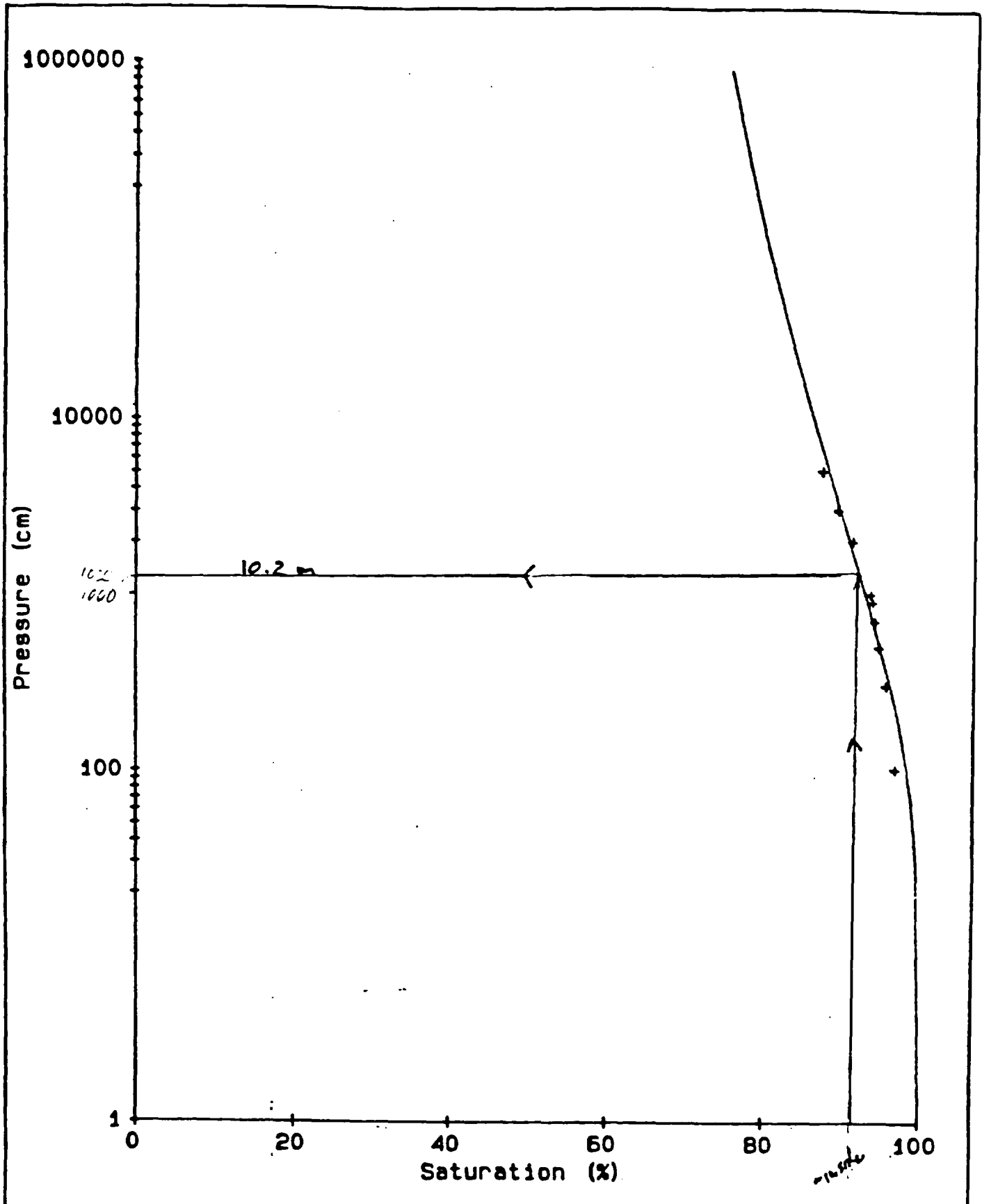
GRJ. MAIN PILE TAILINGS. 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS. 17.7% -200 (S5-4)

FIGURE No. 1



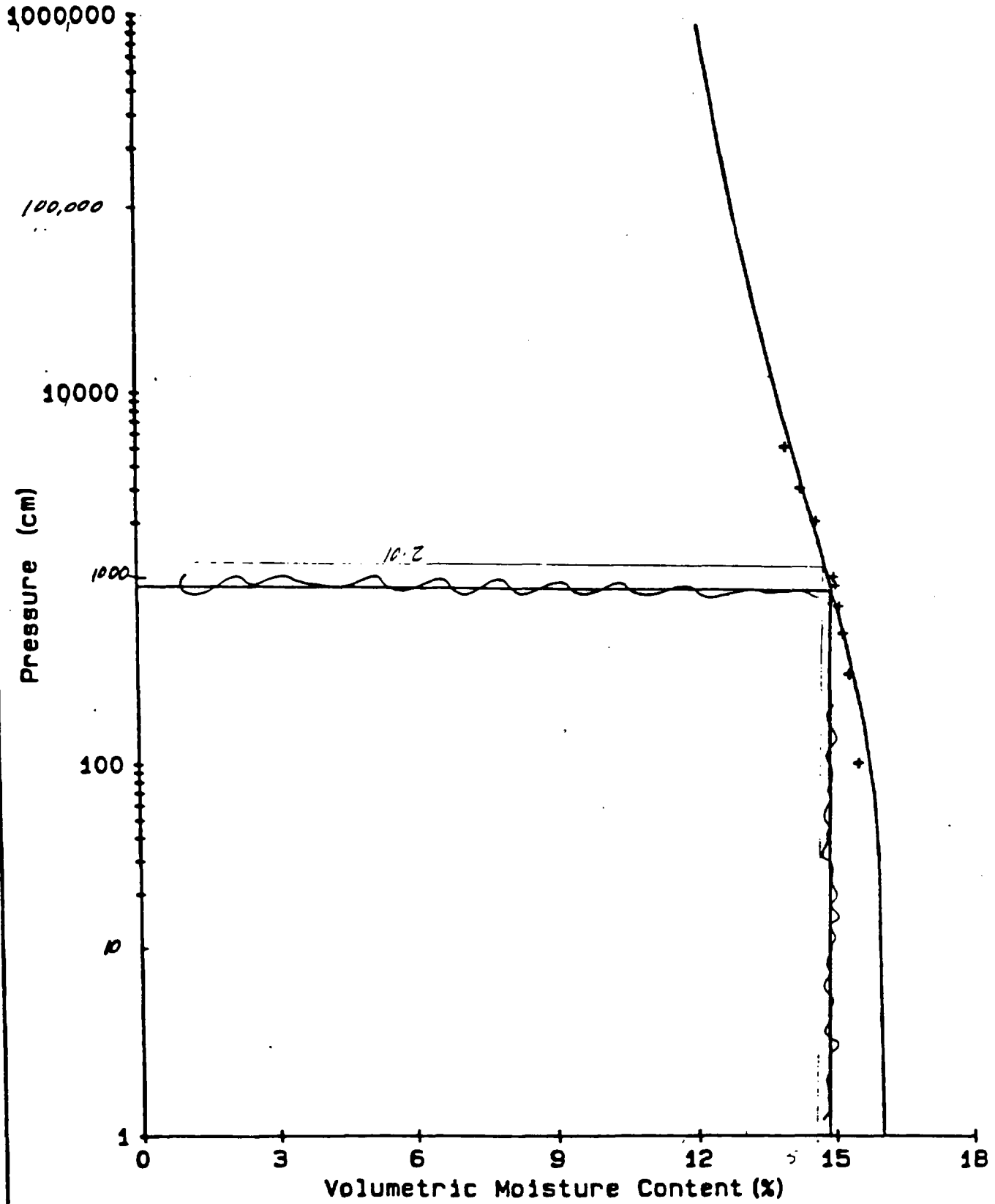
GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE NO. 2



ESTES GULCH, WASATCH FORMATION

Figure #3



ESTES GULCH, WASATCH FORMATION

Figure # 4

CALCULATION:

Utilization of a FEM analysis such as the UNSAT-2 computer code requires construction of a finite element mesh. The FEM mesh utilizied is a two-dimensional (2D) section through the disposal cell. The mesh is required to model the physical system for algorithms to solve partial differential equations governing variably saturated flow simulating both horizontal and vertical movement of water. The mesh used in this analysis was determined by locating the longest downgradient drainage path along the base of the proposed disposal cell excavation. This section is indicated on Figures #5 and #6 showing plan views of the proposed excavation and final grading plans, respectively. This excavation plan is MKE's design of Case 2BX which is for a moderate depth excavation. From these drawings the upper and lower boundaries of the mesh are specified. Thickness of the vicinity property and tailings materials were obtained from a preliminary cross-sectional sketch provided by MKE shown in Figure #7. Using this information the finite element mesh shown in Figure #8 is constructed. Metric units are used in this analysis for consistency with the UNSAT2 computer code. Therefore, all input is in meters or meters/day when units are necessary.

From the moisture/pressure relationships determined in laboratory testing, the unsaturated hydraulic parameters can be obtained. Unsaturated hydraulic properties are given by an analysis suggested by van Genuchten to solve a closed-form equation relating soil moisture contents to hydraulic conductivities derived by Mualem. For input into the UNSAT2 computer code a restriction is placed on determination of the Mualem "m" parameter of $m = 1 - 1/N$. A more detailed discussion on this restriction is provided in the TAC calculation GRJ-01-90-02-03-00 by J. Crain and G. Smith, "Grand Junction, Cheney Disposal Site, Transient Drainage". Unsaturated hydraulic Maulem parameters for each material type are listed in Table I below.

Results of the RETC analyses performed on DBS&A test data indicate the placed materials existing at much drier moisture conditions, holding less moisture at considerably greater negative matric potentials than previous testing had indicated. Therefore, comparative FEM analyses were performed using unsaturated material properties that were utilized in preliminary analyses by Crain and Smith (reference 2) and Crain (reference 1).

FINAL GRADING - COVER

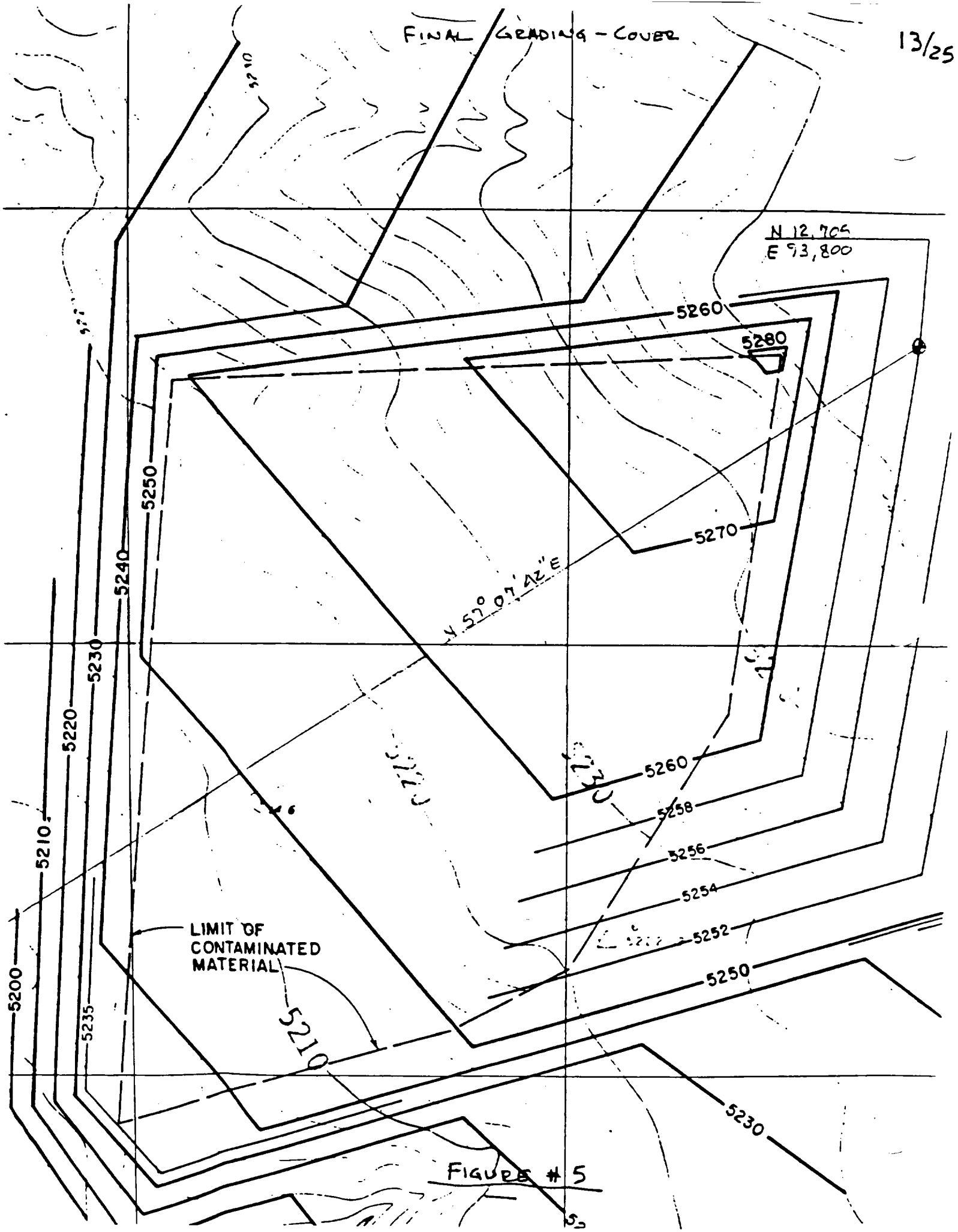


FIGURE # 5

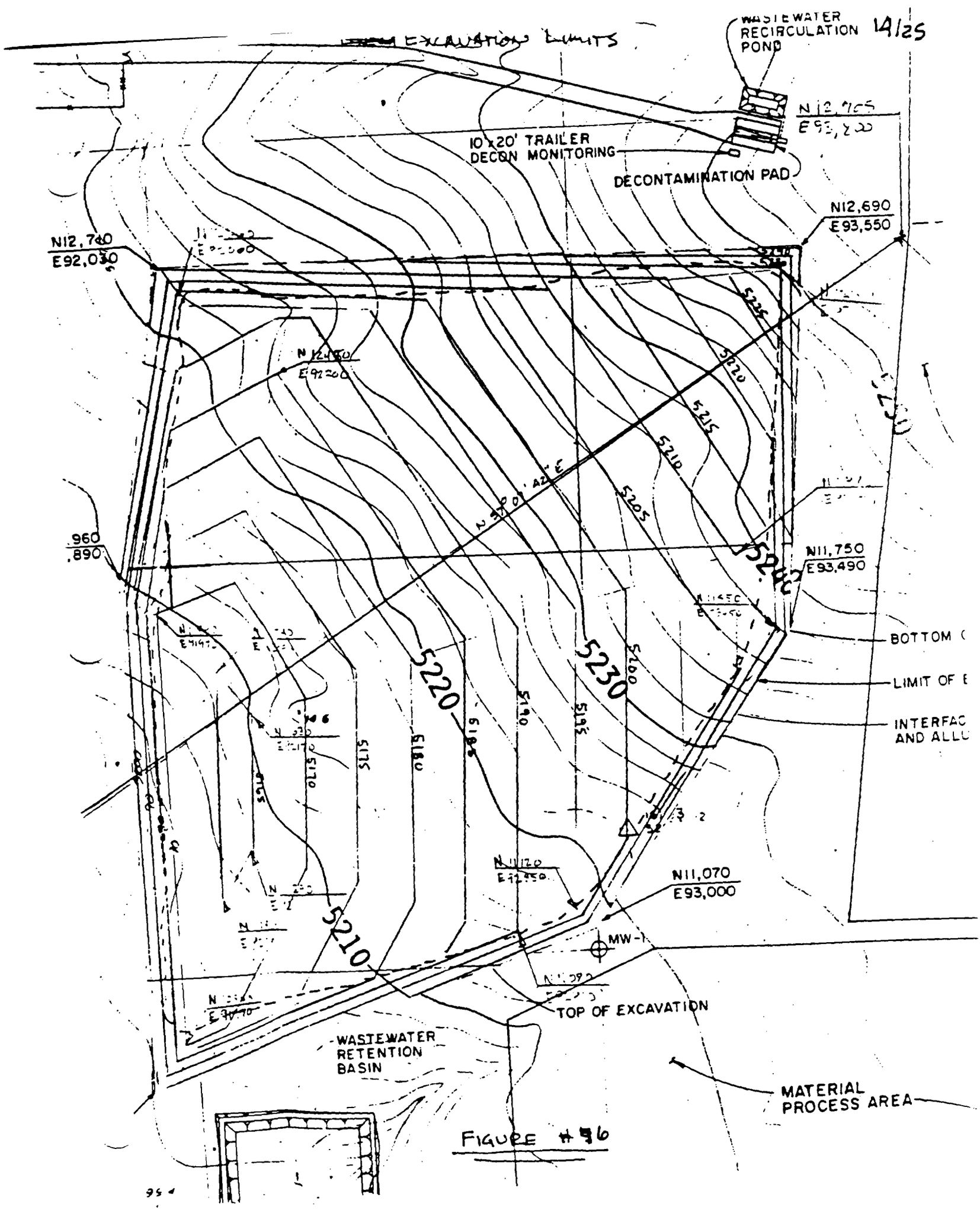
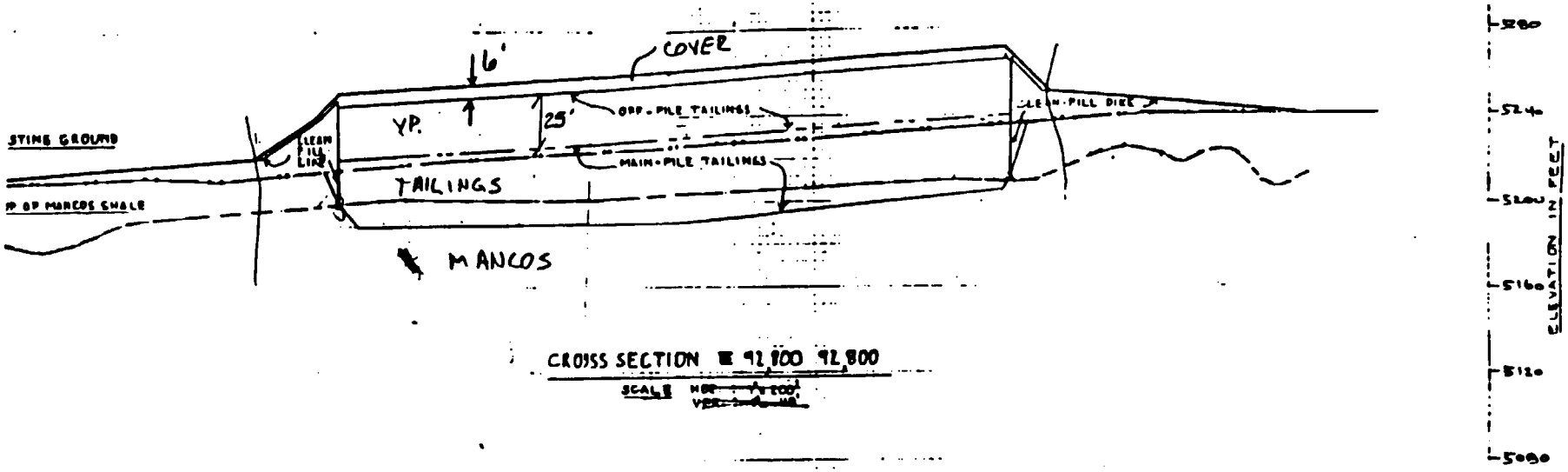

EXCAVATION LIMITS
WASTEWATER RECIRCULATION POND
14/25
10'x20' TRAILER DECON MONITORING
DECONTAMINATION PAD
N12,690
E93,550
N12,740
E92,030
N12,450
E92200
N 20° 00' AZ E
960
890
N11,750
E93,490
BOTTOM
LIMIT OF E
INTERFAC
AND ALLU
N11,070
E93,000
MW-1
TOP OF EXCAVATION
WASTEWATER RETENTION BASIN
MATERIAL PROCESS AREA
5230
5220
5210
5240
5235
5225
5220
5215
5210
5205
5200
5195
5190
5185
5180
5175
5170
5165

FIGURE #6

JACOBS ENGINEERING

DATE ____ BY ____

PRELIM: CASE 2BK 3' DEEPER



PROJECT : UMTRA-GRJ
JOB NUMBER: 5025-16
DATE : APRIL 5, 1990

MK-ENVIRONMENTAL SERVICES

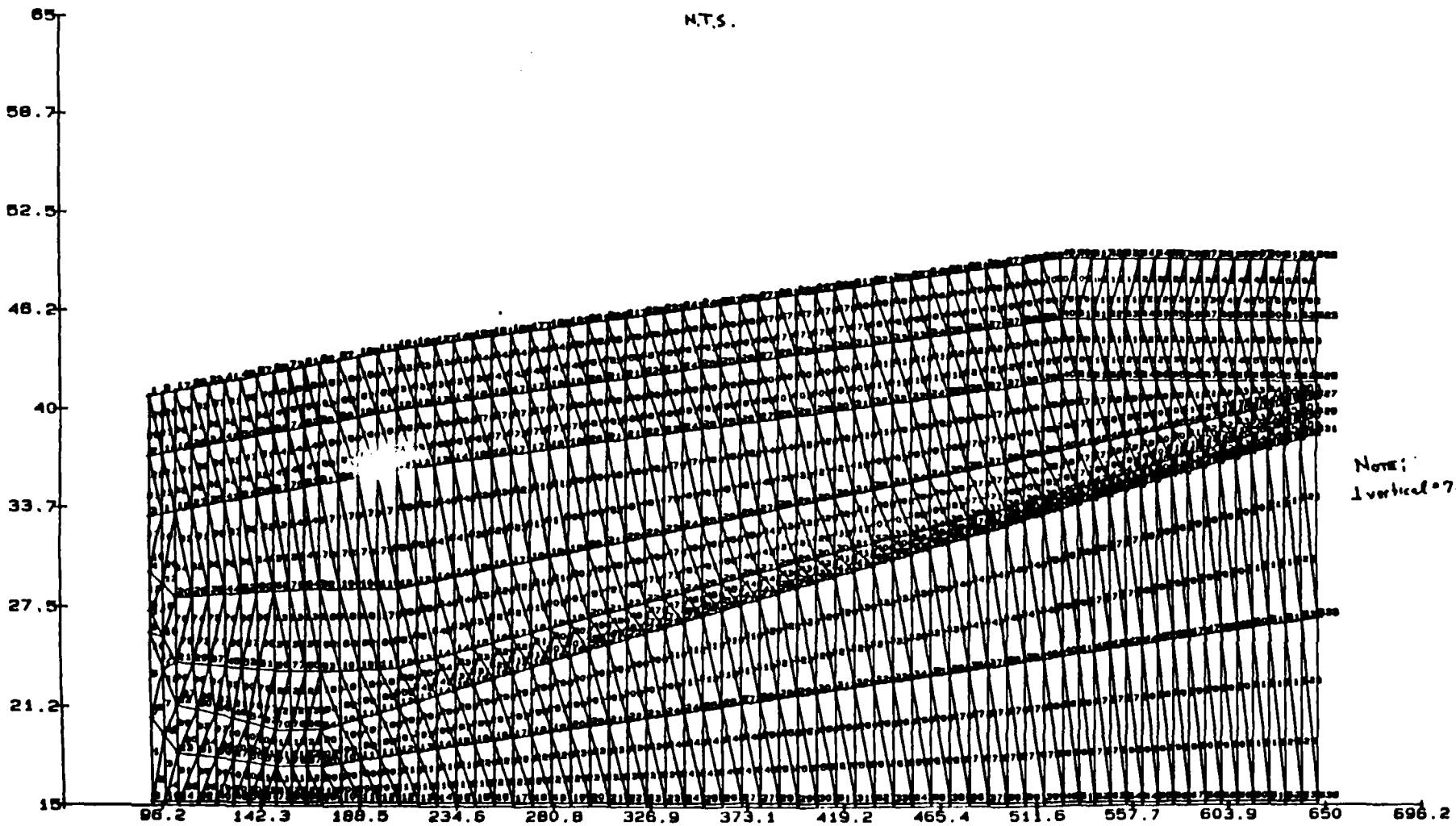
SHEET NO. 15/25 JOB NO. ____

FIGURE #7

NOTE: THIS FIGURE USED TO DETERMINE RELATIVE THICKNESSES OF CONTAMINATED MATERIALS

CHENEY DISPOSAL CELL

N.T.S.



Note:
1 vertical = 7.4 horiz.

Figure #8

Table I

Unsaturated Hydraulic Parameters

(DBS&A)

material	%-200 sieve	θ_s (%)	θ_r(%)	α (1/meter)	N
V.P.	66.5	0.4025	0.2103	3.30	1.35
tailings	23.8	0.4670	0.2211	0.34	1.71
foundation bedrock	-	0.1600	0.0800	0.63	1.08

(previous)

material	%-200 sieve	θ_s (%)	θ_r(%)	α (1/meter)	N
V.P.	52	0.1969	0.0949	0.45	5.92
tailings	32	0.3613	0.1257	0.65	1.24
foundation bedrock	-	0.1600	0.0800	0.63	1.08

The UNSAT2 computer code also requires data in addition to that provided in Table 1, including saturated hydraulic conductivies and matric potential, in consistent units. These properties should be determined for the materials at initial placement conditions. Saturated permeabilities (k_{SAT}) are obtained from laboratory testing and matric potential (Ψ)are determined from RETC output.

Determination of Ψ follows this conservative method: from the moisture density relationship defined by ASTM D698 (standard Proctor test), the maximum dry density , γ_d and optimum moisture content ,w_{opt} are provided. Construction specifications indicate contaminated materials will be placed at 90% maximum dry density within -3% optimum to optimum moisture content. The placement volumetric moisture content (θ) or corresponding saturation (S) is determined by computing the optimum moisture content at 90% maximum dry density. This provides the most moisture in the materials existing at the lowest dry density or maximum void ratio, e . This computation is outlined below and requires the ratio of material weight of solids to weight of water, or the specific gravity of solids, G_s .

$$0.9 \times \gamma_d = \gamma_{placement} \quad (1)$$

$$e = ((G_s \times \gamma_w)/\gamma_{placement}) - 1.0 \quad (2)$$

$$S = (G_s \times w_c)/e \quad (3)$$

where γ_w = unit weight of water = 1.0 g/cc

Using the formulas listed above, information pertaining to remolded materials supplied by DBS&A are presented in Table 2 below. Water contents listed are gravimetric.

Table 2

material	G_s	γ_d (g/cc)	$90\% \gamma_d$	e	w_{opt} (%)	S(%)
V.P.	2.66	1.88	1.69	0.592	13.6	63
tailings	2.76	1.62	1.46	0.893	19.1	59

From RETC produced plots of saturation versus Ψ given in Figure no. s 1 and 2 the matric potential for each remolded material type is determined. Since the foundation materials will remain in situ, the value of -10.2 meters is determined from computed saturation varying between 87 tO 90%. This determination is presented on Figure no. 3.

Saturated permeabilities are also needed for UNSAT2 input. Remolded values are required for placed contaminated materials while an in situ value is needed for foundation bedrock. Values listed in Table 3 were determined in the laboratory and field accordingly.

Table 3

DBS&A

material	k (meters/day)	Ψ (meters)
V.P.	$k_v = k_h = 9.42 \times 10^{-2}$	-20.0
tailings	$k_v = k_h = 1.25 \times 10^{-2}$	-24.8
foundation bedrock	$k_h = 3.46 \times 10^{-3}$	-10.2
	$k_v = 1.73 \times 10^{-4}$	-10.2

previous data

material	k (meters/day)	Ψ (meters)
V.P.	$k_v = k_h = 2.62 \times 10^{-3}$	-2.75
tailings	$k_v = k_h = 4.84 \times 10^{-2}$	-2.50
foundation bedrock	$k_h = 3.46 \times 10^{-3}$	-10.2
	$k_v = 1.73 \times 10^{-4}$	-10.2

To model expected field as close as possible, nodes along the base of the mesh were coded intially as unsaturated seepage nodes at there initial matric potential. This allowed moisture to exit the model under atmospheric pressure at a rate controlled by the matric potential of the overlying nodes. A complete copy of the input files used are provided in the Appendix.

In these analyses the mesh extended around 14 feet into the underlying foundation bedrock beneath the lowest portion of the cell. This enables the moisture to be tracked through the upper foundation materials. Analysis indicates any moisture entering the foundation is accepted vertically downward and does not extend laterally beyond the downstream edge of the cell. Since the vertical hydraulic conductivity of the foundation is considered to be homogeneous and isotropic, once water enters the foundation no mounding of water is possible.

RESULTS

Using the capillarity data provided by DBS&A results in no ponding of any water within the cell. However, changes in matric potential (soil tension) do occur with time as indicated on Figure no.'s 9 and 10 showing pressure contours at variuos times throughout the life of the cell. Soil tensions increase from influx at the top of the cell are indicated by noticing the increasing values of matric potential with time from the surface downward into the cell. From the time progression shown the pressures can be seen to equalize with time through the 87.8 year plot. The next two time plots, (500 and 1000 years) show the influx through the cover being held by the vicinity property material, which is indicated by the closely spaced contours near midheight. This influx is accepted by the tailings before entering the foundation. Tailings are not holding the moisture as indicated by the more widely spaced contours. The closely spaced contours at the edge of the cell shown in the first time plots reflect the high negative matric potentials introduced by compaction of fine grained soils near maximum dry density and optimum moisture content.

When the previous moisture data is utilizied, a ponding depth of 3.75 meters (12.3 feet) is predicted in the cell. Ponding of water is in the base of the cell with the highest pressures indicated at node #94. A plot of positive pressure versus time obtained from node #94 is presented on Figure no. 11. This plot illustrates how moisture is accepted by the underlying foundation clayshales.

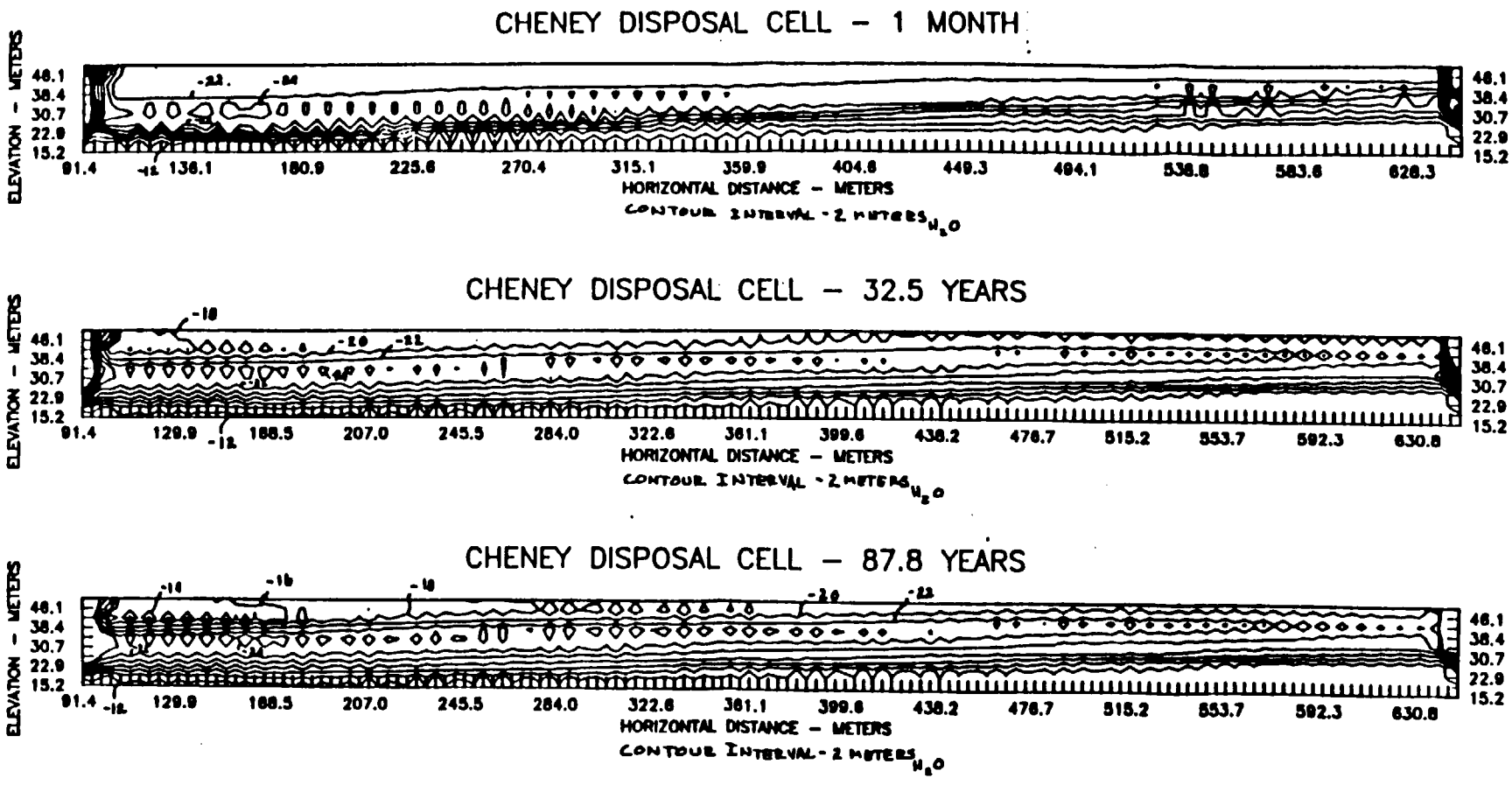
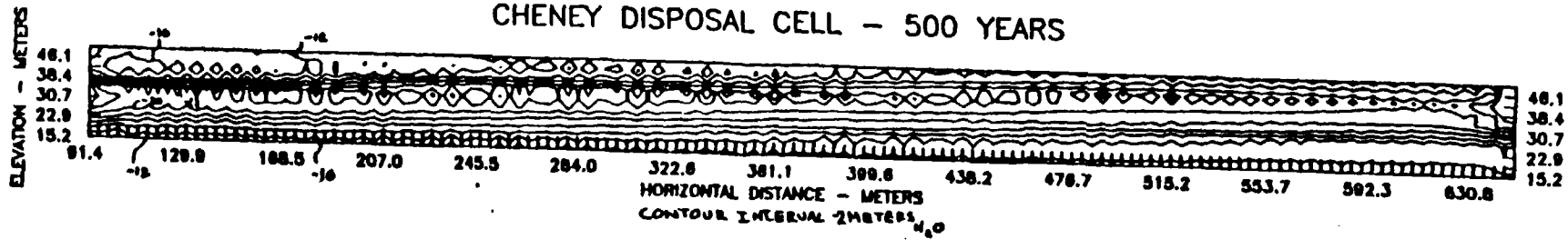

CHENEY DISPOSAL CELL – 1 MONTH
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
136.1
180.9
225.6
270.4
315.1
359.9
404.6
449.3
494.1
538.8
583.6
628.3
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS H_2O
CHENEY DISPOSAL CELL – 32.5 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS H_2O
CHENEY DISPOSAL CELL – 87.8 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS H_2O

FIGURE #9


CHENEY DISPOSAL CELL – 500 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL 2 METERS

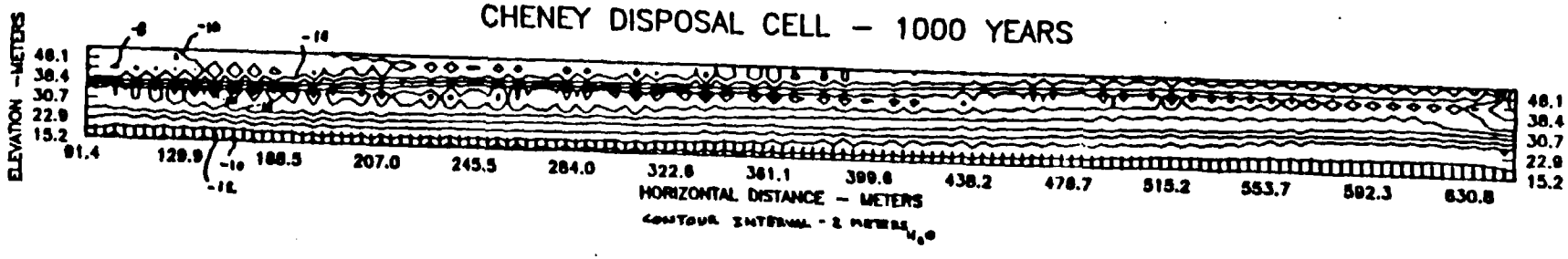

CHENEY DISPOSAL CELL – 1000 YEARS
ELEVATION – METERS
46.1
38.4
30.7
22.9
15.2
91.4
129.9
168.5
207.0
245.5
284.0
322.6
361.1
399.6
438.2
476.7
515.2
553.7
592.3
630.8
HORIZONTAL DISTANCE – METERS
CONTOUR INTERVAL - 2 METERS

FIGURE # 10

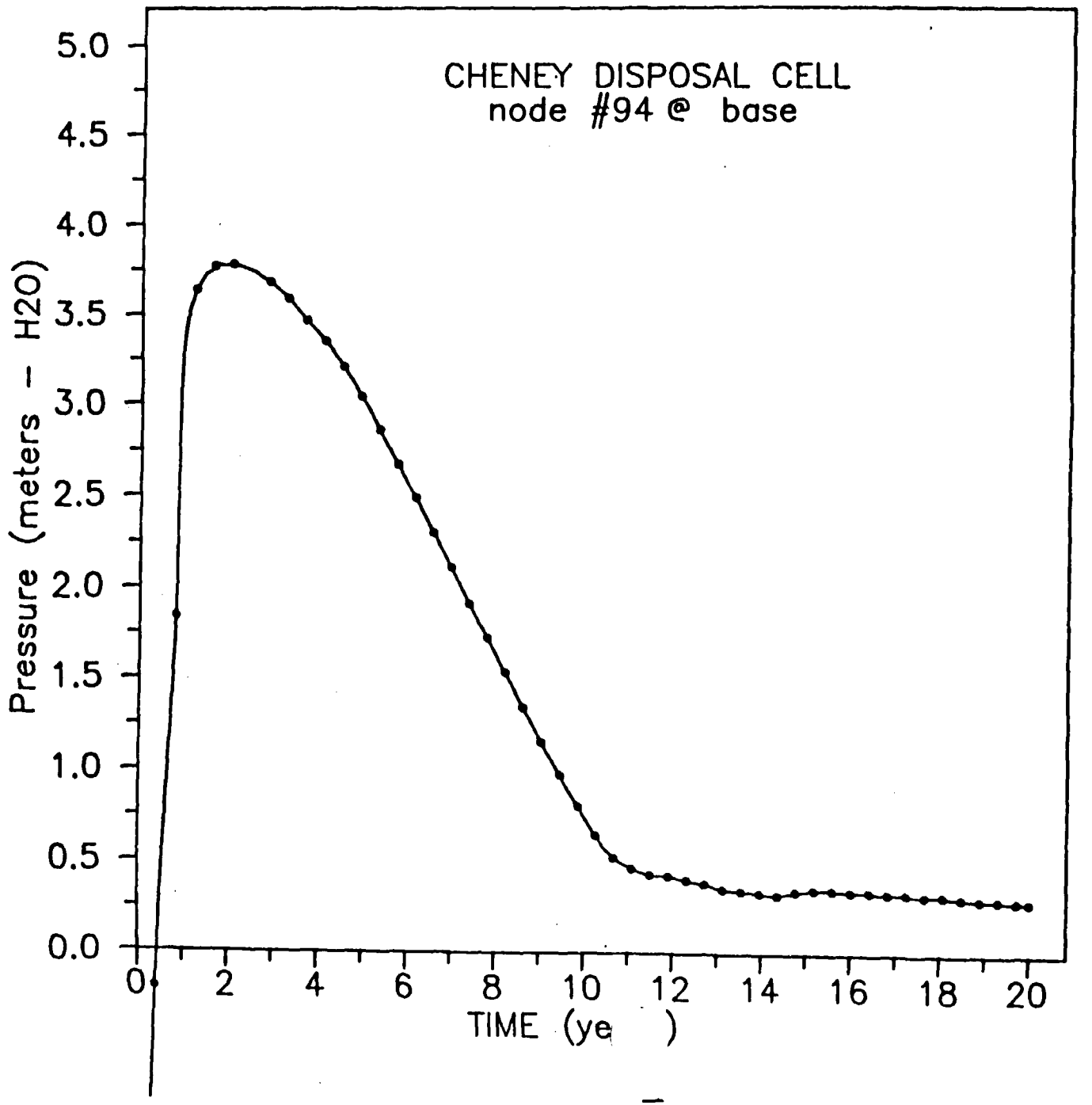

CHENEY DISPOSAL CELL
node #94 @ base
Pressure (meters - H20)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
TIME (ye)

Figure #11

DISCUSSION:

Wasatch Formation in lieu of Mancos Formation:

Geotechnical engineering properties and infiltration characteristics of Mancos Formation shale and Wasatch Formation shale may be considered similar for this analysis because of the following conditions. Both lithologic units would carry the same engineering classification. Both materials are clayshales high in smectite minerals. Although the Mancos material is an older formation of the Cretaceous period while the Wasatch was formed during the much younger Tertiary period, both materials possess similar effects from weathering. Both units occur at similar depths beneath similar overburden materials. This overburden generally consists of silty, sandy clays derived from the underlying parent shale. The consistent overburden material and depth produced a closely matched depth of weathering in both units. Semi-arid climatic conditions exist at both locations which creates a similar force causing the weathering.

Weathering produces fracturing and micro-fracturing and general degradation within the rock mass. These fractures provide flow paths through the material. It is widely accepted that smectite minerals possess a high swell potential. Because the overburden material and depths are similar at both locations, the applied overburden stress will be similar. Thus, the possible degree of swell that can occur upon moisture increases will also be similar. The above swell similarity will produce similar void ratios in both materials. This is confirmed by approximately equal dry unit weights. Similar void ratios and mineral types produce similar pore sizes which control pore fluid tensions which govern unsaturated flow characteristics.

Considering all of the above, differences in hydraulic characteristics between Mancos Formation shales and Wasatch Formation shales are negligible.

SUMMARY OF RESULTS:

Using results from this analysis in conjunction with results from previous analyses indicated that some ponding will possibly occur. The actual depth of this ponding ranges from no ponding to slightly over 12 feet. The spread in resulting depths is mainly due to varations in the capillarity data. None of the analyses indicate that the level of the water approaches the elevation of the lowest paleochannel. Thus, these models have indicated that seepage of contaminates out of the cell into paleochannels allowing an exit path for the contamination to reach useable aquifers, is not shown to occur.

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

APPENDIX

TAC CALCULATION GET-08-90-12-05-00

RETC INPUT - VICINITY PROPERTY MATERIALS
- MAIN PILE TAILINGS
- WASATCH FORMATION

UNSAT2 INPUT - DBS&A data
- previous data

```
*************************************************************
*                                                           *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                 *
*                                                           *
*GRJ, VICINITY PROPERTY MATERIALS, (RS-3/ #5-15 & #5-16)    *
*                                                           *
*     MUALEM-BASED RESTRICTION, M=1-1/N                     *
*     ANALYSIS OF RETENTION DATA ONLY                       *
*     MTYPE= 3     METHOD= 2                                *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.2285	1
2	WCS	.4069	1
3	ALPHA	.0500	1
4	N	2.0000	1
5	M	.5000	0
6	EXPO	.5000	0
7	CONDS	1.09E-04	0

OBSERVED DATA

OBS. NO.	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	.100	.4069	1.0000
2	.100	.3978	1.0000
3	102.000	.3311	1.0000
4	102.000	.3316	1.0000
5	305.900	.2970	1.0000
6	305.900	.2904	1.0000
7	1019.800	.2671	1.0000
8	1019.800	.2560	1.0000
9	3059.400	.2609	1.0000
10	3059.400	.2550	1.0000
11	7138.600	.2380	1.0000
12	7138.600	.2325	1.0000
13	15297.000	.2325	1.0000
14	15297.000	.2285	1.0000

NIT	SSQ	WCR	WCS	ALPHA	N
0	.01877	.2285	.4069	.0500	2.0000
10	.00042	.2103	.4025	.0330	1.3504

CORRELATION MATRIX

	1	2	3	4
1	1.0000			
2	-.0354	1.0000		
3	-.8130	.2576	1.0000	
4	.9671	-.0485	-.9117	1.0000

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .99070334

VARIABLE	VALUE	S.E.COEFF.	T-VALUE	95% CONFIDENCE LIMITS LOWER	UPPER
WCR	.21025	.01530	13.74	.1762	.24[illegible]
WCS	.40246	.00460	87.44	.3922	.41[illegible]
ALPHA	.03297	.01231	2.68	.0055	.06[illegible]
N	1.35042	.09971	13.54	1.1283	1.5[illegible]

OBSERVED AND FITTED DATA
==========

NO	P	LOG-P	WC-OBS	WC-FIT	WC-DIF
[illegible]	[illegible]0D+00	-1.0000	.4069	.4024	.0045
[illegible]	[illegible]D+00	-1.0000	.3978	.4024	-.0046
[illegible]	[illegible]+03	2.0086	.3311	.3302	.0009
[illegible]	[illegible]+03	2.0086	.3316	.3302	.0014
[illegible]	[illegible]+03	2.4856	.2970	.2948	.0022
[illegible]	[illegible]+03	2.4856	.2904	.2948	-.0044
[illegible]	[illegible]+04	3.0085	.2671	.2662	.0009
[illegible]	[illegible]0D+04	3.0085	.2560	.2662	-.0102
[illegible]	.30590+04	3.4856	.2609	.2484	.0125
10	.30590+04	3.4856	.2550	.2484	.0066
11	.71390+04	3.8536	.2380	.2386	-.0006
12	.71390+04	3.8536	.2325	.2386	-.0061
13	.15300+05	4.1846	.2325	.2320	.0005
14	.15300+05	4.1846	.2285	.2320	-.0035

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES
==========

	UNWEIGHTED	WEIGHTED
RETENTION DATA	.00042	.00042
COND/DIFF DATA	.00000	.00000
ALL DATA	.00042	.00042

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)
==========

WC	P	LOGP	COND	LOGK	DIF	LOGD
.2115	.59120+08	7.772	.5965D-23	-23.224	.8377D-12	-1[illegible]
.2127	.81790+07	6.913	.1763D-20	-20.754	.1713D-10	-1[illegible]
.2151	.11310+07	6.054	.5211D-18	-18.283	.3502D-09	-9.[illegible]
.2199	.15650+06	5.195	.1540D-15	-15.812	.7159D-08	-8.1[illegible]
.2247	.49210+05	4.692	.4294D-14	-14.367	.4183D-07	-7.[illegible]
.2295	.21650+05	4.335	.4553D-13	-13.342	.1464D-06	-6.[illegible]
.2343	.11450+05	4.059	.2843D-12	-12.546	.3868D-06	-6.[illegible]
.2391	.68050+04	3.833	.1270D-11	-11.896	.8558D-06	-6.[illegible]
.2439	.43810+04	3.642	.4502D-11	-11.347	.1675D-05	-5.[illegible]
.2487	.29910+04	3.476	.1348D-10	-10.870	.2999D-05	-5.[illegible]
.2535	.21350+04	3.329	.3546D-10	-10.450	.5013D-05	-5.[illegible]
.2583	.15790+04	3.198	.8431D-10	-10.074	.7944D-05	-5.[illegible]
.2631	.12010+04	3.080	.1846D-09	-9.734	.1206D-04	-4.9[illegible]
.2679	.93510+03	2.971	.3778D-09	-9.423	.1766D-04	-4.[illegible]
.2727	.74220+03	2.871	.7307D-09	-9.136	.2511D-04	-4.[illegible]
.2775	.59870+03	2.777	.1347D-08	-8.871	.3482D-04	-4.[illegible]
.2823	.48980+03	2.690	.2382D-08	-8.623	.4727D-04	-4.[illegible]
.2871	.40540+03	2.608	.4066D-08	-8.391	.6302D-04	-4.[illegible]
.2919	.33900+03	2.530	.6726D-08	-8.172	.8271D-04	-4.[illegible]
.2967	.28590+03	2.456	.1083D-07	-7.965	.1071D-03	-3.9[illegible]
.3015	.24300+03	2.386	.1702D-07	-7.769	.1370D-03	-3.[illegible]
.3064	.20790+03	2.318	.2617D-07	-7.582	.1736D-03	-3.[illegible]
.3112	.17860+03	2.252	.3951D-07	-7.403	.2180D-03	-3.[illegible]
.3160	.15450+03	2.189	.5864D-07	-7.232	.2717D-03	-3.[illegible]
.3208	.13400+03	2.127	.8574D-07	-7.067	.3366D-03	-3.4[illegible]
.3256	.11660+03	2.067	.1237D-06	-6.908	.4148D-03	-3.[illegible]

.3352	.8870D+02	1.948	.2472D-06	-6.604	.6233D-03	-3.205
.3400	.7746D+02	1.889	.3487D-06	-6.458	.7616D-03	-3.118
.3448	.6762D+02	1.830	.4845D-06	-6.315	.9301D-03	-3.031
.3496	.5894D+02	1.770	.6690D-06	-6.175	.1137D-02	-2.944
.3544	.5124D+02	1.710	.9197D-06	-6.036	.1392D-02	-2.856
.3592	.4435D+02	1.647	.1261D-05	-5.899	.1712D-02	-2.766
.3640	.3814D+02	1.581	.1726D-05	-5.763	.2118D-02	-2.674
.3688	.3252D+02	1.512	.2366D-05	-5.626	.2645D-02	-2.578
.3736	.2737D+02	1.437	.3256D-05	-5.487	.3345D-02	-2.476
.3784	.2262D+02	1.354	.4516D-05	-5.345	.4309D-02	-2.366
.3832	.1817D+02	1.259	.6351D-05	-5.197	.5706D-02	-2.244
.3880	.1395D+02	1.145	.9144D-05	-5.039	.7891D-02	-2.103
.3928	.9835D+01	.993	.1375D-04	-4.862	.1178D-01	-1.929
.3977	.5613D+01	.749	.2279D-04	-4.642	.2095D-01	-1.679
.4001	.3283D+01	.516	.3240D-04	-4.489	.3380D-01	-1.471
.4025	.0000D+00		.1090D-03	-3.963		

END OF PROBLEM
==========

```
*****************************************************************
*                                                               *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                     *
*                                                               *
*SOIL MAIN FILE TAILINGS, 03 1% -200 (55-3)                     *
*                                                               *
*     MULAM-BASED PERTURBATION, M=1-1/N                         *
*     ANALYSIS OF RETENTION DATA ONLY                           *
*     MTYPE= 3,    METHOD= 2                                    *
*                                                               *
*****************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS
==========

NO	NAME	INITIAL VALUE	INTEX
1	WCR	[illegible]	1
2	WCS	[illegible]	1
3	ALPHA	[illegible]	1
4	N	[illegible]	1
5	W	[illegible]	1
6	[illegible]	[illegible]	1
7	[illegible]	[illegible]	1

OBSERVED DATA
==========

OBS NO	PRESS HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	112 000	[illegible]	1.0000
2	309 900	[illegible]	1.0000
3	1019 000	[illegible]	1.0000
4	[illegible]	[illegible]	1.0000
5	7139 400	[illegible]	[illegible]
6	15799 000	[illegible]	[illegible]

NO	SSQ	WCR	ALPHA	N
0	[illegible]	[illegible]	[illegible]	[illegible]
10	.00072	.2211	[illegible]	[illegible]

CORRELATION MATRIX
==========

	1	2	3
1	[illegible]		
2	[illegible]	[illegible]	
3	[illegible]	[illegible]	[illegible]

SQ. ROOT MEAN PROPORTION OF OBSERVED VS FITTED VALUES = [illegible]
==========

[illegible] LEAST-SQUARES ANALYSIS FINAL RESULTS

VARIABLE	VALUE	S.E.COEFF.	T-VALUE	95% CONFIDENCE LIMITS LOWER	UPPER
[illegible]	[illegible]	[illegible]	6.45	[illegible]	[illegible]
A_F-A	.00342	.00097	3.53	[illegible]	[illegible]
N	1.70993	.29152	5.87	.7922	2.4774

OBSERVED AND FITTED DATA

NO	F	LOG-F	WO-OBS	WO-FIT	WO-DIF
1	11220+03	2.0507	.4427	.4496	.0172
2	.30590+03	2.4954	.3391	.4225	-.0134
3	10200+04	3.0088	.3700	.3178	.0144
4	.30590+04	3.4954	.2545	.2472	-.0107
5	71350+04	3.8534	.2473	.2445	-.0032
6	15400+05	4.1875	.2414	.2399	.0057

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

	INCLUDED	EXCLUDED
RETENTION DATA	[illegible]	[illegible]
[illegible] DATA	[illegible]	[illegible]
ALL DATA	[illegible]	[illegible]

[illegible] LATERALLY RESTRICTED (MTYPE = 3)

N	F	LOG	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4471	.19991-07	2.079	.19720-05	-5.714	.74881-02	-2.117
4473	.16970-07	2.019	.24150-05	-5.617	.88877-02	-2.[illegible]
4474	.14130-07	2.157	.27450-05	-5.516	.10277-01	-1.919
4486	.11417-07	2.745	.38920-05	-5.410	.16357-01	-1.786
4547	.89140-08	1.957	.51030-05	-5.292	.2741[illegible]-01	-1.[illegible]
4609	.57910-08	1.743	.70690-05	-5.151	.40470-01	-1.391
4639	.38120-08	1.581	.87760-05	-5.057	.49750-01	-1.187
4677	.00000-00		.15000-04	-4.824		

END OF PROBLEM
==========

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*************************************************************
*                                                           *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                  *
*                                                           *
*ESTES GULCH, WASATCH FORMATION                              *
*                                                           *
*    MUALEM-BASED RESTRICTION, M=1-1/N                      *
*    ANALYSIS OF RETENTION DATA ONLY                        *
*    MTYPE= 3     METHOD= 2                                 *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS
==========

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.0800	0
2	WCS	.1600	0
3	ALPHA	.0500	1
4	N	2.0000	1
5	M	.5000	0
6	EXPO	.5000	0
7	CONDS	2.00E-06	0

OBSERVED DATA
==========

OBS. NO.	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	5103.600	.1392	1.0000
2	3062.200	.1425	1.0000
3	2041.400	.1456	1.0000
4	1020.700	.1494	1.0000
5	918.700	.1499	1.0000
6	714.500	.1505	1.0000
7	510.400	.1515	1.0000
8	306.200	.1529	1.0000
9	102.100	.1548	1.0000
10	.000	.1578	1.0000

NIT	SSQ	ALPHA	N
0	.03821	.0500	2.0000
8	.00002	.0063	1.0803

CORRELATION MATRIX
==========

	1	2
1	1.0000	
2	-.9610	1.0000

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .96008671
==========

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS
==========

95% CONFIDENCE LIMITS

2/3

VARIABLE	VALUE	S.E. COEFF.	T-VALUE	LOWER	UPPER
ALPHA	.00675	.00241	2.60	.0007	.0116
N	1.08007	.01250	86.42	1.0514	1.1091

OBSERVED AND FITTED DATA
****

NO	P	LOG-P	WC-OBS	WC-FIT	WC-DIF
1	.5104D+04	3.7079	.1392	.1405	-.0013
2	.3062D+04	3.4860	.1425	.1429	-.0004
3	.2041D+04	3.3099	.1456	.1449	.0007
4	.1021D+04	3.0099	.1494	.1483	.0011
5	.9187D+03	2.9632	.1499	.1488	.0011
6	.7145D+03	2.8540	.1505	.1500	.0005
7	.5104D+03	2.7079	.1515	.1515	-.0000
8	.3062D+03	2.4860	.1529	.1537	-.0008
9	.1021D+03	2.0090	.1546	.1572	-.0024
10	.10000-04	-5.0000	.1578	.1600	-.0022

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES
****

	UNWEIGHTED	WEIGHTED
RETENTION DATA	.00002	.00002
COND/DIFF DATA	.00000	.00000
ALL DATA	.00002	.00002

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)
****

WC	P	LOGP	COND	LOGK	DIF	LOGD
.0940	.4283D+12	11.632	.1955D-30	-30.709	.7451D-16	-16.128
.0960	.8116D+11	10.909	.7603D-29	-29.119	.4805D-15	-15.318
.0980	.1871D+11	10.272	.1920D-27	-27.717	.2487D-14	-14.604
.1000	.5036D+10	9.702	.3450D-26	-26.462	.1082D-13	-13.966
.1020	.1536D+10	9.186	.4705D-25	-25.327	.4093D-13	-13.388
.1040	.5196D+09	8.716	.5111D-24	-24.291	.1379D-12	-12.861
.1060	.1917D+09	8.283	.4567D-23	-23.339	.4213D-12	-12.375
.1080	.7616D+08	7.882	.3498D-22	-22.456	.1185D-11	-11.926
.1100	.3225D+08	7.508	.2319D-21	-21.635	.3105D-11	-11.509
.1120	.1443D+08	7.159	.1360D-20	-20.866	.7643D-11	-11.117
.1140	.6781D+07	6.831	.7169D-20	-20.145	.1781D-10	-10.749
.1160	.3327D+07	6.522	.3436D-19	-19.464	.3956D-10	-10.403
.1180	.1696D+07	6.230	.1513D-18	-18.820	.8413D-10	-10.075
.1200	.8954D+06	5.952	.6173D-18	-18.210	.1721D-09	-9.764
.1220	.4876D+06	5.686	.2352D-17	-17.629	.3402D-09	-9.468
.1240	.2731D+06	5.436	.8420D-17	-17.075	.6512D-09	-9.186
.1260	.1569D+06	5.196	.2849D-16	-16.545	.1211D-08	-8.917
.1280	.9231D+05	4.965	.9154D-16	-16.038	.2195D-08	-8.659
.1300	.5547D+05	4.744	.2805D-15	-15.552	.3884D-08	-8.411
.1320	.3399D+05	4.531	.8230D-15	-15.085	.6722D-08	-8.172
.1340	.2120D+05	4.326	.2320D-14	-14.634	.1141D-07	-7.943
.1360	.1344D+05	4.128	.6307D-14	-14.200	.1901D-07	-7.721
.1380	.8639D+04	3.936	.1658D-13	-13.780	.3118D-07	-7.506
.1400	.5623D+04	3.750	.4230D-13	-13.374	.5044D-07	-7.297
.1420	.3696D+04	3.568	.1051D-12	-12.978	.8066D-07	-7.093
.1440	.2448D+04	3.389	.2551D-12	-12.593	.1279D-06	-6.893
.1460	.1627D+04	3.211	.6080D-12	-12.216	.2019D-06	-6.695
.1480	.1080D+04	3.033	.1431D-11	-11.845	.3188D-06	-6.496
.1500	.7105D+03	2.852	.3349D-11	-11.475	.5077D-06	-6.294

.1520	.4576D+03	2.661	.7896D-11	-11.103	.8251D-06	-6.084
.1540	.2821D+03	2.450	.1912D-10	-10.718	.1398D-05	-5.855
.1560	.1584D+03	2.200	.4953D-10	-10.305	.2579D-05	-5.589
.1580	.6911D+02	1.840	.1535D-09	-9.814	.5870D-05	-5.231
.1590	.3330D+02	1.522	.3311D-09	-9.480	.1116D-04	-4.952
.1600	.0000D+00		.2000D-07	-7.699		

END OF PROBLEM

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CHENEY DISPOSAL CELL - 20 ANALYSIS - 1.0E-0[illegible]
235 17 924 1 3 0 100 1 79 1 0. 0. 0.

CHENEY DISPOSAL CELL
~~DSB~~
DBS&A data

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584
    [illegible]    [illegible]    1.156E+0 1.875E-04    1 [illegible]
 1.05E+00 1.0E+01
9.428E-02  9.428E-02  [illegible]  [illegible]  [illegible]  1.3E+00  [illegible]
1.[illegible]E-02  1.[illegible]E-02  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
[illegible]  1.73[illegible]E-04  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
  1    0    91.4    41.8    -8[illegible].0 2.64E-04
  2   -2    91.4    [illegible]    -8[illegible]
  3   -2    91.4    [illegible]    -8[illegible]
  4   -2    91.4    [illegible]    -8[illegible]
  5   -2    91.4    [illegible]    -8[illegible]
  6   -2    91.4    25.9    -10.2
  7   -2    91.4    20.6    -10.2
  8   -2    91.4    15.2    -10.2
  9    0    97.5    41.0    -2.75 5.27E-04
 10    0    97.5    37.2    -2.75
 11    0    97.5    32.4    -2.5[illegible]
 12    0    97.5    28.9    -2.5[illegible]
 13    0    97.5    25.7    -2.5[illegible]
 14    0    97.5    [illegible]    -10.2
 15    0    97.5    19.4    -10.2
 16   -2    97.5    15.2    -10.2
 17    0   103.6    41.2    -2.75 5.9[illegible]E-04
 18    0   103.6    37.4    -2.75
 19    0   103.6    33.5    -2.5[illegible]
 20    0   103.6    28.1    -2.5[illegible]
 21    0   103.6    24.0    -2.5[illegible]
 22    0   103.6    21.3    -10.2
 23    0   103.6    18.3    -10.2
 24   -2   103.6    15.2    -10.2
 25    0   111.2    41.4    -2.75 6.6[illegible]E-04
 26    0   111.2    37.6    -2.75
 27    0   111.2    33.7    -2.5[illegible]
 28    0   111.2    28.2    -2.5[illegible]
 29    0   111.2    24.0    -2.5[illegible]
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31	0	112.9	15.2	[illegible]	
32	-2	112.9	15.2	-10.2	
33	0	118.9	41.6	-2.75	6.61E-04
34	0	118.9	37.8	-2.75	
35	0	118.9	33.9	-2.50	
36	0	118.9	28.3	-2.50	
37	0	118.9	23.9	-2.50	
38	0	121.5	20.8	-10.2	
39	0	121.5	18.0	-10.2	
40	-2	121.5	15.2	-10.2	
41	0	126.5	41.6	-2.75	6.57E-04
42	0	126.5	38.0	-2.75	
43	0	126.5	34.2	-2.50	
44	0	126.5	28.3	-2.50	
45	0	126.5	23.8	-2.50	
46	0	129.5	20.6	-10.2	
47	0	129.5	17.9	-10.2	
48	-2	129.5	15.2	-10.2	
49	0	134.1	42.0	-2.75	6.57E-04
50	0	134.1	38.2	-2.75	
51	0	134.1	34.4	-2.50	
52	0	134.1	28.4	-2.50	
53	0	134.1	23.7	-2.50	
54	0	136.8	20.3	-10.2	
55	0	136.8	17.8	-10.2	
56	-2	136.8	15.2	-10.2	
57	0	141.7	42.2	-2.75	6.61E-04
58	0	141.7	38.4	-2.75	
59	0	141.7	34.5	-2.50	
60	0	141.7	28.5	-2.50	
61	0	141.7	23.6	-2.50	
62	0	143.4	20.1	-10.2	
63	0	143.4	17.7	[illegible]	
64	-2	143.4	15.2	-10.2	
65	0	149.4	42.4	[illegible]	[illegible]
66		149.4	38.6	[illegible]	
67	0	149.4	34.5	-2.50	
68	0	149.4	28.6	-2.50	
69	0	149.4	23.6	-2.50	
70	0	149.4	[illegible]	-10.2	
71	0	149.4	17.5	-10.2	
72	-2	149.4	15.2	-10.2	
73	0	156.5	42.6	-2.75	6.13E-04
74	0	156.5	38.7	-2.75	
75	0	156.5	34.9	-2.50	
76	0	156.5	28.6	-2.50	
77	0	156.5	23.6	-2.50	
78	0	156.5	17.5	-10.2	
79	0	156.5	17.5	-10.2	
80	-2	156.5	15.2	-10.2	
81	0	163.6	42.7	-2.75	6.13E-04
82	0	163.6	38.9	-2.75	
83	0	163.6	35.1	-2.50	
84	0	163.6	28.6	-2.50	
85	0	163.6	23.5	-2.50	
86	0	163.6	19.8	-10.2	
87	0	163.6	17.5	-10.2	
88	-2	163.6	15.2	-10.2	
89	0	170.7	42.9	-2.75	7.91E-04
90	0	170.7	39.1	-2.75	
91	0	170.7	35.3	-2.50	
92	0	170.7	28.7	-2.50	
93	0	170.7	23.5	-2.50	
94	0	170.7	19.6	-10.2	
95	0	170.7	17.5	-10.2	

99	0	179.6	36.6	-2.50	
100	0	179.8	28.7	-2.50	
101	0	179.6	23.6	-2.50	
102	0	179.8	20.2	-10.2	
103	0	1[illegible]8	17.7	-10.2	
104	-2	1[illegible]8	15.2	-10.2	
105	0	189.0	43.4	-2.75	7.91E-04
106	0	189.0	39.6	-2.75	
107	0	189.0	35.8	-2.50	
108	0	189.0	26.7	-2.50	
109	0	189.0	23.6	-2.50	
110	0	189.0	20.5	-10.2	
111	0	189.0	17.9	-10.2	
112	-2	189.0	15.2	-10.2	
113	0	198.1	43.7	-2.75	7.91E-04
114	0	198.1	39.8	-2.75	
115	0	198.1	36.0	-2.50	
116	0	198.1	28.7	-2.50	
117	0	198.1	23.7	-2.50	
118	0	198.1	20.9	-10.2	
119	0	198.1	18.1	-10.2	
120	-2	198.1	15.2	-10.2	
121	0	207.3	43.9	-2.75	7.86E-04
122	0	207.3	40.1	-2.75	
123	0	207.3	36.3	-2.50	
124	0	207.3	25.7	-2.50	
125	0	207.3	23.7	-2.50	
126	0	207.3	21.3	-10.2	
127	-2	207.3	15.2	-10.2	
128	0	207.3	15.3	-10.2	
129	0	216.3	44.1	-2.75	7.81E-04
130	0	216.3	40.3	-2.75	
131	0	216.3	36.4	-2.50	
132	0	216.3	29.1	-2.50	
133	0	216.3	24.1	-2.50	
134	0	216.3	21.6	-10.2	
135	-2	216.3	15.2	-10.2	
136	0	216.3	15.4	-10.2	
137	0	225.4	44.1	-2.75	7.82E-04
138	0	225.4	40.4	-2.75	
139	0	225.4	36.6	-2.50	
140	0	225.4	29.2	-2.50	
141	0	225.4	24.4	-2.50	
142	0	225.4	22.0	-10.2	
143	-2	225.4	15.2	-10.2	
144	0	225.4	18.6	-10.2	
145	0	234.4	44.4	-2.75	7.82E-04
146	0	234.4	40.6	-2.75	
147	0	234.4	36.8	-2.50	
148	0	234.4	29.5	-2.50	
149	0	234.4	24.7	-2.50	
150	0	234.4	22.4	-10.2	
151	-2	234.4	15.2	-10.2	
152	0	234.4	15.8	-10.2	
153	0	243.5	44.6	-2.75	7.82E-04
154	0	243.5	40.8	-2.75	
155	0	243.5	36.9	-2.50	
156	0	243.5	29.8	-2.50	
157	0	243.5	25.0	-2.50	
158	0	243.5	22.7	-10.2	
159	-2	243.5	15.2	-10.2	
160	0	243.5	19.0	-10.2	
161	0	252.5	44.8	-2.75	7.82E-04
162	0	252.5	40.9	-2.75	

163	0	252.5	37.1	-2.75	
164	0	252.5	30.0	-2.50	
165	0	252.5	25.3	-2.50	
166	0	252.5	23.1	-10.2	
167	-2	252.5	15.2	-10.2	
168	0	252.5	19.2	-10.2	
169	0	261.6	44.9	-2.75	7.82E-04
170	0	261.6	41.1	-2.75	
171	0	261.6	37.3	-2.50	
172	0	261.6	30.3	-2.50	
173	0	261.6	25.7	-2.50	
174	0	261.6	23.4	-10.2	
175	-2	261.6	15.2	-10.2	
176	0	261.6	19.3	-10.2	
177	0	270.7	45.1	-2.75	7.82E-04
178	0	270.7	41.3	-2.75	
179	0	270.7	37.5	-2.50	
180	0	270.7	30.5	-2.50	
181	0	270.7	26.0	-2.50	
182	0	270.7	23.8	-10.2	
183	-2	270.7	15.2	-10.2	
184	0	270.7	19.5	-10.2	
185	0	279.7	45.3	-2.75	7.82E-04
186	0	279.7	41.5	-2.75	
187	0	279.7	37.6	-2.50	
188	0	279.7	30.8	-2.50	
189	0	279.7	26.3	-2.50	
190	0	279.7	24.2	-10.2	
191	-2	279.7	15.2	-10.2	
192	0	279.7	19.7	-10.2	
193	0	288.8	45.5	-2.75	7.82E-04
194	0	288.8	41.4	-2.75	
195		288.8	37.5	-2.50	
196	0	288.8	31.0	-2.50	
197	0	288.8	26.4	-2.50	
198		288.8	24.5	-10.2	
199	-2	288.8	15.2	-10.2	
200	0	288.8	19.9	-10.2	
201	0	297.8	45.6	-2.75	7.82E-04
202	0	297.8	41.5	-2.75	
203	0	297.8	38.0	-2.50	
204	0	297.8	31.3	-2.50	
205	0	297.8	26.9	-2.50	
206	0	297.8	24.9	-10.2	
207	-2	297.8	15.2	-10.2	
208	0	297.8	20.1	-10.2	
209	0	306.9	45.8	-2.75	7.82E-04
210	0	306.9	42.0	-2.75	
211	0	306.9	38.1	-2.50	
212	0	306.9	31.5	-2.50	
213	0	306.9	27.3	-2.50	
214	0	306.9	25.3	-10.2	
215	-2	306.9	15.2	-10.2	
216	0	306.9	20.3	-10.2	
217	0	315.9	46.0	-2.75	7.82E-04
218	0	315.9	42.1	-2.75	
219	0	315.9	38.3	-2.50	
220	0	315.9	31.8	-2.50	
221	0	315.9	27.6	-2.50	
222	0	315.9	25.6	-10.2	
223	-2	315.9	15.2	-10.2	
224	0	315.9	20.4	-10.2	
225	0	325.0	46.2	-2.75	7.82E-04
226	0	325.0	42.3	-2.75	
227	0	325.0	38.5	-2.50	

230	0	325.0	46.6	-10.2	
231	-2	325.0	15.2	-10.2	
232	0	325.0	20.6	-10.2	
233	0	334.1	46.3	-2.75	7.82E-04
234	0	334.1	42.5	-2.75	
235	0	334.1	38.6	-2.50	
236	0	334.1	32.3	-2.50	
237	0	334.1	28.2	-2.50	
238	0	334.1	26.3	-10.2	
239	-2	334.1	15.2	-10.2	
240	0	334.1	20.8	-10.2	
241	0	343.1	46.5	-2.75	7.82E-04
242	0	343.1	42.7	-2.75	
243	0	343.1	38.8	-2.50	
244	0	343.1	32.6	-2.50	
245	0	343.1	28.5	-2.50	
246	0	343.1	26.7	-10.2	
247	-2	343.1	15.2	-10.2	
248	0	343.1	21.9	-10.2	
249	0	352.2	46.7	-2.75	7.82E-04
250	0	352.2	42.8	-2.75	
251	0	352.2	39.0	-2.50	
252	0	352.2	32.6	-2.50	
253	0	352.2	28.9	-2.50	
254	0	352.2	27.1	-10.2	
255	-2	352.2	15.2	-10.2	
256	0	352.2	21.2	-10.2	
257	0	361.2	46.9	-2.75	7.82E-04
258	0	361.2	43.0	-2.75	
259	0	361.2	39.2	-2.50	
260	0	361.2	33.1	-2.50	
261	0	361.2	29.2	-2.50	
262	0	361.2	27.4	-10.2	
263	-2	361.2	15.2	-10.2	
264	0	361.2	21.2	-10.2	
265	0	370.3	47.0	-2.75	7.82E-04
266	0	370.3	43.2	-2.75	
267	0	370.3	39.3	-2.50	
268	0	370.3	33.3	-2.50	
269	0	370.3	29.5	-2.50	
270	0	370.3	27.5	-10.2	
271	-2	370.3	15.2	-10.2	
272	0	370.3	21.5	-10.2	
273	0	379.3	47.2	-2.75	7.82E-04
274	0	379.3	43.3	-2.75	
275	0	379.3	39.5	-2.50	
276	0	379.3	33.4	-2.50	
277	0	379.3	29.8	-2.50	
278	0	379.3	28.2	-10.2	
279	-2	379.3	15.2	-10.2	
280	0	379.3	21.7	-10.2	
281	0	388.4	47.4	-2.75	7.82E-04
282	0	388.4	43.5	-2.75	
283	0	388.4	39.7	-2.50	
284	0	388.4	33.9	-2.50	
285	0	388.4	30.1	-2.50	
286	0	388.4	28.5	-10.2	
287	-2	388.4	15.2	-10.2	
288	0	388.4	21.9	-10.2	
289	0	397.5	47.6	-2.75	7.82E-04
290	0	397.5	43.7	-2.75	
291	0	397.5	39.8	-2.50	
292	0	397.5	34.1	-2.50	
293	0	397.5	30.5	-2.50	

296	0	397.5	52.1	[illegible]	
297	0	406.5	47.7	-2.75	7.82E-04
298	0	406.5	43.9	-2.75	
299	0	406.5	40.0	-2.50	
300	0	406.5	34.4	-2.50	
301	0	406.5	30.8	-2.50	
302	0	406.5	29.2	-10.2	
303	-2	406.5	15.2	-10.2	
304	0	406.5	22.2	-10.2	
305	0	415.6	47.9	-2.75	7.82E-04
306	0	415.6	44.0	-2.75	
307	0	415.6	40.2	-2.50	
308	0	415.6	34.6	-2.50	
309	0	415.6	31.1	-2.50	
310	0	415.6	29.6	-10.2	
311	-2	415.6	15.2	-10.2	
312	0	415.6	22.4	-10.2	
313	0	424.6	48.1	-2.75	7.82E-04
314	0	424.6	44.2	-2.75	
315	0	424.6	40.3	-2.50	
316	0	424.6	34.9	-2.50	
317	0	424.6	31.4	-2.50	
318	0	424.6	30.0	-10.2	
319	-2	424.6	15.2	-10.2	
320	0	424.6	22.6	-10.2	
321	0	433.7	48.2	-2.75	7.82E-04
322	0	433.7	44.4	-2.75	
323	0	433.7	40.5	-2.50	
324	0	433.7	35.1	-2.50	
325	0	433.7	31.7	-2.50	
326	0	433.7	30.3	-10.2	
327	-2	433.7	15.2	-10.2	
328	0	433.7	22.8	-10.2	
329	0	442.7	48.4	-2.75	7.82E-04
330	0	442.7	44.6	-2.75	
331	0	442.7	40.7	-2.50	
332	0	442.7	35.4	-2.50	
333	0	442.7	32.1	-2.50	
334	0	442.7	30.7	-10.2	
335	-2	442.7	15.2	-10.2	
336	0	442.7	23.0	-10.2	
337	0	451.8	48.6	-2.75	7.82E-04
338	0	451.8	44.7	-2.75	
339	0	451.8	40.9	-2.50	
340	0	451.8	35.7	-2.50	
341	0	451.8	32.4	-2.50	
342	0	451.8	31.1	-10.2	
343	-2	451.8	15.2	-10.2	
344	0	451.8	23.1	-10.2	
345	0	460.9	48.8	-2.75	7.82E-04
346	0	460.9	44.9	-2.75	
347	0	460.9	41.0	-2.50	
348	0	460.9	35.9	-2.50	
349	0	460.9	32.7	-2.50	
350	0	460.9	31.4	-10.2	
351	-2	460.9	15.2	-10.2	
352	0	460.9	23.3	-10.2	
353	0	469.9	48.9	-2.75	7.82E-04
354	0	469.9	45.1	-2.75	
355	0	469.9	41.2	-2.50	
356	0	469.9	36.2	-2.50	
357	0	469.9	33.0	-2.50	
358	0	469.9	31.8	-10.2	
359	-2	469.9	15.2	-10.2	
360	0	469.9	23.5	-10.2	

360	0	479.0	45.0	-2.75	
361	0	479.0	41.4	-2.50	
362	0	479.0	36.4	-2.50	
363	0	479.0	33.4	-2.50	
364	0	479.0	32.1	-10.2	
365	-2	479.0	15.2	-10.2	
366	0	479.0	23.7	-10.2	
367	0	488.0	49.3	-2.75	7.82E-04
368	0	488.0	45.4	-2.75	
369	0	488.0	41.5	-2.50	
370	0	488.0	36.7	-2.50	
371	0	488.0	33.7	-2.50	
372	0	488.0	32.5	-10.2	
373	-2	488.0	15.2	-10.2	
374	0	488.0	23.9	-10.2	
375	0	497.1	49.5	-2.75	7.82E-04
376	0	497.1	45.6	-2.75	
377	0	497.1	41.7	-2.50	
378	0	497.1	36.9	-2.50	
379	0	497.1	34.0	-2.50	
380	0	497.1	32.9	-10.2	
381	-2	497.1	15.2	-10.2	
382	0	497.1	24.1	-10.2	
383	0	506.1	49.6	-2.75	7.82E-04
384	0	506.1	45.6	-2.75	
385	0	506.1	41.9	-2.50	
386	0	506.1	37.2	-2.50	
387	0	506.1	34.3	-2.50	
388	0	506.1	33.2	-10.2	
389	-2	506.1	15.2	-10.2	
390	0	506.1	24.2	-10.2	
391	0	515.2	49.5	-2.75	7.82E-04
392	0	515.2	45.9	-2.75	
393	0	515.2	42.0	-2.50	
394	0	515.2	37.5	-2.50	
395	0	515.2	34.6	-2.50	
396	0	515.2	33.6	-10.2	
397	-2	515.2	15.2	-10.2	
398	0	515.2	24.4	-10.2	
399	0	524.3	50.0	-2.75	7.21E-04
400	0	524.3	46.1	-2.75	
401	0	524.3	42.2	-2.50	
402	0	524.3	37.7	-2.50	
403	0	524.3	35.0	-2.50	
404	0	524.3	34.0	-10.2	
405	0	524.3	24.6	-10.2	
406	-2	524.3	15.2	-10.2	
407	0	531.9	50.0	-2.75	6.57E-04
408	0	531.9	46.1	-2.75	
409	0	531.9	42.2	-2.50	
410	0	531.9	37.9	-2.50	
411	0	531.9	35.3	-2.50	
412	0	531.9	34.3	-10.2	
413	0	531.9	24.8	-10.2	
414	-2	531.9	15.2	-10.2	
415	0	539.5	50.0	-2.75	6.57E-04
416	0	539.5	46.1	-2.75	
417	0	539.5	42.2	-2.50	
418	0	539.5	38.1	-2.50	
419	0	539.5	35.4	-2.50	
420	0	539.5	34.6	-10.2	
421	0	539.5	24.9	-10.2	
422	-2	539.5	15.2	-10.2	
423	0	547.1	50.0	-2.75	6.57E-04

427	0	547.1	[illegible]	[illegible]	
428	0	547.1	38.3	-2.50	
429	0	547.1	35.9	-2.50	
430	0	547.1	34.9	-10.2	
431	0	547.1	25.1	-10.2	
432	-2	547.1	15.2	-10.2	
433	0	554.7	50.0	-2.75	6.57E-04
434	0	554.7	46.1	-2.75	
435	0	554.7	42.2	-2.50	
436	0	554.7	38.6	-2.50	
437	0	554.7	36.2	-2.50	
438	0	554.7	35.2	-10.2	
439	0	554.7	25.2	-10.2	
440	-2	554.7	15.2	-10.2	
441	0	562.4	50.0	-2.75	6.57E-04
442	0	562.4	46.1	-2.75	
443	0	562.4	42.2	-2.50	
444	0	562.4	38.8	-2.50	
445	0	562.4	36.5	-2.50	
446	0	562.4	35.5	-10.2	
447	0	562.4	25.4	-10.2	
448	-2	562.4	15.2	-10.2	
449	0	570.0	50.0	-2.75	6.57E-04
450	0	570.0	46.1	-2.75	
451	0	570.0	42.2	-2.50	
452	0	570.0	39.0	-2.50	
453	0	570.0	36.8	-2.50	
454	0	570.0	35.8	-10.2	
455	0	570.0	25.5	-10.2	
456	-2	570.0	15.2	-10.2	
457	0	577.6	50.0	-2.75	6.57E-04
458	0	577.6	46.1	-2.75	
459	0	577.6	42.2	-2.50	
460	0	577.6	39.2	-2.50	
461	0	577.6	37.1	-2.50	
462	0	577.6	36.1	-10.2	
463	0	577.6	25.7	-10.2	
464	-2	577.6	15.2	-10.2	
465	0	585.2	50.0	-2.75	6.57E-04
466	0	585.2	46.1	[illegible]	
467	0	585.2	42.2	-2.50	
468	0	585.2	39.4	-2.50	
469	0	585.2	37.5	-2.50	
470	0	585.2	36.4	-10.2	
471	0	585.2	25.8	-10.2	
472	-2	585.2	15.2	-10.2	
473	0	592.8	50.0	-2.75	6.57E-04
474	0	592.8	46.1	-2.75	
475	0	592.8	42.2	-2.50	
476	0	592.8	39.6	-2.50	
477	0	592.8	37.8	-2.50	
478	0	592.8	36.7	-10.2	
479	0	592.8	26.0	-10.2	
480	-2	592.8	15.2	-10.2	
481	0	600.5	50.0	-2.75	6.57E-04
482	0	600.5	46.1	-2.75	
483	0	600.5	42.2	-2.50	
484	0	600.5	39.8	-2.50	
485	0	600.5	38.1	-2.50	
486	0	600.5	37.0	-10.2	
487	0	600.5	26.1	-10.2	
488	-2	600.5	15.2	-10.2	
489	0	608.1	50.0	-2.75	6.57E-04
490	0	608.1	46.1	-2.75	
491	0	608.1	42.2	-2.50	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

494	0	608.1	37.3	-10.2	
495	0	608.1	26.3	-10.2	
496	-2	608.1	15.2	-10.2	
497	0	615.7	50.0	-2.75	6.57E-04
498	0	615.7	46.1	-2.75	
499	0	615.7	42.2	-2.50	
500	0	615.7	40.2	-2.50	
501	0	615.7	38.7	-2.50	
502	0	615.7	37.6	-10.2	
503	0	615.7	26.4	-10.2	
504	-2	615.7	15.2	-10.2	
505	0	623.3	50.0	-2.75	6.57E-04
506	0	623.3	46.1	-2.75	
507	0	623.3	42.2	-2.50	
508	0	623.3	40.5	-2.50	
509	0	623.3	39.0	-2.50	
510	0	623.3	37.9	-10.2	
511	0	623.3	26.6	-10.2	
512	-2	623.3	15.2	-10.2	
513	0	630.9	50.0	-2.75	6.57E-04
514	0	630.9	46.1	-2.75	
515	0	630.9	42.2	-2.50	
516	0	630.9	40.7	-2.50	
517	0	630.9	39.3	-2.50	
518	0	630.9	38.2	-10.2	
519	0	630.9	26.7	-10.2	
520	-2	630.9	15.2	-10.2	
521	0	638.6	50.0	-2.75	6.57E-04
522	0	646.2	50.0	-50.0	3.28E-04
523	-2	646.2	46.1	-80.0	
524	0	638.6	46.1	-2.75	
525	-2	646.2	42.2	-80.0	
526	0	638.6	42.2	-2.50	
527	-2	646.2	41.1	-80.0	
528	0	638.6	41.0	-2.50	
529	-2	646.2	40.0	-80.0	
530	0	638.6	39.0	-2.50	
531	-2	646.2	38.0	-10.2	
532	0	638.6	37.0	-10.2	
533	-2	646.2	27.0	-10.2	
534	0	638.6	24.9	-10.2	
535	-2	638.6	15.2	-10.2	
536	-2	646.2	15.2	-10.2	

1	8	15	7	7	3
2	8	16	15	15	3
3	16	16	15	15	3
4	16	24	23	23	3
5	7	14	6	6	3
6	7	15	14	14	3
7	15	22	14	14	3
8	15	23	22	22	3
9	6	13	5	5	2
10	6	14	13	13	2
11	14	21	13	13	2
12	14	22	21	21	2
13	5	12	4	4	2
14	5	13	12	12	2
15	13	20	12	12	2
16	13	21	20	20	2
17	4	11	3	3	2
18	4	12	11	11	2
19	12	19	11	11	2
20	12	20	19	19	2
21	3	11	2	2	1

23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	15	15	10	10	1
25	2	10	1	1	1
26	10	9	1	1	1
27	10	18	9	9	1
28	18	17	9	9	1
29	17	26	25	25	1
30	17	18	26	26	1
31	18	27	26	26	1
32	18	19	27	27	1
33	25	34	33	33	1
34	25	26	34	34	1
35	26	35	34	34	1
36	26	27	35	35	1
37	33	42	41	41	1
38	33	34	42	42	1
39	34	43	42	42	1
40	34	35	43	43	1
41	41	50	49	49	1
42	41	42	50	50	1
43	42	51	50	50	1
44	42	43	51	51	1
45	49	58	57	57	1
46	49	50	58	58	1
47	50	59	58	58	1
48	[illegible]	51	59	59	1
49	57	66	65	65	1
50	57	58	66	66	1
51	58	67	66	66	1
52	58	59	67	67	1
53	67	59	68	68	2
54	59	60	68	68	2
55	59	51	60	60	2
56	51	54	60	60	2
57	51	43	52	52	2
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694	378	377	369	369	1
695	378	386	377	377	1
696	386	385	377	377	1
697	386	394	385	385	1
698	394	393	385	385	1
699	394	402	393	393	1
700	402	401	393	393	1
701	401	402	409	409	1
702	402	410	409	409	1
703	402	411	410	410	1
704	402	403	411	411	1
705	409	410	417	417	1
706	410	418	417	417	1
707	410	419	418	418	1
708	410	411	419	419	1
709	417	418	425	425	1
710	418	426	425	425	1
711	419	427	426	426	1
712	418	419	427	427	1
713	425	426	433	433	1
714	426	434	433	433	1
715	426	435	434	434	1
716	426	427	435	435	1
717	433	434	441	441	1
718	434	442	441	441	1
719	434	443	442	442	1
720	434	435	443	443	1
721	441	442	449	449	
722	442	450	449	449	1
723	442	451	450	450	1
724	442	443	451	451	1
725	449	450	457	457	1
726	450	458	457	457	1
727	450	459	458	458	1
728	450	451	459	459	1
729	457	458	465	465	1
730	458	466	465	465	1
731	458	467	466	466	1
732	458	459	467	467	1
733	465	466	473	473	1
734	466	474	473	473	1
735	466	475	474	474	1
736	466	467	475	475	1
737	473	474	481	481	1
738	474	482	481	481	1
739	474	483	482	482	1
740	474	475	483	483	1
741	481	482	489	489	1
742	482	490	489	489	1
743	482	491	490	490	1
744	482	483	491	491	1
745	489	490	497	497	1
746	490	498	497	497	1
747	490	499	498	498	1

750	498	505	505	505	1
751	498	507	506	506	1
752	498	499	507	507	1
753	505	506	513	513	1
754	506	514	513	513	1
755	506	515	514	514	1
756	506	507	515	515	1
757	513	514	521	521	1
758	514	524	521	521	1
759	514	526	524	524	1
760	514	515	526	526	1
761	521	524	522	522	1
762	524	523	527	522	1
763	524	525	523	523	1
764	524	526	525	525	1
765	403	412	411	411	2
766	403	404	412	412	2
767	404	413	412	412	2
768	404	405	413	413	2
769	405	414	413	413	2
770	405	406	414	414	2
771	411	420	419	419	2
772	411	412	420	420	2
773	412	421	420	420	2
774	412	413	421	421	2
775	413	422	421	421	2
776	413	414	422	422	2
777	419	428	427	427	2
778	419	420	428	428	2
779	420	429	428	428	2
780	420	421	429	429	2
781	421	430	429	429	2
782	421	422	430	430	2
783	427	436	435	435	2
784	427	428	436	436	1
785	428	437	436	436	2
786	428	429	437	437	2
787	429	438	437	437	2
788	429	430	438	438	2
789	435	444	443	443	2
790	435	436	444	444	2
791	436	445	444	444	2
792	436	437	445	445	2
793	437	446	445	445	2
794	437	438	446	446	2
795	443	452	451	451	2
796	443	444	452	452	2
797	444	453	452	452	2
798	444	445	453	453	2
799	445	454	453	453	2
800	445	446	454	454	2
801	451	460	459	459	2
802	451	452	460	460	2
803	452	461	460	460	2
804	452	453	461	461	2
805	453	462	461	461	2
806	453	454	462	462	2
807	459	468	467	467	2
808	459	460	468	468	2
809	460	469	468	468	2
810	460	461	469	469	2
811	461	470	469	469	2
812	461	462	470	470	2
813	467	476	475	475	2

816	468	469	477	477	2
817	469	478	477	477	2
818	469	470	478	478	2
819	475	484	483	483	2
820	475	476	484	484	2
821	476	485	484	484	2
822	476	477	485	485	2
823	477	486	485	485	2
824	477	478	486	486	2
825	483	492	491	491	2
826	483	484	492	492	2
827	484	493	492	492	2
828	484	485	493	493	2
829	485	494	493	493	2
830	485	486	494	494	2
831	491	500	499	499	2
832	491	492	500	500	2
833	492	501	500	500	2
834	492	493	501	501	2
835	493	502	501	501	2
836	493	494	502	502	2
837	499	508	507	507	2
838	499	500	508	508	2
839	500	509	508	508	2
840	500	501	509	509	2
841	501	510	509	509	2
842	501	502	510	510	2
843	507	516	515	515	2
844	507	508	516	516	2
845	508	517	516	516	2
846	508	509	517	517	2
847	509	518	517	517	2
848	509	510	518	518	2
849	515	528	526	526	2
850	515	516	528	528	2
851	516	530	528	528	2
852	516	517	530	530	2
853	517	532	530	530	2
854	517	518	532	532	2
855	526	527	525	525	2
856	526	528	527	527	2
857	528	529	527	527	2
858	528	530	529	529	2
859	530	531	529	529	2
860	530	532	531	531	2
861	406	415	414	414	3
862	406	407	415	415	3
863	407	416	415	415	3
864	407	408	416	416	3
865	414	423	422	422	3
866	414	415	423	423	3
867	415	424	423	423	3
868	415	416	424	424	3
869	422	431	430	430	3
870	422	423	431	431	3
871	423	432	431	431	3
872	423	424	432	432	3
873	430	439	438	438	3
874	430	431	439	439	3
875	431	440	439	439	3
876	431	432	440	440	3
877	438	447	446	446	3
878	438	439	447	447	3
879	439	448	447	447	3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

882	446	447	455	455	3
883	447	456	455	455	3
884	447	448	456	456	3
885	454	463	462	462	3
886	454	455	463	463	3
887	455	464	463	463	3
888	455	456	464	464	3
889	462	471	470	470	3
890	462	463	471	471	3
891	463	472	471	471	3
892	463	464	472	472	3
893	470	479	478	478	3
894	470	471	479	479	3
895	471	480	479	479	3
896	471	472	480	480	3
897	478	487	486	486	3
898	478	479	487	487	3
899	479	488	487	487	3
900	479	480	488	488	3
901	486	495	494	494	3
902	486	487	495	495	3
903	487	496	495	495	3
904	487	488	496	496	3
905	494	503	502	502	3
906	494	495	503	503	3
907	495	504	503	503	3
908	495	496	504	504	3
909	502	511	510	510	3
910	502	503	511	511	3
911	503	512	511	511	3
912	503	504	512	512	3
913	510	519	518	518	3
914	510	511	519	519	3
915	511	520	519	519	3
916	511	512	520	520	3
917	518	527	526	526	3
918	518	519	527	527	3
919	519	528	527	527	3
920	519	520	528	528	3
921	527	533	531	531	3
922	527	532	533	533	3
923	534	536	533	533	3
924	534	535	536	536	3

RESTART CHENEY DISPOSAL CELL-2D ANALYSIS-1.0E-07 cm/sec COVER FLUX/100-50 YR-5
2 -1
1.5 25.0 500.0 1.10 1.825E+04 1.0

RESTART CHENEY DISPOSAL CELL-2D ANALYSIS-1.0E-07 cm/sec COVER FLUX/500-1000 YR-5
2 -1
25 365.0 500.0 1.20 1.825E+05 1.0

RESTART CHENEY DISPOSAL CELL-2D ANALYSIS-1.0E-07 cm/sec COVER FLUX/500-1000 Y
2 -1
365 3650.0 3650.0 1.25 3.650E+05 1.0

END

CHELEY DISPOSAL CELL
w/ previous data

-1

-1

-1

1	-1							
477								
1	-1							
487								
1	-1							
488								
1	-1							
495								
1	-1							
504								
1	-1							
512								
1	-1							
520								
1	-1							
523								
1	-1							
525								
1	-1							
527								
1	-1							
535								
1	-1							
537								
1	-1							
537								
1								
540								
1								
5								
[illegible]	[illegible]	[illegible]	1.[illegible]	7.[illegible]	1.5			
1.[illegible]	1.[illegible]							
2.[illegible]	2.[illegible]	7.1[illegible]	0.0	1.[illegible]	5.[illegible]	7.[illegible]		
4.[illegible]	4.[illegible]	0.3[illegible]	0.0	1.[illegible]	1.4[illegible]	0.[illegible]		
7.[illegible]	7.[illegible]	7.1[illegible]	0.0	1.[illegible]	[illegible]	1.[illegible]		
[illegible]	[illegible]	8.2	40.8	-[illegible]	7.4[illegible]			
2	-2	8.2	37.8	-[illegible]				
3	-2	91.2	33.7	-[illegible]				
4	-2	91.2	29.7	-[illegible]				
5	-2	91.4	27.3	-[illegible]				
6	-2	91.4	24.9	-[illegible]				
7	-2	91.4	20.6	-10.2				
8	-2	91.4	15.2	-10.2				
9	0	97.5	41.[illegible]	-2.75	5.[illegible]			
10	0	97.5	37.3	-2.75				
11	0	97.5	33.2	-[illegible]				
12	0	97.5	29.9	-[illegible]				
13	0	97.5	25.7	-[illegible]				
14	0	97.5	23.6	-[illegible]				
15	0	97.5	19.4	-[illegible]				
16	-2	97.5	15.2	-10.2				
17	0	103.6	41.2	-2.75	5.925-[illegible]			
18	0	103.6	37.4	-2.75				
19	0	103.6	33.5	-2.[illegible]				
20	0	103.6	29.1	-2.[illegible]				
21	0	103.6	24.8	-2.[illegible]				
22	0	103.6	21.3	-10.2				
23	0	103.6	16.5	-10.2				
24	-2	103.6	15.2	-10.2				
25	0	111.2	41.4	-2.75	6.615-[illegible]			
26	0	111.2	37.6	-2.75				
27	0	111.2	33.7	-2.50				
28	0	111.2	29.2	-2.50				
29	0	111.2	24.9	-2.50				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				

33	0	118.9	41.4	-2.75	6.41E-04
34	0	118.9	37.6	-2.75	
35	0	118.9	33.9	-2.50	
36	0	118.9	28.3	-2.50	
37	0	118.9	23.9	-2.50	
38	0	121.5	20.8	-10.2	
39	0	121.5	18.0	-10.2	
40	-2	121.5	15.2	-10.2	
41	0	126.5	41.8	-2.75	6.57E-04
42	0	126.5	39.0	-2.75	
43	0	126.5	34.2	-2.50	
44	0	126.5	28.3	-2.50	
45	0	126.5	23.5	-2.50	
46	0	129.5	20.6	-10.2	
47	0	129.5	17.9	-10.2	
48	-2	129.5	15.2	-10.2	
49	0	134.1	42.0	-2.75	6.57E-04
50	0	134.1	39.2	-2.75	
51	0	134.1	34.4	-2.50	
52	0	134.1	29.1	-2.50	
53	0	134.1	23.7	-2.50	
54	0	136.5	20.3	-10.2	
55	0	136.8	17.8	-10.2	
56	-2	136.8	15.2	-10.2	
57	0	141.7	42.0	-2.75	6.41E-04
58	0	141.7	39.4	-2.75	
59	0	141.7	34.6	-2.50	
60	0	141.7	29.2	-2.50	
61	0	141.7	23.9	-2.50	
62	0	147.4	20.1	-10.2	
63	0	147.4	17.7	-10.2	
64	-2	147.4	15.0	-10.2	
65	0	149.4	40.4	-2.75	6.39E-04
66	0	149.4	35.5	-2.75	
67	0	149.4	30.5	-2.50	
68	0	149.4	25.6	-2.50	
69	0	149.7	20.6	-2.50	
70	0	149.7	18.0	-10.2	
71	0	149.7	17.5	-10.2	
72	-2	149.4	15.2	-10.2	
73	0	156.9	40.6	-2.75	6.17E-04
74	0	156.9	35.7	-2.75	
75	0	156.9	30.9	-2.50	
76	0	156.9	25.6	-2.50	
77	0	156.9	20.1	-2.50	
78	0	162.8	19.3	-10.2	
79	0	162.8	17.5	-10.2	
80	-2	162.8	15.2	-10.2	
81	0	163.6	42.7	-2.75	6.13E-04
82	0	163.6	38.9	-2.75	
83	0	163.6	35.1	-2.50	
84	0	163.6	28.4	-2.50	
85	0	163.6	23.5	-2.50	
86	0	167.6	19.8	-10.2	
87	0	167.6	17.5	-10.2	
88	-2	167.6	15.2	-10.2	
89	0	170.7	42.9	-2.75	7.91E-04
90	0	170.7	39.1	-2.75	
91	0	170.7	35.3	-2.50	
92	0	170.7	29.7	-2.50	
93	0	170.7	23.5	-2.50	
94	0	170.7	19.8	-10.2	
95	0	170.7	17.5	-10.2	
96	-2	170.7	15.2	-10.2	

99	0	179.8	38.6	-2.50	
100	0	179.8	26.7	-2.50	
101	0	179.8	23.6	-2.50	
102	0	179.8	20.2	-10.2	
103	0	179.8	17.7	-10.2	
104	-2	179.8	15.2	-10.2	
105	0	189.0	43.4	-2.75	7.91E-04
106	0	189.0	39.6	-2.75	
107	0	189.0	36.6	-2.50	
108	0	189.0	25.7	-2.50	
109	0	189.0	23.6	-2.50	
110	0	189.0	20.5	-10.2	
111	0	189.0	17.9	-10.2	
112	-2	189.0	15.2	-10.2	
113	0	198.1	43.7	-2.75	7.91E-04
114	0	198.1	39.8	-2.75	
115	0	198.1	36.0	-2.50	
116	0	198.1	25.7	-2.50	
117	0	198.1	23.7	-2.50	
118	0	198.1	20.9	-10.2	
119	0	198.1	18.1	-10.2	
120	-2	198.1	15.2	-10.2	
121	0	207.3	43.9	-2.75	7.56E-04
122	0	207.3	40.1	-2.75	
123	0	207.3	36.3	-2.50	
124	0	207.3	28.7	-2.50	
125	0	207.3	22.5	-2.50	
126	0	207.3	21.3	-10.2	
127	-2	207.3	15.2	-10.2	
128	0	207.3	15.3	-10.2	
129	0	216.3	44.1	-2.75	7.87E-04
130	0	216.3	40.3	-2.75	
131	0	216.3	36.4	-2.50	
132	0	216.3	28.7	-2.50	
133	0	216.3	24.1	-2.50	
134	0	216.3	21.6	-10.2	
135	-2	216.3	15.2	-10.2	
136	0	216.3	19.4	-10.2	
137	0	225.4	44.2	-2.75	7.87E-04
138	0	225.4	40.4	-2.75	
139	0	225.4	36.6	-2.50	
140	0	225.4	29.2	-2.50	
141	0	225.4	24.4	-2.50	
142	0	225.4	22.0	-10.2	
143	-2	225.4	15.2	-10.2	
144	0	225.4	19.4	-10.2	
145	0	234.4	44.4	-2.75	7.80E-04
146	0	234.4	40.6	-2.75	
147	0	234.4	36.9	-2.50	
148	0	234.4	29.5	-2.50	
149	0	234.4	24.7	-2.50	
150	0	234.4	22.4	-10.2	
151	-2	234.4	15.2	-10.2	
152	0	234.4	19.8	-10.2	
153	0	243.5	44.6	-2.75	7.83E-04
154	0	243.5	40.8	-2.75	
155	0	243.5	36.9	-2.50	
156	0	243.5	29.8	-2.50	
157	0	243.5	25.0	-2.50	
158	0	243.5	22.7	-10.2	
159	-2	243.5	15.2	-10.2	
160	0	243.5	19.0	-10.2	
161	0	252.5	44.8	-2.75	7.83E-04
162	0	252.5	40.9	-2.75	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

[illegible]	[illegible]	251.5	[illegible]	-2.50	
165	[illegible]	252.5	[illegible]	[illegible]	
166	[illegible]	252.5	[illegible]	-10.2	
167	-2	252.5	15.2	-10.2	
168	0	252.5	19.2	-10.2	
169	0	261.6	44.9	-2.75	7.82E-04
[illegible]	0	261.6	41.1	-2.75	
[illegible]	0	261.6	37.3	-2.50	
172	0	261.6	[illegible]	-2.50	
173	0	261.6	25.7	-2.50	
174	0	261.6	23.4	-10.2	
175	-2	261.6	19.2	-10.2	
176	0	261.6	19.3	-10.2	
177	0	270.7	45.1	-2.75	7.82E-04
178	0	270.7	41.3	-2.75	
179	0	270.7	37.5	-2.50	
180	0	270.7	30.5	-2.50	
181	0	270.7	26.0	-2.50	
182	0	270.7	23.8	-10.2	
183	-2	270.7	15.2	-10.2	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
185	0	[illegible]	[illegible]	-2.75	7.82E-04
186	0	279.7	41.5	-2.75	
187	0	279.7	37.6	-2.50	
188	[illegible]	279.7	30.2	-2.50	
189	0	279.7	26.7	-2.50	
[illegible]	0	[illegible]	24.2	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	-10.2	
193	0	288.8	[illegible]	-2.75	7.82E-04
194	[illegible]	288.8	41.4	[illegible]	
[illegible]	[illegible]	288.8	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	-2	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	45.4	[illegible]	7.82E-04
[illegible]	[illegible]	297.8	41.5	[illegible]	
[illegible]	[illegible]	297.9	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	297.8	26.9	-2.50	
204	[illegible]	297.9	24.9	-10.2	
[illegible]	-2	297.9	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	45.8	[illegible]	7.82E-04
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	0	306.9	33.1	-2.50	
[illegible]	0	306.9	31.5	-2.50	
213	0	306.9	27.3	[illegible]	
214	0	306.9	25.3	-10.2	
215	-2	306.9	15.2	-10.2	
[illegible]	0	306.9	20.2	-10.2	
217	0	315.9	44.0	-2.75	7.82E-04
[illegible]	0	315.9	42.1	-2.75	
[illegible]	0	315.9	38.3	[illegible]	
220	[illegible]	315.9	31.8	-2.50	
221	0	315.9	27.4	-2.50	
[illegible]	0	315.9	25.6	-10.2	
[illegible]	-2	315.9	15.2	-10.2	
[illegible]	[illegible]	315.9	20.4	-10.2	
225	[illegible]	325.1	44.2	-2.75	7.82E-04
[illegible]	0	325.0	42.7	-2.75	
[illegible]	0	325.0	38.5	-2.50	
[illegible]	0	[illegible]	[illegible]	[illegible]	

230	0	333.1	26.0	-10.2	
231	-2	333.1	15.2	-10.2	
232	0	333.1	20.6	-10.2	
233	0	334.1	46.3	-2.75	7.83E-04
234	0	334.1	42.5	-2.75	
235	0	334.1	38.6	-2.50	
236	0	334.1	32.3	-2.50	
237	0	334.1	28.2	-2.50	
238	0	334.1	24.3	-10.2	
239	-2	334.1	15.2	-10.2	
240	0	334.1	20.8	-10.2	
241	0	343.1	46.5	-2.75	7.82E-04
242	0	343.1	42.7	-2.75	
243	0	343.1	38.8	-2.50	
244	0	343.1	32.6	-2.50	
245	0	343.1	28.5	-2.50	
246	0	343.1	24.7	-10.2	
247	-2	343.1	15.2	-10.2	
248	0	343.1	21.0	-10.2	
249	0	352.2	44.7	-2.75	7.82E-04
250	0	352.2	42.8	-2.75	
251	0	352.2	39.0	-2.50	
252	0	352.2	32.8	-2.50	
253	0	352.2	28.9	-2.50	
254	0	352.2	27.1	-10.2	
255	-2	352.2	15.2	-10.2	
256	0	352.2	21.0	-10.2	
257	0	361.2	44.9	-2.75	7.83E-04
258	0	361.2	43.0	-2.75	
259	0	361.2	39.2	-2.50	
260	0	361.2	33.1	-2.50	
261	0	361.2	29.2	-2.50	
262	0	361.2	27.4	-10.2	
263	-2	361.2	15.2	-10.2	
264	0	361.2	21.9	-10.2	
265	0	370.3	47.0	-2.75	7.83E-04
266	0	370.3	43.2	-2.75	
267	0	370.3	39.3	-2.50	
268	0	370.3	33.3	-2.50	
269	0	370.3	29.5	-2.50	
270	0	370.3	27.8	-10.2	
271	-2	370.3	15.2	-10.2	
272	0	370.3	21.5	-10.2	
273	0	379.3	47.2	-2.75	7.83E-04
274	0	379.3	43.3	-2.75	
275	0	379.3	39.5	-2.50	
276	0	379.3	33.6	-2.50	
277	0	379.3	29.8	-2.50	
278	0	379.3	26.2	-10.2	
279	-2	379.3	15.2	-10.2	
280	0	379.3	21.7	-10.2	
281	0	388.4	47.4	-2.75	7.83E-04
282	0	388.4	43.5	-2.75	
283	0	388.4	39.7	-2.50	
284	0	388.4	33.9	-2.50	
285	0	388.4	30.1	-2.50	
286	0	388.4	26.5	-10.2	
287	-2	388.4	15.2	-10.2	
288	0	388.4	21.9	-10.2	
289	0	397.5	47.6	-2.75	7.83E-04
290	0	397.5	43.7	-2.75	
291	0	397.5	39.9	-2.50	
292	0	397.5	34.1	-2.50	
293	0	397.5	30.3	-2.50	
294	0	397.5	26.9	-10.2	

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	0	406.5	29.2	-10.2	
[illegible]	-2	406.5	15.2	-10.2	
304	0	406.5	22.0	-10.2	
305	0	415.6	47.9	-2.75	7.82E-04
306	0	415.6	44.0	-2.75	
307	0	415.6	40.0	-2.50	
308	0	415.6	34.6	-2.50	
309	0	415.6	31.1	-2.50	
310	0	415.6	29.6	-10.2	
311	-2	415.6	15.2	-10.2	
312	0	415.6	22.4	-10.2	
313	0	424.6	48.1	-2.75	7.82E-04
314	0	424.6	44.0	-2.75	
315	0	424.6	40.0	-2.50	
316	0	424.6	34.9	-2.50	
317	0	424.6	31.1	-2.50	
318	0	424.6	30.0	-10.2	
319	-2	424.6	15.2	-10.2	
320	0	424.6	22.4	-10.2	
321	0	433.7	48.0	-2.75	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
337	0	451.6	46.6	-2.75	7.82E-04
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
343	-2	[illegible]	15.2	[illegible]	
344	0	451.8	23.1	-10.2	
345	0	460.9	48.8	-2.75	7.82E-04
346	0	460.9	44.9	-2.75	
347	0	460.9	41.0	-2.50	
348	0	460.9	35.9	-2.50	
349	0	460.9	32.7	-2.50	
[illegible]	0	460.9	31.2	-10.2	
[illegible]	-2	460.9	15.2	-10.2	
[illegible]	0	460.9	23.3	-10.2	
353	0	469.9	48.9	-2.75	7.82E-04
354	0	469.9	45.1	-2.75	
[illegible]	0	469.9	41.0	-2.50	
[illegible]	0	469.9	36.2	-2.50	
357	0	469.9	33.0	-2.50	
358	0	469.9	31.6	-10.2	
359	-2	469.9	15.2	-10.2	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	547.1	38.9	-2.50	
430	[illegible]	547.1	34.9	-10.2	
431	0	547.1	25.1	-10.2	
432	-2	547.1	15.2	-10.2	
433	0	554.7	50.0	-2.75	6.57E-04
[illegible]	0	554.7	46.1	-2.75	
[illegible]	0	554.7	42.2	-2.50	
436	0	554.7	38.6	-2.50	
437	0	554.7	36.2	-2.50	
438	0	554.7	35.2	-10.2	
439	0	554.7	25.2	-10.0	
440	-2	554.7	15.2	-10.2	
441	0	562.4	50.0	-2.75	6.57E-04
442	0	562.4	46.1	-2.75	
443	0	562.4	42.2	-2.50	
444	0	562.4	38.8	-2.50	
445	0	562.4	36.5	-2.50	
446	[illegible]	562.4	35.5	-10.2	
447	[illegible]	562.4	25.4	-10.0	
448	-2	562.4	15.2	-10.2	
449	0	570.0	50.0	-2.75	6.57E-04
450	0	570.0	46.1	-2.75	
451	0	570.0	42.2	-2.50	
452	[illegible]	570.0	38.0	[illegible]	
453	0	570.0	34.8	-2.50	
454	[illegible]	570.0	34.8	-10.2	
455	[illegible]	570.0	25.8	[illegible]	
456	-2	570.0	15.2	[illegible]	
457	0	577.6	50.0	-2.75	6.57E-04
458	0	577.6	46.1	[illegible]	
459	0	577.6	42.2	[illegible]	
[illegible]	[illegible]	577.6	38.2	[illegible]	
[illegible]	[illegible]	[illegible]	34.1	[illegible]	
462	[illegible]	[illegible]	34.1	[illegible]	
463	[illegible]	577.6	25.7	[illegible]	
[illegible]	-2	577.6	15.2	[illegible]	
465	0	585.2	50.0	-2.75	6.57E-04
[illegible]	[illegible]	[illegible]	46.1	-2.75	
467	0	[illegible]	42.2	-2.50	
468	[illegible]	585.2	38.4	-2.50	
469	0	585.2	37.5	-2.50	
470	0	585.2	34.4	-10.2	
471	[illegible]	585.2	25.8	-10.2	
472	-2	585.2	15.2	[illegible]	
473	0	592.8	50.0	-2.75	6.57E-04
474	0	592.8	46.1	-2.75	
475	0	592.8	42.2	-2.50	
476	0	592.8	38.2	-2.50	
477	0	592.8	37.8	-2.50	
478	0	592.8	34.7	-10.2	
479	0	592.8	25.0	-10.0	
480	-2	592.8	15.2	-10.2	
481	0	600.5	50.0	-2.75	6.57E-04
482	0	600.5	46.1	-2.75	
483	0	600.5	42.2	-2.50	
484	0	600.5	38.8	-2.50	
485	0	600.5	38.1	-2.50	
486	0	600.5	37.0	-10.2	
487	0	600.5	34.1	-10.2	
488	-2	600.5	15.2	-10.2	
489	0	608.1	50.0	-2.75	6.57E-04
490	0	608.1	46.1	-2.75	
491	0	608.1	42.2	-2.50	
492	0	608.1	40.0	-2.50	

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[illegible]	18	17	9	9	1
29	17	24	25	25	1
30	17	18	24	26	1
31	18	27	26	26	1
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33	25	34	33	33	1
34	25	26	34	34	1
35	26	35	34	34	1
36	26	27	35	35	1
37	33	42	41	41	1
38	33	34	42	42	1
39	34	43	42	42	1
40	34	35	43	43	1
41	41	50	49	49	1
42	41	42	50	50	1
43	42	51	50	50	1
44	42	43	51	51	1
45	48	58	57	57	1
46	49	57	58	58	1
47	50	59	58	58	1
48	50	51	59	59	1
49	57	66	65	65	1
50	57	58	66	66	1
51	58	67	66	66	1
52	58	59	67	67	1
53	47	55	49	65	2
54	55	67	49	65	2
55	54	61	60	60	2
56	51	57	60	60	2
[illegible]	51	49	50	50	2
[illegible]	49	[illegible]	50	50	2
59	43	[illegible]	44	44	2
[illegible]	73	74	44	44	2
[illegible]	38	[illegible]	74	74	2
47	77	78	74	74	2
48	77	19	78	78	2
[illegible]	18	77	78	78	2
65	63	61	65	65	2
66	68	60	61	61	2
67	67	57	61	61	2
68	67	57	53	53	2
69	57	45	53	53	2
70	57	44	45	45	2
71	44	37	45	45	2
72	44	36	37	37	2
73	36	29	37	37	2
74	36	28	29	29	2
75	28	21	29	29	2
76	28	20	21	21	2
77	69	62	70	70	2
78	69	61	62	62	2
79	61	54	62	62	2
80	61	53	54	54	2
81	53	46	54	54	2
82	53	45	46	46	2
83	45	38	46	46	2
84	45	37	38	38	2
85	37	30	38	38	2
86	30	29	30	30	2
87	29	22	30	30	2
88	22	21	22	22	2

157	99	107	99	99	1
158	107	106	99	99	1
159	107	115	106	106	1
160	115	114	106	106	1
161	115	123	114	114	1
162	123	122	114	114	1
3	90	98	89	89	1
4	98	97	89	89	1
165	98	106	97	97	1
166	106	105	97	97	1
167	106	114	105	105	1
168	114	113	105	105	1
169	114	122	113	113	1
170	122	121	113	113	1
171	123	115	124	124	2
172	115	116	124	124	2
173	115	107	116	116	2
174	107	108	116	116	2
175	107	99	108	108	2
176	99	100	108	108	2
177	99	91	100	100	2
178	91	92	100	100	2
179	124	116	125	125	2
180	116	117	125	125	2
181	116	109	117	117	2
182	109	108	117	117	2
183	109	100	109	109	2
184	[illegible]	101	109	109	2
185	100	92	101	101	2
186	92	93	101	101	2
187	125	117	126	126	2
188	117	118	126	126	2
9	117	109	118	118	2
190	109	110	118	118	2
191	109	101	110	110	2
192	101	102	110	110	2
193	101	93	102	102	2
194	93	94	102	102	2
195	126	118	127	127	2
196	118	119	127	127	2
197	118	110	119	119	2
198	110	111	119	119	2
199	110	102	111	111	2
200	102	103	111	111	2
201	102	94	103	103	2
202	94	95	103	103	2
203	128	119	127	127	3
204	119	120	127	127	3
205	119	111	120	120	3
206	111	112	120	120	3
207	111	103	112	112	3
208	103	104	112	112	3
209	103	95	104	104	3
210	95	96	104	104	3
211	127	135	128	128	3
212	135	134	128	128	3
213	135	143	136	136	3
214	143	144	136	136	3
215	143	15	144	144	3
216	151	152	144	144	3
217	151	159	152	152	3
218	159	167	152	152	3
219	159	167	160	160	3
220	167	168	160	160	3

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
290	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
291	168	176	166	166	3
292	174	[illegible]	166	166	3
293	176	[illegible]	174	174	3
[illegible]	184	187	174	174	3
[illegible]	184	192	187	192	3
296	192	[illegible]	187	192	3
297	192	200	190	190	3
298	200	198	190	190	3
299	200	208	198	198	3
300	208	206	198	198	3
301	208	216	206	206	3
302	216	214	206	206	3
303	216	224	214	214	3
304	224	[illegible]	214	214	3
305	224	[illegible]	222	222	3
306	232	[illegible]	222	222	3
307	232	[illegible]	232	232	3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
309	[illegible]	[illegible]	238	238	3
310	[illegible]	246	238	238	3
311	248	256	246	246	3
312	254	[illegible]	246	246	3
313	[illegible]	[illegible]	[illegible]	[illegible]	3
314	244	[illegible]	[illegible]	[illegible]	3
[illegible]	264	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-08-90-14-11 DISCIPLINE Hydro NO. OF SHEETS 92

PROJECT:
UMTRA Site Characterization

SITE:
Grand Junction processing site, Colorado

FEATURE:
Statistical evaluation of existing groundwater contamination

SOURCES OF DATA:
DART water quality records

SOURCES OF FORMULAE & REFERENCES:
EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance."

TAD, 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		B Gallaher	08/10/90	S Reinert	8/13/90		
				S Reinert	8/20/90	Karl Fredrickson	8/20/90

JEG-AL-ENG-51 (6/87)

JE JACOBS ENGINEERING

DATE 7 August 1990 SUBJECT SHEET NO. i

BY BJ CHKD. EK JOB NO. JL

A. PURPOSE OF CALCULATION:

To assess alluvial groundwater contamination with hazardous constituents at the Grand Junction processing site using only statistical methods. Statistics are applied to those hazardous constituents in which contamination is not readily evident.

B. METHODS AND PROCEDURES

Water quality data available for monitor wells at the processing site were analyzed using the EPA approach outlined in the TAD. This approach is presented in the attached flowchart. The statistical approach is designed for comparing background water quality to onsite / downgradient water quality for constituents with no MCLs. The statistical comparison method selected depends on whether concentrations in the onsite / downgradient wells exceed statistical maximum background concentrations, and on the percentage of "nondetects" in the sample population.

Comparison is made of the concentrations of hazardous constituents in upgradient and downgradient wells. The list of hazardous constituents in the Grand Junction tailings was determined previously (Calc Set GRJ-07-90-15-01).

FORM 91-005-1 (4/81)

Not all of the identified hazardous constituents, have ~~one~~ were statistically analyzed.

were not analyzed because of their insolubility in groundwater geochemical conditions, thus precluding the possibility of contamination. constituents

C. DATA SOURCES

Groundwater quality records and general statistical descriptions were obtained from DART. To represent recent conditions, only data available from 1987 were used in the analysis. The ~~data~~ wells are grouped according to flow relationships as follows:

Upgradient	Downgradient	Cross-Gradient
588	585	737
710	586	742
744	589	
745	590	
746	733	
	736	
	740	

DART water quality data tables are presented in Attachment 1.

D. CALCULATIONS AND ANALYSES

Following EPA protocol (1989), the under quality data were analyzed using one of two background well to compliance well procedures: the test of proportions or the one-way analysis of variance (AN 7 If more than 50% of the observation

are below the detection limit (MDL), then the appropriate comparison is a test of proportions. One-way ANOVAs were performed for other constituents (no evidence of seasonality were seen in the data to require useage of an alternate ANOVA approach). The test of proportions is presented in attachment II and the ANOVA is presented in attachment III

E. RESULTS

Results of the calculations are summarized in the attached table.

F. CONCLUSIONS

The statistical analyses show the likelihood that alluvial groundwater downgradient of the processing site is contaminated with uranium and molybdenum. KB ~~and gross alpha~~. There are insufficient data, however, to statistically determine which individual well(s), if any, is contaminated, but maximum concentrations appear to be found in the southwest corner of the processing site. This corresponds to the pattern of uranium contamination. Although net gross alpha concentrations exceed the mcls in downgradient monitor wells the concentrations are within the range of background and net gross alpha is not a groundwater contaminant

JE JACOBS ENGINEERING

DATE 09 August 1990 SUBJECT

BY BD CHKD. [illegible]

SHEET NO. 4

JOB NO. [illegible]

Results of Analysis Summary

Hazardous Constituent	Contamination Indicated?	Reason/Remarks
1) Aluminum	No	NS*
2) Antimony	No	Passed Test of Proportions (TOP)
3) Arsenic	No	Passed ANOVA
4) Barium	No	Passed TOP
5) Beryllium	No	Not detected in groundwater
6) Cadmium	No	Passed ANOVA
7) Chromium	No	Passed TOP
8) Cobalt	No	Not detected in groundwater
9) Copper Stat Max = .014 Secondary St[illegible]	No	Downgradient wells do not exceed secondary's
10) Cyanide	No	NS
11) Fluoride	No	NS
12) (Net) Gross alpha	No	Passed ANOVA
13) Lead	No	Passed TOP
14) Mercury	No	Not detected in ground-w[illegible]
15) Molybdenum	Likely	Failed ANOVA
16) Nickel	No	Passed TOP
17) Nitrate	No	Passed TOP
18) Radium-226 &	No	Passed TOP
19) Selenium	No	Passed ANOVA
20) Silver	No	Passed TOP
21) Strontium	No	NS
22) Tin Stat Max .0465 3 Mo 2 Lo 1 Hi	No	Passed ANOVA
23) Uranium	Yes	Downgradient concs. 5X upgradient
24) Vanadium de an [illegible]	No	Passed TOP
25) Sulfide	No	NS
26) Zinc	No	Downgradient Wells do not exceed sec. standar

*NS = Element of hazardous compound that is not soluble in ground water conditions.

FORM 91-005-1 (4/81)

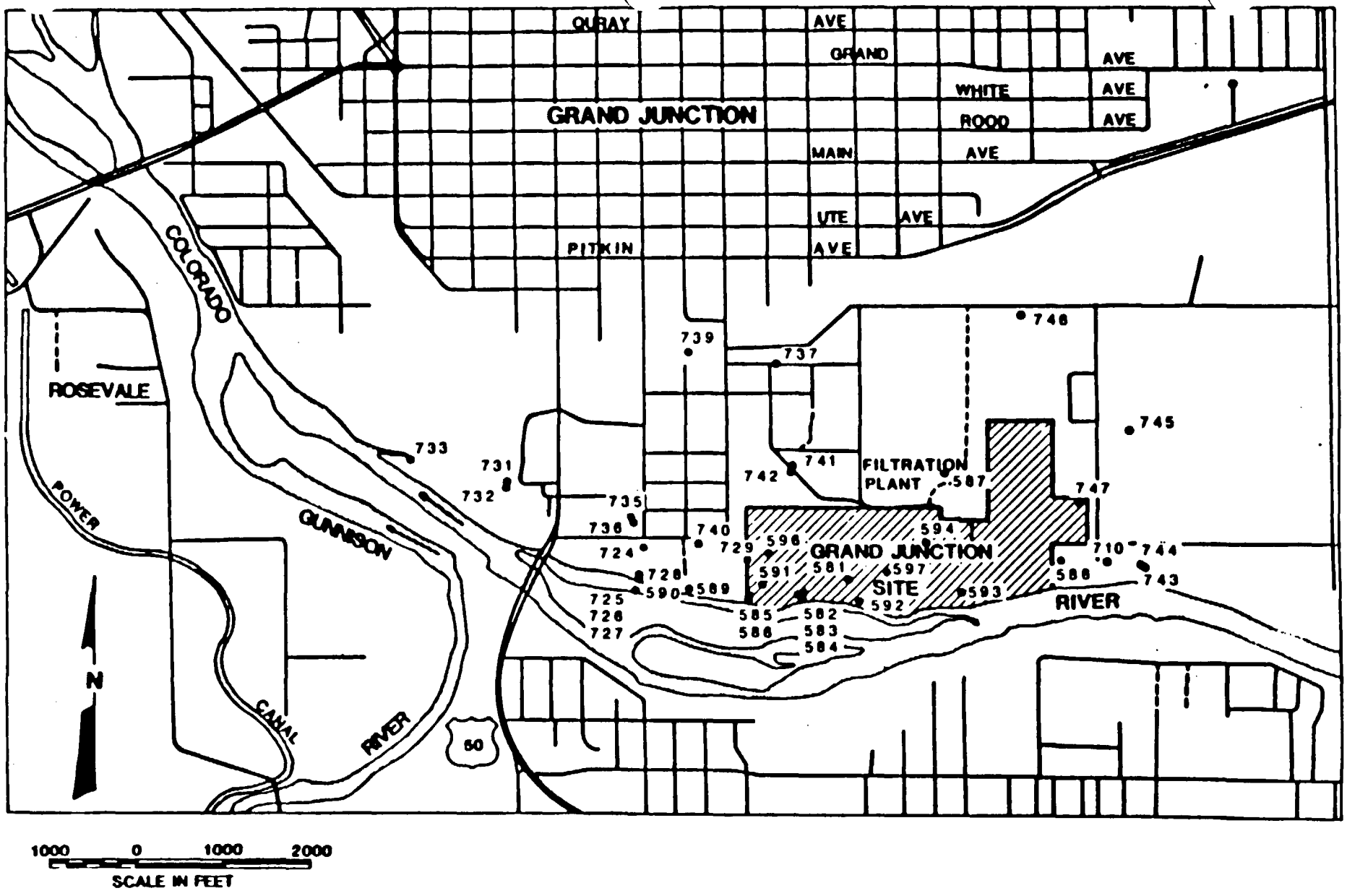

FIGURE F.3.1
MONITORING WELL LOCATIONS NEAR GRAND JUNCTION SITE

BACKGROUND WELL TO COMPLIANCE WELL COMPARISONS

EPA (1989) protocol.

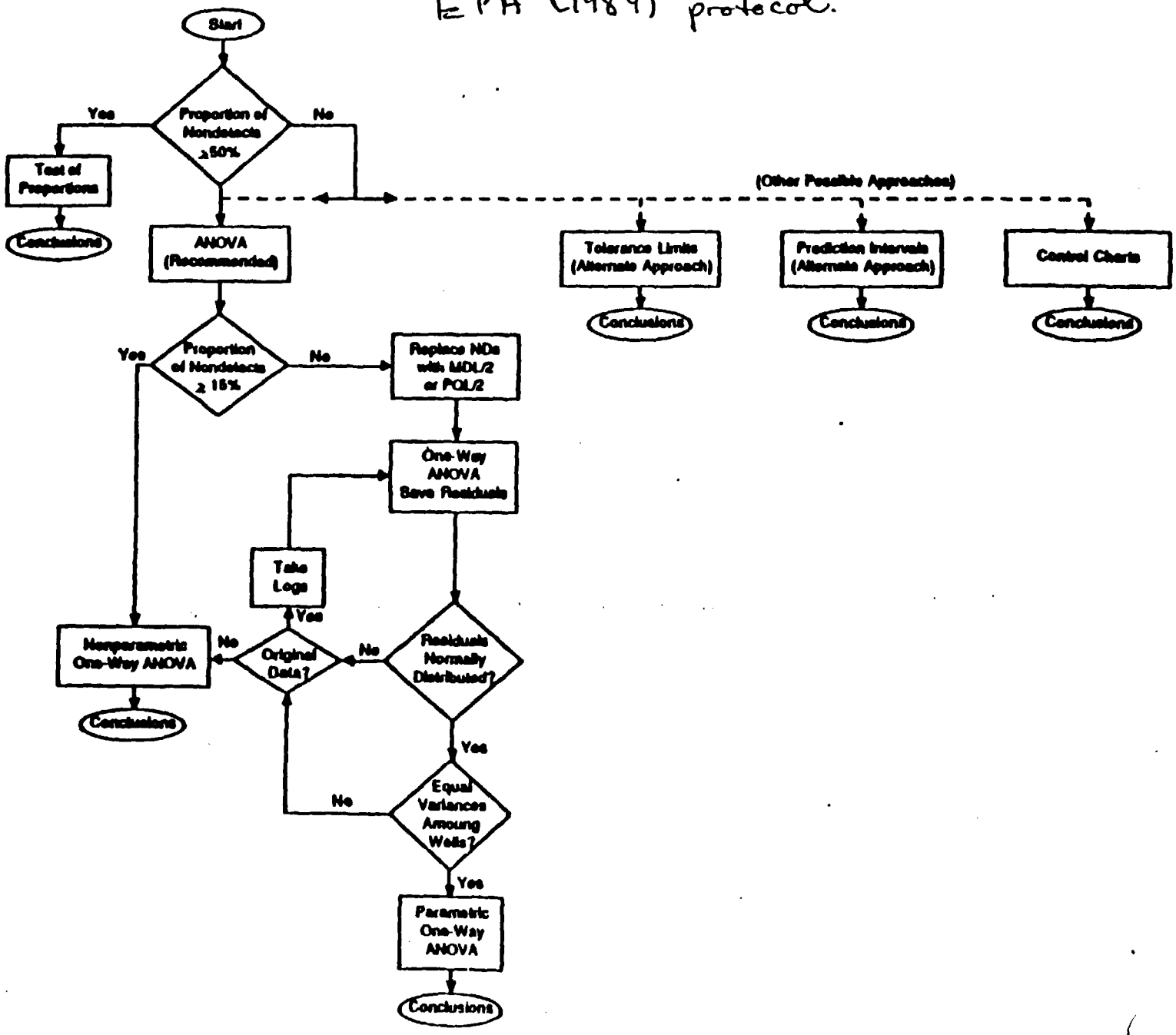

Figure 5-1. Background well [illegible] compliance well comparisons.

8/20/90

JACOBS ENGINEERING

DATE 9 August 1990 SUBJECT

BY BY CHKD. SM 8/20/90

SHEET NO. 7

JOB NO. SM 8/20/90

References:

EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities", U.S. Environmental Protection Agency, Office of Solid Waste, EPA/530-SW-89-026

FORM 91-005-1 (4/81)

JE JACOBS ENGINEERING

DATE _____ SUBJECT

BY BS CHKD. [illegible] 8/10/90

SHEET NO. 8

JOB NO. _____

Attachment I.

DART Water Quality Records.

FORM 91-005-1 (4/81)

Table . , Alluvial water quality by parameter
SITE: CRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ALKALINITY	0581	03/07/89	0001	AL	O	MG/L CACO3		539.	-
	0585	03/01/89	0001	AL	D			563.	-
	0586	03/01/89	0001	AL	D			629.	-
	0588	03/06/89	0001	AL	U			229.	-
	0589	03/01/89	0001	AL	D			588.	-
	0589	08/03/89	0001	AL	D			572.	-
	0590	09/22/88	0001	AL	D			488.	-
	0590	03/01/89	0001	AL	D			448.	-
	0590	08/03/89	0001	AL	D			485.	-
	0590	11/02/89	0001	AL	D			467.	-
	0710	03/06/89	0001	AL	U			465.	-
	0733	09/17/87	0001	AL	D			456.	-
	0733	09/22/88	0001	AL	D			651.	-
	0733	02/28/89	0001	AL	D			633.	-
	0733	08/03/89	0001	AL	D			631.	-
	0733	11/02/89	0001	AL	D			632.	-
	0736	02/28/89	0001	AL	D			503.	-
	0736	08/03/89	0001	AL	D			534.	-
	0736	11/02/89	0001	AL	D			591.	-
	0737	09/17/87	0001	AL	C			456.	-
	0737	09/22/88	0001	AL	C			462.	-
	0737	03/04/89	0001	AL	C			420.	-
	0737	08/07/89	0001	AL	C			468.	-
	0740	09/24/87	0001	AL	D			491.	-
	0740	02/28/89	0001	AL	D			411.	-
	0742	03/03/89	0001	AL	C			471.	-
	0744	03/05/89	0001	AL	U			328.	-
	0744	08/03/89	0001	AL	U			20.5	-
	0744	11/02/89	0001	AL	U			306.	-
	0745	09/17/87	0001	AL	U			526.	-
	0745	09/22/88	0001	AL	U			518.	-
	0745	03/05/89	0001	AL	U			532.	-
	0745	08/03/89	0001	AL	U			554.	-
	0745	11/02/89	0001	AL	U			529.	-
	0746	09/17/87	0001	AL	U			419.	-
	0746	09/22/88	0001	AL	U			426.	-
	0746	03/05/89	0001	AL	U			438.	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
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U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ALKALINITY	0746	08/03/89	0001	AL	U	MG/L CACO3		442.	-
	0746	11/02/89	0001	AL	U			439.	-
ALUMINUM	0581	03/07/89	0001	AL	O	MG/L	<	0.1	-
	0585	03/01/89	0001	AL	D		<	0.1	-
	0586	03/01/89	0001	AL	D		<	0.1	-
	0588	03/06/89	0001	AL	U		<	0.1	-
	0589	03/01/89	0001	AL	D		<	0.1	-
	0589	08/03/89	0001	AL	D		<	0.1	-
	0590	09/22/88	0001	AL	D			0.3	-
	0590	03/01/89	0001	AL	D		<	0.1	-
	0590	08/03/89	0001	AL	D		<	0.1	-
	0590	11/02/89	0001	AL	D		<	0.1	-
	0710	03/06/89	0001	AL	U		<	0.1	-
	0733	09/17/87	0001	AL	O			0.38	-
	0733	09/22/88	0001	AL	D			0.3	-
	0733	02/28/89	0001	AL	D		<	0.1	-
	0733	08/03/89	0001	AL	D			0.1	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D			0.3	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C			0.55	-
	0737	09/22/88	0001	AL	C			0.3	-
	0737	03/04/89	0001	AL	C		<	0.1	-
	0737	08/07/89	0001	AL	C		<	0.1	-
	0740	09/24/87	0001	AL	D			0.72	-
	0740	02/28/89	0001	AL	D		<	0.1	-
	0742	03/03/89	0001	AL	C		<	0.1	-
	0744	03/05/89	0001	AL	U		<	0.1	-
	0744	08/03/89	0001	AL	U		<	0.1	-
	0744	11/02/89	0001	AL	U		<	0.1	-
	0745	09/17/87	0001	AL	U			0.33	-
	0745	09/22/88	0001	AL	U			0.2	-
	0745	03/05/89	0001	AL	U		<	0.1	-
	0745	08/03/89	0001	AL	U		<	0.1	-
	0745	11/02/89	0001	AL	U		<	0.1	-

FORMATION OF COMPLETION CODE:
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C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ALUMINUM	0746	09/17/87	0001	AL	U	MG/L		0.38	-
	0746	09/22/88	0001	AL	U			0.3	-
	0746	03/05/89	0001	AL	U		<	0.1	-
	0746	08/03/89	0001	AL	U		<	0.1	-
	0746	11/02/89	0001	AL	U		<	0.1	-
AMMONIUM	0581	03/07/89	0001	AL	O	MG/L		170.	-
	0585	03/01/89	0001	AL	D			300.	-
	0586	03/01/89	0001	AL	D			300.	-
	0588	03/06/89	0001	AL	U			9.5	-
	0589	03/01/89	0001	AL	D			1.4	-
	0589	08/03/89	0001	AL	D			160.	-
	0590	09/22/88	0001	AL	D			21.	-
	0590	03/01/89	0001	AL	D			20.2	-
	0590	08/03/89	0001	AL	D			20.5	-
	0590	11/02/89	0001	AL	D			2.0	-
	0710	03/06/89	0001	AL	U			61.	-
	0733	09/17/87	0001	AL	D		<	0.1	-
	0733	09/22/88	0001	AL	D		<	0.1	-
	0733	02/28/89	0001	AL	D			0.4	-
	0733	08/03/89	0001	AL	D		<	0.1	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D		<	0.1	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C		<	0.1	-
	0737	09/22/88	0001	AL	C		<	0.1	-
	0737	03/04/89	0001	AL	C			0.4	-
	0737	08/07/89	0001	AL	C		<	0.1	-
	0740	09/24/87	0001	AL	D			50.	-
	0740	02/28/89	0001	AL	D			31.1	-
	0742	03/03/89	0001	AL	C			0.3	-
	0744	03/05/89	0001	AL	U			1.7	-
	0744	08/03/89	0001	AL	U			1.3	-
	0744	11/02/89	0001	AL	U			1.0	-
	0745	09/17/87	0001	AL	U			0.3	-
	0745	09/22/88	0001	AL	U		<	0.1	-

FORMATION OF COMPLETION CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
AMMONIUM	0745	03/05/89	0001	AL	U	MG/L		0.3	-
	0745	08/03/89	0001	AL	U		<	0.1	-
	0745	11/02/89	0001	AL	U		<	0.1	-
	0746	09/17/87	0001	AL	U		<	0.1	-
	0746	09/22/88	0001	AL	U		<	0.1	-
	0746	03/05/89	0001	AL	U			0.1	-
	0746	08/03/89	0001	AL	U		<	0.1	-
	0746	11/02/89	0001	AL	U		<	0.1	-
ANTIMONY	0581	03/07/89	0001	AL	O	MG/L	<	0.003	-
	0585	03/01/89	0001	AL	D		<	0.003	-
	0586	03/01/89	0001	AL	D		<	0.003	-
	0588	03/06/89	0001	AL	U		<	0.003	-
	0589	03/01/89	0001	AL	D		<	0.003	-
	0589	08/03/89	0001	AL	D			0.017	-
	0590	03/01/89	0001	AL	D		<	0.003	-
	0590	08/03/89	0001	AL	D			0.009	-
	0590	11/02/89	0001	AL	D			0.012	-
	0710	03/06/89	0001	AL	U		<	0.003	-
	0733	02/28/89	0001	AL	D		<	0.003	-
	0733	08/03/89	0001	AL	D			0.014	-
	0733	11/02/89	0001	AL	D			0.017	-
	0736	02/28/89	0001	AL	D		<	0.003	-
	0736	08/03/89	0001	AL	D			0.016	-
	0736	11/02/89	0001	AL	D			0.014	-
	0737	03/04/89	0001	AL	C		<	0.003	-
	0737	08/07/89	0001	AL	C			0.013	-
	0740	02/28/89	0001	AL	D		<	0.003	-
	0742	03/03/89	0001	AL	C		<	0.003	-
	0744	03/05/89	0001	AL	U		<	0.003	-
	0744	08/03/89	0001	AL	U		<	0.003	-
	0744	11/02/89	0001	AL	U		<	0.003	-
	0745	03/05/89	0001	AL	U		<	0.003	-
	0745	08/03/89	0001	AL	U			0.009	-
	0745	11/02/89	0001	AL	U		<	0.003	-
	0746	03/05/89	0001	AL	U		<	0.003	-
	0746	08/03/89	0001	AL	U			0.012	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
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D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B.2

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ANTIMONY	0746	11/02/89	0001	AL	U	MG/L		0.004	-
ARSENIC	0581	03/07/89	0001	AL	O	MG/L		0.01	-
	0585	03/01/89	0001	AL	D			0.01	-
	0586	03/01/89	0001	AL	D			0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D			0.01	-
	0590	09/22/88	0001	AL	D			0.04	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	09/17/87	0001	AL	D			0.015	-
	0733	09/22/88	0001	AL	D			0.05	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D			0.01	-
	0733	11/02/89	0001	AL	D			0.013	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.01	-
	0736	11/02/89	0001	AL	D			0.015	-
	0737	09/17/87	0001	AL	C			0.012	-
	0737	09/22/88	0001	AL	C			0.05	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C			0.01	-
	0740	09/24/87	0001	AL	D			0.012	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	09/17/87	0001	AL	U			0.016	-
	0745	09/22/88	0001	AL	U			0.02	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	09/17/87	0001	AL	U			0.015	-

FORMATION OF COMPLETION CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ARSENIC	0746	09/22/88	0001	AL	U	MG/L		0.04	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U			0.016	-
BARIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.1	-
	0585	03/01/89	0001	AL	D		<	0.1	-
	0586	03/01/89	0001	AL	D		<	0.1	-
	0588	03/06/89	0001	AL	U		<	0.1	-
	0589	03/01/89	0001	AL	D		<	0.1	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	09/22/88	0001	AL	D		<	0.1	-
	0590	03/01/89	0001	AL	D		<	0.1	-
	0590	08/03/89	0001	AL	D		<	0.1	-
	0590	11/02/89	0001	AL	D		<	0.1	-
	0710	03/06/89	0001	AL	U		<	0.1	-
	0733	09/17/87	0001	AL	D			0.02	-
	0733	09/22/88	0001	AL	D		<	0.1	-
	0733	02/28/89	0001	AL	D		<	0.1	-
	0733	08/03/89	0001	AL	D		<	0.1	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D		<	0.1	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C			0.02	-
	0737	09/22/88	0001	AL	C		<	0.1	-
	0737	03/04/89	0001	AL	C		<	0.1	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	09/24/87	0001	AL	D			0.03	-
	0740	02/28/89	0001	AL	D		<	0.1	-
	0742	03/03/89	0001	AL	C		<	0.1	-
	0744	03/05/89	0001	AL	U		<	0.1	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.1	-
	0745	09/17/87	0001	AL	U			0.02	-
	0745	09/22/88	0001	AL	U		<	0.1	-
	0745	03/05/89	0001	AL	U		<	0.1	-

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
BARIUM	0745	08/03/89	0001	AL	U	MG/L	<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.1	-
	0746	09/17/87	0001	AL	U			0.02	-
	0746	09/22/88	0001	AL	U		<	0.1	-
	0746	03/05/89	0001	AL	U		<	0.1	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.1	-
BERYLLIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.005	-
	0585	03/01/89	0001	AL	D		<	0.005	-
	0586	03/01/89	0001	AL	D		<	0.005	-
	0588	03/06/89	0001	AL	U		<	0.005	-
	0589	03/01/89	0001	AL	D		<	0.005	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.005	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.005	-
	0733	02/28/89	0001	AL	D		<	0.005	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.005	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.005	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.005	-
	0742	03/03/89	0001	AL	C		<	0.005	-
	0744	03/05/89	0001	AL	U		<	0.005	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.005	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.005	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
O - ON-SITE
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C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
BROMIDE	0590	11/02/89	0001	AL	D	MG/L		.1	-
	0733	11/02/89	0001	AL	D			1.0	-
	0736	11/02/89	0001	AL	D			1.2	-
	0744	11/02/89	0001	AL	U		<	.1	-
	0745	11/02/89	0001	AL	U			.2	-
	0746	11/02/89	0001	AL	U			.1	-
CADMIUM	0581	03/07/89	0001	AL	D	MG/L		0.001	-
	0585	03/01/89	0001	AL	D		<	0.001	-
	0586	03/01/89	0001	AL	D		<	0.001	-
	0588	03/06/89	0001	AL	U		<	0.001	-
	0589	03/01/89	0001	AL	D		<	0.001	-
	0589	08/03/89	0001	AL	D			0.025	-
	0590	09/22/88	0001	AL	D			0.023	-
	0590	03/01/89	0001	AL	D			0.001	-
	0590	08/03/89	0001	AL	D			0.010	-
	0590	11/02/89	0001	AL	D			0.002	-
	0710	03/06/89	0001	AL	U		<	0.001	-
	0733	09/17/87	0001	AL	D		<	0.005	-
	0733	09/22/88	0001	AL	D			0.016	-
	0733	02/28/89	0001	AL	D		<	0.001	-
	0733	08/03/89	0001	AL	D			0.013	-
	0733	11/02/89	0001	AL	D			0.001	-
	0736	02/28/89	0001	AL	D		<	0.001	-
	0736	08/03/89	0001	AL	D			0.014	-
	0736	11/02/89	0001	AL	D			0.002	-
	0737	09/17/87	0001	AL	C		<	0.005	-
	0737	09/22/88	0001	AL	C			0.018	-
	0737	03/04/89	0001	AL	C		<	0.001	-
	0737	08/07/89	0001	AL	C			0.029	-
	0740	09/24/87	0001	AL	D		<	0.005	-
	0740	02/28/89	0001	AL	D		<	0.001	-
	0742	03/03/89	0001	AL	C		<	0.001	-
	0744	03/05/89	0001	AL	U		<	0.001	-
	0744	08/03/89	0001	AL	U			0.006	-
	0744	11/02/89	0001	AL	U		<	0.001	-
	0745	09/17/87	0001	AL	U		<	0.005	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
O - ON-SITE
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CADMIUM	0745	09/22/88	0001	AL	U	MG/L		0.013	-
	0745	03/05/89	0001	AL	U		<	0.001	-
	0745	08/03/89	0001	AL	U			0.012	-
	0745	11/02/89	0001	AL	U			0.002	-
	0746	09/17/87	0001	AL	U		<	0.005	-
	0746	09/22/88	0001	AL	U			0.017	-
	0746	03/05/89	0001	AL	U		<	0.001	-
	0746	08/03/89	0001	AL	U			0.039	-
	0746	11/02/89	0001	AL	U			0.002	-
CALCIUM	0581	03/07/89	0001	AL	O	MG/L		600.	-
	0585	03/01/89	0001	AL	D			560.	-
	0586	03/01/89	0001	AL	D			560.	-
	0588	03/06/89	0001	AL	U			102.	-
	0589	03/01/89	0001	AL	D			540.	-
	0589	08/03/89	0001	AL	D			489.	-
	0590	09/22/88	0001	AL	D			549.	-
	0590	03/01/89	0001	AL	D			540.	-
	0590	08/03/89	0001	AL	D			488.	-
	0590	11/02/89	0001	AL	D			463.	-
	0710	03/06/89	0001	AL	U			427.	-
	0733	09/17/87	0001	AL	D			418.	-
	0733	09/22/88	0001	AL	D			439.	-
	0733	02/28/89	0001	AL	D			434.	-
	0733	08/03/89	0001	AL	D			417.	-
	0733	11/02/89	0001	AL	D			399.	-
	0736	02/28/89	0001	AL	D			510.	-
	0736	08/03/89	0001	AL	D			487.	-
	0736	11/02/89	0001	AL	D			492.	-
	0737	09/17/87	0001	AL	C			473.	-
	0737	09/22/88	0001	AL	C			523.	-
	0737	03/04/89	0001	AL	C			530.	-
	0737	08/07/89	0001	AL	C			497.	-
	0740	09/24/87	0001	AL	D			517.	-
	0740	02/28/89	0001	AL	D			370.	-
	0742	03/03/89	0001	AL	C			570.	-
	0744	03/05/89	0001	AL	U			257.	-

FORMATION OF COMPLETION CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CALCIUM	0744	08/03/89	0001	AL	U	MG/L		139.	-
	0744	11/02/89	0001	AL	U			93.1	-
	0745	09/17/87	0001	AL	U			378.	-
	0745	09/22/88	0001	AL	U			429.	-
	0745	03/05/89	0001	AL	U			394.	-
	0745	08/03/89	0001	AL	U			372.	-
	0745	11/02/89	0001	AL	U			466.	-
	0746	09/17/87	0001	AL	U			448.	-
	0746	09/22/88	0001	AL	U			483.	-
	0746	03/05/89	0001	AL	U			510.	-
	0746	08/03/89	0001	AL	U			452.	-
	0746	11/02/89	0001	AL	U			451.	-
CHLORIDE	0581	03/07/89	0001	AL	O	MG/L		720.	-
	0585	03/01/89	0001	AL	D			850.	-
	0586	03/01/89	0001	AL	D			870.	-
	0588	03/06/89	0001	AL	U			195.	-
	0589	03/01/89	0001	AL	D			910.	-
	0589	08/03/89	0001	AL	D			1000.	-
	0590	09/22/88	0001	AL	D			810.	-
	0590	03/01/89	0001	AL	D			851.	-
	0590	08/03/89	0001	AL	D			750.	-
	0590	11/02/89	0001	AL	D			740.	-
	0710	03/06/89	0001	AL	U			640.	-
	0733	09/17/87	0001	AL	D			1100.	-
	0733	09/22/88	0001	AL	D			1170.	-
	0733	02/28/89	0001	AL	D			1150.	-
	0733	08/03/89	0001	AL	D			1200.	-
	0733	11/02/89	0001	AL	D			1200.	-
	0736	02/28/89	0001	AL	D			980.	-
	0736	08/03/89	0001	AL	D			960.	-
	0736	11/02/89	0001	AL	D			1000.	-
	0737	09/17/87	0001	AL	C			1060.	-
	0737	09/22/88	0001	AL	C			1170.	-
	0737	03/04/89	0001	AL	C			1200.	-
	0737	08/07/89	0001	AL	C			1300.	-
	0740	09/24/87	0001	AL	D			890.	-

FORMATION OF COMPLETION CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B3

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CHLORIDE	0740	02/28/89	0001	AL	D	MG/L		700.	-
	0742	03/03/89	0001	AL	C			920.	-
	0744	03/05/89	0001	AL	U			310.	-
	0744	08/03/89	0001	AL	U			149.	-
	0744	11/02/89	0001	AL	U			160.	-
	0745	09/17/87	0001	AL	U			600.	-
	0745	09/22/88	0001	AL	U			500.	-
	0745	03/05/89	0001	AL	U			430.	-
	0745	08/03/89	0001	AL	U			490.	-
	0745	11/02/89	0001	AL	U			570.	-
	0746	09/17/87	0001	AL	U			695.	-
	0746	09/22/88	0001	AL	U			700.	-
	0746	03/05/89	0001	AL	U			720.	-
	0746	08/03/89	0001	AL	U			730.	-
	0746	11/02/89	0001	AL	U			720.	-
CHROMIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-
	0586	03/01/89	0001	AL	D		<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	09/22/88	0001	AL	D			0.14	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	09/17/87	0001	AL	D		<	0.01	-
	0733	09/22/88	0001	AL	D			0.14	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	09/17/87	0001	AL	C		<	0.01	-
	0737	09/22/88	0001	AL	C			0.16	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CHROMIUM	0737	03/04/89	0001	AL	C	MG/L	<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	09/24/87	0001	AL	D		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	09/17/87	0001	AL	U		<	0.01	-
	0745	09/22/88	0001	AL	U			0.13	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	09/17/87	0001	AL	U		<	0.01	-
	0746	09/22/88	0001	AL	U			0.15	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
COBALT	0581	03/07/89	0001	AL	O	MG/L	<	0.05	-
	0585	03/01/89	0001	AL	D		<	0.05	-
	0586	03/01/89	0001	AL	D		<	0.05	-
	0588	03/06/89	0001	AL	U		<	0.05	-
	0589	03/01/89	0001	AL	D		<	0.05	-
	0589	08/03/89	0001	AL	D		<	0.05	-
	0590	03/01/89	0001	AL	D		<	0.05	-
	0590	08/03/89	0001	AL	D		<	0.05	-
	0590	11/02/89	0001	AL	D		<	0.05	-
	0710	03/06/89	0001	AL	U		<	0.05	-
	0733	02/28/89	0001	AL	D		<	0.05	-
	0733	08/03/89	0001	AL	D		<	0.05	-
	0733	11/02/89	0001	AL	D		<	0.05	-
	0736	02/28/89	0001	AL	D		<	0.05	-
	0736	08/03/89	0001	AL	D		<	0.05	-
	0736	11/02/89	0001	AL	D		<	0.05	-
	0737	03/04/89	0001	AL	C		<	0.05	-
	0737	08/07/89	0001	AL	C		<	0.05	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
COBALT	0740	02/28/89	0001	AL	D	MG/L	<	0.05	-
	0742	03/03/89	0001	AL	C		<	0.05	-
	0744	03/05/89	0001	AL	U		<	0.05	-
	0744	08/03/89	0001	AL	U		<	0.05	-
	0744	11/02/89	0001	AL	U		<	0.05	-
	0745	03/05/89	0001	AL	U		<	0.05	-
	0745	08/03/89	0001	AL	U		<	0.05	-
	0745	11/02/89	0001	AL	U		<	0.05	-
	0746	03/05/89	0001	AL	U		<	0.05	-
	0746	08/03/89	0001	AL	U		<	0.05	-
	0746	11/02/89	0001	AL	U		<	0.05	-
COPPER	0581	03/07/89	0001	AL	O	MG/L	<	0.02	-
	0585	03/01/89	0001	AL	D		<	0.02	-
	0586	03/01/89	0001	AL	D		<	0.02	-
	0588	03/06/89	0001	AL	U		<	0.02	-
Stat Max of B:	0589	03/01/89	0001	AL	D		<	0.02	-
0.014	0589	08/03/89	0001	AL	D		<	0.02	-
	0590	09/22/88	0001	AL	D			0.03	-
	0590	03/01/89	0001	AL	D		<	0.02	-
	0590	08/03/89	0001	AL	D		<	0.02	-
	0590	11/02/89	0001	AL	D		<	0.02	-
	0710	03/06/89	0001	AL	U		<	0.02	-
	0733	09/17/87	0001	AL	D			0.02	-
	0733	09/22/88	0001	AL	D			0.03	-
	0733	02/28/89	0001	AL	D		<	0.02	-
	0733	08/03/89	0001	AL	D		<	0.02	-
	0733	11/02/89	0001	AL	D		<	0.02	-
	0736	02/28/89	0001	AL	D		<	0.02	-
	0736	08/03/89	0001	AL	D			0.03	-
	0736	11/02/89	0001	AL	D		<	0.02	-
	0737	09/17/87	0001	AL	C			0.04	-
	0737	09/22/88	0001	AL	C			0.02	-
	0737	03/04/89	0001	AL	C		<	0.02	-
	0737	08/07/89	0001	AL	C		<	0.02	-
	0740	09/24/87	0001	AL	D			0.07	-
	0740	02/28/89	0001	AL	D		<	0.02	-

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

B9
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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
COPPER	0742	03/03/89	0001	AL	C	MG/L	<	0.02	-
	0744	03/05/89	0001	AL	U		<	0.02	-
	0744	08/03/89	0001	AL	U		<	0.02	-
	0744	11/02/89	0001	AL	U		<	0.02	-
	0745	09/17/87	0001	AL	U			0.02	-
	0745	09/22/88	0001	AL	U		<	0.02	-
	0745	03/05/89	0001	AL	U		<	0.02	-
	0745	08/03/89	0001	AL	U		<	0.02	-
	0745	11/02/89	0001	AL	U		<	0.02	-
	0746	09/17/87	0001	AL	U			0.02	-
	0746	09/22/88	0001	AL	U			0.02	-
	0746	03/05/89	0001	AL	U		<	0.02	-
	0746	08/03/89	0001	AL	U		<	0.02	-
	0746	11/02/89	0001	AL	U		<	0.02	-
CYANIDE	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-
	0586	03/01/89	0001	AL	D		<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CYANIDE	0744	11/02/89	0001	AL	U	MG/L	<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
FLUORIDE	0581	03/07/89	0001	AL	O	MG/L		4.4	-
	0585	03/01/89	0001	AL	D			3.4	-
	0586	03/01/89	0001	AL	D			3.7	-
	0588	03/06/89	0001	AL	U			0.4	-
	0589	03/01/89	0001	AL	D			0.4	-
	0589	08/03/89	0001	AL	D			0.4	-
	0590	09/22/88	0001	AL	D			0.5	-
	0590	03/01/89	0001	AL	D			0.4	-
	0590	08/03/89	0001	AL	D			0.4	-
	0590	11/02/89	0001	AL	D			0.5	-
	0710	03/06/89	0001	AL	U			1.0	-
	0733	09/17/87	0001	AL	D			0.66	-
	0733	09/22/88	0001	AL	D			0.7	-
	0733	02/28/89	0001	AL	D			0.7	-
	0733	08/03/89	0001	AL	D			0.6	-
	0733	11/02/89	0001	AL	D			0.7	-
	0736	02/28/89	0001	AL	D			0.7	-
	0736	08/03/89	0001	AL	D			0.7	-
	0736	11/02/89	0001	AL	D			0.7	-
	0737	09/17/87	0001	AL	C			1.08	-
	0737	09/22/88	0001	AL	C			1.0	-
	0737	03/04/89	0001	AL	C			1.3	-
	0737	08/07/89	0001	AL	C			0.9	-
	0740	09/24/87	0001	AL	D			0.65	-
	0740	02/28/89	0001	AL	D			0.8	-
	0742	03/03/89	0001	AL	C			0.9	-
	0744	03/05/89	0001	AL	U			0.5	-
	0744	08/03/89	0001	AL	U			0.5	-
	0744	11/02/89	0001	AL	U			0.7	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
FLUORIDE	0745	09/17/87	0001	AL	U	MG/L		0.76	-
	0745	09/22/88	0001	AL	U			0.7	-
	0745	03/05/89	0001	AL	U			0.8	-
	0745	08/03/89	0001	AL	U			0.6	-
	0745	11/02/89	0001	AL	U			0.7	-
	0746	09/17/87	0001	AL	U			1.45	-
	0746	09/22/88	0001	AL	U			1.3	-
	0746	03/05/89	0001	AL	U			1.6	-
	0746	08/03/89	0001	AL	U			1.2	-
	0746	11/02/89	0001	AL	U			1.3	-
GROSS ALPHA	0581	03/07/89	0001	AL	O	PCI/L		71.	33.
	0585	03/01/89	0001	AL	D			182.	58.
	0586	03/01/89	0001	AL	D			223.	50.
	0588	03/06/89	0001	AL	U			3.	6.3
	0589	03/01/89	0001	AL	D			115.	45.
	0589	08/03/89	0001	AL	D			130.	60.
	0590	09/22/88	0001	AL	D			110.	50.
	0590	03/01/89	0001	AL	D			135.	53.
	0590	08/03/89	0001	AL	D			140.	60.
	0590	11/02/89	0001	AL	D			130.	40.
	0710	03/06/89	0001	AL	U			21.	33.
	0733	09/17/87	0001	AL	D			3.	41.
	0733	09/22/88	0001	AL	D			65.	49.
	0733	02/28/89	0001	AL	D			0.	41.
	0733	08/03/89	0001	AL	D			160.	70.
	0733	11/02/89	0001	AL	D			49.	50.
	0736	02/28/89	0001	AL	D			60.	50.
	0736	08/03/89	0001	AL	D			110.	70.
	0736	11/02/89	0001	AL	D			58.	59.
	0737	09/17/87	0001	AL	C			15.	42.
	0737	09/22/88	0001	AL	C			100.	60.
	0737	03/04/89	0001	AL	C			0.	46.
	0737	08/07/89	0001	AL	C			31.	62.
	0740	09/24/87	0001	AL	D			69.	51.
	0740	02/28/89	0001	AL	D			30.	36.
	0742	03/03/89	0001	AL	C			101.	52.

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Table Alluvial water quality by parameter
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09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
GROSS ALPHA	0744	03/05/89	0001	AL	U	PCI/L		19.	15.
	0744	08/03/89	0001	AL	U			6.7	8.5
	0744	11/02/89	0001	AL	U			14.	8.
	0745	09/17/87	0001	AL	U			2.	35.
	0745	09/22/88	0001	AL	U			15.	34.
	0745	03/05/89	0001	AL	U			29.	24.
	0745	08/03/89	0001	AL	U			41.	26.
	0745	11/02/89	0001	AL	U			38.	28.
	0746	09/17/87	0001	AL	U			0.	38.
	0746	09/22/88	0001	AL	U			27.	38.
	0746	03/05/89	0001	AL	U			0.	28.
	0746	08/03/89	0001	AL	U			58.	61.
	0746	11/02/89	0001	AL	U			56.	48.
GROSS BETA	0581	03/07/89	0001	AL	O	PCI/L		76.	26.
	0585	03/01/89	0001	AL	D			176.	43.
	0586	03/01/89	0001	AL	D			147.	34.
	0588	03/06/89	0001	AL	U			12.	5.
	0589	03/01/89	0001	AL	D			145.	35.
	0589	08/03/89	0001	AL	D			110.	30.
	0590	09/22/88	0001	AL	D			110.	30.
	0590	03/01/89	0001	AL	D			57.	35.
	0590	08/03/89	0001	AL	D			120.	30.
	0590	11/02/89	0001	AL	D			72.	24.
	0710	03/06/89	0001	AL	U			58.	29.
	0733	09/17/87	0001	AL	D			51.	29.
	0733	09/22/88	0001	AL	D			64.	28.
	0733	02/28/89	0001	AL	D			21.	35.
	0733	08/03/89	0001	AL	D			93.	32.
	0733	11/02/89	0001	AL	D			34.	28.
	0736	02/28/89	0001	AL	D			42.	37.
	0736	08/03/89	0001	AL	D			87.	30.
	0736	11/02/89	0001	AL	D			39.	32.
	0737	09/17/87	0001	AL	C			77.	31.
	0737	09/22/88	0001	AL	C			100.	30.
	0737	03/04/89	0001	AL	C			36.	40.
	0737	08/07/89	0001	AL	C			55.	37.

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09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
GROSS BETA	0740	09/24/87	0001	AL	D	PCI/L		140.	40.
	0740	02/28/89	0001	AL	D			24.	27.
	0742	03/03/89	0001	AL	C			48.	36.
	0744	03/05/89	0001	AL	U			12.	11.
	0744	08/03/89	0001	AL	U			13.	5.
	0744	11/02/89	0001	AL	U			11.	4.
	0745	09/17/87	0001	AL	U			57.	29.
	0745	09/22/88	0001	AL	U			41.	24.
	0745	03/05/89	0001	AL	U			0.	16.
	0745	08/03/89	0001	AL	U			19.	13.
	0745	11/02/89	0001	AL	U			23.	17.
	0746	09/17/87	0001	AL	U			64.	30.
	0746	09/22/88	0001	AL	U			65.	24.
	0746	03/05/89	0001	AL	U			40.	26.
	0746	08/03/89	0001	AL	U			32.	32.
	0746	11/02/89	0001	AL	U			110.	40.
IRON	0581	03/07/89	0001	AL	O	MG/L		14.	-
	0585	03/01/89	0001	AL	D			12.	-
	0586	03/01/89	0001	AL	D			16.	-
	0588	03/06/89	0001	AL	U			0.35	-
	0589	03/01/89	0001	AL	D			5.7	-
	0589	08/03/89	0001	AL	D			9.75	-
	0590	09/22/88	0001	AL	D			0.11	-
	0590	03/01/89	0001	AL	D		<	0.03	-
	0590	08/03/89	0001	AL	D			0.12	-
	0590	11/02/89	0001	AL	D			0.12	-
	0710	03/06/89	0001	AL	U			1.56	-
	0733	09/17/87	0001	AL	D			0.34	-
	0733	09/22/88	0001	AL	D			0.94	-
	0733	02/28/89	0001	AL	D			0.97	-
	0733	08/03/89	0001	AL	D			1.10	-
	0733	11/02/89	0001	AL	D			0.94	-
	0736	02/28/89	0001	AL	D		<	0.03	-
	0736	08/03/89	0001	AL	D			0.16	-
	0736	11/02/89	0001	AL	D			0.11	-
	0737	09/17/87	0001	AL	C		<	0.01	-

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PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
IRON	0737	09/22/88	0001	AL	C	MG/L		0.16	-
	0737	03/04/89	0001	AL	C			0.06	-
	0737	08/07/89	0001	AL	C			0.19	-
	0740	09/24/87	0001	AL	D		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.03	-
	0742	03/03/89	0001	AL	C			0.25	-
	0744	03/05/89	0001	AL	U		<	0.03	-
	0744	08/03/89	0001	AL	U			0.03	-
	0744	11/02/89	0001	AL	U			0.04	-
	0745	09/17/87	0001	AL	U			0.11	-
	0745	09/22/88	0001	AL	U			0.39	-
	0745	03/05/89	0001	AL	U			0.82	-
	0745	08/03/89	0001	AL	U			0.59	-
	0745	11/02/89	0001	AL	U			0.57	-
	0746	09/17/87	0001	AL	U			0.01	-
	0746	09/22/88	0001	AL	U			0.15	-
	0746	03/05/89	0001	AL	U		<	0.03	-
	0746	08/03/89	0001	AL	U			0.12	-
	0746	11/02/89	0001	AL	U			0.12	-
LEAD	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-
	0586	03/01/89	0001	AL	D		<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D			0.01	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D			0.02	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D			0.02	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.02	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.01	-

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LEAD	0737	08/07/89	0001	AL	C	MG/L		0.02	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U			0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
MAGNESIUM	0581	03/07/89	0001	AL	O	MG/L		259.	-
	0585	03/01/89	0001	AL	D			382.	-
	0586	03/01/89	0001	AL	D			374.	-
	0588	03/06/89	0001	AL	U			39.5	-
	0589	03/01/89	0001	AL	D			332.	-
	0589	08/03/89	0001	AL	D			319.	-
	0590	09/22/88	0001	AL	D			383.	-
	0590	03/01/89	0001	AL	D			390.	-
	0590	08/03/89	0001	AL	D			332.	-
	0590	11/02/89	0001	AL	D			334.	-
	0710	03/06/89	0001	AL	U			310.	-
	0733	09/17/87	0001	AL	D			408.	-
	0733	09/22/88	0001	AL	D			432.	-
	0733	02/28/89	0001	AL	D			432.	-
	0733	08/03/89	0001	AL	D			374.	-
	0733	11/02/89	0001	AL	D			395.	-
	0736	02/28/89	0001	AL	D			462.	-
	0736	08/03/89	0001	AL	D			421.	-
	0736	11/02/89	0001	AL	D			449.	-
	0737	09/17/87	0001	AL	C			485.	-
	0737	09/22/88	0001	AL	C			548.	-
	0737	03/04/89	0001	AL	C			550.	-
	0737	08/07/89	0001	AL	C			565.	-
	0740	09/24/87	0001	AL	D			406.	-

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MAGNESIUM	0740	02/28/89	0001	AL	D	MG/L		310.	-
	0742	03/03/89	0001	AL	C			500.	-
	0744	03/05/89	0001	AL	U			147.	-
	0744	08/03/89	0001	AL	U			81.0	-
	0744	11/02/89	0001	AL	U			52.1	-
	0745	09/17/87	0001	AL	U			289.	-
	0745	09/22/88	0001	AL	U			301.	-
	0745	03/05/89	0001	AL	U			256.	-
	0745	08/03/89	0001	AL	U			252.	-
	0745	11/02/89	0001	AL	U			281.	-
	0746	09/17/87	0001	AL	U			458.	-
	0746	09/22/88	0001	AL	U			504.	-
	0746	03/05/89	0001	AL	U			525.	-
	0746	08/03/89	0001	AL	U			478.	-
	0746	11/02/89	0001	AL	U			469.	-
MANGANESE	0581	03/07/89	0001	AL	O	MG/L		4.90	-
	0585	03/01/89	0001	AL	D			3.62	-
	0586	03/01/89	0001	AL	D			4.16	-
	0588	03/06/89	0001	AL	U			0.28	-
	0589	03/01/89	0001	AL	D			2.17	-
	0589	08/03/89	0001	AL	D			2.11	-
	0590	09/22/88	0001	AL	D			1.52	-
	0590	03/01/89	0001	AL	D			1.22	-
	0590	08/03/89	0001	AL	D			1.49	-
	0590	11/02/89	0001	AL	D			1.51	-
	0710	03/06/89	0001	AL	U			1.93	-
	0733	09/17/87	0001	AL	D			1.69	-
	0733	09/22/88	0001	AL	D			1.49	-
	0733	02/28/89	0001	AL	D			1.27	-
	0733	08/03/89	0001	AL	D			1.54	-
	0733	11/02/89	0001	AL	D			1.50	-
	0736	02/28/89	0001	AL	D			0.94	-
	0736	08/03/89	0001	AL	D			1.64	-
	0736	11/02/89	0001	AL	D			1.88	-
	0737	09/17/87	0001	AL	C			2.21	-
	0737	09/22/88	0001	AL	C			2.02	-

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MANGANESE	0737	03/04/89	0001	AL	C	MG/L		1.80	-
	0737	08/07/89	0001	AL	C			2.08	-
	0740	09/24/87	0001	AL	D			3.50	-
	0740	02/28/89	0001	AL	D			2.46	-
	0742	03/03/89	0001	AL	C			1.78	-
	0744	03/05/89	0001	AL	U			1.07	-
	0744	08/03/89	0001	AL	U			0.58	-
	0744	11/02/89	0001	AL	U			0.43	-
	0745	09/17/87	0001	AL	U			1.34	-
	0745	09/22/88	0001	AL	U			1.32	-
	0745	03/05/89	0001	AL	U			1.13	-
	0745	08/03/89	0001	AL	U			1.20	-
	0745	11/02/89	0001	AL	U			1.38	-
	0746	09/17/87	0001	AL	U			1.37	-
	0746	09/22/88	0001	AL	U			1.34	-
	0746	03/05/89	0001	AL	U			1.38	-
	0746	08/03/89	0001	AL	U			1.38	-
	0746	11/02/89	0001	AL	U			1.39	-
MECHANICAL SIEVE TEST 3/8 INCH	0746	08/03/89	0001	AL	U	% PASSING		3690.	-
MERCURY	0581	03/07/89	0001	AL	O	MG/L	<	0.0002	-
	0585	03/01/89	0001	AL	D		<	0.0002	-
	0586	03/01/89	0001	AL	D		<	0.0002	-
	0588	03/06/89	0001	AL	U		<	0.0002	-
	0589	03/01/89	0001	AL	D		<	0.0002	-
	0589	08/03/89	0001	AL	D		<	0.0002	-
	0590	03/01/89	0001	AL	D		<	0.0002	-
	0590	08/03/89	0001	AL	D		<	0.0002	-
	0590	11/02/89	0001	AL	D		<	0.0002	-
	0710	03/06/89	0001	AL	U		<	0.0002	-
	0733	02/28/89	0001	AL	D		<	0.0002	-
	0733	08/03/89	0001	AL	D		<	0.0002	-
	0733	11/02/89	0001	AL	D		<	0.0002	-
	0736	02/28/89	0001	AL	D		<	0.0002	-
	0736	08/03/89	0001	AL	D		<	0.0002	-
	0736	11/02/89	0001	AL	D		<	0.0002	-

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MERCURY	0737	03/04/89	0001	AL	C	MG/L	<	0.0002	-
	0737	08/07/89	0001	AL	C		<	0.0002	-
	0740	02/28/89	0001	AL	D		<	0.0002	-
	0742	03/03/89	0001	AL	C		<	0.0002	-
	0744	03/05/89	0001	AL	U		<	0.0002	-
	0744	08/03/89	0001	AL	U		<	0.0002	-
	0744	11/02/89	0001	AL	U		<	0.0002	-
	0745	03/05/89	0001	AL	U		<	0.0002	-
	0745	08/03/89	0001	AL	U		<	0.0002	-
	0745	11/02/89	0001	AL	U		<	0.0002	-
	0746	03/05/89	0001	AL	U		<	0.0002	-
	0746	08/03/89	0001	AL	U		<	0.0002	-
	0746	11/02/89	0001	AL	U		<	0.0002	-
MOLYBDENUM	0581	03/07/89	0001	AL	O	MG/L		0.10	-
	0585	03/01/89	0001	AL	D			0.24	-
	0586	03/01/89	0001	AL	D			0.14	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D			0.04	-
	0589	08/03/89	0001	AL	D			0.06	-
	0590	03/01/89	0001	AL	D			0.01	-
	0590	08/03/89	0001	AL	D			0.04	-
	0590	11/02/89	0001	AL	D			0.04	-
	0710	03/06/89	0001	AL	U			0.06	-
	0733	02/28/89	0001	AL	D			0.01	-
	0733	08/03/89	0001	AL	D			0.05	-
	0733	11/02/89	0001	AL	D			0.04	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.09	-
	0736	11/02/89	0001	AL	D			0.04	-
	0737	03/04/89	0001	AL	C			0.07	-
	0737	08/07/89	0001	AL	C			0.09	-
	0740	02/28/89	0001	AL	D			0.07	-
	0742	03/03/89	0001	AL	C			0.03	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U			0.01	-
	0744	11/02/89	0001	AL	U			0.02	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MOLYBDENUM	0745	03/05/89	0001	AL	U	MG/L		0.02	-
	0745	08/03/89	0001	AL	U			0.03	-
	0745	11/02/89	0001	AL	U			0.05	-
	0746	03/05/89	0001	AL	U			0.15	-
	0746	08/03/89	0001	AL	U			0.14	-
	0746	11/02/89	0001	AL	U			0.15	-
NICKEL	0581	03/07/89	0001	AL	O	MG/L	<	0.04	-
	0585	03/01/89	0001	AL	D			0.06	-
	0586	03/01/89	0001	AL	D			0.04	-
	0588	03/06/89	0001	AL	U		<	0.04	-
	0589	03/01/89	0001	AL	D		<	0.04	-
	0589	08/03/89	0001	AL	D		<	0.04	-
	0590	09/22/88	0001	AL	D			0.11	-
	0590	03/01/89	0001	AL	D		<	0.04	-
	0590	08/03/89	0001	AL	D		<	0.04	-
	0590	11/02/89	0001	AL	D			0.05	-
	0710	03/06/89	0001	AL	U		<	0.04	-
	0733	09/17/87	0001	AL	D			0.01	-
	0733	09/22/88	0001	AL	D			0.12	-
	0733	02/28/89	0001	AL	D		<	0.04	-
	0733	08/03/89	0001	AL	D		<	0.04	-
	0733	11/02/89	0001	AL	D			0.05	-
	0736	02/28/89	0001	AL	D		<	0.04	-
	0736	08/03/89	0001	AL	D		<	0.04	-
	0736	11/02/89	0001	AL	D			0.05	-
	0737	09/17/87	0001	AL	C		<	0.01	-
	0737	09/22/88	0001	AL	C			0.13	-
	0737	03/04/89	0001	AL	C		<	0.04	-
	0737	08/07/89	0001	AL	C		<	0.04	-
	0740	09/24/87	0001	AL	D		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.04	-
	0742	03/03/89	0001	AL	C		<	0.04	-
	0744	03/05/89	0001	AL	U		<	0.04	-
	0744	08/03/89	0001	AL	U		<	0.04	-
	0744	11/02/89	0001	AL	U		<	0.04	-
	0745	09/17/87	0001	AL	U		<	0.01	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
NICKEL	0745	09/22/88	0001	AL	U	MG/L		0.09	-
	0745	03/05/89	0001	AL	U		<	0.04	-
	0745	08/03/89	0001	AL	U		<	0.04	-
	0745	11/02/89	0001	AL	U		<	0.04	-
	0746	09/17/87	0001	AL	U		<	0.01	-
	0746	09/22/88	0001	AL	U			0.12	-
	0746	03/05/89	0001	AL	U		<	0.04	-
	0746	08/03/89	0001	AL	U		<	0.04	-
	0746	11/02/89	0001	AL	U		<	0.04	-
NITRATE	0581	03/07/89	0001	AL	O	MG/L		1.0	-
	0585	03/01/89	0001	AL	D		<	1.0	-
	0586	03/01/89	0001	AL	D		<	1.0	-
	0588	03/06/89	0001	AL	U		<	1.0	-
	0589	03/01/89	0001	AL	D		<	1.0	-
	0589	08/03/89	0001	AL	D		<	1.	-
	0590	09/22/88	0001	AL	D			5.7	-
	0590	03/01/89	0001	AL	D			2.0	-
	0590	08/03/89	0001	AL	D		<	1.	-
	0590	11/02/89	0001	AL	D		<	0.1	-
	0710	03/06/89	0001	AL	U		<	1.0	-
	0733	09/17/87	0001	AL	D			0.4	-
	0733	09/22/88	0001	AL	D		<	1.	-
	0733	02/28/89	0001	AL	D		<	1.0	-
	0733	08/03/89	0001	AL	D			4.0	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	1.0	-
	0736	08/03/89	0001	AL	D			2.5	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C			0.4	-
	0737	09/22/88	0001	AL	C		<	1.	-
	0737	03/04/89	0001	AL	C		<	1.0	-
	0737	08/07/89	0001	AL	C		<	1.	-
	0740	09/24/87	0001	AL	D			2.2	-
	0740	02/28/89	0001	AL	D			2.0	-
	0742	03/03/89	0001	AL	C		<	1.0	-
	0744	03/05/89	0001	AL	U		<	1.0	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
NITRATE	0744	08/03/89	0001	AL	U	MG/L		29.	-
	0744	11/02/89	0001	AL	U			1.5	-
	0745	09/17/87	0001	AL	U			3.5	-
	0745	09/22/88	0001	AL	U		<	1.	-
	0745	03/05/89	0001	AL	U		<	1.0	-
	0745	08/03/89	0001	AL	U		<	1.	-
	0745	11/02/89	0001	AL	U		<	0.1	-
	0746	09/17/87	0001	AL	U			3.5	-
	0746	09/22/88	0001	AL	U		<	1.	-
	0746	03/05/89	0001	AL	U			1.0	-
	0746	08/03/89	0001	AL	U		<	1.	-
	0746	11/02/89	0001	AL	U		<	0.1	-
PH	0581	03/07/89	0001	AL	O	SU		7.10	-
	0585	03/01/89	0001	AL	D			7.0	-
	0586	03/01/89	0001	AL	D			7.05	-
	0588	03/06/89	0001	AL	U			7.87	-
	0589	03/01/89	0001	AL	D			7.06	-
	0589	08/03/89	0001	AL	D			7.03	-
	0590	09/22/88	0001	AL	D			6.85	-
	0590	03/01/89	0001	AL	D			6.97	-
	0590	08/03/89	0001	AL	D			7.03	-
	0590	11/02/89	0001	AL	D			6.83	-
	0710	03/06/89	0001	AL	U			7.0	-
	0733	09/17/87	0001	AL	D			6.90	-
	0733	09/22/88	0001	AL	D			7.77	-
	0733	02/28/89	0001	AL	D			7.03	-
	0733	08/03/89	0001	AL	D			7.09	-
	0733	11/02/89	0001	AL	D			7.30	-
	0736	02/28/89	0001	AL	D			7.04	-
	0736	08/03/89	0001	AL	D			6.89	-
	0736	11/02/89	0001	AL	D			6.83	-
	0737	09/17/87	0001	AL	C			7.0	-
	0737	09/22/88	0001	AL	C			7.12	-
	0737	03/04/89	0001	AL	C			7.07	-
	0737	08/07/89	0001	AL	C			7.12	-
	0740	09/24/87	0001	AL	D			6.80	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
PH	0740	02/28/89	0001	AL	D	SU		7.11	-
	0742	03/03/89	0001	AL	C			7.02	-
	0744	03/05/89	0001	AL	U			7.18	-
	0744	08/03/89	0001	AL	U			7.16	-
	0744	11/02/89	0001	AL	U			7.27	-
	0745	09/17/87	0001	AL	U			6.90	-
	0745	09/22/88	0001	AL	U			7.08	-
	0745	03/05/89	0001	AL	U			7.02	-
	0745	08/03/89	0001	AL	U			7.03	-
	0745	11/02/89	0001	AL	U			6.85	-
	0746	09/17/87	0001	AL	U			7.0	-
	0746	09/22/88	0001	AL	U			7.03	-
	0746	03/05/89	0001	AL	U			7.20	-
	0746	08/03/89	0001	AL	U			7.18	-
	0746	11/02/89	0001	AL	U			7.10	-
POTASSIUM	0581	03/07/89	0001	AL	O	MG/L		56.	-
	0585	03/01/89	0001	AL	D			68.	-
	0586	03/01/89	0001	AL	D			71.	-
	0588	03/06/89	0001	AL	U			6.5	-
	0589	03/01/89	0001	AL	D			49.	-
	0589	08/03/89	0001	AL	D			66.6	-
	0590	09/22/88	0001	AL	D			23.4	-
	0590	03/01/89	0001	AL	D			15.8	-
	0590	08/03/89	0001	AL	D			25.5	-
	0590	11/02/89	0001	AL	D			25.7	-
	0710	03/06/89	0001	AL	U			19.	-
	0733	09/17/87	0001	AL	D			8.82	-
	0733	09/22/88	0001	AL	D			9.1	-
	0733	02/28/89	0001	AL	D			8.1	-
	0733	08/03/89	0001	AL	D			9.2	-
	0733	11/02/89	0001	AL	D			10.2	-
	0736	02/28/89	0001	AL	D			8.4	-
	0736	08/03/89	0001	AL	D			12.7	-
	0736	11/02/89	0001	AL	D			13.1	-
	0737	09/17/87	0001	AL	C			10.5	-
	0737	09/22/88	0001	AL	C			10.9	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
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PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
POTASSIUM	0737	03/04/89	0001	AL	C	MG/L		10.1	-
	0737	08/07/89	0001	AL	C			11.9	-
	0740	09/24/87	0001	AL	D			26.0	-
	0740	02/28/89	0001	AL	D			16.0	-
	0742	03/03/89	0001	AL	C			6.9	-
	0744	03/05/89	0001	AL	U			6.4	-
	0744	08/03/89	0001	AL	U			7.5	-
	0744	11/02/89	0001	AL	U			5.9	-
	0745	09/17/87	0001	AL	U			5.05	-
	0745	09/22/88	0001	AL	U			5.7	-
	0745	03/05/89	0001	AL	U			4.9	-
	0745	08/03/89	0001	AL	U			5.0	-
	0745	11/02/89	0001	AL	U			6.0	-
	0746	09/17/87	0001	AL	U			8.28	-
	0746	09/22/88	0001	AL	U			9.4	-
	0746	03/05/89	0001	AL	U			8.4	-
	0746	08/03/89	0001	AL	U			10.9	-
	0746	11/02/89	0001	AL	U			10.7	-
RADIUM-226	0581	03/07/89	0001	AL	O	PCI/L		1.2	0.5
	0585	03/01/89	0001	AL	D			0.0	0.2
	0586	03/01/89	0001	AL	D			0.8	0.4
	0588	03/06/89	0001	AL	U			0.0	0.2
	0589	03/01/89	0001	AL	D			0.0	0.2
	0589	08/03/89	0001	AL	D			0.1	0.2
	0590	09/22/88	0001	AL	D			0.1	0.1
	0590	03/01/89	0001	AL	D			0.0	0.2
	0590	08/03/89	0001	AL	D			0.1	0.1
	0590	11/02/89	0001	AL	D			0.1	0.1
	0710	03/06/89	0001	AL	U			0.2	0.2
	0733	09/17/87	0001	AL	D			0.0	0.1
	0733	09/22/88	0001	AL	D			0.1	0.1
	0733	02/28/89	0001	AL	D			0.0	0.2
	0733	08/03/89	0001	AL	D			0.0	0.1
	0733	11/02/89	0001	AL	D			0.0	0.1
	0736	02/28/89	0001	AL	D			0.0	0.2
	0736	08/03/89	0001	AL	D			0.0	0.1

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
RADIUM-226	0736	11/02/89	0001	AL	D	PCI/L		0.0	0.1
	0737	09/17/87	0001	AL	C			0.0	0.1
	0737	09/22/88	0001	AL	C			0.2	0.2
	0737	03/04/89	0001	AL	C			0.1	0.2
	0737	08/07/89	0001	AL	C			0.0	0.1
	0740	09/24/87	0001	AL	D			0.0	0.1
	0740	02/28/89	0001	AL	D			0.0	0.2
	0742	03/03/89	0001	AL	C			0.0	0.1
	0744	03/05/89	0001	AL	U			0.0	0.1
	0744	08/03/89	0001	AL	U			0.0	0.1
	0744	11/02/89	0001	AL	U			0.2	0.2
	0745	09/17/87	0001	AL	U			0.0	0.1
	0745	09/22/88	0001	AL	U			0.1	0.1
	0745	03/05/89	0001	AL	U			0.0	0.2
	0745	08/03/89	0001	AL	U			0.1	0.2
	0745	11/02/89	0001	AL	U			0.0	0.1
	0746	09/17/87	0001	AL	U			0.1	0.2
	0746	09/22/88	0001	AL	U			0.1	0.1
	0746	03/05/89	0001	AL	U			0.1	0.2
	0746	08/03/89	0001	AL	U			0.0	0.1
	0746	11/02/89	0001	AL	U			0.0	0.1
RADIUM-228	0581	03/07/89	0001	AL	O	PCI/L		0.5	1.3
	0585	03/01/89	0001	AL	D			2.3	1.2
	0586	03/01/89	0001	AL	D			2.0	1.3
	0588	03/06/89	0001	AL	U			0.4	1.4
	0589	03/01/89	0001	AL	D			2.3	1.4
	0589	08/03/89	0001	AL	D			0.2	0.8
	0590	09/22/88	0001	AL	D			0.0	0.7
	0590	03/01/89	0001	AL	D			0.7	1.3
	0590	08/03/89	0001	AL	D			1.0	0.9
	0590	11/02/89	0001	AL	D			0.0	1.0
	0710	03/06/89	0001	AL	U			0.0	1.3
	0733	09/17/87	0001	AL	D			0.4	1.6
	0733	09/22/88	0001	AL	D			0.0	0.7
	0733	02/28/89	0001	AL	D			0.5	1.3
	0733	08/03/89	0001	AL	D			0.2	0.9

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SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
RADIUM-228	0733	11/02/89	0001	AL	D	PCI/L		1.0	0.9
	0736	02/28/89	0001	AL	D			0.3	1.3
	0736	08/03/89	0001	AL	D			0.9	0.9
	0736	11/02/89	0001	AL	D			0.7	0.9
	0737	09/17/87	0001	AL	C			2.0	1.9
	0737	09/22/88	0001	AL	C			1.3	1.0
	0737	03/04/89	0001	AL	C			1.5	1.3
	0737	08/07/89	0001	AL	C			1.0	0.8
	0740	09/24/87	0001	AL	D			0.5	1.0
	0740	02/28/89	0001	AL	D			2.0	1.5
	0742	03/03/89	0001	AL	C			1.7	1.4
	0744	03/05/89	0001	AL	U			0.1	1.5
	0744	08/03/89	0001	AL	U			0.7	0.8
	0744	11/02/89	0001	AL	U			0.3	1.0
	0745	09/17/87	0001	AL	U			0.4	0.8
	0745	09/22/88	0001	AL	U			0.3	0.9
	0745	03/05/89	0001	AL	U			1.0	1.1
	0745	08/03/89	0001	AL	U			0.0	0.9
	0745	11/02/89	0001	AL	U			0.7	0.9
	0746	09/17/87	0001	AL	U			1.0	0.9
	0746	09/22/88	0001	AL	U			0.1	0.7
	0746	03/05/89	0001	AL	U			1.2	1.2
	0746	08/03/89	0001	AL	U			0.6	0.9
	0746	11/02/89	0001	AL	U			0.7	0.8
SELENIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.025	-
	0586	03/01/89	0001	AL	D		<	0.025	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.025	-
	0589	08/03/89	0001	AL	D			0.028	-
	0590	09/22/88	0001	AL	D			0.142	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D			0.025	-
	0590	11/02/89	0001	AL	D			0.036	-
	0710	03/06/89	0001	AL	U		<	0.025	-
	0733	09/17/87	0001	AL	D			0.164	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SELENIUM	0733	09/22/88	0001	AL	D	MG/L		0.196	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D			0.025	-
	0733	11/02/89	0001	AL	D			0.039	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.026	-
	0736	11/02/89	0001	AL	D			0.038	-
	0737	09/17/87	0001	AL	C			0.159	-
	0737	09/22/88	0001	AL	C			0.199	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C			0.026	-
	0740	09/24/87	0001	AL	D			0.127	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U			0.012	-
	0744	11/02/89	0001	AL	U			0.011	-
	0745	09/17/87	0001	AL	U			0.067	-
	0745	09/22/88	0001	AL	U			0.060	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U			0.018	-
	0745	11/02/89	0001	AL	U			0.030	-
	0746	09/17/87	0001	AL	U			0.060	-
	0746	09/22/88	0001	AL	U			0.191	-
	0746	03/05/89	0001	AL	U			0.05	-
	0746	08/03/89	0001	AL	U			0.057	-
	0746	11/02/89	0001	AL	U			0.060	-
SILICA - SIO2	0590	11/02/89	0001	AL	D	MG/L		20.	-
	0733	11/02/89	0001	AL	D			17.	-
	0736	11/02/89	0001	AL	D			21.	-
	0744	11/02/89	0001	AL	U			17.	-
	0745	11/02/89	0001	AL	U			17.	-
	0746	11/02/89	0001	AL	U			17.	-
SILVER	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-

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09/17/87 TO 11/02/89
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SILVER	0586	03/01/89	0001	AL	D	MG/L	<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D			0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.01	-
	0736	11/02/89	0001	AL	D			0.01	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U			0.01	-
SODIUM	0581	03/07/89	0001	AL	O	MG/L		805.	-
	0585	03/01/89	0001	AL	D			985.	-
	0586	03/01/89	0001	AL	D			990.	-
	0588	03/06/89	0001	AL	U			144.	-
	0589	03/01/89	0001	AL	D			1080.	-
	0589	08/03/89	0001	AL	D			1070.	-
	0590	09/22/88	0001	AL	D			975.	-
	0590	03/01/89	0001	AL	D			950.	-
	0590	08/03/89	0001	AL	D			953.	-

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SODIUM	0590	11/02/89	0001	AL	D	MG/L		944.	-
	0710	03/06/89	0001	AL	U			736.	-
	0733	09/17/87	0001	AL	D			1327.	-
	0733	09/22/88	0001	AL	D			1220.	-
	0733	02/28/89	0001	AL	D			1220.	-
	0733	08/03/89	0001	AL	D			1250.	-
	0733	11/02/89	0001	AL	D			1200.	-
	0736	02/28/89	0001	AL	D			1190.	-
	0736	08/03/89	0001	AL	D			1200.	-
	0736	11/02/89	0001	AL	D			1180.	-
	0737	09/17/87	0001	AL	C			1400.	-
	0737	09/22/88	0001	AL	C			1220.	-
	0737	03/04/89	0001	AL	C			1230.	-
	0737	08/07/89	0001	AL	C			1230.	-
	0740	09/24/87	0001	AL	D			1240.	-
	0740	02/28/89	0001	AL	D			728.	-
	0742	03/03/89	0001	AL	C			950.	-
	0744	03/05/89	0001	AL	U			309.	-
	0744	08/03/89	0001	AL	U			234.	-
	0744	11/02/89	0001	AL	U			186.	-
	0745	09/17/87	0001	AL	U			668.	-
	0745	09/22/88	0001	AL	U			573.	-
	0745	03/05/89	0001	AL	U			540.	-
	0745	08/03/89	0001	AL	U			404.	-
	0745	11/02/89	0001	AL	U			554.	-
	0746	09/17/87	0001	AL	U			909.	-
	0746	09/22/88	0001	AL	U			871.	-
	0746	03/05/89	0001	AL	U			910.	-
	0746	08/03/89	0001	AL	U			841.	-
	0746	11/02/89	0001	AL	U			843.	-
SPECIFIC CONDUCTANCE	0581	03/07/89	0001	AL	O	UMHO/CM		4500.	-
	0585	03/01/89	0001	AL	D			4600.	-
	0586	03/01/89	0001	AL	D			4600.	-
	0588	03/06/89	0001	AL	U			800.	-
	0589	03/01/89	0001	AL	D			4400.	-
	0589	08/03/89	0001	AL	D			2700.	-

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PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SPECIFIC CONDUCTANCE	0590	09/22/88	0001	AL	D	UMHO/CM		6000.	-
	0590	03/01/89	0001	AL	D			3500.	-
	0590	08/03/89	0001	AL	D			3220.	-
	0590	11/02/89	0001	AL	D			1700.	-
	0710	03/06/89	0001	AL	U			3600.	-
	0733	09/17/87	0001	AL	D			7000.	-
	0733	09/22/88	0001	AL	D			7500.	-
	0733	02/28/89	0001	AL	D			4100.	-
	0733	08/03/89	0001	AL	D			3400.	-
	0733	11/02/89	0001	AL	D			1000.	-
	0736	02/28/89	0001	AL	D			4400.	-
	0736	08/03/89	0001	AL	D			1280.	-
	0736	11/02/89	0001	AL	D			1050.	-
	0737	09/17/87	0001	AL	C			7100.	-
	0737	09/22/88	0001	AL	C			7000.	-
	0737	03/04/89	0001	AL	C			6000.	-
	0737	08/07/89	0001	AL	C			3780.	-
	0740	09/24/87	0001	AL	D			7000.	-
	0740	02/28/89	0001	AL	D			3400.	-
	0742	03/03/89	0001	AL	C			4900.	-
	0744	03/05/89	0001	AL	U			1800.	-
	0744	08/03/89	0001	AL	U			980.	-
	0744	11/02/89	0001	AL	U			75.	-
	0745	09/17/87	0001	AL	U			4000.	-
	0745	09/22/88	0001	AL	U			3550.	-
	0745	03/05/89	0001	AL	U			2950.	-
	0745	08/03/89	0001	AL	U			2000.	-
	0745	11/02/89	0001	AL	U			405.	-
	0746	09/17/87	0001	AL	U			5500.	-
	0746	09/22/88	0001	AL	U			4900.	-
	0746	03/05/89	0001	AL	U			4300.	-
	0746	08/03/89	0001	AL	U			3700.	-
	0746	11/02/89	0001	AL	U			900.	-
STRONTIUM	0581	03/07/89	0001	AL	O	MG/L		7.3	-
	0585	03/01/89	0001	AL	D			4.65	-
	0586	03/01/89	0001	AL	D			4.44	-

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STRONTIUM	0588	03/06/89	0001	AL	U	MG/L		1.04	-
	0589	03/01/89	0001	AL	D			5.3	-
	0589	08/03/89	0001	AL	D			4.49	-
	0590	09/22/88	0001	AL	D			6.2	-
	0590	03/01/89	0001	AL	D			4.93	-
	0590	08/03/89	0001	AL	D			4.9	-
	0590	11/02/89	0001	AL	D			5.36	-
	0710	03/06/89	0001	AL	U			4.89	-
	0733	09/17/87	0001	AL	D			6.95	-
	0733	09/22/88	0001	AL	D			6.5	-
	0733	02/28/89	0001	AL	D			5.1	-
	0733	08/03/89	0001	AL	D			5.2	-
	0733	11/02/89	0001	AL	D			6.15	-
	0736	02/28/89	0001	AL	D			5.0	-
	0736	08/03/89	0001	AL	D			4.6	-
	0736	11/02/89	0001	AL	D			6.45	-
	0737	09/17/87	0001	AL	C			7.30	-
	0737	09/22/88	0001	AL	C			7.2	-
	0737	03/04/89	0001	AL	C			7.3	-
	0737	08/07/89	0001	AL	C			6.22	-
	0740	09/24/87	0001	AL	D			6.25	-
	0740	02/28/89	0001	AL	D			4.10	-
	0742	03/03/89	0001	AL	C			5.7	-
	0744	03/05/89	0001	AL	U			2.39	-
	0744	08/03/89	0001	AL	U			1.41	-
	0744	11/02/89	0001	AL	U			1.06	-
	0745	09/17/87	0001	AL	U			4.50	-
	0745	09/22/88	0001	AL	U			4.1	-
	0745	03/05/89	0001	AL	U			4.18	-
	0745	08/03/89	0001	AL	U			3.47	-
	0745	11/02/89	0001	AL	U			4.88	-
	0746	09/17/87	0001	AL	U			6.60	-
	0746	09/22/88	0001	AL	U			6.5	-
	0746	03/05/89	0001	AL	U			7.1	-
	0746	08/03/89	0001	AL	U			5.83	-
	0746	11/02/89	0001	AL	U			6.48	-
SULFATE	0581	03/07/89	0001	AL	O	MG/L		2940.	-

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SULFATE	0585	03/01/89	0001	AL	D	MG/L		3950.	-
	0586	03/01/89	0001	AL	D			3940.	-
	0588	03/06/89	0001	AL	U			179.	-
	0589	03/01/89	0001	AL	D			3510.	-
	0589	08/03/89	0001	AL	D			3660.	-
	0590	09/22/88	0001	AL	D			3420.	-
	0590	03/01/89	0001	AL	D			3420.	-
	0590	08/03/89	0001	AL	D			3310.	-
	0590	11/02/89	0001	AL	D			3140.	-
	0710	03/06/89	0001	AL	U			2770.	-
	0733	09/17/87	0001	AL	D			3310.	-
	0733	09/22/88	0001	AL	D			3130.	-
	0733	02/28/89	0001	AL	D			3240.	-
	0733	08/03/89	0001	AL	D			3170.	-
	0733	11/02/89	0001	AL	D			3230.	-
	0736	02/28/89	0001	AL	D			3850.	-
	0736	08/03/89	0001	AL	D			3720.	-
	0736	11/02/89	0001	AL	D			3960.	-
	0737	09/17/87	0001	AL	C			4130.	-
	0737	09/22/88	0001	AL	C			3880.	-
	0737	03/04/89	0001	AL	C			3920.	-
	0737	08/07/89	0001	AL	C			4060.	-
	0740	09/24/87	0001	AL	D			3930.	-
	0740	02/28/89	0001	AL	D			2520.	-
	0742	03/03/89	0001	AL	C			3880.	-
	0744	03/05/89	0001	AL	U			1020.	-
	0744	08/03/89	0001	AL	U			611.	-
	0744	11/02/89	0001	AL	U			385.	-
	0745	09/17/87	0001	AL	U			2140.	-
	0745	09/22/88	0001	AL	U			2210.	-
	0745	03/05/89	0001	AL	U			1990.	-
	0745	08/03/89	0001	AL	U			1760.	-
	0745	11/02/89	0001	AL	U			2460.	-
	0746	09/17/87	0001	AL	U			3450.	-
	0746	09/22/88	0001	AL	U			3550.	-
	0746	03/05/89	0001	AL	U			3620.	-
	0746	08/03/89	0001	AL	U			3690.	-
	0746	11/02/89	0001	AL	U			3620.	-

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TEMPERATURE	0581	03/07/89	0001	AL	O	C - DEGREE		14.	-
	0585	03/01/89	0001	AL	D			10.0	-
	0586	03/01/89	0001	AL	D			9.5	-
	0588	03/06/89	0001	AL	U			7.5	-
	0589	03/01/89	0001	AL	D			11.5	-
	0589	08/03/89	0001	AL	D			17.5	-
	0590	09/22/88	0001	AL	D			17.0	-
	0590	03/01/89	0001	AL	D			9.0	-
	0590	08/03/89	0001	AL	D			16.5	-
	0590	11/02/89	0001	AL	D			16.0	-
	0710	03/06/89	0001	AL	U			11.0	-
	0733	09/17/87	0001	AL	D			17.0	-
	0733	09/22/88	0001	AL	D			21.0	-
	0733	02/28/89	0001	AL	D			14.5	-
	0733	08/03/89	0001	AL	D			17.5	-
	0733	11/02/89	0001	AL	D			16.0	-
	0736	02/28/89	0001	AL	D			12.0	-
	0736	08/03/89	0001	AL	D			22.5	-
	0736	11/02/89	0001	AL	D			20.0	-
	0737	09/17/87	0001	AL	C			15.5	-
	0737	09/22/88	0001	AL	C			16.5	-
	0737	03/04/89	0001	AL	C			15.0	-
	0737	08/07/89	0001	AL	C			16.5	-
	0740	09/24/87	0001	AL	D			17.0	-
	0740	02/28/89	0001	AL	D			11.0	-
	0742	03/03/89	0001	AL	C			14.	-
	0744	03/05/89	0001	AL	U			10.	-
	0744	08/03/89	0001	AL	U			20.5	-
	0744	11/02/89	0001	AL	U			20.0	-
	0745	09/17/87	0001	AL	U			14.0	-
	0745	09/22/88	0001	AL	U			14.	-
	0745	03/05/89	0001	AL	U			13.	-
	0745	08/03/89	0001	AL	U			14.0	-
	0745	11/02/89	0001	AL	U			15.0	-
	0746	09/17/87	0001	AL	U			15.0	-
	0746	09/22/88	0001	AL	U			14.	-
	0746	03/05/89	0001	AL	U			15.	-

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TEMPERATURE	0746	08/03/89	0001	AL	U	C - DEGREE		16.0	-
	0746	11/02/89	0001	AL	U			14.0	-
THALLIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.1	-
	0585	03/01/89	0001	AL	D		<	0.1	-
	0586	03/01/89	0001	AL	D		<	0.1	-
	0588	03/06/89	0001	AL	U		<	0.1	-
	0589	03/01/89	0001	AL	D		<	0.1	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.1	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.1	-
	0733	02/28/89	0001	AL	D		<	0.1	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.1	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.1	-
	0742	03/03/89	0001	AL	C		<	0.1	-
	0744	03/05/89	0001	AL	U		<	0.1	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.1	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.1	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
THORIUM-230	0581	03/07/89	0001	AL	O	PCI/L		0.2	0.2
	0585	03/01/89	0001	AL	D			0.2	0.3
	0586	03/01/89	0001	AL	D			0.8	0.3
	0588	03/06/89	0001	AL	U			0.2	0.2

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
THORIUM-230	0589	03/01/89	0001	AL	D	PCI/L		0.4	0.2
	0589	08/03/89	0001	AL	D			0.3	0.8
	0590	09/22/88	0001	AL	D			0.6	0.5
	0590	03/01/89	0001	AL	D			0.3	0.2
	0590	08/03/89	0001	AL	D			0.1	0.4
	0590	11/02/89	0001	AL	D			0.3	0.4
	0710	03/06/89	0001	AL	U			0.3	0.2
	0733	09/17/87	0001	AL	D			0.0	0.6
	0733	09/22/88	0001	AL	D			0.1	0.3
	0733	02/28/89	0001	AL	D			0.6	0.3
	0733	08/03/89	0001	AL	D			0.0	0.3
	0733	11/02/89	0001	AL	D			0.0	0.3
	0736	02/28/89	0001	AL	D			0.3	0.2
	0736	08/03/89	0001	AL	D			0.3	0.5
	0736	11/02/89	0001	AL	D			0.0	0.3
	0737	09/17/87	0001	AL	C			0.1	0.7
	0737	09/22/88	0001	AL	C			0.1	0.3
	0737	03/04/89	0001	AL	C			0.3	0.2
	0737	08/07/89	0001	AL	C			0.0	0.6
	0740	09/24/87	0001	AL	D			1.2	1.0
	0740	02/28/89	0001	AL	D			1.1	0.5
	0742	03/03/89	0001	AL	C			0.4	0.3
	0744	03/05/89	0001	AL	U			0.5	0.2
	0744	08/03/89	0001	AL	U			0.2	0.8
	0744	11/02/89	0001	AL	U			0.0	0.3
	0745	09/17/87	0001	AL	U			0.0	0.7
	0745	09/22/88	0001	AL	U			0.0	0.3
	0745	03/05/89	0001	AL	U			0.1	0.2
	0745	08/03/89	0001	AL	U			0.0	0.5
	0745	11/02/89	0001	AL	U			0.1	0.4
	0746	09/17/87	0001	AL	U			0.2	0.8
	0746	09/22/88	0001	AL	U			0.2	0.4
	0746	03/05/89	0001	AL	U			0.4	0.4
	0746	08/03/89	0001	AL	U			0.6	0.9
	0746	11/02/89	0001	AL	U			0.0	0.3
TIN	0581	03/07/89	0001	AL	O	MG/L	<	0.03	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TIN	0585	03/01/89	0001	AL	D	MG/L	<	0.03	-
	0586	03/01/89	0001	AL	D		<	0.03	-
	0588	03/06/89	0001	AL	U		<	0.03	-
	0589	03/01/89	0001	AL	D			0.03	-
	0589	08/03/89	0001	AL	D			0.029	-
	0590	03/01/89	0001	AL	D		<	0.03	-
	0590	08/03/89	0001	AL	D			0.020	-
	0590	11/02/89	0001	AL	D			0.117	-
	0710	03/06/89	0001	AL	U		<	0.03	-
	0733	02/28/89	0001	AL	D			0.03	-
	0733	08/03/89	0001	AL	D			0.024	-
	0733	11/02/89	0001	AL	D			0.116	-
	0736	02/28/89	0001	AL	D		<	0.03	-
	0736	08/03/89	0001	AL	D			0.020	-
	0736	11/02/89	0001	AL	D			0.120	-
	0737	03/04/89	0001	AL	C		<	0.03	-
	0737	08/07/89	0001	AL	C			0.030	-
	0740	02/28/89	0001	AL	D			0.03	-
	0742	03/03/89	0001	AL	C		<	0.03	-
	0744	03/05/89	0001	AL	U		<	0.03	-
	0744	08/03/89	0001	AL	U		<	0.005	-
	0744	11/02/89	0001	AL	U			0.013	-
	0745	03/05/89	0001	AL	U		<	0.03	-
	0745	08/03/89	0001	AL	U			0.010	-
	0745	11/02/89	0001	AL	U			0.052	-
	0746	03/05/89	0001	AL	U		<	0.03	-
	0746	08/03/89	0001	AL	U			0.029	-
	0746	11/02/89	0001	AL	U			0.108	-
TOTAL DISSOLVED SOLIDS	0581	03/07/89	0001	AL	O	MG/L		5380.	-
	0585	03/01/89	0001	AL	D			6890.	-
	0586	03/01/89	0001	AL	D			6820.	-
	0588	03/06/89	0001	AL	U			844.	-
	0589	03/01/89	0001	AL	D			6680.	-
	0589	08/03/89	0001	AL	D			7090.	-
	0590	09/22/88	0001	AL	D			6690.	-
	0590	03/01/89	0001	AL	D			6780.	-

3 hits over Std max.
2 hits are downgradient
1 hits is backgrounds
Std max =
.0465
Std min:
0.0025

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TOTAL DISSOLVED SOLIDS	0590	08/03/89	0001	AL	D	MG/L		6180.	-
	0590	11/02/89	0001	AL	D			5770.	-
	0710	03/06/89	0001	AL	U			5260.	-
	0733	09/17/87	0001	AL	D			7790.	-
	0733	09/22/88	0001	AL	D			7100.	-
	0733	02/28/89	0001	AL	D			7100.	-
	0733	08/03/89	0001	AL	D			6730.	-
	0733	11/02/89	0001	AL	D			6970.	-
	0736	02/28/89	0001	AL	D			7740.	-
	0736	08/03/89	0001	AL	D			7120.	-
	0736	11/02/89	0001	AL	D			7580.	-
	0737	09/17/87	0001	AL	C			8670.	-
	0737	09/22/88	0001	AL	C			8050.	-
	0737	03/04/89	0001	AL	C			7940.	-
	0737	08/07/89	0001	AL	C			8250.	-
	0740	09/24/87	0001	AL	D			7850.	-
	0740	02/28/89	0001	AL	D			5390.	-
	0742	03/03/89	0001	AL	C			7300.	-
	0744	03/05/89	0001	AL	U			2270.	-
	0744	08/03/89	0001	AL	U			1420.	-
	0744	11/02/89	0001	AL	U			1050.	-
	0745	09/17/87	0001	AL	U			4920.	-
	0745	09/22/88	0001	AL	U			4480.	-
	0745	03/05/89	0001	AL	U			4170.	-
	0745	08/03/89	0001	AL	U			3790.	-
	0745	11/02/89	0001	AL	U			4710.	-
	0746	09/17/87	0001	AL	U			7010.	-
	0746	09/22/88	0001	AL	U			6680.	-
	0746	03/05/89	0001	AL	U			6720.	-
	0746	08/03/89	0001	AL	U			6820.	-
	0746	11/02/89	0001	AL	U			6890.	-
TOTAL ORGANIC CARBON	0581	03/07/89	0001	AL	O	MG/L		18.	-
	0585	03/01/89	0001	AL	D			28.	-
	0586	03/01/89	0001	AL	D			34.	-
	0588	03/06/89	0001	AL	U		<	1.	-
	0589	03/01/89	0001	AL	D			21.	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TOTAL ORGANIC CARBON	0589	08/03/89	0001	AL	D	MG/L		146.	-
	0590	09/22/88	0001	AL	D			159.	-
	0590	03/01/89	0001	AL	D			11.	-
	0590	08/03/89	0001	AL	D			95.	-
	0590	11/02/89	0001	AL	D			130.	-
	0710	03/06/89	0001	AL	U			10.	-
	0733	09/17/87	0001	AL	D			180.	-
	0733	09/22/88	0001	AL	D			193.	-
	0733	02/28/89	0001	AL	D			9.0	-
	0733	08/03/89	0001	AL	D			141.	-
	0733	11/02/89	0001	AL	D			110.	-
	0736	02/28/89	0001	AL	D			9.0	-
	0736	08/03/89	0001	AL	D			142.	-
	0736	11/02/89	0001	AL	D			87.	-
	0737	09/17/87	0001	AL	C			144.6	-
	0737	09/22/88	0001	AL	C			142.	-
	0737	03/04/89	0001	AL	C			10.	-
	0737	08/07/89	0001	AL	C			115.	-
	0740	09/24/87	0001	AL	D			150.2	-
	0740	02/28/89	0001	AL	D			10.	-
	0742	03/03/89	0001	AL	C			9.0	-
	0744	03/05/89	0001	AL	U			2.	-
	0744	08/03/89	0001	AL	U			62.	-
	0744	11/02/89	0001	AL	U			52.	-
	0745	09/17/87	0001	AL	U			150.2	-
	0745	09/22/88	0001	AL	U			156.	-
	0745	03/05/89	0001	AL	U			5.	-
	0745	08/03/89	0001	AL	U			91.	-
	0745	11/02/89	0001	AL	U			110.	-
	0746	09/17/87	0001	AL	U			130.4	-
	0746	09/22/88	0001	AL	U			138.	-
	0746	03/05/89	0001	AL	U			9.0	-
	0746	08/03/89	0001	AL	U			111.	-
	0746	11/02/89	0001	AL	U			100.	-
URANIUM	0581	03/07/89	0001	AL	O	MG/L		0.043	-
	0585	03/01/89	0001	AL	D			0.29	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
URANIUM	0586	03/01/89	0001	AL	D	MG/L		0.29	-
	0588	03/06/89	0001	AL	U		<	0.003	-
	0589	03/01/89	0001	AL	D			0.18	-
	0589	08/03/89	0001	AL	D			0.071	-
	0590	09/22/88	0001	AL	D			0.229	-
	0590	03/01/89	0001	AL	D			0.19	-
	0590	08/03/89	0001	AL	D			0.112	-
	0590	11/02/89	0001	AL	D			0.125	-
	0710	03/06/89	0001	AL	U			0.027	-
	0733	09/17/87	0001	AL	D			0.0678	-
	0733	09/22/88	0001	AL	D			0.0711	-
	0733	02/28/89	0001	AL	D			0.08	-
	0733	08/03/89	0001	AL	D			0.050	-
	0733	11/02/89	0001	AL	D		<	0.0003	-
	0736	02/28/89	0001	AL	D			0.129	-
	0736	08/03/89	0001	AL	D			0.083	-
	0736	11/02/89	0001	AL	D			0.095	-
	0737	09/17/87	0001	AL	C			0.0529	-
	0737	09/22/88	0001	AL	C			0.0684	-
	0737	03/04/89	0001	AL	C			0.064	-
	0737	08/07/89	0001	AL	C			0.059	-
	0740	09/24/87	0001	AL	D			0.213	-
	0740	02/28/89	0001	AL	D			0.12	-
	0742	03/03/89	0001	AL	C			0.093	-
	0744	03/05/89	0001	AL	U			0.021	-
	0744	08/03/89	0001	AL	U			0.010	-
	0744	11/02/89	0001	AL	U			0.0087	-
	0745	09/17/87	0001	AL	U			0.0427	-
	0745	09/22/88	0001	AL	U			0.0397	-
	0745	03/05/89	0001	AL	U			0.045	-
	0745	08/03/89	0001	AL	U			0.034	-
	0745	11/02/89	0001	AL	U			0.035	-
	0746	09/17/87	0001	AL	U			0.0564	-
	0746	09/22/88	0001	AL	U			0.0512	-
	0746	03/05/89	0001	AL	U			0.059	-
	0746	08/03/89	0001	AL	U			0.058	-
	0746	11/02/89	0001	AL	U			0.057	-
VANADIUM	0581	03/07/89	0001	AL	O	MG/L		0.01	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
VANADIUM	0585	03/01/89	0001	AL	D	MG/L		0.11	-
	0586	03/01/89	0001	AL	D			0.14	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	09/22/88	0001	AL	D			0.07	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
Stat	0733	09/17/87	0001	AL	D			0.09	-
	0733	09/22/88	0001	AL	D			0.07	-
Max	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
0.035	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.04	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	09/17/87	0001	AL	C			0.13	-
	0737	09/22/88	0001	AL	C			0.08	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	09/24/87	0001	AL	D			0.15	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	09/17/87	0001	AL	U			0.07	-
	0745	09/22/88	0001	AL	U			0.06	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	09/17/87	0001	AL	U			0.09	-
	0746	09/22/88	0001	AL	U			0.07	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ZINC	0581	03/07/89	0001	AL	O	MG/L		0.016	-
	0585	03/01/89	0001	AL	D		<	0.005	-
	0586	03/01/89	0001	AL	D		<	0.005	-
	0588	03/06/89	0001	AL	U		<	0.005	-
	0589	03/01/89	0001	AL	D			0.019	-
	0589	08/03/89	0001	AL	D			0.006	-
	0590	09/22/88	0001	AL	D			0.027	-
	0590	03/01/89	0001	AL	D			0.006	-
	0590	08/03/89	0001	AL	D			0.009	-
	0590	11/02/89	0001	AL	D		<	0.005	-
	0710	03/06/89	0001	AL	U		<	0.005	-
	0733	09/17/87	0001	AL	D		<	0.005	-
	0733	09/22/88	0001	AL	D			0.014	-
	0733	02/28/89	0001	AL	D		<	0.005	-
	0733	08/03/89	0001	AL	D		<	0.005	-
	0733	11/02/89	0001	AL	D		<	0.005	-
	0736	02/28/89	0001	AL	D		<	0.005	-
	0736	08/03/89	0001	AL	D		<	0.005	-
	0736	11/02/89	0001	AL	D		<	0.005	-
	0737	09/17/87	0001	AL	C		<	0.005	-
	0737	09/22/88	0001	AL	C			0.015	-
	0737	03/04/89	0001	AL	C		<	0.005	-
	0737	08/07/89	0001	AL	C		<	0.005	-
	0740	09/24/87	0001	AL	D		<	0.005	-
	0740	02/28/89	0001	AL	D		<	0.005	-
	0742	03/03/89	0001	AL	C		<	0.005	-
	0744	03/05/89	0001	AL	U		<	0.005	-
	0744	08/03/89	0001	AL	U		<	0.005	-
	0744	11/02/89	0001	AL	U		<	0.005	-
	0745	09/17/87	0001	AL	U			0.362	-
	0745	09/22/88	0001	AL	U			0.021	-
	0745	03/05/89	0001	AL	U		<	0.005	-
	0745	08/03/89	0001	AL	U		<	0.005	-
	0745	11/02/89	0001	AL	U		<	0.005	-
	0746	09/17/87	0001	AL	U		<	0.005	-
	0746	09/22/88	0001	AL	U			0.017	-
	0746	03/05/89	0001	AL	U		<	0.005	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ZINC	0746	08/03/89	0001	AL	U	MG/L	<	0.005	-
	0746	11/02/89	0001	AL	U		<	0.005	-

FORMATION OF COMPLETION CODE:

FLOW RELATIONSHIP CODE:

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT

DATA FILE NAME: J:\DART\GRJ01\GWQ10015.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 53

BY BJ CHKD. _____ JOB NO. _____

Attachment II.

Test of Proportions Analyses

FORM 91-005-1 (4/81)

Test of Proportions Procedure

54
BY
SL 8/20/90

be appropriate when the number of detected compounds is quite small relative to the number of compounds analyzed for as might occur in detection monitoring.

PURPOSE

The test of proportions determines whether the proportion of compounds detected in the compliance well data differs significantly from the proportion of compounds detected in the background well data. If there is a significant difference, this is statistically significant evidence of contamination.

PROCEDURE

- The procedure uses the normal distribution approximation to the binomial distribution. This assumes that the sample size is reasonably large. Generally, if the proportion of detected values is denoted by P, and the sample size is n, then the normal approximation is adequate, provided that nP and n(1-P) both are greater than or equal to 5.

Step 1. Determine X, the number of background well samples in which the compound was detected. Let n be the total number of background well samples analyzed. Compute the proportion of detects:

$$\hat{P}_u = x/n$$

Step 2. Determine Y, the number of compliance well samples in which the compound was detected. Let M be the total number of compliance well samples analyzed. Compute the proportion of detects:

$$\hat{P}_d = y/m$$

Step 3. Compute the standard error of the difference in proportions:

$$S_D = [[(x+y)/(n+m)][1 - (x+y)/(n+m)][1/n + 1/m]]^{1/2}$$

and form the statistic:

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

Step 4. Compare the absolute value of Z to the 97.5th percentile from the standard normal distribution, 1.96. If the absolute value of Z exceeds 1.96, this provides statistically significant evidence at the 5% significance level that the proportion of compliance well samples where the compound was detected exceeds the proportion of background well samples where the compound was detected. This would be interpreted as evidence of contamination. (The two-sided test is used to provide information about differences in either direction.)

EXAMPLE

Table 8-2 contains data on cadmium concentrations measured in background well and compliance wells at a facility. In the table, "BDL" is used for below detection limit.

Test of Proportions (TOP)

All Alluvial Wells

Analytes to be tested:	Percent of Non-Detects
Antimony	62.1
Barium	87.2
Chromium	87.2
Lead	79.3
Nickel	~~64.1~~ 71.8
Nitrate	64.1
Ra-226	56.4
Silver	86.2

Antimony

Upgradient – Number of Samples (N) = 11

$\hat{P}_u$ = Proportion of Detects = (100−72.7)/100 (% of non-detects)

= 0.273

x = Number of samples w detects = 3

Downgradient – Number of Samples (M) = 14

~~Proportion~~ Percentage of non-detects = 50.0

$\hat{P}_d$ = Proportion of Detects = (100−50)/100

y = 7 (Number of hits) = 0.500

Standard error of the difference in proportions:

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m] \right\}^{1/2}$$

$$= \left\{ [(3+7)/(11+14)][1-(3+7)/(11+14)][1/11 + 1/14] \right\}^{1/2}$$

$$= \left\{ [\tfrac{10}{25}][1 - 10/25][0.0909 + 0.0714] \right\}^{1/2}$$

$$= \left\{ [0.4][0.6][0.1623] \right\}^{1/2}$$

$$= \cancel{\sqrt{1.162}} = \sqrt{.0389}$$

$$= \cancel{1.078} = .197$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D = \cancel{(0.273 - 0.5)/1.078} = -0.211$$

$$(.273 - 0.5)/.197 = \quad = 1.15$$

$$|-1.15| = 1.15 \le 1.97$$

To determine if there is statistical evidence of contamination, compare the absolute value of Z to the 97.5 th percentile from the standard normal distribution, 1.96.

Because $|-0.211| < 1.96$, contamination with antimony is not indicated statistically at the 5% significance level

Barium (TOP)

Upgradient Wells: Number of samples (N) = 15
Percent of non-detects = 86.7
$\hat{P}_u$ = Proportion of detects ~~= 0.137~~ 0.137
X = Number of detects = 2

Downgradient wells:
Number of samples (m) = 18
Percent of non-detects = 88.9
$\hat{P}_d$ = Proportion of detects = ~~[illegible]~~ 0.111
y = 2 (number of hits)

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+2)/(15+18)][1-(2+2)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{[0.1212][0.878][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

$$= \frac{(0.137 - 0.111)}{0.114} = 0.228$$

Since $Z < 1.96$, no evidence of contamination w. Barium

JE JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO 58

BY BD CHKD. SK 8/20/90 JOB NO. _____

Chromium (TOP)

Upgradient Wells:

n = number of samples = 15

Percent of non-detects = 86.7

$\hat{P}_u$ = Proportion of detects = 0.133

x = number of detects = 2

Downgradient Wells:

m = 18

Percent of non-detects = 88.9

$\hat{P}_d$ = 0.111

y = 2

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ \left[\frac{(2+2)}{(15+18)}\right]\left[1-\frac{2+2}{15+18}\right]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{ [0.1212][0.8788][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/0.114$$

$$= (0.133 - 0.111)/0.114 = 0.193$$

Since $Z < 1.96$, no evidence of contamination w. Chromium.

FORM 91-005-1 (4/81)

Lead (TOP)

Upgradient wells:

n = number of samples = 11
Percent of non-detects = 90.9
$\hat{P}_u$ = Proportion of detects = (100 − 90.9)/100 = 0.091
x = number of detects = 1

Downgradient wells
m = 14
Percent non-detects = 71.4
$\hat{P}_d$ = 0.286
y = 4

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)][\tfrac{1}{n}+\tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(1+4)/(11+14)][1-(1+5)/(11+14)][\tfrac{1}{11}+\tfrac{1}{14}] \right\}^{1/2}$$

$$= \left\{ [0.2][0.76][0.162] \right\}^{1/2}$$

$$= 0.157$$

$$Z = (\hat{P}_u - \hat{P}_d)/0.157$$

$$= (0.091 - 0.286)/0.157 = -1.24$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with lead.

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 6c

BY BJ CHKD. SL 8/20/90 JOB NO. _____

Nickel (TOP)

Upgradient wells:

n = number of samples = 15

Percent of non-detects = 86.7

$\hat{P}_u$ = proportion of detects = 0.133 $[(100-86.7)/100]$

x = number of detects = 2

Downgradient wells:

m = 18

% non-detects = 55.6

$\hat{P}_d$ = $(100-55.6)/100$ = 0.446

y = # detects = 8

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+8)/(15+18)][1-(2+8)/(15+18)][\tfrac{1}{15}+\tfrac{1}{18}]\right\}^{1/2}$$

$$= \left\{[0.303][0.697][0.122]\right\}^{1/2}$$

$$= 0.161$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

$$= (0.091 - 0.286)/0.161 = -1.21$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with nickel

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 61

BY BD CHKD. _____ JOB NO. _____

SK

Nitrate (TOP)

Upgradient wells:

$n = 15$

% non-detects = 66.7

$\hat{p}_u = (100 - 66.7)/100 = 0.333$

x = # detects = 5

Downgradient wells:

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = .389$

$y = 7$

$$S_D = \left\{ [(x+y)/(n+m)][1 - (x+y)/(n+m)][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(5+7)/(15+18)][1 - (x+y)/(n+m))][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [0.36][0.636][0.122] \right\}^{1/2}$$

$$= 0.167$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.333 - 0.389)/0.167$$

$$= -0.335$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with nitrate.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO 62

BY BM CHKD. _____ JOB NO. _____

Ra-226 (TOP)

Upgradient wells:

$n = 15$

% non-detects = 46.7

$\hat{p}_u = (100 - 46.7)/100 = 0.533$

$x = 8$

Downgradient wells:

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = 0.389$

$y = 7$

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ [(8+7)/(15+18)][1-(8+7)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{ [0.45][0.55][0.12]\right\}^{1/2}$$

$$= 0.172$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.533 - .389)/0.172$$

$$= 0.83$$

Since $Z < 1.96$, there is no statistical evidence of contamination w. Ra-226.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 63

BY BD CHKD. _____ JOB NO. _____

Silver (TOP)

Upgradient wells:

$n = 11$

% non-detects $= 90.9$

$\hat{p}_u = (100 - 90.9)/100 = 0.091$

$x = 1$

Downgradient wells:

$m = 14$

% non-detects $= 78.6$

$\hat{p}_d = 0.214$

$y = 3$

$$S_D = \left\{ [(x+y)/(n+m)] [1 - (x+y)/(n+m)] [\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(1+3)/(11+14)] [1 - (1+3)/(11+14)] [\tfrac{1}{11} + \tfrac{1}{14}] \right\}^{1/2}$$

$$= \left\{ [0.16] [0.84] [0.16] \right\}^{1/2}$$

$$= 0.148$$

$$Z = (0.091 - 0.214)/0.148$$

$$= -0.83$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination w. Silver.

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Vanadium: (ug/l)

Upgradient Wells
Number of Samples (n) = 15
Percent of non-detects: 73.3
$\hat{P}_u$ = Proportion of detects: .267
x = Number of detects: 4

Downgradient Wells
Number of Samples (m) = 18
Percent of non-detects = 61.1
$\hat{P}_u$ = Proportion of detects = .389
y = Number of detects = 7

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m] \right\}^{1/2}$$

$$= \left\{ [(4+7)/(15+18)][1-(4+7)/(15+18)][1/15 + 1/18] \right\}^{1/2}$$

$$\left\{ (.33)(.67)(.12) \right\}^{1/2}$$

$$S_D = .162$$

$$Z = (.267 - .389)/.162$$

$$Z = -.75$$

$$|Z| = .75$$

$.75 \leq 1.96$, No evidence of Contamination w. Vanadium.

FORM 91-005-1 (4/81)

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
15	20.5000	554.0000	439.0000	411.4333	142.1499	0.3455	0.0	315.1248	507.7419	NORMAL	
ALUMINUM			MG/L								
15	0.0500	0.3800	0.0500	NA	NA	NA	73.3	0.0500	0.3000	NONPARAMETRIC	2
AMMONIUM			MG/L								
15	0.0500	61.0000	0.1000	NA	NA	NA	46.7	0.0500	1.7000	NONPARAMETRIC	2
ANTIMONY			MG/L								
11	0.0015	0.0120	0.0015	NA	NA	NA	72.7	0.0015	0.0090	NONPARAMETRIC	2
ARSENIC			MG/L								
15	0.0050	0.0400	0.0050	NA	NA	NA	66.7	0.0050	0.0160	NONPARAMETRIC	2
BARIUM			MG/L								
15	0.0200	0.0500	0.0500	NA	NA	NA	86.7	0.0500	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
11	0.0025	0.0050	0.0050	NA	NA	NA	100.0	0.0025	0.0050	NONPARAMETRIC	2
BROMIDE			MG/L								
3	0.0500	0.2000	0.1000	NA	NA	NA	33.3	NA	NA	UNKNOWN	1
CADMIUM			MG/L								
15	0.0005	0.0390	0.0005	NA	NA	NA	53.3	0.0005	0.0130	NONPARAMETRIC	2
CALCIUM			MG/L								
15	93.1000	510.0000	427.0000	360.0733	141.7940	0.3938	0.0	264.0059	456.1407	NORMAL	
CHLORIDE			MG/L								
15	149.0000	730.0000	570.0000	507.2667	212.8646	0.4196	0.0	363.0479	651.4854	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHROMIUM			MG/L								
15	0.0050	0.1500	0.0050	NA	NA	NA	86.7	0.0050	0.0050	NONPARAMETRIC	2
COBALT			MG/L								
11	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2
COPPER			MG/L								
15	0.0100	0.0200	0.0100	NA	NA	NA	80.0	0.0100	0.0200	NONPARAMETRIC	2
CYANIDE			MG/L								
11	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2
FLUORIDE			MG/L								
15	0.4000	1.6000	0.7600	0.9007	0.3800	0.4220	0.0	0.6432	1.1582	NORMAL	
GROSS ALPHA			PCI/L								
15	0.0000	58.0000	19.0000	NA	NA	NA	13.3	2.0000	41.0000	NONPARAMETRIC	9
GROSS BETA			PCI/L								
15	0.0000	110.0000	32.0000	NA	NA	NA	6.7	12.0000	64.0000	NONPARAMETRIC	9
IRON			MG/L								
15	0.0100	1.5600	0.1200	0.1274	4.9406	NA	13.3	0.0432	0.3759	LOGNORMAL	7,8
LEAD			MG/L								
11	0.0050	0.0100	0.0050	NA	NA	NA	90.9	0.0050	0.0050	NONPARAMETRIC	2
MAGNESIUM			MG/L								
15	39.5000	525.0000	289.0000	296.1733	165.3434	0.5583	0.0	184.1509	408.1958	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MANGANESE			MG/L								
15	0.2800	1.9300	1.3400	1.1680	0.4292	0.3675	0.0	0.8772	1.4588	NORMAL	
MECHANICAL SIEVE TEST 3/8 INCH			% PASSING								
1	3690.0000	3690.0000	3690.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
MERCURY			MG/L								
11	0.0001	0.0001	0.0001	NA	NA	NA	100.0	0.0001	0.0001	NONPARAMETRIC	2
MOLYBDENUM			MG/L								
11	0.0050	0.1500	0.0300	NA	NA	NA	18.2	0.0050	0.1500	NONPARAMETRIC	2
NICKEL			MG/L								
15	0.0200	0.1200	0.0200	NA	NA	NA	86.7	0.0200	0.0200	NONPARAMETRIC	2
NITRATE			MG/L								
15	0.5000	29.0000	0.5000	NA	NA	NA	66.7	0.5000	3.5000	NONPARAMETRIC	2
POTASSIUM			MG/L								
15	4.9000	19.0000	6.5000	7.9753	3.6348	0.4558	0.0	5.5127	10.4379	NORMAL	
RADIUM-226			PCI/L								
15	0.0000	0.2000	0.0000	NA	NA	NA	46.7	0.0000	0.1000	NONPARAMETRIC	2
RADIUM-228			PCI/L								
15	0.0000	1.2000	0.4000	NA	NA	NA	13.3	0.1000	1.0000	NONPARAMETRIC	9
SELENIUM			MG/L								
15	0.0025	0.1910	0.0300	NA	NA	NA	26.7	0.0025	0.0600	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SILICA - SIO2			MG/L								
3	17.0000	17.0000	17.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
SILVER			MG/L								
11	0.0050	0.0100	0.0050	NA	NA	NA	90.9	0.0050	0.0050	NONPARAMETRIC	2
SODIUM			MG/L								
15	144.0000	910.0000	573.0000	581.4667	272.9403	0.4694	0.0	396.5458	766.3875	NORMAL	
SPECIFIC CONDUCTANCE			UMHO/CM								
15	75.0000	5500.0000	2950.0000	2630.6667	1746.8123	0.6640	0.0	1447.1771	3814.1562	NORMAL	
STRONTIUM			MG/L								
15	1.0400	7.1000	4.5000	4.2953	2.0643	0.4806	0.0	2.8968	5.6939	NORMAL	
SULFATE			MG/L								
15	179.0000	3690.0000	2210.0000	2230.3333	1240.7943	0.5563	0.0	1389.6780	3070.9886	NORMAL	
TEMPERATURE			C - DEGREE								
15	7.5000	20.5000	14.0000	14.2000	3.3048	0.2327	0.0	11.9610	16.4390	NORMAL	
THALLIUM			MG/L								
11	0.0050	0.0500	0.0050	NA	NA	NA	100.0	0.0050	0.0500	NONPARAMETRIC	2
THORIUM-230			PCI/L								
15	0.0000	0.6000	0.2000	NA	NA	NA	26.7	0.0000	0.4000	NONPARAMETRIC	2
TIN			MG/L								
11	0.0025	0.1080	0.0025	NA	NA	NA	54.5	0.0025	0.0520	NONPARAMETRIC	2
TOTAL DISSOLVED SOLIDS			MG/L								
15	844.0000	7010.0000	4710.0000	4468.9333	2207.1403	0.4939	0.0	2973.5651	5964.3015	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TOTAL ORGANIC CARBON	MG/L	15	0.5000	156.0000	91.0000	75.1400	58.3794	0.7769	6.7	35.5871	114.6929	NORMAL	
URANIUM	MG/L	15	0.0015	0.0590	0.0397	0.0364	0.0192	0.5273	6.7	0.0234	0.0494	NORMAL	
VANADIUM	MG/L	15	0.0050	0.0900	0.0050	NA	NA	NA	73.3	0.0050	0.0700	NONPARAMETRIC	2
ZINC	MG/L	15	0.0025	0.3620	0.0025	NA	NA	NA	80.0	0.0025	0.0170	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10015.DAT

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
18	411.0000	651.0000	548.5000	542.9444	76.2978	0.1405	0.0	496.7807	589.1082	NORMAL	
ALUMINUM			MG/L								
18	0.0500	0.7200	0.0500	NA	NA	NA	66.7	0.0500	0.3000	NONPARAMETRIC	2
AMMONIUM			MG/L								
18	0.0500	300.0000	1.7000	NA	NA	NA	38.9	0.0500	50.0000	NONPARAMETRIC	2
ANTIMONY			MG/L								
14	0.0015	0.0170	0.0052	NA	NA	NA	50.0	0.0015	0.0160	NONPARAMETRIC	2
ARSENIC			MG/L								
18	0.0050	0.0500	0.0100	NA	NA	NA	38.9	0.0050	0.0150	NONPARAMETRIC	2
BARIUM			MG/L								
18	0.0200	0.0500	0.0500	NA	NA	NA	88.9	0.0500	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
14	0.0025	0.0050	0.0037	NA	NA	NA	100.0	0.0025	0.0050	NONPARAMETRIC	2
BROMIDE			MG/L								
3	0.1000	1.2000	1.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
CADMIUM			MG/L								
18	0.0005	0.0250	0.0010	NA	NA	NA	44.4	0.0005	0.0140	NONPARAMETRIC	2
CALCIUM			MG/L								
18	370.0000	560.0000	488.5000	481.7778	58.3454	0.1211	0.0	446.4760	517.0795	NORMAL	
CHLORIDE			MG/L								
18	700.0000	1200.0000	935.0000	951.7222	160.7789	0.1689	0.0	854.4433	1049.0011	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHROMIUM			MG/L								
18	0.0050	0.1400	0.0050	NA	NA	NA	88.9	0.0050	0.0050	NONPARAMETRIC	2
COBALT			MG/L								
14	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2
COPPER			MG/L								
18	0.0100	0.0700	0.0100	NA	NA	NA	72.2	0.0100	0.0300	NONPARAMETRIC	2
CYANIDE			MG/L								
14	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2
FLUORIDE			MG/L								
18	0.4000	3.7000	0.6800	0.7071	1.8820	NA	0.0	0.4823	1.0366	LOGNORMAL	7,8
GROSS ALPHA			PCI/L								
18	0.0000	223.0000	110.0000	NA	NA	NA	5.6	49.0000	140.0000	NONPARAMETRIC	9
GROSS BETA			PCI/L								
18	21.0000	176.0000	79.5000	85.1111	47.4191	0.5571	0.0	56.4203	113.8020	NORMAL	
IRON			MG/L								
18	0.0150	16.0000	0.2500	NA	NA	NA	22.2	0.0150	5.7000	NONPARAMETRIC	2
LEAD			MG/L								
14	0.0050	0.0200	0.0050	NA	NA	NA	71.4	0.0050	0.0200	NONPARAMETRIC	2
MAGNESIUM			MG/L								
18	310.0000	462.0000	386.5000	385.2778	45.5603	0.1183	0.0	357.7116	412.8439	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MANGANESE			MG/L								
18	0.9400	4.1600	1.5900	1.9839	0.8992	0.4532	0.0	1.4398	2.5279	NORMAL	
MERCURY			MG/L								
14	0.0001	0.0001	0.0001	NA	NA	NA	100.0	0.0001	0.0001	NONPARAMETRIC	2
MOLYBDENUM			MG/L								
14	0.0050	0.2400	0.0400	0.0625	0.0619	0.9907	7.1	0.0186	0.1064	NORMAL	
NICKEL			MG/L								
18	0.0100	0.1200	0.0200	NA	NA	NA	55.6	0.0200	0.0500	NONPARAMETRIC	2
NITRATE			MG/L								
18	0.4000	5.7000	0.5000	NA	NA	NA	61.1	0.5000	2.2000	NONPARAMETRIC	2
POTASSIUM			MG/L								
18	8.1000	71.0000	15.9000	25.9233	22.0474	0.8505	0.0	12.5836	39.2631	NORMAL	
RADIUM-226			PCI/L								
18	0.0000	0.8000	0.0000	NA	NA	NA	61.1	0.0000	0.1000	NONPARAMETRIC	2
RADIUM-228			PCI/L								
18	0.0000	2.3000	0.6000	NA	NA	NA	16.7	0.2000	2.0000	NONPARAMETRIC	2
SELENIUM			MG/L								
18	0.0025	0.1960	0.0255	NA	NA	NA	38.9	0.0025	0.1270	NONPARAMETRIC	2
SILICA - SIO2			MG/L								
3	17.0000	21.0000	20.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
SILVER			MG/L								
14	0.0050	0.0100	0.0050	NA	NA	NA	78.6	0.0050	0.0100	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SODIUM			MG/L								
18	728.0000	1327.0000	1130.0000	1094.5556	154.4391	0.1411	0.0	1001.1125	1187.9986	NORMAL	
SPECIFIC CONDUCTANCE			UMHO/CM								
18	1000.0000	7500.0000	3800.0000	3936.1111	2012.9847	0.5114	0.0	2718.1593	5154.0630	NORMAL	
STRONTIUM			MG/L								
18	4.1000	6.9500	5.1500	5.3650	0.8413	0.1568	0.0	4.8560	5.8740	NORMAL	
SULFATE			MG/L								
18	2520.0000	3960.0000	3420.0000	3467.2222	385.8650	0.1113	0.0	3233.7555	3700.6890	NORMAL	
TEMPERATURE			C - DEGREE								
18	9.0000	22.5000	16.2500	15.3056	4.0079	0.2619	0.0	12.8806	17.7305	NORMAL	
THALLIUM			MG/L								
14	0.0050	0.0500	0.0275	NA	NA	NA	100.0	0.0050	0.0500	NONPARAMETRIC	2
THORIUM-230			PCI/L								
18	0.0000	1.2000	0.3000	NA	NA	NA	22.2	0.0000	0.6000	NONPARAMETRIC	2
TIN			MG/L								
14	0.0025	0.1200	0.0265	NA	NA	NA	28.6	0.0025	0.1160	NONPARAMETRIC	2
TOTAL DISSOLVED SOLIDS			MG/L								
18	5390.0000	7850.0000	6930.0000	6903.8889	653.0214	0.0946	0.0	6508.7798	7298.9980	NORMAL	
TOTAL ORGANIC CARBON			MG/L								
18	9.0000	193.0000	102.5000	91.9556	66.4230	0.7223	0.0	51.7665	132.1446	NORMAL	
URANIUM			MG/L								
18	0.0015	0.2900	0.1160	0.1332	0.0819	0.6146	5.6	0.0837	0.1827	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
VANADIUM			MG/L								
18	0.0050	0.1500	0.0050	NA	NA	NA	61.1	0.0050	0.0900	NONPARAMETRIC	2
ZINC			MG/L								
18	0.0025	0.0270	0.0025	NA	NA	NA	66.7	0.0025	0.0090	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10016.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO 74

BY BJ CHKD. _____ JOB NO. _____

Attachment III.

ANOVA Analyses

FORM 91-005-1 (4/81)

Based on a DART statistical analysis of the pooled under quality data set, the statistical distributions for the ANOVA analyses are as follows:

	Distribution	Recommended ANOVA
Arsenic	Nonparametric	Nonparametric
Cadmium	↓	↓
Gross alpha		
Molybdenum	Normal	Parametric
Selenium	Nonparametric	Nonparametric

Alluvial water quality statistics for down, cross, and upgradient wells (data pooled)
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
38	20.5000	651.0000	478.0000	479.5132	119.5044	0.2492	0.0	432.3854	526.6410	NORMAL	
ALUMINUM			MG/L								
38	0.0500	0.7200	0.0500	NA	NA	NA	68.4	0.0500	0.1000	NONPARAMETRIC	2
AMMONIUM			MG/L								
38	0.0500	300.0000	0.3000	NA	NA	NA	44.7	0.0500	1.7000	NONPARAMETRIC	2
ANTIMONY			MG/L								
28	0.0015	0.0170	0.0015	NA	NA	NA	60.7	0.0015	0.0120	NONPARAMETRIC	2
ARSENIC			MG/L								
38	0.0050	0.0500	0.0075	NA	NA	NA	50.0	0.0050	0.0120	NONPARAMETRIC	2
BARIUM			MG/L								
38	0.0200	0.0500	0.0500	NA	NA	NA	86.8	0.0500	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
28	0.0025	0.0050	0.0037	NA	NA	NA	100.0	0.0025	0.0050	NONPARAMETRIC	2
BROMIDE			MG/L								
6	0.0500	1.2000	0.1500	NA	NA	NA	16.7	0.0500	1.2000	NONPARAMETRIC	2,6
CADMIUM			MG/L								
38	0.0005	0.0390	0.0008	NA	NA	NA	50.0	0.0005	0.0100	NONPARAMETRIC	2
CALCIUM			MG/L								
38	93.1000	570.0000	464.5000	438.5816	116.5657	0.2658	0.0	392.6127	484.5505	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHLORIDE	MG/L	38	149.0000	1300.0000	830.0000	799.7368	303.2459	0.3792	0.0	680.1487	919.3250	NORMAL	
CHROMIUM	MG/L	38	0.0050	0.1600	0.0050	NA	NA	NA	86.8	0.0050	0.0050	NONPARAMETRIC	2
COBALT	MG/L	28	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2
COPPER	MG/L	38	0.0100	0.0700	0.0100	NA	NA	NA	73.7	0.0100	0.0100	NONPARAMETRIC	2
CYANIDE	MG/L	28	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2
FLUORIDE	MG/L	38	0.4000	3.7000	0.7000	0.9289	0.6987	0.7521	0.0	0.6534	1.2045	NORMAL	
GROSS ALPHA	PCI/L	38	0.0000	223.0000	45.0000	NA	NA	NA	10.5	19.0000	100.0000	NONPARAMETRIC	9
GROSS BETA	PCI/L	38	0.0000	176.0000	56.0000	NA	NA	NA	2.6	36.0000	77.0000	NONPARAMETRIC	9
IRON	MG/L	38	0.0100	16.0000	0.1550	NA	NA	NA	18.4	0.1100	0.5700	NONPARAMETRIC	2
LEAD	MG/L	28	0.0050	0.0200	0.0050	NA	NA	NA	78.6	0.0050	0.0050	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MAGNESIUM			MG/L								
38	39.5000	565.0000	386.5000	369.0947	131.1267	0.3553	0.0	317.3836	420.8059	NORMAL	
MANGANESE			MG/L								
38	0.2800	4.1600	1.4950	1.6611	0.7796	0.4693	0.0	1.3536	1.9685	NORMAL	
MECHANICAL SIEVE TEST 3/8 INCH			% PASSING								
1	3690.0000	3690.0000	3690.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
MERCURY			MG/L								
28	0.0001	0.0001	0.0001	NA	NA	NA	100.0	0.0001	0.0001	NONPARAMETRIC	2
MOLYBDENUM			MG/L								
28	0.0050	0.2400	0.0400	0.0609	0.0568	0.9330	10.7	0.0343	0.0874	NORMAL	
NICKEL			MG/L								
38	0.0100	0.1300	0.0200	NA	NA	NA	71.1	0.0200	0.0200	NONPARAMETRIC	2
NITRATE			MG/L								
38	0.4000	29.0000	0.5000	NA	NA	NA	65.8	0.5000	0.5000	NONPARAMETRIC	2
POTASSIUM			MG/L								
38	4.9000	71.0000	10.1500	12.1114	2.0769	NA	0.0	9.0787	16.1573	LOGNORMAL	7,8
RADIUM-226			PCI/L								
38	0.0000	0.8000	0.0000	NA	NA	NA	57.9	0.0000	0.1000	NONPARAMETRIC	2
RADIUM-228			PCI/L								
38	0.0000	2.3000	0.7000	NA	NA	NA	13.2	0.3000	1.0000	NONPARAMETRIC	9

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SELENIUM	MG/L	38	0.0025	0.1990	0.0260	NA	NA	NA	34.2	0.0025	0.0570	NONPARAMETRIC	2
SILICA - SIO2	MG/L	6	17.0000	21.0000	17.0000	18.1667	1.8348	0.1010	0.0	15.6460	20.6873	NORMAL	
SILVER	MG/L	28	0.0050	0.0100	0.0050	NA	NA	NA	85.7	0.0050	0.0050	NONPARAMETRIC	2
SODIUM	MG/L	38	144.0000	1400.0000	951.5000	906.6842	337.8274	0.3726	0.0	773.4585	1039.9099	NORMAL	
SPECIFIC CONDUCTANCE	UMHO/CM	38	75.0000	7500.0000	3650.0000	3660.2632	2072.2539	0.5661	0.0	2843.0485	4477.4778	NORMAL	
STRONTIUM	MG/L	38	1.0400	7.3000	5.1500	5.1242	1.6303	0.3182	0.0	4.4813	5.7672	NORMAL	
SULFATE	MG/L	38	179.0000	4130.0000	3420.0000	3045.6579	1060.5553	0.3482	0.0	2627.4170	3463.8988	NORMAL	
TEMPERATURE	C - DEGREE	38	7.5000	22.5000	15.0000	14.8947	3.4586	0.2322	0.0	13.5308	16.2587	NORMAL	
THALLIUM	MG/L	28	0.0050	0.0500	0.0275	NA	NA	NA	100.0	0.0050	0.0500	NONPARAMETRIC	2
THORIUM-230	PCI/L	38	0.0000	1.2000	0.2000	NA	NA	NA	23.7	0.1000	0.3000	NONPARAMETRIC	2
TIN	MG/L	28	0.0025	0.1200	0.0165	NA	NA	NA	42.9	0.0025	0.0300	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME			UNITS					STATISTICAL RANGE			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TOTAL DISSOLVED SOLIDS			MG/L								
38	844.0000	8670.0000	6800.0000	6092.4737	1992.1555	0.3270	0.0	5306.8467	6878.1007	NORMAL	
TOTAL ORGANIC CARBON			MG/L								
38	0.5000	193.0000	97.5000	84.2868	62.4133	0.7405	2.6	59.6735	108.9001	NORMAL	
URANIUM			MG/L								
38	0.0015	0.2900	0.0615	0.0863	0.0733	0.8488	5.3	0.0574	0.1152	NORMAL	
VANADIUM			MG/L								
38	0.0050	0.1500	0.0050	NA	NA	NA	65.8	0.0050	0.0600	NONPARAMETRIC	2
ZINC			MG/L								
38	0.0025	0.3620	0.0025	NA	NA	NA	73.7	0.0025	0.0025	NONPARAMETRIC	2

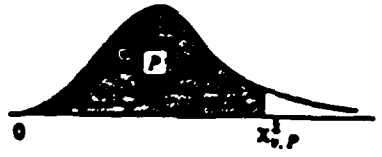
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: J:\DART\GRJ01\GWQ10020.DAT

Table used to obtain "tabulated" H statistic for one-way nonparametric ANOVA analyses

S1

TABLE 1. PERCENTILES OF THE χ^2 DISTRIBUTION WITH ν DEGREES OF FREEDOM, $\chi^2_{\nu,P}$



ν \ P	0.750	0.900	0.950	0.975	0.990	0.995	0.999
1	1.323	2.706	3.841	5.024	6.635	7.879	10.83
2	2.773	4.605	5.991	7.378	9.210	10.60	13.82
3	4.108	6.251	7.815	9.348	11.34	12.84	16.27
4	5.385	7.779	9.488	11.14	13.28	14.86	18.47
5	6.626	9.236	11.07	12.83	15.09	16.75	20.52
6	7.841	10.64	12.59	14.45	16.81	18.55	22.46
7	9.037	12.02	14.07	16.01	18.48	20.28	24.32
8	10.22	13.36	15.51	17.53	20.09	21.96	26.12
9	11.39	14.68	16.92	19.02	21.67	23.59	27.88
10	12.55	15.99	18.31	20.48	23.21	25.19	29.59
11	13.70	17.28	19.68	21.92	24.72	26.76	31.26
12	14.85	18.55	21.03	23.34	26.22	28.30	32.91
13	15.98	19.81	22.36	24.74	27.69	29.82	34.53
14	17.12	21.06	23.68	26.12	29.14	31.32	36.12
15	18.25	22.31	25.00	27.49	30.58	32.80	37.70
16	19.37	23.54	26.30	28.85	32.00	34.27	39.25
17	20.49	24.77	27.59	30.19	33.41	35.72	40.79
18	21.60	25.99	28.87	31.53	34.81	37.16	42.31
19	22.72	27.20	30.14	32.85	36.19	38.58	43.82
20	23.83	28.41	31.41	34.17	37.57	40.00	45.32
21	24.93	29.62	32.67	35.48	38.93	41.40	46.80
22	26.04	30.81	33.92	36.78	40.29	42.80	48.27
23	27.14	32.01	35.17	38.08	41.64	44.18	49.73
24	28.24	33.20	36.42	39.36	42.98	45.56	51.18
25	29.34	34.38	37.65	40.65	44.31	46.93	52.62
26	30.43	35.56	38.89	41.92	45.64	48.29	54.05
27	31.53	36.74	40.11	43.19	46.96	49.64	55.48
28	32.62	37.92	41.34	44.46	48.28	50.99	56.89
29	33.71	39.09	42.56	45.72	49.59	52.34	58.30
30	34.80	40.26	43.77	46.98	50.89	53.67	59.70
40	45.62	51.80	55.76	59.34	63.69	66.77	73.40
50	56.33	63.17	67.50	71.42	76.15	79.49	86.66
60	66.98	74.40	79.08	83.30	88.38	91.95	99.61
70	77.58	85.53	90.53	95.02	100.4	104.2	112.3
80	88.13	96.58	101.9	106.6	112.3	116.3	124.8
90	98.65	107.6	113.1	118.1	124.1	128.3	137.2
100	109.1	118.5	124.3	129.6	135.8	140.2	149.4

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences.* Vol. I. Second Edition. John Wiley and Sons, New York.

TABLE 2. 95th PERCENTILES OF THE F-DISTRIBUTION WITH ν_1 AND ν_2 DEGREES OF FREEDOM, $F_{\nu_1,\nu_2,0.95}$

§2

Table used to obtain "tabulated" F statistic for ANOVA analyses.
(one-way parametric)

ν_2 \ ν_1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.5[illegible]
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.5[illegible]
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.6[illegible]
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.3[illegible]
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.6[illegible]
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.2[illegible]
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.9[illegible]
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.7[illegible]
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.5[illegible]
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.4[illegible]
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.3[illegible]
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.2[illegible]
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.1[illegible]
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.0[illegible]
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.0[illegible]
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.9[illegible]
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.9[illegible]
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.8[illegible]
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.8[illegible]
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.8[illegible]
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.7[illegible]
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.7[illegible]
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.7[illegible]
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.7[illegible]
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.6[illegible]
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.6[illegible]
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.6[illegible]
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.6[illegible]
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.6[illegible]
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.5[illegible]
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.3[illegible]
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.2[illegible]
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.0[illegible]

NOTE: ν_1: Degrees of freedom for numerator
ν_2: Degrees of freedom for denominator

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences*. Vol. I. Second Edition. John Wiley and Sons, New York.

SHEET NO. 63 JOB NO.

SUBJECT Arsenic ANOVA's

DATE BY CHKD.

Arsenic

Sampling Points	← Upgradient →					← Downgradient →							← Cross-gradient →	
	B 588	B 710	B 744	B 745	B 746	M 585	M 586	M 589	M 590	M 723	M 736	M 740	M 737	M 742
Fall 1987	M	M	M	0.016	0.015	M	M	M	M	0.015	M	0.012	0.012	M
Fall 1988	M	M	M	0.02	0.04	M	M	M	0.04	0.05	M	M	0.05 ↓	M ↓
Spring 1989	0.005 ~~<0.01~~	0.005 ~~<0.01~~	0.005 ~~<0.01~~	0.005 ~~<0.01~~	0.005	0.01	0.01	0.01	0.005	0.005	0.005	0.005	0.005	0.005
Summer 1989	M	M	0.005 ~~<0.01~~	0.005	0.005	M	M	0.005	0.005	0.01	0.01	M	0.01	M
Fall 1989	M	M	0.005 ~~<0.01~~	0.005	0.016	M	M	M	0.005	0.013	0.015	M	M	M

M = missing data

N = number of samples = 39

P = number of wells = 14

39 - 14 = 25

Note: Sample results reported as < MDL, are assumed to be $\frac{1}{2}$ MDL.

file name: GRJAS.SX

Arsenic

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AS

VARIABLE A...A. ...E ONEWAY NONPARAMETRIC AOV

VARIABLE	MEAN RANK	SAMPLE SIZE
3588	10.0	1
3712	10.0	1
3744	10.0	3
3745	19.3	5
3746	23.6	5
M585	22.5	1
M586	22.5	1
M589	16.3	2
M590	16.4	4
M733	25.6	5
M736	20.8	3
M740	15.3	2
M737	24.1	4
M742	10.0	1
TOTAL	19.5	38

KRUSKAL-WALLIS STATISTIC 9.1524
P VALUE, USING CHI-SQUARED APPROXIMATION 0.7613

PARAMETRIC AOV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	984.0	75.69	0.61	0.8249
WITHIN	24	2.994E+03	124.7		
TOTAL	37	3.978E+03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 36
MAX DIFF ALLOWED BETWEEN TIES 1.00E-05

CASES INCLUDED 38 MISSING CASES 32

13 degrees of freedom. Table 1 @ 5% significance level to find tabulated H value = 22.36

Since the calculated value (9.15) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

SHEET NO. 7 (7)

JOB NO.

SUBJECT Cadmium ANOVAs

DATE

BY CHKD.

Cadmium

Sampling Points	← Upgradient →					← Downgradient →							← Cross-gradient →	
	588	710	744	745	746	515	516	519	530	731	736	740	737	742
Fall 1987	M	M	M	0.003	0.003	M	M	M	M	0.003	M	M	.002	M
Fall 1988	M	M	M	0.013	0.017	M	M	M	0.023	0.016	M	M	.018	M
Spring 1989	0.005	0.005	0.005	0.005	0.005	.0005	.0005	.0005	0.001	.0005	.0005	.003	.0005	.0005
Summer 1989	M	M	0.006	0.012	0.039	M	M	0.025	0.010	0.013	0.014	.0005	.029	M
Fall 1989	M	M	0.005	0.002	0.002	M	M	M	0.002	0.001	0.002	M	M	M

File name: GRJCD.SX

Note: Sample results reported as < method detection limit, are assumed to be $= \frac{MDL}{2}$

Cadmium

KRUSKAL-WALLIS ONE-WAY NONPARAMETRIC ANOVA

VARIABLE	MEAN RANK	SAMPLE SIZE
3555	7.0	1
3710	7.0	1
3746	19.3	3
3765	21.0	5
3766	23.7	5
M555	7.0	1
M556	7.0	1
M559	21.5	2
M570	23.6	4
M733	21.1	5
M736	18.7	3
M740	14.7	2
M737	24.0	4
M742	7.0	1
TOTAL	19.5	33

KRUSKAL-WALLIS STATISTIC 9.2974
P VALUE USING CHI-SQUARE APPROXIMATION 0.7575

PARAMETRIC ANOVA APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	1.0985E-03	84.49	0.62	0.8148
WITHIN	19	3.0748E-03	136.4		
TOTAL	32	4.1733E-03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 26
MAX DIFF ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 33 MISSING CASES 33

13 DF. At 5% significance level tabulated H value = 22.36
Since the calculated value (9.29) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

SHEET NO. 8 of 8 JOB NO. 65

DATE ____ SUBJECT Molybdenum ANOVA

BY ____ CHKD. ____

Molybdenum

Sampling Points	Upgradient							Downgradient					Cross-gradient	
	588	710	744	745	746	515	516	519	530	723	736	740	737	742
Fall 1987														
Fall 1988														
Spring 1989	.005	.06	.005	.02	.15	.24	.14	.04	.01	.01	.005	.07	.07	.03
Summer 1989	M	M	.01	.03	.14	M	M ~~.005~~	.06	.04	.05	.09	M	.09	M
Fall 1989	M	M	.02	.05	.15	M	M	M	.04	.04	.04	M	M	M

N = # of samples = 27
P = number of wells = 14

27 − 14 = 13 ∴ sample size large enough to conduct ANOVA

file name: GRJMO.SX

Note: values < MDL are assumed to be = $\frac{MDL}{2}$

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Molybdenum

ONE WAY AOV

VARIABLE	MEAN	SAMPLE SIZE	GROUP VARIANCE
B588	5.000E-03	1	M
B710	6.000E-02	1	M
B744	1.167E-02	3	5.833E-05
B745	3.333E-02	3	2.333E-04
B746	1.467E-01	3	3.333E-05
M585	2.400E-01	1	M
M586	1.400E-01	1	M
M589	5.000E-02	2	2.000E-04
M590	3.000E-02	3	3.000E-04
M733	3.333E-02	3	4.333E-04
M736	4.500E-02	3	1.825E-03
M740	7.000E-02	1	M
M737	8.000E-02	2	2.000E-04
M742	3.000E-02	1	M
TOTAL	6.089E-02	28	

SOURCE	DF	SS	MS	F	P
BETWEEN	13	8.099E-02	6.230E-03	14.14	0.0000
WITHIN	14	6.167E-03	4.405E-04		
TOTAL	27	8.715E-02			

	CHI SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	8.11	7	0.3230

COCHRAN'S Q 0.5558
LARGEST VAR / SMALLEST VAR 54.75

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.919E-03
EFFECTIVE CELL SIZE 2.0

CASES INCLUDED 28 MISSING CASES 42

The calculated F statistic (14.14) ~~is~~ ~~less than~~ exceeds the tabulated F (2.51), and the hypothesis of equal well means must be rejected. Contamination is suggested.

SHEET NO. 43 of 53

JOB NO.

JACOBS ENGINEERING

DATE

SUBJECT Selenium ANOVAs

BY

CHKD.

Selenium

Sampling Points	Upgradient					Downgradient							Cross-gradient	
	588	710	741	745	746	515	516	519	520	723	736	740	737	742
Fall 1987	M	M	M	.067	.060	M	M	M	M	.164	M	.127	.159	M
Fall 1988	M	M	M	.060	0.191	M	M	M	.142	.196	M	M	.199	M
Spring 1989	.005	.012	.005	.005	.05	.012	.012	M	.005	.005	.005	.005	.005	.005
Summer 1989	M	M	.012	.018	0.057	M	M	.028	.026	.025	.026	M	.026	M
Fall 1989	M	M	.011	.030	.060	M	M	M	.036	.039	.038	M	M	M

N = 37 samples
P = 14 wells

37 - 14 = 23 ∴ sample size large enough

file name: GRTSE.SX

Note. Values < MDL are assumed to be = $\frac{MDL}{2}$

9C ~~9C~~
BD 4

Selenium

KRUSKAL-WALLIS ONE-WAY NONPARAMETRIC AOV

VARIABLE	MEAN RANK	SAMPLE SIZE
3588	5.0	1
3711	12.5	1
3744	9.2	3
3745	19.8	5
3746	28.4	5
M585	12.5	1
M586	12.5	1
M589	22.0	1
M592	18.9	4
M733	23.0	5
M736	15.5	3
M740	19.0	2
M737	23.4	4
M742	5.0	1
TOTAL	19.0	37

KRUSKAL-WALLIS STATISTIC 12.6183
P VALUE USING CHI-SQUARED APPROXIMATION 0.4782

PARAMETRIC AOV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	1.454E-03	111.9	0.95	0.5190
WITHIN	23	2.696E-03	117.0		
TOTAL	36	4.150E-03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 22
MAX DIFF ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

At 5% significance level, tabulated H value = 22.36.
Since the calculated value (12.6) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

1 in Non-parametric ANOVA

Sampling Periods	← Upgradient →					← Downgradient →							← Cross-Gradient →	
	588	710	749	745	746	585	586	589	590	733	736	740	737	742
Fall 1987	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Fall 1988	.015	M	M	M	M	M	M	M	M	M	M	M	M	M
Spring 1989	M	.085	.015	.015	.015	.015	.015	.03	.015	.03	.015	.03	.075	.015
Summer 1989	M	M	.0025	.01	.027	M	M	.029	.02	.024	.02	M	.03	M
Fall 1989	M	M	.013	.052	.108	M	M	M	.117	.116	.12	M	M	M

M indicates Missing data

11
22

BUBJECT

DATE

BY

CHKD.

SHEET NO.

JOB NO.

92

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV Tin

VARIABLE	MEAN RANK	SAMPLE SIZE
3333	[illegible]	[illegible]
3712	[illegible]	[illegible]
3722	[illegible]	[illegible]
3723	[illegible]	[illegible]
3726	[illegible]	[illegible]
3333	[illegible]	[illegible]
3336	[illegible]	[illegible]
3337	[illegible]	[illegible]
3372	[illegible]	[illegible]
3733	[illegible]	[illegible]
3736	[illegible]	[illegible]
3742	[illegible]	[illegible]
3737	[illegible]	[illegible]
3742	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]

At 5% significance level,
tabulated H value = 22.36
Since the calculated value (12.91)
is less than tabulated value (22.4)
Accept the hypothesis of no-contamination
at the 5% level.

KRUSKAL-WALLIS STATISTIC [illegible]
P VALUE: USING CHI-SQUARED APPROXIMATION [illegible]

PARAMETRIC AOV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	[illegible]	[illegible]	[illegible]	[illegible]
WITHIN	[illegible]	[illegible]	[illegible]		
TOTAL	[illegible]	[illegible]			

TOTAL NUMBER OF VALUES WHICH WERE TIED [illegible]
MAX DIFF. ALLOWED BETWEEN TIES [illegible]

CASES INCLUDED [illegible] MISSING CASES [illegible]

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KRUSKAL-WALLIS ONEWAY NONPARAMETRIC ANOVA

VARIABLE	MEAN RANK	SAMPLE SIZE
3555	19.0	1
3712	22.0	1
3744	20.7	3
3745	15.6	5
3746	17.7	4
3555	9.0	1
3556	29.0	1
3559	22.5	2
3590	24.2	4
3733	22.6	5
3735	17.3	3
3740	9.0	2
3737	15.0	4
3742	30.0	1
TOTAL	19.0	37

Net Gross Alpha

One-Way Non-Parametric Anova

KRUSKAL-WALLIS STATISTIC 5.1852
P VALUE USING CHI-SQUARED APPROXIMATION 0.0228

At the 5% significance level, tabulated H value = 22.36

Since the calculated value (5.18) is less than the tabulated value (22.36) Accept the hypothesis of no contamination at the 5% level.

PARAMETRIC ADV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	866.3	66.66	0.52	0.8664
WITHIN	23	2.9445E-03	128.0		
TOTAL	36	3.8102E-03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 17
MAXIMUM DIFF ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

Net Gross Alpha Non-Parametric ANOVA.

Sampling Periods	← Upgradient →					← Downgradient →							Cross-Gradient	
	588	710	749	745	746	585	586	589	590	733	736	740	737	742
Fall 1987	M	M	M	-.27 Ø	Ø	M	M	M	M	-.45 Ø	M	-.15 Ø	-.20 Ø	M
Fall 1988	M	M	M	-.12 Ø	7.3 Ø	M	M	M	.47 Ø	16.9	M	-.22 Ø	51.9	M
Spring 1989	1.02	2.5	4.59	-1.57 Ø	0	-.17 Ø	24	-.84 Ø	4.64	0	-.28 Ø	M	0	36.19
Summer 1989	M	M	.139	17.6	18.21	M	M	81.9	63.1	125.7	53	M	-10.16 Ø	M
Fall 1989	M	M	8.04	14.0	16.87	M	M	M	44.23	98.9	-7.7 Ø	M	M	M

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JE JACOBS ENGINEERING

DATE ____ SUBJECT ____

BY ____ CHKD. SML 8/20/96

SHEET NO. ____ JOB NO. ____

Uranium Parametric ANOVA

Sampling Periods	← Upgradient →					← Downgradient →							← Cross-Gradient →	
	588	710	744	745	746	585	586	589	590	733	736	740	737	742
Fall 1987	M	M	M	.04	.056	M	M	M	M	.07	M	.213	.052	M
Fall 1988	M	M	M	.04	.05	M	M	M	.229	.07	M	M	.07	M
Spring 1989	.0015	.027	.021	.04	.06	0.29	.29	.18	.19	.08	.129	.12	.06	.093
Summer 1989	M	M	.010	.03	.06	M	M	.071	.112	.05	.083	.11	.06	M
Fall 1989	M	M	.009	.03	.06	M	M	M	.125	.0015	.095	M	M	M

File name

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SHEET NO ____ JOB NO. ____ SUBJECT ____ DATE ____ BY ____ CHKD. ____

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ONE WAY ANOVA

VARIABLE	MEAN	SAMPLE SIZE	GROUP VARIANCE
3333	1.8000E-03	1	*
3712	2.7000E-02	1	*
3744	1.3000E-02	3	4.6300E-03
3745	3.6000E-02	5	3.0000E-03
3746	5.7200E-02	5	1.9200E-03
3888	2.9000E-01	1	*
3886	2.9000E-01	1	*
3889	1.0500E-01	2	4.0500E-03
3892	1.6400E-01	4	3.0400E-03
3932	5.4000E-02	5	1.0200E-03
3936	1.0100E-01	3	6.3000E-04
3940	1.6650E-01	2	4.3250E-03
3937	6.0500E-02	4	5.4300E-03
3942	4.3000E-02	1	*
TOTAL	5.5860E-02	38	

SOURCE	DF	SS	MS	F	P
BETWEEN	13	1.7510E-01	1.3470E-02	12.77	0.0000
WITHIN	24	2.5310E-02	1.0550E-03		
TOTAL	37	2.0050E-01			

	CHI SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	34.09	8	0.0000

COCHRAN'S C 0.3975
LARGEST VAR / SMALLEST VAR 315.1

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 4.6795E-03
EFFECTIVE CELL SIZE 2.7

CASES INCLUDED 38 MISSING CASES 32

Uranium

Parametric ANOVA

tabulated value = 2.19

The calculated F statistic (12.77) exceeds the tabulated value (2.19) and the hypotheses of equal well means must be rejected. Contamination is suggested.

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JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ03-07-90-13-06(01)-00 DISCIPLINE Hydrology NO. OF SHEETS 77

PROJECT:

UMTRA

SITE: GRJ03: Cheney disposal site for the GRJ Tailings, Grand Junction, CO

FEATURE: Geochemical Attenuation of Contaminations by Soil: Attenuation capacities of the geologic materials beneath the proposed disposal cell

SOURCES OF DATA:

All included in the attachments

SOURCES OF FORMULAE & REFERENCES:

~~ASME~~

Standard arithmetic calculations

1. ASA/SSSA (American Society of Agronomy, Inc./Soil Science Society of America, Inc.) 1986. Methods of Soil Analysis: Physical and Mineralogical Methods Part 1, 2nd Edition, A. Klute et all., eds, Agronomy, Number 9 (Part 1), Madison Wisconsin

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		[illegible]	9/11/90	[illegible]	9/90	[illegible]	9/90

8/86

SEP 90

GEOCHEMICAL ATTENUATION OF CONTAMINA~~TIONS~~ATS BY SOIL: ATTENUATION CAPACITIES OF THE GEOLOGIC MATERIALS BENEATH THE PROPOSED DISPOSAL CELL AT THE CHENEY, GRAND JUNCTION, SITE.

CALCULATION NUMBER: GRJ03-07-90-13-06(01)-00.

A. Purpose

The purpose of this calculation is to develop quantitatively the capacities for attenuation of the hazardous constituents in the tailings pore water by the geologic materials beneath the Grand Junction tailings disposal cell at the proposed Cheney site.

The attenuation capacities thus determined will be incorporated in the overall design data base for the tailings disposal cell, and will be used in particular to develop groundwater protection strategy at the Cheney site.

B. Overview of Method

The attenuation capacities were determined using data from column and batch tests performed following the general procedures described in Attachment A of this calculation. Several composite samples for the Quaternary alluvium and the Mancos shale were tested. The composite samples were prepared using the available drill cuttings, and grab samples from the freshly opened pits at the Cheney site. The composite samples are described in Attachment B. Additionally, samples of a peat from a bog near grand Junction and supplied by local vendor were also tested, in the event a geochemical barrier with peat were needed for contaminant attenuation. Two types of samples containing the peat were tested: one containing 100 percent peat and the other composed of 10 percent peat mixed with one of the alluvium composite samples (sample 179-4).

The composite samples of alluvium and Mancos shale were characterized for the physical and chemical parameters that control attenuation capacities. These parameters include grain size distribution, acid neutralization potential, soil pH, cation exchange capacities, and content of various reactive minerals and chemical constituents. The physical and chemical parameters on the composite samples are provided in Attachment C.

Two test fluids were used during the tests. The groundwater from the monitor well 589 at the Grand Junction processing site spiked with known amounts of arsenic, cadmium, molybdenum, lead and selenium were used for the batch tests, and also for the initial column tests. The composition of this groundwater after spiking is shown in Attachment D-1. The test fluid used for the subsequent tests was a composite water sample prepared by mixing the water samples collected using lysimeters installed at the bottom of the

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tailings but within the unsaturated zone of the Grand Junction tailings pile. The concentrations of the hazardous constituents arsenic, beryllium, cadmium, cobalt, chromium, nickel, selenium, uranium, vanadium and zinc in this test fluid were elevated by spiking with known amounts of soluble salts of these constituents. Attachment D-2 shows the composition of this test fluid.

In order to estimate reproducibility of the column tests, triplicate columns were tested for several of the composite sample. The reproducibility data are provided in Attachment D-3.

A complete chemical analysis was conducted on each of the leachates from the batch and the column tests. For the column tests, each effluent pore volume was separately analyzed. The chemical analysis was performed using the EPA approved analytical methods by the Core Laboratories, an EPA Contract Laboratory Participant, under a subcontractors agreement to the Jacobs Engineering Group.

C. Assumptions

1. The composite samples used for the tests represent the Quaternary alluvium and the Mancos Shale beneath the disposal site at Cheney. This is a reasonable assumption given the fact that a) the composites were prepared thoroughly mixing all available drill cuttings from a large number of wells that are geographically well distributed at the site and b) in case of the composites from the experimental pits, these composites were prepared mixing several randomly collected subsamples; however, these latter composites do not reflect the special variability unlike the drill-cuttings composites.

2. The simulated test fluids represent the chemistry of the tailings pore water expected to present at the bottom of the stabilized tailings pile.

This is a reasonable assumption for both of the test fluids used because of the following reasons. The chemistry of the groundwater from the well 589 is generally similar to that of the tailings pore water. The composite test solution prepared by mixing water samples from the lysimeters installed in the tailings should closely represent the chemistry of the tailings pore water. The first test fluid (groundwater from well 589) was not spiked with all of the hazardous constituents present in the tailings. This fact however, does not affect the chemical behavior of the test fluid.

3. The flow rates used in the column tests is applicable to the flow rate of the tailings leachate through the subsurface materials at the Cheney site.

The flow rate used in the column tests were more rapid than the expected flow rate of tailings leachate in the alluvium and the Mancos Shale underlying the proposed disposal cell. This fact however, indicates that the hazardous constituents are likely to

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be attenuated more effectively than in the laboratory tests due to longer residence time of the pore fluid in the alluvium and the Mancos Shale at the Cheney site. (this is a conservative assumption)

D. Material Properties

The physical and chemical properties of the composite samples used in the batch and column tests are presented in Attachment C.

E. Data Sources

All data used in calculations of the attenuation capacities are presented in the text and Attachments D. Additional supporting data are presented in Attachments A, B, C and E.

F. Calculation

Assume that the concentration of a hazardous constituent "X" in test fluid is A mg/l, and the concentration of "X" in the leachate from the batch or column test is B mg/l. The percent of "X" attenuated is calculated as follows:

$$\text{Percent "X" attenuated} = \frac{A - B}{A} \times 100.$$

For example, the concentration of As in test solution is 2.3 mg/l and that in the batch leachate of the Mancos Shale composite is 0.007 mg/l (Table 1). Percent As attenuated is calculated as follows:

$$\text{Percent } \underline{\text{As}} \text{ attenuated} = \frac{2.3 - 0.007}{2.3} \times 100 = 99.7.$$

The concentration of the hazardous constituents in the test fluid and the percent attenuation of these constituents for the batch test is given in Table 1.

Table 2 shows the concentrations of the hazardous constituents in the first effluent pore volumes for the column tests and Table 3 shows the corresponding percent attenuation data for arsenic, cadmium, molybdenum, nickel, selenium, uranium and zinc. Because of the very slow flow rate through the shale samples, column test data are vailable only for the alluvium samples.

G. Conclusions and Recommendations

The test solution for the batch tests was spiked with only four hazardous constituents: arsenic, cadmium, selenium and molybdenum. The data show that arsenic and cadmium were almost completely attenuated by the alluvium and the Mancos Shale. Both selenium and molybdenum are partially attenuated by the Mancos Shale. The alluvium also partially attenuated selenium, but shows no

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measurable attenuation for molybdenum.

Chemical analysis of the first effluent pore volumes through the columns of the alluvium samples are shown in Table 2. The data show that all hazardous constituents that were detected in the tailings pore water (Attachment D-4) are below or close to their detection limits in the first effluent pore volumes except arsenic, cadmium, molybdenum, nickel, selenium, uranium, zinc, strontium, fluoride and nitrate; small amounts of strontium and fluoride were released by the test materials except the two samples containing peat which partially attenuated fluoride; all materials released nitrate.

The concentrations of strontium, fluoride and nitrate in the groundwater of the Mancos Shale and the Dakota Sandstone (Attachment E) at the Cheney disposal site are below or close to those in the first effluent pore volumes (Table 2). This implies that strontium, fluoride and nitrate leached naturally by meteoric water from the geologic materials above the groundwater at the Cheney disposal site do not significantly elevate their concentrations in the groundwater.

Table 3 shows that all column test materials attenuated arsenic and cadmium below their EPA MCLs; attenuated more than 85 percent of uranium, vanadium and zinc, and attenuated variable but significant amounts of molybdenum, selenium and nickel. It should be noted that the concentrations of all of these hazardous constituents in the test fluid were higher than those in the tailings pore water (Attachment D-4). If the tailings pore water concentrations were used in the column tests, it is likely that the concentrations of these constituents in the effluent solutions of the first pore volumes would be close to, or below, the EPA groundwater standards.

In summary, the batch and column test data demonstrate that the alluvium and the Mancos Shale underlying the proposed disposal site will attenuate the hazardous constituents present in the tailings pore water; and it is likely that the concentrations of the hazardous constituents in the tailings leachate would be reduced to below the EPA standards due to attenuation by the alluvium.
some constituents, but not all

Results

the results are presented in tables 1, 2 and 3. See the last paragraph above for conclusions.

References

All included in the attachments.

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TABLES AND ATTACHMENTS

Tables

Table	Description
1	Results of the batch tests ... Test fluid composition and hazardous constituents attenuation data from batch tests.
2	Chemical analysis of the first effluent pore volumes in column tests
3	Percent hazardous constituents attenuated from the first effluent pore volumes in column tests.

Attachment	Description
A	Batch and column test procedures.
B	Description of the composite samples used in the batch and column tests.
C	Mineralogical and Chemical Characterization ... Physical and chemical properties of the composite samples.
D-1	Composition of the spiked groundwater from well 589.
D-2	Hazardous constituents detected in the pore water of the Grand Junction tailings.
D-3	Compositions of the test fluids prepared by mixing water samples from the lysimeters installed in the tailings pile, and spiking with known concentrations of hazardous constituents.
D-4	Reproducibility of column tests: Chemical analyses of the first effluent pore volumes of the triplicate columns of individual test materials.
E	Groundwater quality of the Mancos Shale and the Dakota Sandstone.

9/17/90

L.M. COOKE PE, PHG
SEP '90

Table 1

Results of the batch tests, cheney disposal site, Grand Junction, Colorado

	Concentration of hazardous constituents, mg/l (percent attenuated)			
	As	Cd	Mo	Se
Test solution	2.30	0.076	6.20	8.4
Test pad Alluvium (GCM-2, -3 and -4)	0.016 (99.3)	<0.005 (93.4)	6.20 (0)	4.80 (42.9)
Homogenized Alluvium (GCM-1)	0.024 (99.0)	0.006 (92.1)	6.30 (0)	3.50 58.5)
Mancos Shale (GCM-5)	0.007 (99.7)	0.005 (93.4)	5.25 (15.3)	2.10 (75)

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L.M. COOK
SEP '90

Table 2

Chemical analysis of the first effluent pore volume from column tests, Cheney disposal site, Grand Junction, Colorado .

	Concentration in mg/l					
Sample No	179-1	179-2	179-3	179-4	179-4+10% peat	Peat
Hazardous constituents						
Al	< 0.50	<0.50	<0.50	<0.50	0.533	0.566
Sb	<0.001	<0.004	0.0013	0.006	<0.001	0.001
As	0.003	0.005	0.0057	0.005	0.006	0.012
Ba	0.100	<0.10	<0.10	0.10	<0.1	0.10
Be	<0.050	<0.05	<0.05	<0.05	<0.05	0.05
B	3.583	2.85	2.75	4.23	3.867	0.1
Br	0.420	0.85	14.33	5.47	2.077	0.2133
Cd	0.0006	0.0009	0.001	0.0008	0.001	0.0012
Ca	548.33	503	908	503	650	1600
Cl	1900	2033	3433	3067	1966	1400
Cr	<0.100	<0.1	<0.10	<0.10	<0.1	0.1
Co	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Cu	0.20	0.10	<0.10	0.167	<0.133	0.10
F	1.6	1.67	1.733	2.533	0.467	0.20
Fe	<0.2	<0.2	<0.20	<0.20	0.133	0.433
Pb	<0.001	<0.001	<0.001	<0.001	,0.001	0.001
Mg	531.77	500	423	673	505	473
Mn	0.533	0.50	0.10	<0.10	0.60	2.933
Hg	<.0002	<.0001	<.0001	<.0001	<.0001	0.0001
Mo	3.033	2.6	1.10	1.67	0.633	0.50
Ni	1.2	1.167	1.033	1.33	1.533	0.90
NO3	340.20	77.43	438.4	584	668	1935
PO4	0.167	0.167	0.233	0.10	0.233	0.967
K	26.67	20.0	5.0	25.0	16.70	26.67
Se	0.567	0.67	0.20	1.43	0.70	0.03
SiO2	26.16	22.0	17.83	26.83	36.0	55.83
Ag	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Na	3076	3720	4193	5682	3358	458
Sr	8.92	8.8	11.92	10.32	7.7	9.33
SO4	7486	8150	7066	11566	6130	2879
Tl	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Sn	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
TDS	14528	15589	16286	21822	13220	8755
U	0.5633	0.114	0.0427	0.108	0.094	0.0057
V	<0.100	<0.10	<0.1	<0.10	<0.10	0.10
Zn	0.233	0.167	0.20	0.133	0.267	0.267

(1) Arithmetic mean of three column-effluents for each material

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L.M. COCKS PE, PHG
SEP '90

Table 3

Percent hazardous constituents attenuated from the first pore volumes in the column tests, Cheney disposal site, Grand Junction, Colorado

Hazardous constituents	Percent hazardous constituents attenuated					
Sample No	179-1	179-2	179-3	179-4	179-4+10% peat	peat
As	99.4	99.91	99.99	99.91	99.89	99.76
Cd	99.91	99.86	99.86	99.89	99.83	99.86
Mo	31.14	40.91	96.07	62.05	85.61	86.64
Ni	78.95	79.53	97.32	80.12	73.10	84.21
Se	82.82	79.79	93.94	56.58	78.79	99.09
U	85.38	97.04	99.96	97.20	97.56	99.84
Zn	96.97	97.83	97.40	98.27	96.53	97.40

9/17/90

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L.M. COCHS PE, PHE

SEP '90

7/27/90

7/5/90

(The Original signed copy of Attachment A is in Attachment A of Calc # GUN08-05-90-13-06(01)-00 for the Gunnison Landfill disposal site)

ATTACHMENT A

BATCH AND COLUMN TESTING PROCEDURES

L.M. COONS PE, PHD
SEP '90

Date: March 7, 1990

REVISED PROCEDURE: Section 16-1-8 Date: 09-12-88 Effective: 10-27-88

TITLE: Batch and Column Testing

1.0 PURPOSE

Provide a procedure to perform batch and column leach tests on uranium mill tailings, soils, sediments, or combinations and mixtures thereof.

2.0 SCOPE

This procedure is applicable to TAC and its contractors or subcontractors who have responsibilities and duties to perform batch or column leach experiments. Further, portions of Section 10.8.2 entitled "Packaging and Shipping Procedure for Unassayed Tailings Samples", Section 14.4.1 entitled "Soil and Rock Core Borehole and Test Pit Logging", Section 16.1.10 entitled "Field Measurements of Water Samples for Temperature, Conductivity, pH, Alkalinity, and Total Acid", and Section 16.1.13 entitled "Field Measurements of Oxidation/Reduction Potential (E_h) in Water Samples", are also applicable to this procedure.

3.0 SAFETY GUIDANCE

Safety procedures outlined in this section must be followed when applicable to sample collection, moisture content determination, batch leach experiments and column leach experiments. Exposures to hazardous chemicals and radioactive materials must be kept as low as reasonably achievable in accordance with the ALARA principle. All hazardous and radioactive materials must be properly stored and transported (Section 10.8.2).

3.1 Analysts handling hazardous and/or radioactive samples must wear appropriate attire (e.g., rubber gloves, lab coat, glasses and dust masks) to limit unnecessary exposure.

3.2 Attire, where practicable, shall be disposable and will be disposed of in a designated container.

3.3 All analysts working at the Rad Lab must have and wear a TLD badge to document radiation exposure(s).

3.4 Analysts must be properly trained in the use of radiation survey meters prior to conducting sample or contamination surveys.

3.5 All radioactive materials stored in the North Bay or Geotech areas must be signed out using the Log Books for each area.

L.M. SEP '90

3.6 Analysts must exercise caution and provide controls when practicable to prevent unnecessary exposure, contamination of laboratory equipment and release of hazardous and/or radioactive materials.

3.7 All hazardous chemicals such as acids must be properly stored when not in use.

3.8 Containment must be provided when liquids containing hazardous and/or radioactive materials are being used.

3.9 Every attempt must be made to avoid production of mixed wastes by separating chemical and radioactive wastes whenever possible.

3.10 Analysts must immediately notify the Radiation Protection Officer if radioactive materials are released and notify the Laboratory Manager if hazardous chemicals are released.

3.11 Spilled or released hazardous and/or radioactive materials must be cleaned up as quickly as possible following notification procedures of 3.10.

3.12 Contaminated labware and decontamination wash solutions must be placed in separate designated disposal containers.

4.0 CHEMICALS AND REAGENTS

4.1 Laboratory Reagent(s)–Consult with Geochemist or Hydrologist to determine reagent grade chemicals, reagents, or other solutions required for experiment.

4.2 Synthetic Ground Water–an aqueous solution comprised of reagent grade chemicals or solutions that approximate ground water sample concentrations based on previous laboratory results. See 8.1 and 9.1.

A. ALTERNATE. Mix distilled water with tailings, soil, sediments, or other combination(s) and mixture(s) of samples. Filter and use the filtrate for the experiment. Record weight of sample and volume of distilled water used.

4.3 Lixiviants–an aqueous solution that contains a compound which will promote the dissolution or desorption of soluble constituents within the aquifer matrix. See 8.1 and 9.1.

A. Prepare lixiviant solution(s) as required by the Geochemist or Hydrologist. Record weight of lixiviant(s) added to liquid and volume of liquid used to prepare solution. Specify lixiviant(s) used. NOTE: Liquid may be distilled water, ground water, or other suitable liquid.

B. Prepare lixiviant(s) in solid form, as required by the Geochemist or Hydrologist. Weigh lixiviant(s), mix with sample or add lixiviant to column. See B.1 or B.2 below. Record weight of lixiviant(s) and sample used. Specify lixiviant(s) used. NOTE: Sample may consist of tailings, soil, sediment, or a pre-determined combination and mixture of these media. See 8.1 and 9.1.

1. Determine lixiviant(s) to be used, weigh out appropriate aliquot, and mix well with sample. Add mixture to column as directed in 9.4.

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2. Determine lixiviant(s) to be used, weigh out an appropriate aliquot, and add to column as a single unmixed layer. NOTE: Place lixiviant on top or bottom of column.

4.4 Water, deionized (ASTM Class II or better). See Reference 11.2.

4.5 Nitric Acid: HNO_3. Reagent Grade (~70%: ~16 M or ~16 N).

4.6 Silica sand

4.7 Radiac Wash or equivalent (Use for radioactive decontamination).

A. 30% (v/v) Radiac Wash Solution: Add ~600 mL of Radiac Wash to a 2,000 mL graduate cylinder containing ~1300 mL of deionized water and mix well. Add deionized water to the 2,000 mL mark and mix well. Pour solution into a polyethylene container labelled with "~30% (v/v) Radiac Wash Solution", "600 mL Radiac Wash/2,000 mL deionized water", date, and initials.

B. ALTERNATE. 5% (w/v) Na_4EDTA Solution: Add 50 grams of Tetrasodium EDTA reagent powder to a 1000 mL volumetric flask and add ~500 mL of distilled water to dissolve the EDTA powder. Add distilled water to the 1000 mL mark on the flask and mix solution well. Pour solution into plastic container. Label container with "DeCon Solution", "~5% (W/V) Na_4EDTA Solution", "50 g Na_4EDTA/liter of distilled water", add date, and initial. Dispose of solution into toxic or hazardous waste container after 6-8 weeks and replenish solution with a fresh batch of EDTA solution.

5.0 EQUIPMENT AND SUPPLIES

5.1 Portable Radiation Survey Meters:

A. Beta-Gamma

B. Alpha Scintillation

5.2 Top Loading Balance, 0.1 g

5.3 Analytical Balance, 0.10 mg.

5.4 Wrist Action Shaker: with timer and automatic/manual operation

5.5 Conductivity Meter with thermometer

5.6 pH Meter, with automatic temperature compensator (ATC) and with expandable readout.

5.7 Thermometer

5.8 Refrigerator set at 4° C.

5.9 Drying Oven: 0-200° C. Range

5.10 Pump, peristaltic: with variable speed, with 3/16" I.d. tubing.

5.11 Pyrex or polyethylene beakers: 50, 100, 150, 250, 400 mL

5.12 Pyrex or polyethylene Erlenmeyer flasks: 125, 250, 500, 1000 mL

5.13 Pyrex or polythylene graduate cylinders: 50, 100, 250, and 500 mL

5.14 Pyrex filter flask, heavy duty: 2000 mL

5.15 Pyrex or polyethylene filter apparatus: 50 , 300, 500 mL

5.16 Filters:

A. Membrane filter; 0.45 u , 2" diameter

B. Glass fiber filter (for column(s); 75 mm diameter, Micron Separations, inc.

C. Polyethylene filter disc (for column(s); ~4" diameter and with 15-25 holes in the disc.

D. Mini-Capsule filter (No. 12123) or equivalent: 0.45 um, Gelman Sciences

5.17 Stoppers:

A. Rubber; Nos. 7, 8, 9, and 10

B. Bakelite or equivalent (for columns); machined, 4" diameter with 3/16" o.d. x ~3" length glass or polyethylene tube located in center of stopper. Two (2) each for each column.

5.18 Column(s), polycarbonate. Purchase from local supplier and cut into appropriate lengths.

A. ~12" x ~4" i.d.

B. ~48" x ~4" i.d.

5.19 Tygon tubing or equivalent:

A. 3/16" i.d. x 1/16" wall

B. 1/2" i.d. x 1/8" wall

5.20 Plastic Pans: ~12" width x ~14" length x ~8" height

5.21 Aluminum pans (to hold sample): disposable

5.22 Laboratory Log Book

6.0 PROCEDURE: Sample Collection

- Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.

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- If the samples are contaminated, portions of Section 10.8.2, are applicable to this procedure. If the samples are uncontaminated, portions of Section 14.4.1 are applicable to this procedure. Sample collectors must be familiar with and use appropriate portions of Section 10.8.2 and Section 14.4.1.

6.1 Collect tailings, soil, or sediment samples with clean utensils and store in sample containers. Mix sample well.

6.2 Determine radioactivity of sample and record value in uR/hr on sample data sheet and on sample container. NOTE: Use calibrated portable radiation survey meter(s).

6.3 Prepare logs of test pits and core holes according to Section 14.1.4 of the Albuquerque Operations Manual.

6.4 The methods for cleaning labware used to collect the sample(s) will be dependent upon the components of interest, (e.g., samples collected for organic analyses should not come in contact with plastic, etc).

7.0 PROCEDURE: Moisture Content Determination or Preparation of a Dried Sample

- Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.
- Use ASTM Method 2216, see Reference 11.1.

7.1 Weigh 100 g aliquot of sample into a sample container labelled with sample identification number. Record net weight as "wet weight". Sample consists of tailings, soil, sediments or any combination and mixture thereof.

A. ALTERNATE. If sample is to be analyzed as a wet sample, omit all of 7.0 and proceed directly with 8.2 or 9.2.

7.2 Place sample container into a drying oven, set temperature controller to 100° C., close oven door, and turn oven on. Check temperature reading on the thermometer periodically.

A. Oven should be located in an exhaust hood or should be vented out of the building with appropriate exhaust tubing.

7.3 Dry sample for 4-12 hours. Upon completion of drying time, shut off oven, and allow sample to cool to room temperature. NOTE: Length of drying time depends on type of sample and amount of moisture in the sample.

7.4 Weigh sample and record net weight as "Dry Weight". Record the following information in the laboratory log book: A) date and time of determination, B) sample number, location, and description, C) mass of sample before drying ("Wet Weight"), D) drying time and temperature, and E) mass of dry sample ("Dry Weight").

7.5 Calculate and report percent moisture as follows:

% = (Wet Weight - Dry Weight) ÷ Wet Weight x 100%.

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7.6 Pulverize dried sample by placing sample into 3 or 4 heavy duty plastic bags and crush sample into fine dust by beating bag with a rubber mallet. Mix sample by shaking and tumbling bag. NOTE: If necessary, use additional bags if bag(s) are punctured.

A. ALTERNATE. Use a mortar and pestle to pulverize the sample.

7.7 Sample now ready for analysis.

8.0 PROCEDURE: Batch Leach Experiments

- Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.
- Perform Batch Leach Experiments according to the JEG-modified version of ASTM Method 4319-83. See Reference 11.2.

8.1 Consult with Geochemist or Hydrologist to determine method of batch preparation and use of solution.

A. Should sample(s) be analyzed in wet or dry form? Should solid lixiviant(s) be mixed with the sample?

B. What kind of lixiviant(s) will be used? Will lixiviants require mixing before use? What is the composition of the lixiviant(s)? Mixtures? What will "groundwater" consist of (i.e. distilled water, synthetic groundwater, site specific groundwater, or other solution)?

C. What volume in mL will constitute a "Pore Volume?" After what pore volume(s) should samples be collected?

8.2 Weigh 200 g of a wet sample into a 1000 mL Erlenmeyer flask labelled with sample number. Weigh sample to the nearest 0.01 g and record weight as wet weight. NOTE: Sample is tailings, soil, sediment, or a combination and mixture thereof.

A. ALTERNATE. Weigh out 75 $\pm$ 5 g of a dried and pulverized sample into a 500 mL Erlenmeyer flask. Weigh sample to the nearest 0.01 and record weight as dry weight.

8.3 Add ~800 mL of distilled water to the flask and mix solution. Record volume in log book. Stopper flask. NOTE: Use, if required, synthetic ground water (see 3.2), site specific ground water, or lixiviant solution (see 3.3) as a leach medium. Add liquid volume equal to ~four (4) times the amount of solid sample.

A. ALTERNATE. Add ~300 mL of distilled water to the flask of 8.2A. Stopper flask. Record volume in log book. See NOTE of 8.3.

8.4 Mount flasks on Wrist Action Shaker and tighten clamps so that flasks do not move. Place a plastic pan beneath flasks so that leaks or spills may be caught in the pans. CAUTION: Neck of flask or clamp may break due to excess pressure.

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8.5 Turn on shaker and shake samples for 60 minutes. During shaking period, check flasks periodically to make sure they are secure and to see if liquid and samples are mixing well. If necessary, stop shaker and tighten clamps. After shaker stops, allow samples to set for 2-4 hours.

8.6 Repeat 8.5 once more. Allow samples to set overnight. Check stoppers and flasks for leakage.

8.7 Repeat 8.5 and 8.6 each day for two (2) more days. NOTE: Samples must be shaken twice a day for three (3) days.

8.8 Without agitating sample solution, loosen clamps and carefully remove flasks from the shaker, loosen stoppers, and place samples on lab bench.

8.9 Filter sample solution into a clean 1000 mL erlenmeyer flask labelled with sample number and gently mix solution. Observe and record physical description of the filtrate (e.g., clear, cloudy, color, etc.). NOTE: Record date and time of sample collection, sample number, and description.

A. NOTE: Assemble filter apparatus as follows: Place ~ 5-6 feet of clean 3/16" i.d. tygon tubing into peristaltic pump and hand tighten screws. To outlet end of filter apparatus, add Mini-Capsule filter (see 5.15D) and tighten hose clamp. Rinse unit with ~1000 mL of distilled water. Unit now ready for sample and filtration. NOTE: Adjust pump rate to desired speed.

8.10 Divide filtrate into appropriate aliquots for field or laboratory analysis.

A. Pour a 200 mL aliquot into a pre-cleaned 16 oz. sample bottle. Acidify aliquot to pH 2.0 with 2-3 mL of HNO_3 and mix well. Label bottle with sample identification, "M", "HNO_3 added", date, initials and comments (if any). Refrigerate sample at 4° C. Ship samples to the laboratory for metals determination.

B. Pour a 200 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "A-1", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C. Ship samples to the laboratory for anion determinations.

C. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "Parameters", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C.

8.11 Perform chemical measurements at the time of collection according to sample analysis requirements (e.g., pH, E_h, Conductivity, excess lixiviant, and alkalinity). Use aliquot from 8.10C above. Use paragraphs 7.0, 8.0, and 9.0 of Section 16.1.10 for these measurements.

A. Calibrate pH Meter. Record standard(s) used as well as date and time of calibration. Measure sample pHs and record data.

B. Calibrate Redox Potential (E_h) Meter. Record standard used as well as date and time of calibration. Measure sample E_{hs} and record data. NOTE: Use Section 16.1.13 for these measurements.

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C. Calibrate Conductance Meter. Record date and time of calibration as well as standard(s) used. Measure sample conductance and record data.

D. If sample volume permits, determine alkalinity of sample. Record data on sample analysis sheet.

8.12 Dispose of sample by adding ~50 mL of distilled water to flask and swirling sample mixture until sample is suspended. Quickly pour sample solution into a radwaste container. Rinse flask with ~50 mL of distilled water and repeat swirling. Pour solution into a radwaste container labelled with "Radioactive Waste", Site name, and date. Add contaminated labware and sample waste solution(s). Store in Radwaste storage area.

8.13 Clean uncontaminated labware (e.g., beakers, flasks, etc.) by soaking labware overnight in ~30% (v/v) Radiac Wash and by washing them with a laboratory detergent. Rinse labware a minimum of three (3) times with hot water followed by a minimum of three (3) rinses of deionized water (see 3.1) and allow labware to air dry.

A. Soak uncontaminated labware overnight in a 30% (v/v) Radiac Wash Solution. Save solution for 6-8 weeks. Dispose of solution into designated radwaste containers and fill the soak container with fresh solution of diluted Radiac Wash. NOTE: As an alternate, use ~5% (w/v) Na_4EDTA Solution.

9.0 PROCEDURE: Column Leach Experiment

o Safety guidance provided in 3.0 must be followed, as applicable, for this procedure.

9.1 Consult with Geochemist or Hydrologist to determine method of column preparation and collection of eluates.

A. Should sample(s) be analyzed in wet or dry form? Should solid lixiviant(s) be mixed with the sample and added to the column or added to the column as a single layer? Should vacuum be used during part or all of column procedure? Should groundwater or lixiviant be added to the top or bottom of the column? Should sample be eluted from the top or bottom of the column?

B. What kind of lixiviant(s) will be used? Will lixiviants require mixing before use? What is the composition of the lixiviant(s)? Mixtures?

C. What volume in mL will constitute a "Pore Volume?" After what pore volume(s) should samples be collected? What liquid, if required, will be contained in the reservoir (e.g., distilled water, synthetic groundwater, site specific groundwater, lixiviant solution, etc.)

9.2 Determine radioactivity of the sample in uR/hr. Record value on sample data sheet and on sample container. NOTE: Compare radioactivity values of that on the sample container to the sample to be processed. If necessary, consult with Geochemist/Hydrologist to determine laboratory precautions to be exercised when processing the sample.

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9.3 Assemble column for experiment.

A. Take a clean column (~12" x 4" i.d.) and insert a machined stopper. NOTE: Apply a small amount of inert lubricant on the side of the stopper and push stopper into column. Use same procedure for longer column (i.e., ~48" x ~4" i.d.).

B. Place column onto column rack and tighten clamp.

C. Place a plastic pan directly underneath the column so that any leaks or spills from the column may be collected.

D. Through the open end of the column, add a filter disc (~4" dia.).

E. Add a glass fiber filter (75mm dia.). Place the filter so that it is adjacent to and lies flat on the filter disc. NOTE: Use a rod or other suitable instrument to properly insert and place the filter.

F. Add ~100 g of silica sand onto filter and level layer of sand.

G. Column now ready for sample (i.e., tailings, soil, sediment, or pre-determined combination and mixture).

9.4 Weigh out a predetermined amount of sample and add sample to the column. Record weight of sample. Pack column. This is one "lift".

A. In the event that solid lixiviants are to be added, prepare sample according to 3.3 B.

9.5 Continue 9.4 until ten (10) lifts or ~10" of sample have been added to and packed in the column. NOTE: The density should result in a transmissivity factor equal to 10^{-3} to 10^{-5} cm/sec. The upper two inches of the column will serve as a fluid reservoir.

9.6 Complete filling of the column by adding ~100 g of silica sand onto the topmost layer of the sample.

9.7 Place a 4" diameter glass fiber filter on top of the silica sand layer and a filter disc on top of the filter.

9.8 Place a Bakelite stopper into the top of the column and push stopper into the column. NOTE: Lubricate the sides of the stopper with petroleum or silicone jelly.

9.9 Connect one end of the column to a 2000 mL filter flask with 9/16 i.d. tygon tubing and the other end of the column to a reservoir with 3/16" i.d. tygon tubing. Adjust reservoir height to ~60 inches from top of column. This is sometimes called "head". NOTE: Reservoir will contain a solution specified by the Geochemist or Hydrologist. See 9.1.

9.10 Open reservoir and allow liquid to flow into column. Allow the column to fill with liquid and the solids to become saturated with the liquid. When column has been saturated with liquid and liquid begins collecting in the collection flask, adjust column exit flow rate to one pore volume per day OR to flow rate specified by Geochemist or Hydrologist. Adjust the head to ensure a minimum flow rate of one

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pore volume per five days. NOTE: A pore volume is the amount of liquid required to saturate the sample in the column.

9.11 Collect sample(s) for analysis directly from the column effluent stream and after elution of the following pore volumes: 2, 5, 10, and immediately before termination of the experiment. NOTE: Determine and record effluent characteristics [e.g., date and time of sample collection, sample number and description, physical description (i.e., clear, cloudy, brown, yellow, etc.), excess lixiviant, or any other parameters that may be specific to the type of experiment].

9.12 Divide sample into appropriate aliquots for field or laboratory analysis.

A. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Acidify aliquot to pH 2.0 with 1-2 mL of HNO_3 and mix well. Label bottle with sample identification, "M", "HNO_3 added", date, initials and comments (if any). Refrigerate sample at 4° C.

B. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "A-1", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C.

C. Pour a 100 mL aliquot into a pre-cleaned 16 oz. sample bottle. Label bottle with sample identification, "Parameters", "No preservative added", date, initials, and comments (if any). Refrigerate sample at 4° C.

9.13 Perform chemical measurements at the time of collection according to sample analysis requirements (e.g., pH, E_h, Conductivity, excess lixiviant, and alkalinity). Use aliquot from 9.12C above. Use paragraphs 7.0, 8.0, and 9.0 of Section 16.1.10 for these measurements.

A. Calibrate pH Meter. Record standard(s) used as well as date and time of calibration. Measure sample pHs and record data.

B. Calibrate Redox Potential (E_h) Meter. Record standard used as well as date and time of calibration. Measure sample E_{hs} and record data. NOTE: Use Section 16.1.13 for these measurements.

C. Calibrate Conductance Meter. Record date and time of calibration as well as standard(s) used. Measure sample conductance and record data.

D. If sample volume permits, determine alkalinity of sample. Record data on sample analysis sheet.

9.14 Conclude the experiment at the end of 20 days or upon addition and elution of a specified number of pore volumes.

9.15 Disassemble column apparatus and dispose of sample into a radwaste container labelled with "Radioactive Waste", Site name, and date. Add sample waste solution(s) and contaminated labware.

9.16 Clean uncontaminated labware (e.g., beakers, flasks, etc.) by soaking labware overnight in ~30% (v/v) Radiac Wash and by washing them with a laboratory detergent. Rinse labware a minimum of three (3) times with hot water followed by a

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minimum of three (3) rinses of deionized water (see 3.1) and allow labware to air dry.

A. Soak uncontaminated labware overnight in a 30% (v/v) Radiac Wash Solution. Save solution for 6-8 weeks. Dispose of solution into designated radwaste containers and fill the soak container with fresh solution of diluted Radiac Wash. NOTE: As an alternate, use ~5% (w/v) Na_4EDTA Solution.

10.0 ATTACHMENTS

11.0 REFERENCES

11.1 ASTM, 1984. "Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures", Method D2216. Soil and Rock, Building Stones; Volume 04.08. ASTM, 1916 Race St., Philadelphia, PA.

11.2 ASTM, 1984. "Distribution Ratios by the Short-Term Batch Method", Method 4319. Soil and Rock, Building Stones; Volume 04.08. ASTM, 1916 Race St., Philadelphia, PA.

12.0 PROCEDURE REVIEW AND APPROVAL

Prepared By: _____
TAC Representative — Date

Reviewed By: _____
Task Manager — Date

Reviewed By: _____
Quality Assurance Manager — Date

Approved By: _____
Project Manager/
Deputy Project Manager — Date

ATTACHMENT B

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ATTACHMENT B

Description of the composite samples used in the batch and column tests.

Sample No	Sample Type
GCM-1	Drill cuttings composite of the alluvium: well 835 cuttings were used
GCM-2	Test pad composite for the alluvium; the composite was prepared by mixing several subsamples of the alluvium collected from the test pad 2 used for the infiltrometer tests
GCM-3	Same as GCM-2 but from a different location within the test pad 2
GCM-4	Same as GCM-3 above but from another location within the test Pad 2.
GCM-5	Mancos Shale composite prepared by using several subsamples form the test pad 1 used for the infiltrometer test.
179-1	Alluvium composite without the clayey gravel (GC) and the low plastic clay (CL) fractions prepared using drill cuttings from several drill holes at the Cheney disposal site.
179-2	The 179-1 composite mixed with 10 percent Mancos Shale.
179-3	Top Soil composite prepared using the available cuttings from the drill holes at the Cheney disposal site.
179-4	Alluvium composite prepared using the available grill cuttings and screened to finer than one inch.

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ATTACHMENT C

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PREPARED FOR:

JACOBS ENGINEERING GROUP, INC.
ALBUQUERQUE OPERATIONS

MINERALOGICAL AND CHEMICAL CHARACTERIZATION OF SEDIMENT SAMPLES FROM COLORADO

FOR SAMPLES GCM-1, GCM-2, GCM-3, GCM-4 AND GCM-5

(See Attachment B for sample description)

By

Wolfgang Baum

August 21, 1989

Project 9 M 12

9/12/90

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BACKGROUND AND OBJECTIVE

Jacobs Engineering Group, Inc. requested a chemical and mineralogical characterization of five sediment samples from Colorado. ~~The samples originated from a lake bed and a weathered shale outcrop.~~

The objective of the study was as follows:

- Bulk Mineralogy

  Includes a preliminary stereomicroscopic examination with a description of the overall mineralogical features and bulk x-ray diffraction analysis. Special attention will be given to any minerals other than clays or zeolites which could exhibit sorptive capacity (e.g. hydrous Fe/Mn oxides, jarosites, Al-hydroxides).

- Detailed Clay Mineralogy

  Includes the identification of clay and clay-like minerals by x-ray diffraction analysis on the clay fraction in various sample mounts (random, oriented, glycolated, heat-treated mounts). SEM analysis may be used to assist in microchemical characterization.

- Size Analysis for Sand, Silt and Clay Fractions

  Size analysis for sand, silt and clay fractions will be made followed by x-ray diffraction analysis of the size fractions.

- Cation Exchange Capacity
- Acid Neutralization
- Acid-Soluble Fe and Mn
- Gypsum Content
- Pyrite Content
- Total Carbon and Organic Carbon

The laboratory work was performed under Jacobs Engineering Purchase Order No. Subcontract 34-6705-S-89-0052.

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SAMPLES RECEIVED AND METHODS OF STUDY

Five sediment samples were received at the PMET laboratories on August 3, 1989. The samples were subjected to routine chain of custody procedures (PMET letter of August 7, 1989). The sample designations are given in Table 1 below.

Table 1

Sample Designations

PMET No.	Customer I.D.	Weight(g)
108-1	GCM-1 : Alluvium Composite	807.11
108-2	GCM-2 : Test Pad Alluvium	809.60
108-3	GCM-3 : " " "	809.60
108-4	GCM-4 : " " "	288.98
108-5	GCM-5 : Test Pad	804.15

See Attachment B for additional description

The laboratory work included sample preparation, chemical analyses, optical microscopy, x-ray diffraction analyses, and micro-screen analyses.

The as-received samples were weighed and thoroughly blended. Thereafter, adequate portions were split out for the laboratory work. The methodology of the chemical and mineralogical analyses as well as the quality control procedures were according to our report of July 10, 1989.

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Chemical Characterization

The samples are characterized by a low cation exchange capacity which ranges from 15.1 to 17.4 meq/100 g and reflects a clay mineralogy which is dominated by micas, illite and kaolinite with minor amounts of swelling clays. Due to elevated carbonate contents, the samples exhibit a high neutralization potential. The sulfide content is very low whereas sulfate concentrations are elevated. However, substantial amounts of the sulfates are due to iron sulfates.

The results of the chemical characterization are presented in Table 2.

Table 2

Chemical Characterization of Sediment Samples

Element	Sample Designations GCM-1	GCM-2	GCM-3	GCM-4	GCM-5
Total C,%	1.80	1.02	1.38	0.91	3.18
Organic C,%	0.35	0.41	0.06	0.03	0.64
Total S,%	0.64	0.37	0.25	0.37	0.08
Sulfide S,%	0.04	<0.01	<0.01	<0.01	<0.01
Sulfate S,%	1.73	1.07	0.87	1.01	0.13
Acid Sol. Fe,%	2.82	2.26	2.26	2.81	1.77
Acid Sol. Mn,%	0.055	0.062	0.086	0.051	0.03
Cat.Ex.Cap., (meq/100 g)	17.2	17.4	15.1	16.2	15.6
Exchangeable Ca, (meq/100 g)	98.3	79.6	80.3	58.6	71.1
Exchangeable Mg, (meq/100 g)	5.13	4.48	5.57	7.09	4.80
Exchangeable Na, (meq/100 g)	4.54	4.76	4.58	2.79	4.53
Exchangeable K, (meq/100 g)	0.82	0.75	0.88	1.39	0.71
Neutr. Potent. (t $CaCO_3$/ 1000 t soil)	170	107	155	94.3	271
Potential Acidity (t H^+/1000 t soil)	0.13	0.06	0.16	0.10	0.22

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Mineralogical Characterization

The (alluvial?) sediment samples (GCM-1 to GCM-4) consist of gray-brown, sandy, calcareous material which contains significant amounts of heavily altered volcanic rocks. The alteration has resulted in the formation of various clay minerals and considerable amounts of (hydrous) iron oxidation products. Except for sample GCM-2, all samples including the shale are characterized by substantial amounts of carbonates.

Sample GCM-5 consists of a slick, laminated heavily altered gray-green clay shale containing noticeable amounts of disseminated mica.

The UV-light examination did not indicate the presence of fluorescent minerals. Minor to trace amounts of magnetite and ferromagnetic rock fragments (mostly of volcanic origin) were found in Samples GCM-1 to GCM-4. A microchemical staining test with 4-hydroxyaniline indicates the presence of minor amounts of swelling clay in all samples. A Geiger counter scan showed a very weak response level in samples GCM-1 and GCM-2.

Mineralogically all samples contain major amounts of quartz and clay minerals with variable concentrations of calcite and feldspar (albite). Very low concentrations (<1% volume) of ultrafine sulfides (pyrite) were found in samples GCM-1, -2 and -3. Most of the disseminated and matrix sulfides have been oxidized into hematite and magnetite both of which locally act as a cementing matrix to brecciated/agglomerated gangue.

The sediment samples also contain noticeable amounts of zeolites (primarily analcite and minor wairakite). Zeolites are common authigenic silicates in (saline) lake sediments. It is tentatively concluded that the wairakite (hydrated Ca-Al-silicate) may have formed through zeolite alteration.

Following are the petrographic sample descriptions.

Sample GCM-1

Brown-gray, calcareous sediment with high calcite content. The calcite is in part well crystallized. The sample contains considerable amounts of altered volcanic rock fragments which consist of dark gray to red porphyritic fine grained rocks. The fine particle fraction contains considerable amounts of micaceous clay minerals with minor amount of swelling clay, iron oxidation products and carbonaceous matter as grain coatings. Approximately less than 1% volume of ultrafine (<10 micron) disseminated pyrite. The clay minerals contain large amounts of pigment-like hematite. Some brecciated and/or agglomerated particles which are cemented by hydrous iron oxides, hematite and magnetite. A minor amount of the iron

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oxides contain unoxidized residual sulfides. Noticeable levels of spinels in the heavy mineral fraction.

Sample GCM-2

Gray, sandy gravel with moderately rounded rock fragments which include tuffs, pyroclastic breccias, sandstones, lava flows, chert and quartz particles as well as ferruginous carbonate concretions (caliche-like). The finer particle fractions contain minor amounts of bleached mica and chlorite-bearing volcanic rock fragments. Most of the rock particles contained in the sample are heavily altered - some beyond the possibility of conclusive identification. Contains small aggregates of swelling clay. Major source of clay minerals appears to be heavily altered fragments of volcanic rocks and/or their pyroclastics.

Sample GCM-3

Gray-brown, calcareous gravel fraction with angular to subrounded, heavily altered rock fragments. This sample is petrographically similar to sample GCM-2. Many of the limonitic particles exhibit coatings of manganese dentrites. Alteration of rock fragments appears to be more intense than in sample GCM-2. Considerable amounts of clay agglomerations and clay coatings on larger rock particles. Approximately 30% of brecciated/agglomerated rock material which is cemented by iron oxides.

Sample GCM-4

Light brown, calcareous, fine grained sandy sediment with high carbonate (calcite) content. Distinctly more quartz. Sample contains traces of cinnabar. The rock fragments consist of heavily altered volcanic rocks and clay-sand agglomerations. Most of the quartz fragments are angular. Minor amounts of hornblende and traces of carbonaceous matter and bleached mica. Many of the rock fragments exhibit clay coatings which are 30 to 100 microns in thickness.

Sample GCM-5

Gray-green, heavily altered shale containing fine disseminations of less than 20 micron mica flakes. The sample shows some lamination and disintegration. Minor to trace amounts of swelling clay minerals and a very high carbonate content. Small amounts of jarosite.

The petrographic and mineralogical characteristics are summarized and quantified in Tables 3A and 3B.

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Table 3

Overall Petrographic and Mineralogical Characteristics of Sediment/Shale Samples

A. Petrographic Characteristics*

Component	GCM-1	GCM-2	GCM-3	GCM-4	GCM-5
		(in % volume)			
Rock fragments	35-45	>50	>50	30	<10
Clay	8-15	10-20	20-25	8-15	>>50
Iron Oxidation	15-20	20	10-20	20-25	<10
Carbonates	10-15	<10	10-20	20-30	20-30

B. Mineralogical Characteristics** BULK MINERALOGY (other than clay minerals)

Mineral					
Quartz	Major	Major	Major	Major	Major
Calcite	Moderate	Minor	Moderate	Moderate	Major
Dolomite	Minor	Minor	Minor	Minor	Minor
Zeolites	Minor	Moderate	Minor	Min-Mod.	-
Muscovite	Min-Tr.	Trace	Trace	Minor	Min-Mod.
Albite	Moderate	Major	Min-Mod.	Minor	Trace

Major = 30->50%
Moderate = 10-30%
Minor = 5-10%
Trace = <5%

* Based on stereomicroscope examination

** Based on bulk x-ray diffraction analysis
Further details would require petrographic thin section study and subsequent modal analyses.

Clay Mineralogy

Prior to the x-ray diffraction analyses of the clay fraction, the total amounts of sand, silt and clay were determined by wet screen analyses of large (50-100 g) blended and split sample portions. (Reference 1). The results are summarized in Table 4.

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Table 4

Total Amounts of Sand, Silt and Clay Fractions

Sample	Sand (+63 micron)	Silt (-63+5 micron)	Clay (-5 micron)
GCM-1	57 % wt.	21 % wt.	22 % wt.
GCM-2	90 "	4 "	6 "
GCM-3	86 "	7 "	7 "
GCM-4	70 "	14 "	16 "
GCM-5	2 "	23 "	75 "

When evaluating the total clay content as established in Table 4 by physical classification, the following features should be considered. In soil/sediment samples containing larger feldspathic rock fragments and which are partially or completely altered to clay or clay-like minerals, the actual total clay content may be slightly higher than obtained by sizing. This is due to the fact that many of the gravel and sand-sized rock fragments contain alteration-related, encapsulated clay which will not report to the clay fraction in a sedimentation or screen analysis. Furthermore, the occurrence of iron oxide-cemented coarse clay aggregates will also retain some of the clay in the sand or silt fractions.

For any clay analysis of sediments or soil samples containing rock fragments which have been exposed to clay-producing alteration (i.e. argillic, sericitic, propylitic, alunitic), a petrographic thin section study concurrent with the sedimentation screen analysis is recommended.

Based upon the x-ray analysis of the size fractions and microscopic work, the following semi-quantitative clay distribution has been established.

	Contained Clay (% distribution)		
Sample	Sand Fraction	Silt Fraction	Clay Fraction
GCM-1	<5	15-20	75
GCM-2	20-25	20	60
GCM-3	15	20	65-70
GCM-4	10-15	15	60-70
GCM-5	<5	10	85-90

The determination of clay minerals was facilitated through x-ray diffraction analysis of various sample mounts (random, oriented, glycolated, heat-treated) prepared from -2 micron clay fractions.

This work showed that the samples investigated contain a complex clay mineralogy which is dominated by micas, illite and kaolinite. Swelling clays (montmorillonite, interstratified

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kaolinite-smectite, smectite-illite) occur mostly in minor amounts. The clay minerals in samples GCM-1 and GCM-4 exhibit poor crystallinity and/or submicron particle sizes. The major clay minerals in the weathered shale sample GCM-5, i.e. kaolinite and dioctahedral illite, show a good degree of crystallization.

Samples GCM-2, -3 and -4 contain minor but distinct amounts of zeolites (analcite). The presence of the analcite-related zeolite (alteration?) mineral wairakite in samples GCM-1 to GCM-4 was already described earlier in this report. In addition, minor to trace amounts of a interstratified chlorite-mica were found in Sample GCM-2.

A summary of the clay mineralogy and a semi-quantitative assessment of the clays is shown in Table 5.

Table 5

Semi-Quantitative Clay Mineralogy of Sediment Samples
(-2 micron fraction)

Clay Minerals	Samples				
	GCM-1	GCM-2	GCM-3	GCM-4	GCM-5
Montmorillonite	Minor	Moder.	Minor	-	Minor
Muscovite (Sericite)	Major	Major	Moder.	Trace	Trace
Kaolinite-Smectite*	Moder.	Trace	Trace	-	-
Kaolinite	Moder.	Major	Major	Major	Major
Dioctahedral Illite	-	-	-	Major	Major
Smectite-Illite*	-	-	-	Major	-
Analcite	-	Trace	Minor	Trace	-

* interstratified

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CONCLUSIONS

- The sediment samples (GCM-1 to GCM-4) analyzed during this chemical-mineralogical characterization contain clay fractions representing 5 to 20% of the sample. However, clay-type alteration is also prevalent in the silt and sand fractions due to argillic/sericitic alteration of feldspathic (volcanic) rock fragments. The overall clay content may therefore be slightly higher than indicated by the size classification alone. The weathered shale sample exhibits a clay content of 75%.

- All samples are characterized by a complex clay mineralogy which consists primarily of micas, illite and kaolinite with minor amounts of swelling clays (montmorillonite, interstratified kaolinite-smectite, smectite-illite). In addition, there are noticeable amounts of zeolites (analcite and wairakite).

- The cation exchange measurements are in agreement with the clay mineralogy which showed that kaolinite, muscovite and illite are the dominating clay phases. These minerals exhibit low cation exchange capacities of less than 20 meq/100 g. The analyzed cation exchange capacity of the five samples ranged from 15.1 to 17.4 meq/100 g.

- A typical feature of the samples is a significant carbonate content which consists of calcite and dolomite.

- The presence of minor to trace amounts of zeolites may increase the selective sorption potential for solubilized heavy metals.

- In addition to clay minerals and zeolites, minor adsorptive effects can be expected from hydrous iron oxidation products which occur in pigment-like disseminations and as particle coatings throughout the sample material.

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PREPARED FOR:

JACOBS ENGINEERING GROUP INC.

ALBUQUERQUE OPERATIONS

CHEMICAL AND MINERALOGICAL CHARACTERIZATION OF 17 SOIL SAMPLES FROM THE CHENEY RESERVOIR SITE

FOR SAMPLES 179-1, 179-2, 179-3 AND 179-4

(See Attachment B for sample description)

By

Wolfgang Baum

January 16, 1990

Project 9 M 12

9/17/90

LM. COONS PE...
SEP '90

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BACKGROUND AND OBJECTIVE

Jacobs Engineering Group Inc. requested a chemical and mineralogical characterization of seventeen soil samples from the Cheney Reservoir site near Grand Junction, Colorado.

The objective of the work was as follows:

- Bulk Mineralogy

  Includes a preliminary stereomicroscopic examination with a description of the overall petrographic and mineralogical features and a bulk x-ray analysis. Special attention will be given to any minerals other than clays or zeolites which could exhibit sorptive capacity (e.g., hydrous Fe/Mn oxides, jarosites, Al-hydroxides).

- Detailed Clay Mineralogy

  Includes the identification of clay and clay-like minerals by x-ray diffraction analysis on the clay fraction in various sample mounts (random, oriented, glycolated, heat-treated). SEM analysis may be used to assist in microchemical characterization.

- Size Analysis for Sand, Silt and Clay Fractions

  Size analysis for sand, silt and clay fractions will be made followed by mineralogical analysis of the size fractions.

- Total Clay Content
- Cation Exchange Capacity
- Acid Neutralization
- HCl-Soluble Fe
- HCl-Soluble Mn
- Gypsum Content
- Pyrite Content
- Calcium Carbonate Content
- Total Carbon
- Organic Carbon
- Soil pH & Eh
- Determine the Overall Mineralogy of an Unknown Rock Sample

The laboratory work was performed under Jacobs Engineering subcontract purchase order 34-6705-S-90-0014.

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SAMPLES RECEIVED AND METHODS OF STUDY

Seventeen samples were received at the PMET laboratories on December 13, 1989. The samples were subjected to routine chain of custody procedures (PMET letter of December 18, 1989). The sample designations are given in Table 1 below.

Table 1

Sample Designations

PMET No.	Jacobs Designation		Weight(g)
179-1	GRJ-03	5-Mancos Contact w/o CL&GC Comp.	1111.0
-2	"	" " " "	
		+ 10% Mancos Shale	1091.25
-3	"	1-5' Composite Top Soil	952.66
-4	"	Screened Alluvium MK	1047.46
-5	GRJ-03	818	170.0
-6	"	821	140.0
-7	"	825	199.0
-8	"	833 1-5'	193.0
-9	"	901 1-5'	142.0
-10	"	933 1-5'	190.0
-11	"	938 1-5'	244.0
-12	"	941 1-5'	179.0
-13	"	953	232.0
-14	"	958	166.0
-15	"	959 1-5'	190.0
-16	"	964 1-5'	183.0
-17	"	Flint/Chalcedony	65.8

For samples 179-1 to 179-4, a complete chemical characterization was requested. Samples 179-5 to 179-16 were submitted for measurement of soil pH, Eh and carbonate content. One sample, 179-17, was submitted for bulk x-ray diffraction analysis only.

The laboratory work included sample preparation, chemical analyses, optical microscopy with modal analyses, microchemical staining, screen analyses, x-ray diffraction analyses, and SEM microscopy.

The samples as received were examined microscopically prior to any separation work. Thereafter, each sample was thoroughly blended and adequate portions were split out for the laboratory work. In addition to the standard microscopic carbonate analyses of samples 179-5 to 179-16, bulk x-ray diffraction

analyses were also performed on each of these samples. This work was done free of charge. The carbonate and gypsum contents of samples 179-1 to 179-16 were cross-examined by selective microchemical staining tests (Alizarin Red S and Clayton Yellow respectively) followed by microscopic quantification of the stained particles. The pH of the drill core samples was determined on -10 mesh material using ASTM method 9045 for measuring soil pH. The Eh was measured according to ASTM procedure D 1498-76 (electrometric measurement of oxidation-reduction potential). For solution extraction, a saturated soil paste was prepared. The methodology of the chemical and mineralogical analyses as well as the quality control procedures were according to our report submitted to JE on July 10, 1989.

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DISCUSSION OF RESULTS

Chemical Characterization

Samples 179-1 to 179-4 are characterized by increased carbonate carbon contents ranging from 1.2 to 1.86%. Virtually all of the sulfur occurs as sulfate sulfur. The potential acidity is very low. Significant amounts of HCl-soluble iron (3.6 to 5.4%) were found in all samples. The cation exchange capacity in the four samples is low, ranging from 11.7 to 17.8 meq/100 g. However, all samples exhibit a high neutralization potential ranging from 110 to 183 tons $CaCO_3$/1000 tons of soil due to the presence of vast amounts of carbonates. The pH measurements indicate weakly alkaline soil pH.

The results of the chemical characterization are presented in the following Table 2.

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Table 2

Chemical Analysis of Sediment Samples
From Cheney Reservoir

Element	179-1	179-2	179-3	179-4	179-5	179-6	179-7	179-8	179-9	179-10	179-11	179-12	179-13	179-14	179-15
	Sample Designations														
Total C, %	1.44	1.61	2.07	1.51	1.35	3.64	2.47	4.31	1.48	1.49	1.27	2.28	1.86	2.53	2.04
Carbonate C, %	1.23	1.38	1.86	1.42	1.01	3.33	2.22	3.97	1.11	1.18	1.11	2.05	1.67	2.26	1.82
Organic C, %	0.21	0.23	0.21	0.09	0.34	0.31	0.25	0.34	0.37	0.31	0.16	0.23	0.19	0.27	0.22
Total S, %	0.70	0.75	0.78	0.77											
Sulfide S, %	<0.02	<0.02	<0.02	<0.02											
Sulfate S, %	0.70	0.75	0.78	0.77											
HCl-Sol Fe, %	5.4	5.0	3.6	3.6											
HCl-Sol Mn, %	0.091	0.083	0.057	0.062											
Eh, mV*	108	100	102	110	85	108	112	88	118	115	70	80	87	90	85
pH	7.85	7.97	8.05	8.12	7.79	8.18	8.28	8.49	7.81	7.99	8.17	8.25	8.14	8.11	8.34
Cation Exch. Capacity**	11.7	13.2	17.8	15.6											
Exchangeable Ca**	62.4	73.6	137	69.4											
Exchangeable Mg**	2.82	3.78	5.64	4.51											
Exchangeable Na**	0.563	2.28	2.77	3.56											
Exchangeable K**	0.297	0.377	0.373	0.345											
Exchangeable Na Percentage	4.83	17.3	15.6	22.8											
Neutralis. Potential (Tons $CaCO_3$/1000 Tons Soil)	176	110	183	110											
Potential Acidity (Tons H^+/1000 Tons Soil)	0.03	0.02	<0.01	0.02											

*Relative to Hydrogen, American Sign Convention
**In meq/100g

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Mineralogical Characterization

All four samples represent similar petrographic characteristics and can be classified as lithic, calcareous-clayey, sandy soils. The samples contain substantial amounts of rock fragments most of which appear to be of basic igneous or volcanic origin. The rock fragments also contain substantial amounts of ultrafine hematite with minor magnetite. Some of the lithic components are complex and would require thin section study for further characterization.

The samples contain large amounts of carbonates most of which consist of fine-grained calcite which is often intimately admixed with clay or iron oxidation products. Sample 179-4 contains distinctly more ferruginous carbonates. Microchemical staining tests did not give any evidence for the presence of dolomite. This conclusion was also confirmed through subsequent x-ray analysis.

Considerable amounts of the carbonates constitute a cementing matrix for silica sand particles. Some of the carbonates have originated from the alteration of feldspathic and/or ferromagnesian rock-forming minerals. Certain amounts of the carbonates occur as calcareous nodules and layers known to be typical products of caliche (calcrete) formation. During megascopic examination and effervescence testing, the carbonate content of the samples appears to be extremely high which is primarily due to the presence of fine carbonate coatings on coarser, noncarbonate particles.

Another characteristic feature of the samples is the presence of moderate amounts of gypsum which occur primarily as rosette-like aggregates. Minor amounts of acicular-fibrous gypsum were also found.

The soil sample material exhibits poor consolidation. Minor to trace amounts of zeolites are associated with the dark (volcanic?) rock fragments primarily in form of vesicular occurrences.

A summary of the overall petrographic characteristics is given in Table 3 and additional details of the mineralogical features are described in the following petrographic sample characteristics.

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Table 3

Overall Petrographic Characteristics
of Soil Samples from the Cheney Reservoir Site

Petrographic Feature	Sample Designations			
	179-1	179-2	179-3	179-4
Color	Gray-green	Gray-black	Red-brown	Brown-gray
Geiger Counter Response	-	-	-	-
Effervescence Carbonate Test	High	High	High	High
Short-wave UV Response	Gypsum Calcite	Gypsum Calcite	Gypsum Calcite	Gypsum Calcite
Presence of Ferromagnetics	1-3%	1-3%	1-3%	3-4%
Rock Fragments	30%	30-35%	25-30%	30-35%
Carbonate Content*	10-15%	10-15%	15-18%	15%
Gypsum Content*	5-10%	5-10%	3-5%	10-15%
Classification	Lithic Calcareous-Clayey Sand	Lithic Calcareous-Clayey Sand with High Shale Content	Lithic Ferruginous Calcareous-Clayey Sand	Lithic Ferrugin. Calcar.-Clayey Sand

All data in volume %.
* Estimate based on selective staining.

Sample 179-1

Black to light brown sample material with considerable amounts of rock fragments. The sample is characterized by a high calcite content and consists primarily of a micaceous sand with relict feldspar. The rock fragments consist of ferruginous porphyritic fine-grained volcanic (or igneous) rocks, limonite aggregates, basic igneous or volcanic rocks, chert, calcareous

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sandstone and rhyolite. Significant amounts of the rock fragments exhibit attachments/coatings of clay minerals. Relatively coarse-grained gypsum occurs as light brown, rosette-like aggregates.

Sample 179-2

Black to light brown lithology characterized by large amounts of basic volcanic (or igneous) rock fragments, calcite and significant amounts of shale fragments (15%). Due to the higher amounts of clay introduced by the shale, this sample exhibits considerably more particle agglomerations. The suite of rock fragments is virtually identical with the lithic material found in Sample 179-2. Zeolite minerals appear to occur in the vesicular volcanic rocks. Most of the limonite particles are coated with manganese dentrites. Noticeable amounts of heavily oxidized clayey to feldspathic rock fragments with hematite dispersion. Minor amounts of rosette-like, coarse-grained gypsum particles. Some of the heavily altered, carbonate-bearing material may represent volcanic ash.

Sample 179-3

Light brown, clayey sand with greenish dark gray rock fragments some of which are several centimeters in diameter. Considerable amounts of gypsum. The rock fragments consist primarily of heavily altered porphyritic volcanic (or igneous) rocks which contained significant amounts of biotite and/or hornblende. The sample contains swelling clays most of which appear to be iron-bearing. Presence of zeolites is indicated in association with vesicular volcanic rocks. The sand fraction contains large amounts of roots and wood particles. Minor amounts of volcanic glass (obsidian-like material). The clay content in the coarser size fractions is primarily related to argillized rock fragments. Minor amounts of limonite nodules with admixed clay and carbonates. Moderate amounts of chalcedony. The silt size particle fraction is high in mica minerals (=mostly muscovite).

Sample 179-4

Light brown, sulfate and carbonate-rich silica sand with large amounts of heavily altered rock fragments. Most of the rock particles appear to be from basic to intermediate volcanics and/or igneous rocks which have been exposed to argillization of feldspars and iron oxidation and bleaching of the ferromagnesian minerals. The sample contains noticeable

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amounts of rosette-like and acicular gypsum as well as sandstone fragments with calcite cement.

The bulk x-ray diffraction analyses of the as-received material confirmed that quartz and calcite are major sample constituents followed by moderate amounts of feldspar (anorthite), gypsum, and titanite. In addition, minor amounts the Ca-carbonate-silicate tilleyite and traces of portlandite (Ca-hydroxide) were detected. Tilleyite is almost exclusively of metamorphic origin where it forms in calc-silicate rocks or in contact marbles.

Additional Samples

In addition to the four main characterization samples, eleven soil samples were submitted for determination of pH, Eh, and carbonate content only. One sample, 179-17, was submitted for x-ray diffraction analysis. The eleven samples exhibit overall mineralogical-petrographic characteristics which are similar to sample 179-1 to 179-4.

X-Ray Diffraction Analysis of Sample 179-17

This sample was received as a two-inch specimen described as flint or chalcedony. The megascopic examination showed that the sample consisted of a gray to light gray, moderately hard, slightly porous material which exhibited precipitation texture and contained embedded (fossil?) wood fragments (branches). The XRD analysis showed that this sample contains large amounts of portlandite (Ca-hydroxide). Table 4 summarizes the mineral phases identified in this sample.

Table 4

Mineralogy of Sample 179-17

Mineral	Frequency
Portlandite	Major
Calcite	Minor
Wermlandite (Ca-Mg-Al-Fe-carbonate hydrate)	Minor
Ca-Silicate (hydrated)	Minor

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The mineralogical modal analysis of the soil samples are summarized in Table 5.

Table 5

Mineralogical Modal Analyses of Cheney Reservoir Samples

Sample	Vol.% Sulfide*	Vol.% Total Clay**	Vol.% Carbonate	Vol.% Gypsum
179-1	2	26	17	12
-2	1	30	13	10
-3	<1	40	10	5
-4	<1	29	19	15
-5	n.a.	n.a.	9	n.a.
-6	"	"	19	"
-7	"	"	17	"
-8	"	"	16	"
-9	"	"	10	"
-10	"	"	11	"
-11	"	"	17	"
-12	"	"	20	"
-13	"	"	12	"
-14	"	"	11	"
-15	"	"	18	"
-16	"	"	11	"

Based on point count and cross-count analyses of dry bulk samples, oil immersion grain mounts and polished sections.

* Primarily pyrite

** Includes all clay and clay-like minerals contained in all size fractions

n.a. = not analyzed

Clay Mineralogy

(Reference 1)

Prior to the x-ray diffraction analyses of the -2 micron clay fraction, the total amounts of sand, silt and clay were determined by wet screening of a 50-gram blended sample split. All size fractions were thoroughly examined by optical and x-ray methods for major and minor mineral constituents. The results of the screen analyses are summarized in Table 6.

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Table 6

Total Amounts of Sand, Silt and Clay Fractions

Sample	Sand Fraction (+63 micron) Wt. %	Silt Fraction (-63+5 micron) Wt. %	Clay Fraction (-5 micron) Wt. %
179-1	66.09	11.84	22.07
-2	66.96	11.62	21.27
-3	44.75	12.34	42.91
-4	63.72	13.29	22.99

The subsequent optical microscope analyses showed the following mineralogical characteristics of the sand, silt and clay fractions.

Sand Fractions

Contains primarily rock fragments and silica sand particles with minor amounts of sulfates and mixed argillic/iron oxide/hydroxide particles. Minor clay concentrations occur in this fraction due to partially altered feldspathic rock fragments and/or clay minerals being aggregated with other sand fraction constituents. The sand fractions of samples 179-1 and 179-2 consist basically of rock fragments (>60%) whereas sample 179-3 is dominated by silica sand with only 5-10% rock fragments. Sample 179-4 is characterized by increased amounts of iron alteration products admixed with silica sand particles and 10-20% rock fragments.

Silt Fractions

The silt fractions consist predominantly of quartz particles with considerable amounts (25-45%) of mica (muscovite), carbonates and minor sulfates. The clay content of the silt fractions is low ranging from 1 to 5%.

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Clay Fractions

The -5 micron clay fractions are characterized by major amounts of clay minerals (25 to 59 vol. %) admixed with substantial concentrations of clay-sized quartz and minor to trace amounts of calcite and gypsum. The determination of the clay minerals was facilitated through x-ray diffraction analyses of various sample mounts (random, oriented, glycolated, heat-treated) prepared from -2 micron clay fractions.

This work showed that the Cheney Reservoir samples are characterized by the dominance of montmorillonite, mica (muscovite) and kaolinite. A summary of the clay mineralogy and a semi-quantitative assessment is given in Table 7.

Table 7

Semi-Quantitative Clay Mineralogy of Cheney Reservoir Samples (-2 micron fraction)

Sample	Major	Frequency Major-Moderate	Minor-Trace
179-1	Montmorillonite	Muscovite* Kaolinite	Dioct. Illite Smectite-mica
179-2	Montmorillonite**	Kaolinite Muscovite	Dioct. Illite Smectite-mica
179-3	-	Montmorillonite Kaolinite*** Dioct. Illite	Muscovite
179-4	Montmorillonite	Muscovite Kaolinite	

* Mixed layering of the mica is indicated by a series of reflections on the low-angle side of the 10 Å spacing.

** When compared to sample 179-1, sample 179-2 has a slightly higher (5%) montmorillonite and muscovite content.

*** Both the montmorillonite as well as the kaolinite show distinctly less crystallinity than in the other samples.

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CONCLUSIONS

- The four soil samples received from the Cheney Reservoir site represent calcareous-clayey and sandy soils with a high amount of rock fragments and gypsum. The additional eleven soil samples exhibit a similar mineralogical composition. The hand specimen sample (179-17) consists primarily of portlandite with minor amounts of calcite and hydrated calcium silicates. The portlandite formation may be due to the decomposition of calcium silicates.

- The clay mineralogy of the four soil samples is characterized by the dominance of montmorillonite, muscovite and kaolinite. Minor amounts of dioctahedral illite and smectite-mica were also observed.

- The samples are characterized by a very low potential acidity, low cation exchange capacities ranging from 11 to 17 meq/100 g, weakly alkaline pH and high neutralization potentials ranging from 110 to 183 tons $CaCO_3$/1000 tons of soil. The determination of the quantitative significance of zeolites introduced by certain vesicular volcanic rocks would require additional laboratory work.

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ATTACHMENT D

9/12/90

D-1 Composition of the spiked groundwater from well 589 PH3

L.M. COCKS P.E., PH3
SEP '89

:e Code: GRJ03
:ation ID: 528 : Dopped Feed Solution
mple ID: 01
mple Date Time: 08/07/89

Lab No. : 89-W1/04855
Date Received: 08/08/89

Parameters

Chloride	1100.	mg/l
Sulfate	3589.	mg/l
Sodium, dissolved	990	mg/l
Potassium, dissolved	54.	mg/l
Magnesium, dissolved	305	mg/l
Calcium, dissolved	500	mg/l
Boron, dissolved	.55	mg/l
Fluoride	.3	mg/l
Nitrogen, ammonia	132.	mg/l
Nitrate as NO3	-.1	mg/l
Silica, dissolved	16	mg/l
Phosphate	.5	mg/l
Aluminum, dissolved	.21	mg/l
Antimony, dissolved	.002	mg/l
Arsenic, dissolved	2.3	mg/l
Barium, dissolved	.03	mg/l
Cadmium, dissolved	.076	mg/l
Chromium, dissolved	-.01	mg/l
Cobalt, dissolved	.01	mg/l
Copper, dissolved	.01	mg/l
Iron, dissolved	-.02	mg/l
Lead, dissolved	-.001	mg/l
Manganese, dissolved	1.67	mg/l
Mercury, dissolved	-.0002	mg/l
Molybdenum, dissolved	6.20	mg/l
Nickel, dissolved	-.02	mg/l
Selenium, dissolved	8.4	mg/l
Silver, dissolved	.01	mg/l
Strontium, dissolved	5.	mg/l
Tin, dissolved	-.1	mg/l
Vanadium, dissolved	-.01	mg/l
Zinc, dissolved	.02	mg/l
Solids, total dissolved	6554.	mg/l

pH - 8.08
Eh - 222 mv
Zobell - 233 mv
Temp - 24.0 °C
Ec - 8,000 umhos
Alkalinity - 449 at 4.50

emarks:

ote: Negative sign "-" denotes that the value is less than "<"

h V. Poulsen, Laboratory Director

Ralph V. Poulsen B.H.

9/11/90

L.M. COUN
SEP '90

D-2

Compositions of the test fluids prepared by mixing water samples from the lysimeters installed in the tailings pile, and spiking with known concentrations of hazardous constituents.

Hazardous constituents	Analysis date and concentration, mg/l December 19. 1989	December 28, 1989
AG	< .05	< .1
AL	< .50	< .5
AS	5.9	5.4
B	.65	.8
BA	< .10	< .1
BE	.180	< .05
BR	.99	.08
CA	675.	670.
CD	.9000	.7000
CL	900.	710.
CO	5.25	< .1
CR	.10	< .1
CU	1.10	.2
F	.7	.7
FE	.30	< .2
HG	< .0001	< .0001
K	85.	90.
MG	305.	340.
MN	7.10	5.6
MO	5.00	4.4
NA	820.	896.
NI	5.90	5.7
NO3	256.1	< .1
PB	< .001	< .01
PO4	.5	.7
SB	.008	.004
SE	4.0	3.3
SIO	49.5	48.
SN	< .020	< .020
SO4	4017.	4042.
SR	7.40	5.5
TDS	6536.	6696.
TL	< .010	< .010
U	4.760	3.851
V	21.3	15.8
ZN	13.1	7.7

(1) The composite water sample was prepared by mixing water samples from the tailings lysimeters

L.N. CO
SEP '90

D-3 Reproducibility of column tests: Chemical analyses of the first effluent pore volumes of the triplicate columns of individual test materials.

L.M. COOKS PE, PHG
SEP '90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM (-GC,-CL)
FIRST PORE VOLUME

Sample # 179-1

	COLUMN NUMBER 650	COLUMN NUMBER 651	COLUMN NUMBER 652	MEAN	STD
AL	< 0.5	< 0.5	< 0.5	0.5	0
SB	< 0.001	< 0.001	< 0.001	0.001	0
AS	0.002	0.004	0.004	0.003333	0.001154
BA	< 0.1	< 0.1	0.1	0.1	0
BE	< 0.05	< 0.05	< 0.05	0.05	0
B	3.9	3.2	3.65	3.583333	0.354729
BR	0.6	0.51	0.15	0.42	0.238117
CD	0.0007	0.0006	0.0005	0.0006	0.0001
CA	570	545	530	548.3333	20.20725
CL	2200	1700	1800	1900	264.5751
CR	< 0.1	< 0.1	< 0.1	0.1	0
CO	0.05	< 0.05	< 0.05	0.05	0
CU	0.3	0.1	0.2	0.2	0.1
F	1.7	1.5	1.6	1.6	0.1
FE	< 0.2	< 0.2	< 0.2	0.2	0
PB	< 0.001	< 0.001	< 0.001	0.001	0
MG	565	530	500	531.6666	32.53203
MN	0.5	0.6	0.5	0.533333	0.057735
HG	0.0003	0.0001	0.0001	0.000166	0.000115
MO	2.7	3.2	3.2	3.033333	0.288675
NI	1.1	1.2	1.3	1.2	0.1
NO3	154.9	60.7	805	340.2	405.2748
PO4	0.2	0.1	0.2	0.166666	0.057735
K	20	30	30	26.66666	5.773502
SE	0.7	0.5	0.5	0.566666	0.115470
SIO	27	25.5	26	26.16666	0.763762
AG	< 0.05	< 0.05	< 0.05	0.05	0
NA	1795	3510	3925	3076.666	1129.184
SR	8.2	9.35	9.2	8.916666	0.625166
SO4	7837	6651	7969	7485.666	725.8493
TL	< 0.01	< 0.01	< 0.01	0.01	0
SN	< 0.02	< 0.02	< 0.02	0.02	0
TDS	15696	12898	14990	14528	1455.089
U	0.463	0.865	0.362	0.563333	0.266087
V	< 0.1	< 0.1	< 0.1	0.1	0
ZN	0.3	0.2	0.2	0.233333	0.057735

9/12/90

Sample # 174 - 2

L.H. COLLINS PE...
SEP '90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM (-GC,-CL)+10% MANCOS SHALE
FIRST PORE VOLUME

	653	654	655	MEAN	STD
AL	< 0.5	< 0.5	< 0.5	0.5	0
SB	0.01	< 0.001	< 0.001	0.004	0.005196
AS	0.004	0.005	0.005	0.004666	0.000577
BA	0.1	< 0.1	0.1	0.1	0
BE	< 0.05	< 0.05	< 0.05	0.05	0
B	3.05	2.8	2.7	2.85	0.180277
BR	0.82	0.93	0.81	0.853333	0.066583
CD	0.001	0.0007	0.0009	0.000866	0.000152
CA	540	500	470	503.3333	35.11884
CL	2000	2100	2000	2033.333	57.73502
CR	< 0.1	< 0.1	< 0.1	0.1	0
CO	< 0.05	< 0.05	< 0.05	0.05	0
CU	< 0.1	0.1	0.1	0.1	0
F	1.6	1.7	1.7	1.666666	0.057735
FE	< 0.2	< 0.2	< 0.2	0.2	0
PB	< 0.001	< 0.001	< 0.001	0.001	0
MG	530	470	500	500	30
MN	0.5	0.5	0.5	0.5	0
	0.0001	0.0001	0.0001	0.0001	0
MO	2.8	2.4	2.6	2.6	0.2
NI	1.2	1.2	1.1	1.166666	0.057735
NO3	13.6	0.9	217.8	77.43333	121.7268
PO4	0.2	0.2	0.1	0.166666	0.057735
K	35	15	10	20	13.22875
SE	0.7	0.7	0.6	0.666666	0.057735
SIO	24	21.5	20.5	22	1.802775
AG	< 0.05	< 0.05	< 0.05	0.05	0
NA	4125	3855	3720	3900	206.2159
SR	7.6	8.15	8.8	8.183333	0.600694
SO4	7508	8257	8150	7971.666	405.0954
TL	< 0.01	< 0.01	< 0.01	0.01	0
SN	< 0.02	< 0.02	< 0.02	0.02	0
TDS	14662	16324	15780	15588.66	847.3590
U	0.176	0.068	0.099	0.114333	0.055608
V	< 0.1	< 0.1	< 0.1	0.1	0
ZN	0.2	0.1	0.2	0.166666	0.057735

9/12/90

L.M. COOKS PE. PhD
SEP '90

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Sample #

179-3

ON OF LEACHATE DATA FROM COLUMN
TESTS FOR TOP SOIL
FIRST PORE VOLUME

	659	660	661	MEAN	STD
AL	< 0.5	< 0.5	< 0.5	0.5	0
SB	< 0.001	0.001	0.002	0.001333	0.000577
AS	0.006	0.006	0.005	0.005666	0.000577
BA	< 0.1	< 0.1	0.1	0.1	0
BE	< 0.05	< 0.05	< 0.05	0.05	0
B	3.2	2.9	2.15	2.75	0.540832
BR	14	14	15	14.33333	0.577350
CD	0.001	0.0009	0.001	0.000966	0.000057
CA	900	900	925	908.3333	14.43375
CL	3200	3500	3600	3433.333	208.1665
CR	< 0.1	0.1	< 0.1	0.1	0
CO	< 0.05	< 0.05	< 0.05	0.05	0
CU	< 0.1	< 0.1	0.1	0.1	0
F	1.8	1.6	1.8	1.733333	0.115470
FE	< 0.2	< 0.2	< 0.2	0.2	0
PB	0.001	< 0.001	< 0.001	0.001	0
MG	435	400	435	423.3333	20.20725
	0.1	< 0.1	0.1	0.1	0
	0.0001	0.0001	0.0001	0.0001	0
MO	1.2	1.2	0.9	1.1	0.173205
NI	0.9	1.2	1	1.033333	0.152752
NO3	440	427.7	447.5	438.4	9.996499
PO4	0.1	0.1	< 0.5	0.233333	0.230940
K	5	5	5	5	0
SE	0.2	0.2	0.2	0.2	0
SIO	21	18	14.5	17.83333	3.253203
AG	< 0.05	< 0.05	< 0.05	0.05	0
NA	4135	4210	4235	4193.333	52.04164
SR	11.5	13	11.25	11.91666	0.946484
SO4	7055	7080	7063	7066	12.76714
TL	< 0.01	< 0.01	< 0.01	0.01	0
SN	< 0.02	< 0.02	< 0.02	0.02	0
TDS	15920	16226	16714	16286.66	400.4614
U	0.043	0.044	0.041	0.042666	0.001527
V	0.1	< 0.1	< 0.1	0.1	0
ZN	0.2	0.2	0.2	0.2	0

9/14/90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM ("1")
FIRST PORE VOLUME

Sample # 179-4

L.M. COONS PE. PHG
SEP '90

	656	657	658	MEAN	STD
AL	< 0.5	< 0.5	< 0.5	0.5	0
SB	0.015	< 0.001	< 0.001	0.005666	0.008082
AS	0.004	0.006	0.005	0.005	0.001
BA	0.1	0.1	< 0.1	0.1	0
BE	< 0.05	< 0.05	< 0.05	0.05	0
B	3.8	3.75	5.15	4.233333	0.794250
BR	7	0.22	9.2	5.473333	4.680612
CD	0.0008	0.001	0.0006	0.0008	0.0002
CA	465	520	525	503.3333	33.29164
CL	2400	3700	3100	3066.666	650.6407
CR	< 0.1	0.1	< 0.1	0.1	0
CO	< 0.05	< 0.05	< 0.05	0.05	0
CU	0.2	< 0.1	0.2	0.166666	0.057735
F	2.5	2.6	2.5	2.533333	0.057735
FE	< 0.2	< 0.2	< 0.2	0.2	0
PB	< 0.001	< 0.001	< 0.001	0.001	0
MG	675	780	565	673.3333	107.5096
[illegible]	< 0.1	< 0.1	< 0.1	0.1	0
HG	0.0001	0.0001	0.0002	0.000133	0.000057
MO	1.7	1.2	2.1	1.666666	0.450924
NI	1.1	1.1	1.2	1.133333	0.057735
NO3	492.8	641.5	617.8	584.0333	79.89407
PO4	0.1	0.1	0.1	0.1	0
K	35	20	20	25	8.660254
SE	1.6	1.8	0.9	1.433333	0.472581
SIO	22	30	28.5	26.83333	4.252450
AG	< 0.05	< 0.05	< 0.05	0.05	0
NA	5670	6365	5010	5681.666	677.5753
SR	10.2	10.5	10.25	10.31666	0.160727
SO4	10496	12570	11632	11566	1038.574
TL	< 0.01	< 0.01	< 0.01	0.01	0
SN	< 0.02	< 0.02	< 0.02	0.02	0
TDS	19298	24470	21698	21822	2588.228
U	0.076	0.152	0.096	0.108	0.039395
V	0.1	0.1	0.1	0.1	0
ZN	0.1	0.2	0.1	0.133333	0.057735
PH	7.23	8.18	8.20	7.87	—
Eh				0.181	
Cond					
AIK					

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9/10/90

D-4

Hazardous constituents detected in the pore water of the Grand Junction tailings.

Tailings Pore Water Quality Statistics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 99% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
11	7.0000	679.0000	175.0000	173.4411	3.6401	NA	0.0	59.0920	509.0678	LOGNORMAL	7,8
ALUMINUM			MG/L								
14	0.0500	78.9667	0.1033	NA	NA	NA	25.0	0.0500	5.7000	NONPARAMETRIC	2
AMMONIUM			MG/L								
13	27.0000	892.3333	305.5000	243.9303	2.8709	NA	0.0	111.3508	534.3649	LOGNORMAL	7,8
ANTIMONY			MG/L								
14	0.0015	0.0173	0.0062	NA	NA	NA	46.4	0.0015	0.0095	NONPARAMETRIC	2
ARSENIC			MG/L								
14	0.0050	1.3125	0.1067	0.0918	5.4562	NA	3.6	0.0276	0.3052	LOGNORMAL	7,8
BARIUM			MG/L								
14	0.0100	0.0733	0.0342	NA	NA	NA	32.1	0.0233	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
14	0.0025	0.1730	0.0031	NA	NA	NA	50.0	0.0025	0.0125	NONPARAMETRIC	2
BORON			MG/L								
13	0.2600	2.0400	0.4600	0.6234	1.7047	NA	0.0	0.4193	0.9269	LOGNORMAL	7,8
CADMIUM			MG/L								
14	0.0005	0.2873	0.0118	0.0111	12.0844	NA	14.3	0.0019	0.0647	LOGNORMAL	7,8
CALCIUM			MG/L								
14	445.5000	1005.0000	523.5000	547.0648	1.2475	NA	0.0	467.7507	639.8279	LOGNORMAL	7,8

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS
SEP 93

Tailings Pore Water Quality S. tics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

PARAMETER NAME			UNITS					STATISTICAL RANGE			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHLORIDE			MG/L								
12	296.7500	1830.0000	1044.7500	925.9731	1.6570	NA	0.0	623.0485	1376.1789	LOGNORMAL	7,8
CHROMIUM			MG/L								
14	0.0050	0.0525	0.0050	NA	NA	NA	82.1	0.0050	0.0367	NONPARAMETRIC	2
COBALT			MG/L								
14	0.0250	0.6300	0.0900	NA	NA	NA	32.1	0.0250	0.3800	NONPARAMETRIC	2
COPPER			MG/L								
14	0.0100	3.0333	0.0492	NA	NA	NA	17.9	0.0100	2.6050	NONPARAMETRIC	2
CYANIDE			MG/L								
14	0.0400	0.1600	0.0800	0.0710	1.6920	NA	4.8	0.0489	0.1030	LOGNORMAL	7,8
FLUORIDE			MG/L								
14	0.7000	15.2800	4.7000	4.4638	2.6410	NA	0.0	2.2438	8.8801	LOGNORMAL	7,8
GROSS ALPHA			PCI/L								
9	113.0000	8020.0000	558.0000	794.7962	4.9612	NA	0.0	169.3478	3730.1988	LOGNORMAL	7,8
GROSS BETA			PCI/L								
9	109.0000	2675.0000	666.0000	585.5358	3.4625	NA	0.0	176.5463	1941.9950	LOGNORMAL	7,8
IRON			MG/L								
14	0.0150	213.5000	8.3000	4.4329	20.7171	NA	14.3	0.5181	37.9285	LOGNORMAL	7,8
LEAD			MG/L								
14	0.0040	0.0670	0.0050	NA	NA	NA	53.6	0.0050	0.0453	NONPARAMETRIC	2

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

,17,25,33,41,49,57,65,73,81,89,97,A5,B3,C1,C9,D7.

L.M. COONS PE, PHg
SEP '90

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COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR ALLUVIUM ((1")+10% PEAT
FIRST PORE VOLUME

Sample : 10% Peat in sample 179-4

	665	666	667	MEAN	STD
AL	< 0.5	< 0.5	0.6	0.533333	0.057735
SB	< 0.001	0.001	< 0.001	0.001	0
AS	0.003	< 0.005	0.01	0.006	0.003605
BA	0.1	< 0.1	< 0.1	0.1	0
BE	< 0.05	< 0.05	< 0.05	0.05	0
B	3.3	3	5.3	3.866666	1.250333
BR	0.96	0.57	4.7	2.076666	2.280226
CD	0.0012	0.0012	0.0011	0.001166	0.000057
CA	600	650	700	650	50
CL	1800	1300	2800	1966.666	763.7626
CR	0.1	< 0.1	< 0.1	0.1	0
CO	< 0.05	< 0.05	< 0.05	0.05	0
CU	0.2	< 0.1	< 0.1	0.133333	0.057735
F	0.5	0.5	0.4	0.466666	0.057735
FE	< 0.001	0.2	0.2	0.133666	0.114892
	< 0.001	< 0.001	0.001	0.001	0
[illegible]	405	410	700	505	168.8934
MN	0.5	0.6	0.7	0.6	0.1
HG	<0.0001	<0.0001	0.0001	0.0001	0
MO	< 0.5	0.9	< 0.5	0.633333	0.230940
NI	1.4	1.6	1.6	1.533333	0.115470
NO3	609.8	407.9	986.9	668.2	293.8846
PO4	0.2	0.2	0.3	0.233333	0.057735
K	15	15	20	16.66666	2.886751
SE	0.4	0.4	1.3	0.7	0.519615
SIO	36.5	34	37.5	36	1.802775
AG	< 0.05	< 0.05	< 0.05	0.05	0
NA	3075	2600	4400	3358.333	932.8495
SR	6.8	7.05	9.25	7.7	1.348146
SO4	4075	5038	7277	6130	1120.512
TL	< 0.01	< 0.01	< 0.01	0.01	0
SN	< 0.02	< 0.02	< 0.02	0.02	0
TDS	12766	10254	16642	13220.66	3218.179
U	0.076	0.072	0.135	0.094333	0.035275
V	< 0.1	< 0.1	0.1	0.1	0
ZN	0.2	0.3	0.3	0.266666	0.057735

9/12/90

COMPARISON OF LEACHATE DATA FROM COLUMN
TESTS FOR PEAT
FIRST PORE VOLUME

Peat

L.M. COCKS PE. PH2
SEP '90

	662	663	664	MEAN	STD
AL	< 0.5	0.7	< 0.5	0.566666	0.115470
SB	< 0.001	0.001	< 0.001	0.001	0
AS	0.011	0.016	0.011	0.012666	0.002886
BA	0.1	0.1	0.1	0.1	0
BE	< 0.05	< 0.05	< 0.05	0.05	0
B	< 0.1	< 0.1	< 0.1	0.1	0
BR	0.28	0.08	0.28	0.213333	0.115470
CD	0.0013	0.0011	0.0013	0.001233	0.000115
CA	1600	1600	1600	1600	0
CL	1400	1400	1400	1400	0
CR	0.1	< 0.1	0.1	0.1	0
CO	< 0.05	< 0.05	< 0.05	0.05	0
CU	< 0.1	< 0.1	< 0.1	0.1	0
F	0.2	0.2	0.2	0.2	0
FE	0.4	0.5	0.4	0.433333	0.057735
PB	< 0.001	< 0.001	< 0.001	0.001	0
MG	490	440	490	473.3333	28.86751
[illegible]	2.9	3	2.9	2.933333	0.057735
HG	0.0001	0.0002	0.0001	0.000133	0.000057
MO	< 0.5	< 0.5	< 0.5	0.5	0
NI	0.8	1.1	0.8	0.9	0.173205
NO3	1935.4	1934.1	1935.4	1934.966	0.750555
PO4	1	0.9	1	0.966666	0.057735
K	25	30	25	26.66666	2.886751
SE	0.03	0.03	0.03	0.03	0
SIO	56.5	54.5	56.5	55.83333	1.154700
AG	< 0.05	< 0.05	< 0.05	0.05	0
NA	460	455	460	458.3333	2.886751
SR	9.7	8.6	9.7	9.333333	0.635085
SO4	2824	2988	2824	2878.666	94.68544
TL	< 0.01	< 0.01	< 0.01	0.01	0
SN	< 0.02	< 0.02	< 0.02	0.02	0
TDS	8778	8710	8778	8755.333	39.25981
U	0.007	< 0.003	0.007	0.005666	0.002309
V	0.1	< 0.1	0.1	0.1	0
ZN	0.3	0.2	0.3	0.266666	0.057735

9/12/90

Tailings Pore Water Quality Statistics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

PARAMETER NAME	# OF SAMP	MINIMUM	MAXIMUM	UNITS MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MAGNESIUM				MG/L								
	14	158.0000	512.5000	246.5000	265.8329	1.4847	NA	0.0	200.9294	351.7813	LOGNORMAL	7,8
MANGANESE				MG/L								
	14	1.9300	8.3333	4.6975	4.6087	1.6435	NA	0.0	3.2416	6.5524	LOGNORMAL	7,8
MERCURY				MG/L								
	9	0.0001	0.0003	0.0001	NA	NA	NA	85.7	0.0001	0.0003	NONPARAMETRIC	2
MOLYBDENUM				MG/L								
	14	0.0617	4.3500	0.2462	NA	NA	NA	21.4	0.0958	0.8567	NONPARAMETRIC	2
NICKEL				MG/L								
	14	0.0200	3.7133	0.5400	0.3420	5.2409	NA	7.1	0.1058	1.185[illegible]	LOGNORMAL	7,8
NITRATE				MG/L								
	12	0.3500	3465.0000	1.1333	NA	NA	NA	42.1	0.4000	1420.0000	NONPARAMETRIC	2
PHOSPHATE				MG/L								
	13	0.2000	4.0000	0.9000	0.8700	2.7700	NA	5.0	0.4078	1.8557	LOGNORMAL	7,8
POTASSIUM				MG/L								
	14	21.0000	233.5000	67.5000	70.7768	1.9421	NA	0.0	44.2308	113.2551	LOGNORMAL	7,8
RADIUM-226				PCI/L								
	10	0.0000	668.9000	18.9667	NA	NA	NA	0.0	1.0565	413.0500	NONPARAMETRIC	9
RADIUM-228				PCI/L								
	10	0.0000	3.8000	0.5500	NA	NA	NA	30.0	0.0000	2.9000	NONPARAMETRIC	2

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametric distribution was used because the data failed the normal distribution test and includes values ≤0.

L.M. COOLIS P.E. PHB
SEP '90

Tailings Pore Water Qual tistics
Lysimeters 550-556, 600-6[illegible], 640-646
SITE: GRJ01 GRAND JUNCTION
08/17/89 TO 01/15/90
REPORT DATE: 07/07/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SELENIUM	MG/L	14	0.0025	0.8700	0.0732	NA	NA	NA	25.0	0.0025	0.4600	NONPARAMETRIC	2
SILICA - SIO2	MG/L	13	17.1000	83.0000	39.7500	35.6165	1.6407	NA	0.0	24.6466	51.4491	LOGNORMAL	7,8
SILVER	MG/L	14	0.0026	0.0208	0.0050	NA	NA	NA	71.4	0.0035	0.0189	NONPARAMETRIC	2
SODIUM	MG/L	14	390.5000	1205.0000	775.0000	740.6519	1.3977	NA	0.0	584.2911	938.8560	LOGNORMAL	7,8
SPECIFIC CONDUCTANCE	UMHO/CM	15	6200.0000	15000.0000	9180.0000	10147.0110	1.3377	NA	0.0	8331.5067	12358.1286	LOGNORMAL	7,8
STRONTIUM	MG/L	14	3.9133	5.9200	5.4325	5.0564	1.1635	NA	0.0	4.5421	5.6289	LOGNORMAL	7,8
SULFATE	MG/L	12	2198.5000	4487.0000	3327.5000	3378.3908	1.2494	NA	0.0	2836.7667	4023.4271	LOGNORMAL	7,8
SULFIDE	MG/L	14	0.0300	60.0000	0.0500	NA	NA	NA	82.4	0.0500	0.0500	NONPARAMETRIC	2
TEMPERATURE	C - DEGREE	15	6.3000	16.7000	12.5000	12.2622	1.2539	NA	0.0	10.5192	14.2939	LOGNORMAL	7,8
THALLIUM	MG/L	14	0.0500	0.0500	0.0500	NA	NA	NA	100.0	0.0500	0.0500	NONPARAMETRIC	2

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

SEP 90

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Tailings Pore Water Quality Statistics
Lysimeters 550-556, 600-604, 640-646
SITE: GRJ01 GRAND JUNCTION
06/17/89 TO 01/15/90
REPORT DATE: 07/07/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
THORIUM-230			PCI/L								
5	3.5900	29.6000	18.8800	12.9673	2.5996	NA	0.0	2.6157	64.2843	LOGNORMAL	7,8
TIN			MG/L								
8	0.0025	0.0170	0.0025	NA	NA	NA	75.0	0.0025	0.0170	NONPARAMETRIC	2
TOTAL DISSOLVED SOLIDS			MG/L								
13	4563.0000	10345.0000	6457.0000	6609.3040	1.2970	NA	0.0	5447.3447	8019.1178	LOGNORMAL	7,8
TOTAL KJELDAHL NITROGEN			MG/L								
13	0.5000	731.0000	223.0000	103.2699	9.6318	NA	7.7	19.1652	556.4608	LOGNORMAL	7,8
URANIUM			MG/L								
14	0.0750	29.7000	0.9850	0.7777	5.3430	NA	0.0	0.2373	2.5484	LOGNORMAL	7,8
VANADIUM			MG/L								
14	0.0050	27.6333	1.3058	0.6522	14.0823	NA	7.1	0.1002	4.2453	LOGNORMAL	7,8
ZINC			MG/L								
14	0.0025	7.0533	0.2798	0.2544	15.8659	NA	7.1	0.0359	1.8019	LOGNORMAL	7,8

Note the data at each location was averaged before the statistical calculations were performed.
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

INPUT DATA FILENAME: J:\DART\GRJ01\GM010005.DAT

L.M. COOK'S P.C.
SEP '90

L.M. COUN

ATTACHMENT E

Groundwater quality of the Mancos Shale and the Dakota Sandstone.

Table Background water quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GAJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 90% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
7	260.0000	1219.0000	377.0000	454.6454	1.8947	NA	0.0	212.8025	971.3346	LOGNORMAL	7,8
ALUMINUM			MG/L								
7	0.0500	0.4300	0.1750	NA	NA	NA	45.0	0.0500	0.4300	NONPARAMETRIC	2
AMMONIUM			MG/L								
7	0.0500	4.5000	0.5000	NA	NA	NA	55.0	0.0500	4.5000	NONPARAMETRIC	2
ANTIMONY			MG/L								
6	0.0015	0.0610	0.0072	NA	NA	NA	36.4	0.0015	0.0610	NONPARAMETRIC	2,6
ARSENIC			MG/L								
7	0.0044	0.0085	0.0050	NA	NA	NA	80.0	0.0044	0.0085	NONPARAMETRIC	2
BARIUM			MG/L								
7	0.0200	0.0600	0.0400	NA	NA	NA	52.9	0.0200	0.0600	NONPARAMETRIC	2
BERYLLIUM			MG/L								
6	0.0037	0.0050	0.0037	NA	NA	NA	100.0	0.0037	0.0050	NONPARAMETRIC	2,6
BORON			MG/L								
4	0.0650	1.7200	0.7900	NA	NA	NA	33.3	0.0650	1.7200	NONPARAMETRIC	2,4
BROMIDE			MG/L								
3	1.0000	5.5000	1.2000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) Data from a minimum of 4 locations must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
4) The stat. range is the 87.5% confidence interval due to a sample size of 4. The maximum is the 93.8% one sided confidence int.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

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Table 3.36 Background water quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GAJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CADMIUM	MG/L	7	0.0005	0.0050	0.0018	NA	NA	NA	52.9	0.0005	0.0050	NONPARAMETRIC	2
CALCIUM	MG/L	7	11.5000	462.0000	204.2000	185.5234	3.9872	NA	0.0	28.9050	532.4673	LOGNORMAL	7,8
CATION/ANION BALANCE	%	3	-2.7900	0.0000	-1.5000	NA	NA	NA	66.7	NA	NA	UNKNOWN	1
CHLORIDE	MG/L	7	29.4000	2400.0000	230.0000	313.3838	5.4014	NA	0.0	42.2576	2324.6672	LOGNORMAL	7,8
CHROMIUM	MG/L	7	0.0050	0.0100	0.0050	NA	NA	NA	85.0	0.0050	0.0100	NONPARAMETRIC	2
COBALT	MG/L	6	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2,6
COPPER	MG/L	7	0.0100	0.0300	0.0150	NA	NA	NA	76.5	0.0100	0.0300	NONPARAMETRIC	2
CYANIDE	MG/L	6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
FLUORIDE	MG/L	7	0.1900	1.6000	0.4325	0.5457	2.1611	NA	0.0	0.2185	1.3630	LOGNORMAL	7,8

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) Data from a minimum of 4 locations must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

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L.M. COONS

Table 3.36 Background water quality in the Hanson Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
GROSS ALPHA	PCI/L	7	6.8000	73.5000	18.0000	20.3795	2.5760	NA	5.9	6.6225	62.7143	LOGNORMAL	7,8
GROSS BETA	PCI/L	7	9.8500	69.0000	18.5500	21.6624	1.9410	NA	5.9	9.8527	47.6276	LOGNORMAL	7,8
IRON	MG/L	7	0.0500	0.5100	0.1450	0.1654	2.0809	NA	5.0	0.0693	0.3950	LOGNORMAL	7,8
LEAD	MG/L	6	0.0050	0.0200	0.0088	NA	NA	NA	69.2	0.0050	0.0200	NONPARAMETRIC	2,6
MAGNESIUM	MG/L	7	12.6500	260.0000	91.7667	61.4801	2.9755	NA	0.0	16.8532	224.5452	LOGNORMAL	7,8
MANGANESE	MG/L	7	0.0250	0.6900	0.2210	0.1594	3.0795	NA	5.0	0.0419	0.6064	LOGNORMAL	7,8
MERCURY	MG/L	6	0.0001	0.0002	0.0001	NA	NA	NA	91.7	0.0001	0.0002	NONPARAMETRIC	2,6
MOLYBDENUM	MG/L	6	0.0125	0.1150	0.0675	NA	NA	NA	31.3	0.0125	0.1150	NONPARAMETRIC	2,6
NICKEL	MG/L	7	0.0200	0.0280	0.0200	NA	NA	NA	94.7	0.0200	0.0280	NONPARAMETRIC	2
NITRATE	MG/L	7	0.5000	3.0000	1.7200	NA	NA	NA	60.0	0.5000	3.0000	NONPARAMETRIC	2

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS PE. PHS
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Table 3.36 Backgro[illegible]ter quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 95% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
PHOSPHATE			MG/L								
4	0.0750	0.3100	0.1775	NA	NA	NA	33.3	0.0750	0.3100	NONPARAMETRIC	2,4
POTASSIUM			MG/L								
7	2.7300	19.0000	5.9500	5.7098	2.0295	NA	0.0	2.4430	13.2344	LOGNORMAL	7,8
RADIUM-226			PCI/L								
7	0.0750	1.3500	0.3000	NA	NA	NA	31.3	0.0750	1.3500	NONPARAMETRIC	2
RADIUM-228			PCI/L								
7	0.0500	1.0000	0.4500	NA	NA	NA	35.3	0.0500	1.0000	NONPARAMETRIC	2
SELENIUM			MG/L								
7	0.0030	0.1095	0.0155	NA	NA	NA	35.0	0.0030	0.1095	NONPARAMETRIC	2
SILICA - SIO2			MG/L								
5	8.6000	42.0000	10.4500	16.9153	2.2525	NA	0.0	4.3383	65.9543	LOGNORMAL	7,8
SILVER			MG/L								
4	0.0050	0.0075	0.0050	NA	NA	NA	92.3	0.0050	0.0075	NONPARAMETRIC	2,4
SODIUM			MG/L								
7	80.6000	2445.0000	1125.0000	502.3447	4.0092	NA	0.0	94.2784	2676.6506	LOGNORMAL	7,8
SPECIFIC CONDUCTANCE			UMHO/CM								
7	664.6667	6500.0000	1873.0000	1808.9055	2.4343	NA	0.0	628.0524	5209.9774	LOGNORMAL	7,8

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
4) The stat. range is the 87.5% confidence interval due to a sample size of 4. The maximum is the 93.8% one sided confidence int.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

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L.M. Co[illegible]

Table 3.36 Background water quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
STRONTIUM			MG/L								
7	1.2450	9.0000	2.6700	3.3706	2.0819	NA	0.0	1.4185	8.0643	LOGNORMAL	7,8
SULFATE			MG/L								
7	344.6000	3690.0000	875.2000	920.8585	2.1770	NA	0.0	365.4535	2320.3509	LOGNORMAL	7,8
SULFIDE			MG/L								
5	0.0500	16.5000	1.0250	NA	NA	NA	33.3	0.0500	16.5000	NONPARAMETRIC	2,5
TEMPERATURE			C - DEGREE								
7	12.6500	39.7600	14.0000	16.2430	1.4897	NA	0.0	10.1146	26.0795	LOGNORMAL	7,8
THALLIUM			MG/L								
6	0.0050	0.0525	0.0275	NA	NA	NA	72.7	0.0050	0.0525	NONPARAMETRIC	2,6
THORIUM-230			PCI/L								
6	0.0000	0.6000	0.0750	NA	NA	NA	44.4	0.0000	0.6000	NONPARAMETRIC	2,6
TIN			MG/L								
6	0.0025	0.1530	0.0265	NA	NA	NA	42.9	0.0025	0.1530	NONPARAMETRIC	2,6
TOTAL DISSOLVED SOLIDS			MG/L								
7	873.4000	7010.0000	4195.0000	2909.9871	2.2242	NA	0.0	1125.8183	7521.6620	LOGNORMAL	7,8
TOTAL KJELDAHL NITROGEN			MG/L								
2	3.0000	4.0000	3.5000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) Data from a minimum of 4 locations must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
5) The stat. range is the 93.8% confidence interval due to a sample size of 5. The maximum is the 96.9% one sided confidence int.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS PE. PHB
SEP '90

Table 3.36 Backgro[illegible]ter quality in the Mancos Shale at the Cheney disposal site, Colorado
SITE: GRJ03 CHENEY RESERVOIR
07/27/86 TO 06/27/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	95% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TOTAL ORGANIC CARBON			MG/L								
7	20.0000	104.0000	63.0000	54.9848	2.0427	NA	0.0	23.5362	128.4546	LOGNORMAL	7,8
URANIUM			MG/L								
7	0.0027	0.0110	0.0096	0.0065	1.0671	NA	10.0	0.0051	0.0136	LOGNORMAL	7,8
VANADIUM			MG/L								
7	0.0050	0.1300	0.0750	NA	NA	NA	35.0	0.0050	0.1300	NONPARAMETRIC	2
ZINC			MG/L								
7	0.0067	0.0250	0.0112	NA	NA	NA	30.0	0.0067	0.0250	NONPARAMETRIC	2

Note the data at each location was averaged before the statistical calculations were performed
* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

INPUT DATA FILENAME: J:\DART\GRJ03\GW10919.DAT

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SEP 90

Table Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY	MG/L CACO3	5	5667.0000	9139.0000	7861.0000	7439.2000	1329.8636	0.1788	0.0	5210.7352	9667.6648	NORMAL	
ALUMINUM	MG/L	6	0.0500	0.0500	0.0500	NA	NA	NA	100.0	0.0500	0.0500	NONPARAMETRIC	2,6
AMMONIUM	MG/L	6	5.2000	8.0000	6.0500	6.2667	1.0690	0.1706	0.0	4.7982	7.7352	NORMAL	
ANTIMONY	MG/L	3	0.0015	0.0015	0.0015	NA	NA	NA	100.0	NA	NA	UNKNOWN	1
ARSENIC	MG/L	6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
BARIUM	MG/L	6	4.4400	38.0000	33.3000	27.2567	13.1413	0.4821	0.0	9.2037	45.3096	NORMAL	
BERYLLIUM	MG/L	3	0.0025	0.0025	0.0025	NA	NA	NA	100.0	NA	NA	UNKNOWN	1
BORON	MG/L	6	1.5000	3.1300	2.0450	2.2633	0.6217	0.2747	0.0	1.4095	3.1174	NORMAL	
CADMIUM	MG/L	6	0.0005	0.0005	0.0005	NA	NA	NA	100.0	0.0005	0.0005	NONPARAMETRIC	2,6
CALCIUM	MG/L	6	14.5000	42.0000	33.8000	31.6833	9.7016	0.3062	0.0	18.3557	45.0110	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Table 3.39 Dakota Sands)ter quality statistics at the
Cheney disposal si. and Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHLORIDE			MG/L								
6	3040.0000	4850.0000	4310.0000	4085.0000	731.7835	0.1791	0.0	3079.8183	5090.1817	NORMAL	
CHROMIUM			MG/L								
6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
COBALT			MG/L								
6	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2,6
COPPER			MG/L								
6	0.0100	0.0200	0.0100	NA	NA	NA	66.7	0.0100	0.0200	NONPARAMETRIC	2,6
CYANIDE			MG/L								
6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
FLUORIDE			MG/L								
6	1.2000	2.2000	1.4000	1.4667	0.3724	0.2234	0.0	1.1551	2.1782	NORMAL	
GROSS ALPHA			PCI/L								
6	0.0000	90.0000	37.5000	NA	NA	NA	33.3	0.0000	90.0000	NONPARAMETRIC	2,6
GROSS BETA			PCI/L								
6	0.0000	160.0000	102.5000	NA	NA	NA	16.7	0.0000	160.0000	NONPARAMETRIC	2,6
IRON			MG/L								
6	0.2500	0.8000	0.4850	0.5067	0.2106	0.4156	0.0	0.2174	0.7960	NORMAL	
LEAD			MG/L								
6	0.0050	0.0100	0.0050	NA	NA	NA	83.3	0.0050	0.0100	NONPARAMETRIC	2,6

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 90% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MAGNESIUM			MG/L								
6	13.7000	42.0000	22.5000	26.7167	10.7682	0.4031	0.0	11.9238	41.5095	NORMAL	
MANGANESE			MG/L								
6	0.0200	0.3900	0.1100	0.0809	3.5524	NA	0.0	0.0142	0.4615	LOGNORMAL	7,8
MERCURY			MG/L								
6	0.0001	0.0910	0.0001	NA	NA	NA	83.3	0.0001	0.0910	NONPARAMETRIC	2,6
MOLYBDENUM			MG/L								
6	0.0050	0.2100	0.0500	NA	NA	NA	33.3	0.0050	0.2100	NONPARAMETRIC	2,6
NICKEL			MG/L								
6	0.0200	0.0200	0.0200	NA	NA	NA	100.0	0.0200	0.0200	NONPARAMETRIC	2,6
NITRATE			MG/L								
6	0.5000	10.0000	1.7500	NA	NA	NA	50.0	0.5000	10.0000	NONPARAMETRIC	2,6
PHOSPHATE			MG/L								
6	0.1200	11.4000	2.6000	1.4390	5.4103	NA	0.0	0.1415	14.6324	LOGNORMAL	7,8
POTASSIUM			MG/L								
6	14.0000	111.0000	71.6500	67.2167	39.0846	0.5815	0.0	13.5212	120.9121	NORMAL	
RADIUM-226			PCI/L								
6	1.5000	32.0000	2.8500	4.7334	3.6747	NA	0.0	0.7928	28.2906	LOGNORMAL	7,8
RADIUM-228			PCI/L								
6	3.4000	48.0000	23.5000	25.0667	15.7915	0.6300	0.0	3.3730	46.7603	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

L.M. COONS SEP '90

Table 3.39 Dakota [illegible]stone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 90% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SELENIUM	MG/L	6	0.0025	0.0050	0.0025	NA	NA	NA	83.3	0.0025	0.0050	NONPARAMETRIC	2,6
SILICA - SIO2	MG/L	6	0.0000	44.0000	18.3500	21.2333	13.1767	0.6206	0.0	3.1317	39.3350	NORMAL	
SILVER	MG/L	6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
SODIUM	MG/L	6	4210.0000	7020.0000	5950.0000	5756.6667	1012.9692	0.1760	0.0	4365.0047	7148.2387	NORMAL	
SPECIFIC CONDUCTANCE	UMHO/CM	2	15.5000	21000.0000	10507.7950	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
STRONTIUM	MG/L	6	3.5900	9.0500	7.7200	7.1850	2.0867	0.2904	0.0	4.3184	10.0516	NORMAL	
SULFATE	MG/L	6	6.2000	175.0000	54.3000	67.0167	61.0021	0.9222	0.0	-17.0043	151.9176	NORMAL	
SULFIDE	MG/L	6	0.0500	10.0000	0.1700	NA	NA	NA	50.0	0.0500	10.0000	NONPARAMETRIC	2,6
TEMPERATURE	C - DEGREE	5	16.9000	22.1000	19.0000	19.4200	1.0939	0.0975	0.0	16.2463	22.5937	NORMAL	
THALLIUM	MG/L	3	0.0500	0.1000	0.0500	NA	NA	NA	66.7	NA	NA	UNKNOWN	1

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TOTAL DISSOLVED SOLIDS	MG/L	6	10500.0000	18300.0000	15355.0000	14518.3333	2780.8662	0.1915	0.0	10698.1833	18338.5434	NORMAL	
TOTAL KJELDAHL NITROGEN	MG/L	3	0.5000	5.0000	0.5000	NA	NA	NA	66.7	NA	NA	UNKNOWN	1
URANIUM	MG/L	6	0.0004	0.0032	0.0015	NA	NA	NA	50.0	0.0004	0.0052	NONPARAMETRIC	2,6
VANADIUM	MG/L	6	0.0050	0.0300	0.0050	NA	NA	NA	83.3	0.0050	0.0300	NONPARAMETRIC	2,6
ZINC	MG/L	6	0.0025	4.0600	0.6995	NA	NA	NA	33.3	0.0025	4.0600	NONPARAMETRIC	2,6

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

INPUT DATA FILENAME: J:\DART\GRJ03\GW10020.DAT

77
SEP '90
L.M. COOKS PE.

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ03-07-90-13-06(0)-00 But reported as GRJ03-07-90-13-06(3)-00 in the RAP. DISCIPLINE Hydrology NO. OF SHEETS 22

PROJECT:

UMTRA

SITE: GRJ03 : Cheney disposal site for the GRJ tailings, Grand Junction, Colorado

FEATURE: Aquifer Hydraulic and Geochemical Properties: Geochemical Modeling: Speciation and Saturation Indices of Groundwater in the Mancos Shale

SOURCES OF DATA:

1. Groundwater Quality data from selected Mancos shale groundwater wells - presented in this calculation
2. Geochemical computer code - PHREEQE (referenced below) was used

SOURCES OF FORMULAE & REFERENCES:

Parkhurst, D.L., Thorstenson, D.C., and Plummer, L.N., 1980. "PHREEQE - A Computer Program for Geochemical Calculations," U.S.G.S. Water Resources Investigations, 80-96, Washington D.C., 210 p.

PRELIMINARY CALC. ☐ FINAL CALC. ☒ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		[illegible]	9/12/90	[illegible]	9/20/90	KB	9/21/90

DETERMINATION OF DISSOLVED SPECIES AND MINERALS SATURATION INDICES OF THE HAZARDOUS CONSTITUENTS IN GROUNDWATER OF THE MANCOS SHALE UNDERLYING THE PROPOSED DISPOSAL CELL AT THE CHENEY SITE, GRAND JUNCTION, COLORADO

CALCULATION NUMBER: GRJ03-07-90-14-14(01)-00 (WAS REPORTED AS GRJ03-07-90-13-06(02)-00 IN THE LATEST GRAND JUNCTION RAP).

A. Purpose

The batch and column test data presented in Calculation GRJ03-07-90-31-06(01))-00 demonstrate that the hazardous constiutents present in the Grand Junction tailings pore water will be attenuated by the Quaternary alluvium and Mancos Shale underlying the disposal cell at the proposed Cheney site. The purpose of this calculation is to determine if the geochemical condition of the groundwater where it is present in the Mancos Shale underneath the Cheney site, is also conducive to attenuation of the hazardous constituents by chemical precipitation.

B. Overview of Method

The numerical computer code PHREEQE was used to determine a) the dissolved species of the hazardous constiutents in the groundwater of the Mancos Shale and, b) the saturation indices of several minerals that contain these hazardous constituents. The dissolved species indicate which species of a chemical element is stable in the solution. Saturation index on the other hand, is a measure of solubility of a mineral, that is, whether a mineral precipitates or dissolves in a solution of known chemical composition and condition. The computational details used by PHREEQE are provided in Parkhurst and others(1980).

The input parameters for this computation consisted of the following types:

a) On-site measured parameters of the Mancos Shale groundwater geochemical condition. These parameters are: oxidation-reduction potential, pH, alkalinity, electrical conductance and temperature. The measurements were made following the procedures described in the UMTRA Project Standard Operating Procedure No. 16.1.13. The data are provided in Attachment A.

b) Concentrations of several dissolved constituents including the hazardous constituents that are present in the groundwater. The chemical analysis of groundwater in wells 981 and 982 are provided in Attachment B.

The input parameters used in the computation for the groundwater from wells 981 and 982 are summarized in Attachments C and D

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respectively.

The values of the saturation indices and the dissolved species of the hazardous constituents are read off directly from the computer print outs presented in Attachments C and D.

C. Assumptions

1. The calculation represents thermodynamic equilibrium reactions with no consideration for time dependence of these reactions (kinetic effects). This is a reasonable assumption as the reactions involving the constituents of interest are probably instantaneous.

2. The thermodynamic data base adequately represents the minerals and the dissolved species that are present in the Mancos groundwater. The data base is not adequate in that a) the number of minerals and dissolved species for the elements for which data is present are limited, and b) for a number of elements (for example, bismuth, copper, cobalt and chromium) no data is in the data base.

D. Material properties

Not applicable.

E. Data Sources

Thermodynamic data, chemical equations, procedures for calculation of the dissolved species and saturation indices for minerals containing hazardous constituents are in PHREEQE data base of the UMTRA Project file maintained at the DOE's Albuquerque office. The groundwater data used in the calculation are in Attachments A and B of this calculation.

F. Solution

The details of calculations performed is voluminous and are not attached. However, they can be exactly reproduced using PHREEQE and the chemical input parameters shown in Attachments C and D, with the input oxidation-reduction potential held constant and the density of the solution being 1 gram per milliliter.

The dissolved species and the saturation indices of minerals for the groundwater in wells 981 and 982 are shown in Attachments C and D respectively. The dominant dissolved species and the minerals containing selected chemical elements including the hazardous constituents of interest are highlighted in these Attachments.

G. Conclusions and Recommendations

1. The data presented in Attachments C and D strongly support the field observations (Attachment A) that the groundwater in the

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Mancos Shale underneath the proposed disposal cell is in a highly reducing geochemical condition. Methane gas was produced during drilling of wells into the Mancos Shale; the modeling data show that the groundwater is supersaturated with respect to methane (well 982) and pyrite, and the chemically reduced ~~dissolved~~ species of various elements including those of sulfur, iron, arsenic, ~~cadmium~~, molybdenum, selenium and uranium are predicted to be dominant in the Mancos groundwater. This highly reducing geochemical condition coupled with the alkaline pH condition will insolubilize the hazardous constituents present in the Grand Junction tailings pore leachate.

2. The saturation indices of the hazardous constituents presented in Attachments C and D show that the Mancos groundwater is supersaturated with respect to coffinite (USiO4), sphalerite (ZnS), greenockite (CdS), galena (PbS), ferroselite (FeSe2), native selenium (Se) and molybdenite (MoS). Therefore, these hazardous constituents are predicted to precipitate in these mineral forms as the tailings leachate mixes with the Mancos groundwater. The concentration of other hazardous constituents in the Mancos groundwater was below their detection limits.

H. Results

The dissolved species and minerals-saturation indices of the various constituents of interest, including the hazardous constituents, are highlighted in Attachments C and D. Also see the conclusions above.

I. References

See the cover sheet of this calculation.

J. Attachments

Attachment A: On-site measured parameters of groundwater condition in the Mancos Shale at the Cheney site.

Attachment B: Chemical analysis of groundwater in Wells 981 and 982 in the Mancos Shale at the Cheney site.

Attachment C: PHREEQE (model) predicted dissolved species and minerals-saturation indices of various constituents present in the Mancos groundwater, Well 981.

Attachment D: PHREEQE model predicted dissolved species and minerals-saturation indices on various constituents present in the Mancos groundwater, Well 982.

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Attachment A: On-site measured parameters of groundwater condition in the Mancos Shale at the Cheney site.

FOUNDATION	WELL NUMBER	Eh(mV)	pH	TDS* (mg/l)	ALKALINITY (mg/l as CaCO3)	TEMP (C)
ALLUVIUM	808	206	7.48	1170	327	14
ALLUVIUM	811S	227	7.36	664	286	12
ALLUVIUM	820	24	7.49	1630		14
ALLUVIUM	828	-20	7.51	620	474	14
ALLUVIUM	8292	208	7.23	680	401	13
ALLUVIUM	904	111	7.31	966	422	13
ALLUVIUM	965	221	7.09	798	290	15
ALLUVIUM	966	247	7.31	812	349	13
ALLUVIUM	967	255	7.40	760	259	12
MANCOS SHALE	811D	57	7.14	4320	457	10
MANCOS SHALE	981	-252	8.38	4220	1148	12
MANCOS SHALE	982	-355	7.22	6210	1002	14
DAKOTA SANDSTO	977	-12.5	7.21	12100	6630	19
DAKOTA SANDSTO	978		7.43	15410	7861	19
DAKOTA SANDSTO	971		7.80	15300	7899	17

*= LABORATORY MEASUREMENTS MADE ON SAMPLE COLLECTED
ALL OTHER MEASUREMENTS MADE IN FIELD FROM 11/89-2/90

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Attachment B: Chemical analysis of groundwater in Wells 981 and 982 in the Mancos Shale at the Cheney site.

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WATER QUALITY ANALYTICAL RESULTS

SITE ID: BRJ03
SAMPLE DATE: 11/18/89

LOCATION ID: 981
ANALYTICAL LAB CODE: BAR

SAMPLE ID: 0.

LAB SAMPLE CONTROL ID: 1554-14
ANALYSIS CHECKED BY: [illegible]

DATE RECEIVED: 11-20-89
DATE CHECKED: 12-22-89

COMMENTS: Total Report DR #035, Lot 2
ASD-34-6764-[illegible]5-88-[illegible]

PARAMETER	V I	PARAMETER VALUE	VALUE UNCERTAINTY	DETECTION LIMIT	UNITS OF MEASURE	COMMENTS
AG	<	.01		0.01	MG/L	
AL	<	.1		0.1	MG/L	
AS		.012		0.01	MG/L	
BA	<	.1		0.1	MG/L	
BE	<	.01		0.01	MG/L	
BR		6.9		0.1	MG/L	
CA		9.82		0.01	MG/L	
CD		.003		0.001	MG/L	
CL		1610.		1.0	MG/L	
CN	<	.01		0.01	MG/L	
CO	<	.05		0.05	MG/L	
CR	<	.01		0.01	MG/L	
CU	<	.02		0.02	MG/L	
F		1.5		0.1	MG/L	
FE		.23		0.03	MG/L	
GA		140.	50.	1.0	PCI/L	
GB		55.	22.	0.5	PCI/L	
	<	.0002		0.0002	MG/L	
		6.8		0.01	MG/L	
MG		11.0		0.001	MG/L	
MN		.04		0.01	MG/L	
MO		.21		0.01	MG/L	
NA		1540.		0.002	MG/L	
NH4		3.2		0.1	MG/L	
NI	<	.04		0.04	MG/L	
NO3	<	.1		1.0	MG/L	
PB		.02		0.01	MG/L	
REL		0.0	0.1	1.0	PCI/L	
RAB		0.1	1.6	1.0	PCI/L	
S		14.		0.1	MG/L	
SB		.011		0.003	MG/L	
SE		.009		0.005	MG/L	
SIO		11.		2.0	MG/L	
SN		.101		0.005	MG/L	
SO4		426.		0.1	MG/L	
SR		1.79		0.1	MG/L	
TDS		4170.		10.0	MG/L	
TL	<	.01		0.01	MG/L	
TOC		69.		1.0	MG/L	
U		0.0084		0.003	MG/L	
V	<	.01		0.01	MG/L	
ZN		.011		0.005	MG/L	

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WATER QUALITY ANALYTICAL RESULTS

SITE ID: GRJ03
SAMPLE DATE: 11/18/89

LOCATION ID: 982
ANALYTICAL LAB CODE: BAR

SAMPLE ID: 0:

LAB SAMPLE CONTROL ID: 1556-15
ANALYSIS CHECKED BY: [illegible]

DATE RECEIVED: 11-[illegible]
DATE CHECKED: 12-[illegible]

COMMENTS: Total Report DO# 035, lot 2
ASD-34-6704-5-88

PARAMETER	V I	PARAMETER VALUE	VALUE UNCERTAINTY	DETECTION LIMIT	UNITS OF MEASURE	COMMENTS
AG	<	.01		0.01	MG/L	
AL	<	.1		0.1	MG/L	
AS	<	.01		0.01	MG/L	
BA	<	.1		0.1	MG/L	
BE	<	.01		0.01	MG/L	
BR		3.7		0.1	MG/L	
CA		19.5		0.01	MG/L	
CD		.004		0.001	MG/L	
CL		2320.		1.0	MG/L	
CN	<	.01		0.01	MG/L	
CO	<	.05		0.05	MG/L	
CR	<	.01		0.01	MG/L	
CU	<	.02		0.02	MG/L	
F		1.4		0.1	MG/L	
FE		.07		0.03	MG/L	
GA		38.	49.	1.0	PCI/L	
GR		36.	24.	0.5	PCI/L	
HG		.0002		0.0002	MG/L	
K		7.9		0.01	MG/L	
MG		17.2		0.001	MG/L	
MN		.10		0.01	MG/L	
MO		.02		0.01	MG/L	
NA		2300.		0.002	MG/L	
NH4		5.0		0.1	MG/L	
NI	<	.04		0.04	MG/L	
NO3	<	.1		1.0	MG/L	
PB		.03		0.01	MG/L	
RGL		0.5	0.3	1.0	PCI/L	
RAB		1.9	1.1	1.0	PCI/L	
S	<	4.		0.1	MG/L	
SB		.041		0.003	MG/L	
SE		.014		0.005	MG/L	
SIO		8.		2.0	MG/L	
SN		.153		0.005	MG/L	
SO4		1040.		0.1	MG/L	
SR		4.50		0.1	MG/L	
TOL		0.0	0.3	1.0	PCI/L	
TDS		6440.		10.0	MG/L	
TL		.041		0.01	MG/L	
TOC		23.		1.0	MG/L	
U		0.0038		0.003	MG/L	
	<	.01		0.01	MG/L	
ZN		.020		0.005	MG/L	

9/14/90
9/20/90

Attachment C: PHREEQE (model) predicted dissolved species and minerals-saturation indices of various constituents present in the Mancos groundwater, Well 981.

```
ENTS
IES
MIN
        ed and minerals saturation indices in mancos groundwater, Cheney si
...JD      0          .00000
ENTS
      10          50.
       0          D.
TION 1
os Shale, GRJ Cheney Site, well 0981
D 2     8.36     -4.45     12.0     1.00
  2.268D-02  11  9.820D+00  12  3.000D-03  13  1.610D+03  16  1.500D+00
  2.300D-01  19  6.800D+00  21  1.100D+01  22  4.000D-02  35  3.507D-01
  1.540D+03  23  1.103D+01  27  2.000D-02  29  4.680D+01  37  1.456D-02
  1.760D+01  31  1.790D+00  32  9.492D-03  34  1.100D-02  10  1.148D+02
TION NUMBER 1          Mancos Shale, GRJ Cheney Site, well 0981
```

pH

Pe = 16.92Eh

Temperature, °C

Density of solution (water), g/cc

Pe to Eh Conversion

$$Pe = \frac{F}{2.3RT} Eh$$

F = Faraday Const = 23.06 kcal/volt-gram

R = "Gas Constant" = 0.001987 kcal/deg

T = 298.15°K

INPUT PARAMETERS FOR GROUNDWATER FROM WELL #981

Input values are in correspondence. 9/20/90

TOTAL MOLALITIES OF ELEMENTS

ELEMENT	MOLALITY	LOG MOLALITY
AS	1.603229D-07	-6.795D
TOT ALK	2.301715D-03	-2.6379
CA	2.458389D-04	-3.6093
CD	2.678063D-08	-7.5722
CL	4.556566D-02	-1.3414
F	7.922113D-05	-4.1012
FE	4.132328D-06	-5.3638
K	1.744925D-04	-3.7562
MG	4.539622D-04	-3.343D
MN	7.305568D-07	-6.1363
N	1.784910D-04	-3.7464
NA	6.721286D-02	-1.1725
PB	9.685636D-08	-7.0139
S	4.886356D-04	-3.3105
SI	1.837325D-04	-3.7358
SR	2.049624D-05	-4.6853
U	3.527066D-08	-7.4526
ZN	1.688425D-07	-6.7725
MO	2.200149D-06	-5.6575
SE	1.143219D-07	-6.9419

----DESCRIPTION OF SOLUTION----

PH =	8.3800
PE =	-4.4540
ACTIVITY H2O =	.9962
IONIC STRENGTH =	.0600
TEMPERATURE =	12.0000
ELECTRICAL BALANCE =	2.0087D-02
THOR =	-2.8445D+04
TOTAL ALKALINITY =	2.3017D-03
ITERATIONS =	22

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DISTRIBUTION OF SPECIES

DISSOLVED SPECIES

I	SPECIES	Z	MOLALITY	LOG MOLALITY	ACTIVITY	LOG ACTIVITY	GAMMA	LOG GAMMA
1	H+	1.0	5.12192D-09	-8.2906	4.16869D-09	-8.3800	8.13894D-01	-.0894
2	E-	-1.0	2.84446D-04	4.4540	2.84446D-04	4.4540	1.00000D+00	.0000
3	H2O	.0	9.98015D-01	-.0009	9.98015D-01	-.0009	1.00000D+00	.0000
6	H3AS04	.0	3.67369D-20	-19.4349	3.72479D-20	-19.4289	1.01391D+00	.0060
10	CO3 2-	-2.0	3.29927D-05	-4.4816	1.44773D-05	-4.8393	4.38804D-01	-.3577
11	CA 2+	2.0	2.38583D-04	-3.6224	1.13850D-04	-3.9437	4.77194D-01	-.3213
12	CD 2+	2.0	2.26779D-10	-9.6406	1.00389D-10	-9.9983	4.38804D-01	-.3577
13	CL-	-1.0	4.55658D-02	-1.3414	3.63673D-02	-1.4393	7.98127D-01	-.0979
16	F-	-1.0	7.78361D-05	-4.1088	6.33503D-05	-4.1983	8.13894D-01	-.0894
17	FE 2+	2.0	4.02945D-06	-5.3948	1.76814D-06	-5.7525	4.38804D-01	-.3577
19	K+	1.0	1.74323D-04	-3.7586	1.39132D-04	-3.8566	7.98127D-01	-.0979
21	MG 2+	2.0	4.39683D-04	-3.3569	2.15105D-04	-3.6674	4.89227D-01	-.3105
22	MN 2+	2.0	6.60430D-07	-6.1802	2.89799D-07	-6.5379	4.38804D-01	-.3577
23	NO3 -	-1.0	0.00000D+00	-80.9115	0.00000D+00	-81.0010	8.13894D-01	-.0894
24	NA+	1.0	6.71087D-02	-1.1732	5.47571D-02	-1.2616	8.15946D-01	-.0883
27	PB 2+	2.0	7.57188D-10	-9.1039	3.45421D-10	-9.4617	4.38804D-01	-.3577
29	SO4 2-	-2.0	4.23085D-04	-3.3736	1.78927D-04	-3.7473	4.22910D-01	-.3738
30	H4SiO4	.0	1.80605D-04	-3.7433	1.83117D-04	-3.7373	1.01391D+00	.0060
31	SR 2+	2.0	2.04982D-05	-4.6883	8.99468D-06	-5.0463	4.38804D-01	-.3577
32	UO2 2+	2.0	1.60383D-21	-20.7948	7.03766D-22	-21.1526	4.38804D-01	-.3577
34	ZN 2-	2.0	4.82668D-08	-7.3164	2.11793D-08	-7.6741	4.38804D-01	-.3577
35	MOO4 2-	-2.0	2.19631D-06	-5.6584	9.63816D-07	-6.0161	4.38804D-01	-.3577
51	H3BO3	.0	1.44856D-07	-6.8391	1.46871D-07	-6.8331	1.01391D+00	.0060
53	FE 3+	3.0	1.72707D-23	-22.7677	2.67522D-24	-23.5726	1.56714D-01	-.8049
55	NH4 +	1.0	1.76081D-04	-3.7494	1.44939D-04	-3.8388	8.13894D-01	-.0894
57	HS-	-1.0	1.68728D-08	-7.7728	1.37324D-08	-7.8623	8.13894D-01	-.0894
58	SO3 2-	-2.0	1.60788D-15	-14.7938	7.05414D-16	-15.1516	4.38804D-01	-.3577
61	UO2 +	1.0	1.93256D-14	-13.7139	1.57293D-14	-13.8033	8.13894D-01	-.0894
65	O--	-1.0	1.05837D-06	-5.9754	8.61399D-07	-6.0648	8.13894D-01	-.0894
66	H3SiO4 -	-1.0	3.12691D-06	-5.5049	2.54497D-06	-5.5943	8.13894D-01	-.0894
67	H2SiO4--	-2.0	5.39279D-10	-9.2682	2.36635D-10	-9.6259	4.38804D-01	-.3577
75	NH4SO4 -	-1.0	4.10474D-07	-6.3867	3.34052D-07	-6.4761	8.13894D-01	-.0894
76	MSO4 +	1.0	3.19444D-05	-7.4956	2.59993D-05	-7.5850	8.13894D-01	-.0894
77	MGF +	1.0	7.77052D-07	-6.1124	6.26368D-07	-6.2018	8.13894D-01	-.0894
78	MGCO3 AQ	.0	2.40288D-06	-5.6196	2.43420D-06	-5.6136	1.01391D+00	.0060
79	MGHCO3 +	1.0	5.23330D-06	-5.2981	4.09657D-06	-5.3876	8.13894D-01	-.0894
80	MGSO4 AQ	.0	6.06147D-06	-5.2174	6.14578D-06	-5.2114	1.01391D+00	.0060
84	CAOH +	1.0	2.76169D-09	-8.5588	2.24789D-09	-8.6482	8.13894D-01	-.0894
85	CAHCO3 +	1.0	1.71061D-06	-5.7669	1.39225D-06	-5.8563	8.13894D-01	-.0894
86	CACO3 AQ	.0	1.82999D-06	-5.7376	1.85545D-06	-5.7316	1.01391D+00	.0060
87	CASO4 AQ	.0	3.65501D-06	-5.4371	3.70586D-06	-5.4311	1.01391D+00	.0060
91	CAF +	1.0	5.76239D-08	-7.2394	4.65997D-08	-7.3288	8.13894D-01	-.0894
92	NACO3 -	-1.0	9.09461D-06	-5.0412	7.40221D-06	-5.1306	8.13894D-01	-.0894
93	NAHCO3 A	.0	3.91858D-05	-4.4069	3.97309D-05	-4.4009	1.01391D+00	.0060
94	NASO4 -	-1.0	5.53506D-05	-4.2569	4.50495D-05	-4.3463	8.13894D-01	-.0894
96	NAF AQ	.0	5.54866D-07	-6.2558	5.62586D-07	-6.2498	1.01391D+00	.0060
97	KSO4 -	-1.0	1.69571D-07	-6.7706	1.38013D-07	-6.8601	8.13894D-01	-.0894
109	FEOH +	1.0	5.95706D-08	-7.2250	4.84842D-08	-7.3144	8.13894D-01	-.0894
110	FEOH3 -1	-1.0	2.67645D-13	-12.5381	2.35741D-13	-12.6276	8.13894D-01	-.0894
111	FESO4 AQ	.0	4.32773D-08	-7.3637	4.38793D-08	-7.3577	1.01391D+00	.0060
113	FEOH2 AQ	.0	2.95725D-11	-10.5247	3.02551D-11	-10.5187	1.01391D+00	.0060
115	FE(HS)2	.0	2.93096D-13	-12.5330	2.97173D-13	-12.5270	1.01391D+00	.0060
116	FE(HS)3	-1.0	5.09544D-19	-18.2926	4.14714D-19	-18.3823	8.13894D-01	-.0894
117	FEOH 2+	2.0	4.23366D-15	-17.3733	1.85783D-18	-17.7310	4.38804D-01	-.3577
119	FESO4 +	1.0	3.62086D-24	-23.4412	2.94499D-24	-23.5306	8.13894D-01	-.0894
120	FECL 2+	2.0	4.35163D-24	-23.3613	1.90960D-24	-23.7191	4.38804D-01	-.3577
121	FECL2 +	1.0	5.66426D-25	-24.2318	4.77265D-25	-24.3212	8.13894D-01	-.0894
122	FECL3 AQ	.0	1.71196D-27	-26.7665	1.73577D-27	-26.7605	1.01391D+00	.0060
123	FECL4 -	-1.0	1.09734D-17	-17.9597	8.93116D-18	-17.9491	8.13894D-01	-.0894

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125	FEOH	1.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
127	FEF 2+	2.0	4.961910-22	-21.3044	2.177310-22	-21.6621	4.366040-01	-.3577
128	FEF2 +	1.0	5.752990-22	-21.2401	4.662320-22	-21.3295	8.136940-01	-.0894
129	FEF3 AQ	.0	4.427870-23	-22.3538	4.489440-23	-22.3478	1.013910+00	.0060
130	FE(SO4)2	-1.0	1.942810-26	-25.7116	1.581240-26	-25.8010	8.136940-01	-.0894
134	BROH +	1.0	5.756970-11	-10.2395	4.685560-11	-10.3292	8.136940-01	-.0894
	MNCL +	1.0	5.238910-08	-7.2808	4.263910-08	-7.3702	8.136940-01	-.0894
	MNCL2 AQ	.0	4.154510-10	-9.3815	4.212330-10	-9.3765	1.013910+00	.0060
138	MNCL3 -	-1.0	8.485220-12	-11.0713	6.906360-12	-11.1605	8.136940-01	-.0894
139	MNOH +	1.0	7.236260-10	-9.1405	5.859550-10	-9.2299	8.136940-01	-.0894
140	MN(OH)3	-1.0	7.743560-17	-16.1111	6.302450-17	-16.2005	8.136940-01	-.0894
141	MNF +	1.0	1.596900-10	-9.7967	1.299710-10	-9.8862	8.136940-01	-.0894
142	MNSO4 AQ	.0	7.875200-09	-8.1037	7.984750-09	-8.0977	1.013910+00	.0060
144	MNHCO3 +	1.0	8.554970-09	-8.0678	6.962840-09	-8.1572	8.136940-01	-.0894
162	ZNCL +	1.0	1.398770-09	-8.8543	1.138450-09	-8.9437	8.136940-01	-.0894
163	ZNCL2 AQ	.0	4.048570-11	-10.3927	4.104880-11	-10.3867	1.013910+00	.0060
164	ZNCL3 -	-1.0	1.676810-12	-11.7720	1.543800-12	-11.8114	8.136940-01	-.0894
165	ZNCL4 2-	-2.0	5.744470-14	-13.2407	2.520780-14	-13.5985	4.366040-01	-.3577
166	ZNF +	1.0	1.962960-11	-10.7071	1.597640-11	-10.7965	8.136940-01	-.0894
167	ZNOH +	1.0	2.326730-09	-8.6333	1.893710-09	-8.7227	8.136940-01	-.0894
168	ZN(OH)2	.0	3.048690-09	-8.5159	3.091300-09	-8.5099	1.013910+00	.0060
169	ZN(OH)3	-1.0	1.495120-12	-11.8253	1.216870-12	-11.9148	8.136940-01	-.0894
170	ZN(OH)4	-2.0	3.474740-17	-16.4591	1.524730-17	-16.8168	4.366040-01	-.3577
171	ZNOHCL A	.0	6.022280-09	-8.2202	6.106050-09	-8.2142	1.013910+00	.0060
172	ZN(HS)2	.0	3.430920-09	-8.4646	3.478650-09	-8.4586	1.013910+00	.0060
173	ZN(HS)3	-1.0	8.483650-16	-15.0714	6.924780-16	-15.1605	8.136940-01	-.0894
174	ZNSO4 AQ	.0	7.891200-10	-9.1029	8.000970-10	-9.0969	1.013910+00	.0060
175	ZN(SO4)2	-2.0	2.944370-12	-11.5310	1.292300-12	-11.8857	4.366040-01	-.3577
180	ZNHCO3 +	1.0	1.977120-19	-18.7040	1.609160-19	-18.7934	8.136940-01	-.0894
181	ZNCO3 AQ	.0	6.033940-08	-7.2194	6.117880-08	-7.2134	1.013910+00	.0060
182	ZN(CO3)2	-2.0	4.315380-08	-7.3650	1.693800-08	-7.7227	4.366040-01	-.3577
[illegible]	CDCL +	1.0	4.193690-10	-9.3679	3.331830-10	-9.4773	8.136940-01	-.0894
	CDCL2 AQ	.0	4.738860-11	-10.3243	4.804750-11	-10.3183	1.013910+00	.0060
185	CDCL3 -	-1.0	1.101360-12	-11.9561	8.963930-13	-12.0475	8.136940-01	-.0894
186	CDF +	1.0	9.837110-14	-13.0071	6.006360-14	-13.0966	8.136940-01	-.0894
187	CDF2 AQ	.0	1.256560-17	-16.9008	1.274040-17	-16.8945	1.013910+00	.0060
188	CD(CO3)3	-4.0	1.363550-17	-16.8653	5.055360-19	-18.2962	3.707510-02	-1.4309
189	CDOH +	1.0	8.964190-13	-12.0475	7.295900-13	-12.1369	8.136940-01	-.0894
190	CD(OH)2	.0	2.534900-14	-13.5960	2.570160-14	-13.5900	1.013910+00	.0060
191	CD(OH)3	-1.0	8.482640-19	-18.0715	6.903970-19	-18.1609	8.136940-01	-.0894
192	CD(OH)4	-2.0	3.357110-24	-23.4740	1.473110-24	-23.8316	4.366040-01	-.3577
193	CDZOH +3	3.0	2.711460-21	-20.5668	4.249250-22	-21.3717	1.567140-01	-.8049
194	CDOHCL A	.0	2.432260-11	-10.6140	2.466090-11	-10.6080	1.013910+00	.0060
196	CDSO4 AQ	.0	4.781910-12	-11.3277	4.767310-12	-11.3217	1.013910+00	.0060
197	CDHS +	1.0	2.505350-08	-7.6011	2.039090-08	-7.6906	8.136940-01	-.0894
198	CD(HS)2	.0	6.326760-10	-9.1988	6.414770-10	-9.1928	1.013910+00	.0060
199	CD(HS)3	-1.0	1.638160-15	-14.7856	1.333290-15	-14.8751	8.136940-01	-.0894
200	CD(HS)4	-2.0	6.462510-21	-20.1896	2.835770-21	-20.5473	4.366040-01	-.3577
205	CDHCO3 +	1.0	1.869850-11	-10.7282	1.521860-11	-10.8176	8.136940-01	-.0894
206	CDCO3 AQ	.0	3.592330-10	-9.4446	3.642300-10	-9.4386	1.013910+00	.0060
207	CD(SO4)2	-2.0	2.316150-14	-13.6352	1.016340-14	-13.9930	4.366040-01	-.3577
208	FBCL +	1.0	4.386640-10	-9.3579	3.570260-10	-9.4473	8.136940-01	-.0894
209	FBCL2 AQ	.0	2.616270-11	-10.5823	2.652660-11	-10.5763	1.013910+00	.0060
210	FBCL3 -	-1.0	8.637790-13	-12.0636	7.030240-13	-12.1530	8.136940-01	-.0894
211	FBCL4 2-	-2.0	2.517460-14	-13.5990	1.104680-14	-13.9568	4.366040-01	-.3577
212	FB(CO3)2	-2.0	7.202040-09	-8.1425	3.160260-09	-8.5003	4.366040-01	-.3577
213	FBF +	1.0	4.751120-13	-12.3205	3.691330-13	-12.4099	8.136940-01	-.0894
214	FBFZ AQ	.0	4.964170-16	-15.3042	5.033230-16	-15.2982	1.013910+00	.0060
[illegible]	FBF3 -	-1.0	2.836100-19	-18.5470	2.309910-19	-18.6364	8.136940-01	-.0894
216	FBF4 2-	-2.0	1.576150-23	-22.7969	7.003960-24	-23.1547	4.366040-01	-.3577
217	FBOH +	1.0	1.761150-09	-8.7031	1.612450-09	-8.7925	8.136940-01	-.0894
218	FB(OH)2	.0	1.481230-10	-9.8294	1.501840-10	-9.8234	1.013910+00	.0060
219	FB(OH)3	-1.0	5.072160-13	-12.2945	4.128200-13	-12.3842	8.136940-01	-.0894
220	FBZOH +3	3.0	7.956560-17	-16.0993	1.246910-17	-16.9042	1.567140-01	-.8049

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224	PB(HS)3	-1.0	4.083390-17	-16.3890	3.32344D-17	-16.4764	8.13894D-01	-.0894
225	PB3(OH)4	2.0	5.274320-20	-19.2762	2.32317D-20	-19.6339	4.36804D-01	-.3577
230	PBCO3 AQ	.0	8.571170-08	-7.0670	8.690350-08	-7.0610	1.01391D+00	.0060
231	PB(OH)4	-2.0	5.171610-16	-15.2864	2.269320-16	-15.6441	4.36804D-01	-.3577
232	PB(SO4)2	-2.0	7.437550-14	-13.1266	3.263630-14	-13.4863	4.36804D-01	-.3577
233	PBHCO3 +	1.0	4.059470-10	-9.3915	3.303950-10	-9.4810	8.13894D-01	-.0894
265	HZASO3 -	-1.0	1.545630-08	-7.8106	1.258140-08	-7.9003	8.13894D-01	-.0894
266	HASO3 2-	-2.0	3.021320-12	-11.5195	1.325770-12	-11.8775	4.36804D-01	-.3577
267	ASO3 -3	-3.0	4.910890-17	-16.3058	7.696270-18	-17.1137	1.56714D-01	-.8049
268	H4ASO3 +	1.0	3.727080-16	-15.4286	3.033450-16	-15.5181	8.13894D-01	-.0894
269	HZASO4 -	-1.0	7.145060-14	-13.1460	5.815330-14	-13.2354	8.13894D-01	-.0894
270	HASO4 2-	-2.0	5.230870-12	-11.2614	2.295330-12	-11.6392	4.36804D-01	-.3577
271	ASO4 -3	-3.0	6.373460-15	-14.1956	9.968160-16	-15.0005	1.56714D-01	-.8049
272	HCO3 -	-1.0	2.158660-03	-2.6658	1.756730-03	-2.7552	8.13894D-01	-.0894
273	HZCO3 AQ	.0	2.006550-05	-4.6976	2.034460-05	-4.6916	1.01391D+00	.0060
274	HSO4 -	-1.0	6.250820-11	-10.2041	5.087500-11	-10.2935	8.13894D-01	-.0894
275	HF AQ	.0	2.945310-10	-9.5309	2.986280-10	-9.5249	1.01391D+00	.0060
276	HF2 -	-1.0	8.126220-14	-13.0901	6.613860-14	-13.1795	8.13894D-01	-.0894
277	HZF2 AQ	.0	4.031790-19	-18.3945	4.087860-19	-18.3885	1.01391D+00	.0060
281	HZS AQ	.0	8.372360-10	-9.0772	8.488640-10	-9.0712	1.01391D+00	.0060
282	S 2-	-2.0	3.573940-13	-12.4449	1.565260-13	-12.8046	4.36804D-01	-.3577
283	UOH +3	3.0	5.496190-28	-27.2598	6.616450-29	-28.0647	1.56714D-01	-.8049
284	U(OH)2 +	2.0	7.197800-22	-21.1426	3.158420-22	-21.5005	4.36804D-01	-.3577
285	U(OH)3 +	1.0	1.376580-16	-15.8612	1.120390-16	-15.9506	8.13894D-01	-.0894
286	U(OH)4 A	.0	6.149400-12	-11.2112	6.234940-12	-11.2052	1.01391D+00	.0060
287	U(OH)5 -	-1.0	3.526440-08	-7.4527	2.870150-08	-7.5421	8.13894D-01	-.0894
289	UF2 2+	2.0	6.043520-30	-29.2187	2.651920-30	-29.5764	4.36804D-01	-.3577
290	UF3 +1	1.0	9.427820-30	-29.0256	7.673240-30	-29.1150	8.13894D-01	-.0894
291	UF4 AQ	.0	1.954050-29	-28.7091	1.981240-29	-28.7031	1.01391D+00	.0060
301	UO2OH +1	1.0	7.666760-19	-18.1154	6.240090-19	-18.2048	8.13894D-01	-.0894
304	UO2CO3 A	.0	1.216530-16	-15.9149	1.233450-16	-15.9089	1.01391D+00	.0060
305	UO2(CO3)2	-2.0	2.535550-14	-13.5959	1.112610-14	-13.9537	4.36804D-01	-.3577
306	UO2(CO3)3	-4.0	2.740330-13	-12.5622	1.015980-14	-13.9931	3.70751D-02	-1.4309
307	UO2F +1	1.0	7.221820-21	-20.1414	5.677790-21	-20.2308	8.13894D-01	-.0894
308	UO2F2 AQ	.0	2.453140-21	-20.6050	2.517680-21	-20.5990	1.01391D+00	.0060
309	UO2F3 -1	-1.0	5.426380-23	-22.2655	4.416500-23	-22.3549	8.13894D-01	-.0894
310	UO2F4 2-	-2.0	1.137390-25	-24.9441	4.990930-26	-25.3016	4.36804D-01	-.3577
311	UO2CL +1	1.0	4.746460-23	-22.3236	3.863120-23	-22.4131	8.13894D-01	-.0894
312	UO2SO4 A	.0	4.707160-23	-22.3272	4.772640-23	-22.3212	1.01391D+00	.0060
313	UO2(SO4)2	-2.0	5.478190-25	-24.2614	2.403850-25	-24.6191	4.36804D-01	-.3577
319	UO2-3510	1.0	1.512130-19	-18.8204	1.230720-19	-18.9098	8.13894D-01	-.0894
353	HSO3-	-1.0	5.433810-17	-16.2649	4.422540-17	-16.3543	8.13894D-01	-.0894
354	HZSO3 AQ	.0	6.953620-24	-23.1578	7.050340-24	-23.1518	1.01391D+00	.0060
367	SE2-2	-2.0	5.744550-08	-7.2429	2.508240-08	-7.6006	4.36804D-01	-.3577
368	SE-2	-2.0	7.249430-22	-21.1397	3.181080-22	-21.4974	4.36804D-01	-.3577
369	HSE-	-1.0	3.599870-15	-14.4437	2.929910-15	-14.5331	8.13894D-01	-.0894
370	HZSE	.0	7.313460-20	-19.1359	7.415190-20	-19.1299	1.01391D+00	.0060
371	SEO3-2	-2.0	2.585530-30	-29.5875	1.134540-30	-29.9452	4.36804D-01	-.3577
372	MOO2+	1.0	4.143210-09	-8.3827	3.372130-09	-8.4721	8.13894D-01	-.0894
373	HMOO4-	-1.0	9.480510-29	-28.0267	7.654270-29	-28.1161	8.13894D-01	-.0894

--- LOOK MIN IAP ---

SATURATION INDICES

PHASE	LOG IAP	LOG KT	LOG IAP/KT
URANINIT	-12.2446	-14.4480	2.2034
UO2 (AM	-12.2446	-8.5540	-3.6906
U409 (C)	-41.1271	-41.4693	.3422
U308 (C)	-21.0314	-6.1146	-14.9168
US104 (C	-15.9831	-17.5043	1.5242
UF4 (C)	-62.5559	-28.3389	-34.2169
UF4.2.5H	-62.5550	-37.9206	-24.6372
UO3 (C)	-4.3934	8.3656	-12.7590

→ see Attachment D

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SCHOEPIT	-4.3952	5.8027	-10.1978
RUTHERFO	-25.9919	-14.4461	-11.5458
URANOPHA	-3.4434	17.4900	-20.9334
ANHYDRIT	-7.6910	-4.5140	-3.1770
ARAGONIT	-8.7830	-8.2261	-.5569
ARTINITE	4.5817	10.5604	-5.9787
BRUCITE	13.0939	17.6535	-4.5625
CALCITE	-8.7830	-8.4123	-.3707
CELESTIT	-8.7933	-6.4543	-2.3390
CHALCEDO	-3.7355	-3.6740	-.0615
CHRYSOTI	31.8025	33.9440	-2.1414
CLINOENS	9.3562	12.0086	-2.6524
CRISTOBA	-3.7355	-3.7738	.0382
DIOPSIDE	18.4362	20.9687	-2.5325
DOLOMITE	-17.2896	-16.7230	-.5667
EPSOMITE	-7.4207	-2.2342	-5.1865
SEPIOLIT	14.9739	18.7800	-3.8061
FERRIHYD	14.9309	18.2542	-3.3232
FE3(OH)8	40.6676	46.9583	-6.0907
FEOH)2.7	11.9854	10.3242	1.6612
FES PPT	-40.9044	-39.5696	-1.3147
FE2(SO4)	-31.6549	32.2838	-63.9388
FLUORITE	-12.3402	-11.1174	-1.2228
FORSTERI	22.4487	29.9210	-7.4730
GOETHITE	14.9316	14.3480	.5836
GREENALI	25.5471	20.8100	4.7371
GREIGITE	-166.7729	-160.9802	-5.7926
GYPSUM	-7.6927	-4.8587	-2.8340
HALITE	-2.7036	1.5493	-4.2501
HEMATITE	29.8644	23.7592	6.1053
HUNTITE	-34.3030	-29.1092	-5.1938
HYDRMAGN	-20.9392	-7.0254	-13.9138
JAROSITE	3.7799	29.8453	-26.0655
MACKINAW	-40.9044	-40.3196	-.5847
MAGADIIT	-19.0347	-14.3000	-4.7347
MAGHEMIT	29.8644	33.1183	-3.2539
MAGNESIT	-8.5067	-7.8238	-.6828
MAGNETIT	40.8711	32.1545	8.7166
MELANTER	-9.5056	-2.5656	-6.9403
MIRABILI	-6.2791	-1.7446	-4.5345
NATRON	-7.3711	-1.8360	-5.5351
NESQUEHO	-8.5093	-5.4265	-3.0827
PYRITE	-64.9642	-70.1968	5.2326
QUARTZ	-3.7355	-4.2178	.4823
SIDERITE	-10.5918	-10.3719	-.2199
SIO2(A,G	-3.7355	-2.8330	-.9025
SIO2(A,P	-3.7355	-2.8330	-.9025
SRF2	-13.4425	-8.5818	-4.8607
STRONTIA	-9.8853	-9.2269	-.6584
TALC	24.3323	24.2299	.1024
THENARDI	-6.2704	-.1610	-6.1095
THERMONA	-7.3633	.2236	-7.5869
TREMOLIT	61.2047	59.7783	1.4264
PYROLUSI	18.0724	43.2059	-25.1335
BIRNESSI	18.0724	44.4608	-26.3884
NSUTITE	18.0724	43.8705	-25.7984
BIXBYITE	28.2936	52.6308	-24.3372
HAUSMANN	38.5148	64.2179	-25.7031
PYROCROI	10.2204	15.8449	-5.6245
MANGANIT	14.1464	26.1308	-11.9844
RHODOCHR	-11.3772	-10.3405	-1.0367
MNCL2, 4	-9.4199	2.1292	-11.5492
MNS GREE	-41.6598	-31.6761	-10.0136
MNCO3	-10.2852	3.1873	-13.4725

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ZNCO3, 1	-12.5143	-10.2600	-2.2543
ZNF2	-16.0706	-1.0829	-14.9877
ZN(OH)2	9.0842	11.5000	-2.4158
ZN2(OH)3	8.3499	15.2000	-6.8501
ZN5(OH)8	25.7841	38.5000	-12.7159
ZN7(OH)2	-2.3372	7.5000	-9.8372
ZN4(OH)6	15.8311	28.4000	-12.5689
ZNNO3)2,	-169.6812	3.2559	-172.9371
ZNO(ACT)	9.0850	11.3100	-2.2250
ZINCITE	9.0850	11.8705	-2.7854
ZN3O(SO4	-13.7578	21.0918	-34.8495
ZNS (A)	-42.8260	-44.8423	2.0163
SPHALERI	-42.8260	-47.5653	4.7393
WURTZITE	-42.8260	-45.5187	2.6927
ZNSIO3	5.3495	3.5405	1.8090
WILLEMIT	14.4346	16.4451	-2.0105
ZINCOSIT	-11.4214	3.6516	-15.0730
ZNSO4, 1	-11.4223	-.2145	-11.2078
BIANCHIT	-11.4266	-1.7547	-9.6719
GOSLARIT	-11.4275	-2.0703	-9.3572
CD METAL	-1.0903	14.0915	-15.1818
GAMMA CD	-1.0903	14.1962	-15.2865
OTAVITE	-14.6376	-13.7206	-1.1170
CDCL2	-12.8769	-.5306	-12.3463
CDCL2, 1	-12.8778	-1.6492	-11.2286
CDCL2,2.	-12.8790	-1.9971	-10.8819
CDF2	-16.3945	-2.6552	-15.7396
CD(OH)2	6.7600	13.6500	-6.8900
CDOHCL	-3.0585	3.7676	-6.8261
CD3(OH)4	-.2257	22.5600	-22.7857
CD3OH2(S	-20.7313	6.7100	-27.4413
CD4(OH)6	6.5342	28.4000	-21.8658
MONTEPON	6.7608	15.9474	-9.1865
CDSIO3	3.0253	9.6157	-6.5904
CDSO4	-13.7456	.3925	-14.1382
CDSO4, 1	-13.7465	-1.4087	-12.3378
CDSO4,2.	-13.7479	-1.7263	-12.0216
GREENOCK	-45.1502	-52.1463	6.9961
PB METAL	-.5537	4.2566	-4.8103
COTUNNIT	-12.3402	-4.9571	-7.3831
MATLOCKI	-15.0992	-9.6957	-5.4035
PHOSGENI	-26.6412	-19.8100	-6.8312
CERRUSIT	-14.3010	-13.2924	-1.0086
PBF2	-17.8582	-7.4166	-10.4415
MASSICOT	7.2975	13.4707	-6.1732
LITHARGE	7.2975	13.2673	-5.9699
PBO, .3H	7.2972	12.9800	-5.6828
PB2OCO3	-7.0035	-.1171	-6.8864
LARNAKIT	-5.9115	-.0648	-5.8467
PB3O2SO4	1.3860	11.0934	-9.7074
PB4O3SO4	8.6835	23.2719	-14.5884
PB3O2CO3	.2940	11.9032	-11.6092
PBSIO3	3.5619	7.6294	-4.0675
PB2SIO4	10.8594	20.6268	-9.7694
ANGLESIT	-13.2090	-7.8618	-5.3471
GALENA	-44.6135	-51.4479	6.8344
PLATTNER	15.1456	51.6635	-36.5149
PB2O3	22.4461	61.0400	-38.5939
MINIUM	29.7436	77.1235	-47.3802
PB(OH)2	7.2966	8.6175	-1.3209
LAURIONI	-2.5218	.6200	-3.1418
PB2(OH)3	4.7748	8.7900	-4.0152
HYDCERRU	-21.3053	-17.4800	-3.8453

see Attachment D

see " "

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PB4(OH)6	8.6809	21.1000	-12.4191
ARSENOLI	-109.1150	-85.0707	-24.0442
CLAUDETI	-109.1150	-85.2960	-23.8190
ORIPMENT	-210.2905	-211.6446	1.3541
REALGAR	-83.1153	-76.8833	-6.2320
AS2O5	-38.8552	6.8808	-45.7360
SULFUR	-44.0599	-37.6393	-6.4206
CA3(ASO4	-.4122	22.3000	-22.7122
FEASO4.2	-4.4971	13.7642	-18.2613
MN3ASO42	-8.1984	12.8000	-20.6984
PB3(ASO4	-16.9627	5.8000	-22.7627
ZN3ASO42	-11.6022	13.6500	-25.2522
LIME	12.8155	34.3458	-21.5303
PORTLAND	12.8146	23.6955	-10.8809
WUSTITE	10.8394	12.5204	-1.6810
PERICLAS	13.0918	22.7173	-9.6255
MAG-FERR	42.9562	45.7251	-2.7689
WOLLASTO	9.0799	13.6516	-4.5717
P-WOLLST	9.0799	14.5541	-5.4741
CA-OLIVI	21.8954	39.4775	-17.5821
LARNITE	21.8954	41.0527	-19.1573
CA3SIO5	34.7109	77.4231	-42.7122
MONTICEL	22.1717	31.9214	-9.7497
AKERMINI	31.2816	50.0243	-18.7427
MERWINIT	44.0671	72.1192	-28.0520
LEPIDOCR	14.9318	14.7342	.1976
FE(OH)3S	14.9309	16.0342	-1.1032
NAZSO3	-14.1216	5.0489	-19.1705
KZSO3	-19.3118	8.2828	-27.5946
CASO3.2H	-15.5439	-3.5819	-11.9619
CASO3.5H	-15.5426	-3.1266	-12.4159
MGSO3	-15.2658	7.1152	-22.3810
CH4(GAS)	-53.0047	-43.1184	-9.8864
CO2(GAS)	-21.5984	-18.1777	-3.4207
O2(GAS)	15.7023	87.6856	-71.9833
CAMOO4	-9.9596	-7.7434	-2.2164
NAT. SE	62.5854	-63.7019	126.2873
FERROSEL	-122.0110	-130.7170	8.7060

see Attachment D

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Attachment D: PHREEQE model predicted dissolved species and minerals-saturation indices on various constituents present in the Mancos groundwater, Well 982.

```
gr jD3 Cheney, Mancos water combination, well 982
00000120000 0 0          .00000
ELEMENTS
C          10          50.
           0           0.
SOLUTION 2
gr jD3 Mancos Shale, well #982 at Cheney
16 10 2      7.27      -6.23      14.0      1.00
   9  3.7000+00  10  1.0020+03  11  1.9500+01  12  4.0000-03  13  2.3200+03
  17  7.0000-02  19  7.9000+00  21  1.7200+01  22  1.0000-01  24  2.3000+03
  27  3.0000-02  29  1.0400+03  30  1.1800+01  31  4.5000+00  32  4.3000-03
  34  2.0000-02  35  3.3400-02  37  2.3000-02
SOLUTION NUMBER 2          gr jD3 Mancos Shale, well #982 at Cheney
```

pH

Pe

temperature in °C

density of solution, g/c.c

TOTAL MOLALITIES OF ELEMENTS

continue

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BR	4.661917D-05	-4.3314
TOT ALK	2.015774D-02	-1.6956
CA	4.696219D-04	-3.3285
CD	3.562639D-08	-7.4456
CL	6.568193D-02	-1.1812
FE	1.261913D-06	-5.8990
K	2.034040D-04	-3.6916
MG	7.122608D-04	-3.1474
MN	1.832561D-06	-5.7369
NA	1.007219D-01	-.9969
PB	1.457753D-07	-6.8363
S	1.089971D-02	-1.9626
SI	1.236004D-04	-3.9080
SR	5.170595D-05	-4.2665
U	1.603213D-08	-7.7950
ZN	3.060232D-07	-6.5114
MO	2.102457D-07	-6.6773
SE	1.809523D-07	-6.7424

FOR GROUNDWATER IN WELL #982

----DESCRIPTION OF SOLUTION----

PH =	7.2700
PE =	-6.2308
ACTIVITY H2O =	.9967
IONIC STRENGTH =	.0956
TEMPERATURE =	14.0000
ELECTRICAL BALANCE =	1.7353D-02
THOR =	-1.0000D+05
TOTAL ALKALINITY =	2.0152D-02
ITERATIONS =	15
TOTAL CARBON =	1.4613D-02

DISTRIBUTION OF SPECIES : DISSOLVED SPECIES :

I	SPECIES	Z	MOLALITY	LOG MOLALITY	ACTIVITY	LOG ACTIVITY	GAMMA	LOG GAMMA
1	H+	1.0	6.825250-08	-7.1659	5.370320-08	-7.2700	7.868310-01	-.1041
2	E-	-1.0	1.701370+06	6.2308	1.701370+06	6.2308	1.000000+00	.0000
3	H2O	.0	9.967130-01	-.0014	9.967130-01	-.0014	1.000000+00	.0000
9	BR-	-1.0	4.661920-05	-4.3314	3.668140-05	-4.4356	7.868310-01	-.1041
10	CO3 2-	-2.0	1.770360-05	-4.7519	6.785660-06	-5.1684	3.832690-01	-.4165
11	CA 2+	2.0	4.693760-04	-3.3285	1.999800-04	-3.6990	4.260550-01	-.3705
12	CD 2+	2.0	2.422900-20	-19.6157	9.266730-21	-20.0321	3.832690-01	-.4165
13	CL-	-1.0	6.568180-02	-1.1812	5.025210-02	-1.2988	7.627620-01	-.1176
17	FE 2+	2.0	7.407580-11	-10.1303	2.839250-11	-10.5468	3.832890-01	-.4165
19	K+	1.0	2.034040-04	-3.6916	1.551490-04	-3.8093	7.627620-01	-.1176
21	MG 2+	2.0	6.693760-04	-3.1743	2.952990-04	-3.5297	4.411550-01	-.3554
22	MN 2+	2.0	1.565130-06	-5.8055	5.996960-07	-6.2219	3.832690-01	-.4165
24	NA+	1.0	1.007260-01	-.9964	7.912590-02	-1.1017	7.862980-01	-.1033
27	PB 2+	2.0	6.169940-18	-17.2097	2.364870-18	-17.6262	3.832690-01	-.4165
29	SO4 2-	-2.0	2.576620-22	-21.5889	9.232560-23	-22.0347	3.583200-01	-.4457
30	H4SIO4	.0	1.234060-04	-3.9087	1.261510-04	-3.8991	1.022250+00	.0096
31	SR 2+	2.0	5.170590-05	-4.2665	1.981630-05	-4.7029	3.832690-01	-.4165
32	UO2 2+	2.0	3.167070-24	-23.4993	1.213900-24	-23.9158	3.832690-01	-.4165
34	ZN 2+	2.0	2.865610-17	-16.5398	1.106320-17	-16.9562	3.832690-01	-.4165
35	MOO4 2-	-2.0	6.720920-11	-10.1726	2.576060-11	-10.5890	3.832690-01	-.4165

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61	OH2 +	1.0	1.78543D-13	-12.7532	1.55328D-13	-12.8074	[illegible]	[illegible]	
65	OH-	-1.0	9.99974D-06	-7.0000	7.86611D-08	-7.1041	7.86831D-01	-.1041	
66	H3SIO4 -	-1.0	1.94294D-07	-6.7115	1.52676D-07	-6.8157	7.86831D-01	-.1041	
67	H2SIO4--	-2.0	3.78991D-12	-11.4214	1.45263D-12	-11.8378	3.83289D-01	-.4165	
76	MGOH +	1.0	4.24261D-09	-8.3724	3.33822D-09	-8.4765	7.86831D-01	-.1041	
78	MGCO3 AQ	.0	1.58000D-06	-5.8013	1.61515D-06	-5.7918	1.02225D+00	.0096	
79	MGHCO3 +	1.0	4.12990D-05	-4.3841	3.24954D-05	-4.4882	7.86831D-01	-.1041	
80	MGSO4 AQ	.0	4.33263D-24	-23.3633	4.42898D-24	-23.3537	1.02225D+00	.0096	
84	CAOH +	1.0	4.65119D-10	-9.3324	3.65970D-10	-9.4366	7.86831D-01	-.1041	
85	CAHCO3 +	1.0	1.89096D-05	-4.7233	1.48787D-05	-4.8274	7.86831D-01	-.1041	
86	CACO3 AQ	.0	1.53571D-06	-5.8137	1.56987D-06	-5.8041	1.02225D+00	.0096	
87	CASO4 AQ	.0	3.34563D-24	-23.4755	3.42006D-24	-23.4660	1.02225D+00	.0096	
92	NACO3 -	-1.0	7.10930D-06	-5.1482	5.59382D-06	-5.2523	7.86831D-01	-.1041	
93	NAHCO3 A	.0	3.39121D-04	-3.4696	3.46665D-04	-3.4601	1.02225D+00	.0096	
94	NASO4 -	-1.0	4.32825D-23	-22.3637	3.40560D-23	-22.4678	7.86831D-01	-.1041	
97	KSO4 -	-1.0	1.04823D-25	-24.9795	8.24784D-26	-25.0837	7.86831D-01	-.1041	
109	FEOH +	1.0	9.02177D-14	-13.0447	7.09861D-14	-13.1488	7.86831D-01	-.1041	
110	FEOH3 -1	-1.0	3.25291D-21	-20.4877	2.55949D-21	-20.5918	7.86831D-01	-.1041	
113	FEOH2 AQ	.0	4.06204D-18	-17.3913	4.15241D-18	-17.3817	1.02225D+00	.0096	
115	FE(HS)2	.0	7.34059D-07	-6.1343	7.50390D-07	-6.1247	1.02225D+00	.0096	
116	FE(HS)3	-1.0	5.27780D-07	-6.2775	4.15274D-07	-6.3817	7.86831D-01	-.1041	
117	FEOH 2+	2.0	1.29624D-25	-24.8873	4.96835D-26	-25.3038	3.83289D-01	-.4165	
120	FECL 2+	2.0	2.23880D-30	-29.6500	8.58109D-31	-30.0665	3.83289D-01	-.4165	
123	FEOH2 +	1.0	2.54899D-22	-21.5936	2.00562D-22	-21.6978	7.86831D-01	-.1041	
124	FEOH3 AQ	.0	2.22678D-23	-22.6523	2.27632D-23	-22.6428	1.02225D+00	.0096	
125	FEOH4 -	-1.0	3.76264D-24	-23.4245	2.96356D-24	-23.5286	7.86831D-01	-.1041	
134	SROH +	1.0	1.21853D-11	-10.9152	9.56418D-12	-11.0194	7.86831D-01	-.1041	
136	MNCL +	1.0	1.55086D-07	-6.8097	1.21964D-07	-6.9138	7.86831D-01	-.1041	
137	MNCL2 AQ	.0	1.62868D-09	-8.7882	1.66489D-09	-8.7786	1.02225D+00	.0096	
138	MNCL3 -	-1.0	4.79355D-11	-10.3193	3.77172D-11	-10.4235	7.86831D-01	-.1041	
139	MNO- +	1.0	1.43374D-10	-9.8435	1.12811D-10	-9.9476	7.86831D-01	-.1041	
140	MN(OH)3	-1.0	7.72513D-20	-19.1121	6.07838D-20	-19.2162	7.86831D-01	-.1041	
142	MNSO4 AQ	.0	8.56567D-27	-26.0671	8.75730D-27	-26.0575	1.02225D+00	.0096	
144	MNHCO3 +	1.0	1.10606D-07	-6.9562	8.70299D-08	-7.0603	7.86831D-01	-.1041	
162	ZNCL +	1.0	1.14897D-18	-17.9397	9.04049D-19	-18.0438	7.86831D-01	-.1041	
163	ZNCL2 AQ	.0	4.44483D-20	-19.3521	4.54371D-20	-19.3426	1.02225D+00	.0096	
164	ZNCL3 -	-1.0	3.04033D-21	-20.5171	2.39223D-21	-20.6212	7.86831D-01	-.1041	
165	ZNCL4 2-	-2.0	1.43259D-22	-21.8439	5.49096D-23	-22.2604	3.83289D-01	-.4165	
167	ZNOH +	1.0	1.14878D-19	-18.9398	9.03897D-20	-19.0439	7.86831D-01	-.1041	
168	ZN(OH)2	.0	1.22554D-20	-19.9117	1.25281D-20	-19.9021	1.02225D+00	.0096	
169	ZN(OH)3	-1.0	5.39401D-25	-24.2681	4.24418D-25	-24.3722	7.86831D-01	-.1041	
170	ZN(OH)4	-2.0	1.28364D-30	-29.8915	4.92084D-31	-30.3080	3.83289D-01	-.4165	
171	ZNOHCL A	.0	3.34144D-19	-18.4761	3.41577D-19	-18.4665	1.02225D+00	.0096	
172	ZN(HS)2	.0	2.79446D-07	-6.5537	2.85663D-07	-6.5441	1.02225D+00	.0096	
173	ZN(HS)3	-1.0	2.65772D-08	-7.5440	2.24854D-08	-7.6481	7.86831D-01	-.1041	
176	ZNBR +	1.0	1.35622D-22	-21.8677	1.06711D-22	-21.9718	7.86831D-01	-.1041	
177	ZNBR2 AQ	.0	1.52441D-27	-26.8169	1.55832D-27	-26.8073	1.02225D+00	.0096	
180	ZNHCO3 +	1.0	6.44873D-28	-27.1905	5.07406D-28	-27.2946	7.86831D-01	-.1041	
181	ZNCO3 AQ	.0	1.46487D-17	-16.8342	1.49746D-17	-16.8246	1.02225D+00	.0096	
182	ZN(CO3)2	-2.0	5.66789D-18	-17.2466	2.17244D-18	-17.6631	3.83289D-01	-.4165	
183	CDCL +	1.0	5.45217D-20	-19.2634	4.28994D-20	-19.3675	7.86831D-01	-.1041	
184	CDCL2 AQ	.0	8.42945D-21	-20.0742	8.61697D-21	-20.0646	1.02225D+00	.0096	
185	CDCL3 -	-1.0	2.91703D-22	-21.5351	2.29521D-22	-21.6392	7.86831D-01	-.1041	
188	CD(CO3)3	-4.0	2.23117D-28	-27.6515	4.81546D-30	-29.3174	2.15827D-02	-1.6659	
189	CDOH +	1.0	7.81145D-24	-23.1073	6.14629D-24	-23.2114	7.86831D-01	-.1041	
190	CD(OH)2	.0	1.39781D-26	-25.8546	1.42890D-26	-25.8450	1.02225D+00	.0096	
194	CDOHCL A	.0	2.52204D-22	-21.5982	2.57815D-22	-21.5887	1.02225D+00	.0096	
197	CDHS +	1.0	9.50663D-13	-12.0220	7.48011D-13	-12.1261	7.86831D-01	-.1041	
198	CD(HS)2	.0	9.12836D-09	-8.0396	9.33144D-09	-8.0301	1.02225D+00	.0096	
199	CD(HS)3	-1.0	9.77503D-09	-8.0099	7.69130D-09	-8.1140	7.86831D-01	-.1041	
200	CD(HS)4	-2.0	1.69240D-08	-7.7715	6.46680D-09	-8.1880	3.83289D-01	-.4165	
201	CDBR +	1.0	6.74793D-23	-22.1708	5.30946D-23	-22.2749	7.86831D-01	-.1041	
202	CDBR2 AQ	.0	9.68722D-27	-26.0136	9.90273D-27	-26.0042	1.02225D+00	.0096	

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206	CUCO3 AQ	.0	1.544890-20	-19.8111	1.577260-20	-19.8015	1.022250+00	.0096	
208	PBCL +	1.0	4.530010-18	-17.3439	3.564350-18	-17.4480	7.668310-01	-.1041	
209	PBCL2 AQ	.0	3.437450-19	-18.4638	3.513920-19	-18.4542	1.022250+00	.0096	
210	PBCL3 -	-1.0	1.657520-20	-19.7805	1.304190-20	-19.8847	7.668310-01	-.1041	
211	PBCL4 2-	-2.0	7.512480-22	-21.1242	2.679450-22	-21.5407	3.832690-01	-.4165	
212	PB(CO3)2	-2.0	1.240120-17	-16.9065	4.753260-18	-17.3230	3.832690-01	-.4165	
217	PBOH +	1.0	1.057670-18	-17.9635	8.556110-19	-18.0676	7.668310-01	-.1041	
218	PB(OH)2	.0	6.044930-21	-20.2186	6.179410-21	-20.2091	1.022250+00	.0096	
219	PB(OH)3	-1.0	1.673540-24	-23.7764	1.316800-24	-23.8805	7.668310-01	-.1041	
223	PB(HS)2	.0	1.277420-07	-6.8937	1.305840-07	-6.8841	1.022250+00	.0096	
224	PB(HS)3	-1.0	1.803260-08	-7.7439	1.418860-08	-7.8481	7.668310-01	-.1041	
226	PBBR +	1.0	5.368990-21	-20.2685	4.240230-21	-20.3726	7.668310-01	-.1041	
227	PBBR2 AQ	.0	8.573220-26	-25.0669	8.763950-26	-25.0573	1.022250+00	.0096	
230	PBCO3 AQ	.0	2.727990-16	-15.5642	2.766680-16	-15.5546	1.022250+00	.0096	
231	PB(OH)4	-2.0	1.464070-26	-27.8344	5.611600-29	-28.2509	3.832690-01	-.4165	
233	PBHCO3 +	1.0	1.735870-17	-16.7605	1.365840-17	-16.8646	7.668310-01	-.1041	
272	HCO3 -	-1.0	1.277820-02	-1.8935	1.005430-02	-1.9976	7.668310-01	-.1041	
273	H2CO3 AQ	.0	1.408940-03	-2.8511	1.440280-03	-2.8416	1.022250+00	.0096	
274	HSO4 -	-1.0	4.532540-26	-27.3437	3.566350-26	-27.4478	7.668310-01	-.1041	
281	H2S AQ	.0	3.974650-03	-2.4007	4.063110-03	-2.3911	1.022250+00	.0096	
282	S 2-	-2.0	1.461430-08	-7.8352	5.601490-09	-8.2517	3.832690-01	-.4165	
283	UOH +3	3.0	7.448490-24	-23.1279	8.610000-25	-24.0650	1.155940-01	-.9371	
284	U(OH)2 +	2.0	6.873190-19	-18.1626	2.634420-19	-18.5793	3.832690-01	-.4165	
285	U(OH)3 +	1.0	9.780720-15	-14.0096	7.695770-15	-14.1137	7.668310-01	-.1041	
286	U(OH)4 A	.0	3.333360-11	-10.4771	3.427510-11	-10.4676	1.022250+00	.0096	
287	U(OH)5 -	-1.0	1.599880-08	-7.7959	1.258830-08	-7.9000	7.668310-01	-.1041	
294	UCL +3	3.0	2.231980-30	-29.6513	2.580010-31	-30.5884	1.155940-01	-.9371	
301	UO2CL +1	1.0	1.202340-22	-21.9200	9.460420-23	-22.0241	7.668310-01	-.1041	
304	UO2CO3 A	.0	9.756580-20	-19.0107	9.973630-20	-19.0011	1.022250+00	.0096	
305	UO2(CO3)2	-2.0	1.149680-17	-16.9394	4.406600-18	-17.3559	3.832690-01	-.4165	
306	UO2(CO3)3	-4.0	7.505460-17	-16.1246	1.619880-18	-17.7935	2.158270-02	-1.6659	
311	UO2CL +1	1.0	1.188260-25	-24.9252	9.347990-26	-25.0293	7.668310-01	-.1041	
319	UO2HSO4	1.0	1.442760-23	-22.8408	1.135210-23	-22.9449	7.668310-01	-.1041	
353	HSO3-	-1.0	2.177490-28	-27.6620	1.713320-28	-27.7662	7.668310-01	-.1041	
367	SE2-2	-2.0	8.727460-15	-14.0591	3.348140-15	-14.4756	3.832690-01	-.4165	
368	SE-2	-2.0	3.635280-15	-14.4431	1.381790-15	-14.8596	3.832690-01	-.4165	
369	HSE-	-1.0	1.839140-07	-6.7425	1.423430-07	-6.8467	7.668310-01	-.1041	
370	H2SE	.0	4.884800-11	-10.3387	4.656800-11	-10.3291	1.022250+00	.0096	
5 372	MOO2+	1.0	1.899710-07	-6.7213	1.494910-07	-6.8254	7.668310-01	-.1041	
6 373	HMOO4-	-1.0	2.018710-08	-7.6949	1.588390-08	-7.7990	7.668310-01	-.1041	

---- LOOK MIN IAP ----

SATURATION INDICES

PHASE	LOG IAP	LOG KT	LOG IAP/KT
URANINIT	-11.4542	-14.3636	2.9094
UO2 (AM	-11.4542	-8.5102	-2.9440
U4O9 (C)	-43.7399	-41.2746	-2.4653
U3O8 (C)	-30.2087	-6.1826	-24.0261
USiO4 (C	-15.3505	-17.3982	2.0477
UO3 (C)	-9.3772	8.2625	-17.6397
GUMMITE	-9.3772	11.0461	-20.4233
B-UO2(OH	-9.3787	5.9255	-15.3042
SCHOEPIT	-9.3801	5.7383	-15.1184
RUTHERFO	-29.0842	-14.4461	-14.6381
URANOPHA	-15.7089	17.4900	-33.1989
ANHYDRIT	-25.7337	-4.5341	-21.1995
ARAGONIT	-8.8674	-8.2419	-.6256
ARTINITE	2.3050	10.4070	-8.1020
BRUCITE	11.0074	17.5155	-6.5081
CALCITE	-8.8674	-8.4193	-.4482
CELESTIT	-26.7376	-6.4568	-20.2808
CHALCEDO	-3.8962	-3.6494	-.2468

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DIOPSIDE	14.0559	20.7964	-6.7405
DOLOMITE	-17.5656	-16.7672	-.7983
EPSOMITE	-25.5744	-2.2192	-23.3552
SEPIOLIT	10.3239	16.7800	-6.4561
FERRIHYD	5.0281	18.2008	-13.1727
FE3(OH)8	14.0466	46.8516	-32.8050
FEOH)2.7	2.4579	10.2708	-7.8129
FES PPT	-40.8894	-39.2686	-1.6208
FE2(SO4)	-99.6592	31.8615	-131.5207
FORSTERI	18.1214	29.6621	-11.5406
GOETHITE	5.0295	14.2173	-9.1878
GREENALI	4.1600	20.8100	-16.6300
GREIGITE	-165.4722	-159.8029	-5.6694
GYPSUM	-25.7366	-4.8573	-20.8793
HALITE	-2.4005	1.5542	-3.9547
HEMATITE	10.0605	23.4876	-13.4272
HUNTITE	-34.9619	-29.2467	-5.7151
HYDRMAGN	-23.7909	-7.3041	-16.4868
JAROSITE	-58.0622	29.3908	-87.4530
MACKINAW	-40.8894	-39.9986	-.8908
MAGADIIT	-21.1126	-14.3000	-6.8126
MAGHEMIT	10.0605	33.0116	-22.9510
MAGNESIT	-8.6981	-7.8568	-.8414
MAGNETIT	14.0523	31.7784	-17.7261
MELANTER	-32.5915	-2.5503	-30.0412
MIRABILI	-24.2523	-1.6432	-22.6091
NATRON	-7.3861	-1.7519	-5.6341
NESQUEHO	-8.7024	-5.4574	-3.2450
PYRITE	-83.6935	-89.4945	5.8010
QUARTZ	-3.8762	-4.1646	.2884
SIDERITE	-15.7152	-10.4003	-5.3149
SIO2(A,G	-3.8762	-2.8141	-1.0622
SIO2(A,P	-3.8762	-2.8141	-1.0622
STRONTIA	-9.8713	-9.2306	-.6407
TALC	17.4431	24.0430	-6.6029
THENARDI	-24.2350	-.1640	-24.0740
THERMONA	-7.3732	.2086	-7.5818
TREMOLIT	45.5519	59.2626	-13.7107
PYROLUSI	10.3936	42.9126	-32.5190
BIRNESSI	10.3936	44.3233	-33.9297
NSUTITE	10.3936	43.7333	-33.3397
BIXBYITE	16.7103	52.2745	-33.5642
HAUSMANN	27.0269	63.7902	-36.7633
PYROCROI	8.3152	15.7243	-7.4091
MANGANIT	9.3544	25.9933	-16.6389
RHODOCHR	-11.3903	-10.3516	-1.0387
MNCL2, 4	-8.8253	2.2220	-11.0473
MNS GREE	-36.5645	-31.3860	-5.1784
MNSO4	-28.2566	3.1046	-31.3612
MN2(SO4)	-91.0095	47.8433	-138.8528
ZN METAL	-4.4946	26.7927	-31.2873
ZNCL2	-19.5539	7.5208	-27.0747
SMITHSON	-22.1246	-9.8776	-12.2471
ZNCO3, 1	-22.1261	-10.2600	-11.8661
ZN(OH)2	-2.4191	11.5000	-13.9191
ZN2(OH)3	-13.4056	15.2000	-28.6056
ZN5(OH)8	-29.2303	38.5000	-67.7303
ZN2(OH)2	-41.4100	7.5000	-48.9100
ZN4(OH)6	-46.2482	28.4000	-74.6482
ZNO(ACTI	-2.4177	11.3100	-13.7277
ZINCITE	-2.4177	11.7538	-14.1714
ZN3O(SO4	-80.3995	20.7608	-101.1603
ZNS (A)	-47.2958	-44.5016	-2.7971
SPHALERI	-47.2958	-47.2002	-.0955

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WILLEMIT	-8.7316	16.2670	-24.9985
ZINCOSIT	-38.9909	3.5491	-42.5400
ZNSO4, 1	-38.9923	-.2713	-38.7211
BIANCHIT	-38.9995	-1.7555	-37.2440
GOSLARIT	-39.0009	-2.0527	-36.9483
ZNBR2, 2	-25.8302	5.4209	-31.2511
CD METAL	-7.5705	13.9954	-21.5659
GAMMA CD	-7.5705	14.0993	-21.6699
OTAVITE	-25.2885	-13.7237	-11.4768
CDCL2	-22.6298	-.5545	-22.0753
CDCL2, 1	-22.6313	-1.6589	-20.9724
CDCL2,2.	-22.6334	-1.9880	-20.6454
CD(OH)2	-5.4950	13.6500	-19.1450
CDOHCL	-14.0674	3.7281	-17.7905
CD3(OH)4	-53.0568	22.5600	-75.6168
CD3OH2(S	-89.6286	6.7100	-96.3386
CD4(OH)6	-58.5518	28.4000	-86.9518
MONTEPON	-5.4936	15.8152	-21.3088
CDSIO3	-9.3898	9.5269	-18.9168
CDSO4	-42.0665	.3139	-42.3807
CDSO4, 1	-42.0682	-1.4489	-40.6194
CDSO4,2.	-42.0706	-1.7493	-40.3214
GREENOCK	-50.3747	-51.7380	1.3633
CDBR2, 4	-28.9090	-2.6230	-26.2860
PB METAL	-5.1646	4.2588	-9.4234
COTUNNIT	-20.2239	-4.9272	-15.2966
PHOSGENI	-43.0185	-19.8100	-23.2085
CERRUSIT	-22.7946	-13.2665	-9.5281
MASSICOT	-3.0876	13.3511	-16.4388
LITHARGE	-3.0876	13.1799	-16.2675
PBO, .3H	-3.0881	12.9800	-16.0681
PB2OCO3	-25.8822	-.1782	-25.7040
LARNAKIT	-42.7455	-.0992	-42.6493
PB3O2SO4	-45.8361	10.9826	-56.8187
PB4O3SO4	-48.9237	23.0547	-72.0084
PB3O2CO3	-28.9698	11.7621	-40.7319
PBSIO3	-6.9839	7.5800	-14.5639
PB2SIO4	-10.0715	20.4900	-30.5615
ANGLESIT	-39.6609	-7.8504	-31.8105
GALENA	-47.9658	-51.0233	3.0546
PLATTNER	-1.0107	51.2859	-52.2966
PB2O3	-4.0983	61.0400	-65.1383
MINIUM	-7.1859	76.5753	-83.7612
PB(OH)2	-3.0891	8.5428	-11.6319
LAURIONI	-11.6565	.6200	-12.2765
PB2(OH)3	-14.7455	8.7900	-23.5355
HYDCERRU	-48.6763	-17.4600	-31.2163
PB2O(OH)	-6.1767	26.2000	-32.3767
PBBR2	-26.4973	-5.4074	-21.0899
PB4(OH)6	-48.9280	21.1000	-70.0280
SULFUR	-42.8042	-37.3407	-5.4635
LIME	10.8396	34.0989	-23.2593
PORTLAND	10.8381	23.5317	-12.6936
WUSTITE	3.8903	12.3877	-8.4974
FERICLAS	11.0088	22.5245	-11.5156
MAG-FERR	21.0693	45.2627	-24.1933
WOLLASTO	6.9433	13.5475	-6.6042
P-WOLLST	6.9433	14.4416	-7.4983
CA-OLIVI	17.7829	39.1856	-21.4027
LARNITE	17.7829	40.7472	-22.9643
CASSIOS	28.6224	76.8555	-48.2331
MONTICEL	17.9521	31.6576	-13.7055
AKERMINI	24.8954	49.6163	-24.7208
[illegible]	[illegible]	[illegible]	[illegible]

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9/20/90

NAZSO3	-26.3150	5.0331	-31.3481
KZSO3	-31.7302	8.2712	-40.0014
CASO3.2H	-27.8135	-3.5656	-24.2479
CASO3.5H	-27.8114	-3.1288	-24.6826
MGSO3	-27.6414	7.0169	-34.6563
CH4(GAS)	-28.0177	-42.7928	14.7752
CO2(GAS)	-19.7070	-18.1749	-1.5321
O2(GAS)	4.1539	66.9563	-62.8023
CAMOO4	-14.2881	-7.7397	-6.5484
NAT. SE	59.1517	-63.2575	122.4092
FERROSEL	-116.3714	-129.8086	13.4372
MOLYBDEN	-116.9665	-130.8200	13.8532
MOLYBDIT	-25.1276	-11.7900	-13.3376
ILSEMANN	-77.4598	-77.5900	.1302

9/24/90

9/20/90

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-01-91-15-02-00 DISCIPLINE Hydro NO. OF SHEETS 20

PROJECT: UMTRA Site Characterization

SITE: GRAND JUNCTION (Cheney Reservoir)

FEATURE: Concentration Limits

SOURCES OF DATA:

Groundwater data is obtained from UMTRA DART (data base)

SOURCES OF FORMULAE & REFERENCES:

Technical Approach Document (Dec, 1989)

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		SPeinert	1/30/91	CPrince	2/1/91	KB	2/4/91

RIBA

2/1/91 3/1/91

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Purpose of Calculation

The purpose of this calculation is to determine proposed concentration limits for hazardous constituents and elements of hazardous constituent compounds in groundwater at the Cheney disposal site in Grand Junction, Colorado.

Overview of Method

For those hazardous constituents that have an EPA MCL (arsenic, barium, cadmium, chromium, lead, mercury, molybdenum, nitrate, selenium, silver, uranium, and the activities of radium-226/228 and net gross alpha) background concentrations (listed in table 3.38) are compared to the groundwater standards. If concentrations are less than the standard, then the proposed concentration limit (PCL) will be the same as the EPA MCL. When background concentrations exceed the groundwater standards, the statistical maximum of background is used as a replacement to the EPA MCL. There are certain hazardous constituents and elements in hazardous constituent compounds that do not have any predetermined concentration limits. For these constituents, the PCL will be based on the statistical maximum of background concentrations. In the case where the hazardous constituent was not detected in groundwater, the laboratory detection limit will be used as the PCL. The observed maximum for Net Gross Alpha was chosen to represent the statistical maximum.

Assumptions

The assumption being made in this calculation is that the background monitor wells and number of samples are an accurate indication of background groundwater quality.

Data Source

DOE sampling results from UMTRA Data Analysis and Retrieval System (DART). See tables 3.38 and 3.39.

Attachments

1) List of EPA hazardous constituents and their concentration limits. (Those underlined in blue are the constituent whose PCL is the same as the EPA MCL.

2) Table 3.38 is a list of water quality data for the background monitor wells. (Beside each hazardous constituent is a comment on how its PCL was determined.)

3) Table 3.39 is a list of water quality statistics for background monitor wells. For those hazardous constituents that do not have a concentration limit, the statistical maximum is chosen as the PCL.

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Elements contained in hazardous constituent compounds

Aluminum (Aluminum phosphide)	0.1	<MDL
Cyanide (Soluble salts and complexes)	0.01	<MDL
Fluoride (Carbon oxyfluoride)	2.2	BG
Strontium (Strontium sulfide)	10.1	BG
Sulfide (Strontium sulfide, carbon disulfide)	10.0	BG

* MCL- Maximum concentration limit as defined by the EPA. (Secondary drinking water standards are being used for copper and zinc).

<MDL- Concentrations in background groundwater were less than detection. For these constituents, the concentration limit is the same as the laboratory detection limit.

BG- Concentration limit is based on the statistical maximum concentration of background water quality.

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BY _____ CHKD. _____ JOB NO. _____

2/1/91 2/1/91

List of Hazardous Constituents and their concentration limits

Constituents underlined in blue are those which use the EPA MCL.

MAXIMUM CONCENTRATION OF CONSTITUENTS for GROUNDWATER PROTECTION
(Summarized from DRAFT FINAL EPA Groundwater Standards (of 1/90)) 2/1/
(40 CFR 192.02)

2/1/91

Table 1 - CONCENTRATION LIMITS
(Concentrations of these constituents shall not exceed the following limits or background, whichever is higher)

Arsenic (As)	0.05 mg/l	
Barium (Ba)	1.0	
Cadmium (Cd)	.01	
Chromium (Cr)	.05	
Lead (Pb)	.05	
Mercury (Hg)	.002	
Molybdenum (Mo)	.1	
Nitrate (as N)	10.0	(= 44.0 mg/l NO^3)
Selenium (Se)	.01	
Silver (Ag)	.05	

Benzene (Cyclohexatriene)	0.005 mg/l	Methoxychlor	0.1 mg/l
Carbon tetrachloride	.005	Methyl chloroform	.20
p-Dichlorobenzene(Benzene,1,4-di-)	.075	Toxaphene	.005
1,1-Dichloroethylene(Ethene,1,1-di-)	.007	2,4-D	.1
Endrin	.0002	2,4,5-TP	.01
Ethylene dichloride	.005	Trichloroethylene	.005
Lindane	.004	Vinyl chloride	.002

Combined Radium (Ra-226 & 228)	5	pCi/l	
Combined Uranium (U-234 & 238)	30	"	(= 0.044 mg/l)
Gross Alpha (excluding Rn & U)	15	"	

Appendix I - LISTED CONSTITUENTS
(Partial list: only inorganics w/o MCLs)

Antimony and compounds,	N.O.S.
Aluminum phosphide	#
Beryllium and compounds,	N.O.S.
Calcium chromate	#
Carbon Disulfide	
Carbon oxyfluoride	#
Cyanides (soluble salts and complexes),	N.O.S.
Nickel and compounds,	N.O.S.
Strontium sulfide	#
Thallium and compounds,	N.O.S.
Vanadic acid, ammonium salt	#
Vanadium pentoxide	#
Zinc phosphide	#

N.O.S. - Not Otherwise Specified; Signifies all members of this general class, including those not specifically named in Append.I

- ADDED when this Appendix replaced Appendix IX, 40 CFR 264

Note - Cobalt, Copper, Sulphide, Tin, Vanadium, and Zinc were DELETED when this Appendix replaced Appendix IX

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 6

BY _____ CHKD. _____ JOB NO. _____

2/1/91

2/1/91

Table 3.38

Background water quality data

(BACKGROUND WATER QUALITY)

Table 3.38 Dakota Sandstone water quality by parameter at the [illegible] disposal site, Grand Junction, Colorado
SITE: GRJCS CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
ALKALINITY	0971	02/19/90	0001	KD	D	MG/L CACO3		7899.	-	-
	0971	06/28/90	F014	KD	D			9139.	-	-
	0977	02/02/90	0001	KD	D			6630.	-	-
	0977	06/28/90	F014	KD	D			5667.	-	-
	0978	02/12/90	0001	KD	D			7861.	-	-
ALUMINUM	0971	02/19/90	0001	KD	D	MG/L	<	0.05	0.1	-
	0971	06/28/90	F014	KD	D		<	.1	0.1	-
	0977	02/02/90	0001	KD	D		<	0.05	0.1	-
	0977	06/28/90	F014	KD	D		<	.1	[illegible]	-
	0978	02/12/90	0001	KD	D		<	0.05	0.1	-
	0978	06/29/90	F014	KD	D		<	.1	0.1	-
AMMONIUM	0971	02/19/90	0001	KD	D	MG/L		6.1	0.1	-
	0971	06/28/90	F014	KD	D			8.	0.1	-
	0977	02/02/90	0001	KD	D			5.3	0.1	-
	0977	06/28/90	F014	KD	D			6.	0.1	-
	0978	02/12/90	0001	KD	D			5.2	0.1	-
	0978	06/29/90	F014	KD	D			7.	0.1	-
ANTIMONY	0971	06/28/90	F014	KD	D	MG/L	<	.003	0.003	-
	0977	06/28/90	F014	KD	D		<	.003	0.003	-
	0978	06/29/90	F014	KD	D		<	.003	0.003	-
ARSENIC	0971	02/19/90	0001	KD	D	MG/L	<	0.03	0.01	-
	0971	06/28/90	F014	KD	D		<	.01	0.01	-
	0977	02/02/90	0001	KD	D		<	0.03	0.01	-
	0977	06/28/90	F014	KD	D		<	.01	0.01	-
	0978	02/12/90	0001	KD	D		<	0.03	0.01	-
	0978	06/29/90	F014	KD	D		<	.01	0.01	-
BARIUM	0971	02/19/90	0001	KD	D	MG/L		4.44	0.1	-
	0971	06/28/90	F014	KD	D			18.5	0.1	-
	0977	02/02/90	0001	KD	D			38.	0.1	-
	0977	06/28/90	F014	KD	D			34.1	0.1	-
	0978	02/12/90	0001	KD	D			36.	0.1	-
	0978	06/29/90	F014	KD	D			32.5	0.1	-
BERYLLIUM	0971	02/19/90	0001	KD	D	MG/L	<	0.005	0.005	-

< MDL 0.1 mg/l

< MDL 0.003 mg/l

CL = 0.05 mg/l

see table 3.39

< MDL 0.005 mg/l

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
03/01/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
BERYLLIUM	0977	02/02/90	0001	KD	D	MG/L	<	0.005	0.005	-
	0978	02/12/90	0001	KD	D		<	0.005	0.005	-
BORON	0971	02/19/90	0001	KD	D	MG/L		1.96	0.1	-
	0971	06/28/90	F014	KD	D			2.1	0.1	-
	0977	02/02/90	0001	KD	D			1.99	0.1	-
	0977	06/28/90	F014	KD	D			1.5	0.1	-
	0978	02/12/90	0001	KD	D			3.13	0.1	-
	0978	06/29/90	F014	KD	D			2.9	0.1	-
CADMIUM	0971	02/19/90	0001	KD	D	MG/L	<	0.001	0.001	-
	0971	06/28/90	F014	KD	D		<	.001	0.001	-
	0977	02/02/90	0001	KD	D		<	0.01	0.001	-
	0977	06/28/90	F014	KD	D		<	.001	0.001	-
	0978	02/12/90	0001	KD	D		<	0.001	0.001	-
	0978	06/29/90	F014	KD	D		<	.001	0.001	-
CALCIUM	0971	02/19/90	0001	KD	D	MG/L		32.	0.01	-
	0971	06/28/90	F014	KD	D			38.0	0.01	-
	0977	02/02/90	0001	KD	D			28.	0.01	-
	0977	06/28/90	F014	KD	D			14.5	0.01	-
	0978	02/12/90	0001	KD	D			42.	0.01	-
	0978	06/29/90	F014	KD	D			35.6	0.01	-
CHLORIDE	0971	02/19/90	0001	KD	D	MG/L		4640.	1.0	-
	0971	06/28/90	F014	KD	D			4490.	1.0	-
	0977	02/02/90	0001	KD	D			3360.	1.0	-
	0977	06/28/90	F014	KD	D			3040.	1.0	-
	0978	02/12/90	0001	KD	D			4130.	1.0	-
	0978	06/29/90	F014	KD	D			4850.	1.0	-
CHROMIUM	0971	02/19/90	0001	KD	D	MG/L	<	0.01	0.01	-
	0971	06/28/90	F014	KD	D		<	.01	0.01	-
	0977	02/02/90	0001	KD	D		<	0.01	0.01	-
	0977	06/28/90	F014	KD	D		<	.01	0.01	-
	0978	02/12/90	0001	KD	D		<	0.01	0.01	-
	0978	06/29/90	F014	KD	D		<	.01	0.01	-
COBALT	0971	02/19/90	0001	KD	D	MG/L	<	0.03	0.05	-

<MDL 0.005 mg/l

MCL = 0.01

MCL = 0.05

<MDL 0.05 mg/l

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
COBALT	0971	06/28/90	F014	KD	D	MG/L	<	.05	0.05	-
	0977	02/02/90	0001	KD	D		<	0.03	0.05	-
	0977	06/28/90	F014	KD	D		<	.05	0.05	-
	0978	02/12/90	0001	KD	D		<	0.03	0.05	-
	0978	06/29/90	F014	KD	D		<	.05	0.05	-
COPPER	0971	02/19/90	0001	KD	D	MG/L		0.02	0.02	-
	0971	06/28/90	F014	KD	D		<	.02	0.02	-
	0977	02/02/90	0001	KD	D		<	0.01	0.02	-
	0977	06/28/90	F014	KD	D		<	.02	0.02	-
	0978	02/12/90	0001	KD	D			0.01	0.02	-
	0978	06/29/90	F014	KD	D		<	.02	0.02	-
CYANIDE	0971	02/19/90	0001	KD	D	MG/L	<	0.02	0.01	-
	0971	06/28/90	F014	KD	D		<	.01	0.01	-
	0977	02/02/90	0001	KD	D		<	0.02	0.01	-
	0977	06/28/90	F014	KD	D		<	.01	0.01	-
	0978	02/12/90	0001	KD	D		<	0.02	0.01	-
	0978	06/29/90	F014	KD	D		<	.01	0.01	-
FLUORIDE	0971	02/19/90	0001	KD	D	MG/L		1.6	0.1	-
	0971	06/28/90	F014	KD	D			1.6	0.1	-
	0977	02/02/90	0001	KD	D			2.0	0.1	-
	0977	06/28/90	F014	KD	D			2.2	0.1	-
	0978	02/12/90	0001	KD	D			1.2	0.1	-
	0978	06/29/90	F014	KD	D			1.4	0.1	-
GROSS ALPHA	0971	02/19/90	0001	KD	D	PCI/L		86.	1.0	94.
	0971	06/28/90	F014	KD	D			0.	1.0	120.
	0977	02/02/90	0001	KD	D			98.	1.0	71.
	0977	06/28/90	F014	KD	D			75.	1.0	72.
	0978	02/12/90	0001	KD	D			0.0	1.0	76.
	0978	06/29/90	F014	KD	D			0.	1.0	140.
GROSS BETA	0971	02/19/90	0001	KD	D	PCI/L		146.	0.5	79.
	0971	06/28/90	F014	KD	D			100.	0.5	100.
	0977	02/02/90	0001	KD	D			105.	0.5	48.
	0977	06/28/90	F014	KD	D			160.	0.5	60.
	0978	02/12/90	0001	KD	D			0.0	0.5	68.

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

<MDL 0.05 mg/l

secondary MCL = 1.0 mg/l

<MDL 0.01 mg/l

See table 3.39

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESEARCH
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
GROSS BETA	0978	06/29/90	F014	KD	D	PCI/L		77.	0.5	95.
IRON	0971	02/19/90	0001	KD	D	MG/L		0.50	0.03	-
	0971	06/28/90	F014	KD	D			.51	0.03	-
	0977	02/02/90	0001	KD	D			0.42	0.03	-
	0977	06/28/90	F014	KD	D			.25	0.03	-
	0978	02/12/90	0001	KD	D			0.89	0.03	-
	0978	06/29/90	F014	KD	D			.47	0.03	-
LEAD	0971	02/19/90	0001	KD	D	MG/L	<	0.01	0.01	-
	0971	06/28/90	F014	KD	D			0.01	0.01	-
	0977	02/02/90	0001	KD	D		<	0.05	0.01	-
	0977	06/28/90	F014	KD	D		<	.01	0.01	-
	0978	02/12/90	0001	KD	D		<	0.01	0.01	-
	0978	06/29/90	F014	KD	D		<	.01	0.01	-
MAGNESIUM	0971	02/19/90	0001	KD	D	MG/L		42.	0.001	-
	0971	06/28/90	F014	KD	D			37.6	0.001	-
	0977	02/02/90	0001	KD	D			23.	0.001	-
	0977	06/28/90	F014	KD	D			13.7	0.001	-
	0978	02/12/90	0001	KD	D			22.	0.001	-
	0978	06/29/90	F014	KD	D			22.0	0.001	-
MANGANESE	0971	02/19/90	0001	KD	D	MG/L		0.02	0.01	-
	0971	06/28/90	F014	KD	D			.03	0.01	-
	0977	02/02/90	0001	KD	D			0.21	0.01	-
	0977	06/28/90	F014	KD	D			.03	0.01	-
	0978	02/12/90	0001	KD	D			0.39	0.01	-
	0978	06/29/90	F014	KD	D			.19	0.01	-
MERCURY	0971	02/19/90	0001	KD	D	MG/L	<	0.0002	0.0002	-
	0971	06/28/90	F014	KD	D		<	.0002	0.0002	-
	0977	02/02/90	0001	KD	D		<	0.0002	0.0002	-
	0977	06/28/90	F014	KD	D		<	.0002	0.0002	-
	0978	02/12/90	0001	KD	D		<	0.0002	0.0002	-
	0978	06/29/90	F014	KD	D			.091	0.0002	-
MOLYBDENUM	0971	02/19/90	0001	KD	D	MG/L	<	0.01	0.01	-
	0971	06/28/90	F014	KD	D			.05	0.01	-

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

CL = 0.05 mg/l

CL = 0.09
x Obs from Background

table 3.39

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
MOLYBDENUM	0977	02/02/90	0001	KD	D	MG/L		0.21	0.01	-
	0977	06/28/90	F014	KD	D			.07	0.01	-
	0978	02/12/90	0001	KD	D		<	0.05	0.01	-
	0978	06/29/90	F014	KD	D			.05	0.01	-
NET GROSS ALPHA *	0971	02/19/90	0001	KD	D	PCI/L		84.97	-	-
	0971	06/28/90	F014	KD	D			-2.20	-	-
	0977	02/02/90	0001	KD	D			96.97	-	-
	0977	06/28/90	F014	KD	D			74.73	-	-
	0978	02/12/90	0001	KD	D			-1.03	-	-
	0978	06/29/90	F014	KD	D			-0.27	-	-
NICKEL	0971	02/19/90	0001	KD	D	MG/L	<	0.04	0.04	-
	0971	06/28/90	F014	KD	D		<	.04	0.04	-
	0977	02/02/90	0001	KD	D		<	0.04	0.04	-
	0977	06/28/90	F014	KD	D		<	.04	0.04	-
	0978	02/12/90	0001	KD	D		<	0.04	0.04	-
	0978	06/29/90	F014	KD	D		<	.04	0.04	-
NITRATE	0971	02/19/90	0001	KD	D	MG/L	<	0.1	1.0	-
	0971	06/28/90	F014	KD	D			3.	1.0	-
	0977	02/02/90	0001	KD	D		<	0.1	1.0	-
	0977	06/28/90	F014	KD	D			10.	1.0	-
	0978	02/12/90	0001	KD	D		<	0.1	1.0	-
	0978	06/29/90	F014	KD	D			4.	1.0	-
PH	0971	02/19/90	0001	KD	D	SU		7.80	-	-
	0971	06/28/90	F014	KD	D			7.44	-	-
	0977	02/02/90	0001	KD	D			7.21	-	-
	0977	06/28/90	F014	KD	D			7.66	-	-
	0978	02/12/90	0001	KD	D			7.43	-	-
PHOSPHATE	0971	02/19/90	0001	KD	D	MG/L		3.2	0.1	-
	0971	06/28/90	F014	KD	D			2.6	0.1	-
	0977	02/02/90	0001	KD	D			0.12	0.1	-
	0977	06/28/90	F014	KD	D			2.6	0.1	-
	0978	02/12/90	0001	KD	D			0.3	0.1	-

* NET GROSS ALPHA (GROSS ALPHA - URANIUM) WITH 1 MG URANIUM = 686 PCI

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

: table 3.39

lex Observed Background: 97

<MDL 0.04 mg/l

MCL = 44.0 mg/l

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
PHOSPHATE	0978	06/29/90	F014	KD	D	MG/L		11.4	0.1	-
POTASSIUM	0971	02/19/90	0001	KD	D	MG/L		30.	0.01	-
	0971	06/28/90	F014	KD	D			67.3	0.01	-
	0977	02/02/90	0001	KD	D			14.	0.01	-
	0977	06/28/90	F014	KD	D			111.	0.01	-
	0978	02/12/90	0001	KD	D			76.	0.01	-
	0978	06/29/90	F014	KD	D			105.	0.01	-
RADIUM-226	0971	02/19/90	0001	KD	D	PCI/L		3.5	1.0	0.6
	0971	06/28/90	F014	KD	D			1.7	1.0	0.5
	0977	02/02/90	0001	KD	D			32.0	1.0	2.2
	0977	06/28/90	F014	KD	D			2.2	1.0	0.5
	0978	02/12/90	0001	KD	D			17.9	1.0	1.6
	0978	06/29/90	F014	KD	D			1.5	1.0	0.5
RADIUM-228	0971	02/19/90	0001	KD	D	PCI/L		3.4	1.0	1.9
	0971	06/28/90	F014	KD	D			18.	1.0	2.
	0977	02/02/90	0001	KD	D			35.6	1.0	3.3
	0977	06/28/90	F014	KD	D			48.	1.0	2.
	0978	02/12/90	0001	KD	D			16.4	1.0	2.6
	0978	06/29/90	F014	KD	D			29.	1.0	2.
SELENIUM	0971	02/19/90	0001	KD	D	MG/L	<	0.03	0.005	-
	0971	06/28/90	F014	KD	D			0.005	0.005	-
	0977	02/02/90	0001	KD	D		<	0.03	0.005	-
	0977	06/28/90	F014	KD	D		<	.005	0.005	-
	0978	02/12/90	0001	KD	D		<	0.03	0.005	-
	0978	06/29/90	F014	KD	D		<	.005	0.005	-
SILICA - SIO2	0971	02/19/90	0001	KD	D	MG/L		13.7	2.0	-
	0971	06/28/90	F014	KD	D			46.	2.0	-
	0977	02/02/90	0001	KD	D			17.1	2.0	-
	0977	06/28/90	F014	KD	D			8.	2.0	-
	0978	02/12/90	0001	KD	D			19.6	2.0	-
	0978	06/29/90	F014	KD	D			23.	2.0	-
SILVER	0971	02/19/90	0001	KD	D	MG/L	<	0.01	0.01	-
	0971	06/28/90	F014	KD	D		<	.01	0.01	-

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

226/228
table 3.39

CL = 0.01 mg/l

MCL = 0.05 mg/l

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
SILVER	0977	02/02/90	0001	KD	D	MG/L	<	0.01	0.01	-
	0977	06/28/90	F014	KD	D		<	.01	0.01	-
	0978	02/12/90	0001	KD	D		<	0.01	0.01	-
	0978	06/29/90	F014	KD	D		<	.01	0.01	-
SODIUM	0971	02/19/90	0001	KD	D	MG/L		6100.	0.002	-
	0971	06/28/90	F014	KD	D			7020.	0.002	-
	0977	02/02/90	0001	KD	D			5010.	0.002	-
	0977	06/28/90	F014	KD	D			4210.	0.002	-
	0978	02/12/90	0001	KD	D			6440.	0.002	-
	0978	06/29/90	F014	KD	D			5760.	0.002	-
SPECIFIC CONDUCTANCE	0971	06/28/90	F014	KD	D	UMHO/CM		21000.	-	-
	0977	06/28/90	F014	KD	D			15.59	-	-
STRONTIUM	0971	02/19/90	0001	KD	D	MG/L		9.00	0.1	-
	0971	06/28/90	F014	KD	D			7.43	0.1	-
	0977	02/02/90	0001	KD	D			3.59	0.1	-
	0977	06/28/90	F014	KD	D			6.03	0.1	-
	0978	02/12/90	0001	KD	D			9.05	0.1	-
	0978	06/29/90	F014	KD	D			8.01	0.1	-
SULFATE	0971	02/19/90	0001	KD	D	MG/L		94.2	0.1	-
	0971	06/28/90	F014	KD	D			18.1	0.1	-
	0977	02/02/90	0001	KD	D			175.	0.1	-
	0977	06/28/90	F014	KD	D			6.2	0.1	-
	0978	02/12/90	0001	KD	D			66.2	0.1	-
	0978	06/29/90	F014	KD	D			42.4	0.1	-
SULFIDE	0971	02/19/90	0001	KD	D	MG/L		10.	0.1	-
	0971	06/28/90	F014	KD	D		<	.1	0.1	-
	0977	02/02/90	0001	KD	D		<	1.	0.1	-
	0977	06/28/90	F014	KD	D		<	.1	0.1	-
	0978	02/12/90	0001	KD	D			3.	0.1	-
	0978	06/29/90	F014	KD	D			0.29	0.1	-
TEMPERATURE	0971	02/19/90	0001	KD	D	C - DEGREE		16.9	-	-
	0971	06/28/90	F014	KD	D			20.1	-	-
	0977	02/02/90	0001	KD	D			19.0	-	-

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): - LESS THAN DETECTION LIMIT

(14)

Table 3.38 Dakota Sandstone water quality by parameter at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	DETECTION LIMIT	PARAMETER UNCERTAINTY
TEMPERATURE	0977	06/28/90	F014	KD	D	C - DEGREE		22.1	-	-
	0978	02/12/90	0001	KD	D			19.0	-	-
THALLIUM	0971	02/19/90	0001	KD	D	MG/L	<	0.1	0.1	-
	0977	02/02/90	0001	KD	D		<	0.1	0.1	-
	0978	02/12/90	0001	KD	D			0.1	0.1	-
TOTAL DISSOLVED SOLIDS	0971	02/19/90	0001	KD	D	MG/L		15300.	10.0	-
	0971	06/28/90	F014	KD	D			18300.	10.0	-
	0977	02/02/90	0001	KD	D			12100.	10.0	-
	0977	06/28/90	F014	KD	D			10500.	10.0	-
	0978	02/12/90	0001	KD	D			15410.	10.0	-
	0978	06/29/90	F014	KD	D			15500.	10.0	-
TOTAL KJELDAHL NITROGEN	0971	02/19/90	0001	KD	D	MG/L	<	1.	1.0	-
	0977	02/02/90	0001	KD	D			5.	1.0	-
	0978	02/12/90	0001	KD	D		<	1.	1.0	-
URANIUM	0971	02/19/90	0001	KD	D	MG/L	<	0.003	0.003	-
	0971	06/28/90	F014	KD	D			0.0032	0.003	-
	0977	02/02/90	0001	KD	D		<	0.003	0.003	-
	0977	06/28/90	F014	KD	D			0.0004	0.003	-
	0978	02/12/90	0001	KD	D		<	0.003	0.003	-
	0978	06/29/90	F014	KD	D			0.0004	0.003	-
VANADIUM	0971	02/19/90	0001	KD	D	MG/L	<	0.01	0.01	-
	0971	06/28/90	F014	KD	D			.03	0.01	-
	0977	02/02/90	0001	KD	D		<	0.01	0.01	-
	0977	06/28/90	F014	KD	D		<	.01	0.01	-
	0978	02/12/90	0001	KD	D		<	0.01	0.01	-
	0978	06/29/90	F014	KD	D		<	.01	0.01	-
ZINC	0971	02/19/90	0001	KD	D	MG/L		1.36	0.005	-
	0971	06/28/90	F014	KD	D			1.41	0.005	-
	0977	02/02/90	0001	KD	D			4.06	0.005	-
	0977	06/28/90	F014	KD	D			.039	0.005	-
	0978	02/12/90	0001	KD	D		<	0.005	0.005	-
	0978	06/29/90	F014	KD	D		<	.005	0.005	-

ICL = 0.044 mg/l

radium see table 3.39

ICL = 5.0 mg/l (secondary drinking water standard)

FORMATION OF COMPLETION CODE:
KD - DAKOTA SANDSTONE

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT

DATA FILE NAME: J:\DART\GRJ03\GW010020.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Cay 2/1/91

JM 2/1/91

(15)

Table 3.39

Background water quality statistics

(16)

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
5	5667.0000	9139.0000	7861.0000	7439.2000	1329.8636	0.1788	0.0	5210.7352	9667.6648	NORMAL	
ALUMINUM			MG/L								
6	0.0500	0.0500	0.0500	NA	NA	NA	100.0	0.0500	0.0500	NONPARAMETRIC	2,6
AMMONIUM			MG/L								
6	5.2000	8.0000	6.0500	6.2667	1.0690	0.1706	0.0	4.7982	7.7352	NORMAL	
ANTIMONY			MG/L								
3	0.0015	0.0015	0.0015	NA	NA	NA	100.0	NA	NA	UNKNOWN	1
ARSENIC			MG/L								
6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
BARIUM			MG/L								
6	4.4400	38.0000	33.3000	27.2567	13.1413	0.4821	0.0	9.2037	45.3096	NORMAL	
BERYLLIUM			MG/L								
3	0.0025	0.0025	0.0025	NA	NA	NA	100.0	NA	NA	UNKNOWN	1
BORON			MG/L								
6	1.5000	3.1300	2.0450	2.2633	0.6217	0.2747	0.0	1.4093	3.1174	NORMAL	
CADMIUM			MG/L								
6	0.0005	0.0005	0.0005	NA	NA	NA	100.0	0.0005	0.0005	NONPARAMETRIC	2,6
CALCIUM			MG/L								
6	14.5000	42.0000	33.8000	31.6833	9.7016	0.3062	0.0	18.3557	45.0110	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the [illegible]% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

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Barium-
posed conc. limit is
sed on statistical
aximum of background
45.3 mg/l

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHLORIDE			MG/L								
6	3040.0000	4850.0000	4310.0000	4085.0000	731.7035	0.1791	0.0	3079.8183	5090.1817	NORMAL	
CHROMIUM			MG/L								
6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
COBALT			MG/L								
6	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2,6
COPPER			MG/L								
6	0.0100	0.0200	0.0100	NA	NA	NA	66.7	0.0100	0.0200	NONPARAMETRIC	2,6
CYANIDE			MG/L								
6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
FLUORIDE			MG/L								
6	1.2000	2.2000	1.6000	1.6667	0.3724	0.2234	0.0	1.1551	2.1782	NORMAL	
GROSS ALPHA			PCI/L								
6	0.0000	98.0000	37.5000	NA	NA	NA	33.3	0.0000	98.0000	NONPARAMETRIC	2,6
GROSS BETA			PCI/L								
6	0.0000	160.0000	102.5000	NA	NA	NA	16.7	0.0000	160.0000	NONPARAMETRIC	2,6
IRON			MG/L								
6	0.2500	0.8900	0.4850	0.5067	0.2106	0.4156	0.0	0.2174	0.7960	NORMAL	
LEAD			MG/L								
6	0.0050	0.0100	0.0050	NA	NA	NA	83.3	0.0050	0.0100	NONPARAMETRIC	2,6

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

-460-

loride - proposed
e. limit is based
statistical maximum
background concentration
2 mg/l

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MAGNESIUM			MG/L								
6	13.7000	42.0000	22.5000	26.7167	10.7682	0.4031	0.0	11.9238	41.5095	NORMAL	
MANGANESE			MG/L								
6	0.0200	0.3900	0.1100	0.0809	3.5524	NA	0.0	0.0142	0.4615	LOGNORMAL	7,8
MERCURY			MG/L								
6	0.0001	0.0910	0.0001	NA	NA	NA	83.3	0.0001	0.0910	NONPARAMETRIC	2,6
MOLYBDENUM			MG/L								
6	0.0050	0.2100	0.0500	NA	NA	NA	33.3	0.0050	0.2100	NONPARAMETRIC	2,6
NICKEL			MG/L								
6	0.0200	0.0200	0.0200	NA	NA	NA	100.0	0.0200	0.0200	NONPARAMETRIC	2,6
NITRATE			MG/L								
6	0.5000	10.0000	1.7500	NA	NA	NA	50.0	0.5000	10.0000	NONPARAMETRIC	2,6
PHOSPHATE			MG/L								
6	0.1200	11.4000	2.6000	1.4390	5.4103	NA	0.0	0.1415	14.6324	LOGNORMAL	7,8
POTASSIUM			MG/L								
6	14.0000	111.0000	71.6500	67.2167	39.0866	0.5815	0.0	13.5212	120.9121	NORMAL	
RADIUM-226			PCI/L								
6	1.5000	32.0000	2.8500	4.7334	3.6747	NA	0.0	0.7920	28.2906	LOGNORMAL	7,8
RADIUM-228			PCI/L								
6	3.4000	48.0000	23.5000	25.0667	15.7915	0.6300	0.0	3.3730	46.7603	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, α = 0.01
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.

lybdenum - proposed centration limit is based statistical maximum ntration of background this case it is observed maximum)

-461-

hopsed Concentration mit is based statistical aximum recentration background

= 28.3 + 46.8
= 75

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 99% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SELENIUM	MG/L	6	0.0025	0.0050	0.0025	NA	NA	NA	83.3	0.0025	0.0050	NONPARAMETRIC	2,6
SILICA - SIO2	MG/L	6	8.0000	46.0000	18.3500	21.2333	13.1767	0.6206	0.0	3.1317	39.3350	NORMAL	
SILVER	MG/L	6	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2,6
SODIUM	MG/L	6	4210.0000	7020.0000	5930.0000	5756.6667	1012.9692	0.1760	0.0	4365.0947	7148.2387	NORMAL	
SPECIFIC CONDUCTANCE	UMHO/CM	2	15.5900	21000.0000	10507.7950	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
STRONTIUM	MG/L	6	3.5900	9.0500	7.7200	7.1850	2.0867	0.2904	0.0	4.3184	10.0516	NORMAL	
SULFATE	MG/L	6	6.2000	175.0000	54.3000	67.0167	61.8021	0.9222	0.0	-17.8843	151.9176	NORMAL	
SULFIDE	MG/L	6	0.0500	10.0000	0.1700	NA	NA	NA	50.0	0.0500	10.0000	NONPARAMETRIC	2,6
TEMPERATURE	C - DEGREE	5	16.9000	22.1000	19.0000	19.4200	1.8939	0.0975	0.0	16.2463	22.5937	NORMAL	
THALLIUM	MG/L	3	0.0500	0.1000	0.0500	NA	NA	NA	66.7	NA	NA	UNKNOWN	1

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Strontium - proposed concent. limit is based on statistical maximum of back ground concen. 10.1 mg/l

lfide. posed conc. limit based on statistical imum of background entration 10.0 mg/l

Table 3.39 Dakota Sandstone water quality statistics at the Cheney disposal site, Grand Junction, Colorado
SITE: GRJ03 CHENEY RESERVOIR
02/02/90 TO 06/29/90
REPORT DATE: 08/23/90

PARAMETER NAME	UNITS							STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TOTAL DISSOLVED SOLIDS	MG/L										
6	10500.0000	18300.0000	15355.0000	14518.3333	2780.8662	0.1915	0.0	10698.1033	18338.5634	NORMAL	
TOTAL KJELDAHL NITROGEN	MG/L										
3	0.5000	5.0000	0.5000	NA	NA	NA	66.7	NA	NA	UNKNOWN	1
URANIUM	MG/L										
6	0.0004	0.0032	0.0015	NA	NA	NA	50.0	0.0004	0.0032	NONPARAMETRIC	2,6
VANADIUM	MG/L										
6	0.0050	0.0300	0.0050	NA	NA	NA	83.3	0.0050	0.0300	NONPARAMETRIC	2,6
ZINC	MG/L										
6	0.0025	4.0600	0.6995	NA	NA	NA	33.3	0.0025	4.0600	NONPARAMETRIC	2,6

* Statistical maximum is the 99 percent one sided confidence interval, α = 0.01
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

INPUT DATA FILENAME: J:\DART\GRJ03\GWQ10020.DAT

ed Conc. Limit
btained from Statistic
mum of background
0.03 mg/l

JACOBS ENGINEERING GROUP INC.
ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-08-90-14-11 DISCIPLINE Hydro NO. OF SHEETS ~~92~~ 100

PROJECT:
UMTRA Site Characterization

SITE:
Grand Junction processing site, Colorado

FEATURE:
Statistical evaluation of existing groundwater contamination

SOURCES OF DATA:
DART water quality records

SOURCES OF FORMULAE & REFERENCES:
EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance."

TAD, 1989

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		B Gallaher	8/1/90	S Reinert	8/13/90		
				S Reinert	8/20/90	[illegible]	8/20/90

JEG-AL-ENG-51 (8/87)

A. PURPOSE OF CALCULATION:

To assess alluvial groundwater contamination with hazardous constituents at the Grand Junction processing site using only statistical methods. Statistics are applied to those hazardous constituents in which contamination is not readily evident.

B. METHODS AND PROCEDURES

Water quality data available for monitor wells at the processing site were analyzed using the EPA approach outlined in the TAD. This approach is presented in the attached flowchart. The statistical approach is designed for comparing background water quality to onsite / downgradient water quality for constituents with no MCLs. The statistical comparison method selected depends on whether concentrations in the onsite / downgradient wells exceed statistical maximum background concentrations, and on the percentage of "nondetects" in the sample population.

Comparison is made of the concentrations of hazardous constituents in upgradient and downgradient wells. The list of hazardous constituents in the Grand Junction Tailings was determined previously (Calc Set 4RJ-07-90-15-01).

Not all of the identified hazardous constituents, however, ~~are~~ were statistically analyzed.

were not analyzed because of their insolubility in groundwater geochemical conditions, thus precluding the possibility of contamination.

C. DATA SOURCES

Groundwater quality records and general statistical descriptions were obtained from DART. To represent recent conditions, only data available from 1987 were used in the analysis. The ~~data~~ wells are grouped according to flow relationships as follows:

Upgradient	Downgradient	Cross-Gradient
588	585	737
710	586	742
744	589	
745	590	
746	733	
	736	
	740	

DART water quality data tables are presented in Attachment 1.

D. CALCULATIONS AND ANALYSES

Following EPA protocol (1989), the water quality data were analyzed using one of the background well to compliance well procedures: the test of proportions or the one-way analysis of variance (ANOVA) if more than 50% of the observations

are below the detection limit (XXDL), then the appropriate comparison is a test of proportions. One-way ANOVAs were performed for other constituents (no evidence of seasonality were seen in the data to require useage of an alternate ANOVA approach). The test of proportions is presented in Attachment II and the ANOVA is presented in Attachment III

E. RESULTS

Results of the calculations are summarized in the attached table.

F. CONCLUSIONS.

The statistical analyses show the likelihood that alluvial groundwater downgradient of the processing site is contaminated with uranium and radioactive uranium. KB ~~and gross alpha~~. There are insufficient data, however, to statistically determine which individual well(s), if any, is contaminated, but maximum concentrations appear to be found in the southwest corner of the processing site. This corresponds to the pattern of uranium contamination. Although net gross alpha concentrations exceed the MCLs in downgradient monitor wells, the concentrations are within the range of background and net gross alpha is not a groundwater contaminant

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DATE 09 August 1990 SUBJECT

BY BD CHKD. [illegible]

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JOB NO. [illegible]

Results of Analyses Summary

Hazardous Constituent	Contamination Indicated?	Reason/Remarks
1) Aluminum	No	NS*
2) Antimony	No	Passed Test of Proportions (TOP)
3) Arsenic	No	Passed ANOVA
4) Barium	No	Passed TOP
5) Beryllium	No	Not detected in groundwater
6) Cadmium	No	Passed ANOVA
7) Chromium	No	Passed TOP
8) Cobalt	No	Not detected in ground water
9) Copper	No	Downgradient wells do not exceed secondary
10) Cyanide	No	NS
11) Fluoride	No	NS
12) (Net) Gross alpha	No	Passed ANOVA
13) Lead	No	Passed TOP
14) Mercury	No	Not detected in ground-
15) Molybdenum	Likely	Failed ANOVA
16) Nickel	No	Passed TOP
17) Nitrate	No	Passed TOP
18) Radium-226 &	No	Passed TOP
19) Selenium	No	Passed ANOVA
20) Silver	No	Passed TOP
21) Strontium	No	NS
22) Tin	No	Passed ANOVA
23) Uranium	Yes	Downgradient concs. 5X upgradient
24) Vanadium	No	Passed TOP
25) Sulfide	No	NS
26) Zinc	No	Downgradient Wells do not exceed sec. standards

*NS = Element of hazardous compound that is not soluble in ground water conditions.

FORM 91-005-1 (4/81)

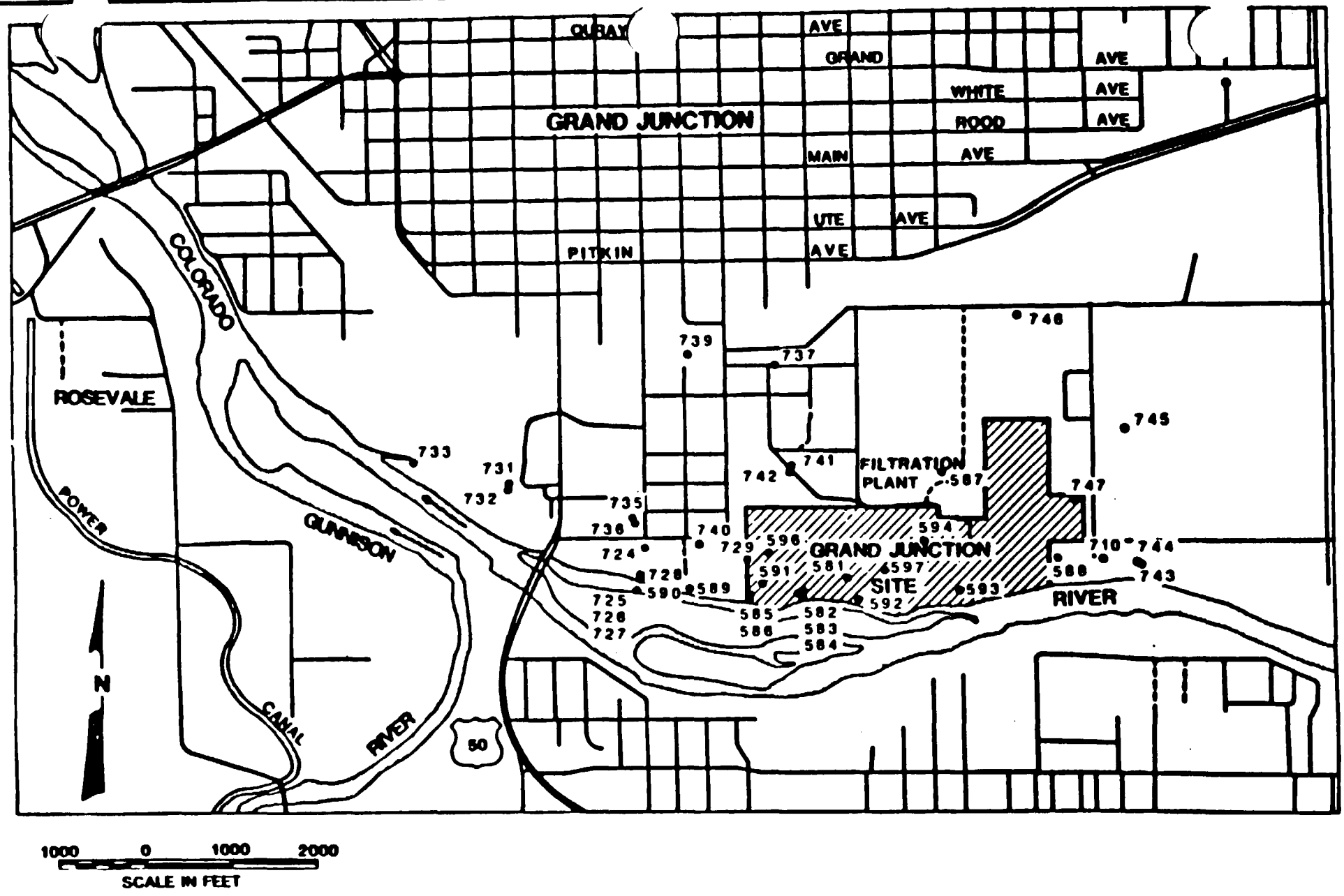

FIGURE F.3.1
MONITORING WELL LOCATIONS NEAR GRAND JUNCTION SITE

BACKGROUND WELL TO COMPLIANCE WELL COMPARISONS

EPA (1989) protocol.

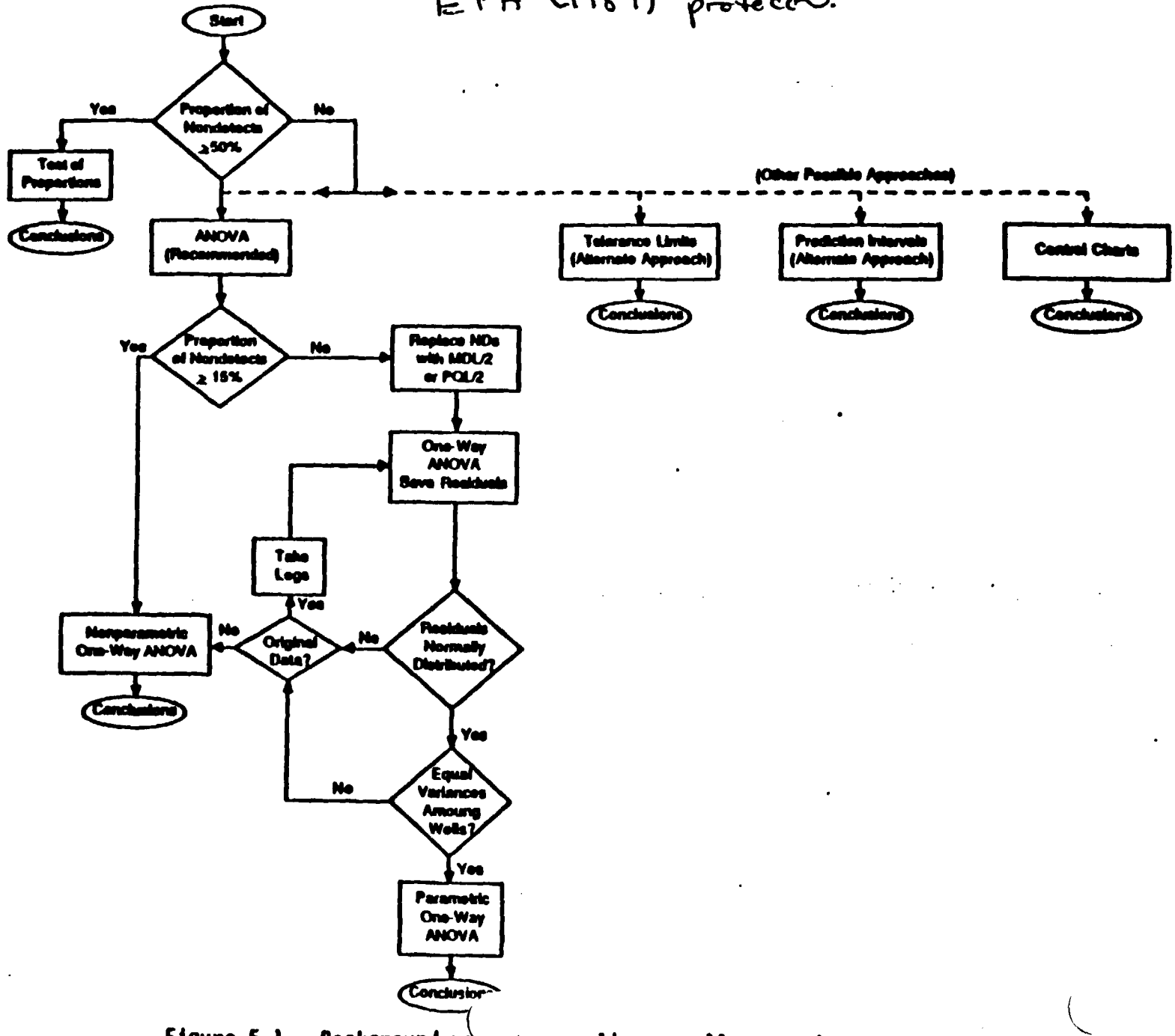

Figure 5-1. Background we. to compliance well comparisons.

8/20/90

JACOBS ENGINEERING

DATE 9 August 1990 SUBJECT

BY BY CHKD. SM 8/20/90

SHEET NO. 7

JOB NO. SM 8/20/90

References:

EPA, 1989. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities". U.S. Environmental Protection Agency, Office of Solid Waste, EPA/530-SW-89-026

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DATE _____ SUBJECT

BY BS CHKD. [illegible] 6/20/90

SHEET NO. 8

JOB NO. _____

Attachment 1.

DART Water Quality Records.

FORM 91-005-1 (4/81)

Table , Al...ial water quality by parameter
SITE: C9J01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ALKALINITY	0581	03/07/89	0001	AL	O	MG/L CACO3		539.	-
	0585	03/01/89	0001	AL	D			563.	-
	0586	03/01/89	0001	AL	D			629.	-
	0588	03/06/89	0001	AL	U			229.	-
	0589	03/01/89	0001	AL	D			588.	-
	0589	08/03/89	0001	AL	D			572.	-
	0590	09/22/88	0001	AL	D			488.	-
	0590	03/01/89	0001	AL	D			448.	-
	0590	08/03/89	0001	AL	D			485.	-
	0590	11/02/89	0001	AL	D			467.	-
	0710	03/06/89	0001	AL	U			465.	-
	0733	09/17/87	0001	AL	D			456.	-
	0733	09/22/88	0001	AL	D			651.	-
	0733	02/28/89	0001	AL	D			633.	-
	0733	08/03/89	0001	AL	D			631.	-
	0733	11/02/89	0001	AL	D			632.	-
	0736	02/28/89	0001	AL	D			503.	-
	0736	08/03/89	0001	AL	D			534.	-
	0736	11/02/89	0001	AL	D			591.	-
	0737	09/17/87	0001	AL	C			456.	-
	0737	09/22/88	0001	AL	C			462.	-
	0737	03/04/89	0001	AL	C			420.	-
	0737	08/07/89	0001	AL	C			468.	-
	0740	09/24/87	0001	AL	D			491.	-
	0740	02/28/89	0001	AL	D			411.	-
	0742	03/03/89	0001	AL	C			471.	-
	0744	03/05/89	0001	AL	U			328.	-
	0744	08/03/89	0001	AL	U			20.5	-
	0744	11/02/89	0001	AL	U			306.	-
	0745	09/17/87	0001	AL	U			526.	-
	0745	09/22/88	0001	AL	U			518.	-
	0745	03/05/89	0001	AL	U			532.	-
	0745	08/03/89	0001	AL	U			554.	-
	0745	11/02/89	0001	AL	U			529.	-
	0746	09/17/87	0001	AL	U			419.	-
	0746	09/22/88	0001	AL	U			426.	-
	0746	03/05/89	0001	AL	U			438.	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ALKALINITY	0746	08/03/89	0001	AL	U	MG/L CACO3		442.	-
	0746	11/02/89	0001	AL	U			439.	-
ALUMINUM	0581	03/07/89	0001	AL	O	MG/L	<	0.1	-
	0585	03/01/89	0001	AL	D		<	0.1	-
	0586	03/01/89	0001	AL	D		<	0.1	-
	0588	03/06/89	0001	AL	U		<	0.1	-
	0589	03/01/89	0001	AL	D		<	0.1	-
	0589	08/03/89	0001	AL	D		<	0.1	-
	0590	09/22/88	0001	AL	D			0.3	-
	0590	03/01/89	0001	AL	D		<	0.1	-
	0590	08/03/89	0001	AL	D		<	0.1	-
	0590	11/02/89	0001	AL	D		<	0.1	-
	0710	03/06/89	0001	AL	U		<	0.1	-
	0733	09/17/87	0001	AL	D			0.38	-
	0733	09/22/88	0001	AL	D			0.3	-
	0733	02/28/89	0001	AL	D		<	0.1	-
	0733	08/03/89	0001	AL	D			0.1	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D			0.3	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C			0.55	-
	0737	09/22/88	0001	AL	C			0.3	-
	0737	03/04/89	0001	AL	C		<	0.1	-
	0737	08/07/89	0001	AL	C		<	0.1	-
	0740	09/24/87	0001	AL	D			0.72	-
	0740	02/28/89	0001	AL	D		<	0.1	-
	0742	03/03/89	0001	AL	C		<	0.1	-
	0744	03/05/89	0001	AL	U		<	0.1	-
	0744	08/03/89	0001	AL	U		<	0.1	-
	0744	11/02/89	0001	AL	U		<	0.1	-
	0745	09/17/87	0001	AL	U			0.33	-
	0745	09/22/88	0001	AL	U			0.2	-
	0745	03/05/89	0001	AL	U		<	0.1	-
	0745	08/03/89	0001	AL	U		<	0.1	-
	0745	11/02/89	0001	AL	U		<	0.1	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ALUMINUM	0746	09/17/87	0001	AL	U	MG/L		0.38	-
	0746	09/22/88	0001	AL	U			0.3	-
	0746	03/05/89	0001	AL	U		<	0.1	-
	0746	08/03/89	0001	AL	U		<	0.1	-
	0746	11/02/89	0001	AL	U		<	0.1	-
AMMONIUM	0581	03/07/89	0001	AL	O	MG/L		170.	-
	0585	03/01/89	0001	AL	D			300.	-
	0586	03/01/89	0001	AL	D			300.	-
	0588	03/06/89	0001	AL	U			9.5	-
	0589	03/01/89	0001	AL	D			1.4	-
	0589	08/03/89	0001	AL	D			160.	-
	0590	09/22/88	0001	AL	D			21.	-
	0590	03/01/89	0001	AL	D			20.2	-
	0590	08/03/89	0001	AL	D			20.5	-
	0590	11/02/89	0001	AL	D			2.0	-
	0710	03/06/89	0001	AL	U			61.	-
	0733	09/17/87	0001	AL	D		<	0.1	-
	0733	09/22/88	0001	AL	D		<	0.1	-
	0733	02/28/89	0001	AL	D			0.4	-
	0733	08/03/89	0001	AL	D		<	0.1	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D		<	0.1	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C		<	0.1	-
	0737	09/22/88	0001	AL	C		<	0.1	-
	0737	03/04/89	0001	AL	C			0.4	-
	0737	08/07/89	0001	AL	C		<	0.1	-
	0740	09/24/87	0001	AL	D			50.	-
	0740	02/28/89	0001	AL	D			31.1	-
	0742	03/03/89	0001	AL	C			0.3	-
	0744	03/05/89	0001	AL	U			1.7	-
	0744	08/03/89	0001	AL	U			1.3	-
	0744	11/02/89	0001	AL	U			1.0	-
	0745	09/17/87	0001	AL	U			0.3	-
	0745	09/22/88	0001	AL	U		<	0.1	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
AMMONIUM	0745	03/05/89	0001	AL	U	MG/L		0.3	-
	0745	08/03/89	0001	AL	U		<	0.1	-
	0745	11/02/89	0001	AL	U		<	0.1	-
	0746	09/17/87	0001	AL	U		<	0.1	-
	0746	09/22/88	0001	AL	U		<	0.1	-
	0746	03/05/89	0001	AL	U			0.1	-
	0746	08/03/89	0001	AL	U		<	0.1	-
	0746	11/02/89	0001	AL	U		<	0.1	-
ANTIMONY	0581	03/07/89	0001	AL	O	MG/L	<	0.003	-
	0585	03/01/89	0001	AL	D		<	0.003	-
	0586	03/01/89	0001	AL	D		<	0.003	-
	0588	03/06/89	0001	AL	U		<	0.003	-
	0589	03/01/89	0001	AL	D		<	0.003	-
	0589	08/03/89	0001	AL	D			0.017	-
	0590	03/01/89	0001	AL	D		<	0.003	-
	0590	08/03/89	0001	AL	D			0.009	-
	0590	11/02/89	0001	AL	D			0.012	-
	0710	03/06/89	0001	AL	U		<	0.003	-
	0733	02/28/89	0001	AL	D		<	0.003	-
	0733	08/03/89	0001	AL	D			0.014	-
	0733	11/02/89	0001	AL	D			0.017	-
	0736	02/28/89	0001	AL	D		<	0.003	-
	0736	08/03/89	0001	AL	D			0.016	-
	0736	11/02/89	0001	AL	D			0.014	-
	0737	03/04/89	0001	AL	C		<	0.003	-
	0737	08/07/89	0001	AL	C			0.013	-
	0740	02/28/89	0001	AL	D		<	0.003	-
	0742	03/03/89	0001	AL	C		<	0.003	-
	0744	03/05/89	0001	AL	U		<	0.003	-
	0744	08/03/89	0001	AL	U		<	0.003	-
	0744	11/02/89	0001	AL	U		<	0.003	-
	0745	03/05/89	0001	AL	U		<	0.003	-
	0745	08/03/89	0001	AL	U			0.009	-
	0745	11/02/89	0001	AL	U		<	0.003	-
	0746	03/05/89	0001	AL	U		<	0.003	-
	0746	08/03/89	0001	AL	U			0.012	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ANTIMONY	0746	11/02/89	0001	AL	U	MG/L		0.004	-
ARSENIC	0581	03/07/89	0001	AL	O	MG/L		0.01	-
	0585	03/01/89	0001	AL	D			0.01	-
	0586	03/01/89	0001	AL	D			0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D			0.01	-
	0590	09/22/88	0001	AL	D			0.04	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	09/17/87	0001	AL	D			0.015	-
	0733	09/22/88	0001	AL	D			0.05	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D			0.01	-
	0733	11/02/89	0001	AL	D			0.013	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.01	-
	0736	11/02/89	0001	AL	D			0.015	-
	0737	09/17/87	0001	AL	C			0.012	-
	0737	09/22/88	0001	AL	C			0.05	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C			0.01	-
	0740	09/24/87	0001	AL	D			0.012	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U.		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	09/17/87	0001	AL	U			0.016	-
	0745	09/22/88	0001	AL	U			0.02	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	09/17/87	0001	AL	U			0.015	-

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ARSENIC	0746	09/22/88	0001	AL	U	MG/L		0.04	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U			0.016	-
BARIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.1	-
	0585	03/01/89	0001	AL	D		<	0.1	-
	0586	03/01/89	0001	AL	D		<	0.1	-
	0588	03/06/89	0001	AL	U		<	0.1	-
	0589	03/01/89	0001	AL	D		<	0.1	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	09/22/88	0001	AL	D		<	0.1	-
	0590	03/01/89	0001	AL	D		<	0.1	-
	0590	08/03/89	0001	AL	D		<	0.1	-
	0590	11/02/89	0001	AL	D		<	0.1	-
	0710	03/06/89	0001	AL	U		<	0.1	-
	0733	09/17/87	0001	AL	D			0.02	-
	0733	09/22/88	0001	AL	D		<	0.1	-
	0733	02/28/89	0001	AL	D		<	0.1	-
	0733	08/03/89	0001	AL	D		<	0.1	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D		<	0.1	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C			0.02	-
	0737	09/22/88	0001	AL	C		<	0.1	-
	0737	03/04/89	0001	AL	C		<	0.1	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	09/24/87	0001	AL	D			0.03	-
	0740	02/28/89	0001	AL	D		<	0.1	-
	0742	03/03/89	0001	AL	C		<	0.1	-
	0744	03/05/89	0001	AL	U		<	0.1	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.1	-
	0745	09/17/87	0001	AL	U			0.02	-
	0745	09/22/88	0001	AL	U		<	0.1	-
	0745	03/05/89	0001	AL	U		<	0.1	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
BARIUM	0745	08/03/89	0001	AL	U	MG/L	<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.1	-
	0746	09/17/87	0001	AL	U			0.02	-
	0746	09/22/88	0001	AL	U		<	0.1	-
	0746	03/05/89	0001	AL	U		<	0.1	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.1	-
BERYLLIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.005	-
	0585	03/01/89	0001	AL	D		<	0.005	-
	0586	03/01/89	0001	AL	D		<	0.005	-
	0588	03/06/89	0001	AL	U		<	0.005	-
	0589	03/01/89	0001	AL	D		<	0.005	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.005	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.005	-
	0733	02/28/89	0001	AL	D		<	0.005	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.005	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.005	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.005	-
	0742	03/03/89	0001	AL	C		<	0.005	-
	0744	03/05/89	0001	AL	U		<	0.005	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.005	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.005	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
BROMIDE	0590	11/02/89	0001	AL	D	MG/L		.1	-
	0733	11/02/89	0001	AL	D			1.0	-
	0736	11/02/89	0001	AL	D			1.2	-
	0744	11/02/89	0001	AL	U		<	.1	-
	0745	11/02/89	0001	AL	U			.2	-
	0746	11/02/89	0001	AL	U			.1	-
CADMIUM	0581	03/07/89	0001	AL	O	MG/L		0.001	-
	0585	03/01/89	0001	AL	D		<	0.001	-
	0586	03/01/89	0001	AL	D		<	0.001	-
	0588	03/06/89	0001	AL	U		<	0.001	-
	0589	03/01/89	0001	AL	D		<	0.001	-
	0589	08/03/89	0001	AL	D			0.025	-
	0590	09/22/88	0001	AL	D			0.023	-
	0590	03/01/89	0001	AL	D			0.001	-
	0590	08/03/89	0001	AL	D			0.010	-
	0590	11/02/89	0001	AL	D			0.002	-
	0710	03/06/89	0001	AL	U		<	0.001	-
	0733	09/17/87	0001	AL	D		<	0.005	-
	0733	09/22/88	0001	AL	D			0.016	-
	0733	02/28/89	0001	AL	D		<	0.001	-
	0733	08/03/89	0001	AL	D			0.013	-
	0733	11/02/89	0001	AL	D			0.001	-
	0736	02/28/89	0001	AL	D		<	0.001	-
	0736	08/03/89	0001	AL	D			0.014	-
	0736	11/02/89	0001	AL	D			0.002	-
	0737	09/17/87	0001	AL	C		<	0.005	-
	0737	09/22/88	0001	AL	C			0.018	-
	0737	03/04/89	0001	AL	C		<	0.001	-
	0737	08/07/89	0001	AL	C			0.029	-
	0740	09/24/87	0001	AL	D		<	0.005	-
	0740	02/28/89	0001	AL	D		<	0.001	-
	0742	03/03/89	0001	AL	C		<	0.001	-
	0744	03/05/89	0001	AL	U		<	0.001	-
	0744	08/03/89	0001	AL	U			0.006	-
	0744	11/02/89	0001	AL	U		<	0.001	-
	0745	09/17/87	0001	AL	U		<	0.005	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CADMIUM	0745	09/22/88	0001	AL	U	MG/L		0.013	-
	0745	03/05/89	0001	AL	U		<	0.001	-
	0745	08/03/89	0001	AL	U			0.012	-
	0745	11/02/89	0001	AL	U			0.002	-
	0746	09/17/87	0001	AL	U		<	0.005	-
	0746	09/22/88	0001	AL	U			0.017	-
	0746	03/05/89	0001	AL	U		<	0.001	-
	0746	08/03/89	0001	AL	U			0.039	-
	0746	11/02/89	0001	AL	U			0.002	-
CALCIUM	0581	03/07/89	0001	AL	O	MG/L		600.	-
	0585	03/01/89	0001	AL	D			560.	-
	0586	03/01/89	0001	AL	D			560.	-
	0588	03/06/89	0001	AL	U			102.	-
	0589	03/01/89	0001	AL	D			540.	-
	0589	08/03/89	0001	AL	D			489.	-
	0590	09/22/88	0001	AL	D			549.	-
	0590	03/01/89	0001	AL	D			540.	-
	0590	08/03/89	0001	AL	D			488.	-
	0590	11/02/89	0001	AL	D			463.	-
	0710	03/06/89	0001	AL	U			427.	-
	0733	09/17/87	0001	AL	D			418.	-
	0733	09/22/88	0001	AL	D			439.	-
	0733	02/28/89	0001	AL	D			434.	-
	0733	08/03/89	0001	AL	D			417.	-
	0733	11/02/89	0001	AL	D			399.	-
	0736	02/28/89	0001	AL	D			510.	-
	0736	08/03/89	0001	AL	D			487.	-
	0736	11/02/89	0001	AL	D			492.	-
	0737	09/17/87	0001	AL	C			473.	-
	0737	09/22/88	0001	AL	C			523.	-
	0737	03/04/89	0001	AL	C			530.	-
	0737	08/07/89	0001	AL	C			497.	-
	0740	09/24/87	0001	AL	D			517.	-
	0740	02/28/89	0001	AL	D			370.	-
	0742	03/03/89	0001	AL	C			570.	-
	0744	03/05/89	0001	AL	U			257.	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CALCIUM	0744	08/03/89	0001	AL	U	MG/L		139.	-
	0744	11/02/89	0001	AL	U			93.1	-
	0745	09/17/87	0001	AL	U			378.	-
	0745	09/22/88	0001	AL	U			429.	-
	0745	03/05/89	0001	AL	U			394.	-
	0745	08/03/89	0001	AL	U			372.	-
	0745	11/02/89	0001	AL	U			466.	-
	0746	09/17/87	0001	AL	U			448.	-
	0746	09/22/88	0001	AL	U			483.	-
	0746	03/05/89	0001	AL	U			510.	-
	0746	08/03/89	0001	AL	U			452.	-
	0746	11/02/89	0001	AL	U			451.	-
CHLORIDE	0581	03/07/89	0001	AL	O	MG/L		720.	-
	0585	03/01/89	0001	AL	D			850.	-
	0586	03/01/89	0001	AL	D			870.	-
	0588	03/06/89	0001	AL	U			195.	-
	0589	03/01/89	0001	AL	D			910.	-
	0589	08/03/89	0001	AL	D			1000.	-
	0590	09/22/88	0001	AL	D			810.	-
	0590	03/01/89	0001	AL	D			851.	-
	0590	08/03/89	0001	AL	D			750.	-
	0590	11/02/89	0001	AL	D			740.	-
	0710	03/06/89	0001	AL	U			640.	-
	0733	09/17/87	0001	AL	D			1100.	-
	0733	09/22/88	0001	AL	D			1170.	-
	0733	02/28/89	0001	AL	D			1150.	-
	0733	08/03/89	0001	AL	D			1200.	-
	0733	11/02/89	0001	AL	D			1200.	-
	0736	02/28/89	0001	AL	D			980.	-
	0736	08/03/89	0001	AL	D			960.	-
	0736	11/02/89	0001	AL	D			1000.	-
	0737	09/17/87	0001	AL	C			1060.	-
	0737	09/22/88	0001	AL	C			1170.	-
	0737	03/04/89	0001	AL	C			1200.	-
	0737	08/07/89	0001	AL	C			1300.	-
	0740	09/24/87	0001	AL	D			890.	-

FORMATION OF COMPLETION CODE:
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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CHLORIDE	0740	02/28/89	0001	AL	D	MG/L		700.	-
	0742	03/03/89	0001	AL	C			920.	-
	0744	03/05/89	0001	AL	U			310.	-
	0744	08/03/89	0001	AL	U			149.	-
	0744	11/02/89	0001	AL	U			160.	-
	0745	09/17/87	0001	AL	U			600.	-
	0745	09/22/88	0001	AL	U			500.	-
	0745	03/05/89	0001	AL	U			430.	-
	0745	08/03/89	0001	AL	U			490.	-
	0745	11/02/89	0001	AL	U			570.	-
	0746	09/17/87	0001	AL	U			695.	-
	0746	09/22/88	0001	AL	U			700.	-
	0746	03/05/89	0001	AL	U			720.	-
	0746	08/03/89	0001	AL	U			730.	-
	0746	11/02/89	0001	AL	U			720.	-
CHROMIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-
	0586	03/01/89	0001	AL	D		<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	09/22/88	0001	AL	D			0.14	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	09/17/87	0001	AL	D		<	0.01	-
	0733	09/22/88	0001	AL	D			0.14	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	09/17/87	0001	AL	C		<	0.01	-
	0737	09/22/88	0001	AL	C			0.16	-

FORMATION OF COMPLETION CODE:
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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CHROMIUM	0737	03/04/89	0001	AL	C	MG/L	<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	09/24/87	0001	AL	D		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	09/17/87	0001	AL	U		<	0.01	-
	0745	09/22/88	0001	AL	U			0.13	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	09/17/87	0001	AL	U		<	0.01	-
	0746	09/22/88	0001	AL	U			0.15	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
COBALT	0581	03/07/89	0001	AL	O	MG/L	<	0.05	-
	0585	03/01/89	0001	AL	D		<	0.05	-
	0586	03/01/89	0001	AL	D		<	0.05	-
	0588	03/06/89	0001	AL	U		<	0.05	-
	0589	03/01/89	0001	AL	D		<	0.05	-
	0589	08/03/89	0001	AL	D		<	0.05	-
	0590	03/01/89	0001	AL	D		<	0.05	-
	0590	08/03/89	0001	AL	D		<	0.05	-
	0590	11/02/89	0001	AL	D		<	0.05	-
	0710	03/06/89	0001	AL	U		<	0.05	-
	0733	02/28/89	0001	AL	D		<	0.05	-
	0733	08/03/89	0001	AL	D		<	0.05	-
	0733	11/02/89	0001	AL	D		<	0.05	-
	0736	02/28/89	0001	AL	D		<	0.05	-
	0736	08/03/89	0001	AL	D		<	0.05	-
	0736	11/02/89	0001	AL	D		<	0.05	-
	0737	03/04/89	0001	AL	C		<	0.05	-
	0737	08/07/89	0001	AL	C		<	0.05	-

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Table Allu... water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
COBALT	0740	02/28/89	0001	AL	D	MG/L	<	0.05	-
	0742	03/03/89	0001	AL	C		<	0.05	-
	0744	03/05/89	0001	AL	U		<	0.05	-
	0744	08/03/89	0001	AL	U		<	0.05	-
	0744	11/02/89	0001	AL	U		<	0.05	-
	0745	03/05/89	0001	AL	U		<	0.05	-
	0745	08/03/89	0001	AL	U		<	0.05	-
	0745	11/02/89	0001	AL	U		<	0.05	-
	0746	03/05/89	0001	AL	U		<	0.05	-
	0746	08/03/89	0001	AL	U		<	0.05	-
	0746	11/02/89	0001	AL	U		<	0.05	-
COPPER	0581	03/07/89	0001	AL	O	MG/L	<	0.02	-
	0585	03/01/89	0001	AL	D		<	0.02	-
	0586	03/01/89	0001	AL	D		<	0.02	-
	0588	03/06/89	0001	AL	U		<	0.02	-
	0589	03/01/89	0001	AL	D		<	0.02	-
	0589	08/03/89	0001	AL	D		<	0.02	-
	0590	09/22/88	0001	AL	D			0.03	-
	0590	03/01/89	0001	AL	D		<	0.02	-
	0590	08/03/89	0001	AL	D		<	0.02	-
	0590	11/02/89	0001	AL	D		<	0.02	-
	0710	03/06/89	0001	AL	U		<	0.02	-
	0733	09/17/87	0001	AL	D			0.02	-
	0733	09/22/88	0001	AL	D			0.03	-
	0733	02/28/89	0001	AL	D		<	0.02	-
	0733	08/03/89	0001	AL	D		<	0.02	-
	0733	11/02/89	0001	AL	D		<	0.02	-
	0736	02/28/89	0001	AL	D		<	0.02	-
	0736	08/03/89	0001	AL	D			0.03	-
	0736	11/02/89	0001	AL	D		<	0.02	-
	0737	09/17/87	0001	AL	C			0.04	-
	0737	09/22/88	0001	AL	C			0.02	-
	0737	03/04/89	0001	AL	C		<	0.02	-
	0737	08/07/89	0001	AL	C		<	0.02	-
	0740	09/24/87	0001	AL	D			0.07	-
	0740	02/28/89	0001	AL	D		<	0.02	-

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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
COPPER	0742	03/03/89	0001	AL	C	MG/L	<	0.02	-
	0744	03/05/89	0001	AL	U		<	0.02	-
	0744	08/03/89	0001	AL	U		<	0.02	-
	0744	11/02/89	0001	AL	U		<	0.02	-
	0745	09/17/87	0001	AL	U			0.02	-
	0745	09/22/88	0001	AL	U		<	0.02	-
	0745	03/05/89	0001	AL	U		<	0.02	-
	0745	08/03/89	0001	AL	U		<	0.02	-
	0745	11/02/89	0001	AL	U		<	0.02	-
	0746	09/17/87	0001	AL	U			0.02	-
	0746	09/22/88	0001	AL	U			0.02	-
	0746	03/05/89	0001	AL	U		<	0.02	-
	0746	08/03/89	0001	AL	U		<	0.02	-
	0746	11/02/89	0001	AL	U		<	0.02	-
CYANIDE	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-
	0586	03/01/89	0001	AL	D		<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
CYANIDE	0744	11/02/89	0001	AL	U	MG/L	<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
FLUORIDE	0581	03/07/89	0001	AL	O	MG/L		4.4	-
	0585	03/01/89	0001	AL	D			3.4	-
	0586	03/01/89	0001	AL	D			3.7	-
	0588	03/06/89	0001	AL	U			0.4	-
	0589	03/01/89	0001	AL	D			0.4	-
	0589	08/03/89	0001	AL	D			0.4	-
	0590	09/22/88	0001	AL	D			0.5	-
	0590	03/01/89	0001	AL	D			0.4	-
	0590	08/03/89	0001	AL	D			0.4	-
	0590	11/02/89	0001	AL	D			0.5	-
	0710	03/06/89	0001	AL	U			1.0	-
	0733	09/17/87	0001	AL	D			0.66	-
	0733	09/22/88	0001	AL	D			0.7	-
	0733	02/28/89	0001	AL	D			0.7	-
	0733	08/03/89	0001	AL	D			0.6	-
	0733	11/02/89	0001	AL	D			0.7	-
	0736	02/28/89	0001	AL	D			0.7	-
	0736	08/03/89	0001	AL	D			0.7	-
	0736	11/02/89	0001	AL	D			0.7	-
	0737	09/17/87	0001	AL	C			1.08	-
	0737	09/22/88	0001	AL	C			1.0	-
	0737	03/04/89	0001	AL	C			1.3	-
	0737	08/07/89	0001	AL	C			0.9	-
	0740	09/24/87	0001	AL	D			0.65	-
	0740	02/28/89	0001	AL	D			0.8	-
	0742	03/03/89	0001	AL	C			0.9	-
	0744	03/05/89	0001	AL	U			0.5	-
	0744	08/03/89	0001	AL	U			0.5	-
	0744	11/02/89	0001	AL	U			0.7	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
FLUORIDE	0745	09/17/87	0001	AL	U	MG/L		0.76	-
	0745	09/22/88	0001	AL	U			0.7	-
	0745	03/05/89	0001	AL	U			0.8	-
	0745	08/03/89	0001	AL	U			0.6	-
	0745	11/02/89	0001	AL	U			0.7	-
	0746	09/17/87	0001	AL	U			1.45	-
	0746	09/22/88	0001	AL	U			1.3	-
	0746	03/05/89	0001	AL	U			1.6	-
	0746	08/03/89	0001	AL	U			1.2	-
	0746	11/02/89	0001	AL	U			1.3	-
GROSS ALPHA	0581	03/07/89	0001	AL	O	PCI/L		71.	33.
	0585	03/01/89	0001	AL	D			182.	58.
	0586	03/01/89	0001	AL	D			223.	50.
	0588	03/06/89	0001	AL	U			3.	6.3
	0589	03/01/89	0001	AL	D			115.	45.
	0589	08/03/89	0001	AL	D			130.	60.
	0590	09/22/88	0001	AL	D			110.	50.
	0590	03/01/89	0001	AL	D			135.	53.
	0590	08/03/89	0001	AL	D			140.	60.
	0590	11/02/89	0001	AL	D			130.	40.
	0710	03/06/89	0001	AL	U			21.	33.
	0733	09/17/87	0001	AL	D			3.	41.
	0733	09/22/88	0001	AL	D			65.	49.
	0733	02/28/89	0001	AL	D			0.	41.
	0733	08/03/89	0001	AL	D			160.	70.
	0733	11/02/89	0001	AL	D			49.	50.
	0736	02/28/89	0001	AL	D			60.	50.
	0736	08/03/89	0001	AL	D			110.	70.
	0736	11/02/89	0001	AL	D			58.	59.
	0737	09/17/87	0001	AL	C			15.	42.
	0737	09/22/88	0001	AL	C			100.	60.
	0737	03/04/89	0001	AL	C			0.	46.
	0737	08/07/89	0001	AL	C			31.	62.
	0740	09/24/87	0001	AL	D			69.	51.
	0740	02/28/89	0001	AL	D			30.	36.
	0742	03/03/89	0001	AL	C			101.	52.

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
GROSS ALPHA	0744	03/05/89	0001	AL	U	PCI/L		19.	15.
	0744	08/03/89	0001	AL	U			6.7	8.5
	0744	11/02/89	0001	AL	U			14.	8.
	0745	09/17/87	0001	AL	U			2.	35.
	0745	09/22/88	0001	AL	U			15.	34.
	0745	03/05/89	0001	AL	U			29.	24.
	0745	08/03/89	0001	AL	U			41.	26.
	0745	11/02/89	0001	AL	U			38.	28.
	0746	09/17/87	0001	AL	U			0.	38.
	0746	09/22/88	0001	AL	U			27.	38.
	0746	03/05/89	0001	AL	U			0.	28.
	0746	08/03/89	0001	AL	U			58.	61.
	0746	11/02/89	0001	AL	U			56.	48.
GROSS BETA	0581	03/07/89	0001	AL	O	PCI/L		76.	26.
	0585	03/01/89	0001	AL	D			176.	43.
	0586	03/01/89	0001	AL	D			147.	34.
	0588	03/06/89	0001	AL	U			12.	5.
	0589	03/01/89	0001	AL	D			145.	35.
	0589	08/03/89	0001	AL	D			110.	30.
	0590	09/22/88	0001	AL	D			110.	30.
	0590	03/01/89	0001	AL	D			57.	35.
	0590	08/03/89	0001	AL	D			120.	30.
	0590	11/02/89	0001	AL	D			72.	24.
	0710	03/06/89	0001	AL	U			58.	29.
	0733	09/17/87	0001	AL	D			51.	29.
	0733	09/22/88	0001	AL	D			64.	28.
	0733	02/28/89	0001	AL	D			21.	35.
	0733	08/03/89	0001	AL	D			93.	32.
	0733	11/02/89	0001	AL	D			34.	28.
	0736	02/28/89	0001	AL	D			42.	37.
	0736	08/03/89	0001	AL	D			87.	30.
	0736	11/02/89	0001	AL	D			39.	32.
	0737	09/17/87	0001	AL	C			77.	31.
	0737	09/22/88	0001	AL	C			100.	30.
	0737	03/04/89	0001	AL	C			36.	40.
	0737	08/07/89	0001	AL	C			55.	37.

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
GROSS BETA	0740	09/24/87	0001	AL	D	PCI/L		140.	40.
	0740	02/28/89	0001	AL	D			24.	27.
	0742	03/03/89	0001	AL	C			48.	36.
	0744	03/05/89	0001	AL	U			12.	11.
	0744	08/03/89	0001	AL	U			13.	5.
	0744	11/02/89	0001	AL	U			11.	4.
	0745	09/17/87	0001	AL	U			57.	29.
	0745	09/22/88	0001	AL	U			41.	24.
	0745	03/05/89	0001	AL	U			0.	16.
	0745	08/03/89	0001	AL	U			19.	13.
	0745	11/02/89	0001	AL	U			23.	17.
	0746	09/17/87	0001	AL	U			64.	30.
	0746	09/22/88	0001	AL	U			65.	24.
	0746	03/05/89	0001	AL	U			40.	26.
	0746	08/03/89	0001	AL	U			32.	32.
	0746	11/02/89	0001	AL	U			110.	40.
IRON	0581	03/07/89	0001	AL	O	MG/L		14.	-
	0585	03/01/89	0001	AL	D			12.	-
	0586	03/01/89	0001	AL	D			16.	-
	0588	03/06/89	0001	AL	U			0.35	-
	0589	03/01/89	0001	AL	D			5.7	-
	0589	08/03/89	0001	AL	D			9.75	-
	0590	09/22/88	0001	AL	D			0.11	-
	0590	03/01/89	0001	AL	D		<	0.03	-
	0590	08/03/89	0001	AL	D			0.12	-
	0590	11/02/89	0001	AL	D			0.12	-
	0710	03/06/89	0001	AL	U			1.56	-
	0733	09/17/87	0001	AL	D			0.34	-
	0733	09/22/88	0001	AL	D			0.94	-
	0733	02/28/89	0001	AL	D			0.97	-
	0733	08/03/89	0001	AL	D			1.10	-
	0733	11/02/89	0001	AL	D			0.94	-
	0736	02/28/89	0001	AL	D		<	0.03	-
	0736	08/03/89	0001	AL	D			0.16	-
	0736	11/02/89	0001	AL	D			0.11	-
	0737	09/17/87	0001	AL	C		<	0.01	-

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Table Alluvi.. water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
IRON	0737	09/22/88	0001	AL	C	MG/L		0.16	-
	0737	03/04/89	0001	AL	C			0.06	-
	0737	08/07/89	0001	AL	C			0.19	-
	0740	09/24/87	0001	AL	D		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.03	-
	0742	03/03/89	0001	AL	C			0.25	-
	0744	03/05/89	0001	AL	U		<	0.03	-
	0744	08/03/89	0001	AL	U			0.03	-
	0744	11/02/89	0001	AL	U			0.04	-
	0745	09/17/87	0001	AL	U			0.11	-
	0745	09/22/88	0001	AL	U			0.39	-
	0745	03/05/89	0001	AL	U			0.82	-
	0745	08/03/89	0001	AL	U			0.59	-
	0745	11/02/89	0001	AL	U			0.57	-
	0746	09/17/87	0001	AL	U			0.01	-
	0746	09/22/88	0001	AL	U			0.15	-
	0746	03/05/89	0001	AL	U		<	0.03	-
	0746	08/03/89	0001	AL	U			0.12	-
	0746	11/02/89	0001	AL	U			0.12	-
LEAD	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-
	0586	03/01/89	0001	AL	D		<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D			0.01	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D			0.02	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D			0.02	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.02	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.01	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
LEAD	0737	08/07/89	0001	AL	C	MG/L		0.02	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U			0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
MAGNESIUM	0581	03/07/89	0001	AL	O	MG/L		259.	-
	0585	03/01/89	0001	AL	D			382.	-
	0586	03/01/89	0001	AL	D			374.	-
	0588	03/06/89	0001	AL	U			39.5	-
	0589	03/01/89	0001	AL	D			332.	-
	0589	08/03/89	0001	AL	D			319.	-
	0590	09/22/88	0001	AL	D			383.	-
	0590	03/01/89	0001	AL	D			390.	-
	0590	08/03/89	0001	AL	D			332.	-
	0590	11/02/89	0001	AL	D			334.	-
	0710	03/06/89	0001	AL	U			310.	-
	0733	09/17/87	0001	AL	D			408.	-
	0733	09/22/88	0001	AL	D			432.	-
	0733	02/28/89	0001	AL	D			432.	-
	0733	08/03/89	0001	AL	D			374.	-
	0733	11/02/89	0001	AL	D			395.	-
	0736	02/28/89	0001	AL	D			462.	-
	0736	08/03/89	0001	AL	D			421.	-
	0736	11/02/89	0001	AL	D			449.	-
	0737	09/17/87	0001	AL	C			485.	-
	0737	09/22/88	0001	AL	C			548.	-
	0737	03/04/89	0001	AL	C			550.	-
	0737	08/07/89	0001	AL	C			565.	-
	0740	09/24/87	0001	AL	D			406.	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MAGNESIUM	0740	02/28/89	0001	AL	D	MG/L		310.	-
	0742	03/03/89	0001	AL	C			500.	-
	0744	03/05/89	0001	AL	U			147.	-
	0744	08/03/89	0001	AL	U			81.0	-
	0744	11/02/89	0001	AL	U			52.1	-
	0745	09/17/87	0001	AL	U			289.	-
	0745	09/22/88	0001	AL	U			301.	-
	0745	03/05/89	0001	AL	U			256.	-
	0745	08/03/89	0001	AL	U			252.	-
	0745	11/02/89	0001	AL	U			281.	-
	0746	09/17/87	0001	AL	U			458.	-
	0746	09/22/88	0001	AL	U			504.	-
	0746	03/05/89	0001	AL	U			525.	-
	0746	08/03/89	0001	AL	U			478.	-
	0746	11/02/89	0001	AL	U			469.	-
MANGANESE	0581	03/07/89	0001	AL	O	MG/L		4.90	-
	0585	03/01/89	0001	AL	D			3.62	-
	0586	03/01/89	0001	AL	D			4.16	-
	0588	03/06/89	0001	AL	U			0.28	-
	0589	03/01/89	0001	AL	D			2.17	-
	0589	08/03/89	0001	AL	D			2.11	-
	0590	09/22/88	0001	AL	D			1.52	-
	0590	03/01/89	0001	AL	D			1.22	-
	0590	08/03/89	0001	AL	D			1.49	-
	0590	11/02/89	0001	AL	D			1.51	-
	0710	03/06/89	0001	AL	U			1.93	-
	0733	09/17/87	0001	AL	D			1.69	-
	0733	09/22/88	0001	AL	D			1.49	-
	0733	02/28/89	0001	AL	D			1.27	-
	0733	08/03/89	0001	AL	D			1.54	-
	0733	11/02/89	0001	AL	D			1.50	-
	0736	02/28/89	0001	AL	D			0.94	-
	0736	08/03/89	0001	AL	D			1.64	-
	0736	11/02/89	0001	AL	D			1.88	-
	0737	09/17/87	0001	AL	C			2.21	-
	0737	09/22/88	0001	AL	C			2.02	-

FORMATION OF COMPLETION CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MANGANESE	0737	03/04/89	0001	AL	C	MG/L		1.80	-
	0737	08/07/89	0001	AL	C			2.08	-
	0740	09/24/87	0001	AL	D			3.50	-
	0740	02/28/89	0001	AL	D			2.46	-
	0742	03/03/89	0001	AL	C			1.78	-
	0744	03/05/89	0001	AL	U			1.07	-
	0744	08/03/89	0001	AL	U			0.58	-
	0744	11/02/89	0001	AL	U			0.43	-
	0745	09/17/87	0001	AL	U			1.34	-
	0745	09/22/88	0001	AL	U			1.32	-
	0745	03/05/89	0001	AL	U			1.13	-
	0745	08/03/89	0001	AL	U			1.20	-
	0745	11/02/89	0001	AL	U			1.38	-
	0746	09/17/87	0001	AL	U			1.37	-
	0746	09/22/88	0001	AL	U			1.34	-
	0746	03/05/89	0001	AL	U			1.38	-
	0746	08/03/89	0001	AL	U			1.38	-
	0746	11/02/89	0001	AL	U			1.39	-
MECHANICAL SIEVE TEST 3/8 INCH	0746	08/03/89	0001	AL	U	% PASSING		3690.	-
MERCURY	0581	03/07/89	0001	AL	O	MG/L	<	0.0002	-
	0585	03/01/89	0001	AL	D		<	0.0002	-
	0586	03/01/89	0001	AL	D		<	0.0002	-
	0588	03/06/89	0001	AL	U		<	0.0002	-
	0589	03/01/89	0001	AL	D		<	0.0002	-
	0589	08/03/89	0001	AL	D		<	0.0002	-
	0590	03/01/89	0001	AL	D		<	0.0002	-
	0590	08/03/89	0001	AL	D		<	0.0002	-
	0590	11/02/89	0001	AL	D		<	0.0002	-
	0710	03/06/89	0001	AL	U		<	0.0002	-
	0733	02/28/89	0001	AL	D		<	0.0002	-
	0733	08/03/89	0001	AL	D		<	0.0002	-
	0733	11/02/89	0001	AL	D		<	0.0002	-
	0736	02/28/89	0001	AL	D		<	0.0002	-
	0736	08/03/89	0001	AL	D		<	0.0002	-
	0736	11/02/89	0001	AL	D		<	0.0002	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MERCURY	0737	03/04/89	0001	AL	C	MG/L	<	0.0002	-
	0737	08/07/89	0001	AL	C		<	0.0002	-
	0740	02/28/89	0001	AL	D		<	0.0002	-
	0742	03/03/89	0001	AL	C		<	0.0002	-
	0744	03/05/89	0001	AL	U		<	0.0002	-
	0744	08/03/89	0001	AL	U		<	0.0002	-
	0744	11/02/89	0001	AL	U		<	0.0002	-
	0745	03/05/89	0001	AL	U		<	0.0002	-
	0745	08/03/89	0001	AL	U		<	0.0002	-
	0745	11/02/89	0001	AL	U		<	0.0002	-
	0746	03/05/89	0001	AL	U		<	0.0002	-
	0746	08/03/89	0001	AL	U		<	0.0002	-
	0746	11/02/89	0001	AL	U		<	0.0002	-
MOLYBDENUM	0581	03/07/89	0001	AL	O	MG/L		0.10	-
	0585	03/01/89	0001	AL	D			0.24	-
	0586	03/01/89	0001	AL	D			0.14	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D			0.04	-
	0589	08/03/89	0001	AL	D			0.06	-
	0590	03/01/89	0001	AL	D			0.01	-
	0590	08/03/89	0001	AL	D			0.04	-
	0590	11/02/89	0001	AL	D			0.04	-
	0710	03/06/89	0001	AL	U			0.06	-
	0733	02/28/89	0001	AL	D			0.01	-
	0733	08/03/89	0001	AL	D			0.05	-
	0733	11/02/89	0001	AL	D			0.04	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.09	-
	0736	11/02/89	0001	AL	D			0.04	-
	0737	03/04/89	0001	AL	C			0.07	-
	0737	08/07/89	0001	AL	C			0.09	-
	0740	02/28/89	0001	AL	D			0.07	-
	0742	03/03/89	0001	AL	C			0.03	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U			0.01	-
	0744	11/02/89	0001	AL	U			0.02	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
MOLYBDENUM	0745	03/05/89	0001	AL	U	MG/L		0.02	-
	0745	08/03/89	0001	AL	U			0.03	-
	0745	11/02/89	0001	AL	U			0.05	-
	0746	03/05/89	0001	AL	U			0.15	-
	0746	08/03/89	0001	AL	U			0.14	-
	0746	11/02/89	0001	AL	U			0.15	-
NICKEL	0581	03/07/89	0001	AL	O	MG/L	<	0.04	-
	0585	03/01/89	0001	AL	D			0.06	-
	0586	03/01/89	0001	AL	D			0.04	-
	0588	03/06/89	0001	AL	U		<	0.04	-
	0589	03/01/89	0001	AL	D		<	0.04	-
	0589	08/03/89	0001	AL	D		<	0.04	-
	0590	09/22/88	0001	AL	D			0.11	-
	0590	03/01/89	0001	AL	D		<	0.04	-
	0590	08/03/89	0001	AL	D		<	0.04	-
	0590	11/02/89	0001	AL	D			0.05	-
	0710	03/06/89	0001	AL	U		<	0.04	-
	0733	09/17/87	0001	AL	D			0.01	-
	0733	09/22/88	0001	AL	D			0.12	-
	0733	02/28/89	0001	AL	D		<	0.04	-
	0733	08/03/89	0001	AL	D		<	0.04	-
	0733	11/02/89	0001	AL	D			0.05	-
	0736	02/28/89	0001	AL	D		<	0.04	-
	0736	08/03/89	0001	AL	D		<	0.04	-
	0736	11/02/89	0001	AL	D			0.05	-
	0737	09/17/87	0001	AL	C		<	0.01	-
	0737	09/22/88	0001	AL	C			0.13	-
	0737	03/04/89	0001	AL	C		<	0.04	-
	0737	08/07/89	0001	AL	C		<	0.04	-
	0740	09/24/87	0001	AL	D		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.04	-
	0742	03/03/89	0001	AL	C		<	0.04	-
	0744	03/05/89	0001	AL	U		<	0.04	-
	0744	08/03/89	0001	AL	U		<	0.04	-
	0744	11/02/89	0001	AL	U		<	0.04	-
	0745	09/17/87	0001	AL	U		<	0.01	-

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Table Allu...al water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
NICKEL	0745	09/22/88	0001	AL	U	MG/L		0.09	-
	0745	03/05/89	0001	AL	U		<	0.04	-
	0745	08/03/89	0001	AL	U		<	0.04	-
	0745	11/02/89	0001	AL	U		<	0.04	-
	0746	09/17/87	0001	AL	U		<	0.01	-
	0746	09/22/88	0001	AL	U			0.12	-
	0746	03/05/89	0001	AL	U		<	0.04	-
	0746	08/03/89	0001	AL	U		<	0.04	-
	0746	11/02/89	0001	AL	U		<	0.04	-
NITRATE	0581	03/07/89	0001	AL	O	MG/L		1.0	-
	0585	03/01/89	0001	AL	D		<	1.0	-
	0586	03/01/89	0001	AL	D		<	1.0	-
	0588	03/06/89	0001	AL	U		<	1.0	-
	0589	03/01/89	0001	AL	D		<	1.0	-
	0589	08/03/89	0001	AL	D		<	1.	-
	0590	09/22/88	0001	AL	D			5.7	-
	0590	03/01/89	0001	AL	D			2.0	-
	0590	08/03/89	0001	AL	D		<	1.	-
	0590	11/02/89	0001	AL	D		<	0.1	-
	0710	03/06/89	0001	AL	U		<	1.0	-
	0733	09/17/87	0001	AL	D			0.4	-
	0733	09/22/88	0001	AL	D		<	1.	-
	0733	02/28/89	0001	AL	D		<	1.0	-
	0733	08/03/89	0001	AL	D			4.0	-
	0733	11/02/89	0001	AL	D		<	0.1	-
	0736	02/28/89	0001	AL	D		<	1.0	-
	0736	08/03/89	0001	AL	D			2.5	-
	0736	11/02/89	0001	AL	D		<	0.1	-
	0737	09/17/87	0001	AL	C			0.4	-
	0737	09/22/88	0001	AL	C		<	1.	-
	0737	03/04/89	0001	AL	C		<	1.0	-
	0737	08/07/89	0001	AL	C		<	1.	-
	0740	09/24/87	0001	AL	D			2.2	-
	0740	02/28/89	0001	AL	D			2.0	-
	0742	03/03/89	0001	AL	C		<	1.0	-
	0744	03/05/89	0001	AL	U		<	1.0	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
NITRATE	0744	08/03/89	0001	AL	U	MG/L		29.	-
	0744	11/02/89	0001	AL	U			1.5	-
	0745	09/17/87	0001	AL	U			3.5	-
	0745	09/22/88	0001	AL	U		<	1.	-
	0745	03/05/89	0001	AL	U		<	1.0	-
	0745	08/03/89	0001	AL	U		<	1.	-
	0745	11/02/89	0001	AL	U		<	0.1	-
	0746	09/17/87	0001	AL	U			3.5	-
	0746	09/22/88	0001	AL	U		<	1.	-
	0746	03/05/89	0001	AL	U			1.0	-
	0746	08/03/89	0001	AL	U		<	1.	-
	0746	11/02/89	0001	AL	U		<	0.1	-
PH	0581	03/07/89	0001	AL	O	SU		7.10	-
	0585	03/01/89	0001	AL	D			7.0	-
	0586	03/01/89	0001	AL	D			7.05	-
	0588	03/06/89	0001	AL	U			7.87	-
	0589	03/01/89	0001	AL	D			7.06	-
	0589	08/03/89	0001	AL	D			7.03	-
	0590	09/22/88	0001	AL	D			6.85	-
	0590	03/01/89	0001	AL	D			6.97	-
	0590	08/03/89	0001	AL	D			7.03	-
	0590	11/02/89	0001	AL	D			6.83	-
	0710	03/06/89	0001	AL	U			7.0	-
	0733	09/17/87	0001	AL	D			6.90	-
	0733	09/22/88	0001	AL	D			7.77	-
	0733	02/28/89	0001	AL	D			7.03	-
	0733	08/03/89	0001	AL	D			7.09	-
	0733	11/02/89	0001	AL	D			7.30	-
	0736	02/28/89	0001	AL	D			7.04	-
	0736	08/03/89	0001	AL	D			6.89	-
	0736	11/02/89	0001	AL	D			6.83	-
	0737	09/17/87	0001	AL	C			7.0	-
	0737	09/22/88	0001	AL	C			7.12	-
	0737	03/04/89	0001	AL	C			7.07	-
	0737	08/07/89	0001	AL	C			7.12	-
	0740	09/24/87	0001	AL	D			6.80	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
PH	0740	02/28/89	0001	AL	D	SU		7.11	-
	0742	03/03/89	0001	AL	C			7.02	-
	0744	03/05/89	0001	AL	U			7.18	-
	0744	08/03/89	0001	AL	U			7.16	-
	0744	11/02/89	0001	AL	U			7.27	-
	0745	09/17/87	0001	AL	U			6.90	-
	0745	09/22/88	0001	AL	U			7.08	-
	0745	03/05/89	0001	AL	U			7.02	-
	0745	08/03/89	0001	AL	U			7.03	-
	0745	11/02/89	0001	AL	U			6.85	-
	0746	09/17/87	0001	AL	U			7.0	-
	0746	09/22/88	0001	AL	U			7.03	-
	0746	03/05/89	0001	AL	U			7.20	-
	0746	08/03/89	0001	AL	U			7.18	-
	0746	11/02/89	0001	AL	U			7.10	-
POTASSIUM	0581	03/07/89	0001	AL	O	MG/L		56.	-
	0585	03/01/89	0001	AL	D			68.	-
	0586	03/01/89	0001	AL	D			71.	-
	0588	03/06/89	0001	AL	U			6.5	-
	0589	03/01/89	0001	AL	D			49.	-
	0589	08/03/89	0001	AL	D			66.6	-
	0590	09/22/88	0001	AL	D			23.4	-
	0590	03/01/89	0001	AL	D			15.8	-
	0590	08/03/89	0001	AL	D			25.5	-
	0590	11/02/89	0001	AL	D			25.7	-
	0710	03/06/89	0001	AL	U			19.	-
	0733	09/17/87	0001	AL	D			8.82	-
	0733	09/22/88	0001	AL	D			9.1	-
	0733	02/28/89	0001	AL	D			8.1	-
	0733	08/03/89	0001	AL	D			9.2	-
	0733	11/02/89	0001	AL	D			10.2	-
	0736	02/28/89	0001	AL	D			8.4	-
	0736	08/03/89	0001	AL	D			12.7	-
	0736	11/02/89	0001	AL	D			13.1	-
	0737	09/17/87	0001	AL	C			10.5	-
	0737	09/22/88	0001	AL	C			10.9	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
POTASSIUM	0737	03/04/89	0001	AL	C	MG/L		10.1	-
	0737	08/07/89	0001	AL	C			11.9	-
	0740	09/24/87	0001	AL	D			26.0	-
	0740	02/28/89	0001	AL	D			16.0	-
	0742	03/03/89	0001	AL	C			6.9	-
	0744	03/05/89	0001	AL	U			6.4	-
	0744	08/03/89	0001	AL	U			7.5	-
	0744	11/02/89	0001	AL	U			5.9	-
	0745	09/17/87	0001	AL	U			5.05	-
	0745	09/22/88	0001	AL	U			5.7	-
	0745	03/05/89	0001	AL	U			4.9	-
	0745	08/03/89	0001	AL	U			5.0	-
	0745	11/02/89	0001	AL	U			6.0	-
	0746	09/17/87	0001	AL	U			8.28	-
	0746	09/22/88	0001	AL	U			9.4	-
	0746	03/05/89	0001	AL	U			8.4	-
	0746	08/03/89	0001	AL	U			10.9	-
	0746	11/02/89	0001	AL	U			10.7	-
RADIUM-226	0581	03/07/89	0001	AL	O	PCI/L		1.2	0.5
	0585	03/01/89	0001	AL	D			0.0	0.2
	0586	03/01/89	0001	AL	D			0.8	0.4
	0588	03/06/89	0001	AL	U			0.0	0.2
	0589	03/01/89	0001	AL	D			0.0	0.2
	0589	08/03/89	0001	AL	D			0.1	0.2
	0590	09/22/88	0001	AL	D			0.1	0.1
	0590	03/01/89	0001	AL	D			0.0	0.2
	0590	08/03/89	0001	AL	D			0.1	0.1
	0590	11/02/89	0001	AL	D			0.1	0.1
	0710	03/06/89	0001	AL	U			0.2	0.2
	0733	09/17/87	0001	AL	D			0.0	0.1
	0733	09/22/88	0001	AL	D			0.1	0.1
	0733	02/28/89	0001	AL	D			0.0	0.2
	0733	08/03/89	0001	AL	D			0.0	0.1
	0733	11/02/89	0001	AL	D			0.0	0.1
	0736	02/28/89	0001	AL	D			0.0	0.2
	0736	08/03/89	0001	AL	D			0.0	0.1

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
RADIUM-226	0736	11/02/89	0001	AL	D	PCI/L		0.0	0.1
	0737	09/17/87	0001	AL	C			0.0	0.1
	0737	09/22/88	0001	AL	C			0.2	0.2
	0737	03/04/89	0001	AL	C			0.1	0.2
	0737	08/07/89	0001	AL	C			0.0	0.1
	0740	09/24/87	0001	AL	D			0.0	0.1
	0740	02/28/89	0001	AL	D			0.0	0.2
	0742	03/03/89	0001	AL	C			0.0	0.1
	0744	03/05/89	0001	AL	U			0.0	0.1
	0744	08/03/89	0001	AL	U			0.0	0.1
	0744	11/02/89	0001	AL	U			0.2	0.2
	0745	09/17/87	0001	AL	U			0.0	0.1
	0745	09/22/88	0001	AL	U			0.1	0.1
	0745	03/05/89	0001	AL	U			0.0	0.2
	0745	08/03/89	0001	AL	U			0.1	0.2
	0745	11/02/89	0001	AL	U			0.0	0.1
	0746	09/17/87	0001	AL	U			0.1	0.2
	0746	09/22/88	0001	AL	U			0.1	0.1
	0746	03/05/89	0001	AL	U			0.1	0.2
	0746	08/03/89	0001	AL	U			0.0	0.1
	0746	11/02/89	0001	AL	U			0.0	0.1
RADIUM-228	0581	03/07/89	0001	AL	O	PCI/L		0.5	1.3
	0585	03/01/89	0001	AL	D			2.3	1.2
	0586	03/01/89	0001	AL	D			2.0	1.3
	0588	03/06/89	0001	AL	U			0.4	1.4
	0589	03/01/89	0001	AL	D			2.3	1.4
	0589	08/03/89	0001	AL	D			0.2	0.8
	0590	09/22/88	0001	AL	D			0.0	0.7
	0590	03/01/89	0001	AL	D			0.7	1.3
	0590	08/03/89	0001	AL	D			1.0	0.9
	0590	11/02/89	0001	AL	D			0.0	1.0
	0710	03/06/89	0001	AL	U			0.0	1.3
	0733	09/17/87	0001	AL	D			0.4	1.6
	0733	09/22/88	0001	AL	D			0.0	0.7
	0733	02/28/89	0001	AL	D			0.5	1.3
	0733	08/03/89	0001	AL	D			0.2	0.9

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
RADIUM-228	0733	11/02/89	0001	AL	D	PCI/L		1.0	0.9
	0736	02/28/89	0001	AL	D			0.3	1.3
	0736	08/03/89	0001	AL	D			0.9	0.9
	0736	11/02/89	0001	AL	D			0.7	0.9
	0737	09/17/87	0001	AL	C			2.0	1.9
	0737	09/22/88	0001	AL	C			1.3	1.0
	0737	03/04/89	0001	AL	C			1.5	1.3
	0737	08/07/89	0001	AL	C			1.0	0.8
	0740	09/24/87	0001	AL	D			0.5	1.0
	0740	02/28/89	0001	AL	D			2.0	1.5
	0742	03/03/89	0001	AL	C			1.7	1.4
	0744	03/05/89	0001	AL	U			0.1	1.5
	0744	08/03/89	0001	AL	U			0.7	0.8
	0744	11/02/89	0001	AL	U			0.3	1.0
	0745	09/17/87	0001	AL	U			0.4	0.8
	0745	09/22/88	0001	AL	U			0.3	0.9
	0745	03/05/89	0001	AL	U			1.0	1.1
	0745	08/03/89	0001	AL	U			0.0	0.9
	0745	11/02/89	0001	AL	U			0.7	0.9
	0746	09/17/87	0001	AL	U			1.0	0.9
	0746	09/22/88	0001	AL	U			0.1	0.7
	0746	03/05/89	0001	AL	U			1.2	1.2
	0746	08/03/89	0001	AL	U			0.6	0.9
	0746	11/02/89	0001	AL	U			0.7	0.8
SELENIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.025	-
	0586	03/01/89	0001	AL	D		<	0.025	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.025	-
	0589	08/03/89	0001	AL	D			0.028	-
	0590	09/22/88	0001	AL	D			0.142	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D			0.025	-
	0590	11/02/89	0001	AL	D			0.036	-
	0710	03/06/89	0001	AL	U		<	0.025	-
	0733	09/17/87	0001	AL	D			0.164	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SELENIUM	0733	09/22/88	0001	AL	D	MG/L		0.196	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D			0.025	-
	0733	11/02/89	0001	AL	D			0.039	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.026	-
	0736	11/02/89	0001	AL	D			0.038	-
	0737	09/17/87	0001	AL	C			0.159	-
	0737	09/22/88	0001	AL	C			0.199	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C			0.026	-
	0740	09/24/87	0001	AL	D			0.127	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U			0.012	-
	0744	11/02/89	0001	AL	U			0.011	-
	0745	09/17/87	0001	AL	U			0.067	-
	0745	09/22/88	0001	AL	U			0.060	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U			0.018	-
	0745	11/02/89	0001	AL	U			0.030	-
	0746	09/17/87	0001	AL	U			0.060	-
	0746	09/22/88	0001	AL	U			0.191	-
	0746	03/05/89	0001	AL	U			0.05	-
	0746	08/03/89	0001	AL	U			0.057	-
	0746	11/02/89	0001	AL	U			0.060	-
SILICA - SIO2	0590	11/02/89	0001	AL	D	MG/L		20.	-
	0733	11/02/89	0001	AL	D			17.	-
	0736	11/02/89	0001	AL	D			21.	-
	0744	11/02/89	0001	AL	U			17.	-
	0745	11/02/89	0001	AL	U			17.	-
	0746	11/02/89	0001	AL	U			17.	-
SILVER	0581	03/07/89	0001	AL	O	MG/L	<	0.01	-
	0585	03/01/89	0001	AL	D		<	0.01	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SILVER	0586	03/01/89	0001	AL	D	MG/L	<	0.01	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D			0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.01	-
	0736	11/02/89	0001	AL	D			0.01	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U			0.01	-
SODIUM	0581	03/07/89	0001	AL	O	MG/L		805.	-
	0585	03/01/89	0001	AL	D			985.	-
	0586	03/01/89	0001	AL	D			990.	-
	0588	03/06/89	0001	AL	U			144.	-
	0589	03/01/89	0001	AL	D			1080.	-
	0589	08/03/89	0001	AL	D			1070.	-
	0590	09/22/88	0001	AL	D			975.	-
	0590	03/01/89	0001	AL	D			950.	-
	0590	08/03/89	0001	AL	D			953.	-

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Table Alt. .t water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SODIUM	0590	11/02/89	0001	AL	D	MG/L		944.	-
	0710	03/06/89	0001	AL	U			736.	-
	0733	09/17/87	0001	AL	D			1327.	-
	0733	09/22/88	0001	AL	D			1220.	-
	0733	02/28/89	0001	AL	D			1220.	-
	0733	08/03/89	0001	AL	D			1250.	-
	0733	11/02/89	0001	AL	D			1200.	-
	0736	02/28/89	0001	AL	D			1190.	-
	0736	08/03/89	0001	AL	D			1200.	-
	0736	11/02/89	0001	AL	D			1180.	-
	0737	09/17/87	0001	AL	C			1400.	-
	0737	09/22/88	0001	AL	C			1220.	-
	0737	03/04/89	0001	AL	C			1230.	-
	0737	08/07/89	0001	AL	C			1230.	-
	0740	09/24/87	0001	AL	D			1240.	-
	0740	02/28/89	0001	AL	D			728.	-
	0742	03/03/89	0001	AL	C			950.	-
	0744	03/05/89	0001	AL	U			309.	-
	0744	08/03/89	0001	AL	U			234.	-
	0744	11/02/89	0001	AL	U			186.	-
	0745	09/17/87	0001	AL	U			668.	-
	0745	09/22/88	0001	AL	U			573.	-
	0745	03/05/89	0001	AL	U			540.	-
	0745	08/03/89	0001	AL	U			404.	-
	0745	11/02/89	0001	AL	U			554.	-
	0746	09/17/87	0001	AL	U			909.	-
	0746	09/22/88	0001	AL	U			871.	-
	0746	03/05/89	0001	AL	U			910.	-
	0746	08/03/89	0001	AL	U			841.	-
	0746	11/02/89	0001	AL	U			843.	-
SPECIFIC CONDUCTANCE	0581	03/07/89	0001	AL	O	UMHO/CM		4500.	-
	0585	03/01/89	0001	AL	D			4600.	-
	0586	03/01/89	0001	AL	D			4600.	-
	0588	03/06/89	0001	AL	U			800.	-
	0589	03/01/89	0001	AL	D			4400.	-
	0589	08/03/89	0001	AL	D			2700.	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
SPECIFIC CONDUCTANCE	0590	09/22/88	0001	AL	D	UMHO/CM		6000.	-
	0590	03/01/89	0001	AL	D			3500.	-
	0590	08/03/89	0001	AL	D			3220.	-
	0590	11/02/89	0001	AL	D			1700.	-
	0710	03/06/89	0001	AL	U			3600.	-
	0733	09/17/87	0001	AL	D			7000.	-
	0733	09/22/88	0001	AL	D			7500.	-
	0733	02/28/89	0001	AL	D			4100.	-
	0733	08/03/89	0001	AL	D			3400.	-
	0733	11/02/89	0001	AL	D			1000.	-
	0736	02/28/89	0001	AL	D			4400.	-
	0736	08/03/89	0001	AL	D			1280.	-
	0736	11/02/89	0001	AL	D			1050.	-
	0737	09/17/87	0001	AL	C			7100.	-
	0737	09/22/88	0001	AL	C			7000.	-
	0737	03/04/89	0001	AL	C			6000.	-
	0737	08/07/89	0001	AL	C			3780.	-
	0740	09/24/87	0001	AL	D			7000.	-
	0740	02/28/89	0001	AL	D			3400.	-
	0742	03/03/89	0001	AL	C			4900.	-
	0744	03/05/89	0001	AL	U			1800.	-
	0744	08/03/89	0001	AL	U			980.	-
	0744	11/02/89	0001	AL	U			75.	-
	0745	09/17/87	0001	AL	U			4000.	-
	0745	09/22/88	0001	AL	U			3550.	-
	0745	03/05/89	0001	AL	U			2950.	-
	0745	08/03/89	0001	AL	U			2000.	-
	0745	11/02/89	0001	AL	U			405.	-
	0746	09/17/87	0001	AL	U			5500.	-
	0746	09/22/88	0001	AL	U			4900.	-
	0746	03/05/89	0001	AL	U			4300.	-
	0746	08/03/89	0001	AL	U			3700.	-
	0746	11/02/89	0001	AL	U			900.	-
STRONTIUM	0581	03/07/89	0001	AL	O	MG/L		7.3	-
	0585	03/01/89	0001	AL	D			4.65	-
	0586	03/01/89	0001	AL	D			4.44	-

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STRONTIUM	0588	03/06/89	0001	AL	U	MG/L		1.04	-
	0589	03/01/89	0001	AL	D			5.3	-
	0589	08/03/89	0001	AL	D			4.49	-
	0590	09/22/88	0001	AL	D			6.2	-
	0590	03/01/89	0001	AL	D			4.93	-
	0590	08/03/89	0001	AL	D			4.9	-
	0590	11/02/89	0001	AL	D			5.36	-
	0710	03/06/89	0001	AL	U			4.89	-
	0733	09/17/87	0001	AL	D			6.95	-
	0733	09/22/88	0001	AL	D			6.5	-
	0733	02/28/89	0001	AL	D			5.1	-
	0733	08/03/89	0001	AL	D			5.2	-
	0733	11/02/89	0001	AL	D			6.15	-
	0736	02/28/89	0001	AL	D			5.0	-
	0736	08/03/89	0001	AL	D			4.6	-
	0736	11/02/89	0001	AL	D			6.45	-
	0737	09/17/87	0001	AL	C			7.30	-
	0737	09/22/88	0001	AL	C			7.2	-
	0737	03/04/89	0001	AL	C			7.3	-
	0737	08/07/89	0001	AL	C			6.22	-
	0740	09/24/87	0001	AL	D			6.25	-
	0740	02/28/89	0001	AL	D			4.10	-
	0742	03/03/89	0001	AL	C			5.7	-
	0744	03/05/89	0001	AL	U			2.39	-
	0744	08/03/89	0001	AL	U			1.41	-
	0744	11/02/89	0001	AL	U			1.06	-
	0745	09/17/87	0001	AL	U			4.50	-
	0745	09/22/88	0001	AL	U			4.1	-
	0745	03/05/89	0001	AL	U			4.18	-
	0745	08/03/89	0001	AL	U			3.47	-
	0745	11/02/89	0001	AL	U			4.88	-
	0746	09/17/87	0001	AL	U			6.60	-
	0746	09/22/88	0001	AL	U			6.5	-
	0746	03/05/89	0001	AL	U			7.1	-
	0746	08/03/89	0001	AL	U			5.83	-
	0746	11/02/89	0001	AL	U			6.48	-
SULFATE	0581	03/07/89	0001	AL	O	MG/L		2940.	-

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SULFATE	0585	03/01/89	0001	AL	D	MG/L		3950.	-
	0586	03/01/89	0001	AL	D			3940.	-
	0588	03/06/89	0001	AL	U			179.	-
	0589	03/01/89	0001	AL	D			3510.	-
	0589	08/03/89	0001	AL	D			3660.	-
	0590	09/22/88	0001	AL	D			3420.	-
	0590	03/01/89	0001	AL	D			3420.	-
	0590	08/03/89	0001	AL	D			3310.	-
	0590	11/02/89	0001	AL	D			3140.	-
	0710	03/06/89	0001	AL	U			2770.	-
	0733	09/17/87	0001	AL	D			3310.	-
	0733	09/22/88	0001	AL	D			3130.	-
	0733	02/28/89	0001	AL	D			3240.	-
	0733	08/03/89	0001	AL	D			3170.	-
	0733	11/02/89	0001	AL	D			3230.	-
	0736	02/28/89	0001	AL	D			3850.	-
	0736	08/03/89	0001	AL	D			3720.	-
	0736	11/02/89	0001	AL	D			3960.	-
	0737	09/17/87	0001	AL	C			4130.	-
	0737	09/22/88	0001	AL	C			3880.	-
	0737	03/04/89	0001	AL	C			3920.	-
	0737	08/07/89	0001	AL	C			4060.	-
	0740	09/24/87	0001	AL	D			3930.	-
	0740	02/28/89	0001	AL	D			2520.	-
	0742	03/03/89	0001	AL	C			3880.	-
	0744	03/05/89	0001	AL	U			1020.	-
	0744	08/03/89	0001	AL	U			611.	-
	0744	11/02/89	0001	AL	U			385.	-
	0745	09/17/87	0001	AL	U			2140.	-
	0745	09/22/88	0001	AL	U			2210.	-
	0745	03/05/89	0001	AL	U			1990.	-
	0745	08/03/89	0001	AL	U			1760.	-
	0745	11/02/89	0001	AL	U			2460.	-
	0746	09/17/87	0001	AL	U			3450.	-
	0746	09/22/88	0001	AL	U			3550.	-
	0746	03/05/89	0001	AL	U			3620.	-
	0746	08/03/89	0001	AL	U			3690.	-
	0746	11/02/89	0001	AL	U			3620.	-

FORMATION OF COMPLETION CODE:
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FLOW RELATIONSHIP CODE:
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PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TEMPERATURE	0581	03/07/89	0001	AL	O	C - DEGREE		14.	-
	0585	03/01/89	0001	AL	D			10.0	-
	0586	03/01/89	0001	AL	D			9.5	-
	0588	03/06/89	0001	AL	U			7.5	-
	0589	03/01/89	0001	AL	D			11.5	-
	0589	08/03/89	0001	AL	D			17.5	-
	0590	09/22/88	0001	AL	D			17.0	-
	0590	03/01/89	0001	AL	D			9.0	-
	0590	08/03/89	0001	AL	D			16.5	-
	0590	11/02/89	0001	AL	D			16.0	-
	0710	03/06/89	0001	AL	U			11.0	-
	0733	09/17/87	0001	AL	D			17.0	-
	0733	09/22/88	0001	AL	D			21.0	-
	0733	02/28/89	0001	AL	D			14.5	-
	0733	08/03/89	0001	AL	D			17.5	-
	0733	11/02/89	0001	AL	D			16.0	-
	0736	02/28/89	0001	AL	D			12.0	-
	0736	08/03/89	0001	AL	D			22.5	-
	0736	11/02/89	0001	AL	D			20.0	-
	0737	09/17/87	0001	AL	C			15.5	-
	0737	09/22/88	0001	AL	C			16.5	-
	0737	03/04/89	0001	AL	C			15.0	-
	0737	08/07/89	0001	AL	C			16.5	-
	0740	09/24/87	0001	AL	D			17.0	-
	0740	02/28/89	0001	AL	D			11.0	-
	0742	03/03/89	0001	AL	C			14.	-
	0744	03/05/89	0001	AL	U			10.	-
	0744	08/03/89	0001	AL	U			20.5	-
	0744	11/02/89	0001	AL	U			20.0	-
	0745	09/17/87	0001	AL	U			14.0	-
	0745	09/22/88	0001	AL	U			14.	-
	0745	03/05/89	0001	AL	U			13.	-
	0745	08/03/89	0001	AL	U			14.0	-
	0745	11/02/89	0001	AL	U			15.0	-
	0746	09/17/87	0001	AL	U			15.0	-
	0746	09/22/88	0001	AL	U			14.	-
	0746	03/05/89	0001	AL	U			15.	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TEMPERATURE	0746	08/03/89	0001	AL	U	C - DEGREE		16.0	-
	0746	11/02/89	0001	AL	U			14.0	-
THALLIUM	0581	03/07/89	0001	AL	O	MG/L	<	0.1	-
	0585	03/01/89	0001	AL	D		<	0.1	-
	0586	03/01/89	0001	AL	D		<	0.1	-
	0588	03/06/89	0001	AL	U		<	0.1	-
	0589	03/01/89	0001	AL	D		<	0.1	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	03/01/89	0001	AL	D		<	0.1	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.1	-
	0733	02/28/89	0001	AL	D		<	0.1	-
	0733	08/03/89	0001	AL	D		<	0.01	-
	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.1	-
	0736	08/03/89	0001	AL	D		<	0.01	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	03/04/89	0001	AL	C		<	0.1	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	02/28/89	0001	AL	D		<	0.1	-
	0742	03/03/89	0001	AL	C		<	0.1	-
	0744	03/05/89	0001	AL	U		<	0.1	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	03/05/89	0001	AL	U		<	0.1	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	03/05/89	0001	AL	U		<	0.1	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-
THORIUM-230	0581	03/07/89	0001	AL	O	PCI/L		0.2	0.2
	0585	03/01/89	0001	AL	D			0.2	0.3
	0586	03/01/89	0001	AL	D			0.8	0.3
	0588	03/06/89	0001	AL	U			0.2	0.2

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
THORIUM-230	0589	03/01/89	0001	AL	D	PCI/L		0.4	0.2
	0589	08/03/89	0001	AL	D			0.3	0.8
	0590	09/22/88	0001	AL	D			0.6	0.5
	0590	03/01/89	0001	AL	D			0.3	0.2
	0590	08/03/89	0001	AL	D			0.1	0.4
	0590	11/02/89	0001	AL	D			0.3	0.4
	0710	03/06/89	0001	AL	U			0.3	0.2
	0733	09/17/87	0001	AL	D			0.0	0.6
	0733	09/22/88	0001	AL	D			0.1	0.3
	0733	02/28/89	0001	AL	D			0.6	0.3
	0733	08/03/89	0001	AL	D			0.0	0.3
	0733	11/02/89	0001	AL	D			0.0	0.3
	0736	02/28/89	0001	AL	D			0.3	0.2
	0736	08/03/89	0001	AL	D			0.3	0.5
	0736	11/02/89	0001	AL	D			0.0	0.3
	0737	09/17/87	0001	AL	C			0.1	0.7
	0737	09/22/88	0001	AL	C			0.1	0.3
	0737	03/04/89	0001	AL	C			0.3	0.2
	0737	08/07/89	0001	AL	C			0.0	0.6
	0740	09/24/87	0001	AL	D			1.2	1.0
	0740	02/28/89	0001	AL	D			1.1	0.5
	0742	03/03/89	0001	AL	C			0.4	0.3
	0744	03/05/89	0001	AL	U			0.5	0.2
	0744	08/03/89	0001	AL	U			0.2	0.8
	0744	11/02/89	0001	AL	U			0.0	0.3
	0745	09/17/87	0001	AL	U			0.0	0.7
	0745	09/22/88	0001	AL	U			0.0	0.3
	0745	03/05/89	0001	AL	U			0.1	0.2
	0745	08/03/89	0001	AL	U			0.0	0.5
	0745	11/02/89	0001	AL	U			0.1	0.4
	0746	09/17/87	0001	AL	U			0.2	0.8
	0746	09/22/88	0001	AL	U			0.2	0.4
	0746	03/05/89	0001	AL	U			0.4	0.4
	0746	08/03/89	0001	AL	U			0.6	0.9
	0746	11/02/89	0001	AL	U			0.0	0.3
TIN	0581	03/07/89	0001	AL	O	MG/L	<	0.03	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TIN	0585	03/01/89	0001	AL	D	MG/L	<	0.03	-
	0586	03/01/89	0001	AL	D		<	0.03	-
	0588	03/06/89	0001	AL	U		<	0.03	-
	0589	03/01/89	0001	AL	D			0.03	-
	0589	08/03/89	0001	AL	D			0.029	-
	0590	03/01/89	0001	AL	D		<	0.03	-
	0590	08/03/89	0001	AL	D			0.020	-
	0590	11/02/89	0001	AL	D			0.117	-
	0710	03/06/89	0001	AL	U		<	0.03	-
	0733	02/28/89	0001	AL	D			0.03	-
	0733	08/03/89	0001	AL	D			0.024	-
	0733	11/02/89	0001	AL	D			0.116	-
	0736	02/28/89	0001	AL	D		<	0.03	-
	0736	08/03/89	0001	AL	D			0.020	-
	0736	11/02/89	0001	AL	D			0.120	-
	0737	03/04/89	0001	AL	C		<	0.03	-
	0737	08/07/89	0001	AL	C			0.030	-
	0740	02/28/89	0001	AL	D			0.03	-
	0742	03/03/89	0001	AL	C		<	0.03	-
	0744	03/05/89	0001	AL	U		<	0.03	-
	0744	08/03/89	0001	AL	U		<	0.005	-
	0744	11/02/89	0001	AL	U			0.013	-
	0745	03/05/89	0001	AL	U		<	0.03	-
	0745	08/03/89	0001	AL	U			0.010	-
	0745	11/02/89	0001	AL	U			0.052	-
	0746	03/05/89	0001	AL	U		<	0.03	-
	0746	08/03/89	0001	AL	U			0.029	-
	0746	11/02/89	0001	AL	U			0.108	-
TOTAL DISSOLVED SOLIDS	0581	03/07/89	0001	AL	O	MG/L		5380.	-
	0585	03/01/89	0001	AL	D			6890.	-
	0586	03/01/89	0001	AL	D			6820.	-
	0588	03/06/89	0001	AL	U			844.	-
	0589	03/01/89	0001	AL	D			6680.	-
	0589	08/03/89	0001	AL	D			7090.	-
	0590	09/22/88	0001	AL	D			6690.	-
	0590	03/01/89	0001	AL	D			6780.	-

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Table A...vial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TOTAL DISSOLVED SOLIDS	0590	08/03/89	0001	AL	D	MG/L		6180.	-
	0590	11/02/89	0001	AL	D			5770.	-
	0710	03/06/89	0001	AL	U			5260.	-
	0733	09/17/87	0001	AL	D			7790.	-
	0733	09/22/88	0001	AL	D			7100.	-
	0733	02/28/89	0001	AL	D			7100.	-
	0733	08/03/89	0001	AL	D			6730.	-
	0733	11/02/89	0001	AL	D			6970.	-
	0736	02/28/89	0001	AL	D			7740.	-
	0736	08/03/89	0001	AL	D			7120.	-
	0736	11/02/89	0001	AL	D			7580.	-
	0737	09/17/87	0001	AL	C			8670.	-
	0737	09/22/88	0001	AL	C			8050.	-
	0737	03/04/89	0001	AL	C			7940.	-
	0737	08/07/89	0001	AL	C			8250.	-
	0740	09/24/87	0001	AL	D			7850.	-
	0740	02/28/89	0001	AL	D			5390.	-
	0742	03/03/89	0001	AL	C			7300.	-
	0744	03/05/89	0001	AL	U			2270.	-
	0744	08/03/89	0001	AL	U			1420.	-
	0744	11/02/89	0001	AL	U			1050.	-
	0745	09/17/87	0001	AL	U			4920.	-
	0745	09/22/88	0001	AL	U			4680.	-
	0745	03/05/89	0001	AL	U			4170.	-
	0745	08/03/89	0001	AL	U			3790.	-
	0745	11/02/89	0001	AL	U			4710.	-
	0746	09/17/87	0001	AL	U			7010.	-
	0746	09/22/88	0001	AL	U			6680.	-
	0746	03/05/89	0001	AL	U			6720.	-
	0746	08/03/89	0001	AL	U			6820.	-
	0746	11/02/89	0001	AL	U			6890.	-
TOTAL ORGANIC CARBON	0581	03/07/89	0001	AL	O	MG/L		18.	-
	0585	03/01/89	0001	AL	D			28.	-
	0586	03/01/89	0001	AL	D			34.	-
	0588	03/06/89	0001	AL	U		<	1.	-
	0589	03/01/89	0001	AL	D			21.	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
TOTAL ORGANIC CARBON	0589	08/03/89	0001	AL	D	MG/L		146.	-
	0590	09/22/88	0001	AL	D			159.	-
	0590	03/01/89	0001	AL	D			11.	-
	0590	08/03/89	0001	AL	D			95.	-
	0590	11/02/89	0001	AL	D			130.	-
	0710	03/06/89	0001	AL	U			10.	-
	0733	09/17/87	0001	AL	D			180.	-
	0733	09/22/88	0001	AL	D			193.	-
	0733	02/28/89	0001	AL	D			9.0	-
	0733	08/03/89	0001	AL	D			141.	-
	0733	11/02/89	0001	AL	D			110.	-
	0736	02/28/89	0001	AL	D			9.0	-
	0736	08/03/89	0001	AL	D			142.	-
	0736	11/02/89	0001	AL	D			87.	-
	0737	09/17/87	0001	AL	C			144.6	-
	0737	09/22/88	0001	AL	C			142.	-
	0737	03/04/89	0001	AL	C			10.	-
	0737	08/07/89	0001	AL	C			115.	-
	0740	09/24/87	0001	AL	D			150.2	-
	0740	02/28/89	0001	AL	D			10.	-
	0742	03/03/89	0001	AL	C			9.0	-
	0744	03/05/89	0001	AL	U			2.	-
	0744	08/03/89	0001	AL	U			62.	-
	0744	11/02/89	0001	AL	U			52.	-
	0745	09/17/87	0001	AL	U			150.2	-
	0745	09/22/88	0001	AL	U			156.	-
	0745	03/05/89	0001	AL	U			5.	-
	0745	08/03/89	0001	AL	U			91.	-
	0745	11/02/89	0001	AL	U			110.	-
	0746	09/17/87	0001	AL	U			130.4	-
	0746	09/22/88	0001	AL	U			138.	-
	0746	03/05/89	0001	AL	U			9.0	-
	0746	08/03/89	0001	AL	U			111.	-
	0746	11/02/89	0001	AL	U			100.	-
URANIUM	0581	03/07/89	0001	AL	O	MG/L		0.043	-
	0585	03/01/89	0001	AL	D			0.29	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
URANIUM	0586	03/01/89	0001	AL	D	MG/L		0.29	-
	0588	03/06/89	0001	AL	U		<	0.003	-
	0589	03/01/89	0001	AL	D			0.18	-
	0589	08/03/89	0001	AL	D			0.071	-
	0590	09/22/88	0001	AL	D			0.229	-
	0590	03/01/89	0001	AL	D			0.19	-
	0590	08/03/89	0001	AL	D			0.112	-
	0590	11/02/89	0001	AL	D			0.125	-
	0710	03/06/89	0001	AL	U			0.027	-
	0733	09/17/87	0001	AL	D			0.0678	-
	0733	09/22/88	0001	AL	D			0.0711	-
	0733	02/28/89	0001	AL	D			0.08	-
	0733	08/03/89	0001	AL	D			0.050	-
	0733	11/02/89	0001	AL	D		<	0.0003	-
	0736	02/28/89	0001	AL	D			0.129	-
	0736	08/03/89	0001	AL	D			0.083	-
	0736	11/02/89	0001	AL	D			0.095	-
	0737	09/17/87	0001	AL	C			0.0529	-
	0737	09/22/88	0001	AL	C			0.0684	-
	0737	03/04/89	0001	AL	C			0.064	-
	0737	08/07/89	0001	AL	C			0.059	-
	0740	09/24/87	0001	AL	D			0.213	-
	0740	02/28/89	0001	AL	D			0.12	-
	0742	03/03/89	0001	AL	C			0.093	-
	0744	03/05/89	0001	AL	U			0.021	-
	0744	08/03/89	0001	AL	U			0.010	-
	0744	11/02/89	0001	AL	U			0.0087	-
	0745	09/17/87	0001	AL	U			0.0427	-
	0745	09/22/88	0001	AL	U			0.0397	-
	0745	03/05/89	0001	AL	U			0.045	-
	0745	08/03/89	0001	AL	U			0.034	-
	0745	11/02/89	0001	AL	U			0.035	-
	0746	09/17/87	0001	AL	U			0.0564	-
	0746	09/22/88	0001	AL	U			0.0512	-
	0746	03/05/89	0001	AL	U			0.059	-
	0746	08/03/89	0001	AL	U			0.058	-
	0746	11/02/89	0001	AL	U			0.057	-
VANADIUM	0581	03/07/89	0001	AL	O	MG/L		0.01	-

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Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
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PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
VANADIUM	0585	03/01/89	0001	AL	D	MG/L		0.11	-
	0586	03/01/89	0001	AL	D			0.14	-
	0588	03/06/89	0001	AL	U		<	0.01	-
	0589	03/01/89	0001	AL	D		<	0.01	-
	0589	08/03/89	0001	AL	D		<	0.01	-
	0590	09/22/88	0001	AL	D			0.07	-
	0590	03/01/89	0001	AL	D		<	0.01	-
	0590	08/03/89	0001	AL	D		<	0.01	-
	0590	11/02/89	0001	AL	D		<	0.01	-
	0710	03/06/89	0001	AL	U		<	0.01	-
Stat	0733	09/17/87	0001	AL	D			0.09	-
	0733	09/22/88	0001	AL	D			0.07	-
max	0733	02/28/89	0001	AL	D		<	0.01	-
	0733	08/03/89	0001	AL	D		<	0.01	-
0.035	0733	11/02/89	0001	AL	D		<	0.01	-
	0736	02/28/89	0001	AL	D		<	0.01	-
	0736	08/03/89	0001	AL	D			0.04	-
	0736	11/02/89	0001	AL	D		<	0.01	-
	0737	09/17/87	0001	AL	C			0.13	-
	0737	09/22/88	0001	AL	C			0.08	-
	0737	03/04/89	0001	AL	C		<	0.01	-
	0737	08/07/89	0001	AL	C		<	0.01	-
	0740	09/24/87	0001	AL	D			0.15	-
	0740	02/28/89	0001	AL	D		<	0.01	-
	0742	03/03/89	0001	AL	C		<	0.01	-
	0744	03/05/89	0001	AL	U		<	0.01	-
	0744	08/03/89	0001	AL	U		<	0.01	-
	0744	11/02/89	0001	AL	U		<	0.01	-
	0745	09/17/87	0001	AL	U			0.07	-
	0745	09/22/88	0001	AL	U			0.06	-
	0745	03/05/89	0001	AL	U		<	0.01	-
	0745	08/03/89	0001	AL	U		<	0.01	-
	0745	11/02/89	0001	AL	U		<	0.01	-
	0746	09/17/87	0001	AL	U			0.09	-
	0746	09/22/88	0001	AL	U			0.07	-
	0746	03/05/89	0001	AL	U		<	0.01	-
	0746	08/03/89	0001	AL	U		<	0.01	-
	0746	11/02/89	0001	AL	U		<	0.01	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

25

Table Alluvial water quality by parameter
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ZINC	0581	03/07/89	0001	AL	O	MG/L		0.016	-
	0585	03/01/89	0001	AL	D		<	0.005	-
	0586	03/01/89	0001	AL	D		<	0.005	-
	0588	03/06/89	0001	AL	U		<	0.005	-
	0589	03/01/89	0001	AL	D			0.019	-
	0589	08/03/89	0001	AL	D			0.006	-
	0590	09/22/88	0001	AL	D			0.027	-
	0590	03/01/89	0001	AL	D			0.006	-
	0590	08/03/89	0001	AL	D			0.009	-
	0590	11/02/89	0001	AL	D		<	0.005	-
	0710	03/06/89	0001	AL	U		<	0.005	-
	0733	09/17/87	0001	AL	D		<	0.005	-
	0733	09/22/88	0001	AL	D			0.014	-
	0733	02/28/89	0001	AL	D		<	0.005	-
	0733	08/03/89	0001	AL	D		<	0.005	-
	0733	11/02/89	0001	AL	D		<	0.005	-
	0736	02/28/89	0001	AL	D		<	0.005	-
	0736	08/03/89	0001	AL	D		<	0.005	-
	0736	11/02/89	0001	AL	D		<	0.005	-
	0737	09/17/87	0001	AL	C		<	0.005	-
	0737	09/22/88	0001	AL	C			0.015	-
	0737	03/04/89	0001	AL	C		<	0.005	-
	0737	08/07/89	0001	AL	C		<	0.005	-
	0740	09/24/87	0001	AL	D		<	0.005	-
	0740	02/28/89	0001	AL	D		<	0.005	-
	0742	03/03/89	0001	AL	C		<	0.005	-
	0744	03/05/89	0001	AL	U		<	0.005	-
	0744	08/03/89	0001	AL	U		<	0.005	-
	0744	11/02/89	0001	AL	U		<	0.005	-
	0745	09/17/87	0001	AL	U			0.362	-
	0745	09/22/88	0001	AL	U			0.021	-
	0745	03/05/89	0001	AL	U		<	0.005	-
	0745	08/03/89	0001	AL	U		<	0.005	-
	0745	11/02/89	0001	AL	U		<	0.005	-
	0746	09/17/87	0001	AL	U		<	0.005	-
	0746	09/22/88	0001	AL	U			0.017	-
	0746	03/05/89	0001	AL	U		<	0.005	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

PARAMETER VALUE INDICATOR (PVI): < - LESS THAN DETECTION LIMIT

Table Alluvial water quality by parameter
SITE: GRJC1 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 07/11/90

PARAMETER NAME	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	UNITS OF MEASURE	PVI	PARAMETER VALUE	PARAMETER UNCERTAINTY
ZINC	0746	08/03/89	0001	AL	U	MG/L	<	0.005	-
	0746	11/02/89	0001	AL	U		<	0.005	-

FORMATION OF COMPLETION CODE: FLOW RELATIONSHIP CODE:

PARAMETER VALUE INDICATOR (PVI): < = LESS THAN DETECTION LIMIT DATA FILE NAME: J:\DART\GRJ01\GWQ10015.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 53

BY BJ CHKD. _____ JOB NO. _____

Attachment II.

Test of Proportions Analyses

FORM 91-005 1 (4/81)

Test of Proportions Procedure

BD
SL 8/20/90

be appropriate when the number of detected compounds is quite small relative to the number of compounds analyzed for as might occur in detection monitoring.

PURPOSE

The test of proportions determines whether the proportion of compounds detected in the compliance well data differs significantly from the proportion of compounds detected in the background well data. If there is a significant difference, this is statistically significant evidence of contamination.

PROCEDURE

- The procedure uses the normal distribution approximation to the binomial distribution. This assumes that the sample size is reasonably large. Generally, if the proportion of detected values is denoted by P, and the sample size is n, then the normal approximation is adequate, provided that nP and n(1-P) both are greater than or equal to 5.

Step 1. Determine X, the number of background well samples in which the compound was detected. Let n be the total number of background well samples analyzed. Compute the proportion of detects:

$$\hat{P}_u = x/n$$

Step 2. Determine Y, the number of compliance well samples in which the compound was detected. Let M be the total number of compliance well samples analyzed. Compute the proportion of detects:

$$\hat{P}_d = y/m$$

Step 3. Compute the standard error of the difference in proportions:

$$S_D = \{[(x+y)/(n+m)][1 - (x+y)/(n+m)][1/n + 1/m]\}^{1/2}$$

and form the statistic:

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

Step 4. Compare the absolute value of Z to the 97.5th percentile from the standard normal distribution, 1.96. If the absolute value of Z exceeds 1.96, this provides statistically significant evidence at the 5% significance level that the proportion of compliance well samples where the compound was detected exceeds the proportion of background well samples where the compound was detected. This would be interpreted as evidence of contamination. (The two-sided test is used to provide information about differences in either direction.)

EXAMPLE

Table 8-2 contains data on cadmium concentrations measured in background well and compliance wells at a facility. In the table, "BDL" is used for below detection limit.

JACOBS ENGINEERING

DATE 8/7/90 SUBJECT

BY BJR CHKD.

SHEET NO. 56

JOB NO. 8/20/90

Test of Proportions (TOP)

All Alluvial Wells

Analytes to be tested:	Percent of Non-Detects
Antimony	62.1
Barium	87.2
Chromium	87.2
Lead	79.3
Nickel	~~64.1~~ 71.8
Nitrate	64.1
Ra-226	56.4
Silver	86.2

Antimony

Upgradient – Number of Samples (N) = 11

$\hat{P}_u$ = Proportion of Detects = (100−72.7)/100 (% of non-detects)

= 0.273

x = Number of samples w detects = 3

Downgradient – Number of Samples (M) = 14

~~Proportion~~ Percentage of non-detects = 50.0

$\hat{P}_d$ = Proportion of Detects = (100−50)/100

= 0.500

y = 7 (Number of hits)

Standard error of the difference in proportions:

$$S_D = \{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\}^{1/2}$$

$$= \{[(3+7)/(11+14)][1-(3+7)/(11+14)][1/11 + 1/14]\}^{1/2}$$

$$= \{[\tfrac{10}{25}][1 - 10/25][0.0909 + 0.0714]\}^{1/2}$$

$$= \{[0.4][0.6][0.1623]\}^{1/2}$$

$$= \cancel{\sqrt{1.162}} = \sqrt{.0389}$$

$$= \cancel{1.078} = .197$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D = \cancel{(0.273 - 0.5)/1.078} = -0.211$$

$$(.273 - 0.5)/.197 = \quad = 1.15$$

$|-1.15| = 1.15 \leq 1.97$

To determine if there is statistical evidence of contamination, compare the absolute value of Z to the 97.5 th percentile from the standard normal distribution, 1.96.

Because $|-0.211|$ (1.15) < 1.96, contamination with antimony is not indicated statistically at the 5% significance level

Barium (TOP)

Upgradient Wells: Number of samples (N) = 15
Percent of non-detects = 86.7
$\hat{P}_u$ = Proportion of detects ~~= 0.137~~ 0.137
X = Number of detects = 2

Downgradient wells:
Number of samples (m) = 18
Percent of non-detects = 88.9
$\hat{P}_d$ = Proportion of detects = ~~11.1~~ 0.111
y = 2 (number of hits)

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+2)/(15+18)][1-(2+2)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{[0.1212][0.878][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/S_D$$

$$= \frac{(0.137-0.111)}{0.114} = 0.228$$

Since $Z < 1.96$, no evidence of contamination w. Barium

DATE _____ SUBJECT _____ SHEET NO. 58

BY BJ CHKD. SK 8/20/90 JOB NO. _____

Chromium (TOP)

Upgradient Wells:

n = number of samples = 15

Percent of non-detects = 86.7

$\hat{P}_u$ = Proportion of detects = 0.133

x = number of detects = 2

Downgradient Wells:

m = 18

Percent of non-detects = 88.9

$\hat{P}_d$ = 0.111

y = 2

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ \left[\frac{(2+2)}{(15+18)}\right]\left[1-\frac{2+2}{15+18}\right]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \left\{ [0.1212][0.8788][0.1222]\right\}^{1/2}$$

$$= 0.114$$

$$Z = (\hat{P}_u - \hat{P}_d)/0.114$$

$$= (0.133 - 0.111)/0.114 = 0.193$$

Since $Z < 1.96$, no evidence of contamination w. Chromium

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 59

BY BS CHKD. SR 8/20/90 JOB NO. _____

Lead (TOP)

Upgradient wells:

n = number of samples = 11
Percent of non-detects = 90.9
$\hat{p}_u$ = Proportion of detects = (100 − 90.9)/100 = 0.091
x = number of detects = 1

Downgradient wells
m = 14
Percent non-detects = 71.4
$\hat{p}_d$ = 0.286
y = 4

$$S_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ [(1+4)/(11+14)][1-(1+5)/(11+14)]\left[\frac{1}{11}+\frac{1}{14}\right]\right\}^{1/2}$$

$$= \{[0.2][0.76][0.162]\}^{1/2}$$

$$= 0.157$$

$$Z = (\hat{p}_u - \hat{p}_d)/0.157$$

$$= (0.091 - 0.286)/0.157 = -1.24$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with lead.

FORM 8: 005.1 (4/81)

DATE _____ SUBJECT _____ SHEET NO. 60

BY BR CHKD. SL 8/20/90 JOB NO. _____

Nickel (TOP)

Upgradient wells:

n = number of samples = 15

Percent of non-detects = 86.7

$\hat{p}_u$ = proportion of detects = 0.133 $[(100-86.7)/100]$

x = number of detects = 2

Downgradient wells:

m = 18

% non-detects = 55.6

$\hat{p}_d$ = $(100-55.6)/100 = 0.446$

y = # detects = 8

$$S_D = \left\{[(x+y)/(n+m)][1-(x+y)/(n+m)][1/n + 1/m]\right\}^{1/2}$$

$$= \left\{[(2+8)/(15+18)][1-(2+8)/(15+18)][\tfrac{1}{15}+\tfrac{1}{18}]\right\}^{1/2}$$

$$= \left\{[0.303][0.697][0.122]\right\}^{1/2}$$

$$= 0.161$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.091 - 0.286)/0.161 = -1.21$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with ~~lead~~ nickel

FORM 91-005-1 (4/81)

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 61

BY BD CHKD. _____ JOB NO. _____

SK

Nitrate (TOP)

Upgradient wells:

$n = 15$

% non-detects = 66.7

$\hat{p}_u = (100 - 66.7)/100 = 0.333$

x = # detects = 5

Downgradient wells:

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = .389$

$y = 7$

$$S_D = \left\{ [(x+y)/(n+m)][1 - (x+y)/(n+m)][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(5+7)/(15+18)][1 - (x+y)/(n+m))][\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \{ [0.36][0.636][0.122] \}^{1/2}$$

$$= 0.167$$

$$Z = (\hat{p}_u - \hat{p}_d)/S_D$$

$$= (0.333 - 0.389)/0.167$$

$$= -0.335$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination with nitrate.

FORM 81-005-1 (4/81)

Ra-226 (TOP)

8k

Upgradient wells:

$n = 15$

% non-detects = 46.7

$\hat{p}_u = (100 - 46.7)/100 = 0.533$

$x = 8$

Downgradient wells..

$m = 18$

% non-detects = 61.1

$\hat{p}_d = (100 - 61.1)/100 = 0.389$

$y = 7$

$$s_D = \left\{ [(x+y)/(n+m)][1-(x+y)/(n+m)]\left[\frac{1}{n}+\frac{1}{m}\right]\right\}^{1/2}$$

$$= \left\{ [(8+7)/(15+18)][1-(8+7)/(15+18)]\left[\frac{1}{15}+\frac{1}{18}\right]\right\}^{1/2}$$

$$= \{ [0.45][0.55][0.12] \}^{1/2}$$

$$= 0.172$$

$$Z = (\hat{p}_u - \hat{p}_d)/s_D$$

$$= (0.533 - .389)/0.172$$

$$= 0.83$$

Since $Z < 1.96$, there is no statistical evidence of contamination w. Ra-226.

JACOBS ENGINEERING

DATE _____ SUBJECT _____ SHEET NO. 63

BY BD CHKD. _____ JOB NO. _____

Silver (TOR)

Upgradient wells:

$n = 11$

% non-detects $= 90.9$

$\hat{p}_u = (100 - 90.9)/100 = 0.091$

$x = 1$

Downgradient wells:

$m = 14$

% non-detects $= 78.6$

$\hat{p}_d = 0.214$

$y = 3$

$$S_D = \left\{ [(x+y)/(n+m)] [1 - (x+y)/(n+m)] [\tfrac{1}{n} + \tfrac{1}{m}] \right\}^{1/2}$$

$$= \left\{ [(1+3)/(11+14)] [1 - (1+3)/(11+14)] [\tfrac{1}{11} + \tfrac{1}{14}] \right\}^{1/2}$$

$$= \left\{ [0.16] [0.84] [0.16] \right\}^{1/2}$$

$$= 0.148$$

$$Z = (0.091 - 0.214)/0.148$$

$$= -0.83$$

Since $|Z| < 1.96$, there is no statistical evidence of contamination w. Silver.

FORM 91-005-1 (4/81)

DATE _____ SUBJECT _____ SHEET NO. _____

BY _____ CHKD. _____ JOB NO. _____

Vanadium: (TEP)

Upgradient Wells

Number of Samples (n) = 15
Percent of non-detects: 73.3
$\hat{P}_u$ = Proportion of detects: .267
x = Number of detects = 4

Downgradient Wells

Number of Samples (m) = 18
Percent of non-detects = 61.1
$\hat{P}_u$ = Proportion of detects = .389
y = Number of detects = 7

$$S_p = \left\{ \left[(x+y)/(n+m) \right] \left[1 - (x+y)/(n+m) \right] \left[1/n + 1/m \right] \right\}^{1/2}$$

$$= \left\{ \left[(11+7)/(15+18) \right] \left[1 - (11+7)/(15+18) \right] \left[1/15 + 1/18 \right] \right\}^{1/2}$$

$$\left\{ (.33)(.67)(.12) \right\}^{1/2}$$

$S_p = .162$

$Z = (.267 - .389)/.162$

$Z = -.75$

$|Z| = .75$

$.75 \nless 1.96$, No evidence of contamination in Vanadium.

FORM 81-005-1 (4/81)

GROUNDWATER (,Y STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
15	20.5000	554.0000	439.0000	411.4333	142.1499	0.3455	0.0	315.1248	507.7619	NORMAL	
ALUMINUM			MG/L								
15	0.0500	0.3800	0.0500	NA	NA	NA	73.3	0.0500	0.3000	NONPARAMETRIC	2
AMMONIUM			MG/L								
15	0.0500	61.0000	0.1000	NA	NA	NA	46.7	0.0500	1.7000	NONPARAMETRIC	2
ANTIMONY			MG/L								
11	0.0015	0.0120	0.0015	NA	NA	NA	72.7	0.0015	0.0090	NONPARAMETRIC	2
ARSENIC			MG/L								
15	0.0050	0.0400	0.0050	NA	NA	NA	66.7	0.0050	0.0160	NONPARAMETRIC	2
BARIUM			MG/L								
15	0.0200	0.0500	0.0500	NA	NA	NA	86.7	0.0500	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
11	0.0025	0.0050	0.0050	NA	NA	NA	100.0	0.0025	0.0050	NONPARAMETRIC	2
BROMIDE			MG/L								
3	0.0500	0.2000	0.1000	NA	NA	NA	33.3	NA	NA	UNKNOWN	1
CADMIUM			MG/L								
15	0.0005	0.0390	0.0005	NA	NA	NA	53.3	0.0005	0.0130	NONPARAMETRIC	2
CALCIUM			MG/L								
15	93.1000	510.0000	427.0000	360.0733	141.7940	0.3938	0.0	264.0059	456.1407	NORMAL	
CHLORIDE			MG/L								
15	149.0000	730.0000	570.0000	507.2667	212.8646	0.4196	0.0	363.0479	651.4854	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHROMIUM	MG/L	15	0.0050	0.1500	0.0050	NA	NA	NA	86.7	0.0050	0.0050	NONPARAMETRIC	2
COBALT	MG/L	11	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2
COPPER	MG/L	15	0.0100	0.0200	0.0100	NA	NA	NA	80.0	0.0100	0.0200	NONPARAMETRIC	2
CYANIDE	MG/L	11	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2
FLUORIDE	MG/L	15	0.4000	1.6000	0.7600	0.9007	0.3800	0.4220	0.0	0.6432	1.1582	NORMAL	
GROSS ALPHA	PCI/L	15	0.0000	58.0000	19.0000	NA	NA	NA	13.3	2.0000	41.0000	NONPARAMETRIC	9
GROSS BETA	PCI/L	15	0.0000	110.0000	32.0000	NA	NA	NA	6.7	12.0000	64.0000	NONPARAMETRIC	9
IRON	MG/L	15	0.0100	1.5600	0.1200	0.1274	4.9406	NA	13.3	0.0432	0.3759	LOGNORMAL	7,8
LEAD	MG/L	11	0.0050	0.0100	0.0050	NA	NA	NA	90.9	0.0050	0.0050	NONPARAMETRIC	2
MAGNESIUM	MG/L	15	39.5000	525.0000	289.0000	296.1733	165.3434	0.5583	0.0	184.1509	408.1958	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER Q. ,Y STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MANGANESE			MG/L								
15	0.2800	1.9300	1.3400	1.1680	0.4292	0.3675	0.0	0.8772	1.4588	NORMAL	
MECHANICAL SIEVE TEST 3/8 INCH			% PASSING								
1	3690.0000	3690.0000	3690.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
MERCURY			MG/L								
11	0.0001	0.0001	0.0001	NA	NA	NA	100.0	0.0001	0.0001	NONPARAMETRIC	2
MOLYBDENUM			MG/L								
11	0.0050	0.1500	0.0300	NA	NA	NA	18.2	0.0050	0.1500	NONPARAMETRIC	2
NICKEL			MG/L								
15	0.0200	0.1200	0.0200	NA	NA	NA	86.7	0.0200	0.0200	NONPARAMETRIC	2
NITRATE			MG/L								
15	0.5000	29.0000	0.5000	NA	NA	NA	66.7	0.5000	3.5000	NONPARAMETRIC	2
POTASSIUM			MG/L								
15	4.9000	19.0000	6.5000	7.9753	3.6348	0.4558	0.0	5.5127	10.4379	NORMAL	
RADIUM-226			PCI/L								
15	0.0000	0.2000	0.0000	NA	NA	NA	46.7	0.0000	0.1000	NONPARAMETRIC	2
RADIUM-228			PCI/L								
15	0.0000	1.2000	0.4000	NA	NA	NA	13.3	0.1000	1.0000	NONPARAMETRIC	9
SELENIUM			MG/L								
15	0.0025	0.1910	0.0300	NA	NA	NA	26.7	0.0025	0.0600	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SILICA - SIO2			MG/L								
3	17.0000	17.0000	17.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
SILVER			MG/L								
11	0.0050	0.0100	0.0050	NA	NA	NA	90.9	0.0050	0.0050	NONPARAMETRIC	2
SODIUM			MG/L								
15	144.0000	910.0000	573.0000	581.4667	272.9403	0.4694	0.0	396.5458	766.3875	NORMAL	
SPECIFIC CONDUCTANCE			UMHO/CM								
15	75.0000	5500.0000	2950.0000	2630.6667	1746.8123	0.6640	0.0	1447.1771	3814.1562	NORMAL	
STRONTIUM			MG/L								
15	1.0400	7.1000	4.5000	4.2953	2.0643	0.4806	0.0	2.8968	5.6939	NORMAL	
SULFATE			MG/L								
15	179.0000	3690.0000	2210.0000	2230.3333	1240.7943	0.5563	0.0	1389.6780	3070.9886	NORMAL	
TEMPERATURE			C - DEGREE								
15	7.5000	20.5000	14.0000	14.2000	3.3048	0.2327	0.0	11.9610	16.4390	NORMAL	
THALLIUM			MG/L								
11	0.0050	0.0500	0.0050	NA	NA	NA	100.0	0.0050	0.0500	NONPARAMETRIC	2
THORIUM-230			PCI/L								
15	0.0000	0.6000	0.2000	NA	NA	NA	26.7	0.0000	0.4000	NONPARAMETRIC	2
TIN			MG/L								
11	0.0025	0.1080	0.0025	NA	NA	NA	54.5	0.0025	0.0520	NONPARAMETRIC	2
TOTAL DISSOLVED SOLIDS			MG/L								
15	844.0000	7010.0000	4710.0000	4468.9333	2207.1403	0.4939	0.0	2973.5651	5964.3015	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the n[illegible]ected values comprise more than 15% of the samples.

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89

GROUNDWATER QUALITY STATISTICS BY PARAMETER-UPGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TOTAL ORGANIC CARBON			MG/L								
15	0.5000	156.0000	91.0000	75.1400	58.3794	0.7769	6.7	35.5871	114.6929	NORMAL	
URANIUM			MG/L								
15	0.0015	0.0590	0.0397	0.0364	0.0192	0.5273	6.7	0.0234	0.0494	NORMAL	
VANADIUM			MG/L								
15	0.0050	0.0900	0.0050	NA	NA	NA	73.3	0.0050	0.0700	NONPARAMETRIC	2
ZINC			MG/L								
15	0.0025	0.3620	0.0025	NA	NA	NA	80.0	0.0025	0.0170	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10015.DAT

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
ALKALINITY			MG/L CACO3								
18	411.0000	651.0000	548.5000	542.9444	76.2978	0.1405	0.0	496.7807	589.1082	NORMAL	
ALUMINUM			MG/L								
18	0.0500	0.7200	0.0500	NA	NA	NA	66.7	0.0500	0.3000	NONPARAMETRIC	2
AMMONIUM			MG/L								
18	0.0500	300.0000	1.7000	NA	NA	NA	38.9	0.0500	50.0000	NONPARAMETRIC	2
ANTIMONY			MG/L								
14	0.0015	0.0170	0.0052	NA	NA	NA	50.0	0.0015	0.0160	NONPARAMETRIC	2
ARSENIC			MG/L								
18	0.0050	0.0500	0.0100	NA	NA	NA	38.9	0.0050	0.0150	NONPARAMETRIC	2
BARIUM			MG/L								
18	0.0200	0.0500	0.0500	NA	NA	NA	88.9	0.0500	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
14	0.0025	0.0050	0.0037	NA	NA	NA	100.0	0.0025	0.0050	NONPARAMETRIC	2
BROMIDE			MG/L								
3	0.1000	1.2000	1.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
CADMIUM			MG/L								
18	0.0005	0.0250	0.0010	NA	NA	NA	44.4	0.0005	0.0140	NONPARAMETRIC	2
CALCIUM			MG/L								
18	370.0000	560.0000	488.5000	481.7778	58.3454	0.1211	0.0	446.4760	517.0795	NORMAL	
CHLORIDE			MG/L								
18	700.0000	1200.0000	935.0000	951.7222	160.7789	0.1689	0.0	854.4433	1049.0011	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHROMIUM			MG/L								
18	0.0050	0.1400	0.0050	NA	NA	NA	88.9	0.0050	0.0050	NONPARAMETRIC	2
COBALT			MG/L								
14	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2
COPPER			MG/L								
18	0.0100	0.0700	0.0100	NA	NA	NA	72.2	0.0100	0.0300	NONPARAMETRIC	2
CYANIDE			MG/L								
14	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2
FLUORIDE			MG/L								
18	0.4000	3.7000	0.6800	0.7071	1.8820	NA	0.0	0.4823	1.0366	LOGNORMAL	7,8
GROSS ALPHA			PCI/L								
18	0.0000	223.0000	110.0000	NA	NA	NA	5.6	49.0000	140.0000	NONPARAMETRIC	9
GROSS BETA			PCI/L								
18	21.0000	176.0000	79.5000	85.1111	47.4191	0.5571	0.0	56.4203	113.8020	NORMAL	
IRON			MG/L								
18	0.0150	16.0000	0.2500	NA	NA	NA	22.2	0.0150	5.7000	NONPARAMETRIC	2
LEAD			MG/L								
14	0.0050	0.0200	0.0050	NA	NA	NA	71.4	0.0050	0.0200	NONPARAMETRIC	2
MAGNESIUM			MG/L								
18	310.0000	462.0000	386.5000	385.2778	45.5603	0.1183	0.0	357.7116	412.8439	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MANGANESE	MG/L	18	0.9400	4.1600	1.5900	1.9839	0.8992	0.4532	0.0	1.4398	2.5279	NORMAL	
MERCURY	MG/L	14	0.0001	0.0001	0.0001	NA	NA	NA	100.0	0.0001	0.0001	NONPARAMETRIC	2
MOLYBDENUM	MG/L	14	0.0050	0.2400	0.0400	0.0625	0.0619	0.9907	7.1	0.0186	0.1064	NORMAL	
NICKEL	MG/L	18	0.0100	0.1200	0.0200	NA	NA	NA	55.6	0.0200	0.0500	NONPARAMETRIC	2
NITRATE	MG/L	18	0.4000	5.7000	0.5000	NA	NA	NA	61.1	0.5000	2.2000	NONPARAMETRIC	2
POTASSIUM	MG/L	18	8.1000	71.0000	15.9000	25.9233	22.0474	0.8505	0.0	12.5836	39.2631	NORMAL	
RADIUM-226	PCI/L	18	0.0000	0.8000	0.0000	NA	NA	NA	61.1	0.0000	0.1000	NONPARAMETRIC	2
RADIUM-228	PCI/L	18	0.0000	2.3000	0.6000	NA	NA	NA	16.7	0.2000	2.0000	NONPARAMETRIC	2
SELENIUM	MG/L	18	0.0025	0.1960	0.0255	NA	NA	NA	38.9	0.0025	0.1270	NONPARAMETRIC	2
SILICA - SIO2	MG/L	3	17.0000	21.0000	20.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
SILVER	MG/L	14	0.0050	0.0100	0.0050	NA	NA	NA	78.6	0.0050	0.0100	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SODIUM			MG/L								
18	728.0000	1327.0000	1130.0000	1094.5556	154.4391	0.1411	0.0	1001.1125	1187.9986	NORMAL	
SPECIFIC CONDUCTANCE			UMHO/CM								
18	1000.0000	7500.0000	3800.0000	3936.1111	2012.9847	0.5114	0.0	2718.1593	5154.0630	NORMAL	
STRONTIUM			MG/L								
18	4.1000	6.9500	5.1500	5.3650	0.8413	0.1568	0.0	4.8560	5.8740	NORMAL	
SULFATE			MG/L								
18	2520.0000	3960.0000	3420.0000	3467.2222	385.8650	0.1113	0.0	3233.7555	3700.6890	NORMAL	
TEMPERATURE			C - DEGREE								
18	9.0000	22.5000	16.2500	15.3056	4.0079	0.2619	0.0	12.8806	17.7305	NORMAL	
THALLIUM			MG/L								
14	0.0050	0.0500	0.0275	NA	NA	NA	100.0	0.0050	0.0500	NONPARAMETRIC	2
THORIUM-230			PCI/L								
18	0.0000	1.2000	0.3000	NA	NA	NA	22.2	0.0000	0.6000	NONPARAMETRIC	2
TIN			MG/L								
14	0.0025	0.1200	0.0265	NA	NA	NA	28.6	0.0025	0.1160	NONPARAMETRIC	2
TOTAL DISSOLVED SOLIDS			MG/L								
18	5390.0000	7850.0000	6930.0000	6903.8889	653.0214	0.0946	0.0	6508.7798	7298.9980	NORMAL	
TOTAL ORGANIC CARBON			MG/L								
18	9.0000	193.0000	102.5000	91.9556	66.4230	0.7223	0.0	51.7665	132.1446	NORMAL	
URANIUM			MG/L								
18	0.0015	0.2900	0.1160	0.1332	0.0819	0.6146	5.6	0.0837	0.1827	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

GROUNDWATE QUALITY STATISTICS BY PARAMETER--DOWNGRADIENT ALLUVIAL WELLS
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 04/24/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
VANADIUM			MG/L								
18	0.0050	0.1500	0.0050	NA	NA	NA	61.1	0.0050	0.0900	NONPARAMETRIC	2
ZINC			MG/L								
18	0.0025	0.0270	0.0025	NA	NA	NA	66.7	0.0025	0.0090	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: C:\DART\GRJ01\GWQ10016.DAT

JACOBS ENGINEERING

DATE _____ SUBJECT SHEET NO. 74

BY BJ CHKD. _____ JOB NO. _____

Attachment III.

ANOVA Analyses

FORM 91-005-1 (4/81)

JE

DATE 09 Aug 1990 SUBJECT

BY BJ CHKD.

SHEET NO. 75

JOB NO.

Based on a DART statistical analysis of the pooled under quality data set, the statistical distributions for the ANOVA analyses are as follows:

	Distribution	Recommended ANOVA
Arsenic	Nonparametric	Nonparametric
Cadmium	↓	↓
Gross alpha		
Molybdenum	Normal	Parametric
Selenium	Nonparametric	Nonparametric

FORM 91-005-1 (4/81)

Alluvial water quality statistics for down, cross, and upgradient wells (data pooled)
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL		DISTRIBUTION TYPE	FOOT NOTE
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *		
ALKALINITY			MG/L CACO3								
38	20.5000	651.0000	478.0000	479.5132	119.5044	0.2492	0.0	432.3854	526.6410	NORMAL	
ALUMINUM			MG/L								
38	0.0500	0.7200	0.0500	NA	NA	NA	68.4	0.0500	0.1000	NONPARAMETRIC	2
AMMONIUM			MG/L								
38	0.0500	300.0000	0.3000	NA	NA	NA	44.7	0.0500	1.7000	NONPARAMETRIC	2
ANTIMONY			MG/L								
28	0.0015	0.0170	0.0015	NA	NA	NA	60.7	0.0015	0.0120	NONPARAMETRIC	2
ARSENIC			MG/L								
38	0.0050	0.0500	0.0075	NA	NA	NA	50.0	0.0050	0.0120	NONPARAMETRIC	2
BARIUM			MG/L								
38	0.0200	0.0500	0.0500	NA	NA	NA	86.8	0.0500	0.0500	NONPARAMETRIC	2
BERYLLIUM			MG/L								
28	0.0025	0.0050	0.0037	NA	NA	NA	100.0	0.0025	0.0050	NONPARAMETRIC	2
BROMIDE			MG/L								
6	0.0500	1.2000	0.1500	NA	NA	NA	16.7	0.0500	1.2000	NONPARAMETRIC	2,6
CADMIUM			MG/L								
38	0.0005	0.0390	0.0008	NA	NA	NA	50.0	0.0005	0.0100	NONPARAMETRIC	2
CALCIUM			MG/L								
38	93.1000	570.0000	464.5000	438.5816	116.5657	0.2658	0.0	392.6127	484.5505	NORMAL	

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
6) The stat. range is the 96.9% confidence interval due to a sample size of 6. The maximum is the 98.5% one sided confidence int.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME	UNITS	# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	STATISTICAL RANGE 98% CONFIDENCE INTERVAL MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
CHLORIDE	MG/L	38	149.0000	1300.0000	830.0000	799.7368	303.2459	0.3792	0.0	680.1487	919.3250	NORMAL	
CHROMIUM	MG/L	38	0.0050	0.1600	0.0050	NA	NA	NA	86.8	0.0050	0.0050	NONPARAMETRIC	2
COBALT	MG/L	28	0.0250	0.0250	0.0250	NA	NA	NA	100.0	0.0250	0.0250	NONPARAMETRIC	2
COPPER	MG/L	38	0.0100	0.0700	0.0100	NA	NA	NA	73.7	0.0100	0.0100	NONPARAMETRIC	2
CYANIDE	MG/L	28	0.0050	0.0050	0.0050	NA	NA	NA	100.0	0.0050	0.0050	NONPARAMETRIC	2
FLUORIDE	MG/L	38	0.4000	3.7000	0.7000	0.9289	0.6987	0.7521	0.0	0.6534	1.2045	NORMAL	
GROSS ALPHA	PCI/L	38	0.0000	223.0000	45.0000	NA	NA	NA	10.5	19.0000	100.0000	NONPARAMETRIC	9
GROSS BETA	PCI/L	38	0.0000	176.0000	56.0000	NA	NA	NA	2.6	36.0000	77.0000	NONPARAMETRIC	9
IRON	MG/L	38	0.0100	16.0000	0.1550	NA	NA	NA	18.4	0.1100	0.5700	NONPARAMETRIC	2
LEAD	MG/L	28	0.0050	0.0200	0.0050	NA	NA	NA	78.6	0.0050	0.0050	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
MAGNESIUM			MG/L								
38	39.5000	565.0000	386.5000	369.0947	131.1267	0.3553	0.0	317.3836	420.8059	NORMAL	
MANGANESE			MG/L								
38	0.2800	4.1600	1.4950	1.6611	0.7796	0.4693	0.0	1.3536	1.9685	NORMAL	
MECHANICAL SIEVE TEST 3/8 INCH			% PASSING								
1	3690.0000	3690.0000	3690.0000	NA	NA	NA	0.0	NA	NA	UNKNOWN	1
MERCURY			MG/L								
28	0.0001	0.0001	0.0001	NA	NA	NA	100.0	0.0001	0.0001	NONPARAMETRIC	2
MOLYBDENUM			MG/L								
28	0.0050	0.2400	0.0400	0.0609	0.0568	0.9330	10.7	0.0343	0.0874	NORMAL	
NICKEL			MG/L								
38	0.0100	0.1300	0.0200	NA	NA	NA	71.1	0.0200	0.0200	NONPARAMETRIC	2
NITRATE			MG/L								
38	0.4000	29.0000	0.5000	NA	NA	NA	65.8	0.5000	0.5000	NONPARAMETRIC	2
POTASSIUM			MG/L								
38	4.9000	71.0000	10.1500	12.1114	2.0769	NA	0.0	9.0787	16.1573	LOGNORMAL	7,8
RADIUM-226			PCI/L								
38	0.0000	0.8000	0.0000	NA	NA	NA	57.9	0.0000	0.1000	NONPARAMETRIC	2
RADIUM-228			PCI/L								
38	0.0000	2.3000	0.7000	NA	NA	NA	13.2	0.3000	1.0000	NONPARAMETRIC	9

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
1) A minimum of 4 samples must be available for the statistical analysis.
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.
7) The lognormal distribution was used because the data failed the normal distribution test.
8) The mean is geometric. The standard deviation is the value to divide or multiply with the geometric mean.
9) The nonparametic distribution was used because the data failed the normal distribution test and includes values ≤0.

Alluvial wate...uality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
SELENIUM			MG/L								
38	0.0025	0.1990	0.0260	NA	NA	NA	34.2	0.0025	0.0570	NONPARAMETRIC	2
SILICA - SIO2			MG/L								
6	17.0000	21.0000	17.0000	18.1667	1.8348	0.1010	0.0	15.6460	20.6873	NORMAL	
SILVER			MG/L								
28	0.0050	0.0100	0.0050	NA	NA	NA	85.7	0.0050	0.0050	NONPARAMETRIC	2
SODIUM			MG/L								
38	144.0000	1400.0000	951.5000	906.6842	337.8274	0.3726	0.0	773.4585	1039.9099	NORMAL	
SPECIFIC CONDUCTANCE			UMHO/CM								
38	75.0000	7500.0000	3650.0000	3660.2632	2072.2539	0.5661	0.0	2843.0485	4477.4778	NORMAL	
STRONTIUM			MG/L								
38	1.0400	7.3000	5.1500	5.1242	1.6303	0.3182	0.0	4.4813	5.7672	NORMAL	
SULFATE			MG/L								
38	179.0000	4130.0000	3420.0000	3045.6579	1060.5553	0.3482	0.0	2627.4170	3463.8988	NORMAL	
TEMPERATURE			C - DEGREE								
38	7.5000	22.5000	15.0000	14.8947	3.4586	0.2322	0.0	13.5308	16.2587	NORMAL	
THALLIUM			MG/L								
28	0.0050	0.0500	0.0275	NA	NA	NA	100.0	0.0050	0.0500	NONPARAMETRIC	2
THORIUM-230			PCI/L								
38	0.0000	1.2000	0.2000	NA	NA	NA	23.7	0.1000	0.3000	NONPARAMETRIC	2
TIN			MG/L								
28	0.0025	0.1200	0.0165	NA	NA	NA	42.9	0.0025	0.0300	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

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Alluvial water quality statistics for down, cross, and upgradient wells
09/22/87 to 11/2/89
SITE: GRJ01 GRAND JUNCTION
09/17/87 TO 11/02/89
REPORT DATE: 08/09/90

PARAMETER NAME			UNITS					STATISTICAL RANGE 98% CONFIDENCE INTERVAL			
# OF SAMP	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION	COEFF. OF VARIATION	% OF NON DETECTS	MINIMUM	MAXIMUM *	DISTRIBUTION TYPE	FOOT NOTE
TOTAL DISSOLVED SOLIDS			MG/L								
38	844.0000	8670.0000	6800.0000	6092.4737	1992.1555	0.3270	0.0	5306.8467	6878.1007	NORMAL	
TOTAL ORGANIC CARBON			MG/L								
38	0.5000	193.0000	97.5000	84.2868	62.4133	0.7405	2.6	59.6735	108.9001	NORMAL	
URANIUM			MG/L								
38	0.0015	0.2900	0.0615	0.0863	0.0733	0.8488	5.3	0.0574	0.1152	NORMAL	
VANADIUM			MG/L								
38	0.0050	0.1500	0.0050	NA	NA	NA	65.8	0.0050	0.0600	NONPARAMETRIC	2
ZINC			MG/L								
38	0.0025	0.3620	0.0025	NA	NA	NA	73.7	0.0025	0.0025	NONPARAMETRIC	2

* Statistical maximum is the 99 percent one sided confidence interval, $\alpha = 0.01$
2) The nonparametric distribution was used because the nondetected values comprise more than 15% of the samples.

INPUT DATA FILENAME: J:\DART\GRJ01\GWQ10020.DAT

Table used to obtain "tabulated" H statistic for one-way nonparametric ANOVA analyses

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TABLE 1. PERCENTILES OF THE χ^2 DISTRIBUTION WITH ν DEGREES OF FREEDOM, $\chi^2_{\nu,P}$

ν \ P	0.750	0.900	0.950	0.975	0.990	0.995	0.999
1	1.323	2.706	3.841	5.024	6.635	7.879	10.83
2	2.773	4.605	5.991	7.378	9.210	10.60	13.82
3	4.108	6.251	7.815	9.348	11.34	12.84	16.27
4	5.385	7.779	9.488	11.14	13.28	14.86	18.47
5	6.626	9.236	11.07	12.83	15.09	16.75	20.52
6	7.841	10.64	12.59	14.45	16.81	18.55	22.46
7	9.037	12.02	14.07	16.01	18.48	20.28	24.32
8	10.22	13.36	15.51	17.53	20.09	21.96	26.12
9	11.39	14.68	16.92	19.02	21.67	23.59	27.88
10	12.55	15.99	18.31	20.48	23.21	25.19	29.59
11	13.70	17.28	19.68	21.92	24.72	26.76	31.26
12	14.85	18.55	21.03	23.34	26.22	28.30	32.91
13	15.98	19.81	22.36	24.74	27.69	29.82	34.53
14	17.12	21.06	23.68	26.12	29.14	31.32	36.12
15	18.25	22.31	25.00	27.49	30.58	32.80	37.70
16	19.37	23.54	26.30	28.85	32.00	34.27	39.25
17	20.49	24.77	27.59	30.19	33.41	35.72	40.79
18	21.60	25.99	28.87	31.53	34.81	37.16	42.31
19	22.72	27.20	30.14	32.85	36.19	38.58	43.82
20	23.83	28.41	31.41	34.17	37.57	40.00	45.32
21	24.93	29.62	32.67	35.48	38.93	41.40	46.80
22	26.04	30.81	33.92	36.78	40.29	42.80	48.27
23	27.14	32.01	35.17	38.08	41.64	44.18	49.73
24	28.24	33.20	36.42	39.36	42.98	45.56	51.18
25	29.34	34.38	37.65	40.65	44.31	46.93	52.62
26	30.43	35.56	38.89	41.92	45.64	48.29	54.05
27	31.53	36.74	40.11	43.19	46.96	49.64	55.48
28	32.62	37.92	41.34	44.46	48.28	50.99	56.89
29	33.71	39.09	42.56	45.72	49.59	52.34	58.30
30	34.80	40.26	43.77	46.98	50.89	53.67	59.70
40	45.62	51.80	55.76	59.34	63.69	66.77	73.40
50	56.33	63.17	67.50	71.42	76.15	79.49	86.66
60	66.98	74.40	79.08	83.30	88.38	91.95	99.61
70	77.58	85.53	90.53	95.02	100.4	104.2	112.3
80	88.13	96.58	101.9	106.6	112.3	116.3	124.8
90	98.65	107.6	113.1	118.1	124.1	128.3	137.2
100	109.1	118.5	124.3	129.6	135.8	140.2	149.4

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences*. Vol. I. Second Edition. John Wiley and Sons, New York.

TABLE 2. 95th PERCENTILES OF THE F-DISTRIBUTION WITH v_1 AND v_2 DEGREES OF FREEDOM, $F_{v_1,v_2,0.95}$

Table used to obtain "tabulated" F statistic for ANOVA analyses. (one-way parametric)

v_2 \ v_1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.5[illegible]
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.5[illegible]
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.6[illegible]
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.3[illegible]
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.6[illegible]
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.2[illegible]
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.9[illegible]
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.7[illegible]
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.5[illegible]
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.4[illegible]
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.3[illegible]
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.2
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.1
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.0[illegible]
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.0
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.9[illegible]
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.9
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.8[illegible]
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.8
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.8
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.7
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.7
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.7
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.7
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	[illegible]
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.6
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.5
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.3
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.2
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.0

NOTE: v_1: Degrees of freedom for numerator
v_2: Degrees of freedom for denominator

SOURCE: Johnson, Norman L. and F. C. Leone. 1977. *Statistics and Experimental Design in Engineering and the Physical Sciences.* Vol. I. Second Edition. John Wiley and Sons, New York.

SHEET NO. 83

JOB NO.

SUBJECT

DATE

BY

CHKD.

Arsenic ANOVA's

Arsenic

Sampling Periods	Upgradient					Downgradient							Cross-gradient	
	588	710	741	745	746	515	516	517	518	731	736	740	737	742
Fall 1987	M	M	M	0.016	0.015	M	M	M	M	0.015	M	0.012	0.012	M
Fall 1988	M	M	M	0.02	0.04	M	M	M	0.04	0.05	M	M	0.05 ↓	M ↓
Spring 1989	0.005 ~~<0.01~~	0.005 ~~<0.01~~	0.005 ~~<0.01~~	0.005 ~~<0.01~~	0.005	0.01	0.01	0.01	0.005	0.005	0.005	0.005	0.005	0.005
Summer 1989	M	M	0.005 ~~<0.01~~	0.005	0.005	M	M	0.005	0.005	0.01	0.01	M	0.01	M
Fall 1989	M	M	0.005 ~~<0.01~~	0.005	0.016	M	M	M	0.005	0.013	0.015	M	M	M

M = missing data

N = number of samples = 39

P = number of wells = 14

39 - 14 = 25

Note: Sample results reported as < MDL, are assumed to be $\frac{1}{2}$ MDL.

file name: GRJAS.SX

Arsenic

[illegible] 94
[illegible]

1.5

[illegible] ONE-WAY NONPARAMETRIC ANOVA

VARIABLE	MEAN RANK	SAMPLE SIZE
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible] STATISTIC [illegible]
P VALUE USING CHI-SQUARED APPROXIMATION [illegible]

PARAMETRIC ANOVA APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WITHIN	[illegible]	[illegible]	[illegible]		
TOTAL	[illegible]	[illegible]			

TOTAL NUMBER OF VALUES WITHIN ONE TIED GROUP [illegible]
MAX DIFF ALLOWED BETWEEN TIES [illegible]

CASES INCLUDED [illegible] MISSING CASES [illegible]

13 degrees of freedom. Table 1 @ 5% significance level to find tabulated H value = 22.36

Since the calculated value (9.15) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

SHEET NO. 7 (B)

JOB NO.

SUBJECT

DATE

BY

CHKD.

Cadmium ANOVAs

Cadmium

Sampling Points	Upgradient					Downgradient							Cross-gradient	
	588	710	744	745	746	515	516	517	530	713	736	740	737	742
Fall 1987	M	M	M	0.003	0.003	M	M	M	M	0.003	M	M	.002	M
Fall 1988	M	M	M	0.013	0.017	M	M	M	0.023	0.016	M	M	.018	M
Spring 1989	0.005	0.005	0.005	0.005	0.005	.0005	.0005	.0005	0.001	.0005	.0005	.003	.0005	.0005
Summer 1989	M	M	0.006	0.012	0.039	M	M	0.025	0.010	0.013	0.014	.0005	.029	M
Fall 1989	M	M	0.005	0.002	0.002	M	M	M	0.002	0.001	0.002	M	M	M

File name: GRJCD.SX

Note: Sample results reported as < method detection limits are assumed to be $= \frac{MDL}{2}$

Cadmium

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV

VARIABLE	MEAN RANK	SAMPLE SIZE
B588	7.0	1
B710	7.0	1
B744	19.3	3
B745	21.0	5
B746	23.7	5
M585	7.0	1
M586	7.0	1
M589	21.5	2
M590	23.6	4
M733	21.1	5
M736	18.7	3
M740	14.7	2
M737	24.0	4
M742	7.0	1
TOTAL	19.5	36

KRUSKAL-WALLIS STATISTIC 9.2921
P VALUE, USING CHI-SQUARED APPROXIMATION 0.7535

PARAMETRIC AOV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	1.0968E+03	84.45	0.62	0.8148
WITHIN	24	3.2746E+03	136.4		
TOTAL	37	4.3712E+03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 24
MAX. DIFF. ALLOWED BETWEEN TIES 1.00E-05

CASES INCLUDED 36 MISSING CASES 37.

13 DF. At 5% significance level tabulated H value = 22.36
Since the calculated value (9.29) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

Molybdenum

Sampling Period	Upgradient					Downgradient					Cross-gradient			
	588	710	744	745	746	515	516	519	530	713	736	740	737	741
Fall 1987														
Fall 1988														
Spring 1989	.005	.06	.005	.02	.15	.24	.14	.04	.01	.01	.005	.07	.07	.03
Summer 1989	M	M	.01	.03	.14	M	M ~~.005~~	.06	.04	.05	.09	M	.09	M
Fall 1989	M	M	.02	.05	.15	M	M	M	.04	.04	.04	M	M	M

N = # of samples = 27
P = number of wells = 14

27 − 14 = 13 ∴ sample size large enough to conduct ANOVA

file name : GRJMO.SX

Note : values < MDL are assumed to be = $\frac{MDL}{2}$

SHEET NO. ____ JOB NO. ____ SUBJECT Molybdenum ANOVAs DATE ____ BY ____ CHKD. ____

NE WAY AOV

Molybdenum

VARIABLE	MEAN	SAMPLE SIZE	GROUP VARIANCE
3588	5.000E-03	1	M
3710	6.000E-02	1	M
3744	1.167E-02	3	5.833E-05
3745	3.333E-02	3	2.333E-04
3746	1.467E-01	3	3.333E-05
M585	2.400E-01	1	M
M586	1.400E-01	1	M
M589	5.000E-02	2	2.000E-04
M590	3.000E-02	3	3.000E-04
M733	3.333E-02	3	4.333E-04
M736	4.500E-02	3	1.825E-03
M740	7.000E-02	1	M
M737	8.000E-02	2	2.000E-04
M742	3.000E-02	1	M
TOTAL	6.089E-02	28	

SOURCE	DF	SS	MS	F	P
BETWEEN	13	8.099E-02	6.230E-03	14.14	0.0000
WITHIN	14	6.167E-03	4.405E-04		
TOTAL	27	8.715E-02			

	CHi SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	8.11	7	0.3230

COCHRAN'S Q 0.5558
LARGEST VAR / SMALLEST VAR 54.75

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 2.919E-03
EFFECTIVE CELL SIZE 2.0

CASES INCLUDED 28 MISSING CASES 42

The calculated F statistic (14.14) ~~is~~ ~~larger than~~ exceeds the tabulated F (2.51), and the hypothesis of equal well means must be rejected. Contamination is suggested.

SHEET NO. 4 of 4 JOB NO.

SUBJECT Selenium ANOVAs

DATE BY CHKD.

Selenium

Sampling Points	Upgradient					Downgradient							Cross-gradient	
	588	710	744	745	746	515	516	519	520	732	736	740	737	742
Fall 1987	M	M	M	.067	.060	M	M	M	M	.164	M	.127	.154	M
Fall 1988	M	M	M	.060	0.191	M	M	M	.142	.196	M	M	.199	M
Spring 1989	.005	.012	.005	.005	.05	.012	.012	M	.005	.005	.005	.005	.005	.005
Summer 1989	M	M	.012	.018	0.057	M	M	.028	.026	.025	.026	M	.026	M
Fall 1989	M	M	.011	.030	.060	M	M	M	.036	.039	.038	M	M	M

N = 37 samples
P = 14 wells

37 − 14 = 23 ∴ sample size large enough

file name: GRTSE.SX

Note: Values < MDL are assumed to be = $\frac{MDL}{2}$

Selenium

D-7

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV

VARIABLE	MEAN RANK	SAMPLE SIZE
B588	5.0	1
B710	12.5	1
B744	9.2	3
B745	19.8	5
B746	28.4	5
M585	12.5	1
M586	12.5	1
M589	20.0	1
M590	18.9	4
M733	23.1	5
M736	15.5	3
M740	18.0	2
M737	23.4	4
M742	5.0	1
TOTAL	19.0	37

KRUSKAL-WALLIS STATISTIC 12.6187
P VALUE, USING CHI-SQUARED APPROXIMATION 0.4780

PARAMETRIC AOV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	1.454E+03	111.9	0.95	0.5190
WITHIN	23	2.696E+03	117.2		
TOTAL	36	4.150E+03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 20
MAX. DIFF. ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

At 5% significance level, tabulated value = 22.36.
Since the calculated value (12.6) is less than the tabulated value (22.4), accept the hypothesis of no contamination at 5% level.

1 in Non-Parametric Analysis

Sampling Periods	← Upgradient →					← Downgradient →							← Cross-Gradient →	
	588	710	749	745	746	585	586	589	590	733	736	740	737	742
Fall 1987	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Fall 1988	.015	M	M	M	M	M	M	M	M	M	M	M	M	M
Spring 1989	M	.085	.015	.015	.015	.015	.015	.03	.015	.03	.015	.03	.035	.015
Summer 1989	M	M	.0025	.01	.029	M	M	.029	.02	.024	.02	M	.03	M
Fall 1989	M	M	.013	.052	.108	M	M	M	.117	.116	.12	M	M	M

M indicates Missing data

17

SHEET NO. 8 of 16

JOB NO. 80

JACOBS ENGINEERING

DATE ____ SUBJECT ____

BY ____ CHKD. ____

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV Tin

VARIABLE	MEAN RANK	SAMPLE SIZE
B588	9.0	1
B710	9.0	1
B744	4.3	3
B745	11.7	3
B746	17.5	3
D585	9.0	1
D586	9.0	1
D589	20.0	2
D590	17.2	3
D733	21.5	3
D736	17.5	3
D740	21.5	1
D737	15.2	2
D742	9.0	1
TOTAL	14.5	25

At 5% significance level,
tabulated H value = 22.36
Since the calculated value (12.91)
is ~~gr~~ less than tabulated value (22.4)
Accept the hypothesis of no-contamination
at the 5% level.

KRUSKAL-WALLIS STATISTIC ~~12.9142~~
P VALUE, USING CHI-SQUARED APPROXIMATION ~~1.4545~~

PARAMETRIC AOV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	816.4	62.95	0.99	0.5064
WITHIN	14	892.6	63.76		
TOTAL	27	1.7108-03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 19
MAX. DIFF. ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 25 MISSING CASES 42

SJL 8/20/90

KRUSKAL-WALLIS ONEWAY NONPARAMETRIC AOV

VARIABLE	MEAN RANK	SAMPLE SIZE
B585	19.0	1
B710	20.0	1
B744	20.7	3
B745	15.6	5
B746	17.7	4
D585	9.0	1
D586	29.0	1
D589	22.5	2
D590	24.2	4
D733	22.6	5
D736	17.3	3
D740	9.0	2
D737	15.0	4
D742	30.0	1
TOTAL	19.0	37

Met Gross Alpha

One-Way Non-Parametric Anova

KRUSKAL-WALLIS STATISTIC 8.1852
P VALUE, USING CHI-SQUARED APPROXIMATION 0.8616

At the 5% significance level, tabulated H value = 22.36

Since the calculated value (8.18) is less than the tabulated value (22.36) Accept the hypothesis of no contamination at the 5% level.

PARAMETRIC AOV APPLIED TO RANKS

SOURCE	DF	SS	MS	F	P
BETWEEN	13	866.3	66.64	0.52	0.8664
WITHIN	23	2.944E+03	128.0		
TOTAL	36	3.810E+03			

TOTAL NUMBER OF VALUES WHICH WERE TIED 17
MAX. DIFF. ALLOWED BETWEEN TIES 1.000E-05

CASES INCLUDED 37 MISSING CASES 33

Net Gross Hydra Non-parametric

Sampling Periods	588	710	749	745	746	585	586	589	590	733	736	740	737	742
	← Upgradient →					← Downgradient →							Crossgradient	
Fall 1987	M	M	M	-.27 Ø	0	M	M	M	M	-.45 Ø	M	-.15 Ø	-.20 Ø	M
Fall 1988	M	M	M	-.12 Ø	7.3 Ø	M	M	M	.49 Ø	16.9	M	-.22 Ø	51.9	M
Spring 1989	1.02	2.5	4.59	-1.57 Ø	0	-.17 Ø	24	-8.4 Ø	4.64	0	-.28 Ø	M	0	36.19
Summer 1989	M	M	.139	17.6	18.21	M	M	81.9	63.1	125.7	53	M	-10.16 Ø	M
Fall 1989	M	M	8.04	14.0	16.57	M	M	M	44.23	98.9	-7.7 Ø	M	M	M

Grjnga.sx

SHEET NO. 7
JOB NO. 22

SUBJECT

DATE
BY
CHKD. SM 8/20/90

Uranium Parametric ANOVA

Sampling Periods	← Upgradient →					← Downgradient →							← Cross Gradient →	
	588	710	749	745	746	585	586	589	590	733	736	740	737	742
Fall 1987	M	M	M	.04	.056	M	M	M	M	.07	M	.213	.052	M
Fall 1988	M	M	M	.04	.05	M	M	M	.229	.07	M	M	.07	M
Spring 1989	.0015	.027	.021	.04	.06	0.29	.29	.18	.19	.08	.129	.12	.06	.093
Summer 1989	M	M	.010	.03	.06	M	M	.071	.112	.05	.083	M	.06	M
Fall 1989	M	M	.009	.03	.06	M	M	M	.125	.0015	.095	M	M	M

File name
Grju.sx

JACOBS ENGINEERING
SUBJECT
DATE
BY
CHKD.
SHEET NO.
JOB NO.
95 JK

ONE WAY AOV

VARIABLE	MEAN	SAMPLE SIZE	GROUP VARIANCE
B555	1.500E-03	1	M
B710	2.700E-02	1	M
B744	1.333E-02	3	4.433E-05
B745	3.600E-02	5	3.000E-05
B746	5.720E-02	5	1.920E-05
D585	2.900E-01	1	M
D586	2.900E-01	1	M
D589	1.250E-01	2	6.050E-03
D590	1.640E-01	4	3.042E-03
D733	5.400E-02	5	1.026E-03
D736	1.010E-01	3	6.300E-04
D740	1.665E-01	2	4.325E-03
D737	6.050E-02	4	5.433E-05
D742	9.300E-02	1	M
TOTAL	5.566E-02	36	

SOURCE	DF	SS	MS	F	P
BETWEEN	13	1.751E-01	1.347E-02	12.77	0.0000
WITHIN	24	2.531E-02	1.055E-03		
TOTAL	37	2.026E-01			

	CHI SQ	DF	P
BARTLETT'S TEST OF EQUAL VARIANCES	34.09	8	0.0000

COCHRANE'S C 0.3975
LARGEST VAR / SMALLEST VAR 315.1

COMPONENT OF VARIANCE FOR BETWEEN GROUPS 4.679E-03
EFFECTIVE CELL SIZE 2.7

CASES INCLUDED 38 MISSING CASES 32

Uranium

Parametric ANOVA

tabulated value = 2.19

The calculated F statistic (12.77) exceeds the tabulated value (2.19) and the hypotheses of equal well means must be rejected. Contamination is suggested.

GROUNDWATER QUALITY ...SUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

PARAMETER NAME	TOTAL # OF SAMP.	UNITS OF MEASURE	MAX CON. LIMIT	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	VALUE EXCEEDING MAX. CON. LIMIT	PARAMETER UNCERTAINTY
ARSENIC	29	MG/L	0.05000	-	-	-	-	-	-	-
BARIUM	29	MG/L	1.00000	-	-	-	-	-	-	-
[redacted]	29	MG/L	0.01000	0589	08/03/89	0001	AL	D	0.025	-
				0590	08/03/89	0001	AL	D	0.010	-
				0733	08/03/89	0001	AL	D	0.013	-
				0736	08/03/89	0001	AL	D	0.014	-
				0737	08/07/89	0001	AL	C	0.029	-
				0745	08/03/89	0001	AL	U	0.012	-
				0746	08/03/89	0001	AL	U	0.039	-
CHROMIUM	29	MG/L	0.05000	-	-	-	-	-	-	-
[redacted]	29	PCI/L	15.00000	0581	03/07/89	0001	AL	O	71.	33.
				0585	03/01/89	0001	AL	D	182.	58.
				0586	03/01/89	0001	AL	D	223.	50.
				0589	03/01/89	0001	AL	D	115.	45.
				0589	08/03/89	0001	AL	D	130.	60.
				0590	03/01/89	0001	AL	D	135.	53.
				0590	08/03/89	0001	AL	D	140.	60.
				0590	11/02/89	0001	AL	D	130.	40.
				0710	03/06/89	0001	AL	U	21.	33.
				0733	08/03/89	0001	AL	D	160.	70.
				0733	11/02/89	0001	AL	D	49.	50.
				0736	02/28/89	0001	AL	D	60.	50.
				0736	08/03/89	0001	AL	D	110.	70.
				0736	11/02/89	0001	AL	D	58.	59.
				0737	08/07/89	0001	AL	C	31.	62.
				0740	02/28/89	0001	AL	D	30.	36.
				0742	03/03/89	0001	AL	C	101.	52.
				0744	03/05/89	0001	AL	U	19.	15.
				0745	03/05/89	0001	AL	U	29.	24.
				0745	08/03/89	0001	AL	U	41.	26.
				0745	11/02/89	0001	AL	U	38.	28.
				0746	08/03/89	0001	AL	U	58.	61.
				0746	11/02/89	0001	AL	U	56.	48.

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT
O - ON-SITE

GROUNDWATER QUALITY MEASUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

PARAMETER NAME	TOTAL # OF SAMP.	UNITS OF MEASURE	MAX CON. LIMIT	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	VALUE EXCEEDING MAX. CON. LIMIT	PARAMETER UNCERTAINTY
LEAD	29	MG/L	0.05000	-	-	-	-	-	-	-
MERCURY	29	MG/L	0.00200	-	-	-	-	-	-	-
[redacted]	29	MG/L	0.10000	0581	03/07/89	0001	AL	O	0.10	-
				0585	03/01/89	0001	AL	D	0.24	-
				0586	03/01/89	0001	AL	D	0.14	-
				0746	03/05/89	0001	AL	U	0.15	-
				0746	08/03/89	0001	AL	U	0.14	-
				0746	11/02/89	0001	AL	U	0.15	-
[redacted]	29	PCI/L	15.00000	0581	03/07/89	0001	AL	O	41.5	-
				0586	03/01/89	0001	AL	D	24.1	-
				0589	08/03/89	0001	AL	D	81.3	-
				0590	08/03/89	0001	AL	D	63.2	-
				0590	11/02/89	0001	AL	D	44.3	-
				0733	08/03/89	0001	AL	D	125.7	-
				0733	11/02/89	0001	AL	D	48.0	-
				0736	08/03/89	0001	AL	D	53.1	-
				0742	03/03/89	0001	AL	C	37.2	-
				0745	08/03/89	0001	AL	U	17.7	-
				0746	08/03/89	0001	AL	U	18.2	-
				0746	11/02/89	0001	AL	U	16.9	-
NITRATE	29	MG/L	44.00000	-	-	-	-	-	-	-
RA-226 & RA-228	29	PCI/L	5.00000	-	-	-	-	-	-	-
[redacted]	29	MG/L	0.01000	0581	03/07/89	0001	AL	O	0.01	-
				0585	03/01/89	0001	AL	D	0.025	-
				0586	03/01/89	0001	AL	D	0.025	-
				0588	03/06/89	0001	AL	U	0.01	-
				0589	03/01/89	0001	AL	D	0.025	-
				0589	08/03/89	0001	AL	D	0.028	-
				0590	03/01/89	0001	AL	D	0.01	-

* NET GROSS ALPHA (GROSS ALPHA - DISSOLVED URANIUM) WITH 1 MG DISSOLVED URANIUM = 686 PCI

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
O - ON-SITE
D - DOWN GRADIENT
U - UPGRADIENT
C - CROSS GRADIENT

GROUNDWATER QUALITY MEASUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

PARAMETER NAME	TOTAL # OF SAMP.	UNITS OF MEASURE	MAX CON. LIMIT	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	VALUE EXCEEDING MAX. CON. LIMIT	PARAMETER UNCERTAINTY
SELENIUM	29	MG/L	0.01000	0590	08/03/89	0001	AL	D	0.025	-
				0590	11/02/89	0001	AL	D	0.036	-
				0710	03/06/89	0001	AL	U	0.025	-
				0733	02/28/89	0001	AL	D	0.01	-
				0733	08/03/89	0001	AL	D	0.025	-
				0733	11/02/89	0001	AL	D	0.039	-
				0736	02/28/89	0001	AL	D	0.01	-
				0736	08/03/89	0001	AL	D	0.026	-
				0736	11/02/89	0001	AL	D	0.038	-
				0737	03/04/89	0001	AL	C	0.01	-
				0737	08/07/89	0001	AL	C	0.026	-
				0740	02/28/89	0001	AL	D	0.01	-
				0742	03/03/89	0001	AL	C	0.01	-
				0744	03/05/89	0001	AL	U	0.01	-
				0744	08/03/89	0001	AL	U	0.012	-
				0744	11/02/89	0001	AL	U	0.011	-
				0745	03/05/89	0001	AL	U	0.01	-
				0745	08/03/89	0001	AL	U	0.018	-
				0745	11/02/89	0001	AL	U	0.030	-
				0746	03/05/89	0001	AL	U	0.05	-
				0746	08/03/89	0001	AL	U	0.057	-
				0746	11/02/89	0001	AL	U	0.060	-
SILVER	29	MG/L	0.05000	-	-	-	-	-	-	-
[redacted]ISSOLVED)	29	MG/L	0.04400	0585	03/01/89	0001	AL	D	0.29	-
				0586	03/01/89	0001	AL	D	0.29	-
				0589	03/01/89	0001	AL	D	0.18	-
				0589	08/03/89	0001	AL	D	0.071	-
				0590	03/01/89	0001	AL	D	0.19	-
				0590	08/03/89	0001	AL	D	0.112	-
				0590	11/02/89	0001	AL	D	0.125	-
				0733	02/28/89	0001	AL	D	0.08	-
				0733	08/03/89	0001	AL	D	0.050	-
				0736	02/28/89	0001	AL	D	0.129	-
				0736	08/03/89	0001	AL	D	0.083	-
				0736	11/02/89	0001	AL	D	0.095	-
				0737	03/04/89	0001	AL	C	0.064	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
U - UPGRADIENT
D - DOWN GRADIENT
C - CROSS GRADIENT

GROUNDWATER QUALITY MEASUREMENTS EXCEEDING MAXIMUM CONCENTRATION LIMITS
SITE: GRJ01 GRAND JUNCTION
02/28/89 TO 11/02/89
REPORT DATE: 11/28/90

PARAMETER NAME	TOTAL # OF SAMP.	UNITS OF MEASURE	MAX CON. LIMIT	LOCATION ID	LOG DATE	SAMPLE ID	FORM COMP	FLOW REL.	VALUE EXCEEDING MAX. CON. LIMIT	PARAMETER UNCERTAINTY
URANIUM (DISSOLVED)	29	MG/L	0.04400	0737	08/07/89	0001	AL	C	0.059	-
				0740	02/28/89	0001	AL	D	0.12	-
				0742	03/03/89	0001	AL	C	0.093	-
				0745	03/05/89	0001	AL	U	0.045	-
				0746	03/05/89	0001	AL	U	0.059	-
				0746	08/03/89	0001	AL	U	0.058	-
				0746	11/02/89	0001	AL	U	0.057	-
URANIUM (TOTAL)	0	PCI/L	30.00000	-	-	-	-	-	-	-

FORMATION OF COMPLETION CODE:
AL - ALLUVIUM

FLOW RELATIONSHIP CODE:
D - DOWN GRADIENT
C - CROSS GRADIENT
U - UPGRADIENT

DATA FILE NAME: J:\DART\GRJ01\GWQ10024.DAT

CALCULATION GRJ-05-91-12-05-00

TRANSIENT DRAINAGE AND STEADY STATE SEEPAGE

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. GRJ-05-91-12-05-00 DISCIPLINE CIVIL/HYDRO NO. OF SHEETS 11 209 w/ appendices

PROJECT:

UMTRA

SITE:

GRAND JUNCTION - CHENEY DISPOSAL CELL

FEATURE:

TRANSIENT DRAINAGE & STEADY STATE SEEPAGE

SOURCES OF DATA:

SEE PAGE 6

SOURCES OF FORMULAE & REFERENCES:

SEE PAGE 6

PRELIMINARY CALC. ☑ FINAL CALC. ☐ SUPERSEDES CALC. NO. _____

	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		G. SMITH	5/91				
01	Conduct permeability update	G. Smith	6/91	[illegible]	6/19/91	[illegible]	6/19/91

8/86

PURPOSE:

The purpose of this calculation is to reanalyze the transient drainage of construction waters used to meet placement specifications of contaminated materials on the overall Cheney Disposal Cell performance. For simplicity and consistency, this reanalysis will utilize the same computer code originally used, the UNSAT2 code by Davis and Neuman (1983). Also, as much of this original analysis is reused as possible. The reanalysis is necessary because of two modifications in assumptions made for the original transient drainage calculation, GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" which are presented below.

These computer analyses reported herein provide insight into time-dependent transient drainage and moisture redistributions occurring within the cell. Unfortunately, absolute determinations of these phenomena are not possible at this time due to limitations in field characterization techniques and in state-of-the-art analysis techniques concerning saturated and unsaturated flow through porous media.

The first modification made to the original analysis is an increased excavation depth of 6 feet in the disposal cell exposing two different material conditions for the Mancos Shale: a fractured, slightly weathered unit underlying the weathered to highly weathered Mancos shale. When the fractured shale was uncovered during excavation of the cell it became necessary to preform additional Sealed Ring Infiltrometer Testing (SDRI) to determine the vertical infiltration rate (I_v) and saturated hydraulic conductivity (K_s) of this unit. This additional testing was performed in the autumn of 1990. Test results indicate a highly permeable zone at the base of the cell in the competent, fractured Mancos Shale possessing a K_s on the order of 1E-05 cm/sec, two orders of magnitude greater than previously determined. Tests were also performed in the weathered shale to confirm conductivity results from the original testing done in 1989. Results from these tests indicate conductivities approximately one order of magnitude lower than originally tested within the weathered Mancos Shale. Conductivity values utilized in this analysis are provided in the Data section of this report.

The second modification is concerned with the effect of placement of tailings materials within the 90 percent ASTM D698 relative compaction without regard to moisture content on the groundwater compliance strategy. Possible ponding of contaminated construction waters within the cell due to transient drainage of construction waters, plus steady-state operating conditions, are analyzed. Placement of the tailings in this 'wet' condition, in conjunction with the low conductivity foundation necessitates a reassessment of the maximum possible depth of ponded water which may occur within the disposal cell and the expected time for drainage. This analysis is performed by assigning a matric

potential to the tailings which is below their optimum moisture content potential.

The original transient drainage calculation, GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell", contains all the hydraulic parameters, both unsaturated and saturated, the FEM mesh specifications, and boundary conditions applied for this reanalysis. A copy of the original Calculation is attached for reference in Appendix I. Modifications required for this analysis involve, separation of the Mancos shale unit into two materials and reassignment of matric potentials to the tailings materials.

METHOD:

Procedures followed in this calculation follow those outlined in the original calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the following additions.

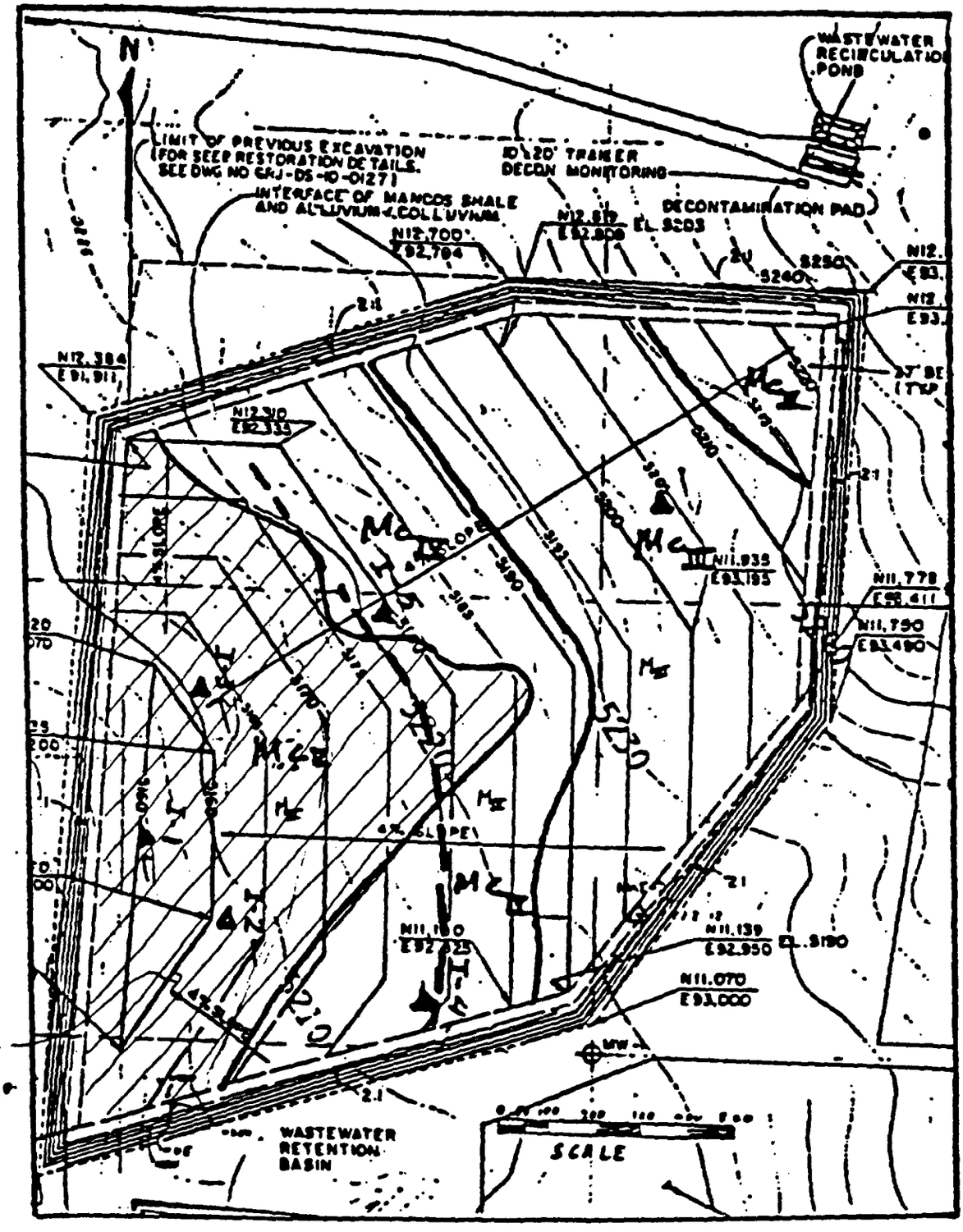
The original FEM mesh necessary to run the UNSAT2 model was <u>not</u> regenerated to incorporate the additional 6 foot excavation depth. The original mesh was used, knowing that waters could pond to an elevation 6 feet higher than the lowest paleochannel elevation. For contaminated water to flow from the cell, horizontal hydraulic gradients would have to exist that are great enough to force the moisture through a 10 foot thick clean-fill dike. The dikes surround the cell and consist of compacted Mancos Shale possessing a saturated hydraulic conductivity of 3×10^{-7} cm/sec.

As mentioned above, the lower portion of the cell was excavated into fractured Mancos Shale. The fractured layer extends beneath the entire cell based on interpretation of corehole logs from borings advanced through the Mancos Shale unit. The Geology report, Attachment 2 of the RAP discusses in detail fracture system. The base of the excavation was mapped during an inspection made in April, 1991 (see reference 3) delineating material types as shown in Figure 1. The original mesh was modified by assigning new material properties to elements in the fractured zones, as scaled off the map and beneath the cell as shown in Figure 2 to model the field conditions.

ASSUMPTIONS:

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell".

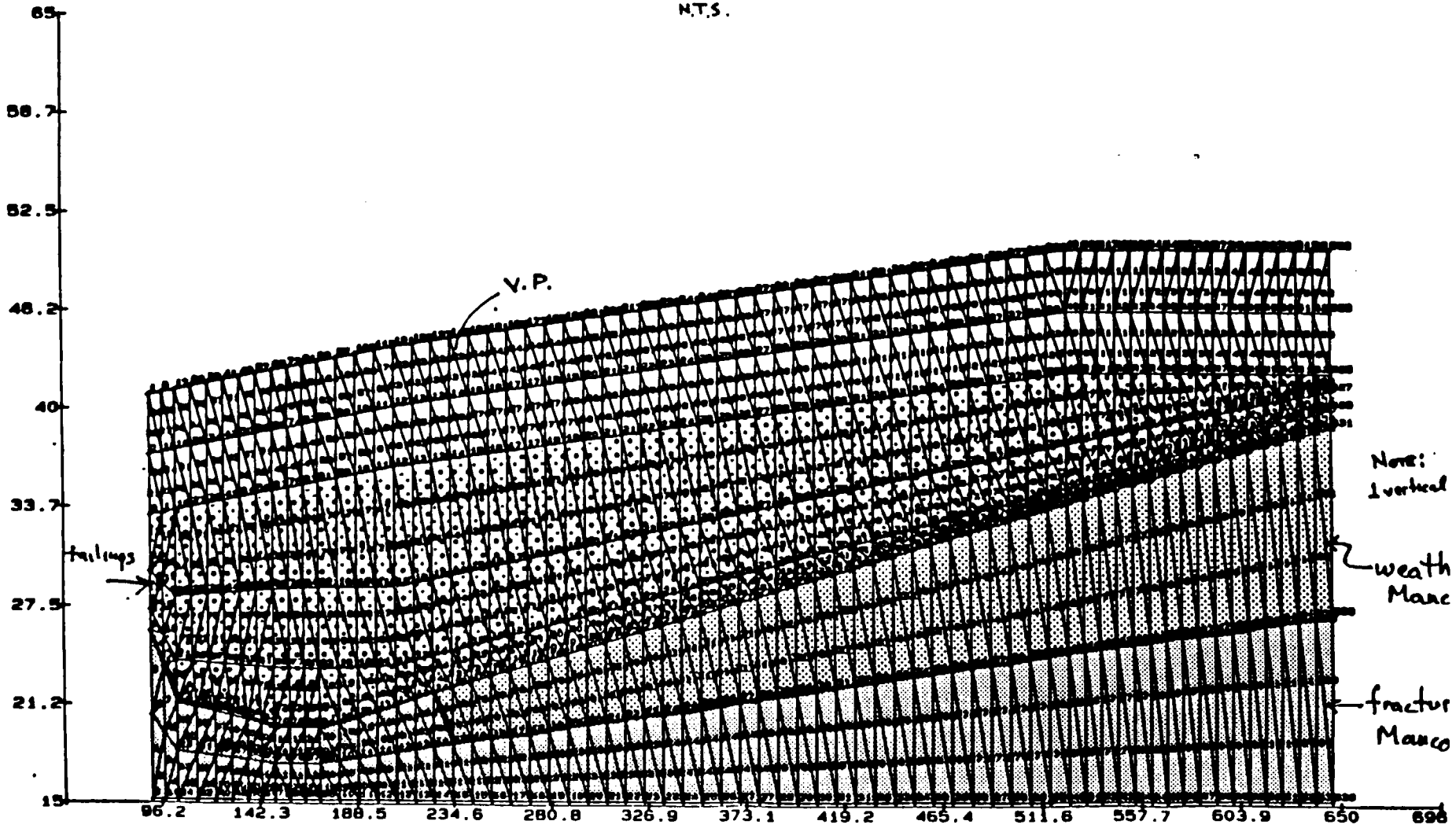
FIGURE 1



fractured, fresh zone

CHENEY DISPOSAL CELL

N.T.S.



REFERENCES:

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the addition of:

1) Smith, G., August 1990., TAC calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady-State Seepage from Cheney Disposal Cell".

2) In Situ Permeability Tests on the Mancos Shale Foundation of the Cheney Disposal Cell, UMTRA Project, Grand Junction, Colorado, prepared for MK-Ferguson by Daniel B. Stevens & Associates, December, 1990.

3) "Final Inspection of the Bottom of the Cheney Disposal Embankment Site, UMTRA Project - Grand Junction, Colorado", a report prepared by Morrison-Knudsen Environmental Services, April 1991.

DATA SOURCE:

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the addition of reference (2).

DATA:

Initial Conditions

Same as outlined in calculation GRJ-08-90-12-05-00, "Transient Drainage and Steady State Seepage from Cheney Disposal Cell" with the additional saturated hydraulic parameters for the fractured Mancos Shale as listed below in Table A.

Table A

Hydraulic Parameters for UNSAT2 Input

material	θ_s / θ_r(%) vol./vol.	α(1/m)	N	K_s(m/day)	ψ(m)
V.P.	0.~~197~~/.4025/ 0.~~095~~ .2130	0.45	5.92	~~2.62E-03~~ 9.42×10^{-2}	-2.75
tailings	0.~~361~~/.4676/ 0.~~126~~ .2211	0.65	1.24	~~4.84E-02~~ 1.25×10^{-2}	-2.50 to -20.0
wthrd Mancos	0.160/ 0.080	0.63	1.08	3.46E-04/ 1.73E-05 4.0×10^{-7} cm/sec 2.0×10^{-8}	-10.2
frctrd Mancos	0.160/ 0.080	0.63	1.08	3.46E-01/ 1.73E-02	-10.2

check w/ input to UNSATZ

GMS 8/12/91

The hydraulic parameters utilized in these analyses for the initial conditions are presented in Table A and Table B. The matric potentials used were obtained from the original calculation listed as 'previous' data, but are applied to the unsaturated hydraulic parameters determined for DBS&A data. The tailings materials are best represented by data presented by Daniel B. Stephens and Associates, sample S5-3. The reasons for this selection are presented in the original calculation.

The matric potentials for the tailings materials are varied as indicated in Table B to analyzing the different placement saturations considered. Matric potential values are theoretical suctions that would exist at placement. It is not expected that gravity drainage would produce suction values greater than -1 bar (-1.02 meters of water), however these high suctions could be created during placement. Each of the values were calculated from the phase relationship, $G_s * w_c = S * e$.

Where,

G_s = the specific gravity of solids,

w_c = gravimetric water content,

S = saturation,

$e = [G_s * \gamma_w / \gamma_d] - 1.0$ with,

γ_w = unit weight of water,

γ_d = specified placement dry unit weight.

The placement moisture content of the V.P. material was not varied from the value used in the original calculation. The V.P. material should be placed as originally specified.

Table B

Matric Potentials Related to Placement Moisture Contents and Saturations for Tailings

Dry Density (g/cc)	Saturation (%)	moisture content (g/g %)	ψ(meters)
1.46	60	19	-20.0
1.46	70	23	-8.50
1.46	80	26	-4.30
1.46	90	29	-2.50

The geometric mean of the saturated hydraulic conductivity for the weathered to highly weathered Mancos Shale was originally

tested to be 2 x 10-7 cm/sec. However, when the geometric mean of the results from all SDRI testing performed was computed,a value of 4 x 10^{-8} cm/sec resulted. Possible reasons for this conductivity difference are provided in the Discussion section.

Boundary Conditions

The boundary conditions utilized in these analyses are identical to those used in the original calculation. The sides and base of the model are specified as unsaturated seepage faces which allows them to exist in a partially saturated condition until moisture influx achieves full saturation. When this occurs, flow is allowed through the node and unrealistic ponding will not occur. The upper boundary surface of the V.P. material has a continuous influx varying from zero to the design saturated hydraulic conductivity of the radon/infiltration barrier of 1.0 x 10^{-7} cm/sec.

CALCULATION:

The UNSAT2 computer code was used to perform the calculation. Typical input and output listings are provided for reference in Appendix II. Listings of all the runs performed are too voluminous to be attached, however complete records of the runs are kept on 5¼ inch micro-computer disks at the UMTRA Project Office in Albuquerque, New Mexico.

RESULTS:

Table C presents results of a series of computer runs which were made to provide some insight into the effect of the two modifications discussed in the Purpose section. Reviewing this Table it is evident that ponding of contaminated water is possible along the weathered portion of the cell if the saturated hydraulic conductivity is on the order of 10^{-8} cm/sec assuming moisture is allowed to pass through the cover at 10^{-7} cm/sec. This condition occurs at any placement moisture content of the tailings. When the cover flux is set to zero, ponding does not occur when the fractures are accounted for. This suggests that transient drainage of construction water will pass from the cell.

When the cover flux is set at 1.0 x 10^{-7} cm/sec and fractures are not accounted for with the foundation conductivity is set at 10^{-7} cm/sec, ponding is likely to occur to a depth of approximately 13 feet if the tailings are placed very wet. Placing the tailings at a workable moisture content under these conditions results in no occurrence of ponding. Accounting for fractures under this condition with a 10^{-7} cm/sec cover flux and tailings placed at a 90% saturation, slight ponding (2-3 meters) may occur along the weathered portion of the cell base, but drains within 5 years.

Table C

Results of UNSAT2 Analyses

cover flux	base flux	tailings saturation (%)	result
1×10^{-7}	1×10^{-7} w/ fractures	90	no significant ponding
1×10^{-7}	1×10^{-8} w/ fractures	90	ponding to V.P./tailings interface
1×10^{-7}	4×10^{-8} w/ fractures	90	ponding to V.P./tailings interface
1×10^{-7}	4×10^{-8} w/ fractures	80	ponding to V.P./tailings interface
1×10^{-7}	4×10^{-8} w/ fractures	70	ponding up through tailings
1×10^{-7}	1×10^{-7}, no fractures	90	approx. 13 ft @ base due to transient drainage
1×10^{-7}	1×10^{-7}, no fractures	60, optimum	no ponding
zero flux	4×10^{-8} w/ fractures	70	no ponding
zero flux	4×10^{-8} w/ fractures	90	no ponding

DISCUSSION:

The transient drainage and moisture redistribution under long-term conditions were modeled in this calculation set assuming both a fractured and non fracturated Mancos Shale foundation possessing saturated hydraulic conductivities on the order of 10^{-8} cm/sec and 10^{-7} cm/sec. Placement moisture contents for the tailings material varying between 60 to 90 percent saturated. The effect of each of these conditions on the overall cell performance is discussed.

In general, when the flux through the cover is greater than the saturated hydraulic conductivity of the foundation material, ponding will occur. In this model, a portion of the foundation is fractured and possesses a relatively high saturated hydraulic conductivity, while the majority of the foundation may be

considered homogeneous. Ponding occurs over the homogeneous section and never over the fractured section when the conductivity of the cover is greatest. The saturated surface will not drain completely as long as the cover flux is greater than the flux allowed through the foundation. When the cover and foundation conductivies are equal, ponding occurs for a short period of time and then drains. This water is transient drainage of construction placement water.

Sealed double ring infiltrometer testing performed in the late autumn of 1990 resulted in lower permeability values for the foundation materials than originally determined. These lower values resulted in a geometric mean of the foundation to be lower than the cover permeability. Consequently, a greater quantity of moisture is allowed to enter the cell than is allowed to leave. This situation results in ponding of water within the cell. The testing that was performed in 1990 was undertaken during late fall to early winter. At this time of year at the site the night time temperatures drop below freezing. Although this was expected and the SDRI devices were equipped with circulation pumps to prevent the water from freezing within the outer-ring (see reference 2), temperatures within the inner-ring of the SDRI device during testing are unknown. Flowrate of water through the inner-ring is measured to calculate the infiltration rate and saturated hydraulic conductivity. It is possible that partial or total freezing of water within the small diameter tubes occurred. These ¼ inch diameter tubes carry flow from flexible bags to the inner ring. Any freezing would have blocked flow, producing an artifical result, indicating an apparent low conductivity material. Likewise, a decrease in temperature also changes the viscosity of the water. However, corrections made for the viscosity do not cause a significant change in the results. Since conditions within the inner-ring cannot accurately be assessed during the testing period, reasonable doubt concerning the accuracy of the results can be made. Therefore, the results from the month long tests performed during 1990 are questionable, and the saturated conductivity of the weathered portion of the Mancos Shale foundation should be taken as originally tested, on the order of 10^{-7} cm/sec.

The range of placement moisture contents for the tailings materials ranged between 19 to 29 percent by weight which relates to 60 to 90 percent saturation. Optimum moisture content for the tailings material is determined by ASTM D698 to be 19 percent. Typically, optimum moisture content of a soil material compacted under ASTM D698 specifications is approximately 80 to 85 % saturated. It is understood that some of the tailings materials exist in situ at a higher moisture content than optimum and drying or mixing the tailings material will cause construction delays. Based on this analysis, the depth of ponding which may occur within the cell is more sensitive to the relative difference between the cover and foundation permeabilities than it is to the placement moisture contents. This is indicated by the fact that the depth of

ponding which was indicated by the computer model was approximately the same, independent of initial moisture content.

A quick analytical check can be made to verify the results of the numerical model. Ponding will occur within the cell if the outflow through the base of the cell is less than the influx through the cover. Assumming saturated conditions, Darcy's Law for 1-D flow can be utilized to compute the flow through the boundaries of the cell. Using the coordinates from the FEM mesh the lengths of the cover and foundation can be simply calculated. The lengths are listed below with the respective coefficients of permeability.

Analytical Computations

component	length (m)	permeability (m/day)	flow (cmd)
cover	554.9	8.64×10^{-5}	0.0479
wthrd base	391.1	1.73×10^{-5}	0.0068
frctrd base	164.8	1.73×10^{-2}	2.8502

Ponding will not occur if the ratio of the outflow over the inflow is greater than one. Thus,

$$[2.8502 + 0.0068]/0.0479 = 59.6$$

$$59.6 \geq 1.0 \therefore \text{ponding should not occur.}$$

SUMMARY:

It is felt that the saturated conductivity of the foundation is most accurately represented by the original testing, on the order of 10^{-7} cm/sec. The numerical analysis and analytical computation both indicate that ponding should not occur within the cell if the fractures are considered and a reasonable saturated conductivity for the weathered foundation are used. An additional safeguard is provided by the fact that all moisture apparently drains from the cell into the underlying fracture system. Therefore, the compaction specifications for the tailings materials only, can safely be relaxed allowing the subcontractor to only meet the 90% dry density specification without regard to moisture content specifications.

APPENDIX I

ORIGINAL CALCULATION

JACOBS ENGINEERING GROUP INC.
ADVANCED SYSTEMS DIVISION, ALBUQUERQUE OPERATIONS

CALCULATION COVER SHEET

CALC NO. ~~GRJ 08 90 12 05 00~~ STET ~~GRJ 05 91 12 05 01~~ DISCIPLINE Geotech/Hydro NO. OF SHEETS 25

PROJECT:
UMTRA

SITE:
GRAND JUNCTION

FEATURE:
TRANSIENT DRAINAGE AND STEADY STATE SEEPAGE FROM CHENEY DISPOSAL CELL

SOURCES OF DATA:
Daniel B. Stevens & Associates
~~Shan-Northern Consulting Geotechnical Engineers~~
MKE-S, Final Grading Plans & Embankment Area Excavations

SOURCES OF FORMULAE & REFERENCES:

SEE PG 3

PRELIMINARY CALC. [X] FINAL CALC. [ ] SUPERSEDES CALC. NO. _____

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
		G. SMITH	8/90	[illegible]	8/9/90	[illegible]	9/6/90
01	~~Incorporate base & wet tailings~~	~~G. SMITH~~	~~5/91~~				

0186

PURPOSE:

To evaluate effects of transient drainage of construction water from placed contaminated materials on overall cell performance. To determine if any ponding and the resulting depth that water is expected to reach within the cell. Compare the resulting water level to the location of the nearest paleochannel and evaluate the possibility of contaminate water leaching from the cell into the channel.

METHOD:

Utilize finite element method (FEM) analysis provided by the UNSAT2 computer code to evaluate the time-drainage effects of transient drainage. Use Maulem's parameters determined from Van Gneuthen's RETC analyses in conjunction with moisture/pressure test data obtained from laboratory analyses performed on the various materials to be used in the final cell construction. Test data were selected from samples that have materials properties and were prepared closest to expected final field conditions. Tailings materials possess any overall slime or fines content (% material passing a #200 mesh sieve) of around 25% (see reference 4). The vicinity property materials have over 60% slimes according to laboratory test results. Samples chosen contain percentage of fine material which are closest to design specifications and were remolded to design densities and water contents.

Two separate analyses are performed to bound the range of estimated material moisture/pressure relationships. Flux rates determined through previous infiltration studies will be applied to the surface of the contaminated materials. These earlier analyses are listed in the reference section. The cover is not included in the model. The condition imposed is the flux through the cover will be governed by the flux rate as determined by the UNSAT-H calculation of 1.78 cm/year (5.68E-08 cm/sec). This rate is conservatively modeled as the design saturated permeability of the radon/infiltration barrier of 1.0E-07 cm/sec.

ASSUMPTIONS:

- laboratory test methods utilized accurately reproduce expected field behavior of placed materials.

- transient drainage of construction waters do not begin until all cell components have been constructed.

- densities and moisture contents of placed materials precisely meet construction specifications.

- all materials are homogenous and isotropic except where specified anisotropity exists.

REFERENCES:

1) Crain, J., March 1990., TAC calculation GRJ-03-90-11-01-00, "Infiltration Through Cover System and Vicinity Properties Material".

2) Crain, J. & Smith, G., Jan. 1990., TAC calculation GRJ-01-90-02-03-00, "Grand Junction, Cheney Disposal Site, Transient Drainage".

3) Davis, L. and Neuman, 1983. Documentation and User's Guide: UNSAT-2 Variably Saturated Flow Model, NRC.

4) Merritt, R.C., 1971., "The Extractive Metallurgy of Uranium", Colorado School of Mines Research Institute.

5) Smith, G., August 1990., TAC calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

6) United States Department of Agriculture, 1987. User's Guide: RETC.

7) Van Genuchten, R., 1980. "A Closed-Form Solution for Predicting the Hydraulic Conductivity of Unsaturated Soils", Journal, Soil Science Society - American, No. 44.

DATA SOURCE:

Daniel B. Stevens and Associates

University of Arizona Hydrology Laboratory

MKE preliminary drawings GRJ-DS-10-0220 rev.1 & GRJ-DS-10-0134 rev.2 of Final Gradings Plans & Tailing Embankment Area Excavation Plan.

DATA:

Copies of laboratory determined moisture/pressure relationship test results from the firm of Daniel B. Stevens & Assoc.(DBS&A) are presented on pages 5 to 7. Computer results of the RETC analyses (see references 6 & 7) of these data are presented in the Appendix with the resulting best fit curves shown on Figures #1 to #2. This data is reproduced from calculation GRJ-08-90-12-02-00, "Determination of Unsaturated Hydrologic Properties, Tailings and Vicinity Property Materials".

Capillarity moisture tests were not successfully performed on the Mancos Formation shale material. Therefore, test results for a similar substitute material were used. Data were obtained from testing performed by the University of Arizona Hydrology Laboratory on Wasatch Formation shale. This material was taken from the UMTRA disposal site in Rifle, Colorado at Estes Gulch. Plots of the unsaturated moisture/pressure relationships are presented on Figures #3 to #4 on pages 10 and 11 . A justification for this substitution is presented in the discussion section of this calculation set.

Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-1	0.0	45.66
	112.2	16.49
	305.9	1.98
	1019.8	6.89
	3059.4	5.19
	7138.6	4.38
	15399.0	3.77
5-2	0.0	45.17
	112.2	20.15
	305.9	8.70
	1019.8	7.04
	3059.4	5.30
	7138.6	4.60
	15399.0	3.66
5-3 S5-3 Tailings	0.0	50.36
	112.2	46.27
	305.9	38.91
	1019.8	33.22
	3059.4	25.65
	7138.6	24.33
	15399.0	24.16
5-4	0.0	51.35
	112.2	47.28
	305.9	41.07
	1019.8	34.69
	3059.4	26.20
	7138.6	23.88
	15399.0	17.87
5-5	0.0	47.19
	112.2	30.62
	305.9	25.49
	1019.8	22.00
	3059.4	17.36
	7138.6	16.54
	15399.0	14.28

* measurement error

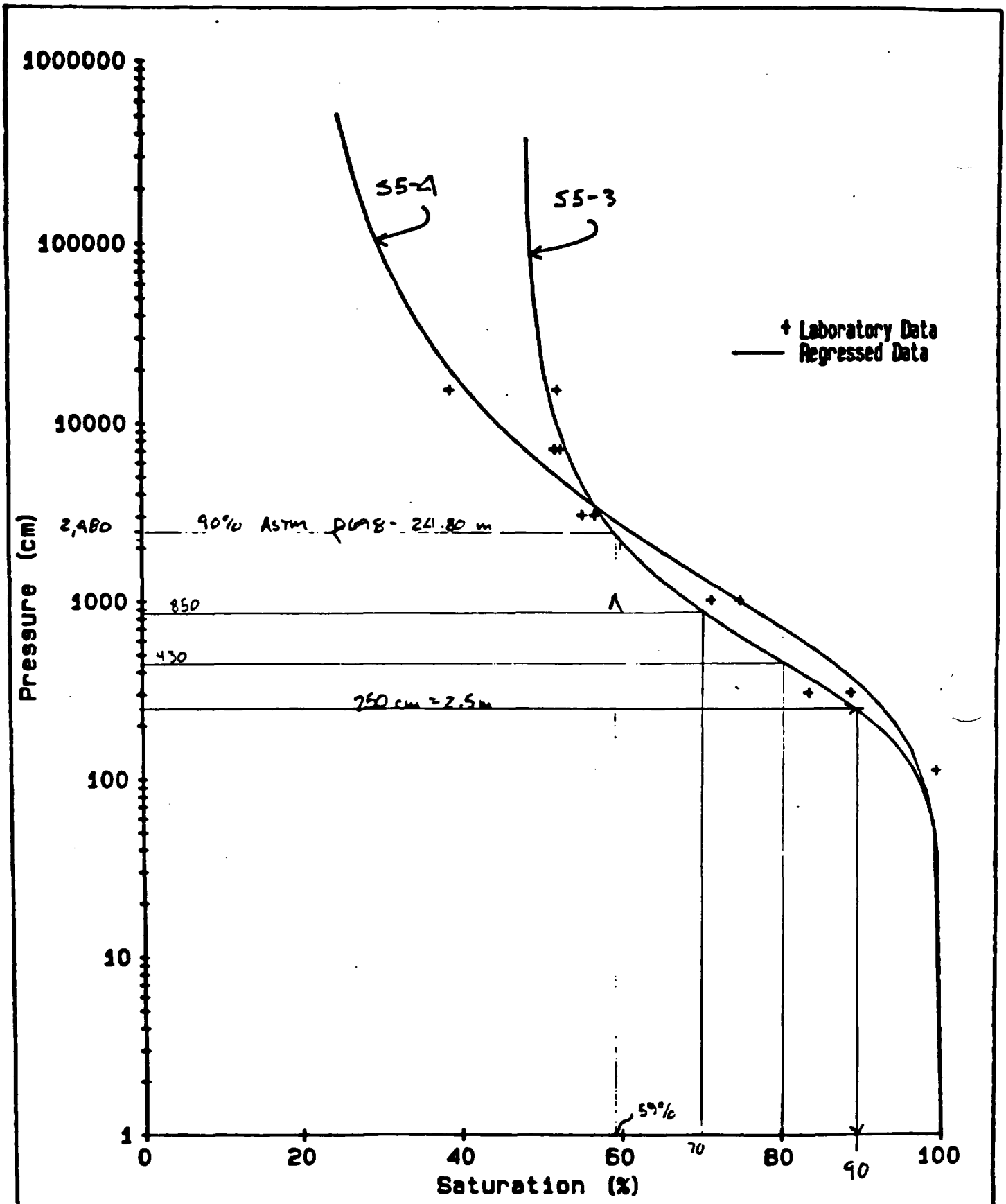
Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-11	0.0	48.34
	112.2	34.35
	305.9	32.49
	1019.8	29.72
	3059.4	22.13
	7138.6	20.60
	15399.0	19.38
5-12	0.0	45.27
	112.2	35.60
	305.9	33.56
	1019.8	31.14
	3059.4	25.80
	7138.6	24.46
	15399.0	24.76
5-13	0.0	46.48
	112.2	37.49
	305.9	35.57
	1019.8	32.68
	3059.4	27.95
	7138.6	26.69
	15399.0	25.77
5-14	0.0	47.39
	112.2	39.10
	305.9	35.24
	1019.8	32.05
	3059.4	26.64
	7138.6	24.20
	15399.0	19.45
5-15 ½ RS-3 Vicinity Property	0.0	40.69
	102.0	33.11
	305.9	29.70
	1019.8	26.71
	3059.4	26.09
	7138.6	23.80
	15297.0	23.25

7/25
19/

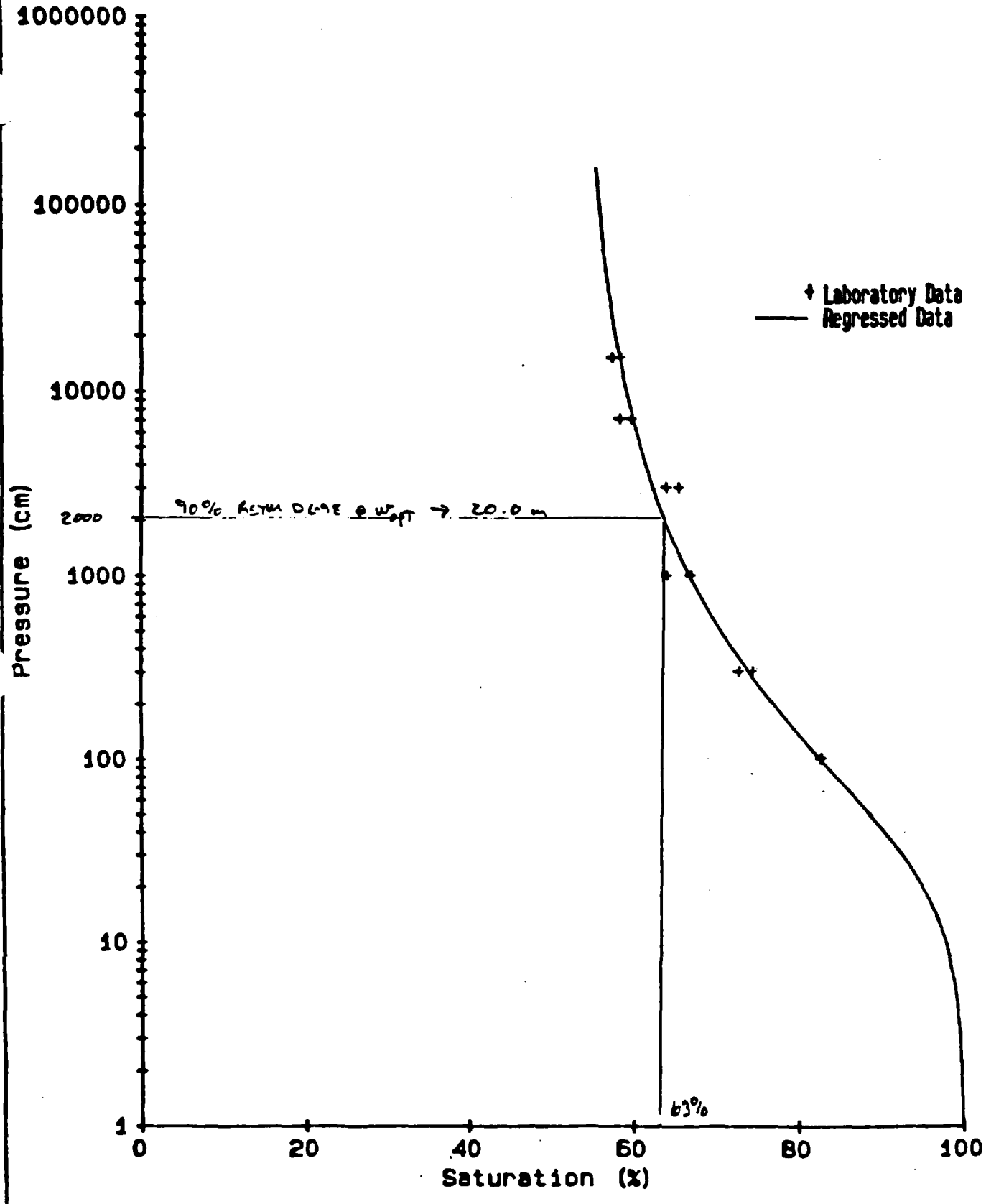
Table 6. Summary of Moisture Characteristics for the Initial Drainage Curve (Continued)

Sample No.	Pressure Head (-cm of water)	Moisture Content (% cm^3/cm^3)
5-16	0.0	39.78
Vicinity	102.0	33.16
Property	305.9	29.04
	1019.8	25.60
	3059.4	25.50
	7138.6	23.25
½ RS-3	15297.0	22.85
5-17	0.0	37.53
	102.0	33.79
	305.9	31.82
	1019.8	29.36
	3059.4	29.17
	7138.6	27.96
	15297.0	28.00
5-18	0.0	39.84
	102.0	34.27
	305.9	31.93
	1019.8	29.16
	3059.4	28.39
	7138.6	27.35
	15297.0	25.85
5-19	0.0	39.85
	102.0	36.29
	305.9	33.62
	1019.8	30.22
	3059.4	29.38
	7138.6	28.46
	15297.0	27.53
5-20	0.0	39.41
	102.0	36.36
	305.9	33.67
	1019.8	30.29
	3059.4	28.47
	7138.6	26.90
	15297.0	26.50



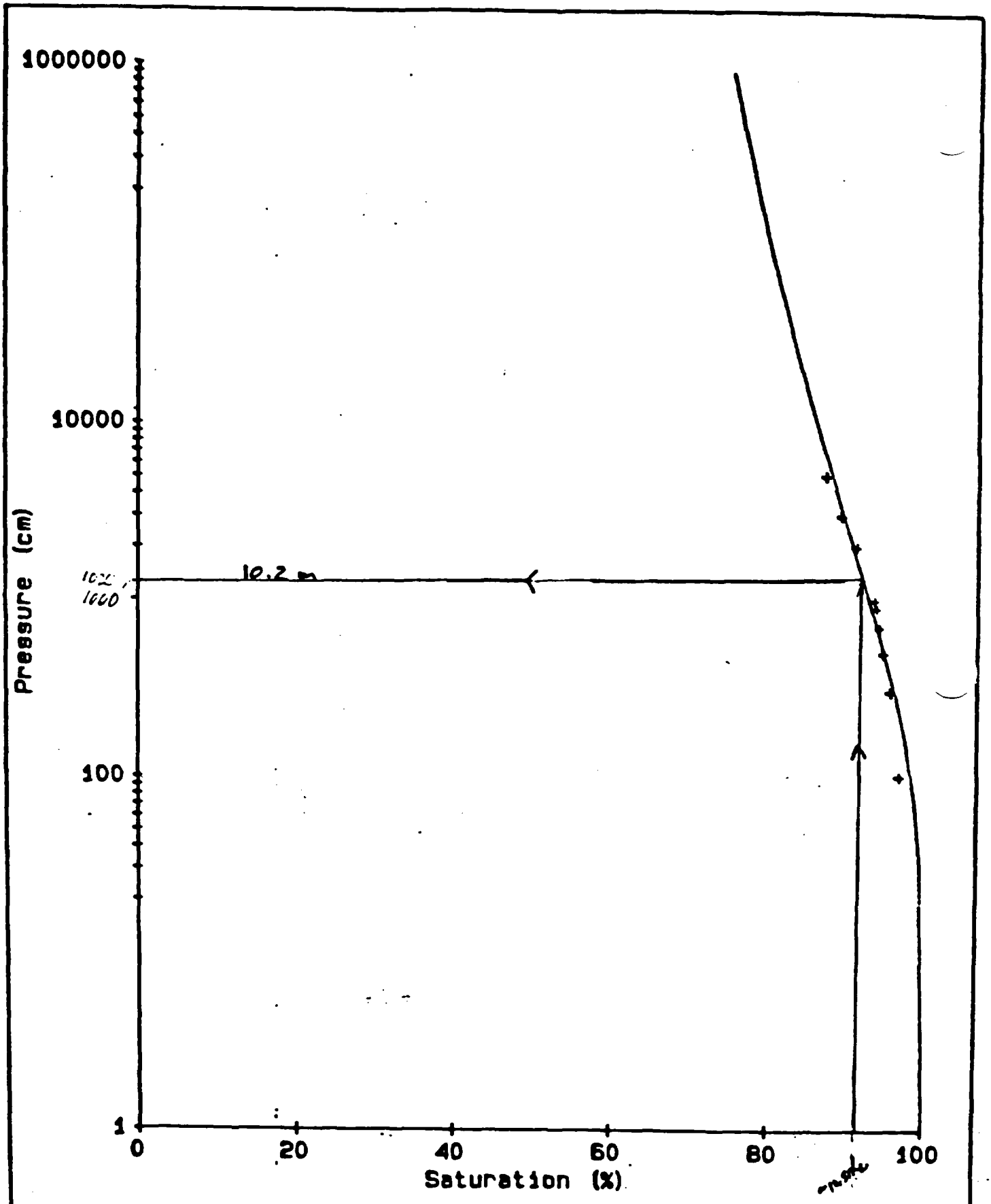
GRJ. MAIN PILE TAILINGS. 23.1% -200 (S5-3)
GRJ. MAIN PILE TAILINGS. 17.7% -200 (S5-4)

FIGURE No. 1



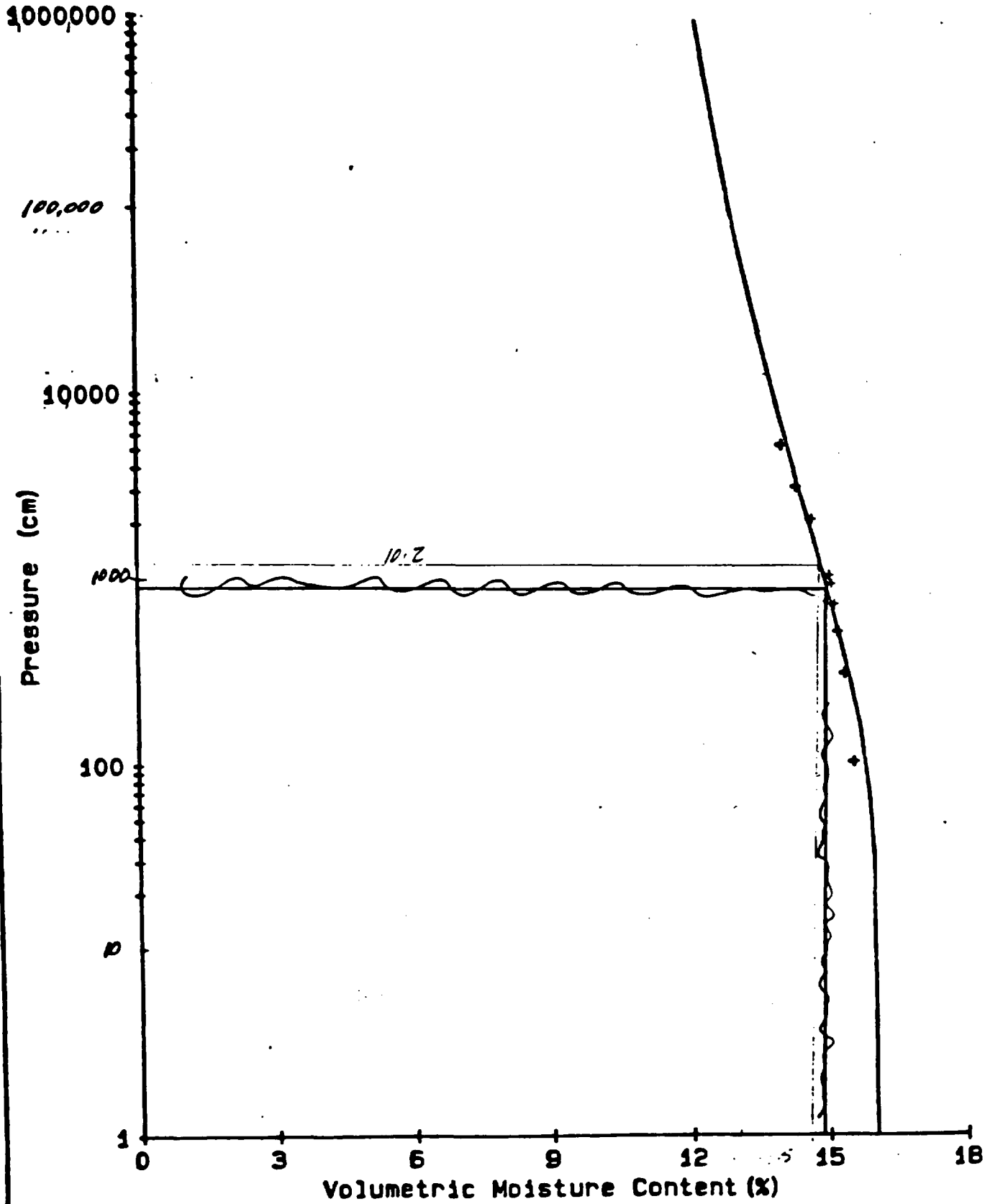
GRJ. VICINITY PROPERTY MATERIALS. (RS-3/ #5-15 & #5-16)

FIGURE NO. 2



ESTES GULCH, WASATCH FORMATION

Figure #3



ESTES GULCH, WASATCH FORMATION

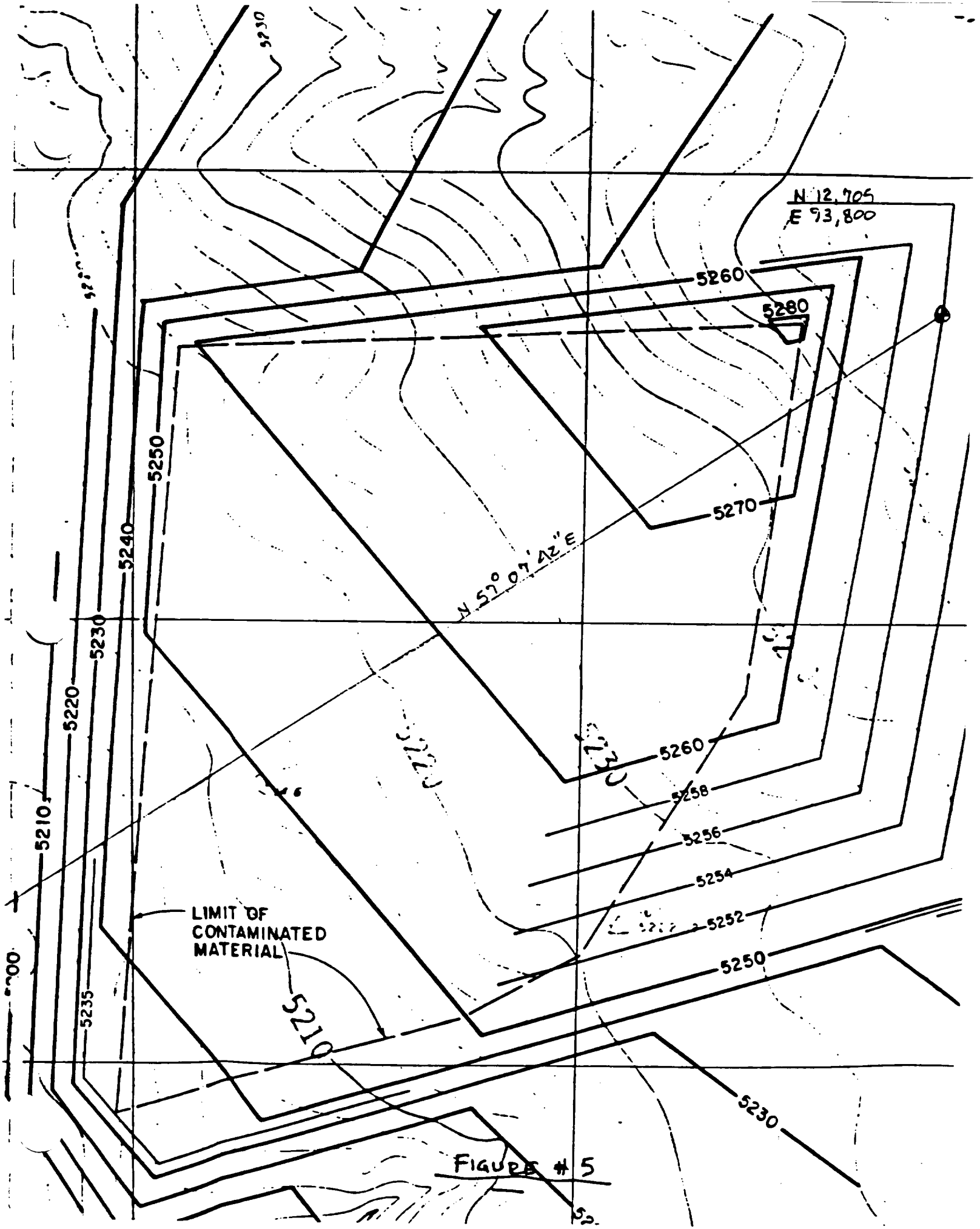
Figure # 4

CALCULATION:

Utilization of a FEM analysis such as the UNSAT-2 computer code requires construction of a finite element mesh. The FEM mesh utilizied is a two-dimensional (2D) section through the disposal cell. The mesh is required to model the physical system for algorithms to solve partial differential equations governing variably saturated flow simulating both horizontal and vertical movement of water. The mesh used in this analysis was determined by locating the longest downgradient drainage path along the base of the proposed disposal cell excavation. This section is indicated on Figures #5 and #6 showing plan views of the proposed excavation and final grading plans, respectively. This excavation plan is MKE's design of Case 2BX which is for a moderate depth excavation. From these drawings the upper and lower boundaries of the mesh are specified. Thickness of the vicinity property and tailings materials were obtained from a preliminary cross-sectional sketch provided by MKE shown in Figure #7. Using this information the finite element mesh shown in Figure #8 is constructed. Metric units are used in this analysis for consistency with the UNSAT2 computer code. Therefore, all input is in meters or meters/day when units are necessary.

From the moisture/pressure relationships determined in laboratory testing, the unsaturated hydraulic parameters can be obtained. Unsaturated hydraulic properties are given by an analysis suggested by van Genuchten to solve a closed-form equation relating soil moisture contents to hydraulic conductivities derived by Mualem. For input into the UNSAT2 computer code a restriction is placed on determination of the Mualem "m" parameter of $m = 1 - 1/N$. A more detailed discussion on this restriction is provided in the TAC calculation GRJ-01-90-02-03-00 by J. Crain and G. Smith, "Grand Junction, Cheney Disposal Site, Transient Drainage". Unsaturated hydraulic Maulem parameters for each material type are listed in Table I below.

Results of the RETC analyses performed on DBS&A test data indicate the placed materials existing at much drier moisture conditions, holding less moisture at considerably greater negative matric potentials than previous testing had indicated. Therefore, comparative FEM analyses were performed using unsaturated material properties that were utilized in preliminary analyses by Crain and Smith (reference 2) and Crain (reference 1).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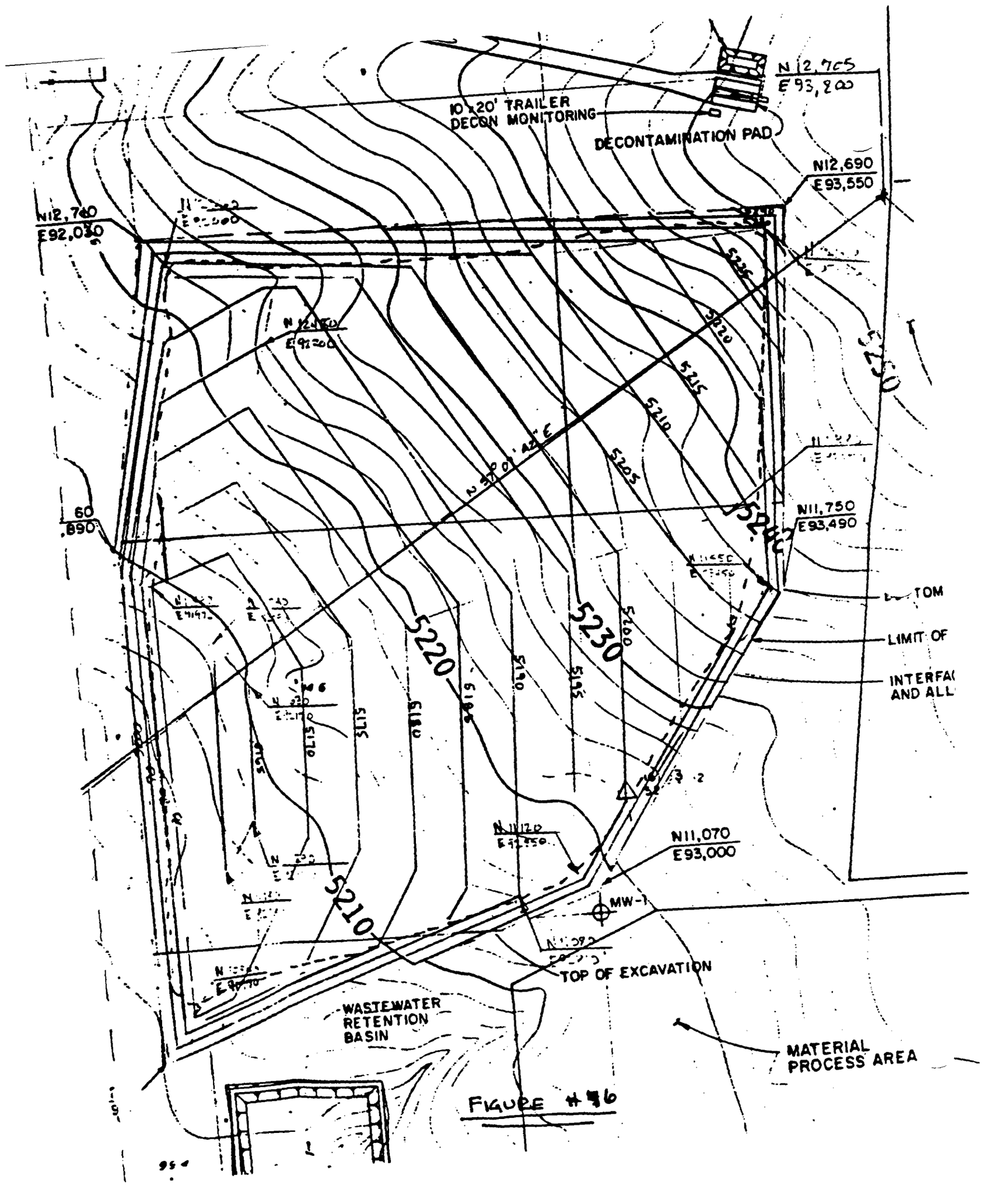
5210
LIMIT OF
CONTAMINATED
MATERIAL
5210
5235
5230

FIGURE # 5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10'x20' TRAILER
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DECONTAMINATION PAD
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N12,760
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N12,760
E92,200
N11,750
E93,490
60
890
N 40° 01' 42" E
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WASTEWATER
RETENTION
BASIN
MATERIAL
PROCESS AREA

FIGURE #6

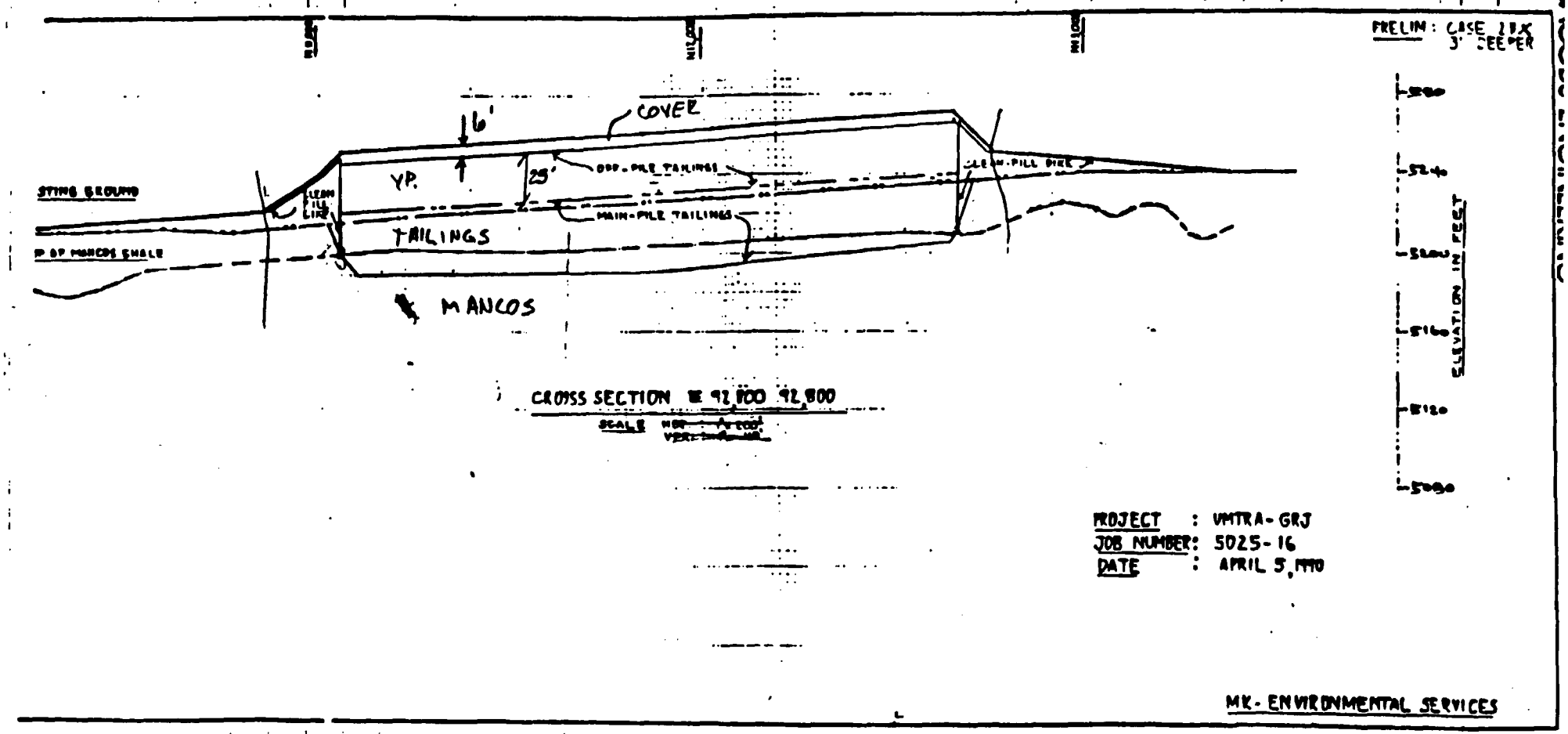


FIGURE #7

NOTE: THIS FIGURE USED TO DETERMINE RELATIVE THICKNESSES OF CONTAMINATED MATERIALS

DATE
BY
SHEET NO. 15/26
JOB NO.

FORM 81-006-1 (4/81)

CHENEY DISPOSAL CELL

N.T.S.

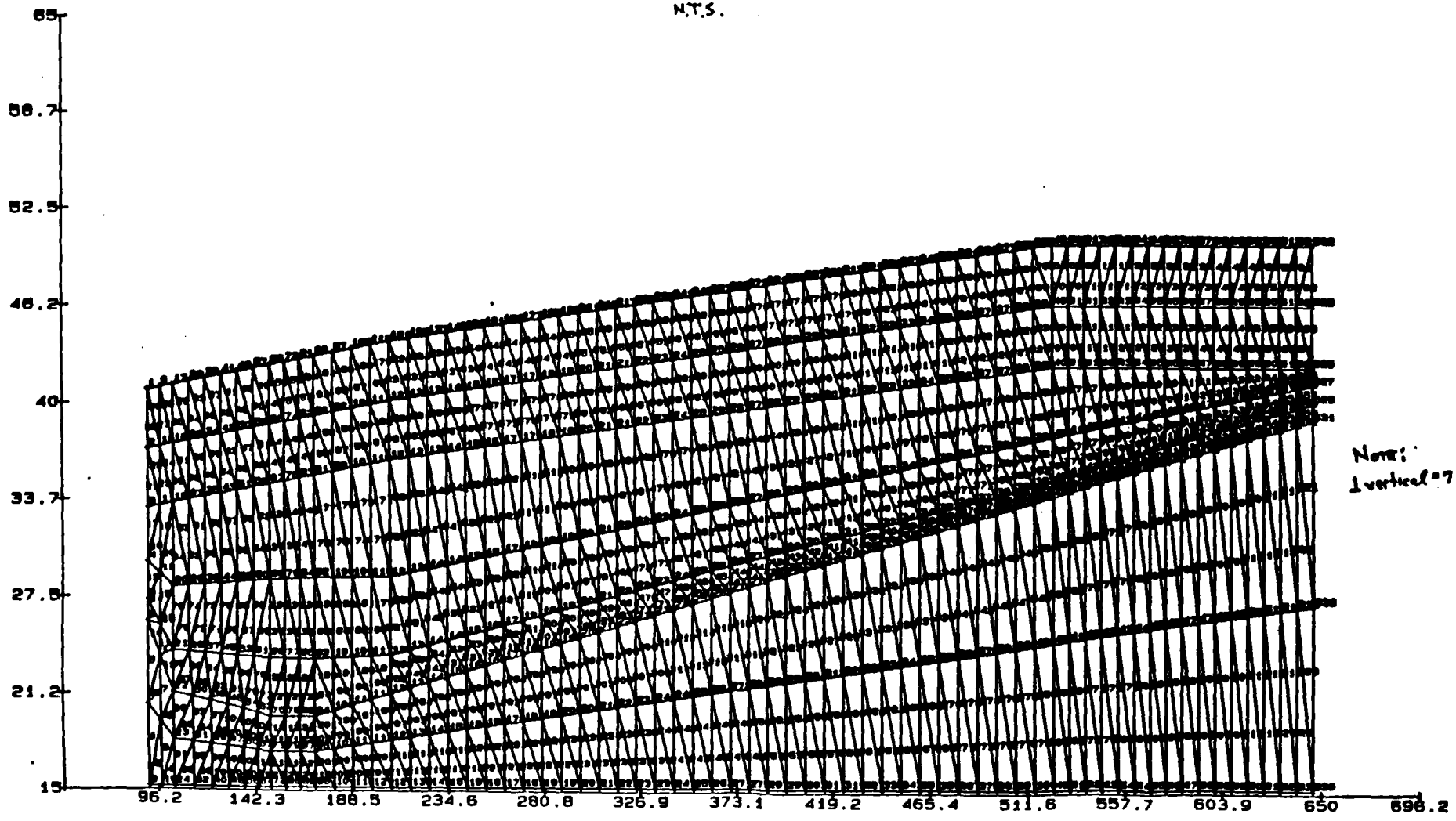


FIGURE 4.8

Table I

Unsaturated Hydraulic Parameters

(DBS&A)

material	%-200 sieve	θ_s (%)	θ_r(%)	α (1/meter)	N
V.P.	66.5	0.4025	0.2103	3.30	1.35
tailings	23.8	0.4670	0.2211	0.34	1.71
oundation					
bedrock	-	0.1600	0.0800	0.63	1.08

(previous)

material	%-200 sieve	θ_s (%)	θ_r(%)	α (1/meter)	N
V.P.	52	0.1969	0.0949	0.45	5.92
tailings	32	0.3613	0.1257	0.65	1.24
oundation					
bedrock	-	0.1600	0.0800	0.63	1.08

The UNSAT2 computer code also requires data in addition to that provided in Table 1, including saturated hydraulic conductivies and matric potential, in consistent units. These properties should be determined for the materials at initial placement conditions. Saturated permeabilities (k_{sat}) are obtained from laboratory testing and matric potential (ψ) are determined from RETC output.

Determination of ψ follows this conservative method: from the moisture density relationship defined by ASTM D698 (standard Proctor test), the maximum dry density, γ_d and optimum moisture content, w_{opt} are provided. Construction specifications indicate contaminated materials will be placed at 90% maximum dry density within -3% optimum to optimum moisture content. The placement volumetric moisture content (θ) or corresponding saturation (S) is determined by computing the optimum moisture content at 90% maximum dry density. This provides the most moisture in the materials existing at the lowest dry density or maximum void ratio, e . This computation is outlined below and requires the ratio of material weight of solids to weight of water, or the specific gravity of solids, G_s .

$$0.9 \times \gamma_d = \gamma_{placement} \quad (1)$$

$$e = ((G_s \times \gamma_w) / \gamma_{placement}) - 1.0 \quad (2)$$

$$S = (G_s \times w_c) / e \quad (3)$$

where γ_w = unit weight of water = 1.0 g/cc

Using the formulas listed above, information pertaining to remolded materials supplied by DBS&A are presented in Table 2 below. Water contents listed are gravimetric.

Table 2

material	G_s	γ_d (g/cc)	$90\%\gamma_d$	e	w_{opt} (%)	S(%)
V.P.	2.66	1.88	1.69	0.592	13.6	63
tailings	2.76	1.62	1.46	0.893	19.1	59

From RETC produced plots of saturation versus Ψ given in Figure no. s 1 and 2 the matric potential for each remolded material type is determined. Since the foundation materials will remain in situ, the value of -10.2 meters is determined from computed saturation varying between 87 tO 90%. This determination is presented on Figure no. 3.

Saturated permeabilities are also needed for UNSAT2 input. Remolded values are required for placed contaminated materials while an in situ value is needed for foundation bedrock. Values listed in Table 3 were determined in the laboratory and field accordingly.

Table 3

DBS&A

material	k_s (meters/day)	Ψ (meters)
V.P.	$k_v = k_h = 9.42 \times 10^{-2}$	-20.0
tailings	$k_v = k_h = 1.25 \times 10^{-2}$	-24.8
foundation bedrock	$k_h = 3.46 \times 10^{-3}$	-10.2
	$k_v = 1.73 \times 10^{-4}$	-10.2

previous data

material	k_s (meters/day)	Ψ (meters)
V.P.	$k_v = k_h = 2.62 \times 10^{-3}$	-2.75
tailings	$k_v = k_h = 4.84 \times 10^{-2}$	-2.50
foundation bedrock	$k_h = 3.46 \times 10^{-3}$	-10.2
	$k_v = 1.73 \times 10^{-4}$	-10.2

To model expected field as close as possible, nodes along the base of the mesh were coded intially as unsaturated seepage nodes at there initial matric potential. This allowed moisture to exit the model under atmospheric pressure at a rate controlled by the matric potential of the overlying nodes. A complete copy of the input files used are provided in the Appendix.

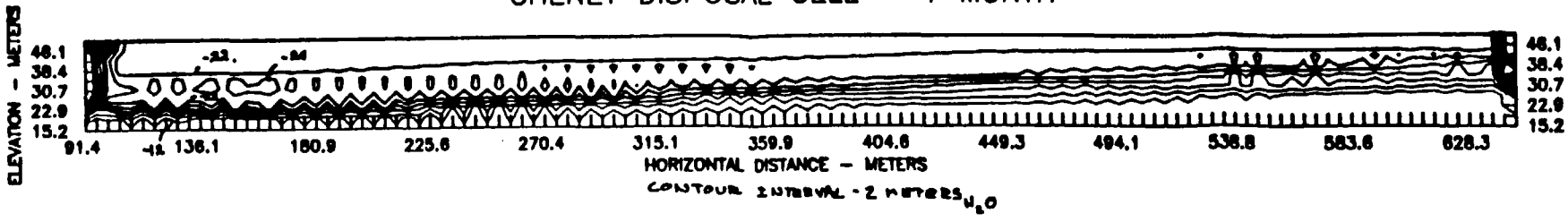
In these analyses the mesh extended around 14 feet into the underlying foundation bedrock beneath the lowest portion of the cell. This enables the moisture to be tracked through the upper foundation materials. Analysis indicates any moisture entering the foundation is accepted vertically downward and does not extend laterally beyond the downstream edge of the cell. Since the vertical hydraulic conductivity of the foundation is considered to be homogeneous and isotropic, once water enters the foundation no mounding of water is possible.

RESULTS

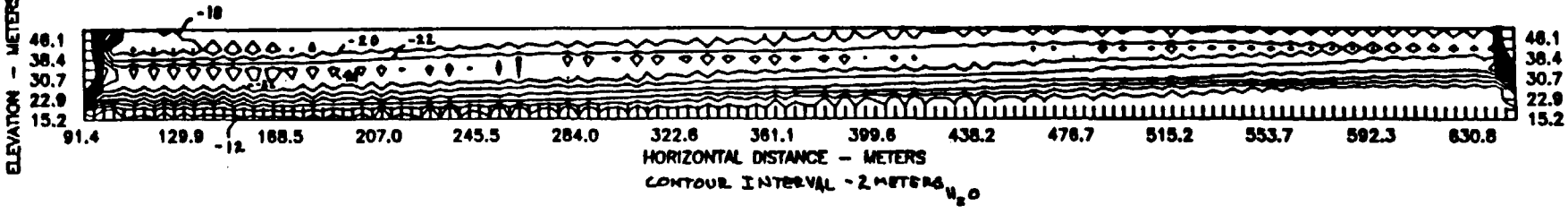
Using the capillarity data provided by DBS&A results in no ponding of any water within the cell. However, changes in matric potential (soil tension) do occur with time as indicated on Figure no.'s 9 and 10 showing pressure contours at variuos times throughout the life of the cell. Soil tensions increase from influx at the top of the cell are indicated by noticing the increasing values of matric potential with time from the surface downward into the cell. From the time progression shown the pressures can be seen to equalize with time through the 87.8 year plot. The next two time plots, (500 and 1000 years) show the influx through the cover being held by the vicinity property material, which is indicated by the closely spaced contours near midheight. This influx is accepted by the tailings before entering the foundation. Tailings are not holding the moisture as indicated by the more widely spaced contours. The closely spaced contours at the edge of the cell shown in the first time plots reflect the high negative matric potentials introduced by compaction of fine grained soils near maximum dry density and optimum moisture content.

When the previous moisture data is utilizied, a ponding depth of 3.75 meters (12.3 feet) is predicted in the cell. Ponding of water is in the base of the cell with the highest pressures indicated at node #94. A plot of positive pressure versus time obtained from node #94 is presented on Figure no. 11. This plot illustrates how moisture is accepted by the underlying foundation clayshales.

CHENEY DISPOSAL CELL – 1 MONTH



CHENEY DISPOSAL CELL – 32.5 YEARS



CHENEY DISPOSAL CELL – 87.8 YEARS

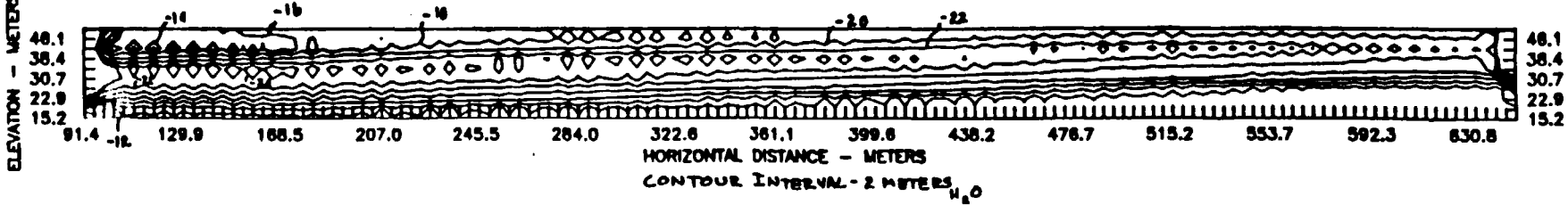
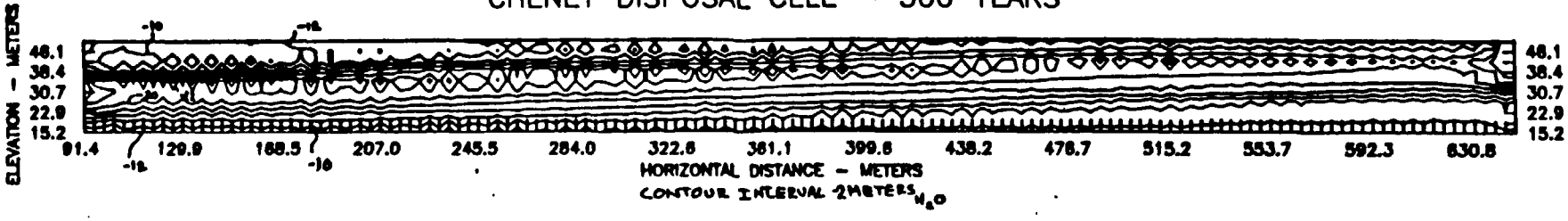
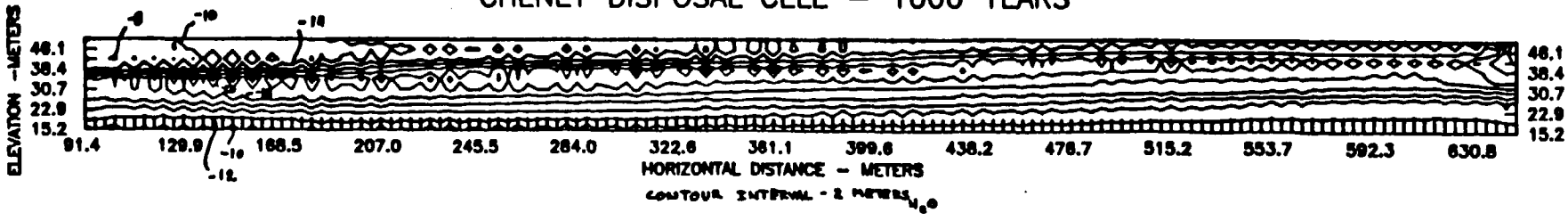


FIGURE #9

CHENEY DISPOSAL CELL – 500 YEARS



CHENEY DISPOSAL CELL – 1000 YEARS



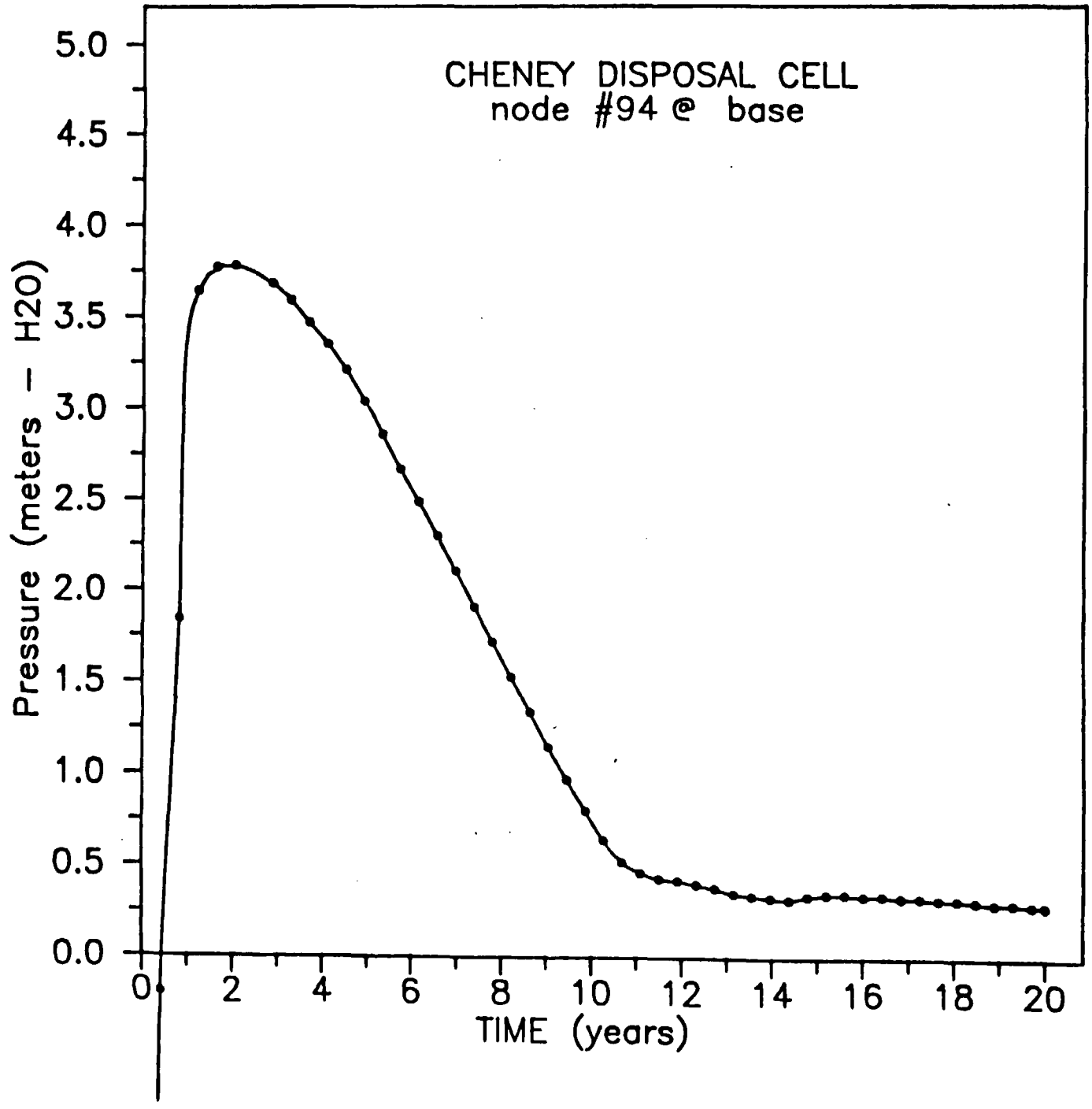

CHENEY DISPOSAL CELL
node #94 @ base
Pressure (meters - H20)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
TIME (years)

Figure #11

DISCUSSION:

Wasatch Formation in lieu of Mancos Formation:

Geotechnical engineering properties and infiltration characteristics of Mancos Formation shale and Wasatch Formation shale may be considered similar for this analysis because of the following conditions. Both lithologic units would carry the same engineering classification. Both materials are clayshales high in smectite minerals. Although the Mancos material is an older formation of the Cretaceous period while the Wasatch was formed during the much younger Tertiary period, both materials possess similar effects from weathering. Both units occur at similar depths beneath similar overburden materials. This overburden generally consists of silty, sandy clays derived from the underlying parent shale. The consistent overburden material and depth produced a closely matched depth of weathering in both units. Semi-arid climatic conditions exist at both locations which creates a similar force causing the weathering.

Weathering produces fracturing and micro-fracturing and general degradation within the rock mass. These fractures provide flow paths through the material. It is widely accepted that smectite minerals possess a high swell potential. Because the overburden material and depths are similar at both locations, the applied overburden stress will be similar. Thus, the possible degree of swell that can occur upon moisture increases will also be similar. The above swell similarity will produce similar void ratios in both materials. This is confirmed by approximately equal dry unit weights. Similar void ratios and mineral types produce similar pore sizes which control pore fluid tensions which govern unsaturated flow characteristics.

Considering all of the above, differences in hydraulic characteristics between Mancos Formation shales and Wasatch Formation shales are negligible.

SUMMARY OF RESULTS:

Using results from this analysis in conjunction with results from previous analyses indicated that some ponding will possibly occur. The actual depth of this ponding ranges from no ponding to slightly over 12 feet. The spread in resulting depths is mainly due to varations in the capillarity data. None of the analyses indicate that the level of the water approaches the elevation of the lowest paleochannel. Thus, these models have indicated that seepage of contaminates out of the cell into paleochannels allowing an exit path for the contamination to reach useable aquifers, is not shown to occur.

APPENDIX

TAC CALCULATION GRJ-08-90-12-05-00

RETC INPUT - VICINITY PROPERTY MATERIALS
- MAIN PILE TAILINGS
- WASATCH FORMATION

UNSAT2 INPUT - DBSÉA data
- previous data

```
*************************************************************
*                                                           *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                 *
*                                                           *
*GRJ, VICINITY PROPERTY MATERIALS, (RS-3/ #5-15 & #5-16)    *
*                                                           *
      MUALEM-BASED RESTRICTION, M=1-1/N                     *
      ANALYSIS OF RETENTION DATA ONLY                       *
*     MTYPE= 3     METHOD= 2                                *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.2285	1
2	WCS	.4069	1
3	ALPHA	.0500	1
4	N	2.0000	1
5	M	.5000	0
6	EXPO	.5000	0
7	CONDS	1.09E-04	0

OBSERVED DATA

OBS. NO.	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	.100	.4069	1.0000
2	.100	.3978	1.0000
[illegible]	102.000	.3311	1.0000
[illegible]	102.000	.3316	1.0000
5	305.900	.2970	1.0000
6	305.900	.2904	1.0000
7	1019.800	.2671	1.0000
8	1019.800	.2560	1.0000
9	3059.400	.2609	1.0000
10	3059.400	.2550	1.0000
11	7138.600	.2380	1.0000
12	7138.600	.2325	1.0000
13	15297.000	.2325	1.0000
14	15297.000	.2285	1.0000

NIT	SSQ	WCR	WCS	ALPHA	N
0	.01877	.2285	.4069	.0500	2.0000
10	.00042	.2103	.4025	.0330	1.3504

CORRELATION MATRIX

	1	2	3	4
1	1.0000			
2	-.0354	1.0000		
3	-.8130	.2576	1.0000	
4	.9671	-.0485	-.9117	1.0000

[illegible]UARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .99070334

WCR	.21025	.01530	13.74	.1762	.2444
WCS	.40246	.00460	87.44	.3922	.4127
ALPHA	.03297	.01231	2.68	.0055	.0604
N	1.35042	.09971	13.54	1.1283	1.5726

OBSERVED AND FITTED DATA

NO	P	LOG-P	WC-OBS	WC-FIT	WC-DIF
1	.1000D+00	-1.0000	.4069	.4024	.0045
2	.1000D+00	-1.0000	.3978	.4024	-.0046
3	.1020D+03	2.0086	.3311	.3302	.0009
4	.1020D+03	2.0086	.3316	.3302	.0014
5	.3059D+03	2.4856	.2970	.2948	.0022
6	.3059D+03	2.4856	.2904	.2948	-.0044
7	.1020D+04	3.0085	.2671	.2662	.0009
8	.1020D+04	3.0085	.2560	.2662	-.0102
9	.3059D+04	3.4856	.2609	.2484	.0125
10	.3059D+04	3.4856	.2550	.2484	.0066
11	.7139D+04	3.8536	.2380	.2386	-.0006
12	.7139D+04	3.8536	.2325	.2386	-.0061
13	.1530D+05	4.1846	.2325	.2320	.0005
14	.1530D+05	4.1846	.2285	.2320	-.0035

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES

	UNWEIGHTED	WEIGHTED
RETENTION DATA	.00042	.00042
COND/DIFF DATA	.00000	.00000
ALL DATA	.00042	.00042

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)

WC	P	LOGP	COND	LOGK	DIF	LOGD
.2115	.5912D+08	7.772	.5965D-23	-23.224	.8377D-12	-12.077
.2127	.8179D+07	6.913	.1763D-20	-20.754	.1713D-10	-10.766
.2151	.1131D+07	6.054	.5211D-18	-18.283	.3502D-09	-9.456
.2199	.1565D+06	5.195	.1540D-15	-15.812	.7159D-08	-8.145
.2247	.4921D+05	4.692	.4294D-14	-14.367	.4183D-07	-7.378
.2295	.2165D+05	4.335	.4553D-13	-13.342	.1464D-06	-6.834
.2343	.1145D+05	4.059	.2843D-12	-12.546	.3868D-06	-6.412
.2391	.6805D+04	3.833	.1270D-11	-11.896	.8558D-06	-6.068
.2439	.4381D+04	3.642	.4502D-11	-11.347	.1675D-05	-5.776
.2487	.2991D+04	3.476	.1348D-10	-10.870	.2999D-05	-5.523
.2535	.2135D+04	3.329	.3546D-10	-10.450	.5013D-05	-5.300
.2583	.1579D+04	3.198	.8431D-10	-10.074	.7944D-05	-5.100
.2631	.1201D+04	3.080	.1846D-09	-9.734	.1206D-04	-4.919
.2679	.9351D+03	2.971	.3778D-09	-9.423	.1766D-04	-4.753
.2727	.7422D+03	2.871	.7307D-09	-9.136	.2511D-04	-4.600
.2775	.5987D+03	2.777	.1347D-08	-8.871	.3482D-04	-4.458
.2823	.4898D+03	2.690	.2382D-08	-8.623	.4727D-04	-4.325
.2871	.4054D+03	2.608	.4066D-08	-8.391	.6302D-04	-4.200
.2919	.3390D+03	2.530	.6726D-08	-8.172	.8271D-04	-4.082
.2967	.2859D+03	2.456	.1083D-07	-7.965	.1071D-03	-3.970
.3015	.2430D+03	2.386	.1702D-07	-7.769	.1370D-03	-3.863
.3064	.2079D+03	2.318	.2617D-07	-7.582	.1736D-03	-3.760
.3112	.1788D+03	2.252	.3951D-07	-7.403	.2180D-03	-3.662
.3160	.1545D+03	2.189	.5864D-07	-7.232	.2717D-03	-3.566
.3208	.1340D+03	2.127	.8574D-07	-7.067	.3366D-03	-3.473
.3256	.1166D+03	2.067	.1237D-06	-6.908	.4148D-03	-3.382
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

.3496	.5894D+02	1.770	.6690D-06	-6.175	.1137D-02	-2.944
.3544	.5124D+02	1.710	.9197D-06	-6.036	.1392D-02	-2.856
.3592	.4435D+02	1.647	.1261D-05	-5.899	.1712D-02	-2.766
.3640	.3814D+02	1.581	.1726D-05	-5.763	.2118D-02	-2.674
.3688	.3252D+02	1.512	.2366D-05	-5.626	.2645D-02	-2.578
.3736	.2737D+02	1.437	.3256D-05	-5.487	.3345D-02	-2.476
.3784	.2262D+02	1.354	.4516D-05	-5.345	.4309D-02	-2.366
.3832	.1817D+02	1.259	.6351D-05	-5.197	.5706D-02	-2.244
.3880	.1395D+02	1.145	.9144D-05	-5.039	.7891D-02	-2.103
.3928	.9835D+01	.993	.1375D-04	-4.862	.1178D-01	-1.929
.3977	.5613D+01	.749	.2279D-04	-4.642	.2095D-01	-1.679
.4001	.3283D+01	.516	.3240D-04	-4.489	.3380D-01	-1.471
.4025	.0000D+00		.1090D-03	-3.963		

END OF PROBLEM
==========

.4424	.14130+03	2.150	.30450-05	-5.516	.12270-01	-1.913
.4486	.11610+03	2.065	.38920-05	-5.410	.16350-01	-1.786
.4547	.95160+02	1.950	.51030-05	-5.292	.23610-01	-1.627
.4609	.57910+02	1.763	.70690-05	-5.151	.40670-01	-1.391
.4639	.36120+02	1.581	.87760-05	-5.057	.65050-01	-1.187
.4670	.00000+00		.15000-04	-4.824		

END OF PROBLEM
==========

```
*************************************************************
*                                                           *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                  *
*                                                           *
*ESTES GULCH, WASATCH FORMATION                             *
*                                                           *
*    MUALEM-BASED RESTRICTION, M=1-1/N                      *
*    ANALYSIS OF RETENTION DATA ONLY                        *
*    MTYPE= 3     METHOD= 2                                 *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.0800	0
2	WCS	.1600	0
3	ALPHA	.0500	1
4	N	2.0000	1
5	M	.5000	0
6	EXPO	.5000	0
7	CONDS	2.00E-06	0

OBSERVED DATA

OBS. NO.	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	5103.600	.1392	1.0000
2	3062.200	.1425	1.0000
3	2041.400	.1456	1.0000
4	1020.700	.1494	1.0000
5	918.700	.1499	1.0000
6	714.500	.1505	1.0000
7	510.400	.1515	1.0000
8	306.200	.1529	1.0000
9	102.100	.1548	1.0000
10	.000	.1578	1.0000

NIT	SSQ	ALPHA	N
0	.03821	.0500	2.0000
8	.00002	.0063	1.0803

CORRELATION MATRIX

	1	2
1	1.0000	
2	-.9610	1.0000

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .96008671

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS

95% CONFIDENCE LIMITS

VARIABLE	VALUE	S.E.COEFF.	T-VALUE	LOWER	UPPER
ALPHA	.00628	.00241	2.60	.0007	.0116
N	1.08227	.01252	86.42	1.0514	1.1091

OBSERVED AND FITTED DATA
==========

NO	P	LOG-P	WC-OBS	WC-FIT	WC-DIF
1	.5104D+04	3.7079	.1392	.1405	-.0013
2	.3062D+04	3.4860	.1425	.1429	-.0004
3	.2041D+04	3.3099	.1454	.1449	.0007
4	.1021D+04	3.0099	.1494	.1483	.0011
5	.9187D+03	2.9632	.1499	.1488	.0011
6	.7145D+03	2.8540	.1505	.1500	.0005
7	.5104D+03	2.7079	.1515	.1515	-.0000
8	.3062D+03	2.4860	.1529	.1537	-.0008
9	.1021D+03	2.0090	.1545	.1572	-.0024
10	.1000D-04	-5.0000	.1576	.1600	-.0022

SUM OF SQUARES OF OBSERVED VERSUS FITTED VALUES
==========

	UNWEIGHTED	WEIGHTED
RETENTION DATA	.00002	.00002
COND/DIFF DATA	.00000	.00000
ALL DATA	.00002	.00002

SOIL HYDRAULIC PROPERTIES (MTYPE = 3)
==========

WC	P	LOGP	COND	LOGK	DIF	LOGD
.0940	.4283D+12	11.632	.1955D-30	-30.709	.7451D-16	-16.128
.0960	.8116D+11	10.909	.7603D-29	-29.119	.4805D-15	-15.318
.0980	.1871D+11	10.272	.1920D-27	-27.717	.2487D-14	-14.604
.1000	.5036D+10	9.702	.3450D-26	-26.462	.1082D-13	-13.966
.1020	.1536D+10	9.186	.4705D-25	-25.327	.4093D-13	-13.388
.1040	.5196D+09	8.716	.5111D-24	-24.291	.1379D-12	-12.861
.1060	.1917D+09	8.283	.4557D-23	-23.339	.4213D-12	-12.375
.1080	.7616D+05	7.882	.3498D-22	-22.456	.1185D-11	-11.926
.1100	.3225D+05	7.508	.2319D-21	-21.635	.3105D-11	-11.508
.1120	.1443D+08	7.159	.1360D-20	-20.866	.7643D-11	-11.117
.1140	.6781D+07	6.831	.7169D-20	-20.145	.1781D-10	-10.749
.1160	.3327D+07	6.522	.3436D-19	-19.464	.3956D-10	-10.403
.1180	.1696D+07	6.230	.1513D-18	-18.820	.8413D-10	-10.075
.1200	.8954D+06	5.952	.6173D-18	-18.210	.1721D-09	-9.764
.1220	.4876D+06	5.686	.2352D-17	-17.629	.3402D-09	-9.468
.1240	.2731D+06	5.436	.8420D-17	-17.075	.6512D-09	-9.186
.1260	.1569D+06	5.196	.2849D-16	-16.545	.1211D-08	-8.917
.1280	.9231D+05	4.965	.9154D-16	-16.038	.2195D-08	-8.659
.1300	.5547D+05	4.744	.2805D-15	-15.552	.3884D-08	-8.411
.1320	.3399D+05	4.531	.8230D-15	-15.085	.6722D-08	-8.172
.1340	.2120D+05	4.326	.2320D-14	-14.634	.1141D-07	-7.943
.1360	.1344D+05	4.128	.6307D-14	-14.200	.1901D-07	-7.721
.1380	.8639D+04	3.936	.1658D-13	-13.780	.3118D-07	-7.506
.1400	.5623D+04	3.750	.4230D-13	-13.374	.5044D-07	-7.297
.1420	.3696D+04	3.568	.1051D-12	-12.978	.8066D-07	-7.093
.1440	.2448D+04	3.389	.2551D-12	-12.593	.1279D-06	-6.893
.1460	.1627D+04	3.211	.6080D-12	-12.216	.2019D-06	-6.695
.1480	.1080D+04	3.033	.1431D-11	-11.845	.3188D-06	-6.496
.1500	.7105D+03	2.852	.3349D-11	-11.475	.5077D-06	-6.294

.152D	.4576D+03	2.661	.7896D-11	-11.103	.8251D-06	-6.084
.154D	.2821D+03	2.450	.1912D-10	-10.718	.1398D-05	-5.855
.156D	.1584D+03	2.200	.4953D-10	-10.305	.2579D-05	-5.589
.158D	.6911D+02	1.840	.1535D-09	-9.814	.5870D-05	-5.231
.159D	.3330D+02	1.522	.3311D-09	-9.480	.1116D-04	-4.952
160D	.0000D+00		.2000D-07	-7.699		

END OF PROBLEM

****

Calculation Cover Sheet

Contract No. 3885-02 Discipline Geohydrology Calc. No. 05-670-15 No. of Sheets 16

Project UMTRA – Grand Junction Site Appendices I, II & III & IV

Feature Disposal Cell

Item Seepage Analysis (Amendment to the calc. no. 05-670-13-00)

Sources of Data

Sources of Formulae & References

See page 1

Preliminary Calc. ☐ Final Calc. ☒ Supersedes Calc. No. ____

Rev. No.	Revision	Calculation By	Date	Checked By	Date	Approved By	Date
0	—	James Kam	11/18/91	D.K. Chen	12/16/91	D.K. Chen	7/8/92

Form 42-110

REFERENCES

1. Jacobs Engineering Group Inc., "UMTRA - Grand Junction - Cheney Disposal Cell, Transient Drainage and Steady Seepage, Calc. No. GRJ-05-91-12-05-0 0, June 1991.

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3. M-K Environmental Services, "UMTRA - Grand Junction Disposal Cell - Infiltration Study Calc. No. 05-670-13-00, August 1990.

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7. M-K Environmental Services, "UMTRAP - Rifle, Colorado, Calculations, Final Design for Construction (Revised) Vol. VII: Tailings Embankment Seepage Evaluation, Collection and Removal - Estes Gulch Disposal Site" , RFL-PH-II, March 1991.

8. M-K Environmental Services, "UMTRA - GRJ - Material Properties", Calc. No. 05-670-05-04, October 1991.

9. M-K Environmental Services, "Northwest Paleochannel Restoration at Cheney Disposal Embankment, Doc # 3885-GRJ-R-01-DRAFT-00, July 1992.

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1.0

INTRODUCTION

Under the Uranium Mill Tailings Remedial Action Plan, approximately 3 million CY of tailings and 2.5 milliion CY of Vicinity Property (VP) materials will be transported from the processing site at Grand Junction ,Colorado, to the Cheney Reservoir disposal site. Both the tailings and the VP materials will be encapsulated in a partially below-grade disposal cell, surrounded by a peripheral dike made of compacted shale and other selected fills. The compacted shale and other selected fills are obtained from excavation of the disposal cell.

Since both the tailings and the VP have a higher permeability than the foundation materials (the Wasatch Formation), there is a potential for water buildup in the cell, particularly along the interface between the foundation and the contaminated materials. Please note hereinafter, "contaminated materials" is used interchangeably with "tailings and VP materials".

A previous study was performed by MKES/SF in August 1990 to evaluate the flooding potential of the cell for transient drainage condition (ie. during drainage of construction water in the contaminated materials) based on certain sequences of contaminated material placement (Ref. 3).

Jacobs Engineering has done a similar study in June 1991 and has extended the analysis to consider also steady-state condition (Ref. 1), again assuming a certain sequence of material placement. Since then, MKES/SF has obtained more accurate information from the field regarding the disposed volumes of tailings and VP materials and more current information on the sequence of placement of these contaminated materials (as-built drawings of October 1991 ,Ref. 6). Thus, there is a need to revise the seepage analysis using this current information.

2.0

PURPOSE

The purpose of this study is to revise the seepage studies performed earlier by MKES/SF and Jacobs Engineering to evaluate the ponding potential in the disposal cell under the following conditions:

* transient drainage without the influence of any cover flux.

* long-term, quasi-steady state infiltration/drainage with influence of cover flux.

3.0

APPROACH

The approach of this study will be to use as much previous information as possible as it applies to the current condition. Therefore, the X - section and computer grid used here will be the same as that adopted in the previous MKES study (Ref.3). The major revisions consist of refinement of material properties based on up-to-date testings and adjustment of material placement sequence based on the current plans and specifications. A schematic sketch of a one-dimensional representation of material placement sequence is shown in Figure 1. Minor revision involves modification of the downstream sideslope of the cell to model as a seepage face rather than as a no-flow boundary.

Figure 2 (sh. 5) shows a plan view of the disposal cell from the as-built drawings (Ref. 6) as of Nov. 1991 indicating the X - section used in the analysis.

MK-ENVIRONMENTAL SERVICES
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Project UMTRA - Grand Junction
Feature Disposal Cell
Item Seepage Analysis

Contract No. 3885-02
Designed JTK
Checked PKK

Sheet 4
File No.
Date 11/18/91
Date 12/16

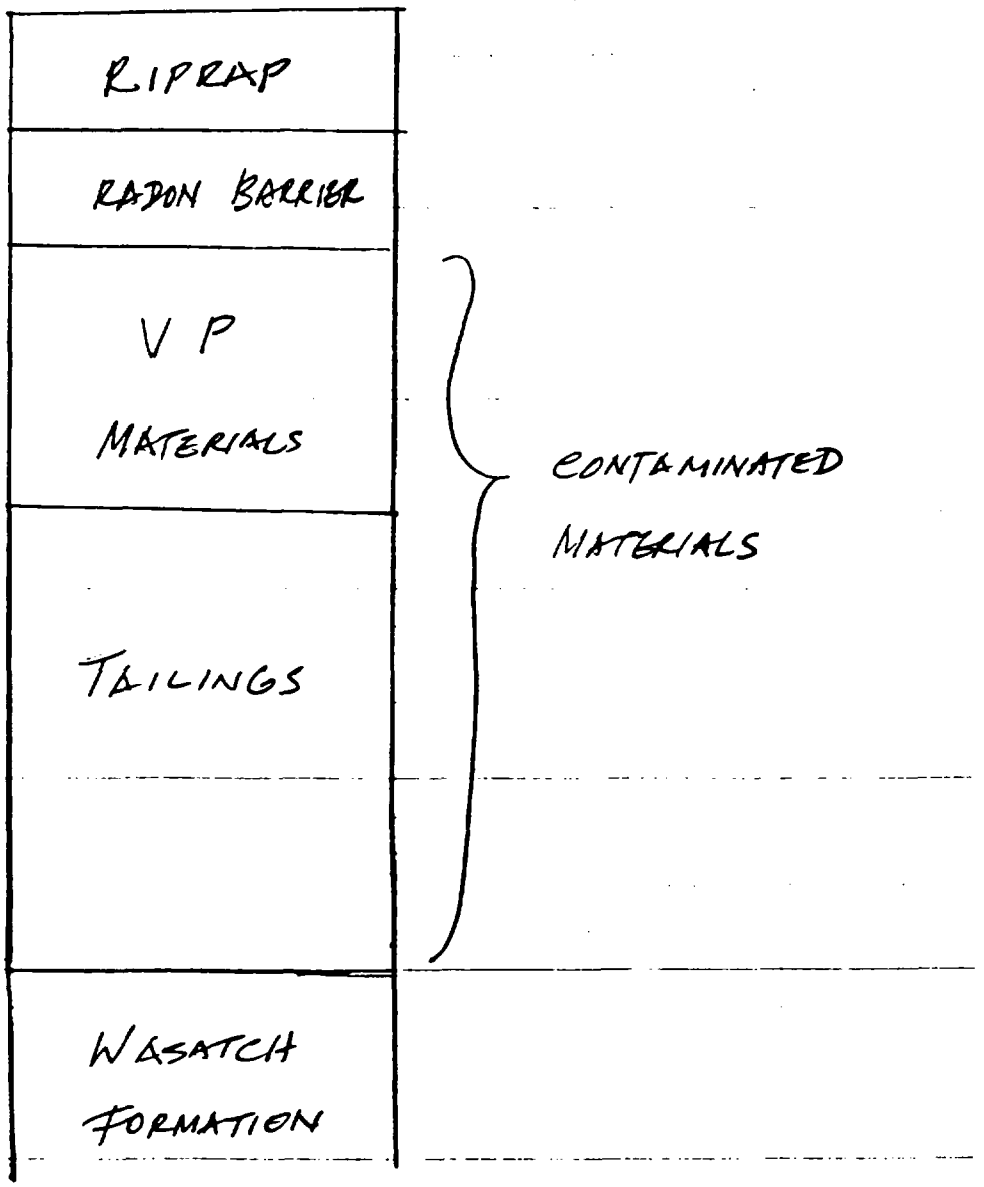

FIGURE 1. Schematic SEQUENCE OF MATERIAL PLACEMENT
(Not in scale)

UMTRA – Grand Junction
Disposal Cell
Seepage Analysis

3685-02

X-Section for
Insert
Simulation

10/25/91

Sh. 5

JTK 10/31/91
PKL 12/16/91

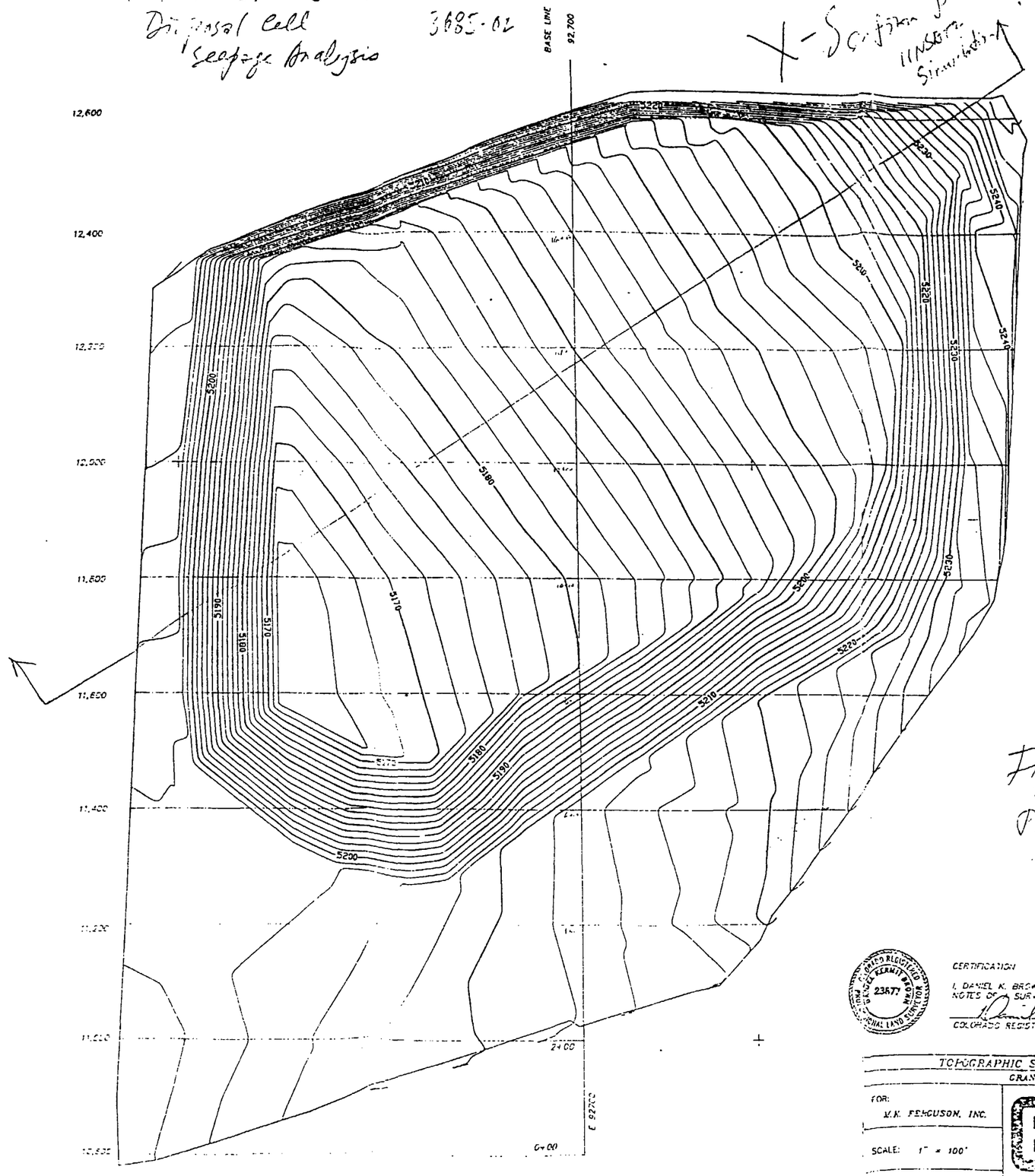

Figure 2
Plan view of
Disposal Cell

CERTIFICATION

I, DANIEL K. BROWN, CERTIFY THAT THIS PLAT IS PREPARED FROM FIELD NOTES OF A SURVEY MADE BY ME IN 1991.

10/1/91

COLORADO REGISTERED PROFESSIONAL LAND SURVEYOR LS 23877

COLORADO REGISTERED PROFESSIONAL LAND SURVEYOR 23877

TOPOGRAPHIC SURVEY OF CHENEY DISPOSAL CELL
GRAND JUNCTION UMPTRA PROJECT

FOR: M.K. FERGUSON, INC.	Q.E.D. SURVEYING SYSTEMS Inc. 1018 COLO. AVE. GRAND JUNCTION COLORADO 81501 (303) 241-2370	SURVEYED BY: DKB, DMM
		DRAWN BY: DKB
SCALE: 1" = 100'		ACAD ID: MKCHX
		SHEET NO. 1 OF 1

The encapsulated cell will consist of a cover made of ripraps and a radon barrier. Since these materials have no bearings on this study , they are not considered in the analysis.

The current construction plan and specification call for placing the majority of tailings at the bottom of the cell, with the VP materials on top of it. Subsequently, the cover discussed earlier will be placed above the VP.

The foundation consists of the Wasatch Formation which varies from fractured shale at the downstream end of the pile to weathered shale at the upstream end.

4.0 MATERIAL PROPERTIES

Average dry densities and moisture contents are estimated from laboratory test results on samples of tailings, VP and shale from the site (Ref. 8) and are included in Appendix I. Since sand tailings constitutes approximately 95 precent of the pile volume as reported in Ref. 8, properties of the sand tailings are assumed for the average tailings. The porosity and initial moisture content of the Watsatch Formation used in this study are derived from previous studies (Ref. 1 and 7).

Saturated hydraulic conductivity (K) for the sand tailings, the VP and the compacted shale are obtained from laboratory testing (Ref. 8) and are shown in Appendix I. Saturated hydraulic conductivities for the weathered and fractured Wasatch are obtained from field testings(Ref. 4) and are reported by Jacobs Engineering in Ref. 1. Accordingly, the K of the weathered and fractured Wasatch used in this study are consistent with those used in the previous analysis by Jacobs Engineering (Ref. 1).

The K values, porosity and moisture content data for all materials used in this study are listed in Table 1 on sheet 8.

Capillary moisture test results for the sand tailings, the VP, and the compacted shale are available in Ref. 8 and are presented in Appendix II. These data are used to derive the unsaturated K vs. moisture content relationship for the above-mentioned materials using the van Genuchten model in the RETC computer program. Results of the RETC runs are included in Appendix II.

TABLE 1
UMTRA - Grand Junction Site Seepage Analysis
Input Hydraulic Parameters
Design Simulation

Materials	Saturated K (cm/sec)		Porosity	Initial Moisture Content (%)			Van Genuuchen Parameter		
	Horiz.	Vert.		Gravi.	Vol.		WCR	ALPHA	N
1.Tailings (sand)	8.6e-4	8.6e-4	0.430	11.0	16.8	*	0.056	0.9996	1.67
				14.8	22.4	**			
2.Vicinity Property	3.2e-5	3.2e-5	0.340	13.6	24.1	**	0.194	0.6662	1.30
3.Weathered Wasatch	4.0e-6	2.0e-7	0.235		23.5		0.0864	0.1780	1.33
4.Trans. Wasatch	4.0e-5	2.0e-6	0.235		23.5		0.0864	0.1780	1.33
5.Fractured Wasatch	4.0e-4	2.0e-5	0.235		23.5		0.0864	0.1780	1.33

* 90 % compaction, dry of optimum

** optimum

The capillary moisture and unsat. K vs. moisture content relationship for the Wasatch Formation are obtained from previous studies (Ref. 1 and 7) and are presented in Appendix II.

The van Genuchten parameters for all material types used in the analysis are shown in Table 1 on sheet 8.

The compacted shale is not listed in the Table because it is not used in the the model analysis for the reasons stated later on sheet 10.

5.0 ANALYSIS

The UNSAT2 computer program is used to simulate flow in the cell during transient state drainage of construction water trapped in the contaminated materials. As stated earlier, a 2-D finite element grid used in a previous study (Ref. 3) is adopted for this analysis and is shown in Figure 3 on sheet 13 with boundary conditions. Shown also in the same figure are approximate location of the interfaces between different material types used in the model, corresponding to the as-built drawings (Ref. 6).

For simplication of analysis, the compacted shale is excluded from the model and is assumed to be replaced by the tailings and the VP materials. This is a conservative assumption because the compacted shale, being less permeable than the tailings and the VP materials, has a tendency to restrain flow from reaching the sideslope of the cell. Hence, its replacement by the contaminated materials will favor the development of a seepage face along the downstream side of the cell. Besides, incorporating more contaminated materials into the model than in reality would induce more drainage of construction water during the transient phase.

The current specification calls for 90% compaction per ASTM D698 (Standard Proctor) for the tailings materials. The sand tailings shall be compacted on the dry side of the optimum moisture content, whereas the slime tailings shall be compacted on the wet side of the optimum moisture content. Compaction requirement for the VP materials is 95% at moisture content on the dry side of optimum.

In this study, the initial moisture content of the VP materials is assumed to be the optimum moisture content (24.1% volumetric) for all four simulation runs (see Table 2). In Runs 1, 2 and 4, the initial moisture content of tailings is taken as the average ~~in-situ~~ moisture content (16.8% volumetric) of the sand tailings in the processing site. This moisture content falls on the dry side of optimum, with achievable compaction level higher than 90%. For Run No. 3, the initial moisture content for the tailings is taken as the optimum moisture content for the sand tailings (22.4% volumetric).

All four runs are conservative with respect to the assumed initial moisture content. Table 3 lists the initial moisture assumptions for the model as compared with reality. For a total volume of 2.5 million CY of VP materials, about 32 ac-ft more construction water than reality is introduced into the VP materials in the model when its moisture content is increased from dry of optimum (about 18% volumetric) to optimum (24.1%).

A worst case scenario is represented by Run No. 3, using the optimum moisture content for the sand tailings as the initial moisture content. As reported in Ref.8, of about 3 million CY of tailings, only 5% is slimes tailings; the rest is sand tailings. Therefore, as the moisture content of slime is brought from wet of optimum to optimum, the volume of water reduced is relatively small compared with the volume of water added as the moisture content of the sand tailings is brought from dry of optimum to optimum. As shown in Table 3, as slimes tailings ~~in reality~~

is compacted to 90% wet of optimum (about 50% volumetric), the volume of water in the slimes is about 16 ac-ft; whereas sand tailings compacted to 90% dry of optimum (16.8%) contains about 100 ac-ft of water. In contrast, there is approximately 140 ac-ft of water in the 3 million CY of tailings in the model, assuming that the tailings is compacted at optimum moisture content. That is, an excess of 24 ac-ft of water in the tailings over existing condition is assumed in the model. Thus, considering the 32 ac-ft of additional water assumed in the VP materials, a total excess of 56 ac-ft of water is imposed in the model.

For Runs 1, 2 and 4 with initial moisture content of tailings at dry of optimum, there is about 10 ac-ft less water in the tailings than in the existing condition because, in reality, 0.15 million CY of slimes is compacted at wet of optimum. However, considering the 32 ac-ft of additional water assumed in the VP materials, there is a net excess of 22 ac-ft of water in the model compared with the existing condition. Thus, these runs are still conservative.

The foundation is composed of the Wasatch Formation, varying from weathered to fractured shale. The capillary suction and unsaturated properties of the Wasatch are assumed the same as those of the Weathered Wasatch used in the UMTRA - Rifle Site Seepage study (Ref.3 and 7). Saturated K of the weathered and the fractured Wasatch in this study are derived from References 1 and 4. A transitional Wasatch between the Weathered and the Fractured Shale is assumed to have a permeability average of those of the Weathered and the Fractured Wasatch.

YMPRA - GRJ Seepage Analysis 3885-02

Sh. 13

Upper boundary
transient state: No-flow boundary

No-flow boundary

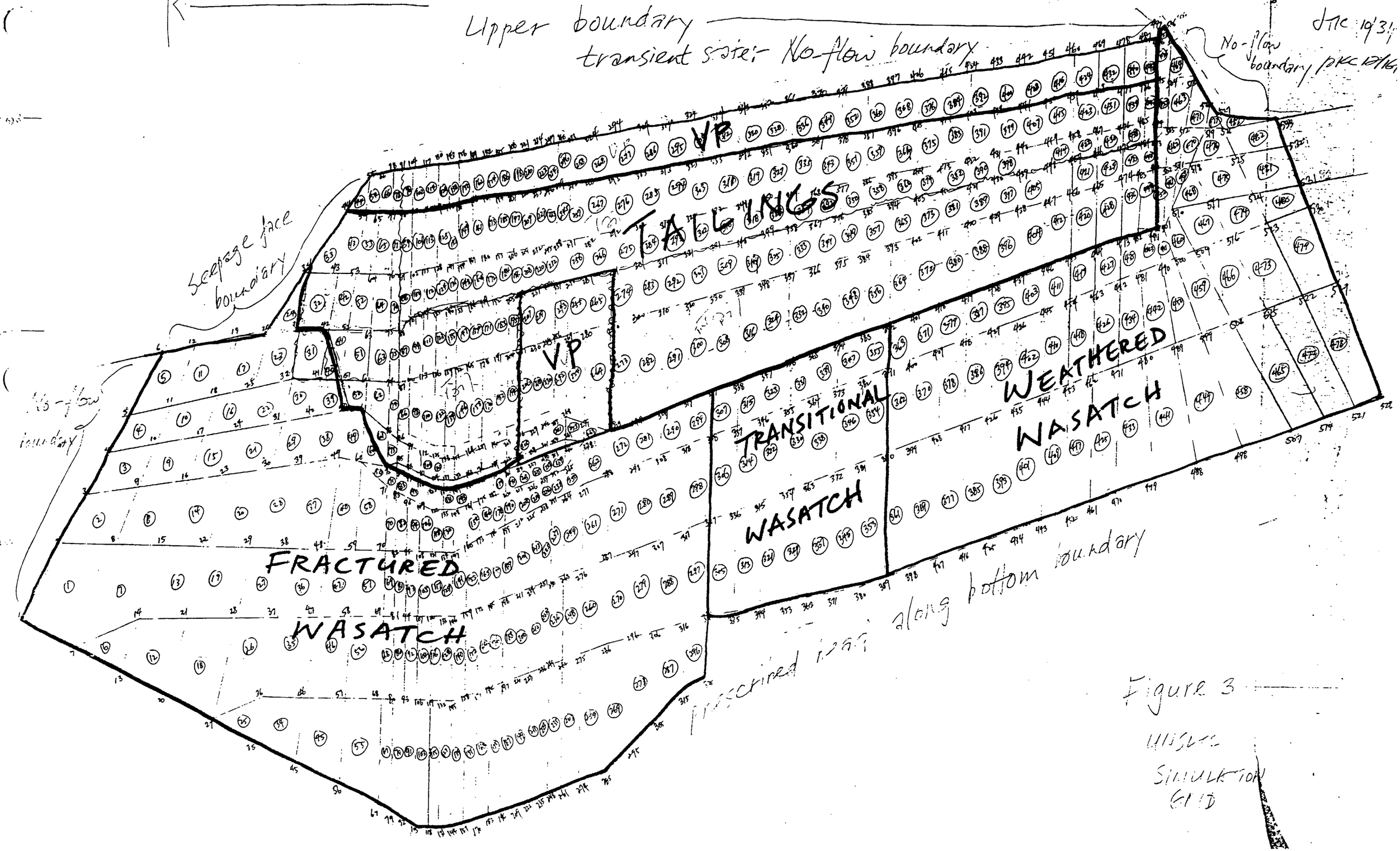

Figure 3

WINSLOW SIMULATION GRID

6.0 RESULTS / CONCLUSIONS

A. Transient State

Table 2 lists the computer runs conducted in this study. The printout of the runs are included in Appendix III. Run No. 1 represents the design case simulation showing no saturation of contaminated materials anywhere during the 20 years of simulation. In this run, the 90% compaction (dry of optimum) and optimum moisture contents are used as initial moisture contents of the tailings and the VP materials, respectively.

Runs 2 through 4 are sensitivity runs with increase in initial moisture content of tailings to optimum (No.3); increase in bottom boundary suction (No.2); and decrease in the Fractured Wasatch permeability (No.4). All shows no flooding in the cell except No.3 which indicates a head buildup of about zero to five feet at the interface between the VP materials and the foundation. However, this will not cause any adverse effects on the cell performance.

B. Long-term or quasi-steady state

The long-term performance of the cell is evaluated by comparing the design cover flux (1.0e-7 cm/sec) with the saturated permeability of the Wasatch. Since the Wasatch permeability is, in general, at least 1 or 2 orders of magnitudes higher than the cover flux, it can be concluded that long-term flooding in the cell is not expected to occur.

TABLE 2. LIST OF COMPUTER RUNS

UMTRA - GRJ

Seepage Analysis

Run No.	Run I.D.	Contaminated Materials		Wasatch K	Bottom B.C.	Cover flux
		Initial moisture content (Vol.)			Prescribed suction (ft)	
		Tailings	VP			
1	GRJPRO3	16.8	24.2	*	-0.05	No
2	GRJPRO4	16.8	24.2	*	-50.0	No
3	GRJPRO5	22.4	24.2	*	-0.05	No
4	GRJPRO6	16.8	24.2	**	-0.05	No

* same as in TABLE 1.

** same as in TABLE 1 except K for Fractured Wasatch

K (Horizontal) = 4.0e-5 cm/sec
K (Vertical) = 2.0e-6 cm/sec

TABLE 3 INITIAL MOISTURE CONTENT ASSUMPTIONS

Run No.	Run I.D.	Contaminated Materials	Approx. Volume (million c.y.)	Initial Moisture Content (Vol.)		Volume of Water (Ac-ft)		Total Vol. of Water (Ac-ft)	
				Model	Reality	Model	Reality	Model	Reality
1	GRJPRO3	Sand Tailings	2.85	16.8%	16.8%	104.1	98.9		
		Slime Tailings	0.15		50.0%		15.5	228.6	207.4
		VP	2.5	24.1%	18.0%	124.5	93.0		
2	GRJPRO4	Sand Tailings	2.85	16.8%	16.8%	104.1	98.9		
		Slime Tailings	0.15		50.0%		15.5	228.6	207.4
		VP	2.5	24.1%	18.0%	124.5	93.0		
3	GRJPRO5	Sand Tailings	2.85	22.4%	16.8%	138.8	98.9		
		Slime Tailings	0.15		50.0%		15.5	263.3	207.4
		VP	2.5	24.1%	18.0%	124.5	93.0		
4	GRJPRO6	Sand Tailings	2.85	16.8%	16.8%	104.1	98.9		
		Slime Tailings	0.15		50.0%		15.5	228.6	207.4
		VP	2.5	24.1%	18.0%	124.5	93.0		

URANIUM STORAGE FACILITY
D-3 POS 2/Cell
Seepage Analysis

3885-02
OTE 11/18/91
PKE 10/16/91

Results/Conclusions (continued)

c. An assessment of the effect of the existence of a paleochannel in the vicinity of the disposal cell on the cell is presented in Appendix IV. The results of the assessment indicate that the disposal cell will perform satisfactorily as expected with insignificant impact from the paleochannel.

APPENDIX I

MK-ENVIRONMENTAL SERVICES
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Sheet A 0

Project UMTRA-GRJ | Contract No. 3885-34 | File No.
Feature Embankment Design | Designed LL | Date 11/05/91
Item Infiltration Study | Checked PYL | Date 11/5/91

REFERENCES

1. UMTRA-GRJ, "Material Properties," MKE CALCULATION No. 05-670-05-04

2. UMTRA-GRJ, "Infiltration Study," MKE CALCULATION No. 05-670-13-00

3. UMTRA-GRJ, "CHENEY Disposal Site, Transient Drainage," Jacobs Engineering Group, Calculation No. GRJ-01-98-02-03-00

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet A 1

Project UMTRA - GJT | Contract No 3885-34 | File No
Feature Embankment Design | Designed HL | Date 11/04/91
Item Infiltration Study | Checked PYL | Date 11/ '91

MATERIAL PROPERTIES FOR INFILTRATION STUDY

The following materials are included in the model:

- VP Material
- SAND Tailings
- MANCOS SHALE (In-Situ)
- COMPACTED MANCOS SHALE (Clean-Fill below grade)
- MINUS 1" Material (Clean-Fill above grade)
- ALLUVIUM (In-Situ)

The following tables are presented:

- TABLE 1: Summary of Max. dry density, optimum moisture content, In-place density and Moisture Content
- TABLE 2: Summary Of Input Hydraulic Parameters for UNSAT 2 analysis
- TABLE 3: Material Properties Initial Conditions

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet A 2

Project UMTRA - GRJ
Feature Embankment Design
Item Infiltration Study

Contract No. 3385-34
Designed HL
Checked PYL

File No.
Date 11/04/91
Date 11/5/91

TABLE 1

SUMMARY OF MAXIMUM DRY DENSITY, OPTIMUM MOISTURE CONTENT, IN-PLACE DENSITY AND MOISTURE CONTENT (Reference 1, Sheet O)

MATERIAL	COMPACTION MAX DRY DENSITY (PCF)	WOPT (GRAVIMETRIC, %)	IN-PLACE DRY DENSITY (PCF)	IN-PLACE W.C.** (VOL, %)	R.C.
VP	116.1	13.6	110.3	21.2	95
SAND	106.7	14.8	96	16.9	90
MANCOS SHALE (IN-SITU)	NA	NA	*	*	NA
COMPACTED SHALE	109.6	17.4	104.1	29.0	95
-1" MATERIAL	120.0	13.1	114.0	23.9	95
ALLUVIUM	NA	NA	*	*	NA

NOTES

R.C. = Relative Compaction, using ASTM D-698.

* - Used Data from TAC and presented in the following page.

NA = Not Applicable

** - WATER CONTENT AS INITIAL VOLUMETRIC MOISTURE CONTENT

TABLE 2

SUMMARY

UMTRA - GRAND JUNCTION INFILTRATION STUDY

INPUT HYDRAULIC PARAMETERS

Material	Saturated K (cm/sec)	Porosity	Initial Volumetric Moisture Content (%)	Van Genuchten Parameters		
				WCR	ALPHA	N
Vicinity Property	3.2E-05	0.34	21.2	(a) 0.1939	0.6662	1.3005
Sand Tailings	8.6E-04	0.43	16.9	(b) 0.0561	0.9996	1.6689
Mancos Shale (In-Situ)	Vertical: 2.0E-08 Horizontal: 4.0E-07	0.16	14.8	(c) 0.0800	0.1915	1.0803
Compacted Mancos Shale	1.0E-06	0.39	29.0	(d) 0.0003	0.0842	1.0450
Minus 1" Material	7.2E-07	0.30	23.9	(e) 0.1911	0.3254	1.5639
Alluvium (In-Situ)	1.0E-04	0.36	17.0	(f) 0.1374	0.1394	1.4806

NOTES (a) - From Sheet 8
(b) - From Sheet 14
(c) - From Sheet 19
(d) - From Sheet 25
(e) - From Sheet 31
(f) - From Sheet 36

GRUTLAK - GRJT
3885-34
Infiltration Study
EF 1/01
PYL 11/5/91

Sh. A3

TABLE 3

UMTRA - GRAND JUNCTION INFILTRATION STUDY

MATERIAL PROPERTIES - INITIAL CONDITIONS

1. Material Interfaces - Initial Conditions

Material Interfaces	Average Head (ft)
VP-SAND	763
VP-COMPACTED SHALE	4219
VP-MINUS 1"	766
SAND-SHALE	21
SAND-COMPACTED SHALE	3462
SAND-ALLUVIUM	211
SAND-MINUS 1"	9
SHALE-COMPACTED SHALE	3477
SHALE-ALLUVIUM	226
ALLUVIUM-MINUS 1"	214
ALLUVIUM-COMPACTED SHALE	3667
MINUS 1"-COMPACTED SHALE	3465
SAND-VP-MINUS 1"	513
SAND-VP-COMPACTED SHALE	2815
SAND-SHALE-ALLUVIUM	152
SAND-ALLUVIUM-COMPACTED SHALE	2447
SAND-SHALE-COMPACTED SHALE	2320
SHALE-COMPACTED SHALE-ALLUVIUM	2456
ALLUVIUM-COMPACTED SHALE-MINUS 1"	2449
VP-COMPACTED SHALE-MINUS 1"	2817
VP-SAND-COMPACTED SHALE-MINUS 1"	2114

Sh. A4
UMTRA - GJOT
3885-34
Infiltration Study
HL 11/04/91
PYL 11/4/91

TABLE 3 (CONT'D)

2. Hydraulic Conductivities At Initial Moisture Content

Material	Initial Volumetric Moisture Content (%)	Hydraulic Conductivities, K (ft/sec)	Hydraulic Conductivities, K (ft/day)
VP	21.2	3.02E-16	2.61E-11
SAND	16.9	6.29E-9	5.40E-04
MANCOS SHALE	14.8	Vertical: 4.69E-14	Vertical: 4.40E-09
COMPACTED SHALE	29	1.6E-16	1.37E-11
MINUS 1"	23.9	3.19E-11	2.76E-06
ALLUVIUM	17.0	1.03E-12	8.90E-08

Sh. #5

Contract - GPT
38RS-34
Infil. Estimation
FK 11/04/91
PYL 11/4/91

APPENDIX I

SUMMARY OF MATERIAL PROPERTIES

Reference: 1 and 2 (Sheet 0)

MATERIAL : Vicinity Property Material

SATURATED K: 3.2×10^{-5} cm/sec = 9.1×10^{-2} ft/day

POROSITY : 34 %

INITIAL VOL. MOISTURE CONTENT : 21.2 %*

HEAD: 1520 feet

M.C. vs Kr & HEAD PER KETC:

VOLUMETRIC MOISTURE CONTENT, %	SUCTION HEAD, ft	Kr
19.5	3.24E+07	3.53E 2
19.8	3.22E+05	1.15E-16
21.2	1.52E+03	2.88E-10
22.7	2.15E+02	6.26E-08
24.1	6.28E+01	1.82E-06
25.6	2.53E+01	2.16E-05
26.7	1.45E+01	9.74E-05
28.5	6.44	8.03E-04
29.6	4.09	2.44E-03
30.7	2.57	6.97E-03
31.8	1.53	1.97E-02
32.5	0.98	4.07E-02
34.0	0	1.00

Number of data pairs = 13

NOTE:

* ASSUMED VALUE

Project Grand Junction
Feature Disposal cell
Item VP material properties for UNSATH

Contract No. 385-34
Designed ACC
Checked H.L.

File No.
Date
Date 7/17

From Ref. 2

Pressure Head vs. Moisture Content

7A & 7B

Based on DBS/A data for VP material (see sheets ~~6 & 7~~)

Pressure head (cm H_2O)	Average Moisture Content (% Vol)		Moisture Content (% vol)	
0	~~38.71~~ 39.01	Adjust for γ_d = 95% γ_{max} by ratio of porosities (ie ~~32.88~~ / ~~33.71~~ 39.01)	~~32.88~~	39.01
102.2	34.51		~~29.31~~	29.09
305.9	31.66		~~26.89~~	26.68
1019.8	28.52		~~24.22~~	24.04
3059.4	27.29		~~23.18~~	23.00
7138.6	25.86		~~21.97~~	21.80
15399.0	25.11		~~21.33~~	21.16

SUPERSEDED

Adjust for γ_d = 95% γ_d by ratio of porosities

$\frac{34}{39.01}$

use this as "observed data" for RETC

⇓ moisture content (% vol)

34
30.08
27.59
24.86
23.79
22.54
21.89

HL 11/04/91
PYL 11/4/91

Sh. 34 A8

From Ref. 2

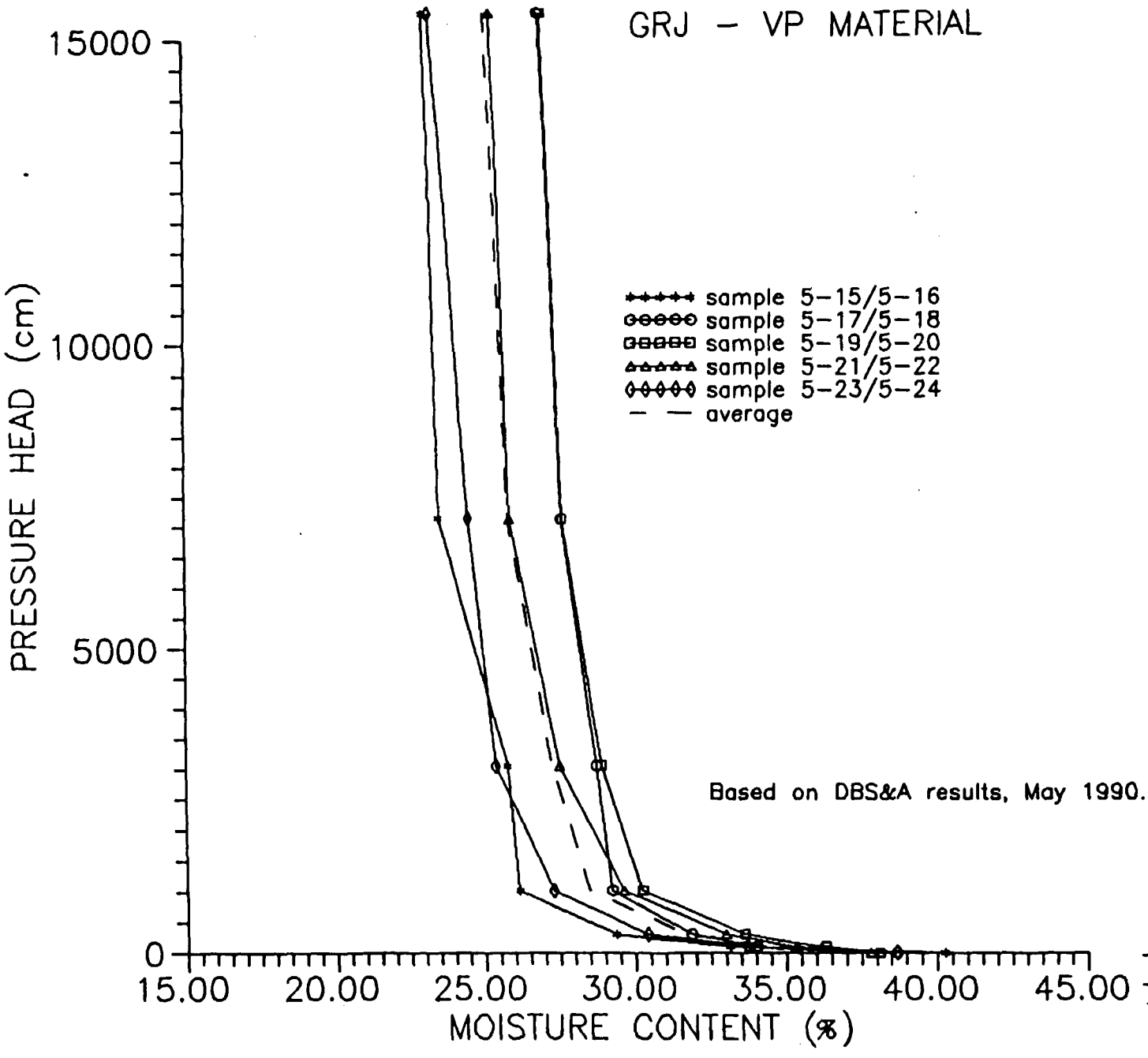
UMTRA-G.
3885-34
Infiltration
Study
HL 11/05/91
PYL 11/5/91

ACC
28-Jun 1990
FILE= GRJVP.WK1

GRAND JUNCTION
VICINITY PROPERTIES - BASED ON 10 SAMPLES
SOURCE OF DATA: DANIEL B. STEPHENS & ASSOCIATES, INC., MAY 1990, LABORATORY ANALYSIS OF SOIL HYDRAULIC PROPERTIES OF THE MAIN GRJ TAILINGS AND VICINTIY PROPERTY MATERIALS, DELIVERY ORDER 005 (Table 6)

VOLUMETRIC MOISTURE CONTENT (%) AT INDICATED PRESSURE HEAD (cm H2O)

SAMPLE NUMBER	0.0	102.2	305.9	1019.8	3059.4	7138.6	15399.0
5-15	40.69	33.11	29.70	26.71	26.09	23.80	23.25
5-16	39.78	33.16	29.04	25.60	25.50	23.25	22.85
AVERAGE	40.24	33.14	29.37	26.16	25.80	23.53	23.05
5-17	37.53	33.79	31.82	29.36	29.17	27.96	28.00
5-18	39.84	34.27	31.93	29.16	28.39	27.35	25.85
AVERAGE	38.69	34.03	31.88	29.26	28.78	27.66	26.93
5-19	39.85	36.29	33.62	30.22	29.38	28.46	27.53
5-20	39.41	36.36	33.67	30.29	28.47	26.90	26.50
AVERAGE	~~38.11~~ 39.63	36.33	33.65	30.26	28.93	27.68	27.02
5-21	36.72	35.57	33.26	29.91	26.67	25.14	25.05
5-22	38.92	35.11	32.76	29.36	28.40	26.67	25.57
AVERAGE	37.82	35.34	33.01	29.64	27.54	25.91	25.31
5-23	39.69	34.01	30.38	27.05	25.37	24.50	23.12
5-24	37.69	33.41	30.45	27.55	25.43	24.57	23.33
AVERAGE	38.69	33.71	30.42	27.30	25.40	24.54	23.23
AVERAGE	~~38.77~~ 39.01	34.51	31.66	28.52	27.29	25.86	25.11



Attm Ref. 2

Page 19

UNITRA-GRJ
Z 835-34
HT 11/05-11
PYC 11/5/91

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: JMTRA - GRJ
Feature: EMBANKMENT DESIGN
Item: INFILTRATION

Contract No.: [illegible]
Designed: HL
Checked: PYL

Sheet # 10
File No.
Date: 9/19/91
Date: 10/31/91

REFERENCE: 1 and 2 (sheet 0)

MATERIAL: Sand Tailings

SATURATED K: 8.6×10^{-4} cm/sec = 2.4 ft/day

POROSITY: 43 %

INITIAL VOL. MOISTURE CONTENT: 16.9 %* HEAD: 5.9 feet

M.C. vs K_r and HEAD PER RETC

Volumetric Moisture Content, %	Suction Head, feet	K_r
5.8	1974	1.27E-13
7.5	88.1	1.16E-08
9.4	31.2	5.21E-07
13.1	10.9	2.36E-05
16.8	5.9	2.23E-4
20.6	3.7	1.11E-3
24.3	2.5	4.01E-03
28.1	1.8	1.18E-02
34.6	0.9	5.98E-02
38.3	0.6	0.1472
41.1	0.3	0.3192
43.0	0.0	1.0

Number of data pairs = 12

NOTE: assumed initial moisture content for sand = in-situ moisture content (11% gravimetric)
γ_d @ 11% moisture content ≥ 90% γ_d max

Project [illegible]
Feature Disposal Cell
Item Tailings Properties for UNSAT2 input

Contract No. [illegible] File No.
Designed ACC Date 6/7/9[illegible]
Checked H. L. Date 7/13/[illegible]

From: REF. 2

Pressure head vs. Moisture Content

Based on DBS/A's results for samples with less than 12% passing 200 sieve (see sheets ~~7/11~~ 13A/13B)

Pressure head (cm H_2O)	Average Volumetric Moisture content (%)	Sample 7/8 Volumetric Moisture Content (%)
0	49.73	45.72
112.2	20.37	22.16
305.9	13.28	13.58
1019.8	10.74	10.52
3059.4	8.20	7.95
7138.6	7.34	7.26
15399.0	6.27	5.98

∴ for UNSAT2 runs, use pressure head vs. moisture content based on sample 7/8.

6/28/90 However, need to adjust volumetric moisture contents to be consistent with γ_d - 90% γ_{dmax} & recomputed porosity (see sheet 17).

∴ for UNSAT2 (as "observed data" for RETC), adjust by porosity (= ~~41.52/45~~ = 43/45.=

Pressure Head (cm H_2O)	M.C. (% vol)	Adjusted M.C. (% vol)
0	45.72	~~41.52~~ 43
112.2	22.16	HL 11/4/91 ~~20.12~~ 20.84
305.9	13.58	PYL 11/4/91 ~~12.33~~ 12.77
1019.8	10.52	~~9.55~~ 9.89
3059.4	7.95	~~7.22~~ 7.48
7138.6	7.26	~~6.59~~ 6.83
15399.0	5.98	~~5.43~~ 5.62

Sh. ~~B~~ A12

From Rep. 2

UMTRA-GRJ
3885-36
Infiltration
Study
HL 11/5/91
PYL 11/5/91

ACC
07-Jun 1990

GRAND JUNCTION FILE = GRJTAIL6.WK1

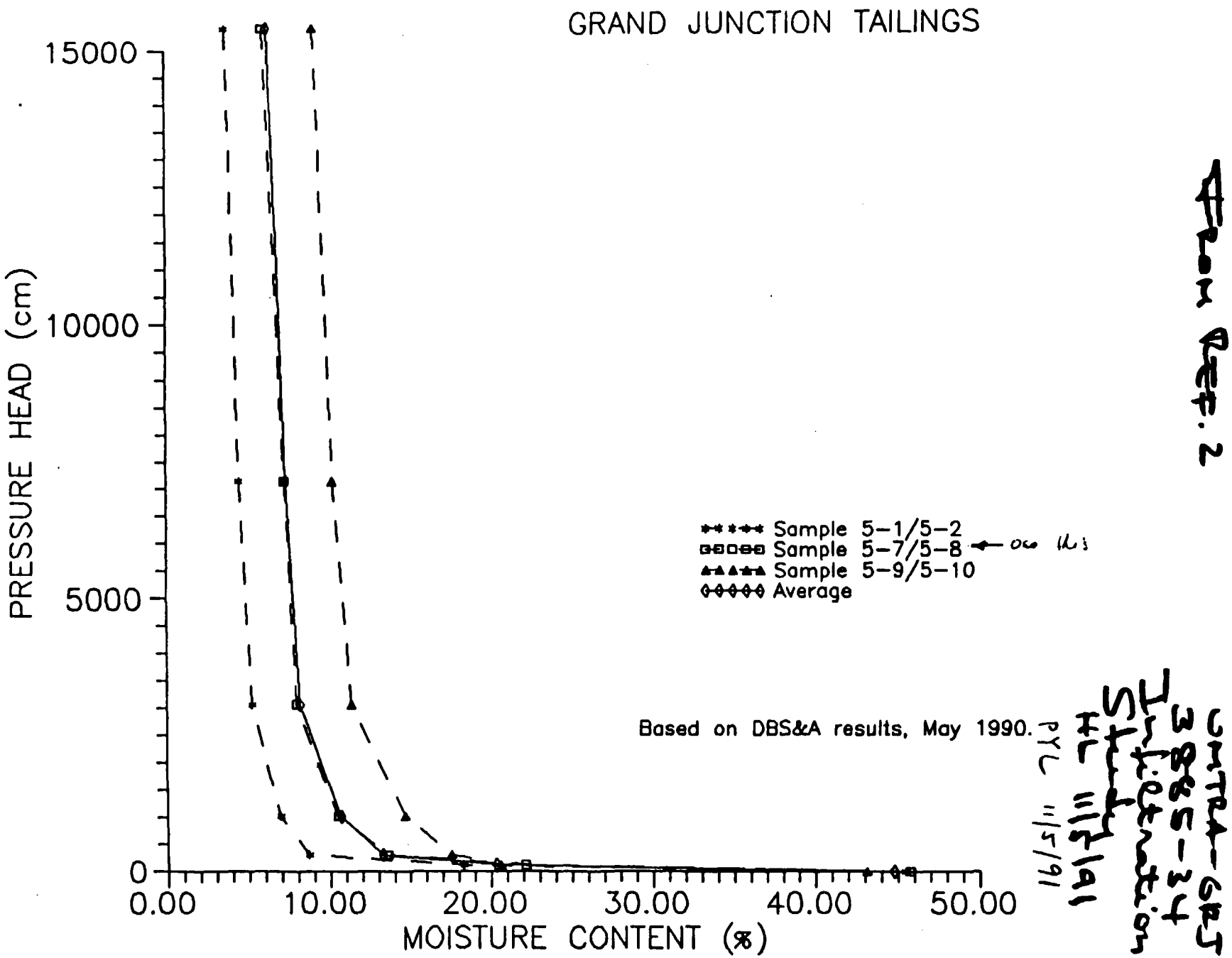
TAILINGS PROPERTIES - BASED ON 6 SAMPLES (PASSING 200 SIEVE < 12%)

SOURCE OF DATA: DANIEL B. STEPHENS & ASSOCIATES, INC., MAY 1990, LABORATORY ANALYSIS OF SOIL HYDRAULIC PROPERTIES OF THE MAIN GRJ TAILINGS AND VICINTIY PROPERTY MATERIALS, DELIVERY ORDER 005 (Table 6)

VOLUMETRIC MOISTURE CONTENT (%) AT INDICATED PRESSURE HEAD (cm H20)

SAMPLE NUMBER	0.0	112.2	305.9	1019.8	3059.4	7138.6	15399.0	
5-1	45.66	16.49	**1.98	6.89	5.19	4.38	3.77	
5-2	45.17	20.15	8.70	7.04	5.30	4.60	3.66	
AVERAGE	45.42	18.32	8.70	6.97	5.25	4.49	3.72	
5-7	45.06	19.37	13.09	10.06	7.57	6.87	6.00	
5-8	46.37	24.94	14.06	10.98	8.33	7.64	5.95	
AVERAGE	45.72	22.16	13.58	10.52	7.95	7.26	5.98	← Use this
5-9	42.21	20.98	17.69	14.98	11.48	10.25	9.31	
5-10	43.90	20.28	17.45	14.49	11.33	10.27	8.93	
AVERAGE	43.06	20.63	17.57	14.74	11.41	10.26	9.12	
AVERAGE	44.73	20.37	13.28	10.74	8.20	7.34	6.27	

** Measurement error, not used.



FROM REF. 2

Sh. 13 A/13

CONTRA-GRJ
3 BBS-34
Liquefaction
Study
FF 11/27/91
PYC 11/5/91

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: UMTRA - GRJ
Feature: Embankment Design
Item: Infiltration

Contract No.: 525-34
Designed: HL
Checked: PYL

Sheet: H14
File No.:
Date: 9/19/91
Date: 11/5/91

REFERENCE: 3 (Sheet 0), copies ATTACHED
MATERIAL: Mancos Shale (In-Situ)

SATURATED K: VERTICAL 5.67E-05 ft/day; HORIZONTAL 1.13E-03 ft/day

POROSITY: 16%

INITIAL VOL. MOISTURE CONTENT: 14.8% HEAD: 35.4 feet

M.C. vs K_r & HEAD PER RETC:

VOLUMETRIC MOISTURE CONTENT, %	SUCTION HEAD, feet	K_r
9.4	1.4E+10	9.77E-24
10.2	5.0E+07	2.35E-18
11.0	1.1E+06	1.16E-14
12.0	29370	3.08E-11
12.8	3028	4.58E-09
13.6	440.8	3.15E-07
14.2	121.2	5.25E-06
14.8	35.4	7.15E-05
15.2	15.0	3.95E-04
15.8	2.3	7.68E-03
16.0	0.0	1.00E+00

Number of data pairs: 11

Sh. A15

from Ref. 3

UMTRA-GRT
3 SHT-34
Infiltration

Table 4

Material	Theta(wt)	Gamma, lb/ft^3	Theta(vol)	Pressure, meters	K(sat), m/day
Tailings	0.180	110.0	0.320	-2.50	4.84E-02
Alluvium	0.140	103.6	0.240	-10.00	8.64E-02
Mancos	0.060	154.2	0.148	-10.20	K_v 1.73E-04 K_h 3.46E-03

PYL 11/5/

Case 1 (deep excavation)

A plot of water level as a function of time at node no. 473, which is the low point of the cross-section, is presented on Figure 5. The maximum water level above the Mancos/tailings interface is 0.53 meter (1.74 feet) and occurs after 3.5 years of simulation. Based on the curve presented on Figure 5, water remains perched on the Mancos for a period of 12 years. The extent of the saturated zone as a function of time is presented on Figure 6 and 7. After a period of 5 years, the model predicts that unsaturated flow occurs in the Mancos beneath the low point of the cross-section.

Discussion

UNSAT2

The program predicts that some water will perch on the Mancos shale. It is expected that with additional moisture coming from the above grade tailings and surface-water infiltration, the depth of perched water would be greater - although not substantially greater. There are several rationale for not expecting a significant rise in the water level above the Mancos even with cover flux and above-grade tailing's moisture included in the model:

1) Preliminary simulations of cover performance using the program UNSAT-H suggests the influx will be extremely low even without the presence of vegetation on the cover.

2) The below-grade cross-section used in the current simulation represents 65 percent of the contaminated material. The remaining 35 percent of the contaminated material at this cross-section are from vicinity properties. Based on laboratory and field tests, the vicinity properties material is dry (moisture content 12.4% by volume) and would not contribute a substantial volume of additional moisture.

Based on the results presented in Figures 6 and 7, the effect of

From Ref. 3

Dr. A16
UMTRA-GRT
3885-34
Infiltration

HL 11/5/91
PYL 11/5/91

```
*************************************************************
*                                                           *
*    ANALYSIS OF SOIL HYDRAULIC PROPERTIES                  *
*                                                           *
WESTES GULCH, WASATCH FORMATION                             *
*                                                           *
*    MUALEM-BASED RESTRICTION, M=1-1/N                      *
*    ANALYSIS OF RETENTION DATA ONLY                        *
*    MTYPE= 3     METHOD= 2                                 *
*                                                           *
*************************************************************
```

INITIAL VALUES OF THE COEFFICIENTS

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.0800	0
2	WCS	.1600	0
3	ALPHA	.0500	1
4	N	2.0000	1
5	M	.5000	0
6	EXPO	.5000	0
7	CONDS	2.00E-08	0

OBSERVED DATA

OBS. NO.	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	5103.600	.1392	1.0000
2	3062.200	.1425	1.0000
3	2041.400	.1456	1.0000
4	1020.700	.1494	1.0000
5	918.700	.1499	1.0000
6	714.500	.1505	1.0000
7	510.400	.1515	1.0000
8	306.200	.1529	1.0000
9	102.100	.1545	1.0000
10	.000	.1578	1.0000

RETC use data

NIT	SSQ	ALPHA	N
0	.03821	.0500	2.0000
8	.00002	.0063	1.0803

CORRELATION MATRIX

	1	2
1	1.0000	
2	-.9610	1.0000

RSQUARED FOR REGRESSION OF OBSERVED VS FITTED VALUES = .96008671

NONLINEAR LEAST-SQUARES ANALYSIS: FINAL RESULTS

95% CONFIDENCE LIMITS

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet A17

Project UMTRA - GRJ | Contract No. 3985-34 | File No.
Feature EMBANKMENT DESIGN | Designed HL | Date 11/01/91
Item INFILTRATION | Checked PYL | Date 11/4/91

REFERENCE : 1 and 2 (Sheet 0)
MATERIAL : Compacted Mancos Shale
SAT K : 1×10^{-6} cm/sec = 2.8×10^{-3} ft/day

POROSITY : 39%

INITIAL VOL. MOISTURE CONTENT : 29% HEAD : 6918 feet

MC vs K_r & HEAD Per RETC :

VOL. MOISTURE CONTENT (%)	SUCTION HEAD (feet)	K_r
9.6	3.17E+14	7.98E-32
11.5	5.42E+12	4.29E-28
13.5	1.74E+11	6.11E-25
16.4	2.29E+9	5.73E-21
18.3	1.92E+8	1.08E-18
20.2	2.06E+7	1.21E-16
23.1	1.05E+6	6.51E-14
25.0	1.76E+5	2.83E-12
26.9	33620	9.28E-11
28.9	7208	2.40E-9
30.8	1702	5.04E-8
32.7	432.9	8.9E-7
34.6	113.5	1.40E-5
36.5	26.2	2.30E-4
38.5	0	1

Number of data points = 15

Feature Disposal Cell
Item Material Properties Summary for UNSAT2

Contract No. 1885-37 File No.
Designed ACC Date 27
Checked H.L. Date 7/9

From Ref. 2

Compacted Shale

- Ksat = ~~4.5~~ 2.8 x 10^{-7} cm/sec (vertical = horizontal)
- initial moisture content = 32.3 % volumetric
- porosity = 20.9 % gravimetric

$$= 20.9 \times \frac{32.3}{18.5} = 36.5\ \%\ \text{volumetric}$$

per H.L's calc's ~~ca~~ sh

- pressure head vs. moisture content

Pressure Head (cm H_2O)	Water Content (% Vol)		Compacted Shale Water Content (% Vol)
5103.6	13.92		~~31.75~~ 33.93
3062.2	14.25		~~32.5~~ 34.73
2041.4	14.56		~~33.22~~ 35.49
1020.7	14.94		~~34.08~~ 36.42
918.7	14.99	* ~~36~~ / 10 =	~~34.20~~ 36.54
714.5	15.05	39 / 16	~~34.33~~ 36.68
510.4	15.15		~~34.56~~ 36.93
306.2	15.29		~~34.88~~ 37.27
102.1	15.48		~~35.31~~ 37.73
0	15.78		~~36.00~~ 38.46

HL 11/04/91
PYL 11/04/91

Marcos Shale
"observed data" per TAC report

Note: 27 June 90
checked w/ P. Sircar, ...
to adjust water contents (% vol.)
by ratio of porosities

- K vs. moisture content
  → to be developed using RETC

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: JMTRA GRJ
Feature: Embankment Design
Item: Infiltration

Contract No. 3535-34
Designed: HL
Checked: PYL

Sheet: II 1.7
File No.:
Date: 9/19/91
Date: 10/31/91

REFERENCE: 1 and 2 (Sheet 0)

Material: -1" material

Saturated k: 7.2×10^{-7} cm/sec = 2×10^{-3} ft/day

Porosity: 30 %

Initial Vol. Moisture Content: 23.9 % Head: 12.2 feet

M.C. vs K_r & HEAD PER RETC:

Volumetric Moisture Content, %	Suction Head, feet	K_r
19.2	24910	6.11E-15
19.6	623.5	1.77E-09
20.2	182.2	1.17E-07
20.7	88.6	1.36E-06
21.3	52.9	7.77E-06
22.3	25.4	9.17E-05
23.4	14.8	5.37E-04
24.4	9.5	2.17E-03
25.5	6.4	7.03E-03
26.9	3.9	2.55E-02
27.9	2.5	6.76E-02
29.0	1.2	1.91E-0
29.8	0.0	1.00E+0

Number of data pairs = 13

Project Grand Junction
Feature Disposal Cell
Item Material Properties Summary for UNSAT2

Contract No. 335-34 File No.
Designed ACC Date 2/7
Checked H.L. Date 7/93

FROM REF. 2

Illinois 1" material

clean-fill for above grade

- Ksat = 4.8×10^{-5} cm/sec (log average of HL calc's.) see sheet

- Pressure Head vs. Moisture Content: (per PS) see sheet 4 attached

Tension (bar)	Pressure Head (cm H_2O)	Moisture Content (% volumetric)
0.1	102	27.0
0.3	306	24.9
0.5	510	22.9
1.0	1020	21.5
2.0	2040	20.9
4.0	4080	20.4
7.0	7140	(20.6)
15.0	15300	19.4

use this for RETC

- K vs. moisture content → to be developed using RETC

- Initial Moisture Content = optimum moisture content = 24.1 % volumetric per H.L. calc see sheet

- porosity = 15.2 * $\frac{24.1}{12.3}$ = 29.8 % volumetric per H.L. calcs see sheet 5

(θ_{sat})

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet #21

Project UMTRA — SRJ | Contract No. 3345-34 | File No.
Feature Embankment Design | Designed HL | Date 9/19/8
Item Infiltration | Checked PYC | Date 10/3/8

Reference: 3 (Copies Attached)

Material: Alluvium

Saturated k: 1×10^{-4} cm/sec $= 2.84 \times 10^{-1}$ ft/day

Porosity: 36%

Initial Vol. Moisture Content: 17%* Head: 415.7f

M.C. vs K_r & Head for RETC:

Volumetric Moisture Content, %	Suction Head, feet	K_r
13.9	276700	2.19E-16
14.3	15460	2.24E-1
16.0	863.4	2.29E-0
17.1	370.8	3.43E-0
19.9	103.9	1.96E-0
22.7	46.3	2.45E-0
23.8	35.6	5.48E-0
25.4	24.8	1.59E-0
28.2	14.3	7.31E-0
31.0	8.1	2.83E-0
33.8	3.8	1.10E-0
36.0	0.0	1.00E+0

Number of data pairs = 12

* ASSUMED VALUE (TAC used 24%)

From Ref. 3

Table 4

Material	Theta(wt)	Gamma, lb/ft³	Theta(vol)	Pressure, meters	K(sat) m/day
Tailings	0.180	110.0	0.320	-2.50	4.84E-02
Alluvium	0.140	103.6	0.240	-10.00	8.64E-02
Mancos	0.060	154.2	0.148	-10.20	K_v 1.73E-04 K_h 3.46E-03

Case 1 (deep excavation)

A plot of water level as a function of time at node no. 473, which is the low point of the cross-section, is presented on Figure 5. The maximum water level above the Mancos/tailings interface is 0.53 meter (1.74 feet) and occurs after 3.5 years of simulation. Based on the curve presented on Figure 5, water remains perched on the Mancos for a period of 12 years. The extent of the saturated zone as a function of time is presented on Figure 6 and 7. After a period of 5 years, the model predicts that unsaturated flow occurs in the Mancos beneath the low point of the cross-section.

Discussion

UNSAT2

The program predicts that some water will perch on the Mancos shale. It is expected that with additional moisture coming from the above grade tailings and surface-water infiltration, the depth of perched water would be greater - although not substantially greater. There are several rationale for not expecting a significant rise in the water level above the Mancos even with cover flux and above-grade tailing's moisture included in the model:

1) Preliminary simulations of cover performance using the program UNSAT-H suggests the influx will be extremely low even without the presence of vegetation on the cover.

2) The below-grade cross-section used in the current simulation represents 65 percent of the contaminated material. The remaining 35 percent of the contaminated material at this cross-section are from vicinity properties. Based on laboratory and field tests, the vicinity properties material is dry (moisture content 12.4% by volume) and would not contribute a substantial volume of additional moisture.

Based on the results presented in Figures 6 and 7, the effect o

```
*****************************************************************
*                                                               *
*     ANALYSIS OF SOIL HYDRAULIC PROPERTIES                     *
*                                                               *
*CHENEY                  , MEDIUM COMPACTION, EMPIRICAL CORRELAT *
*                                                               *
*     MUALEM-BASED RESTRICTION, M=1-1/N                         *
*     ANALYSIS OF RETENTION DATA ONLY                           *
*     MTYPE= 3      METHOD= 2                                   *
*                                                               *
*****************************************************************
```

Guerra-Ent 3B05-34 Infiltration

HL 11/5/91

PYL 11/5/91

ALLUVIUM

INITIAL VALUES OF THE COEFFICIENTS

NO	NAME	INITIAL VALUE	INDEX
1	WCR	.1700	1
2	WCS	.3600	0
3	ALPHA	.0200	1
4	N	2.3000	1
5	M	.5652	0
6	EXPO	.5000	0
7	CONDS	5.00E-05	0

OBSERVED DATA

OBS. NO.	PRESSURE HEAD	WATER CONTENT	WEIGHTING COEFFICIENT
1	15300.000	.1624	1.0000
2	10000.000	.1721	1.0000
3	5000.000	.1899	1.0000
4	2000.000	.2179	1.0000
5	1000.000	.2432	1.0000
6	600.000	.2644	1.0000
7	400.000	.2830	1.0000
8	340.000	.2909	1.0000
9	300.000	.2971	1.0000
10	200.000	.3179	1.0000
11	150.000	.3323	1.0000
12	100.000	.3474	1.0000
13	80.000	.3516	1.0000
14	60.000	.3540	1.0000
15	40.000	.3549	1.0000
16	30.000	.3551	1.0000
17	20.000	.3551	1.0000
18	10.000	.3551	1.0000
19	1.000	.3551	1.0000

RETC observed data.

NIT	SSQ	WCR	ALPHA	N
0	.10345	.1700	.0200	2.3000
8	.00024	.1374	.0046	1.4807

CORRELATION MATRIX

	1	2	3
1	1.0000		
2	-.5543	1.0000	

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project	UMTRA – GRT	Contract No.	88-34	Sheet	
Feature	Disposal Cell	Designed	JK	File No.	
Item	Seepage Analysis	Checked	MK	Date	7/29/92
				Date	7/29/92

APPENDIX IV

According to Ref. 9, a paleochannel exists in the vicinity of the disposal cell. A plan view of the direction of flow in the paleochannel is shown in figure D-1. Figures D-3 through D-6 are X-sections through the cell and the paleochannel with their locations shown in figure D-2. The flow gradients between X-sections C and D and between B and A are computed to be 0.033 and 0.032 (see sh. D-2), respectively.

Results of the seepage analysis (see sh. 14) indicate that a head buildup of up to 5 feet may occur around the lowest point within the disposal cell during the transient drainage in the cell. Because the lowest point in the cell is always below the paleochannel, it is unlikely that the flow in the cell will migrate to the paleochannel (see figures D-3 thru. D-6) and therefore, contamination of the paleochannel by flow from the cell seems impossible.

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet D-2

Project UNTRA – GRT | Contract No. 385-34 | File No.
Feature | Designed HL | Date 7/27/92
Item Paleochannel | Checked HK | Date 7/ /92

ESTIMATED GRADIENT (see figures D3 – D6)

Between cross section C – D (Point 1 @ C, Point 1 @ D)

Distance = 800 ft
ΔElevation = 5197 – 5170 = 27 ft.

$$\text{Gradient} = \frac{27}{800} = 0.03375$$

Between cross section A – B (Point 1 @ A, Point 1 @ B)

Distance = 600 ft
ΔElevation = 5217 – 5198 = 19 ft

$$\text{Gradient} = \frac{19}{600} = 0.0317$$

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet D-3

Project UMTRA - Grand Junction Contract No. 3885-[illegible] File No.
Feature Designed LL Date 7/27/92
Item Paleochannel Checked [illegible] Date 7/29/92

ESTIMATED SATURATED PERMEABILITY

Based on the paleochannel materials:

$$k = 3.7 \times 10^{-1} \text{ cm/sec}$$

Based on the measured steady-state flow of 0.1 gpm:

$$k = 4.7 \times 10^{-3} \text{ cm/sec}$$

REF. NORTHWEST PALEOCHANNEL RESTORATION AT CHENEY DISPOSAL EMBANKMENT, DOC # 3885-GRJ-R-01-DRAFT-00, JULY 1992.

On the other hand, the permeability of the paleochannel is estimated to be at least 2 orders of magnitude higher than that of the Mancos shale (see sh. D-3 and sh. 8). Therefore, relatively insignificant flow from the paleochannel into the shale will occur.

In conclusion, it is unlikely that there will be any hydraulic connection between the disposal cell and the paleochannel and that a minimal or no impact of the existence of the paleochannel on the cell performance will be expected.

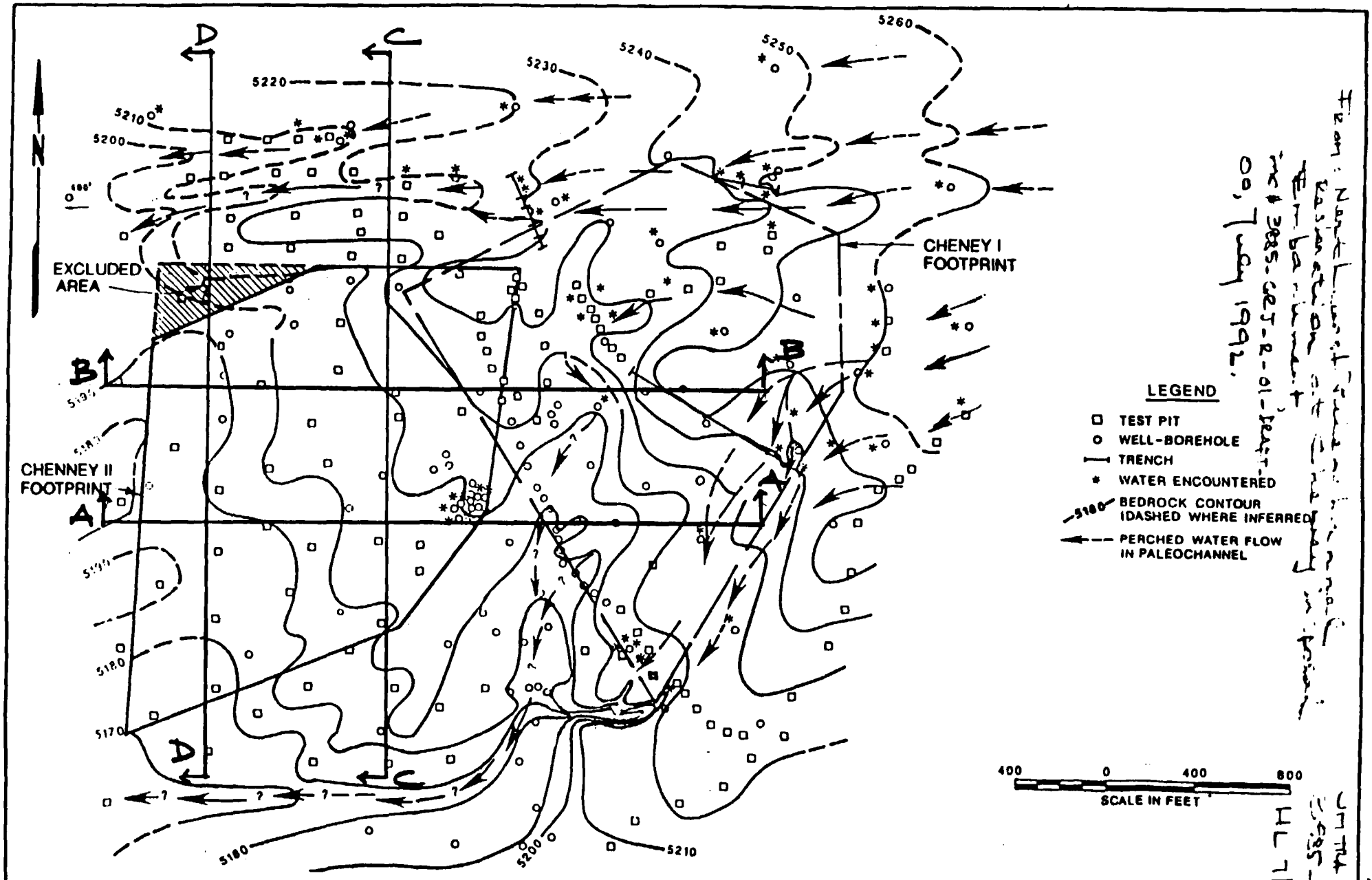
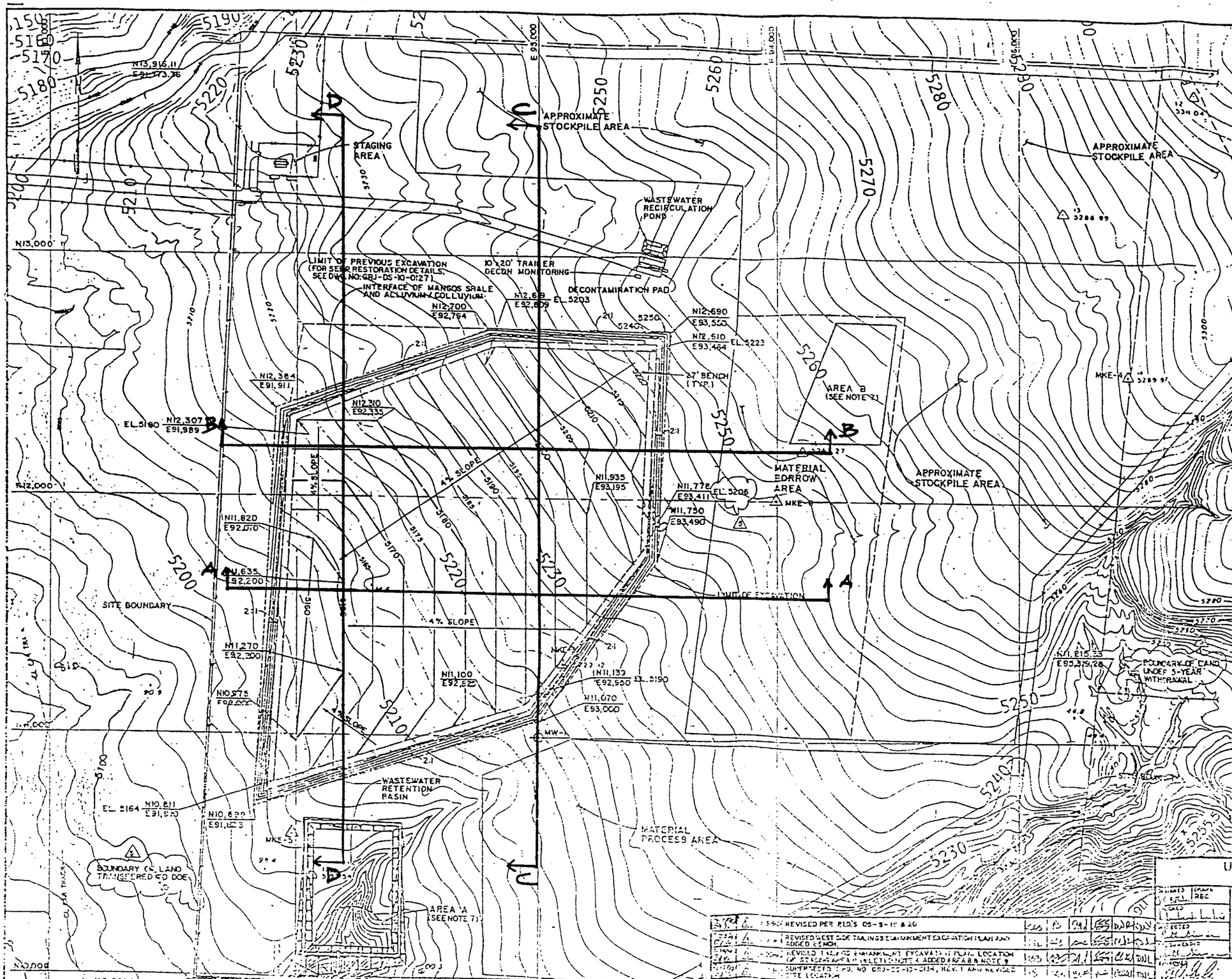


FIGURE D-1- BEDROCK CONTOUR MAP SHOWING WATER-FILLED PALEOCHANNELS CHENEY DISPOSAL SITE



NOTES:

1. ALL UNCONTAMINATED MATERIAL EXCAVATED FROM THE SITE DURING CONSTRUCTION SHALL BE PLACED TEMPORARILY WITHIN THE AREAS INDICATED WITH STABLE SLOPES NO STEEPER THAN 2(H) TO 1(V). MAXIMUM HEIGHT OF THE PILE SHALL BE 30 FEET.
2. THE SUBCONTRACTOR SHALL PROVIDE SUMP AND PUMP TO DRAIN THE PONDED NON-CONTAMINATED WATER FROM RAINSTORM AND SNOW MELT FROM THE TAILINGS EMBANKMENT AREA INTO THE NATURAL DRAIN.
3. THE SUBCONTRACTOR SHALL NOT EXCAVATE INTO THE MANCOS SHALE PRIOR TO THE ISSUANCE OF SUCH INSTRUCTIONS BY THE CONTRACTOR.
4. (DELETED)
5. THE LOCATION OF THE INTERFACE OF MANCOS SHALE WITH ALLUVIUM/COLLUVIUM IS APPROXIMATE ONLY AND IS BASED ON SOIL BORING LOGS. ACTUAL LOCATION MAY VARY IN THE FIELD.
6. THE DESIGNATED MATERIAL BORROW AREA SHALL NOT BE USED AS STOCKPILE AREA WITHOUT THE CONTRACTOR'S APPROVAL.
7. THE SUBCONTRACTOR MAY SPOIL OVERSIZE ROCK FROM THE DISPOSAL CELL EXCAVATION INTO THE DRAINAGE GULLY UNDER THE PROPOSED WASTEWATER RETENTION BASIN (AREA A) IF, AND AS AVAILABLE. IF THIS AREA IS NOT AVAILABLE, THE SUBCONTRACTOR SHALL TEMPORARILY STOCKPILE THE OVERSIZE MATERIAL IN THE DESIGNATED AREA B. HE SHALL DISPOSE OF THIS MATERIAL AS REQUIRED BY THE CONTRACTOR.
8. LOCATIONS OF WASTEWATER RECIRCULATION POND AND DECONTAMINATION PAD ARE APPROXIMATE.
9. A WORKING BENCH APPROXIMATELY 27' WIDE SHALL BE PLACED BELOW THE TRANSITION BETWEEN MANCOS SHALE AND ALLUVIUM. THE SIDESLOPE IN THE MANCOS MAY VARY AS APPROVED BY THE CONTRACTOR.

REFERENCE DRAWINGS:

GRJ-DS-10-0125, CONSTRUCTION FACILITIES AND SITE DRAINAGE
GRJ-DS-10-0223, BORINGS AND TEST PITS LOCATION PLAN

LEGEND:

- 5240 — EXISTING SITE FEATURES AND CONTOURS
- N 12,000 — CONSTRUCTION GRID COORDINATE
- 5250 — CONTOURS OF EXCAVATION
- TEMPORARY CHAIN LINK FENCE AND GATE
- TEMPORARY WIRE FENCE
- ACCESS ROAD
- EXCAVATION
- EMBANKMENT
- MKE-3 — EXISTING PERMANENT SURVEY MONUMENT
- MW-1 — EXISTING WATER SUPPLY WELL

200 0 200 400
SCALE FEET

U. S. DEPARTMENT OF ENERGY
ALBUQUERQUE, NEW MEXICO

CHENEY RESERVOIR DISPOSAL SITE
GRAND JUNCTION, COLORADO
PHASE II CONSTRUCTION

TAILINGS EMBANKMENT AREA EXCAVATION PLAN

MORRISON-KNUDSEN ENGINEERS, INC.
UMTRA PROJECT

PROJECT NO. DE-AC04-83AL19796

DRAWING NO. GRJ-DS-10-0134

REVISIONS
REVISED PER RFI'S DS-5-19 & 20
REVISED WEST SIDE TAILINGS EMBANKMENT EXCAVATION PLAN AND ADDED BENCH
REVISED TAILINGS EMBANKMENT EXCAVATION INITIAL LOCATION OF STOCKPILE AREA B (SEE NOTE 7) ADDED AREA B & NOTE 9
SUPERSEDES DWG. NO. GRJ-DS-10-0134, REV. 1 AND REVISED SITE LOCATION
REVISED TAILINGS EXCAVATION AREA, GRADING, TEMPORARY WIRE FENCE AND STOCKPILE AREA
ISSUED FOR CONSTRUCTION

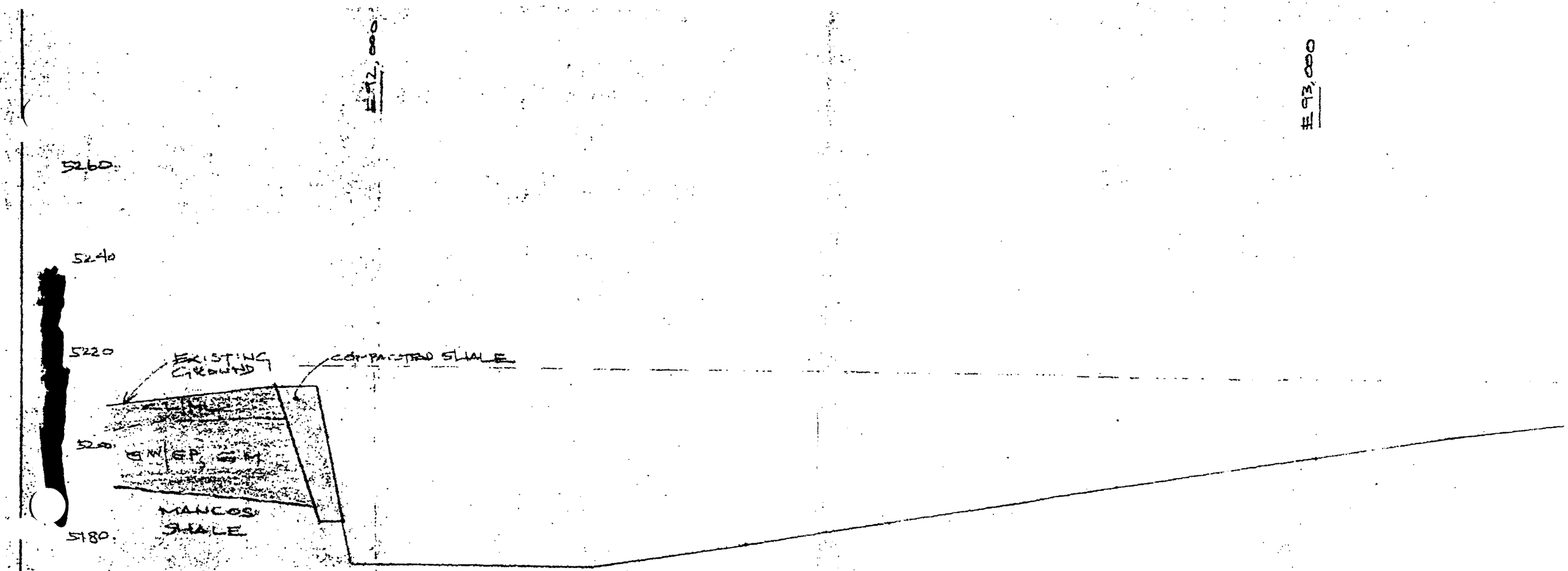


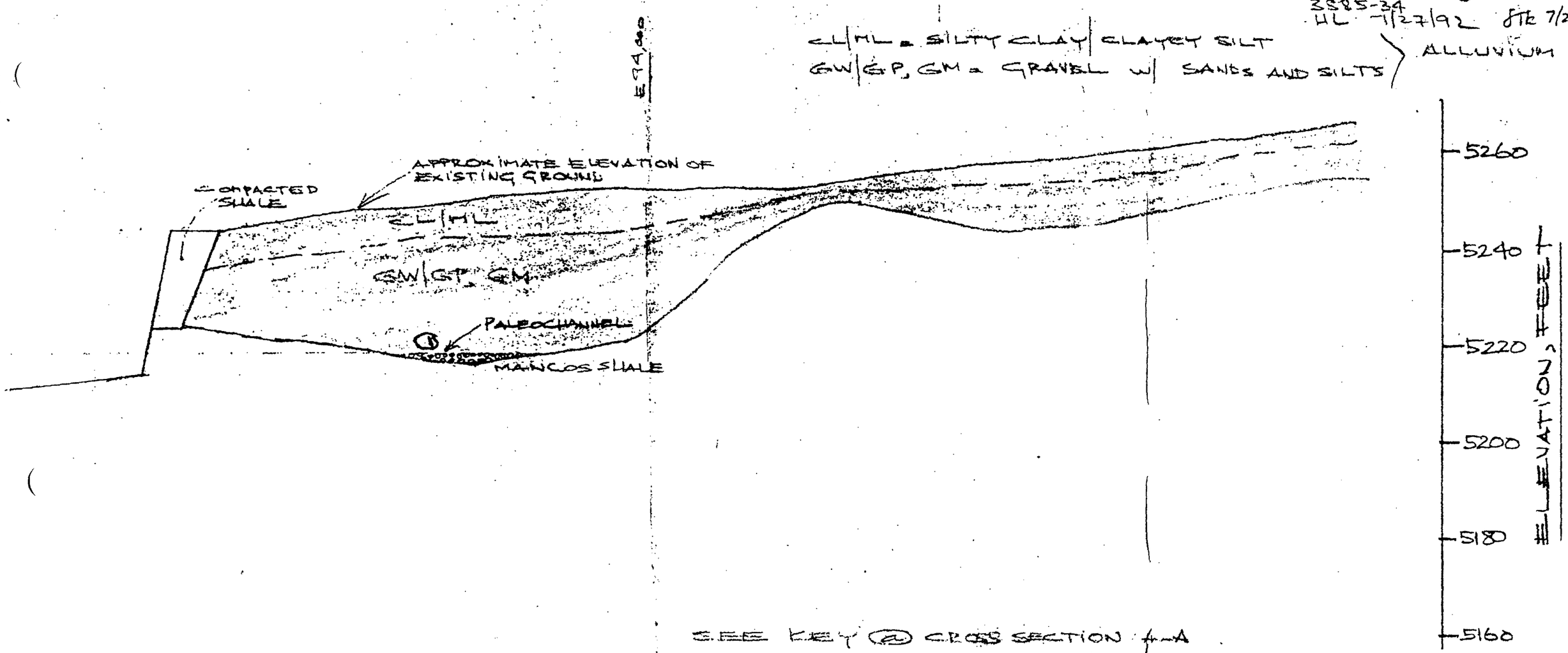
FIGURE D-3

CROSS-SECTION [redacted]

SCALE: HOR 1" = 100'
VER 1" = 20'

UMTRA - GRJ
3885-34
HL 7/27/92

Sh. D-7
STK 7/29/92



SEE KEY (2) CROSS SECTION A-A

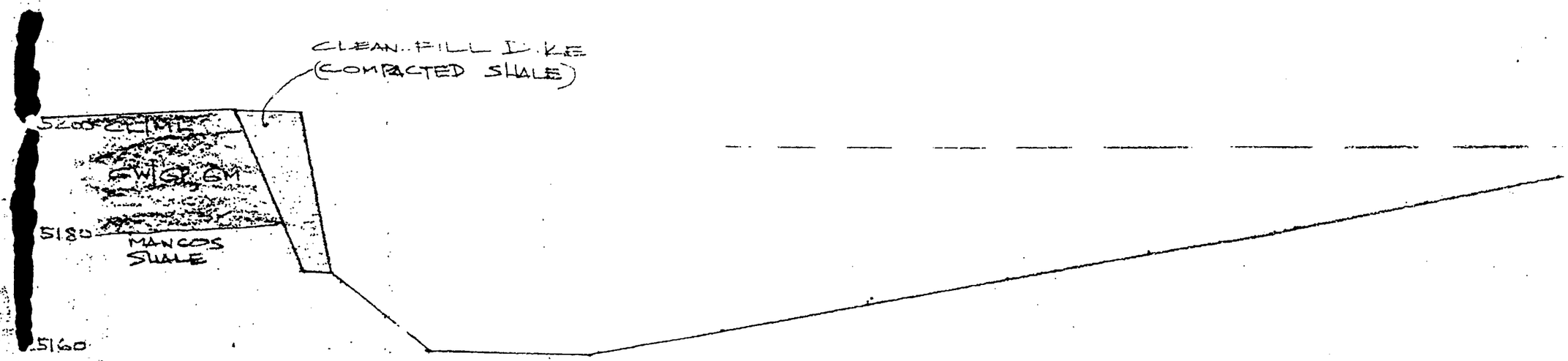


FIGURE D-4

CROSS-SECTION

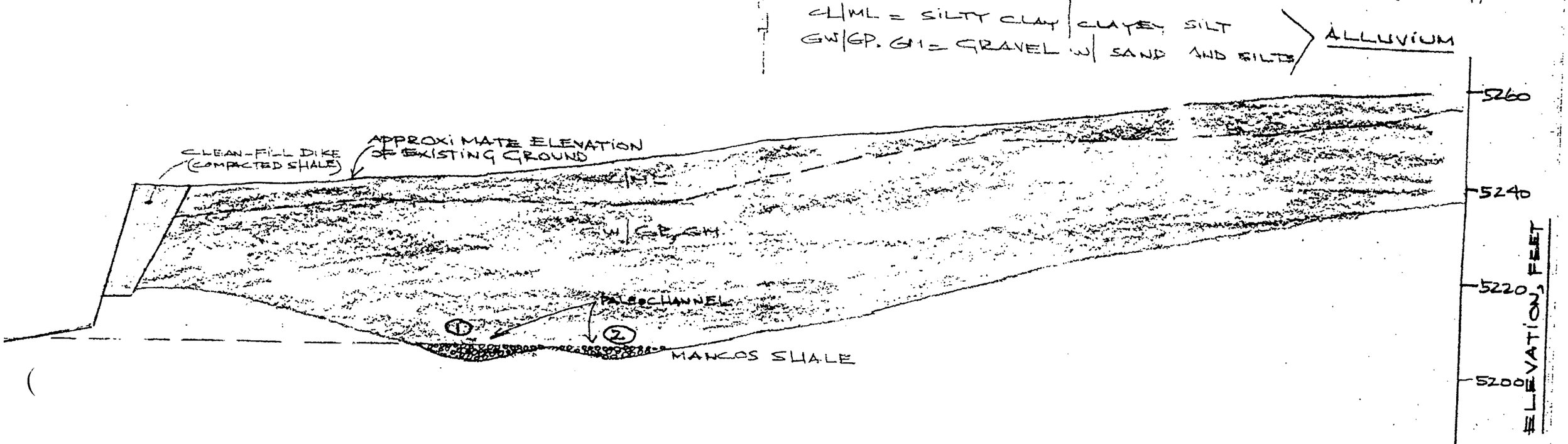
SCALE : DR.

VER.

UMTRA-GRJ
2285-24
HL 7/27/92

Sh. D-8

JTK 7/29/92



KEY

- ALLUVIUM — $k_{sat} = 1.0 \times 10^{-4}$ cm/sec
- COMPACTED SHALE — $k_{sat} = 1.0 \times 10^{-6}$ cm/sec
- IN-SITU SHALE — k_{sat} (HOR) = 4.0×10^{-7} cm/sec; k_{sat} (VERT) = 2.0×10^{-8} cm/sec
- PALEOCHANNEL

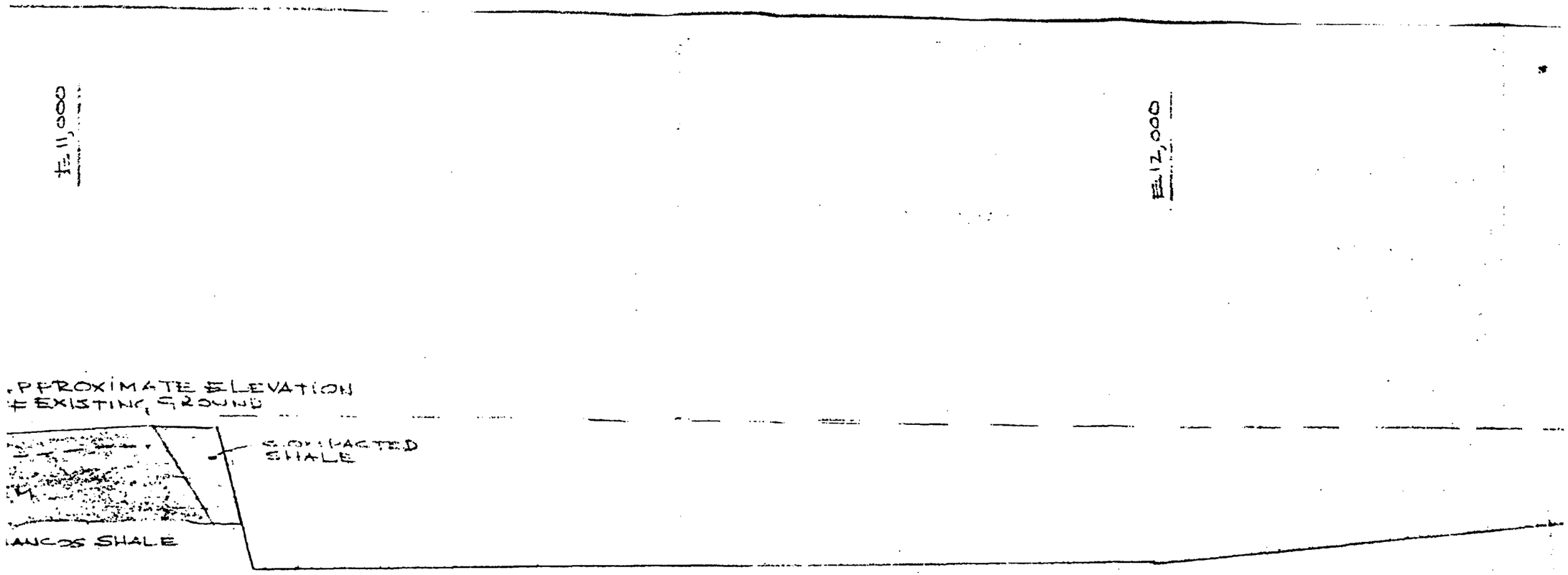

EL 11,000
EL 12,000
APPROXIMATE ELEVATION
OF EXISTING GROUND
COMPACTED
SHALE
MANCOS SHALE

FIGURE D-5

UPMORA-GRJ 4A 8-9
3835-34
HL 7/27/92 JTK 7/27/92

CL|ML = SILTY CLAY|CLAYEY SILT
GW|GP, GM = GRAVEL w/ SANDS AND SILTS
ALLUVIUM

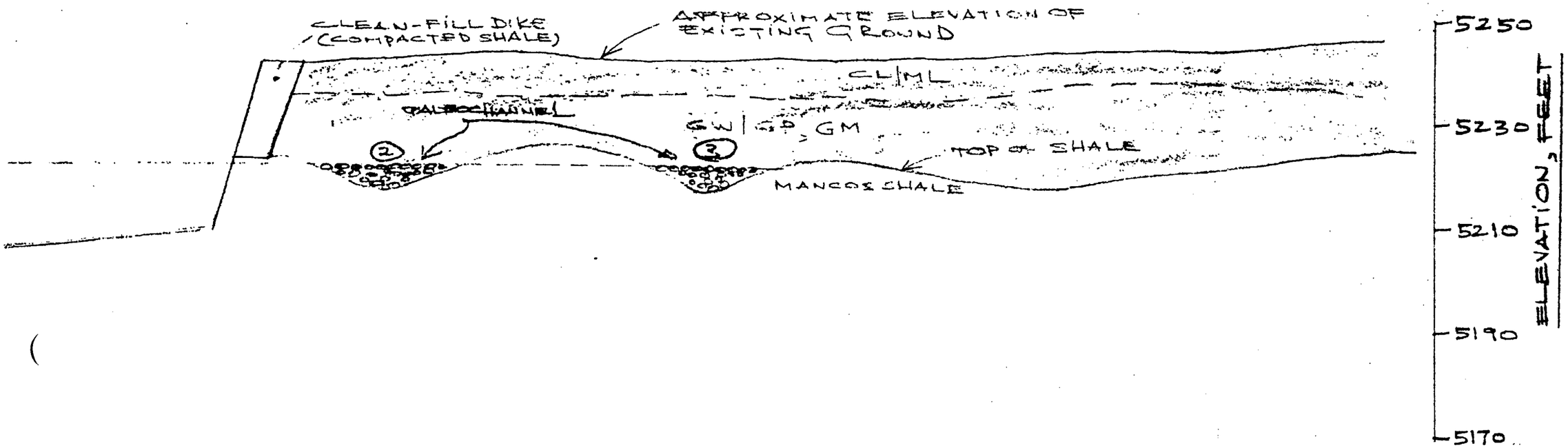


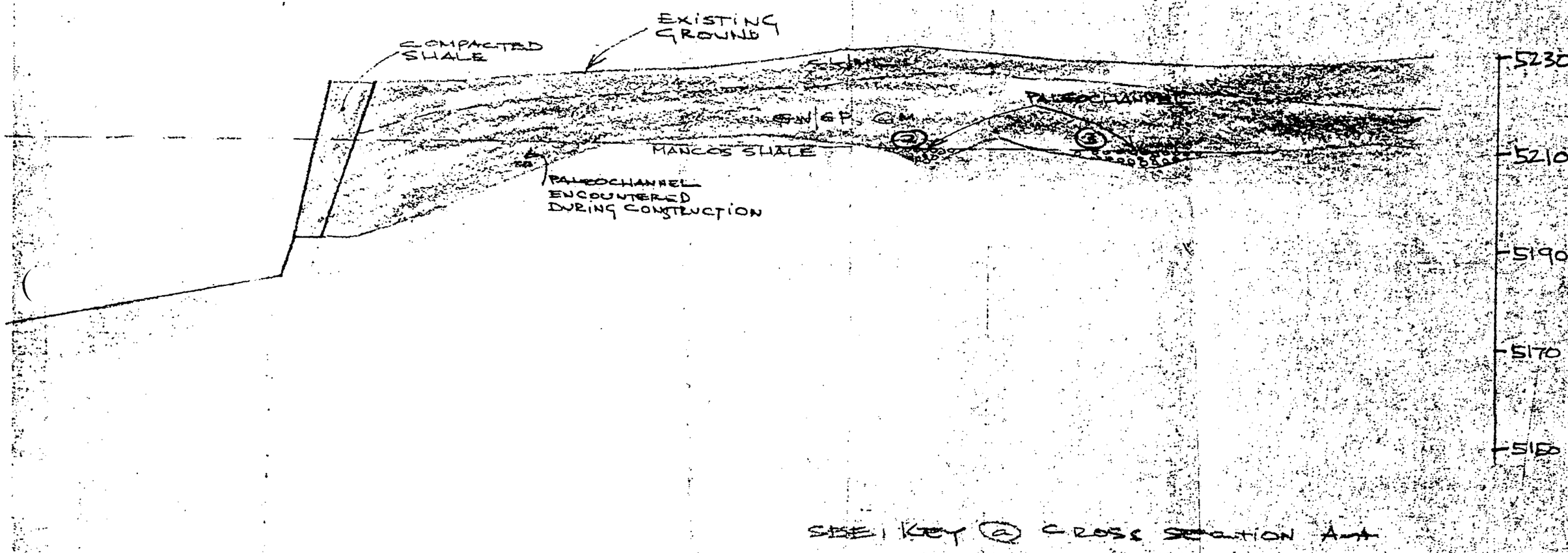
FIG. 4 CROSS SECTION A-A

N 11,000
N 12,000
EXISTING GROUND
COMPACTED SHALE
MANCOS SHALE

UMTRA - GRJ SHD-
3885-34
UL 7/27/92
JTK 7/29/92

N 13,000

CL|ML = SILTY CLAY|CLAYEY SILT
GW|GP, GM = GRAVELL W|SANDS AND SILTS
ALLUVIUM



SEE KEY ② CROSS SECTION A-A