

ORTEK
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LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client Kennecott
Address

Sampled By J. Thresher
P.O. #
Job # 87K10
Report to: B. Burton
Invoice # 1270
Result Sheet No. 39020.00

Name of Rep.
Telephone No. (000) 000-0000

Sample I.D. WR-1A

Date Collected 11/10/88
Date Received 11/11/88

Parameters, units ----- Results -----

T. Sulfur, % < 0.17

Comments:

Signed: David Turiff Date: January 10, 1989

APPENDIX 3.5-P

Acid Consumption, Production, and
Neutralization Data and Methods
Flambeau Project, Ladysmith, WI

TABLE NO. 1

Initial BC Research Acid Consumption Test Results
Equilibrated 10.0-g Sample in 100 mL DI Water

Sample	Natural pH	Volume (mL) of 0.1 N H ₂ SO ₄ Required to Titrate to pH 3.50
WR-1	6.35	2.15
WR-1	6.60	2.15
WR-2	4.85	1.70
WR-2	4.95	1.70
WR-3	4.80	2.50
WR-3	4.70	2.50
WR-4	4.40	2.10
WR-4	4.45	2.10
WR-5	4.30	1.00
WR-5	4.30	0.95
WW-1	3.90	0.55
WW-1	3.90	0.55

TABLE NO. 2

Stepwise Acid Titration of Waste Rock Samples Following 1-Hour
Equilibration in DI Water

Equilibrated 20.0-g Sample in 200 mL DI Water

Volume 0.1 N H ₂ SO ₄ Added (mL)	Total Volume Acid Added (mL)	pH
Sample WR-1		
0.0	0.0	7.93
1.0	1.0	6.28
1.0	2.0	5.72
1.0	3.0	5.45
1.0	4.0	4.99
1.0	5.0	4.80
1.0	6.0	4.69
1.0	7.0	4.58
1.0	8.0	4.47
1.0	9.0	4.37
1.0	10.0	4.30
1.0	11.0	4.34
1.0	12.0	4.25
1.0	13.0	4.20
1.0	14.0	4.13
1.0	15.0	4.12
1.0	16.0	4.10
1.0	17.0	4.07
1.0	18.0	4.05
1.0	19.0	4.02
1.0	20.0	4.02
1.0	21.0	4.00
1.0	22.0	3.97
1.0	23.0	3.94
1.0	24.0	3.93
1.0	25.0	3.85
1.0	26.0	3.66
1.0	27.0	3.64
1.0	28.0	3.50
1.0	29.0	3.52
1.0	30.0	3.49
1.0	31.0	3.35
1.0	32.0	3.20

3.5-P-2

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TABLE NO. 2 (Cont.)

Volume 0.1 N H ₂ SO ₄ Added (mL)	Total Volume Acid Added (mL)	pH
Sample WR-1A		
0.0	0.0	7.64
1.0	1.0	6.25
1.0	2.0	5.39
1.0	3.0	4.81
1.0	4.0	4.47
1.0	5.0	4.22
1.0	6.0	3.97
1.0	7.0	3.70
1.0	8.0	3.47
1.0	9.0	3.35
1.0	10.0	3.15
1.0	11.0	3.08
1.0	12.0	2.90
1.0	13.0	2.74
1.0	14.0	2.64
1.0	15.0	2.56
Sample WR-2		
0.0	0.0	5.68
1.0	1.0	4.82
1.0	2.0	4.27
1.0	3.0	3.89
1.0	4.0	3.70
1.0	5.0	3.45
1.0	6.0	3.28
Sample WR-3		
0.0	0.0	5.45
1.0	1.0	4.92
1.0	2.0	4.65
1.0	3.0	4.44
1.0	4.0	4.25
1.0	5.0	4.05
1.0	6.0	3.93
1.0	7.0	3.87
1.0	8.0	3.65
1.0	9.0	3.59
1.0	10.0	3.55
1.0	11.0	3.31
1.0	12.0	3.77

3.5-P-3

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TABLE NO. 2 (Cont.)

Volume 0.1 N H ₂ SO ₄ Added (mL)	Total Volume Acid Added (mL)	pH
Sample WR-4		
0.0	0.0	4.96
1.0	1.0	4.63
1.0	2.0	4.39
1.0	3.0	4.10
1.0	4.0	4.03
1.0	5.0	3.86
1.0	6.0	3.65
1.0	7.0	3.45
1.0	8.0	3.25
Sample WR-5		
0.0	0.0	4.28
1.0	1.0	4.21
1.0	2.0	4.15
1.0	3.0	4.09
1.0	4.0	4.06
1.0	5.0	4.03
1.0	6.0	3.99
1.0	7.0	3.95
1.0	8.0	3.92
1.0	9.0	3.90
1.0	10.0	3.85
1.0	11.0	3.80
1.0	12.0	3.77
1.0	13.0	3.73
1.0	14.0	3.70
1.0	15.0	3.68
1.0	16.0	3.65
1.0	17.0	3.61
1.0	18.0	3.58
1.0	19.0	3.54
1.0	20.0	3.51
1.0	21.0	3.50
1.0	22.0	3.45
1.0	23.0	3.43
1.0	24.0	3.40
1.0	25.0	3.35

3.5-P-4

KEIR

TABLE NO. 2 (Cont.)

Volume 0.1 N H ₂ SO ₄ Added (mL)	Total Volume Acid Added (mL)	pH
Sample WW-1		
0.0	0.0	3.55
0.5	0.5	3.51
0.5	1.0	3.48
0.5	1.5	3.46
0.5	2.0	3.43
0.5	2.5	3.40
0.5	3.0	3.37

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METHODS USED IN PREPARATION OF TABLE NO. 3

Microbial Confirmation Test Data for Acid Production Potential of Samples WR-3, 4, and 5

1. Procedure followed was similar to that presented in "Waste Characterization Studies of Typical Waste Rocks from the Crandon Mineral Deposit", Project 1-45-513 prepared by the Division of Extractive Metallurgy, B.C. Research, Vancouver, B.C. dated July 1982, Appendix 6, pp. 2-3.

2. The quantity of sample used, also known as the feed, for each sample was:

<u>Sample</u>	<u>Weight</u>
WR-3	30 g.
WR-4	20 g.
WR-5	20 g.

TABLE NO. 3
Microbial Confirmation Test Data for Acid Production Potential of Samples WR-3, 4, and 5

Date	Sample	Weight of Sample plus Flask (gms)	pH	Additions
01/16/89	WR-3 A	219.15	2.50	None
	B	228.74	2.50	None
	WR-4 A	228.26	2.50	None
	B	228.89	2.50	None
	WR-5 A	222.11	2.50	None
	B	220.18	2.50	None
01/17/89	WR-3 A	218.70	3.75	0.45 g H ₂ O
	B	228.28	3.75	0.46 g H ₂ O
	WR-4 A	227.77	3.65	0.50 g H ₂ O
	B	228.37	3.70	0.52 g H ₂ O
	WR-5 A	221.64	2.70	0.47 g H ₂ O
	B	219.71	2.75	0.47 g H ₂ O
01/18/89	WR-3 A	217.60	3.95	1.55 g H ₂ O
	B	227.66	4.05	1.10 g H ₂ O
	WR-4 A	226.48	4.05	1.78 g H ₂ O
	B	228.20	4.05	1.69 g H ₂ O
	WR-5 A	220.82	2.85	1.29 g H ₂ O
	B	218.84	2.85	1.34 g H ₂ O

TABLE NO. 3 (Cont.)

Date	Sample	Weight of Sample plus Flask (gms)	pH	Additions
01/19/89	WR-3 A	218.05	3.75	1.00 g H ₂ O
	B	228.16	3.80	0.58 g H ₂ O
	WR-4 A	227.55	3.90	0.71 g H ₂ O
	B	228.26	3.85	0.63 g H ₂ O
	WR-5 A	220.93	2.85	1.18 g H ₂ O
	B	218.95	2.85	1.23 g H ₂ O
01/21/89	WR-3 A	217.44	3.65	1.71 g H ₂ O
	B	227.14	3.70	1.60 g H ₂ O
	WR-4 A	225.98	3.65	2.28 g H ₂ O
	B	226.88	3.60	2.01 g H ₂ O
	WR-5 A	219.69	2.60	2.42 g H ₂ O
	B	217.89	2.60	2.29 g H ₂ O
01/23/89	WR-3 A	219.82	3.85	?
	B	227.25	3.85	1.49 g H ₂ O
	WR-4 A	226.75	3.85	1.51 g H ₂ O
	B	227.25	3.80	1.64 g H ₂ O
	WR-5 A	220.66	2.75	1.45 g H ₂ O
	B	219.17	2.75	1.01 g H ₂ O

TABLE NO. 3 (Cont.)

Date	Sample	Weight of Sample plus Flask (gms)	pH	Additions
(Following measurements added 15 g of feed to WR-3A and B and 10 g of feed to WR-4 and 5, A and B.)				
<u>New Weights</u>				
01/23/89	WR-3 A	234.43		
	B	243.74		
	WR-4 A	238.27		
	B	238.90		
	WR-5 A	232.11		
	B	230.17		
01/24/89	WR-3 A	233.78	4.25	0.65 g H ₂ O
	B	242.10	4.25	1.64 g H ₂ O
	WR-4 A	237.58	4.15	0.69 g H ₂ O
	B	238.27	4.05	0.63 g H ₂ O
	WR-5 A	231.46	3.15	0.65 g H ₂ O
	B	229.51	3.15	0.66 g H ₂ O
(Terminated testing WR-3 and WR-4 samples. An additional 10 g of feed was added to WR-5 A and B.)				
<u>New Weights</u>				
01/24/89	WR-5 A	242.02		
	B	240.15		
01/25/89	WR-5 A	241.24	3.70	0.78 g H ₂ O
	B	239.34	3.70	0.81 g H ₂ O
01/27/89	WR-5 A	240.39	3.75	1.63 g H ₂ O
	B	238.64	3.75	1.51 g H ₂ O

METHODS USED IN THE PREPARATION OF TABLE NO. 4

Time-Dependent Buffering Capacity of Powdered Waste Rock
Material When Titrated to pH 3.5

1. For each sample, WR-1 through 5, duplicate 10.0-g subsamples were suspended in 100 mL of DI water and stirred for 15 minutes. The pH recorded at this time is called the "natural pH".
2. Since all of the "natural pHs" recorded are greater than 3.50, the suspension is then titrated to $\text{pH } 3.50 \pm 0.02$ with sulfuric acid while stirring. The volume of acid required for this titration is known as the "acid consumption" of the sample.
3. In order to evaluate any time-dependent acid buffering capacity of the samples, each sample titrated to pH 3.50 was stirred for additional successive periods of time. At the end of a preselected time interval, the pH was measured and additional sulfuric acid was used to retitrate the sample to pH 3.50. The intervals between measuring (and retitrating) were successively greater as the experiment proceeded. The final measurements and titrations were conducted more than 130 hours after the ground rock composite was added to the DI water.
4. The powdered rock composites were "aged" approximately 180 days prior to these analyses.

TABLE NO. 4

Time-Dependent Buffering Capacity of Powdered Waste Rock
Material When Titrated to pH 3.5

Time (Hr)	Sample pH	H ₂ SO ₄ Added		Resultant pH
		Volume (mL)	Normality	
SAMPLE WR-1				
1/4	6.95	2.0	1	3.50
1/4	6.95	2.0	1	3.50
1/2	4.00	0.2	1	3.50
1	4.50	0.4	1	3.50
3-1/2	4.19	0.15	0.1	3.50
3-1/2	4.10	0.1	0.1	3.50
7-1/2	4.21	1.0	0.1	3.50
7-1/2	4.12	1.0	0.1	3.50
23	4.43	1.1	0.1	3.50
23	4.35	1.0	0.1	3.50
48	4.28	0.9	0.1	3.50
48	4.25	0.8	0.1	3.50
62	4.30	1.0	0.1	3.50
62	4.27	0.9	0.1	3.50
84	4.23	0.6	0.1	3.50
84	4.20	0.55	0.1	3.50
134	4.23	0.85	0.1	3.50
134	4.24	0.8	0.1	3.50

TABLE NO. 4 (Cont.)

Time (Hr)	Sample pH	H ₂ SO ₄ Added		Resultant pH
		Volume (mL)	Normality	
SAMPLE WR-2				
1/4	5.40	0.4	1	3.50
1/4	5.40	0.2	1	3.50
1/2	3.80	0.1	1	3.50
1/2	3.80	0.1	1	3.50
2	3.63	0.3	0.1	3.50
2	3.10 (*)	---	---	3.10 (?)
4	3.79	0.4	0.1	3.50
4	3.79	0.35	0.1	3.50
20	4.03	0.7	0.1	3.50
20	4.03	0.55	0.1	3.50
48	3.94	0.5	0.1	3.50
48	3.94	0.5	0.1	3.50
62	4.00	0.65	0.1	3.50
62	4.00	0.6	0.1	3.50
84	3.89	0.4	0.1	3.50
84	3.90	0.4	0.1	3.50
134	3.95	0.55	0.1	3.50
134	4.00	0.5	0.1	3.50

* An excess of acid was unintentionally added to the sample, thus lowering the pH to 3.10. The amount of acid added was not recorded.

TABLE NO. 4 (Cont.)

Time (Hr)	Sample pH	H ₂ SO ₄ Added		Resultant pH
		Volume (mL)	Normality	
SAMPLE WR-3				
1/4	5.10	0.45	1	3.50
1/4	5.20	0.45	1	3.50
1/3	3.99	1.5	0.1	3.50
1/3	4.08	1.3	0.1	3.50
1	4.00	1.3	0.1	3.50
1	3.80	1.0	0.1	3.50
4	4.20	1.5	0.1	3.50
4	4.20	1.5	0.1	3.50
20	4.40	1.5	0.1	3.50
20	4.40	1.5	0.1	3.50
45	4.35	1.2	0.1	3.50
45	4.33	1.15	0.1	3.50
62	4.35	1.25	0.1	3.50
62	4.35	1.3	0.1	3.50
84	4.21	0.9	0.1	3.50
84	4.25	0.9	0.1	3.50
134	4.28	1.2	0.1	3.50
134	4.33	1.2	0.1	3.50

TABLE NO. 4 (Cont.)

Time (Hr)	Sample pH	H ₂ SO ₄ Added		Resultant pH
		Volume (mL)	Normality	
SAMPLE WR-4				
1/4	4.95	2.6	0.1	3.50
1/4	4.96	2.6	0.1	3.50
1/2	4.16	0.65	0.1	3.50
1/2	4.23	1.0	0.1	3.50
2	4.16	0.8	0.1	3.50
2	4.15	0.8	0.1	3.50
18	4.40	1.0	0.1	3.50
18	4.40	1.45	0.1	3.50
42	4.25	0.55	0.1	3.50
42	4.23	0.6	0.1	3.50
59	4.27	1.15	0.1	3.50
59	4.25	1.1	0.1	3.50
82	4.16	0.5	0.1	3.50
82	4.16	0.5	0.1	3.50
131	4.30	1.05	0.1	3.50
131	4.27	1.05	0.1	3.50

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TABLE NO. 4 (Cont.)

Time (Hr)	Sample pH	H ₂ SO ₄ Added		Resultant pH
		Volume (mL)	Normality	
SAMPLE WR-5				
1/4	4.40	0.6	0.1	3.50
1/4	4.40	0.6	0.1	3.50
3/4	3.62	0.2	0.1	3.50
3/4	3.62	0.2	0.1	3.50
2-1/2	3.64	0.5	0.1	3.18
2-1/2	3.64	0.25	0.1	3.50
19	4.00	0.4	0.1	3.50
19	4.19	0.4	0.1	3.50
46	3.90	0.3	0.1	3.50
46	3.95	0.25	0.1	3.50
61	3.95	0.5	0.1	3.50
61	4.00	0.35	0.1	3.50
84	3.73	0.15	0.1	3.50
84	3.87	0.20	0.1	3.50
133	3.91	0.25	0.1	3.50
133	4.00	0.35	0.1	3.50

3.5-P-15

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METHODS USED IN THE PREPARATION OF TABLE NO. 5

Changes in "Natural" pH Versus Time for Waste Rock Samples Equilibrated in DI Water

1. Samples of waste rock were equilibrated in DI water (10:1, liquid:solid) within 1-3 hours, 3-10 days and approximately 300 days following the grinding of the rocks. At selected time intervals suspension pHs were recorded. The mean pH (\bar{x} pH) and number of replicate samples (n) for the times of measurement of different "ages" of ground material are presented in this Appendix.
2. The 1-3 hour and 300-day "aged" material pH measurements had 20.0 g suspended in 200-mL DI water. The 3-10 day "aged" material pH measurements had 10.0 g suspended in 100-mL DI water.
3. The pH meter was calibrated using standard buffers of pH 4.1, 7.0, and 10.0 prior to the measurements.

TABLE NO. 5
Changes in "Natural" pH Versus Time for Waste Rock Samples Equilibrated in DI Water

(Hr)	WR-1		WR-1A		WR-2		WR-3		WR-4	
	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)
1/4	7.96 (1)	6.95 (2)	8.03 (2)	8.06 (2)	6.83 (1)	5.40 (2)	5.83 (2)	5.14 (4)	5.43 (2)	4.96 (2)
1/2	7.93 (1)				7.67 (1)		5.87 (2)	5.45 (1)	5.38 (2)	4.96 (1)
1	8.08 (1)	7.98 (2)	7.94 (1)		7.66 (2)	6.67 (1)	5.92 (2)	5.86 (2)	5.40 (2)	
2	8.02 (1)				7.68 (1)	6.94 (1)	5.86 (2)			
4					7.68 (1)	7.14 (1)				
8					7.30 (1)	7.18 (1)	5.81 (2)		5.37 (2)	
16	8.08 (1)									

(Hr)	WR-5		LW-1	
	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)	\bar{x} pH (n)
1/4	4.53 (1)	4.40 (2)	4.51 (1)	4.25 (1)
1/2	4.47 (1)	4.28 (1)	4.58 (1)	4.16 (1)
1	4.40 (1)	4.28 (1)	4.59 (3)	4.05 (1)
2	4.46 (1)	4.28 (1)	4.57 (1)	3.55 (1)
4				3.74 (1)
8				3.74 (1)
16	4.51 (1)		4.09 (1)	

METHODS USED IN THE PREPARATION OF TABLE NO. 6

Stepwise Base Titration of Waste Rock Samples Following 1-Hour Equilibration in DI Water

1. 20.0 g waste rock powder was equilibrated in 200 mL DI water for one hour prior to the titrations.
2. Titrant A contained 1.8146 g Ca(OH)₂/L and titrant B contained 1.8082 g Ca(OH)₂/L.
3. The pH meter was calibrated using standard buffers of pH 4.1, 7.0, and 10.0 prior to each titration.
4. Determinations were made using waste rock material which had aged approximately 300 days.

3.5-P-18

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TABLE NO. 6

Stepwise Base Titration of Waste Rock Samples Following 1-Hour Equilibration in DI Water

Volume Titrant Added	Total Volume Titrant Added (mL)	pH	Volume Titrant Added	Total Volume Titrant Added (mL)	pH
Titration A, WR-1					
0.0	0.0	8.03	0.0	0.0	7.94
Titration A, WR-2					
0.0	0.0	5.90	0.0	0.0	5.93
1.0	1.0	6.50	1.0	1.0	6.35
1.0	2.0	7.20	1.0	2.0	6.81
1.0	3.0	7.99	1.0	3.0	7.29
1.0	4.0	8.32	1.0	4.0	7.87
Titration A, WR-3					
0.0	0.0	5.70	0.0	0.0	5.77
1.0	1.0	6.08	1.0	1.0	6.11
1.0	2.0	6.41	1.0	2.0	6.43
1.0	3.0	6.89	1.0	3.0	6.78
1.0	4.0	7.36	1.0	4.0	7.17
1.0	5.0	7.95	1.0	5.0	7.68
1.0	6.0	8.29	1.0	6.0	8.26
1.0	7.0	8.69	1.0	7.0	8.69
1.0	8.0	9.05	1.0	8.0	9.06
Titration B, WR-1					
Titration B, WR-2					
Titration B, WR-3					

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TABLE NO. 6 (Cont.)

Volume Titrant Added	Total Volume Titrant Added (mL)	pH	Volume Titrant Added	Total Volume Titrant Added (mL)	pH
Titration A, WR-4					
0.0	0.0	5.23	0.0	0.0	5.22
1.0	1.0	5.59	1.0	1.0	5.54
1.0	2.0	5.81	1.0	2.0	5.74
1.0	3.0	6.00	1.0	3.0	5.93
1.0	4.0	6.21	1.0	4.0	6.11
1.0	5.0	6.46	1.0	5.0	6.33
1.0	6.0	6.82	1.0	6.0	6.63
1.0	7.0	7.25	1.0	7.0	7.10
1.0	8.0	7.69	1.0	8.0	7.70
1.0	9.0	8.21	1.0	9.0	8.47
1.0	10.0	8.64	1.0	10.0	9.04
1.0	11.0	8.97			
1.0	12.0	9.40			
Titration B, WR-4					
0.0	0.0		0.0	0.0	
1.0	1.0		1.0	1.0	
1.0	2.0		1.0	2.0	
1.0	3.0		1.0	3.0	
1.0	4.0		1.0	4.0	
1.0	5.0		1.0	5.0	
1.0	6.0		1.0	6.0	
1.0	7.0		1.0	7.0	
1.0	8.0		1.0	8.0	
1.0	9.0		1.0	9.0	
1.0	10.0		1.0	10.0	
Titration A, WR-5					
0.0	0.0	4.58	0.0	0.0	4.64
1.0	1.0	5.06	1.0	1.0	5.05
1.0	2.0	5.28	1.0	2.0	5.24
1.0	3.0	5.45	1.0	3.0	5.48
1.0	4.0	5.58	1.0	4.0	5.58
1.0	5.0	5.70	1.0	5.0	5.69
1.0	6.0	5.84	1.0	6.0	5.80
1.0	7.0	5.94	1.0	7.0	5.94
1.0	8.0	6.16	1.0	8.0	6.05
1.0	9.0	6.40	1.0	9.0	6.26
1.0	10.0	6.64	1.0	10.0	6.45
1.0	11.0	7.05	1.0	11.0	6.68
1.0	12.0	7.84	1.0	12.0	7.17
1.0	13.0	8.78	1.0	13.0	8.15
			1.0	14.0	9.22
Titration B, WR-5					
0.0	0.0		0.0	0.0	
1.0	1.0		1.0	1.0	
1.0	2.0		1.0	2.0	
1.0	3.0		1.0	3.0	
1.0	4.0		1.0	4.0	
1.0	5.0		1.0	5.0	
1.0	6.0		1.0	6.0	
1.0	7.0		1.0	7.0	
1.0	8.0		1.0	8.0	
1.0	9.0		1.0	9.0	
1.0	10.0		1.0	10.0	
1.0	11.0		1.0	11.0	
1.0	12.0		1.0	12.0	
1.0	13.0		1.0	13.0	
			1.0	14.0	

3.5-P-20

KEIR

TABLE NO. 6 (Cont.)

Volume Titrant Added	Total Volume Titrant Added (mL)	pH	Volume Titrant Added	Total Volume Titrant Added (mL)	pH
Titration A, WW-1					
0.0	0.0	3.68	0.0	0.0	3.73
2.0	2.0	4.27	2.0	2.0	4.30
2.0	4.0	4.48	2.0	4.0	4.50
2.0	6.0	4.58	2.0	6.0	4.58
2.0	8.0	4.66	2.0	8.0	4.65
2.0	10.0	4.77	2.0	10.0	4.75
2.0	12.0	4.86	2.0	12.0	4.83
2.0	14.0	4.95	2.0	14.0	4.97
2.0	16.0	5.00	2.0	16.0	5.05
2.0	18.0	5.05	2.0	18.0	5.08
2.0	20.0	5.11	2.0	20.0	5.15
2.0	22.0	5.19	2.0	22.0	5.14
2.0	24.0	5.19	2.0	24.0	5.22
2.0	26.0	5.24	2.0	26.0	5.30
2.0	28.0	5.28	2.0	28.0	5.40
2.0	30.0	5.34	2.0	30.0	5.45
2.0	32.0	5.43	2.0	32.0	5.50
2.0	34.0	5.51	2.0	34.0	5.55
2.0	36.0	5.62	2.0	36.0	5.55
2.0	38.0	5.68	2.0	38.0	5.54
2.0	40.0	5.81	2.0	40.0	5.61
2.0	42.0	5.86	2.0	42.0	5.69
2.0	44.0	6.14	2.0	44.0	5.77
2.0	46.0	6.22	2.0	46.0	5.90
2.0	48.0	6.54	2.0	48.0	6.09
2.0	50.0	6.87	2.0	50.0	6.31
2.0	52.0	7.20	2.0	52.0	6.57
Titration B, WW-1					
0.0	0.0		0.0	0.0	
2.0	2.0		2.0	2.0	
2.0	4.0		2.0	4.0	
2.0	6.0		2.0	6.0	
2.0	8.0		2.0	8.0	
2.0	10.0		2.0	10.0	
2.0	12.0		2.0	12.0	
2.0	14.0		2.0	14.0	
2.0	16.0		2.0	16.0	
2.0	18.0		2.0	18.0	
2.0	20.0		2.0	20.0	
2.0	22.0		2.0	22.0	
2.0	24.0		2.0	24.0	
2.0	26.0		2.0	26.0	
2.0	28.0		2.0	28.0	
2.0	30.0		2.0	30.0	
2.0	32.0		2.0	32.0	
2.0	34.0		2.0	34.0	
2.0	36.0		2.0	36.0	
2.0	38.0		2.0	38.0	
2.0	40.0		2.0	40.0	
2.0	42.0		2.0	42.0	
2.0	44.0		2.0	44.0	
2.0	46.0		2.0	46.0	
2.0	48.0		2.0	48.0	
2.0	50.0		2.0	50.0	
2.0	52.0		2.0	52.0	

3.5-P-21

KEIR

TABLE NO. 6 (Cont.)

Volume Titrant Added	Total Volume Titrant Added (mL)	pH	Volume Titrant Added	Total Volume Titrant Added (mL)	pH
2.0	54.0	7.40	2.0	54.0	6.83
2.0	56.0	7.59	2.0	56.0	7.05
2.0	58.0	7.80	2.0	58.0	7.24
2.0	60.0	8.32	2.0	60.0	7.43
2.0	62.0	9.01	2.0	62.0	7.70
2.0	64.0	9.65	2.0	64.0	8.29
			2.0	66.0	9.05

Chemical Analyses of the Acid-Neutralized Waste Rock Samples

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client KENNECOTT
Address

Sampled By
P.O. #
Job #
Report to:
Invoice # 1460
Result Sheet No. 39180.01

Name of Rep.
Telephone No. (000) 000-0000

Sample I.D. KEN WR-3A KEN WR-4A KEN WR-5A KEN WR-3B KEN WR-4B

Date Collected 01/17/89 01/17/89 01/17/89 01/17/89 01/17/89
Date Received 01/18/89 01/18/89 01/18/89 01/18/89 01/18/89

Parameters, units ----- Results -----

Iron, ug/l 160,000 85,000 31,000 160,000 97,000

Comments:

Signed: David Turiff Date: January 31, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client KENNECOTT
Address

Name of Rep.
Telephone No. (000) 000-0000

Sample I.D. KEN WR-5B

Date Collected 01/17/89
Date Received 01/18/89

Parameters, units ----- Results -----

Iron, ug/l 38,000

Comments:

Signed: David Turiff Date: January 31, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client KENNECOTT
Address
Name of Rep.
Telephone No. (000) 000-0000

Sampled By
P.O. #
Job #
Report to:
Invoice # 1461
Result Sheet No. 39181.01

Sample I.D.	KEN WR-3A	KEN WR-4A	KEN WR-5A	KEN WR-3B	KEN WR-4B
Date Collected	01/18/89	01/18/89	01/18/89	01/18/89	01/18/89
Date Received	01/20/89	01/20/89	01/20/89	01/20/89	01/20/89
Parameters, units	----- Results -----				
Iron, ug/l	130,000	66,000	24,000	130,000	81,000

Comments:

Signed: David Turiff Date: January 31, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client KENNECOTT
Address
Name of Rep.
Telephone No. (000) 000-0000

Sampled By
P.O. #
Job #
Report to:
Invoice # 1461
Result Sheet No. 39181.02

Sample I.D.	KEN WR-5B
Date Collected	01/18/89
Date Received	01/20/89
Parameters, units	----- Results -----
Iron, ug/l	29,000

Comments:

Signed: David Turiff Date: January 31, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client Address KENNECOTT

Name of Rep. Telephone No. (000) 000-0000

Sampled By
P.O. #
Job #
Report to:
Invoice # 1462
Result Sheet No. 39182.01

Sample I.D. KEN WR-3A KEN WR-4A KEN WR-5A KEN WR-3B KEN WR-4B

Date Collected 01/19/89 01/19/89 01/19/89 01/19/89 01/19/89
Date Received 01/20/89 01/20/89 01/20/89 01/20/89 01/20/89

Parameters, units ----- Results -----

Iron, ug/l 140,000 75,000 26,000 130,000 76,000

Comments:

Signed: David Turiff Date: January 31, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client Address KENNECOTT

Name of Rep. Telephone No. (000) 000-0000

Sample I.D. KEN WR-5B

Date Collected 01/19/89
Date Received 01/20/89

Parameters, units ----- Results -----

Iron, ug/l 28,000

Comments:

Signed: David Turiff Date: January 31, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client Kennecott
Address
Name of Rep.
Telephone No. (000) 000-0000

Sampled By J. Thresher
P.O. #
Job # 87K10-02
Report to: B. Burton
Invoice # 1482
Result Sheet No. 39163.01

Sample I.D.	WR-1	WR-2	WR-3	WR-4	WR-5
Date Collected	Untreated 01/24/89	Untreated 01/24/89	Untreated 01/24/89	Untreated 01/24/89	Untreated 01/24/89
Date Received	01/25/89	01/25/89	01/25/89	01/25/89	01/25/89

Parameters, units	Results				
Sulfate, mg/l	60	86	170	180	180
Copper, ug/l	22	1700	6300	24,000	59,000
Iron, ug/l	2400	1200	190	450	11,000
Manganese, ug/l	< 11	250	370	420	510

Comments:

Signed: David Turriff Date: February 3, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client Kennecott
Address
Name of Rep.
Telephone No. (000) 000-0000

Sampled By J. Thresher
P.O. #
Job # 87K10-02
Report to: B. Burton
Invoice # 1482
Result Sheet No. 39163.02

Sample I.D.	WW-1	WR-4	WR-5	WW-1	WR-4
Date Collected	Untreated 01/24/89	pH 6 01/24/89	pH 6 01/24/89	pH 6 01/24/89	pH 7 01/24/89
Date Received	01/25/89	01/25/89	01/25/89	01/25/89	01/25/89

Parameters, units	Results				
Sulfate, mg/l	810	200	190	730	190
Copper, ug/l	180,000	7100	28,000	190,000	1200
Iron, ug/l	130,000	120	530	1500	400
Manganese, ug/l	570	370	470	360	330

Comments:

Signed: David Turriff Date: February 3, 1989

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
Telephone: (414) 498-2222

LABORATORY ANALYSIS RESULTS
W.D.N.R. LAB CERT. NO. 405099530

Client Kennecott
Address
Name of Rep.
Telephone No. (000) 000-0000

Sampled By J. Thresher
P.O. #
Job # 87K10-02
Report to: B. Burton
Invoice # 1482
Result Sheet No. 39163.03

Sample I.D.	WR-5	WW-1
	pH 7	pH 7
Date Collected	01/24/89	01/24/89
Date Received	01/25/89	01/25/89

Parameters, units ----- Results -----

Sulfate, mg/l	380	750
Copper, ug/l	4800	1400
Iron, ug/l	570	1200
Manganese, ug/l	390	300

Comments:

Signed: David Turiff Date: February 3, 1989

APPENDIX 3.5-Q

Complete Wet/Dry Leaching Test Analyses,
Notes, and Methods
Flambeau Project, Ladysmith, WI