

APPENDIX 3.5-R

Methods and Data for Miscellaneous Chemical
and Mineralogical Studies
Flambeau Project, Ladysmith, WI

Generation of Artificial Stormwater Runoff from Till
and Saprolite Materials

1. Artificial stormwater runoff was generated from composited till samples and from the saprolite composite.
2. Till Stormwater Runoff
 - a. A total of 24,192.4 grams of moist till samples (7,080.0 grams of the East till composite, 9,510.3 grams of the West till composite, and 7,602.1 grams of the Central till composite) were composited, divided in two and placed in 5-gallon leaching tanks.
 - b. Each composite was leached with 6-1/2 liters of DI water for eight hours for three consecutive leachings.
 - c. The generated leachates were composited and part of the leachate was equilibrated with soil sediment samples for the leachate sorption studies. The bulk of the leachate was used in the polymer testing for the stormwater runoff collection basins.
3. Saprolite Stormwater Runoff
 - a. A total of 7,254.4 grams of moist saprolite composite was placed in a 5-gallon leaching tank.
 - b. The sample was leached within 4-1/2 liters of DI water for eight hours for three consecutive leachings.
 - c. The generated leachates were composited and used in the polymer testing for the stormwater runoff collection basins.

Overburden and Topsoil Equilibration Results

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

Sampled By J. Thresher
 P.O. #
 Job # 87K10
 Report to: B. Burton
 Invoice # 1413
 Result Sheet No. 39046.01

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

Sample I.D.	Topsoil S.	Topsoil S.	Topsoil S.	Topsoil S.	Topsoil S.
100	50	25	10	0	
Date Collected	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88
Date Received	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88

Parameters, units	Results				
Fe, ug/l	9500	8600	3800	3700	2700
Cr, ug/l	< 30	< 30	< 30	< 30	< 30
Cu, ug/l	31	20	< 10	< 10	< 10

Comments:

Signed: David Turiff Date: January 24, 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: [blank]
Sampled By: J. Thresher
P.O. #: [blank]
Job #: 87K10
Report to: B. Burton
Invoice #: 1413
Telephone No.: (000) 000-0000
Result Sheet No.: 39046.02

Sample I.D.	Sandstone Sorpt. 100	Sandstone Sorpt. 50	Sandstone Sorpt. 25	Sandstone Sorpt. 10	Sandstone Sorpt. 0
Date Collected	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88
Date Received	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88

Parameters, units	Results				
Fe, ug/l	18,000	11,000	7100	9600	9900
Cr, ug/l	46	< 30	< 30	< 30	< 30
Cu, ug/l	430	250	190	250	250

Comments:

Signed: David Turiff Date: January 24, 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: [blank]
Sampled By: J. Thresher
P.O. #: [blank]
Job #: 87K10
Report to: B. Burton
Invoice #: 1413
Telephone No.: (000) 000-0000
Result Sheet No.: 39046.03

Sample I.D.	Till Sorpt. 100	Till Sorpt. 50	Till Sorpt. 25	Till Sorpt. 10	Till Sorpt. 0
Date Collected	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88
Date Received	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88

Parameters, units	Results				
Fe, ug/l	3900	2400	2300	1700	1400
Cr, ug/l	< 30	< 30	< 30	< 30	< 30
Cu, ug/l	23	19	18	12	10

Comments:

Signed: David Turiff Date: January 24, 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
Report to: B. Burton
Invoice # 1413
Result Sheet No. 39046.04

Sample I.D.	Saprolite Sorpt. 100	Saprolite Sorpt. 50	Saprolite Sorpt. 25	Saprolite Sorpt. 10	Saprolite Sorpt. 0
Date Collected	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88
Date Received	12/28/88	12/28/88	12/28/88	12/28/88	12/28/88

Parameters, units	Results				
Fe, ug/l	12,000	9600	9100	6700	9100
Cr, ug/l	< 30	< 30	< 30	< 30	< 30
Cu, ug/l	35	25	17	24	47

Comments:

Signed: David Turiff Date: January 24, 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
Report to: B. Burton
Invoice # 1413
Result Sheet No. 39046.05

Sample I.D.	Till Leachate
Date Collected	12/28/88
Date Received	12/28/88

Parameters, units	Results
Fe, ug/l	9400
Cr, ug/l	< 30
Cu, ug/l	50

Comments:

Signed: David Turiff Date: January 24, 1989

FOTH AND VAN DYKE
 Engineers/Architects
 2737 S. Ridge Road
 P.O. Box 19012
 Green Bay, Wisc. 54307-9012

LABORATORY ANALYSIS RESULTS
 W.D.N.R. LAB CERT. NO. 405051240

Results of the EP Toxicity Analyses for
 Waste Rock Samples WR-1 Through WR-5

Client Kennecott
 Address
 Name of Rep.
 Telephone No. (000) 000-0000
 Sampled By
 Scope I.D. 87K10
 Billing Line No.
 Liaison D. Turriff
 Supply Order No.
 Result Sheet No. 38618.00

Sample I.D.	WR 1 D1 E.P.Tox.	WR 2 D1 E.P. Tox.	WR 3 D1 E.P. Tox.	WR 4 D1 E.P. Tox.	WR 5 D1 E.P. Tox..
Date Collected	9/22/88	9/22/88	9/22/88	9/22/88	9/22/88
Date Received	9/27/88	9/27/88	9/27/88	9/27/88	9/27/88

Parameters, units	Results				
Pb, ug/l	< 2	< 2	4	< 2	< 2
Ag, ug/l	< 50	< 50	< 50	< 50	< 50
Hg, ug/l	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Se, ug/l	< 30	< 30	< 30	< 30	< 30
As, ug/l	< 3	< 3	< 3	< 3	< 3
Ba, ug/l	< 80	< 80	< 80	< 80	< 80
Cd, ug/l	< 10	< 10	< 10	< 10	< 10
Cr, ug/l	< 30	< 30	< 30	< 30	< 30

Comments:

Signed: David Turriff Date: October 28, 1988

Radiochemical Analyses of Selected Ore Samples
(Mill Bench Test Samples) Composites

Originally Submitted as NOI Data File KEN-55

Kennecott Minerals Company
A Division of Kennecott Corporation
Engineering Center
1515 Mineral Square
P.O. Box 11248
Salt Lake City, Utah 84147
801 534-8111

Kennecot

September 5, 1980

To: Dick Olson
Jim Wimmer

From: R. E. Buckley

Subject: Radioactivity of Flambeau Material

In 1978 all of the Flambeau deposit drill core were checked with a Model 111B scintillator for radiation. All readings were within the background count of 0.005 to 0.015 MR/HR.

It was decided that as a result of the intense interest in radioactive wastes in Wisconsin, that mill bench test samples should be checked for Gross Alpha, Gross Beta and Radium-226. The five samples selected are a composite of 14 drill holes which provide an excellent reproduction representation of the ore body.

The analysis shows that the material from the FMC deposit falls well below EPA standards. See attached laboratory report.

Federal Register 45FR27367 dated 4/22/80 under 40 CFR192 Environmental Protection Standards for Uranium Mill Tailings establishes radioactive waste as any solid waste containing an average of radium-226 concentration of five or more picocuries per gram. FMC highest reading was 0.64 ± 0.19 pci/g.

The drinking water standard applying to Gross Alpha and Beta is well above the FMC reading.

The proposed Wisconsin standards would have no effect on FMC.

R. E. Buckley
R. E. Buckley

REB/se
Attachment
cc: C. D. Broadbent
Gordon Reinke
G. D. Schurtz

BEST COPY AVAILABLE



REPORT OF ANALYSIS

BEST COPY AVAILABLE

CUSTOMER KENNECOTT RESEARCH CENTER
 ATTENTION Lynn A. Hutchinson
 ADDRESS 1515 Mineral Square
 CITY Salt Lake City, Utah 84147
 S.O. NO. 5200

DETERMINATION OF GROSS ALPHA,
 TYPE OF ANALYSIS GROSS BETA and RADIUM-226 in
 SOIL SAMPLES

DCK 55762X4
 CUSTOMER ORDER NUMBER
 SAMPLES RECEIVED 6/31/80

Sample Identification	Total Weight (g)	pCi/g(dry)		
		Alpha	Beta	Ra-226
Flambeau DDH Comp. Sample #13	104.5	<10	3.4 ± 1.3	0.30 ± 0.10
Flambeau DDH Comp. Sample #14	106.5	<10	12 ± 2	<0.10
Flambeau DDH Comp. Sample #16	105.0	<10	<2.0	0.64 ± 0.19
Flambeau DDH Comp. Sample #17	108.5	<10	11 ± 2	0.30 ± 0.10
Flambeau DDH Comp. Sample #18	107.0	<10 <i>40/s</i>	6.3 ± 1.4	0.47 ± 0.14 <i>95/s</i>

BEST COPY AVAILABLE

REPORTED VIA TELEPHONE
 REPORTED VIA TWX

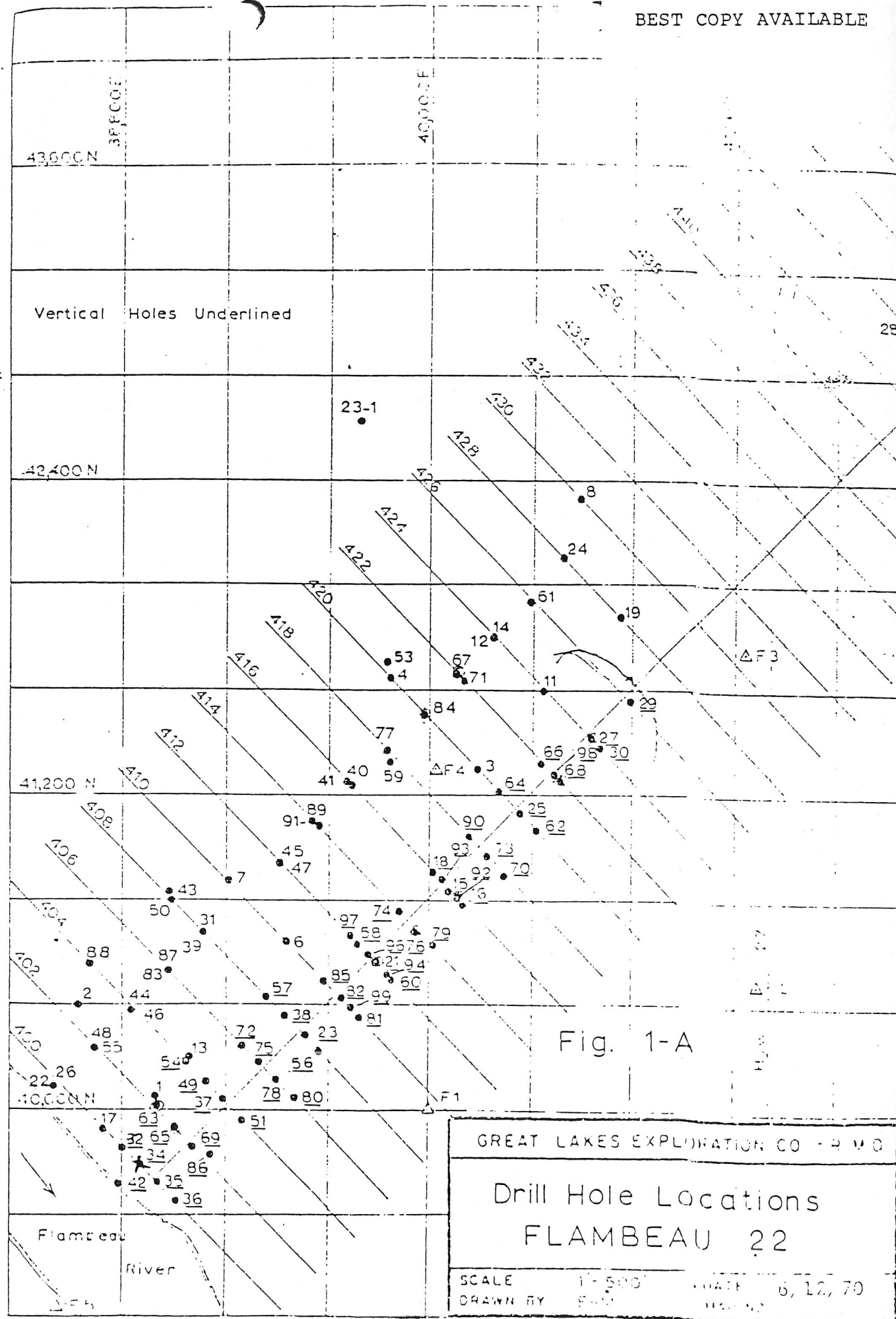
eberline

APPROVED BY *Michael A. Ortiz*
 MICHAEL A. ORTIZ, Manager

DATE 8/25/80

TABLE II
 IDENTIFICATION AND ANALYSES OF METALLURGICAL TEST SAMPLES

Sample	Hole Number	Sample Numbers Inclusive	Assay, Percent or Ounces Per Ton							
			Cu(T)	Cu(NS)	Fe	Pb	Zn	S		
13	22-32	N282 - N290								
	22-63	N1199 - N1201								
	22-65	N1250 - N1262	0.91	0.088	7.82	0.026	0.022	7.56		
14	22-84	02062 - 02068								
	22-67	N1526 - N1537	2.83	.016	14.6	.075	.40	15.1		
15	22-41	N674 - N679	2.24	.004	11.8	.11	.46	12.8		
16	22-68	N1450 - N1455								
	22-98	02493 - 02498								
	22-98	N2008 - N2012								
	22-27	N120 - N127	1.99	.112	24.5	.18	.34	27.6		
17	22-76	N1792 - N1795								
	22-21	N014 - N017								
	22-92	02239 - 02247	2.86	.068	22.0	.060	.39	24.6		
18	22-34	N297 - N312								
	22-34	N320 - N327	5.62	.41	19.6	.020	.017	23.1		



Analytical Data on Black Material in the Sandstone
Originally Submitted as NOI Data File KEN-47



Kennecott Exploration, Inc.

Exploration Services Department

Geochemical
Research
and
Laboratory
Division

June 14, 1974

Mr. K. Markart
Box 194
Ladysmith, Wisconsin 54848

Dear Mr. Markart:

In response to your request for identification of a black cementing mineral in DDH 22-130 at 39' and DDH 22-131 at 38.5', we made a heavy liquid concentrate of the black mineral in DDH 22-130 at 39' and obtained a powder diffraction pattern and optical emission spectrum of the concentrate.

The diffraction pattern shows some broad peaks which could not be indexed. The emission spectrum shows 10-30% Mn, 5-15% Cu, and above average amounts at V, Ti, Cu, Bi, Fe, Cr, Ag, and rare earth elements, especially Y.

We will retain the samples.

Very truly yours,

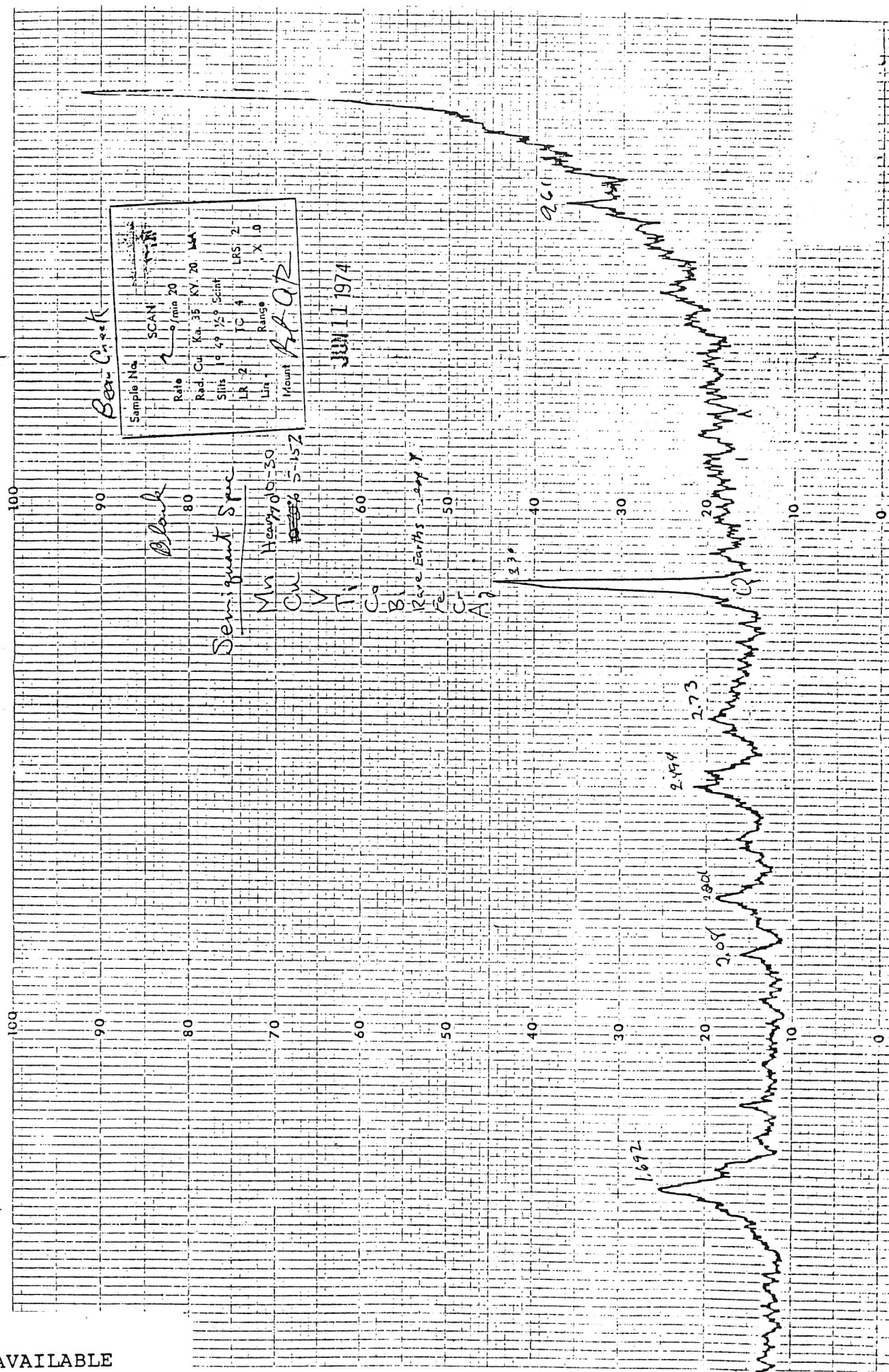
Steve Cone

SC/db
Attachment

cc: L. A. Clark

BEST COPY AVAILABLE

JUN 17 1974



BEST COPY AVAILABLE

3.5-R-17

ATTN: Mr. Steven Cone

REQUEST TO GEOLOGIC RESEARCH
FOR
MINERALOGICAL-PETROGRAPHIC W

BEST COPY AVAILABLE

1. District/Project Ladysmith, Wisconsin Date: 6-4-74
Area Code Name: FLORISSAU Development Code Number: 003-00-0855
State: WISCONSIN County: Rusk
Budget Undertaking (if not Code Name): 003-00-0855

2. Nature of Investigation (porphyry copper, massive sulfide, etc.):
Cambrian sandstone directly above gossan of massive sulfide

Brief Geologic Setting:

SANDSTONE lies unconformably above sulfide ore. It becomes more iron stained & gritty w/ depth. Also black unidentifiable mineral appears near base. Identification of rock samples (field numbers, core intervals; copies of maps and logs):

Vertical DDH 22-130 - 39' +
22-131 - 38.5'

3. Request for (specify-- mineral identification, petrographic examination, alteration, etc):

Mineral Identification: black material that coats cements quartz sandstone as spots in sample 22-1 or lens in 22-130.

4. Samples sent by: K. Markhart On: June 4, 1974

from (address): Bear Creek Mining Comp.
Box 194
Ladysmith, Wisconsin 54848

Report sent to (same as above X):

Date needed (as convenient X): June 4, 1974

5. Justification: Determine whether

Copy to District/Project Manager

By: [Signature]
(Signature)

X-Ray Diffraction Data on the Saprolite Mineralogy
Originally Submitted as Part of NOI Data File KEN-51



Kennecott Exploration, Inc.

Exploration Services Department

Geochemical
Research
and
Laboratory
Division

October 30, 1975
10/31/75

Mr. E. R. May
Flambeau Mining Company
Box 194
Ladysmith, Wisconsin 54848

Dear Ed:

This is to confirm mineralogy of your clay sample from mine section 10N 410 at 370 feet North and a depth of 40 feet. X-ray diffraction of the whole sample shows very strong chlorite and strong quartz with no other minerals. X-ray of the clay-size fraction shows very strong chlorite and a medium-to-weak mica pattern. The amount is insufficient to distinguish biotite from muscovite, but judging from the mineralogy of the Flambeau rocks it probably would be biotite. The X-ray diffraction pattern for vermiculite is rather similar in spacing to the chlorite pattern, but the relative peak intensities are very different. A small amount of vermiculite may be masked by the chlorite peaks, but the main contribution to the X-ray pattern must be chlorite because of the relative peak intensities which we observe. Our preparation of a clay slide indicates that much of the chlorite occurs in particles of less than 2 microns grain size which is the definition of clay-sized particles. However, the X-ray shows that there are no clay minerals other than those cited above.

Very sincerely,

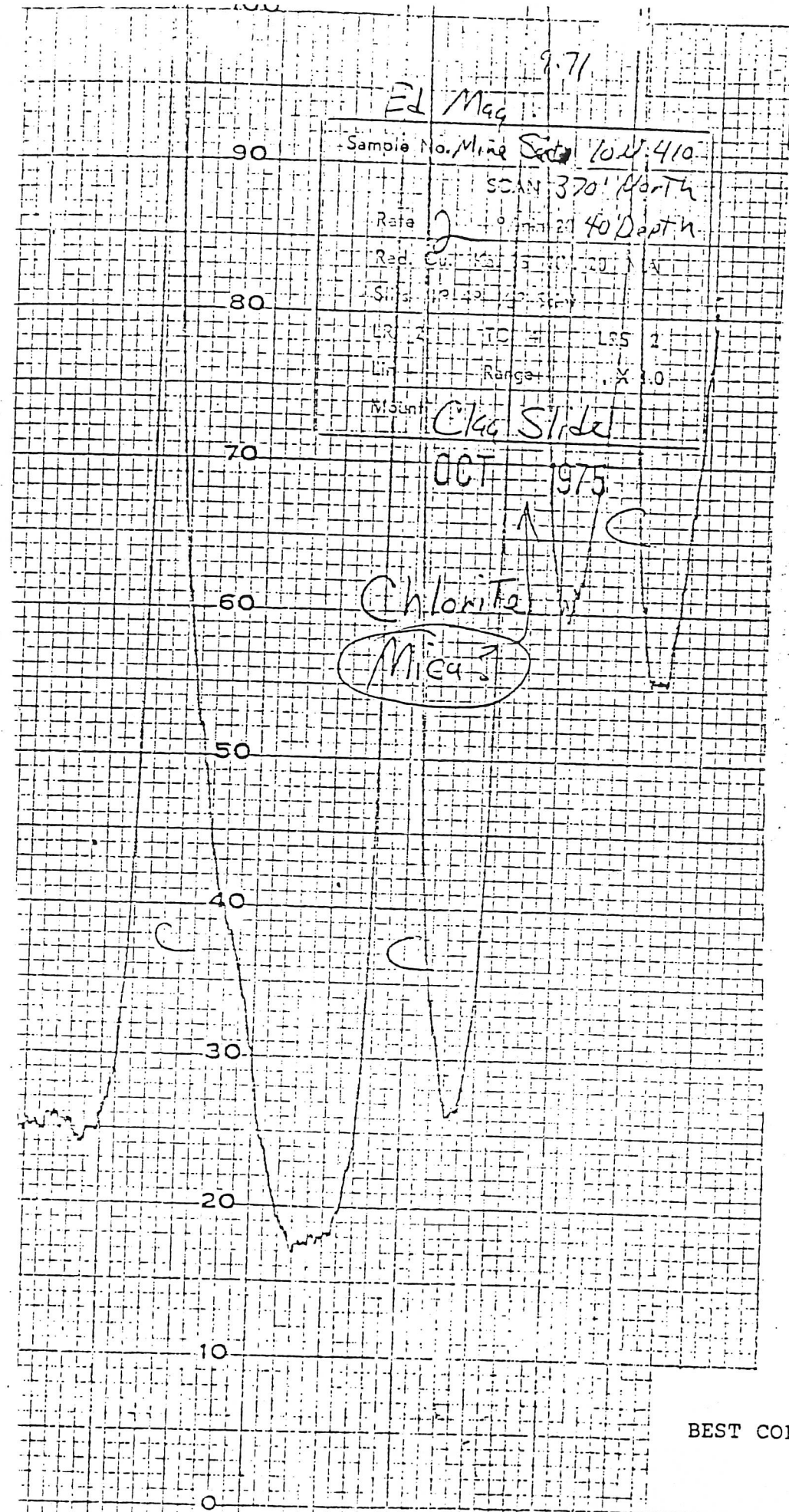
Lloyd A. Clark

LAC/db
Enclosures

BEST COPY AVAILABLE

3.5-R-20

*c.c. Philip Helms
w/enc
9-23-76*



BEST COPY AVAILABLE

3.5-R-21

20 10 4

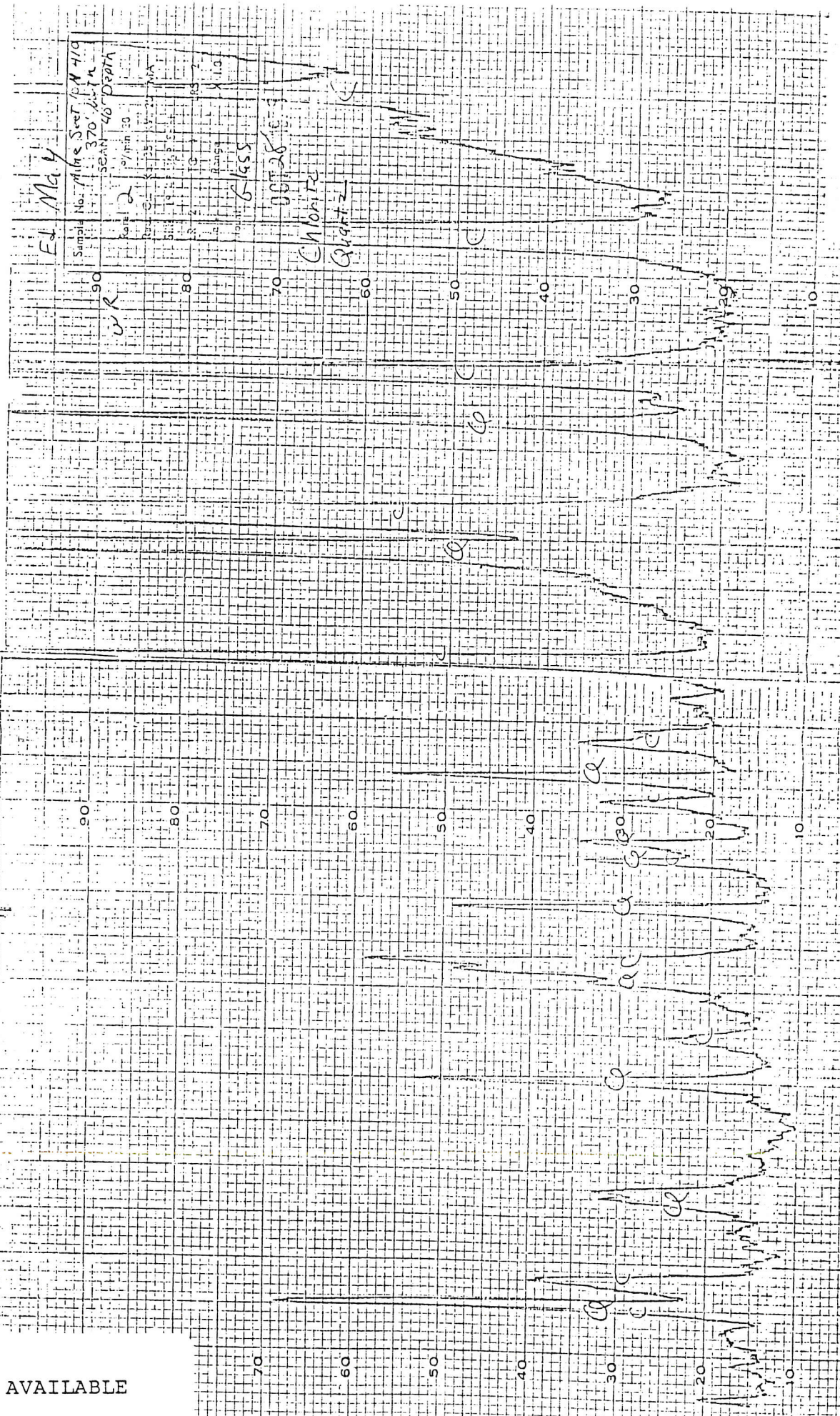


TABLE NO. 3.5-R-1

Calculation of Quantities of Metals Leached
from the Semi-Massive Waste Rock Sample, WW-1

Parameter	Concentration (ug/l)	Quantity (ug/g of Rock Sample)
As	100	0.036
Cu	94,000	34.2
Hg	0.73	2.7×10^{-4}
Se	6	2.2×10^{-3}
Ag	17	6.2×10^{-3}
Cd	94	0.034
Pb	280	0.10
Ni	82	0.030
Zn	24,000	8.74
Cr	14	5.1×10^{-3}

1. Concentration data from Kennecott PER, (Table No. 2-A3, Attachment B) Bench Test Study Report, March 1989.
2. Volume of leachate = 15 L and quantity of WW-1 composite = 41,264.5 gms (data from Kennecott EIR, Section 3.5.6, Waste Characterization).
3. Quantity (ug/g) = Concentration (ug/l) x 15 L divided by 41,264.5 gms.
4. Data was generated from one leaching cycle and represents one point in time.

TABLE NO. 3.5-R-2

Calculation of Quantities of Metals
in the Wastewater Treatment Facility
Lime Sludge

Parameter	Concentration (ug/l)	Quantity (ug/g)
As	950	159
Cu	980,000	163,000
Hg	8.9	1.5
Se	<30	<5
Ag	220	37
Cd	990	165
Pb	220	37
Ni	780	130
Zn	270,000	45,000
Cr	44	7.3
T Solids	0.6 (%)	---

1. Concentration data from Kennecott PER, (Table No. 2-A3, Attachment B). Bench Test Study Report, March 1989.
2. Volume of sludge = 250 ml or 1/4 L.
3. Quantity (ug/g) = Concentration (ug/l) x 0.25 L divided by [250 x 0.006].

TABLE NO. 3.5-R-3

Calculation of Quantities of Metals Leached
From the Till Composite - Series 1

Parameter	Concentration (ug/l)	Quantity (ug/g of Till Sample)
As	11	5.9×10^{-3}
Cd	<3	$<1.6 \times 10^{-3}$
Cr	40	0.022
Cu	120	0.064
Pb	10	5.4×10^{-3}
Hg	<0.50	$<2.7 \times 10^{-4}$
Ni	<30	<0.016
Se	<3	$<1.6 \times 10^{-3}$
Ag	<0.4	$<2.1 \times 10^{-4}$
Zn	68	0.036
Fe	21 mg/l	0.011 mg/g

1. Concentration data from Kennecott PER, (Table No. 3-A1, Attachment B) Bench Test Study Report, March 1989.
2. Volume of leachate = 13 L and quantity of till composite = 24,192.4 gms.
3. Quantity (ug/g) = concentration (ug/l) x 13 L ÷ 24,192.4 gms.
4. Data was generated from one leaching cycle and represents one point in time.

TABLE NO. 3.5-R-4

Calculation of Quantities of Metals Leached
From the Till Composite - Series 2

Parameter	Concentration (ug/l)	Quantity (ug/g of Till Sample)
As	7	3.8×10^{-3}
Cd	<10	$<5.4 \times 10^{-3}$
Cr	24	0.013
Cu	87	0.047
Pb	6	3.2×10^{-3}
Hg	<0.50	$<2.7 \times 10^{-4}$
Ni	<30	<0.016
Se	<3	$<1.6 \times 10^{-3}$
Ag	<0.4	$<2.1 \times 10^{-4}$
Zn	45	0.024
Fe	13 mg/l	7.0×10^{-3} mg/g

1. Concentration data from Kennecott PER (Table No. 3-A2, Attachment B) Bench Test Study Report, March 1989.
2. Volume of leachate = 13 L and quantity of till composite = 24,192.4 gms.
3. Quantity (ug/g) = concentration (ug/l) x 13 L ÷ 24,192.4 gms.
4. Data was generated from one leaching cycle and represents one point in time.

TABLE NO. 3.5-R-5

Calculation of Quantities of Metals Leached
From the Till/Saprolite Composites

Parameter	Concentration (ug/l)	Quantity (ug/g of Till Sample)
As	10	5.6×10^{-3}
Cd	<10	$<5.6 \times 10^{-3}$
Cr	32	0.018
Cu	400	0.22
Pb	100	0.056
Hg	<0.50	$<2.8 \times 10^{-4}$
Ni	<30	<0.017
Se	<3	$<1.7 \times 10^{-3}$
Ag	1.1	6.1×10^{-4}
Zn	150	0.083
Fe	15 mg/l	8.4×10^{-3} mg/g

1. Concentration data from Kennecott PER (Table No. 3-A3, Attachment B) Bench Test Study Report, March 1989.
2. Volume of leachate = 13 L (till) + 4 1/2 L (saprolite).
Quantity of material = 24,192.4 gms (till) + 7,255.4 gms (saprolite).
3. The two separately generated leachates (runoff) were combined 1:1.
4. Quantity (ug/g) = concentration (ug/l) x 17 1/2 L ÷ 31,447.8 gms.
5. Data was generated from one leaching cycle and represents one point in time.

APPENDIX 3.5-S

Total Sulfur Analyses
Flambeau Project, Ladysmith, WI

KEIR