

**2005 Water Quality Data from
Exploration Holes 05EA-107 and 04EA-084**

**Golder Associates Ltd., January 2006
Eagle Project – 2005 Bedrock Hydrogeologic
Investigation, Preliminary Water Quality Results**

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TECHNICAL MEMORANDUM

TO: Jon Cherry, Kennecott Eagle Minerals Company **DATE:** January 13, 2006

FROM: Jacob Waples and Mike Lemon, Golder Associates **REF NO:** 053-2362

EMAIL: JWOZNIEWICZ@GOLDER.COM

RE: **EAGLE PROJECT – 2005 BEDROCK HYDROGEOLOGIC INVESTIGATION, PRELIMINARY WATER QUALITY RESULTS**

1.0 INTRODUCTION

On behalf of Kennecott Eagle Minerals Company (KEMC), Golder Associates Inc. (Golder) completed the second phase of the bedrock hydrogeologic characterization in September and October 2005 at the Eagle Project (Project) in Michigan's Upper Peninsula. This memorandum provides water quality data collected as a part of pump tests of boreholes 04EA-084 and 05EA-107. A more comprehensive analysis and review of the water quality data and pump test program will be provided at a later date.

2.0 SAMPLE METHODS

At total of three pump tests were performed in two boreholes, 04EA-084 and 05EA-107. Field parameters were collected throughout the duration of each pump test and are provided in Appendix A. Water quality samples were collected at the conclusion of the pump tests and, in borehole 04EA-084, periodically throughout the test. Field parameters at the time of water quality sample collection are provided in Table 1.

For borehole 05EA-107, a straddle packer tool was used to isolate two select discrete intervals for pumping and sampling, the 18.20 to 34.90 m interval and the 97.52 to 114.22 m interval. One groundwater sample was collected from the 18.20 to 34.90 m interval after purging 1,410 liters, or 12 system volumes¹. One groundwater sample was also collected from the 97.52 to 114.22 m interval after purging 1,590 liters, or 6 system volumes.

For borehole 04EA-084, a single packer tool was used to isolate the lower portion of the borehole from 249.05 to 302.8 m along the borehole. Water samples were collected after 16,480 liters (21 system volumes), 41,960 liters (53 system volumes), and 66,750 liters (86 system volumes) had been purged. In addition, a blind duplicate and field blank sample were collected after 86 system volumes were purged.

¹ One system volume consists of the volume of the isolated borehole interval plus the volume of the rods.

Water quality samples were collected in laboratory supplied bottles, filtered when appropriate for dissolved constituents, and preserved with ice, with the exception of the mercury sample, which did not require preservation. Water quality samples were delivered to the laboratory following appropriate chain-of-custody protocol.

Based on the system volumes purged and the relative consistency of the field parameters throughout the pumping tests (Appendix A), water quality results can be considered representative of the intervals sampled.

3.0 CHEMISTRY RESULTS

Water quality results are summarized in Table 2. Analytical laboratory sheets are provided in Attachment B. Quality Control/Quality Assurance completed for this study included collection and analysis of a field blank and blind duplicate as presented on Table 3.

TABLES

TABLE 1

SAMPLE INFORMATION AND FIELD PARAMETERS

Borehole	Sample Interval (m along borehole)	Volume Purged (liters)	Temperature (deg C)	pH	Conductivity (uS/cm)	Salinity (0/00)	TDS (mg/L)	Turbidity (NTU)
05EA-107	18.20 to 34.90	1410	9.4	7.57	359	0.2	168	18.5
	97.52 to 114.22	1590	12.3	7.52	599	0.3	287	56.0
04EA-084	249.05 to 302.08	16480	9.4	8.25	4980	2.6	2540	5.92
		41960	10.4	8.42	5980	3.1	3060	2.35
		66750	8.5	8.10	5590	2.9	2840	2.35

TABLE 2

SAMPLING RESULTS

Sample Location Sample Interval Depth Along Borehole in Meters Sample Date and Time Volume Purged Prior to Sampling	05EA-107		04EA-084		04EA-084		04EA-084		04EA-084	
	18.70 to 34.90 9/20/05 - 09:15 12 System Volumes Purged	97.52 to 114.22 9/18/05 - 11:40 6 System Volumes Purged	249.05 to 302.08 9/23/05 - 11:50 21 System Volumes Purged	249.05 to 302.08 9/23/05 - 11:50 21 System Volumes Purged	249.05 to 302.08 9/26/05 - 10:00 54 System Volumes Purged	249.05 to 302.08 9/29/05 - 08:00 86 System Volumes Purged	249.05 to 302.08 9/29/05 - 08:00 86 System Volumes Purged	249.05 to 302.08 9/29/05 - 08:00 86 System Volumes Purged	249.05 to 302.08 9/29/05 - 08:00 86 System Volumes Purged	249.05 to 302.08 9/29/05 - 08:00 86 System Volumes Purged
Field Parameters										
pH	7.57	7.52	8.25	8.25	8.42	8.1	8.1	8.1	8.1	8.1
Conductivity	359	599	4980	4980	5980	5590	5590	5590	5590	5590
Salinity	0.2	0.3	2.6	2.6	3.1	2.9	2.9	2.9	2.9	2.9
Total Dissolved Solids	168	287	2540	2540	3060	2840	2840	2840	2840	2840
Turbidity	18.4	56	5.92	5.92	2.35	2.35	2.35	2.35	2.35	2.35
Temperature (transducer)	9.4	12.3	9.4	9.4	10.4	8.5	8.5	8.5	8.5	8.5
Metals by EPA 600/6-7000										
Aluminum	< 50	< 50	< 50	< 50	NA	< 50	< 50	< 50	< 50	< 50
Antimony	< 5	< 5	< 5	< 5	NA	< 5	< 5	< 5	< 5	< 5
Arsenic	< 2	< 2	23	23	NA	19	19	19	19	19
Barium	< 20	< 20	24	23	NA	< 20	< 20	< 20	< 20	< 20
Beryllium	< 1	< 1	< 1	< 1	NA	< 1	< 1	< 1	< 1	< 1
Boron	940	4100	5800	5700	NA	5900	5900	5900	5900	5900
Cadmium	< 0.5	< 0.5	< 5	< 5	NA	< 5	< 5	< 5	< 5	< 5
Calcium	5.9	3.1	83	79	NA	76	76	76	76	76
Chromium	< 5	< 5	< 5	< 5	NA	< 5	< 5	< 5	< 5	< 5
Cobalt	< 10	< 10	< 10	< 10	NA	< 10	< 10	< 10	< 10	< 10
Copper	< 5	< 5	< 5	< 5	NA	< 5	< 5	< 5	< 5	< 5
Iron	88	79	2200	2500	NA	1800	1800	1800	1800	1800
Lead	< 1	< 1	< 1	< 1	NA	< 1	< 1	< 1	< 1	< 1
Lithium	13	16	140	130	NA	120	120	120	120	120
Magnesium	2.4	0.98	67	66	NA	61	61	61	61	61
Manganese	22	< 20	83	81	NA	68	68	68	68	68
Molybdenum	< 10	< 10	< 10	< 10	NA	< 10	< 10	< 10	< 10	< 10
Mercury	0.81	3.51	0.44	0.6	NA	0.21 J	0.21 J	0.21 J	0.21 J	0.21 J
Nickel	< 25	< 25	< 25	< 25	NA	< 25	< 25	< 25	< 25	< 25
Selenium	< 1	< 1	21	21	NA	17	17	17	17	17
Silver	< 0.2	< 0.2	< 0.2	< 0.2	NA	0.46	0.46	0.46	0.46	0.46
Sodium	21	80	1100	1000	NA	970	970	970	970	970
Strontium	170	91	5300	4700	NA	4800	4800	4800	4800	4800
Zinc	< 10	12	18	26	NA	19	19	19	19	19
Potassium	2.9	1.7	9.2	8.8	NA	9.2	9.2	9.2	9.2	9.2
Physical/Chemical Parameters										
Alkalinity, Bicarbonate	39	70	36	36	NA	37	37	37	37	37
Alkalinity, Carbonate	< 2	28	< 1	< 1	NA	2.9	2.9	2.9	2.9	2.9
Alkalinity, Total	81	98	34	34	NA	40	40	40	40	40
Chloride	1.15	97.3	1980	1980	NA	2040	2040	2040	2040	2040
Fluoride	0.53	0.85	0.99	0.99	NA	1	1	1	1	1
Nitrogen, Ammonia	0.076	0.093	0.29	0.29	NA	0.26	0.26	0.26	0.26	0.26
Nitrogen, Nitrate	< 0.05	< 0.05	< 0.05	< 0.05	NA	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phosphorus, Total	< 0.01	0.033	< 0.01	< 0.01	NA	0.0148	0.0148	0.0148	0.0148	0.0148
Residue, Dissolved	76	278	3990	3990	NA	3560	3560	3560	3560	3560
Sulfate	< 5	< 5	< 5	< 5	NA	< 5	< 5	< 5	< 5	< 5
Tritium	< 1	< 1	< 1	< 1	NA	< 1	< 1	< 1	< 1	< 1
TU	< 0.8	0.6	< 0.69	< 0.69	NA	< 0.71	< 0.71	< 0.71	< 0.71	< 0.71

Notes:
 U Mercury sample results below the method detection limit (MDL) were reported at the MDL.
 J Mercury result is an estimate. See notes in laboratory reports in Attachment B.
 NA Not Analyzed

Prepared By: MSL
 Checked By: PU
 Reviewed By: JSW

ATTACHEMENT A
MEASURED FIELD PARAMETERS

Golder Associates

FIELD PARAMETERS MEASURED FOR 04EA-084 TEST

Date	Time (hr)	Time (min)	Purge Volume (gallons)	Temp (deg C)	pH (s.u.)	Conductivity (uS/cm)	Salinity (000)	TDS (mg/L)	Turbidity (NTU)
9/22/2005	8	35	48.4	9.1	7.51	6060	3.2	3100	85.9
	8	45	80.6	8.3	7.69	6070	3.2	3100	72.3
	9	0	129.6	8.4	8.03	4710	2.4	2370	88.8
	9	30	229.6	8.8	8.28	5470	2.8	2760	66.7
	10	0	325.3	9.1	7.54	5480	2.8	2770	41.1
	10	35	433.6	8.9	7.83	5460	2.9	2800	38.5
	11	4	529.2	9.0	8.38	5480	2.8	2780	31.4
	11	30	613.0	9.4	7.99	5460	2.8	2770	29.9
	12	0	709.8	9.6	7.42	5210	2.7	2700	36.2
	12	30	807.6	9.2	8.02	5360	2.8	2730	22
	13	0	897.6	9.4	8.18	5310	2.8	2710	37
	13	30	986.7	9.3	8.32	5270	2.7	2690	17
	14	0	1075.8	9.4	8.38	5320	2.8	2700	14.4
	14	30	1164.1	9.1	8.42	5280	2.7	2700	11.1
	15	0	1252.3	9.1	8.47	5330	2.8	2700	10.9
	15	45	1384.7	9.7	8.06	5240	2.7	2680	19.6
	17	0	1550.3	9.0	7.88	5333	2.8	2710	13
	18	0	1702.2	9.3	8.55	5180	2.7	2660	9.13
	19	0	1853.4	9.2	8.90	5290	2.7	2670	11.7
	19	30	1929.1	8.6	7.90	5340	2.8	2700	15
	20	0	2004.1	8.6	8.02	5310	2.7	2680	7.95
	21	0	2155.3	8.9	8.23	5280	2.6	2600	9.89
	22	0	2305.4	8.9	8.32	5320	2.8	2690	7.24
	23	0	2454.7	8.4	7.98	5320	2.7	2690	6.97
9/23/2005	0	0	2604.1	8.3	8.01	5330	2.7	2690	6.67
	1	0	2755.4	8.3	8.55	5330	2.7	2690	5.47
	2	0	2906.0	8.2	7.90	5350	2.8	2700	5.29
	3	0	3057.9	8.0	7.97	5380	2.8	2710	4.78
	4	0	3207.9	7.9	7.90	5380	2.7	2680	7.45
	5	0	3359.2	7.9	8.01	5260	2.7	2660	5.1
	6	0	3508.6	7.6	7.99	5370	2.8	2670	5.03
	7	0	3659.2	7.5	7.85	5370	2.7	2690	4.71
	8	0	3808.6	7.4	7.76	5490	2.8	2730	4.73
	8	30	3884.8	8.2	8.34	5180	2.7	2610	5.55
	9	0	3960.5	8.9	8.45	5280	2.7	2670	5.73
	11	0	4255.6	9.0	8.23	5040	2.6	2550	5.35

FIELD PARAMETERS MEASURED FOR 04EA-084 TEST

Date	Time (hr)	Time (min)	Purge Volume (gallons)	Temp (deg C)	pH (s.u.)	Conductivity (uS/cm)	Salinity (0/00)	TDS (mg/L)	Turbidity (NTU)
	11	40	4354.7	9.4	8.25	4980	2.6	2540	5.92
	13	35	4523.8	9.8	8.46	4950	2.6	2520	5.51
	15	0	4664.0	10.1	8.48	4950	2.6	2510	5.51
	16	0	4759.7	10.0	8.37	5010	2.6	2540	5.69
	17	0	4856.0	9.5	8.40	4840	2.4	2340	6.11
	18	0	4953.8	9.5	8.40	4940	2.6	2480	7.42
	19	0	5049.0	9.2	8.20	4720	2.4	2380	7.64
	20	0	5146.3	9.3	7.99	4770	2.5	2460	5.18
	21	0	5242.6	10.3	8.60	4850	2.5	2460	3.79
	22	0	5336.8	9.8	8.79	4930	2.5	2490	3.03
	23	0	5431.6	11.5	8.42	4770	2.5	2400	3.5
9/24/2005	0	0	5527.3	9.1	8.51	4840	2.5	2490	4.57
	1	0	5625.1	10.0	8.26	4870	2.5	2470	3.04
	2	0	5722.4	9.8	8.55	4760	2.1	2480	3.17
	3	0	5818.2	10.0	8.66	4760	2.5	2420	3.43
	4	0	5914.9	9.9	7.42	4700	2.4	2420	4.52
	5	0	6012.8	9.4	8.38	4870	2.5	2460	3.4
	6	0	6109.0	9.6	8.43	4860	2.5	2480	3.02
	7	0	6204.8	9.3	8.56	4890	2.5	2480	2.95
	8	0	6299.0	9.3	8.54	4840	2.5	2460	3.13
	9	0	6392.3	9.0	8.12	6110	3.2	3140	3.03
	10	0	6487.5	9.5	8.33	6160	3.2	3160	2.9
	11	0	6582.2	9.4	8.01	6170	3.2	3180	3.05
	12	0	6675.5	9.3	8.01	6250	3.3	3220	3.06
	13	0	6770.8	9.9	8.24	6180	3.3	3190	2.79
	14	0	6865.5	9.5	8.77	6650	3.5	3450	4.77
	15	0	6962.8	8.7	8.52	6820	3.6	3550	3.35
	16	0	7059.0	8.0	8.97	6970	3.7	3550	4.91
	18	0	7252.6	7.9	8.82	6640	3.5	3380	2.36
	19	0	7347.3	7.9	10.69	6650	3.5	3380	2.17
	20	0	7443.6	8.3	8.30	6620	3.3	3290	2.17
	21	0	7539.8	7.9	9.07	6670	3.5	3400	1.85
	22	0	7637.1	8.3	10.70	6640	3.4	3360	1.92
	23	0	7734.4	7.9	10.89	6890	3.4	3340	1.89
9/25/2005	0	0	7831.7	8.3	9.09	6700	3.5	3410	1.51
	1	0	7928.0	7.9	8.96	6680	3.5	3400	1.56