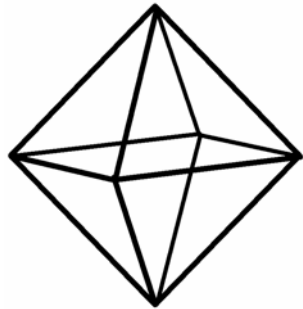


Plan

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**Kennecott**  
Eagle Minerals

Eagle Project  
Subsidence Monitoring Plan

Project No.: 04W018

Kennecott Eagle Minerals Company  
Marquette, Michigan

December 2007

Eagle Project  
Subsidence Monitoring Plan

Project ID: 04W018

Prepared for  
Kennecott Eagle Minerals Company  
***ISO 14001:2004 Registered System***

Prepared by  
Foth Infrastructure & Environment, LLC

December 2007

# Eagle Project Subsidence Monitoring Plan

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# 1 Introduction

## 1.1 Background

Kennecott Eagle Minerals Company (KEMC) is planning to develop an underground nickel and copper mine (Eagle Mine) in Michigamme Township, Marquette County, Michigan. The ore deposit is a high-grade magmatic sulfide deposit containing nickel and copper.

Mining of the ore deposit will be conducted underground using blasthole stoping methods. Over the seven year life of the mine, approximately 3,400,000 tonnes of ore will be extracted. The extracted ore will be hauled to the surface, crushed and transported to a mill for processing.

## 1.2 Purpose

During and after mining operations, KEMC will implement a subsidence monitoring plan as presented herein. The subsidence monitoring plan will measure ground and subsurface displacements at pre-established locations to determine if movements substantiate a detrimental surface subsidence as a result of mining.

## 2 Subsidence Monitoring

Surface subsidence monitoring will be conducted at six locations as shown on Figure 1. In addition, subsurface subsidence monitoring will be conducted in one borehole at the location shown on Figure 1. At the surface locations, permanent survey monuments will be installed by a professional land surveyor. The subsurface monitoring will be conducted via strain gauge or similar device installed in the borehole at approximate elevation 1360 feet (414 meters), approximately 20 feet (6 meters) below the bedrock surface. The strain gauge will measure deflection as a result of subsurface rock displacement that could occur due to mining activities. Subsidence monitoring will be recorded on the subsidence monitoring log provided in Appendix A.

### 2.1 Baseline Survey

One month prior to any underground activities, KEMC will begin ground surface measurements at the monuments and at the borehole, continuing monthly thereafter. The baseline data will be used to monitor subsidence during mining operations.

### 2.2 Monitoring During Mining Operations

During mining operations, subsidence monitoring will be conducted monthly to assess ground displacement due to mining. The subsidence response plan is detailed in Section 3. The subsidence monitoring data will be maintained on-site and will be available to the Department if requested.

### 2.3 Closure and Post Closure Monitoring

At the end of mining operations monitoring, subsidence monitoring will be reduced to a semi-annual basis.

3 Subsidence Response Plan

3.1 Measurable Subsidence

Measurable subsidence is a surface monument displacement of more than 2-inch monthly cumulative from baseline conditions or greater than 1/2 inch displacement from the previous measurement or a subsurface gauge displacement of more than 2-inches cumulative from baseline conditions. A summary of parameters appears in Table 3-1.

Table 3-1  
Subsidence Response

<b>Location</b>	<b>Cumulative</b>	<b>Single Occurrence<sup>(1)</sup></b>
Surface Monument	>2.0"	0.50"
Subsurface Gauge	>2.0"	--

<sup>(1)</sup> Change from previous monthly measurement  
Prepared by: JOS1  
Checked by: SVD1

3.2 Subsidence Response - Assessment Monitoring

If a measurable subsidence is recorded, KEMC’s response is to implement assessment monitoring. KEMC will notify the department within seven days that a measurable subsidence event has been recorded and that assessment monitoring has begun.

Assessment monitoring will include increasing the frequency of monitoring to twice monthly and evaluating impact to the environment. KEMC will conduct assessment monitoring for a period of 90 days and will evaluate the mine progress and the potential for additional surface subsidence.

If during this period, measurable subsidence is determined to be a result of mining operations, KEMC will notify the Department and implement corrective action as presented in Section 4. KEMC will submit a report to the Department summarizing the assessment monitoring conducted over the previous 90 days and whether corrective action will be required.

## 4 Corrective Action

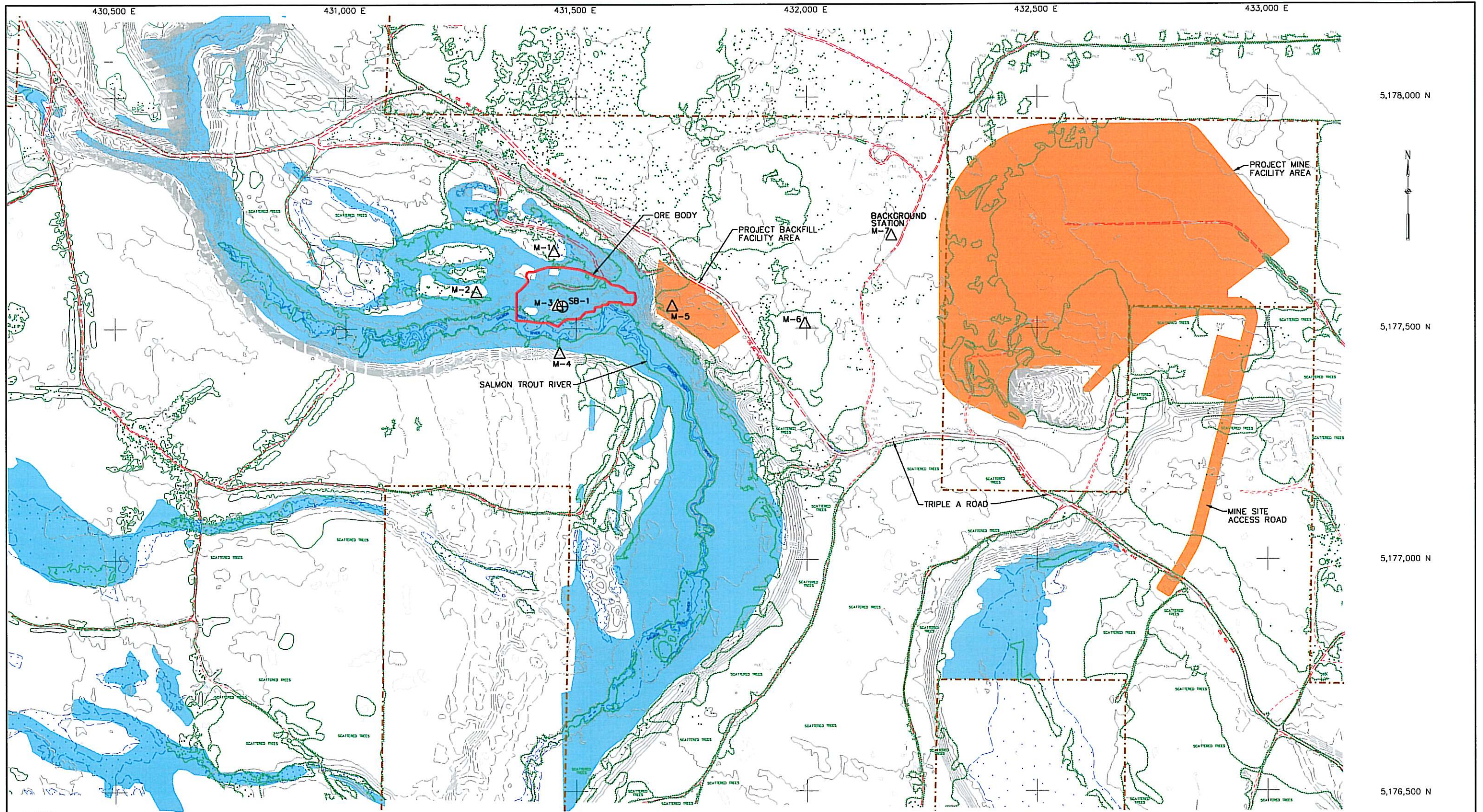
If measurable subsidence is determined and is a result of mining operations, KEMC will implement the following corrective action:

- ◆ Review and revise the mining plan to stabilize the crown pillar such that surface displacement will be contained below measurable subsidence levels.
- ◆ Apply stabilization to the crown pillar, including enhanced mechanical reinforcement that will reduce surface displacement below measurable subsidence. Stabilization could include an enhanced roof bolting pattern and/or other mechanical means to support the mine during operations.

KEMC will implement the corrective action within 30 days after approval of the corrective action plan by the department.

# Figure





**NOTES:**

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: JUNE 2, 2004.
2. MINE PLAN DATA ADAPTED FROM MCINTOSH ENGINEERING, INC., TEMPE, ARIZONA.
3. SURFACE PROPERTY BOUNDARY AS OF NOVEMBER 18, 2004 SUPPLIED BY KENNECOTT VIA GOLDER & ASSOCIATES INC., APRIL 7, 2005.
4. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/94. HORIZONTAL COORDINATES BASED ON UTM ZONE 16.
5. ORE BODY, GROUNDWATER DISCHARGE AREA, WETLAND BOUNDARY (WETLAND AND COASTAL RESOURCES) SUPPLIED BY GOLDER & ASSOCIATES, INC. APRIL 7, 2005.

**LEGEND**

- |  |   |  |
|--|---|--|
| EXISTING CONTOUR   | ROAD EASEMENT PROVIDED BY MCINTOSH ENGINEERING, INC., APRIL, 2005 | SB-1 ⊕ SUBSIDENCE BORING NUMBER AND LOCATION         |
| UNPAVED ROAD   | GROUNDWATER DISCHARGE INVESTIGATION AREA                          | M-1 Δ SUBSIDENCE SURVEY MONUMENT NUMBER AND LOCATION |
| TREE   | PLANIMETRIC WETLAND NOTATION                                      |  |
| TREE LINE  | PROPERTY LINE   |  |
| WCR MAPPED WETLAND BOUNDARY PROVIDED BY GOLDER & ASSOCIATES, INC. APRIL 7, 2005. | PROJECT FACILITY AREA   |  |
| ORE BODY   |   |  |

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY: JOS1		DATE: DEC. '07	
APPROVED BY: SVDI		DATE: DEC. '07	
APPROVED BY:		DATE:	



**FIGURE 1**  
SUBSIDENCE MONITORING PLAN

Scale:	Date: DECEMBER, 2007
Prepared By: JOW	Project No. 04W018

## Appendix A

