

Technical Memorandum

Date: March 2, 2007

To: Hal Fitch, Michigan DEQ

From: David Sainsbury, Ph.D., Itasca Consulting Group, Inc.

Re: Summary of Technical Review Conducted on the Crown Pillar Subsidence and Hydrologic Stability Assessment for the Proposed Eagle Mine

Ref: ICG07-2420-10TM

In 2006, Itasca Consulting Group, Inc. conducted a technical review of the Eagle Mine crown-pillar stability analysis that has been submitted to the Michigan Department of Environmental Quality (MDEQ) by Kennecott Eagle Minerals Company as part of a mining permit application. As part of this technical review process, one report (Sainsbury, 2006a) and several technical memorandums (Sainsbury, 2006b,c,d) were generated and submitted to MFG, Inc and the MDEQ. The following discussion is a summary of the entire technical-review process.

The Eagle Project Mining Permit Application (Kennecott, 2006) describes the proposed mining plan as a transverse longhole method. Mining is proposed to progress from mine level 143 m (~ 295 m below ground surface) upward to mine level 353 m (~ 85 m below ground surface). Mine level 383 m (~ 55 m below ground surface) is proposed be mined selectively based upon future geotechnical analysis. The contact between the peridotite and the overlying glacial till is located at the 415 m level and results in a peridotite crown-pillar thickness of either 62 m or 32 m, depending on whether the 383 m level is extracted. Figure 1 illustrates a schematic of the proposed Eagle Mine stoping geometry.

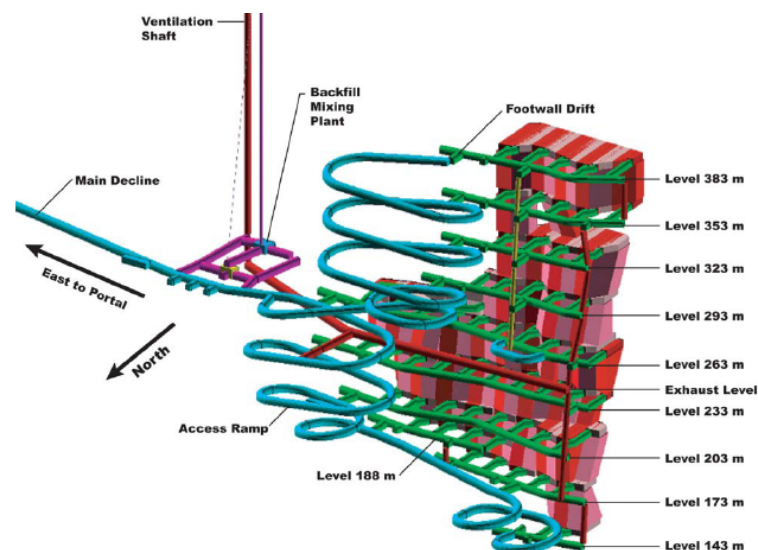


Figure 1 Schematic of proposed Eagle Mine stoping geometry (Kennecott, 2006)

Analyses of crown pillar stability were conducted (Golder, 2005; Golder 2006) for crown pillar thicknesses of 27.5 m and 57.5 m. Based upon these analyses, the Eagle Project Mining Permit Application (Kennecott, 2006) concludes that vertical subsidence at the bedrock/alluvium contact will be no greater than 2 cm and will not jeopardize the stability of the crown pillar. However, the analysis techniques used to assess the Eagle crown-pillar stability do not reflect industry best-practice. In addition, the hydrologic stability of the crown pillar has not been considered. Therefore, the conclusions made within the Eagle Project Mining Permit Application regarding crown pillar subsidence are not considered to be defensible. A detailed review of the crown-pillar stability analysis has been provided in Sainsbury (2006a and 2006c).

After review of the Eagle Project Mining Permit Application (Kennecott, 2006) by the MDEQ, the proposed mine plan was revised to allow for mine development to begin, limiting mining to elevation 327.5 m, resulting in a substantial 87.5-m thick crown pillar. This approach will allow further field investigation and analysis to be conducted prior to mining above elevation 327.5 m, ensuring greater understanding of the actual rock-mass response to mining prior to development of the final crown pillar. Based upon the geotechnical information provided in the Eagle Project Mining Permit Application (Kennecott, 2006), a crown pillar thickness of 87.5 m is considered sufficient to prevent any significant surface subsidence.

Due to the difficulties associated with determining the mechanical properties of a rock mass from limited drill core information, and the limitations of the rock mechanics analyses conducted thus far, an accurate assessment of the crown pillar subsidence and hydrologic stability cannot be made without further detailed field investigation and analysis. As discussed in Sainsbury (2006d), mining should not be permitted above 327.5 m until further detailed field investigation and an industry best-practice analysis are conducted to determine the expected crown-pillar subsidence and hydrologic stability.

REFERENCES

Golder Associates Ltd. (2005) *Eagle Project Geotechnical Study*, Appendix C-2, Report to Kennecott Exploration Company, 04-1193-020.

Golder Associates Ltd. (2006) *Eagle Project Additional Geotechnical Scope*, Appendix C-3, Report to Kennecott Minerals Company, 05-1193-011.

Kennecott Eagle Minerals. (2006) *Eagle Project: Mining Permit Application, Volume 1*, Mining Permit Application submitted to the Michigan Department of Environmental Quality.

Sainsbury, D. (2006a) "Technical Review — Crown Pillar Subsidence and Hydrologic Stability Assessment for the Proposed Eagle Mine," Itasca Consulting Group, Inc., Report to MFG, Inc. and the Michigan Department of Environmental Quality, ICG06-2376-23, May.

Sainsbury, D. (2006b) "Review of Eagle Project Geotechnical Study – Request for Clarification," Itasca Consulting Group, Inc., Technical Memorandum to Golder Associates Ltd., MFG, Inc., and the Michigan Department of Environmental Quality, ICG06-2376-18TM, April.