# APPENDIX I
## Geotechnical stability of pit designs memorandum


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Thursday, 14 September 2023

Attn: William Norrie
Senior Geotechnical Engineer
Evolution Mining, Cowal Gold Operations
Lake Cowal Road
LAKE COWAL NSW 2671

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Dear Will,

**RE: COWAL GOLD OPERATIONS, OPEN PIT CONTINUATION (OPC) STUDY GEOTECHNICAL STABILITY OF PIT DESIGNS**

## 1 INTRODUCTION

Cowal Gold Operations (CGO) engaged Mining One Pty. Ltd. (Mining One) to complete the Open Pit Continuation (OPC) Feasibility Study (FS) to extend their open pit operations.

Mining started at the Endeavour 42 (E42) deposit in 2006, and several pit stages have been mined. Stage H is the current pit design that is being worked at E42, which is due to be completed by the end of 2026. The FS focused on Stage I, which CGO expects to extend the life of E42 by a further ten years to 2034.

## 2 WORK COMPLETED

Mining One has been involved at CGO since 2007, providing geotechnical advice and reviews, pit design assessments, and on-site support. The OPC FS commenced in September 2021. The following work has been completed:

- CGO OPC Feasibility Study, Chapter 6: Geotechnical and Hydrogeology – Evolution Mining report prepared by Mining One, 28th June 2023. This work summarised the comprehensive geotechnical stability and hydrogeology modelling completed by Mining One from late 2021 to early 2023.
- Cowal Stage H, Operational Design Support – Mining One letter report, provided on 25th July 2023. This work provided some further clarity about alternative batter configurations for the remainder of Stage H, which informs the batter designs for Stage I and arose from a recommendation in the OPC FS to complete a statistical analysis of joints, which is to be calibrated after further mining and observations of slope performance. This study also included an updated rockfall simulation to further augment the OPC FS.

Mining One's geotechnical and hydrogeology study was subjected to two phases of peer review:

- An Independent Peer Review process which was undertaken by AMC Consultants (for geotechnical) and Valenza Engineering (for hydrogeology) during the FS at 30%, 60% and at completion. This provided review and improvement through the process; and

- Independent review by Stacey Mining Geotechnical Ltd: “Independent Review of the Mining One Cowal Open Pit Continuation (OPC) Study Slope Design Process”, letter report by Dr. Peter Stacey, 4th November 2022.

## 3 SUMMARY OF FS

Mining One’s FS was based on a comprehensive Pre-Feasibility Study (PFS) geotechnical model, which was further developed from additional data acquisition and analysis. In addition, a thorough review was undertaken of current (Stage H) pit slope performance including reviews of rock fall history, bench crest loss and achieved berm width, alternative batter configuration trials (triple benching), and blasting practices.

The FS included the following work and findings:

- Assessments of batter configurations regarding stability and rock fall hazards, and provisions for crest retention improvements;
- Inter-ramp and overall slope stability was assessed for E42 pit with advanced numerical finite difference modelling using Cavroc SlopeX and FLAC3D. This included a detailed back analysis process to refine and calibrate parameters, based on historical monitoring data and failure records.
- The cover sequence was initially assessed using limit equilibrium methods to determine an optimum slope design profile, and then was modelled using 3D numerical modelling. The cover sequence has experienced several historical failures. Two large failures of the east wall in 2007 provided an opportunity to back analyse the failures with 3D numerical modelling, to provide additional calibration of geotechnical parameters and to ensure a more robust forward model.
- Progressive displacement in the Transported Sediments in the southeastern corner of the pit was noted in early 2020. This was also modelled as part of the back analysis and calibration. Further work was recommended to understand displacement thresholds for ongoing site management, and to refine the strength criterion to provide opportunities to optimise cover sequence designs in the shallower oxide pits. The back analysis work completed was considered adequate for the purposes of the FS.
- Mining One developed a groundwater model to support this geotechnical modelling. The hydrogeology conceptualisation is adapted from previous studies. The model calibration was developed in a transient simulation for the period of 2018 to 2020. Active piezometer data was used as a basis for calibration with model predictions being compared with 1416 points of monitoring data. After calibration, a predictive model was developed for end-of-mine scenarios. Five scenarios were developed for forward modelling to account for residual uncertainties that remain after calibration. These account for a range of depressurisation cases from no drainage, to active drains at various spacings and operational efficiencies.

The overall outcome of the IPR process was that no fatal flaws were identified, and that the methodology and the basis for the stability assessment conform with industry standards.

The IPR findings included the following:

- No fatal flaws were identified, and key project opportunities and risks are well understood;

- Geotechnical modelling has identified an area of instability and high probability of failure of the E42 Stage I pit where the design intersects the Speyburn Fault; and
- The E42 Stage I design incorporates a slightly steeper (by 2-3°) inter-ramp angle that relies on crest loss being reduced compared with historic performance.

Stacey's review in late 2022 noted that:

- "Overall, I find that the proposed Work Processes for the definition of the slope designs follow standard industry practice as outlined in "Guidelines for Open Pit Slope Designs", edited by Read and Stacey and published by CSIRO in 2009."

## 4 SUMMARY COMMENTS ON PIT STABILITY

Based on the FS, concurrent and subsequent operational support work, and Mining One's experience at the site, Mining One confirms that:

- The overall and inter-ramp stability of the Stage I pit design is expected to be stable, except where some concerns were identified in the lower west wall around the Speyburn Fault. These have been noted and are to be addressed in design changes.
- Localised batter scale issues such as batter instability due to intersecting geological structures, and rock fall hazards, are well understood and are to be addressed with continuous improvement.
- The IPR's comments about rock fall risk in relation to the reliance on reduced crest loss have been noted and accounted for in FS costings that allow for rock fall control or mitigation measures, such as barriers. These are to target specific areas requiring rock fall protection as identified during mining. Drilling controls (pre-splitting and line drilling) are to be trialled in Stage H to inform their effectiveness for Stage I. These comments relate to rock fall hazards, not to slope stability.
- The July 2023 assessment provided further clarity about alternative batter configurations to minimise rock fall risk, and recommended periodic review and calibration of the process to further inform the Stage I designs.
- Batter configurations are expected to be optimised within the constraints of inter-ramp and overall slope profiles; that is, no major changes to overall slope profiles are expected.
- Cover sequence modelling is supported by back analysis of historical failures to verify geotechnical parameters, resulting in a forward analysis that predicts adequate FoS for the expected depressurisation cases.

Yours sincerely

**David Lucas**
Principal Geotechnical Engineer
**MINING ONE PTY LTD**

## DOCUMENT INFORMATION

| | |
|---|---|
| **Status** | Final |
| **Version** | 2 |
| **Print Date** | 14th September 2023 |
| **Author(s)** | David Lucas |
| **Reviewed By** | Kevin Dugan |
| **Pathname** | P:\3203_M Evolution Mining Cowal - OPC Early Works Engineering\WPO\7885 |
| **File Name** | 7885v2.docx |
| **Job No** | 3203_M |
| **Distribution** | PDF provided for distribution |

## DOCUMENT CHANGE CONTROL

| Version | Description of changes/amendments | Recipient | Author (s) | Date |
|---|---|---|---|---|
| 1 | First issue of report | W. Norrie | D. Lucas | 12/09/2023 |
| 2 | Updated after client's review | W. Norrie | D. Lucas | 14/09/2023 |

## DOCUMENT REVIEW AND SIGN OFF

| Version | Reviewer | Position | Signature | Date |
|---|---|---|---|---|
| 1 | Kevin Dugan | Senior Principal Geotechnical Engineer |  | 12/09/2023 |