



**COLORADO**  
Division of Reclamation,  
Mining and Safety  
Department of Natural Resources

**Date:** July 20, 2020

**To:** Peter Hays

**From:** Zach Trujillo

**RE:** Henderson Mine, DRMS File No. M-1977-342  
TR-32 Adequacy Response Review

Peter,

I have reviewed Climax Molybdenum Company's 3 Dam, Phase II Buttress Design adequacy response to the Division's adequacy letter. Please see the following comments:

Division Comment 1:

*Please have Henderson provide the additional stability analysis for the 1 Dam to ensure to the Division that long-term stability will remain if material is borrowed from the 1 Dam benches.*

Henderson/AECOM:

*There was a similar question posed during the review of the Phase I Buttress. The response provided below is excerpted from the 2018 TR-29 adequacy review response since it still applies. The original stability design of the 1 Dam was based on an overall design slope of 4:1 (horizontal to vertical). Steeper benches are constructed as part of normal operations as the impoundment steps upstream. These benches serve as access routes during operation until the following upstream step is constructed. A schematic showing the design slope and benches is provide in Figure 1. These benches are regularly grade as part of erosion and storm water control measures and are considered standard maintenance of the impoundment. The overall slope of 4:1 provides embankment stability and this slope is maintained during any bench regrading activities.*

Division:

The material used from the 1 Dam as additional buttressing fill for the 3 Dam is in excess used for creating access for standard maintenance. The overall approved 1 Dam slope remains the same and the global stability should not be impacted with the use of this material. The Division's Comment 1 has been satisfied with no additional comments.

Division Comment 2:

Henderson Mine TR-32 Adequacy Response Review

July 20, 2020



*Please provide additional discussion and stability results for the 3 Dam Phase II buttress design under static conditions to ensure a minimum factor of safety of 1.5 is met as stated under Section 30.*

Henderson/AECOM:

*Steady-state drained loading conditions represents the long-term stability of the dam. Stability analyses were performed on the design section, Sections 2 and 4A, with the designed Phase II buttress and crest elevation of 8,887 ft under steady-state (static) loading conditions using the drained shear strengths shown on Figures 2 and 3. The limit equilibrium computer program UTEXAS4 (Wright, 2008) and Spencer's method of slices were used for the stability analyses. Spencer's method satisfies all conditions of static equilibrium, including horizontal and vertical force imbalance and moment imbalance. Search routines available within UTEXAS4 were used for circular and noncircular trial shear surfaces to locate critical shear surfaces. The results of the two-dimensional (2D) limit equilibrium steady state drained factor of safety for Section 2 is 2.5 and for Section 4A is 2.1. Figures 2 and 3 show resulting failure surfaces for Section 2 and 4A, respectively.*

Division:

With the provided factors of safety being 2.5 (Section 2) and 2.1 (Section 4A) under static conditions for the 3 Dam, the minimum requirements of Section 30 have been met. The Division's Comment 2 has been satisfied with no additional comments.

Division Comment 3:

*It is stated under the cover page for the proposed TR-32 application that a geotechnical investigation was scheduled for June 2020 which could potentially result in minor modifications to the geometry of the buttress. Please provide additional details of the June 2020 investigation (if occurred) and whether this investigation will have an impact on the currently proposed Phase II 3 Dam buttress design.*

Henderson/AECOM:

*A Cone Penetration Test (CPT) field investigation consisting of 14 CPTs with pore pressure dissipation tests was completed in the original 3 Dam buttress area June 2 to 5, 2020. The CPTS ranged in depth from 10 to 20 ft to the natural ground. Results from the CPT program were used to refine the fine tailings extent to and to confirm pore pressure conditions. The CPT investigation showed that the fine tailings material located on the northern side of the original 3 Dam buttress are isolated and confirmed pore pressure conditions. An updated 2D post-earthquake loading stability analysis was completed on design section 4A with the updated fine extents. This analysis was completed using the same procedures described in the 3 Dam, Phase II Buttress Design letter report dated June 1, 2020. Figure 4 presents the updated slope stability results for post-earthquake loading conditions which meets the stability criteria. As a result, the proposed regrade or slope flattening of the northern original 3 Dam buttress is no longer required. Remainder of the design remains consistent with the 3 Dam Phase II submission.*

Division:

Based on the June 2 to 5, 2020 geotechnical investigation, an updated slope profile for Section 4A has been provided and an associated pseudo-static slope stability analysis was conducted. The results of this analysis meet the minimum criteria of 1.3 for seismic conditions as stated under Section 30. The Division's Comment 3 has been satisfied with no additional comments.

This concludes my review of Climax Molybdenum Company's TR-32 adequacy responses. If you have any questions, feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read 'Zach Trujillo', with a stylized, cursive script.

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