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

Date: **April 25, 2025**

To: **Amy Yeldell**

CC: **Travis Marshall**

From: **Zach Trujillo**

RE: **Mid Continent Limestone Quarry, DRMS File No. M-1982-121**
Technical Revision No. 9 – Highwall Reclamation Stabilization Review

Amy,

As requested I have reviewed the provided geotechnical report, "Highwall Reclamation Stabilization" (Report), associated with Technical Revision No. 9 (TR-9). The Report is conducted by Golden Geotechnics, Inc. (GGI) on behalf of RMR Aggregates, Inc. (RMR) for the Mid-Continent Limestone Quarry (Mine). The purpose of the proposed Report is to outline a plan for highwall stabilization for current site conditions in the event of revocation and forfeiture of the Mine. The Report is based on the site reconnaissance and engineering analysis provided in Kildruff Underground Engineering's (KUE) report, "Failure Analyses and Stabilization Report" that was approved under Technical Revision No. 6 (TR-6). For more information on the referenced KUE's engineering report, please refer to TR-6 and the Division's associated review letters dated September 29, 2023, February 6, 2024, and March 25, 2024.

As noted earlier in this memo, the proposed Report is based on the engineering analysis and site reconnaissance conducted by KUE. Most of the site parameters and conditions are carried over to the Report from the original analysis provided under TR-6. The primary differences between KUE's analysis and the Report come from two main factors; 1) the change in designation and associated minimum factor of safety requitements of the Type of Structure/Consequence of Failure from "critical" to "non-critical" as outlined in Section 30, Table 1 of the Policies of the Mined Land Reclamation Board and 2) the use of an increased value of cohesion for the interbed material located between limestone beddings.

Board Policies – Section 30, Table 1

Table 1. - *Recommended Minimum Factors of Safety for Slope Stability Analyses for Operations and Reclamation* outlines the minimum requirements for factors of safety for the Division. The table is broken down into four quadrants based on potential magnitude of damages (critical vs. non-critical) and reliability of geologic information (assumed parameters vs. site specific parameters). As noted in GGI's Report, in the scenario of revocation, the site would no longer be operating and the potential for human safety risk no longer remains. With the Mine inactive, GGI uses the designation of "non-critical" for generalized, assumed, or single test strength measurements. The corresponding minimum factors of safety found with Section, Table 1 are 1.3 for static conditions and 1.15 for seismic conditions.

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Jared S. Polis, Governor | Dan Gibbs, Executive Director | Michael Cunningham, Director

While under the assumption of Mine revocation, it is understood that Mine personnel will no longer be present. However, the potential risk for human safety remains given the location of the site. The Mine is located on public land that is managed by the Bureau of Land Management which is frequented by the public for outdoor recreation. Additionally, the area has cultural and historical significance for Native American tribes in the region. Given that the area has the potential for public interaction, the risk to human safety still exists and is considered "critical". As such, the corresponding minimum factors of safety are 1.5 and 1.3 for static and seismic conditions.

Material Strength Property – Cohesion

Material strength properties used within the Report were assumed and back-calculated values used in KUE's engineering report which was approved under TR-6. With no site-specific material strength testing, material strength properties were taken from published and verified typical values for the encountered limestone and interbed material at the Mine. Using conservative site parameters, a back analysis was conducted by setting the factor of safety to just below 1 which is the minimum criteria for a failure. The purpose of this back analysis was to corroborate the published value for cohesion used in the geotechnical model. For cohesion of the interbed material, empirical values were listed at 40 psf with the back analysis calculated at a value of 550 psf. As an additional measure of conservatism, KUE reduced the back-calculated cohesion to 250 psf which was used in KUE's geotechnical analysis. For more information summarizing the Division's review of KUE's assumptions and parameters, please refer to the Division's review memo for TR-6 dated September 29, 2023.

As discussed in the *Board Policies – Section 30, Table 1* section of this memo, GGI uses the designation of "non-critical". As part of this designation, GGI notes that the additional degree of conservatism regarding the cohesion value for the interbed material is no longer relevant and original back-calculated value of 550 psf. is used in the Report. However, as also discussed earlier in this memo, given that the area has the potential for public interaction, the risk to human safety still exists and the site is still considered "critical" in a revocation scenario. As the site is considered "critical", the interbed cohesion value of 250 psf assigned with the "critical" designation should be consistent and maintained through the engineering analysis for the revocation scenario.

Additional Comments

When reviewing the Report, calculated factors of safety are provided within the discussion however no associated geotechnical slope stability analysis results were provide for the Division's review. The resultant model analyses are necessary for the review to ensure that the discussed site parameters and assumptions are consistent and accurately applied to the slope stability models. Additionally, there were no discussions regarding the seismic parameters applied to the pseudo-static models. However, it should be noted that blasting was discussed but not analyzed in the Report. Under the revocation scenario, blasting will no longer be present and is longer relevant. It was also determined in KUE's report, approved with TR-6, that the pseudo-static seismic acceleration parameters are more conservative and control the analysis.

Adequacy Items

The following is a summary of the Division's comments/questions discussed and observed during the previous sections of this memo:

- As the site is considered "critical", the interbed cohesion value of 250 psf assigned with the "critical" designation should be consistent and maintained through the engineering analysis for the Mine which includes the revocation scenario. **Please have GGI provide updated slope stability analyses with the use of a cohesion value of 250 psf for the interbed material.**

- **Please have GGI provide details regarding the seismic parameters applied to the pseudo-static models.**

- Per Section 30 of the Policies of the Mined Land Reclamation Board, for generalized, assumed, or single test measurements for "critical" structures, the minimum recommended FOS is 1.5 for static conditions and 1.3 for seismic conditions. **Please have GGI provide updated slope stability analyses and recommended mechanical stabilization installation specifics that ensure the minimum recommended factors of safety of 1.5 for static conditions and 1.3 for seismic conditions are met for both the eastern and western sections.**

- **Please have GGI provide the updated geotechnical stability model and results which correspond to the provided factors of safety for the eastern and western sections of the Mine.**

This concludes my review of reviewed the provided GGI geotechnical report, "Highwall Reclamation Stabilization" (Report), associated with Technical Revision No. 9 (TR-9) for Mid-Continent Limestone Quarry. If you have any questions feel free to contact me.

Sincerely,

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