



COLORADO

**Division of Reclamation,
Mining and Safety**

Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

November 15, 2018

Mr. Russell A. Larsen
Kilgore Companies, LLC dba Elam Construction
556 Struthers Ave
Grand Junction, CO 81501

RE: Orchard Grove Industrial Pit, Permit M-1990-094, Incomplete Application for Transfer of Mineral Permit and Succession of Operators, Option two, Revision SO-01

Dear Mr. Larsen,

On February 23, 2018 the Division of Reclamation, Mining and Safety received the Application Form for Transfer of Mineral Permit and Succession of Operators from Parkerson Construction, Inc. to Kilgore Companies, LLC dba Elam Construction, for the Orchard Grove Industrial Pit, Permit M-1990-094. On November 9, 2018 the Division received an extension request to address the remaining adequacy items. The Division has approved the extension request, the new completeness due date is January 8, 2019.

On November 8, 2018 the Division received the slope stability analysis. The information presented does not appear to meet the Division policy for slope stability, (see attached). The following items must be addressed for application to be processed:

1. Structure Agreements were not provided for man-made structures, utilities and roads within 200 ft. of the affected land.
 - a. Provide proof of an attempt to reach an agreement with structures owners, i.e. Certified Mail Receipts of agreements sent
2. Slope Stability/ Geotechnical Analysis
 - a. Please specify the distance from the permit boundary in which future mining (at a near vertical slope) can occur without negatively impacting structures outside the permit boundary.
 - i. During the last inspection slopes were mined near vertical not 1:1. Alternatively the operator may revise the mining plan to make commitments to mine at different slope angle.
 - b. In 2.0 Conclusion, it is stated that the mining slope will result in a failure at 1.0 factor of safety while mining which is below the acceptable 1.3 FOS for non-critical structures and 1.5 FOS for critical structures. Both the mining and reclaimed slopes need to meet the FOS recommendations of Table 1.
 - c. For all structures please specify the distance from the permit boundary to each structure.



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Please return the required documentation to the Division before January 8, 2019 to complete the application for approval. All completed permit documents are required to be submitted for consideration of your Request for Transfer of Mineral Permit and Succession of Operators Application.

If you have any questions, please contact me at 303 866-3567 ext. 8183.

Sincerely,

A handwritten signature in blue ink that reads "Amy Yeldell". The signature is written in a cursive, flowing style.

Amy Yeldell
Environmental Protection Specialist

Cc: Barbra Coria, Division of Reclamation, Mining and Safety
Alan Parkerson, Parkerson Brothers LLC



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PROPOSED SLOPE STABILITY/GEOTECHNICAL ANALYSIS POLICY FOR THE MINED LAND RECLAMATION BOARD

To: Tony Waldron, Mined Land Reclamation Board

From: Tim Cazier, P.E.; TC Wait, P.G.

Date: May 16, 2018 – **FINAL DRAFT**

Re: **Factors of Safety for Slope Stability/Geotechnical Analyses Associated with Mining Operations**

Declaration of Purpose

The Division of Reclamation, Mining and Safety Minerals Program (Division) issues this memorandum to promote the orderly development of the state's natural resources while considering the industry's "standard of care" relative to Factors of Safety with the intent to:

- i. Protect and promote the safety and general welfare of the people of Colorado,
- ii. Ensure reclamation of lands affected by mining to beneficial use, and
- iii. Aid in the protection of aquatic resources and wildlife.

Background

In the past, the Division has typically accepted a factor of safety (FS) greater than 1.0 for slope stability analyses to demonstrate "that such structures shall not be damaged by activities occurring at the mining operation" pursuant to Rules pertaining to permanent man-made structures and geotechnical stability: Construction Materials Rules 6.3.12(b) and 6.4.19(b) and 6.5 and Hard Rock Rules 6.3.12(b), 6.4.20(b) and 6.5. This practice was based on the oversimplified concept that a slope with a $FS > 1.0$ is stable. This is technically true **IF** there is a comprehensive and complete understanding of all the geologic, hydraulic, land use, and other conditions that influence the forces and stresses determining whether or not the slope in question can or will fail. However, this is very rarely possible or feasible, particularly in a mining application. A FS must account for uncertainties (geologic setting, groundwater conditions, mining parameters, etc.), and the selection of an appropriate FS for slope stability should consider the following factors:

1. Magnitude of damages (potential risk to human safety, environmental impact and property damage),
2. Reliability of geologic information such as the proximity to faults, orientation of jointing, and subsurface soil and water data,
3. Changes in soil properties due to mine operations and variability in subsurface material,
4. Accuracy (or approximations used) in developing design/ analysis methods,
5. Additional considerations if relevant: Construction tolerances, Relative change in probability of failure by changing the factor of safety, and Relative cost of increasing or decreasing the factor of safety.

The Division engineering staff has researched the standard of care for factors of safety accepted by the industry, including literature searches, regulatory agency requirements/guidelines, and departments of transportation standards. In order to be consistent with other Colorado State agencies, we also considered FS standards used by the Colorado Department of Transportation (CDOT) and the Colorado Geological Survey



(CGS). CDOT uses the AASHTO minimum FS of 1.3 for construction slopes near roadways and utilities. CGS uses a minimum FS of 1.5 for residential areas when using "generalized" strength values, or 1.3 for analyses when good quality site-specific soil parameters are known. It should be noted that most industry standards assume a permanent slope configuration, ignoring the temporary conditions that are frequently observed in the mining industry.

Guidance for Stability Criteria and Use of Minimum Factors of Safety

Based on the review described above, the permittee should either follow the criteria in Table 1 for all stability analyses submitted to the Division; or, alternatively, the permittee may submit stability analyses based on site-specific engineering analysis performed in consideration of good practices as specified in relevant industry guidelines and/or professional standards and reviewed by the Division on a case-by-case basis.

Slope stability analyses for existing facilities may also be reviewed on a case-by-case basis, subject to the criteria described herein.

Table 1. Recommended Minimum Factors of Safety for Slope Stability Analyses for Operations and Reclamation

Type of Structure/Consequence of Failure	Generalized, Assumed, or Single Test Strength Measurements	Strength Measurements Resulting from Multiple Tests ⁽¹⁾
<u>Non-Critical Structures</u> (e.g., fences) No imminent danger to human life, minor repair costs, and minor environmental impact if slope fails	1.3 (1.15) ⁽²⁾	1.25 (1.1) ⁽²⁾
<u>Critical Structures</u> (e.g., residences, utilities, dams, pipelines, irrigation canals, public roads, etc.) Potential human safety risk, major environmental impact, and major repair costs if slope fails (includes Environmental Protection Facilities/EPFs, such as tailings facilities, heap leach pads, process effluent ponds, milling facilities, overburden/waste rock storage facilities, and hazardous/toxic material storage facilities, etc.)	1.5 (1.3) ⁽²⁾	1.3 (1.15) ⁽²⁾
<p>(1) The number of tests required to provide a high degree of confidence in the strength parameters used depends on the variability of the material being tested and the extent of disturbance.</p> <p>(2) Numbers without parentheses apply for analyses using static conditions. Those within parentheses apply to analyses using seismic parameters. Based on site specific conditions, seismic analyses may be required and parameters selected shall be consistent with the risk and duration of the condition being considered.</p>		

Disclaimer

The values presented in Table 1 are not intended to supersede standards required by other agencies.

Definitions

Factor of Safety – Ratio of forces resisting movement to those driving movement.

Slope Failure – the movement (sliding or collapsing) of rock and/or soil in response to gravitational stresses, often under the influence of a rainfall or seismic activity.

Slope Stability – the resistance of inclined surface to failure by sliding or collapsing.

Slope Stability Analysis – performed to assess the safe design of a human-made or natural slopes (e.g. open-pit mining, excavations, embankments, road cuts, etc.) and the equilibrium conditions.