November 10, 2022

Colorado Division of Reclamation, Mining, and Safety
1313 Sherman St, Rm 215
Denver, CO 80203

Delivered Via Email
RE: Gold Hill Mill, Permit No. M-1994-117
Technical Revision 11 – Times/Wynona Mine Bulkhead Design
Adequacy Response

Mr. Patrick Lennberg

Colorado Milling Company is providing the following response to the November 2, 2022 adequacy letter from the Division regarding the Gold Hill Mill Technical Revision 11.

Bulkhead Design Questions
Schnabel Engineering has produced a memo to address the Division's questions regarding the chosen peak ground acceleration and shear strength assumptions.

Monitoring Plan Comments
Colorado Milling Company will monitor along both sides of the ridge (east and west) from the Times-Winona Adit (8340') up for seeps and springs. General monitoring areas are shown on the attached Bulkhead Location Map. Groundwater levels in existing monitoring wells will be measured during bulkhead filling. The 90-day monitoring period will began upon bulkhead filling.

Please feel free to contact me with any questions

Regards,

Ben Langenfeld, P.E.
Lewicki & Associates, PLLC
(720) 842-5321, ex. 1
benl@lewicki.biz

LEGEND

BUILDINGS AND RELATED STRUCTURES

- Building

ROADS AND RELATED FEATURES

- Light duty road, gravel

RIVERS, LAKES, SHORELINES, AND CANALS

- Monitoring Well

TRANSMISSION LINES AND PIPELINES

- Power transmission line; pole; tower
- Power transmission line, buried
- Telephone/data line, above ground
- Telephone/data line, buried
- Pipeline (non-water), above ground
- Pipeline (non-water), buried

MINING FEATURES

- DRMS Permit Boundary

BASELINE CONTOURS

- Index
  - Approximate of indefinite
- Intermediate
  - Approximate of indefinite
- Supplementary

SEEPAGE MONITORING ZONE

TIMES/WYNONA MINE PORTAL

BULKHEAD INSTALLATION LOCATION

0+00 0+50 1+00 1+50 2+00 2+50 3+00 3+50 4+00 4+50 5+00 5+50 6+00 6+50 7+00 7+50 8+00

TIMES DRILLHOLE

WYNONA SHAFT

SEEPAGE MONITORING ZONE

TP/P

W4

W3

W2

W1

CAPPED WELL

MW1

TUNNEL WORKINGS VIA SCHNABEL SITE DATA

8450' 8425' 8400' 8375' 8350' 8325' 8300' 8275' 8250' 8225' 8200'

Bulkhead Location Map

Gold Hill Mill

DRMS Permit Number: M-1994-117 — **Colorado Milling Company, LLC**

Mine Entry Location:	Latitude: 40.06548	Longitude: 105.48670
State: COLORADO	County: Boulder	Nearest Town: Gold Hill
Section: 12	Township: 1N	Range: 72W PM: 6th
Major Watershed:	Boulder Creek	MSHA ID: ----

Map Scale: 1": 100

0 100 200

N

Map Georeferencing Information:	**Datum: NAD83**	**Projection: CO NORTH**
Survey Source: CO Geo Cache	**Drawn by:** BEL	Date: 05/03/22
Imagery Source: Google	**Checked by:** BEL	Date: 08/10/22
Survey Date: 2019	**Approved by:** BEL	Date: 08/10/22
Imagery Date: 2019		

File Name: Gold Hill Mill

Lewicki & Associates

3375 West Powers Circle
Littleton, CO USA 80123
(303)-346-5196
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Attachments

Schnable Engineering Memo

Schnabel ENGINEERING

600 South Airport Road, Suite A-205
Longmont, Colorado 80503
303-651-1468
schnabel-eng.com

TECHNICAL MEMORANDUM

TO:	Jerry Jergensen	**DATE:**	11/8/2022
COMPANY:	Colorado Milling Company, LLC	**SUBJECT:**	Time Mine Bulkhead Design Calculations
ADDRESS:	50 West 100 South Street Moab, Utah 80342	**PROJECT NAME/NO.:**	22690002.000
FROM:	Christoph Goss, PhD, PE	**CC:**	Ben Langenfeld

We have reviewed the Colorado DRMS letter *Adequacy Review; Technical Revision (TR-11); Gold Hill Mill, Permit No. M-1994-117* dated November 2, 2022 which references the letter *Review of M-1994-117 TR-11; specifically pertaining to hydraulic bulkhead design*, dated November 1, 2022. The letters request two clarifications concerning the bulkhead design. Our response is included herein.

1. The applicant should provide supporting documentation for selection of 0.138 g as the Peak Ground Acceleration associated with an earthquake for this geographic location.

The Peak Ground Acceleration (PGA) was obtained from the USGS Unified Hazard Tool (https://earthquake.usgs.gov/hazards/interactive) for latitude 40.065449, longitude -105.405453. The specific model selected was Dynamic: Conterminous U.S. 2014 (update) (v4.2.0) with a 2% chance of exceedance in 50 years (2475 return period).

2. The applicant should provide additional clarity on the assumption that concrete shear strength is controlling at the bulkhead location. It is noted in the design that both the hanging wall and vein are heavily altered at the bulkhead location, and as such, shear failure may not be controlled by concrete strength. If complete removal of altered material at the bulkhead location prior to installation is not possible how will the punching shear calculation be factored to account for lower strength material controlling shear failure, and what will be the corresponding factor of safety.

The concrete shear strength used in the calculation is 109.5 psi which comes from multiplying the square root of the compressive strength by two (ACI 318-95, 11.3.1.1 and 11.3.2.1). This provides a Factor of Safety of 6.2 for punching shear with water hammer. For comparison, USBM Circular 9020 (Chekan 1985) notes *The Government Mining Engineer of South Africa recommends 85 psi as the allowable shear stress (fs) for concrete placed in the normal manner and 120 psi for plugs where positive contact between rock and plug is ensured by subsequent pressure grouting*. The design for Times Mine does include pressure grouting the rock/concrete contact, hence the 109.5 psi is conservative.

Numerous methods have been developed for estimating the shear strength of the discontinuities in rock. A common one used to calculate factors of safety against sliding uses the standard Mohr-Coulomb failure criteria where the shear strength is equal to the vertical stress times the tangent of the friction angle plus cohesion.

$$\boldsymbol{\tau = c + \sigma_n tan\varphi}$$

$$\tau = peak\ shear\ strength$$
$$\sigma_n = normal\ stress$$
$$c = cohesive\ strength\ of\ the\ cemented\ surface$$
$$\varphi = angle\ of\ friction$$

Practical Rock Engineering (2007 ed) by Dr. Evert Hoek includes a chapter on Shear Strength of Discontinuities in rock masses which in in turn includes Table 1 listing typical ranges of friction angles and cohesion for various materials. Since the controlling load is the water hammer and no movement of the bulkhead is anticipated, the peak shear strength is most applicable. The design also calls for the removal of altered material, likely by a combination of chipping and pressure washing. If material cannot be removed with those methods, it suggests that it is not too weak. For example, clay and heavily fractured rock would be easily removed by pressure washing and chipping. A reasonable yet conservative material from the table would be *Granite: Tectonic shear zone, schistose and broken granites, disintegrated rock and gouge* with a friction angle of 42 degrees and a cohesion of 35 psi. For the tunnel depth and rock density used in the design (26 feet and 165 pcf, respectively), the shear strength is

$$\tau = 26 * \frac{165}{144} * tan42 + 35$$

$$\tau = 62\ psi$$

Reducing 109.5 psi in the punching shear design equations for a 6-foot bulkhead to 62 psi results in a factor of safety of 3.5, the same as flexural bending for water hammer. Hence the 6-foot design length is still acceptable.

STATE OF COLORADO

Ebert - DNR, Jared <jared.ebert@state.co.us>

Fwd: Adequacy Review Letter, TR-11, Gold Hill Mill, M1994-117

Ben Langenfeld <benl@lewicki.biz> Fri, Nov 11, 2022 at 10:27 AM
To: Jared Ebert - DNR <jared.ebert@state.co.us>

Patrick

Attached is the TR 11 adequacy response for Gold Hill Mill. Let me know if you want a hard copy.

Ben Langenfeld, P.E.

Lewicki & Associates

benl@lewicki.biz

Office: (720) 842-5321

Cell: (303) 960-5613

From: Lennberg - DNR, Patrick <patrick.lennberg@state.co.us>
Sent: Wednesday, November 2, 2022 9:36 AM
To: Ben Langenfeld <benl@lewicki.biz>; jerryjergensen@aol.com
Subject: Adequacy Review Letter, TR-11, Gold Hill Mill, M1994-117

Good Morning,

Please find attached to this email a copy of the Division's Adequacy Review Letter for TR-11 at the Gold Hill Mill.

A hard copy will not be mailed unless specifically requested.

Please let me know if you have any questions.

Thank you,

Patrick

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Patrick Lennberg

Environmental Protection Specialist

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

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GHM TR Adeq Response 221110.pdf
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