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

September 26, 2021

Joel Bolduc
Albert Frei & Sons, Inc.
35715 Hwy 40, Building B, Suite 120
Evergreen, CO 80439

Re: Albert Frei & Sons, Inc.; Walstrum Quarry; File No. M-1983-033; Amendment Application (AM-09); Third Geotechnical Review Memo

Mr. Bolduc:

The Division of Reclamation, Mining and Safety (Division/DRMS) reviewed the contents of the adequacy response dated September 15, 2021 submitted for the Walstrum Quarry amendment application (AM-09), Permit No. M-1983-033. A copy of the third review memo from Zach Trujillo dated September 21, 2021 is attached for review.

If you have any questions, please contact me at peter.hays@state.co.us or (303) 866-3567 Ext. 8124.

Sincerely,

Peter S. Hays
Environmental Protection Specialist

Enclosure – Third Review Memo

Ec: Jared Ebert; Division of Reclamation, Mining & Safety

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

Date: **September 21, 2021**

To: **Peter Hays**

CC: **Jason Musick, Jared Ebert**

From: **Zach Trujillo**

RE: **Walstrum Quarry AM-09, DRMS File No. M-1983-033**
Slope Stability Review

Peter,

As requested I have reviewed Walstrum Quarry's (Walstrum) adequacy response dated September 15, 2021 to the Division's Second Adequacy Letter dated September 10, 2021. This review is specific to Item #27 in both of the above referenced letters and the proposed Geotechnical Stability Exhibit (Exhibit) for the AM-09 Walstrum Spur Amendment. The following summarizes all comments:

> **Division** (September 10, 2021)**:** *27. The Division sent a copy of the Geotechnical Review Memo from Zach Trujilo dated August 31, 2021 to the Operator on September 2, 2021. Please respond to the adequacy concern in the memo.*
>
> *When comparing the Division's slope profile to that of the provided profiles with the supplemental information, it appears that the angle of slope used for the low strength rock do not match. Using a 45 degree angle for the low strength rock, the Division's slope profile appears to be angled steeper than that which was provided with the supplemental information. When measuring the provided slope angles within AutoCAD, the maximum angle discovered was 40 degrees. This difference in a higher angle would result in the lower factor of safety as observed with the Division's results for the sensitivity analysis. This leads the Division to believe that perhaps there is a typo in Table 5 within the Exhibit and a lesser angle of slope was used for the sensitivity analysis to result in a factor of safety of 1.15 under pseudo-static conditions.*
>
> *Based on this, please have Walstrum provide the following:*
>
> - *Please have Walstrum confirm the angle used for the low strength rock in the sensitivity analyses that result in the factors of safety provided in Table 5 of the Exhibit.*
>
> **Walstrum** (September 15, 2021): *The Division correctly identified an error in Table 5, which also occurs in Appendix I. Using a hypothetical material with slope of 35 degrees in the sensitivity analysis, the resulting Factors of Safety are 1.15 for 10-ft-thick Xb and 0.95 for 20-ft-thick Xb. See Attachment 5 for the updated page 31 of 35 with corrected Table 5 (Geotechnical*

1313 Sherman Street, Room 215, Denver, CO 80203 P 303.866.3567 F 303.832.8106 http://mining.state.co.us
Jared S. Polis, Governor | Dan Gibbs, Executive Director | Virginia Brannon, Director

Stability Exhibit). See Attachment 6 for the updated page 4 of 8 with corrected Figures 7 and 8 (Geotechnical Stability Exhibit, Appendix I).

With confirmation of the slope angle error for the low strength rock (Xb) discussed in the Exhibit, the Division reconstructed the slope profile for 10-ft-thick Xb at a 35 degree angle under seismic conditions (Sensitivity Analysis) in the slope stability software, GALENA. However, the factor of safety result of the Division's slope stability analysis is still below the Division's requirement under Section 30 of the Policies of the Mined Land Reclamation Board.

Additionally, the Division performed an additional slope stability analysis for the same slope profile but under static conditions. The resulting factors of safety is summarized below in comparison to the results provided by Walstrum and the requirements of the Division for the updated GALENA model.

Factors of Safety - Walstrum Spur Amendment				
Section	Seismic Coefficient	Galena	Walstrum	DRMS Requirements
*2	0	1.15	N/A	N/A
*2	0.12	0.92	1.15	1.15
*Hypothectical Model - 10 ft. thick low strength rock @ 35 degrees				

As shown in the above table, the Division model for the slope profile of 10-ft-thick Xb at a 35 degree angle under static conditions resulted in a factor of safety of 1.15. The results summarized above leads the Division to believe the difference in results is either from 1) differing modeling software and methodology and/or 2) seismic conditions were potentially not included in the Walstrum sensitivity analysis. When reviewing Walstrum's resulting slope stability profile visual for the Sensitivity Analysis found in Appendix I, there is no indication a seismic coefficient of 0.12 was applied to the model outside of the associated title. At the moment, there is no way for the Division to confirm the application of a seismic condition to the Sensitivity Analysis.

Based on the following discussion, please have Walstrum discuss and/or provide the following:

- **Please have Walstrum confirm that the appropriate seismic condition was applied to the Sensitivity Analysis provided in the Exhibit.**

- **If the appropriate seismic condition was applied to the Sensitivity Analysis provided in the Exhibit, please have Walstrum provide the numerical results that outline all parameters, variables and results for the Sensitivity Analysis for the Division's review.**

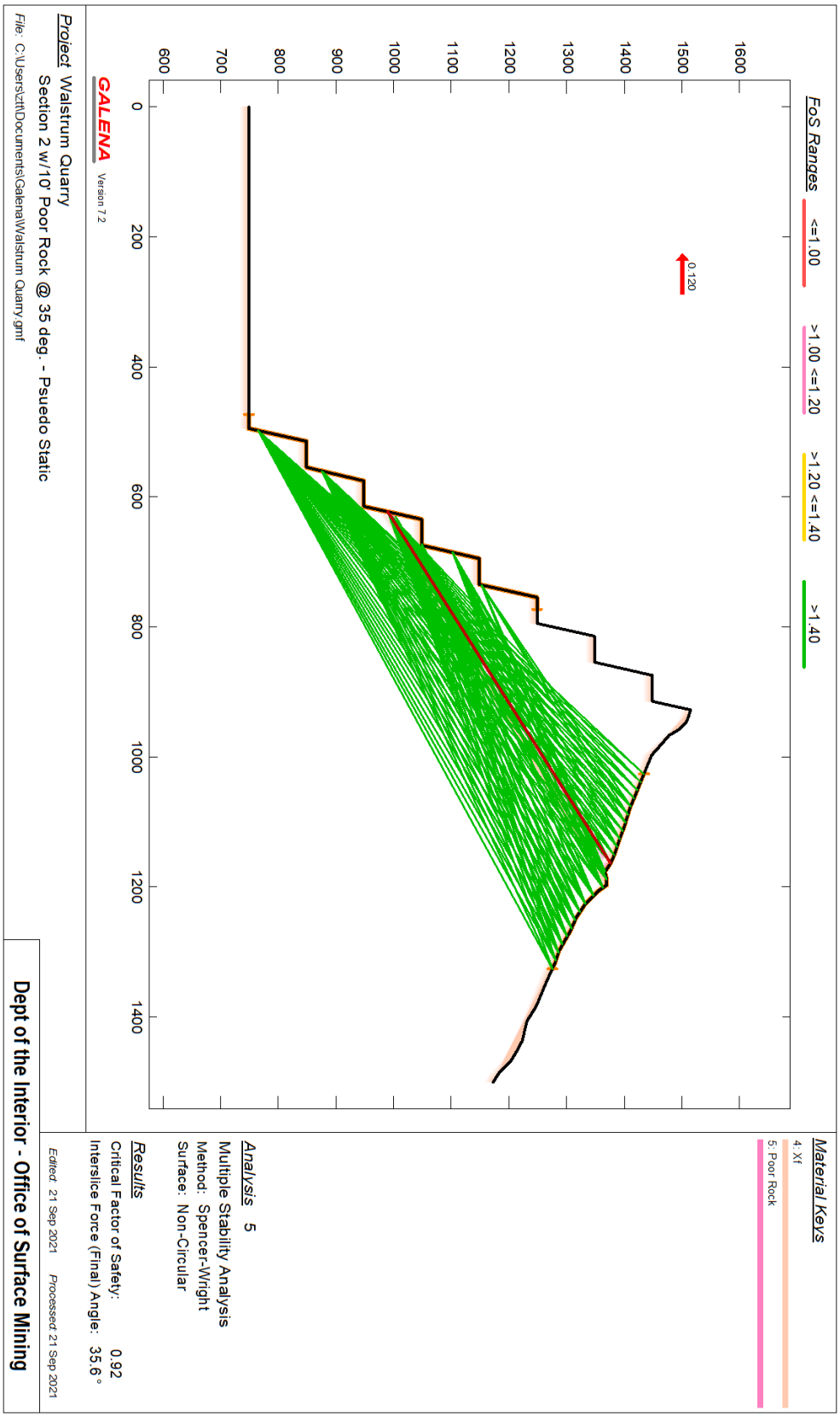
This concludes my review and comments for the Walstrum Quarry's (Walstrum) adequacy response dated September 15, 2021 to the Division's Second Adequacy Letter specific to Item #27. If you have any questions feel free to contact me.

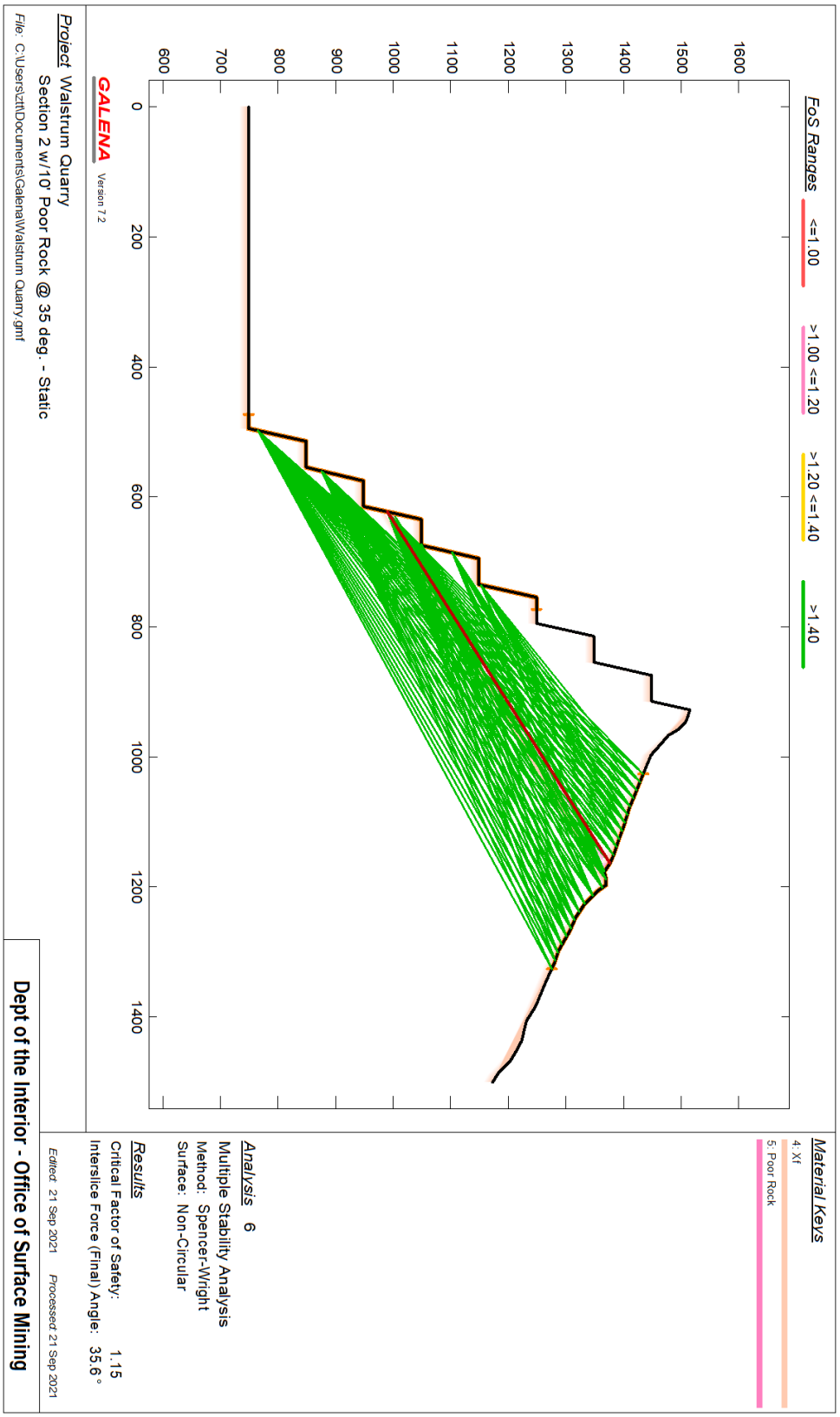
Sincerely,

Zach Trujillo
Environmental Protection Specialist
(303) 866-3567 ext. 8164
Zach.Trujillo@state.co.us

Galena Slope Stability Results

Division's Sensitivity Analysis




FoS Ranges
<=1.00
>1.00 <=1.20
>1.20 <=1.40
>1.40
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
0
200
400
600
800
1000
1200
1400
Material Keys
4: Xf
5: Poor Rock
Analysis 6
Multiple Stability Analysis
Method: Spencer-Wright
Surface: Non-Circular
Results
Critical Factor of Safety: 1.15
Interslice Force (Final) Angle: 35.6°
GALENA Version 7.2
Project Walstrum Quarry
Section 2 w/10' Poor Rock @ 35 deg. - Static
File: C:\Users\ztt\Documents\Galena\Walstrum Quarry.gmf
Edited 21 Sep 2021 Processed 21 Sep 2021
Dept of the Interior - Office of Surface Mining

Division's Slope Profile for Sensitivity Analysis