



COLORADO

**Division of Reclamation,
Mining and Safety**

Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

Date: January 22, 2018

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

From: Peter Hays; Division of Reclamation, Mining & Safety

**Re: Loveland Ready-Mix Concrete, Inc.; Knox Pit; File No. M-2017-036;
Exhibit 6.5 – Second Geotechnical Stability Exhibit Review**

The Division of Reclamation, Mining and Safety (Division/DRMS) has reviewed the Geotechnical Stability Analysis included in Exhibit 6.5 of the Knox Pit 112c permit application and the stability analysis models received on January 3, 2018 in response to the Division's adequacy letter. The Division verified the Applicant's stability analysis models using Clover Technology's Galena v7.1 (Galena) slope stability software.

Pre-Reclamation Slope Stability

The Applicant's cross section was duplicated for verification. The factor of safety produced by Galena (1.35) was lower than the factor of safety produced by the Applicant's calculation (1.7). The factor of safety is greater than the required factor of safety of 1.3. Therefore, the accuracy of the Applicant's calculation is confirmed. A copy of the Galena model is attached.

Generic Worst-Case Post Reclamation Scenario

The Applicant's cross section was duplicated for verification. The factor of safety produced by Galena (1.88) was greater than the required factor of safety of 1.3. Therefore, the stability of the cross section is acceptable. A copy of the Galena model is attached.

Post Reclamation Platte River Power Authority Cross-Section – 50' Offset

The Applicant's cross section was duplicated for verification. The factor of safety produced by Galena (3.28) was lower than the factor of safety produced by the Applicant's calculation (3.71). The factor of safety is greater than the required factor of safety of 1.3. Therefore, the accuracy of the Applicant's analysis is confirmed. A copy of the Galena model is attached.



Post Reclamation Platte River Power Authority Cross-Section – 30' Offset

The Applicant's cross section was duplicated for verification. The factor of safety produced by Galena (2.51) was greater than the factor of safety produced by the Applicant's calculation (2.01). The factor of safety is greater than the required factor of safety of 1.3. Therefore, the accuracy of the Applicant's analysis is confirmed. A copy of the Galena model is attached.

Post Reclamation Cache La Poudre Ditch Cross-Section – 50' Offset

The Applicant's cross section was duplicated for verification. The factor of safety produced by Galena (2.84) was lower than the factor of safety produced by the Applicant's calculation (3.74). The factor of safety is greater than the required factor of safety of 1.3. Therefore, the accuracy of the Applicant's analysis is confirmed. A copy of the Galena model is attached.

Post Reclamation Cache La Poudre Ditch Cross-Section – 30' Offset

The Applicant's cross section was duplicated for verification. The factor of safety produced by Galena (2.23) was greater than the factor of safety produced by the Applicant's calculation (1.89). The factor of safety is greater than the required factor of safety of 1.3. Therefore, the accuracy of the Applicant's analysis is confirmed. A copy of the Galena model is attached.

Conclusion

The Division accepts the stability analysis models for the proposed critical slope cross-section and mining offsets combinations at the Knox Pit. The Applicant must contact the Division immediately and re-evaluate the stability analysis if groundwater is intercepted shallower than expected and/or the soils differ from the expected soil types. The Applicant must understand any transgression of the sloping criteria and mining offsets will be considered a violation of the permit, if approved and issued by the Division.

Enclosures – Galena stability models

Ec: Wally Erickson; Division of Reclamation, Mining & Safety

Material Keys

- 2: Topsoil
- 3: Sandy Gravel
- 4: Bedrock

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

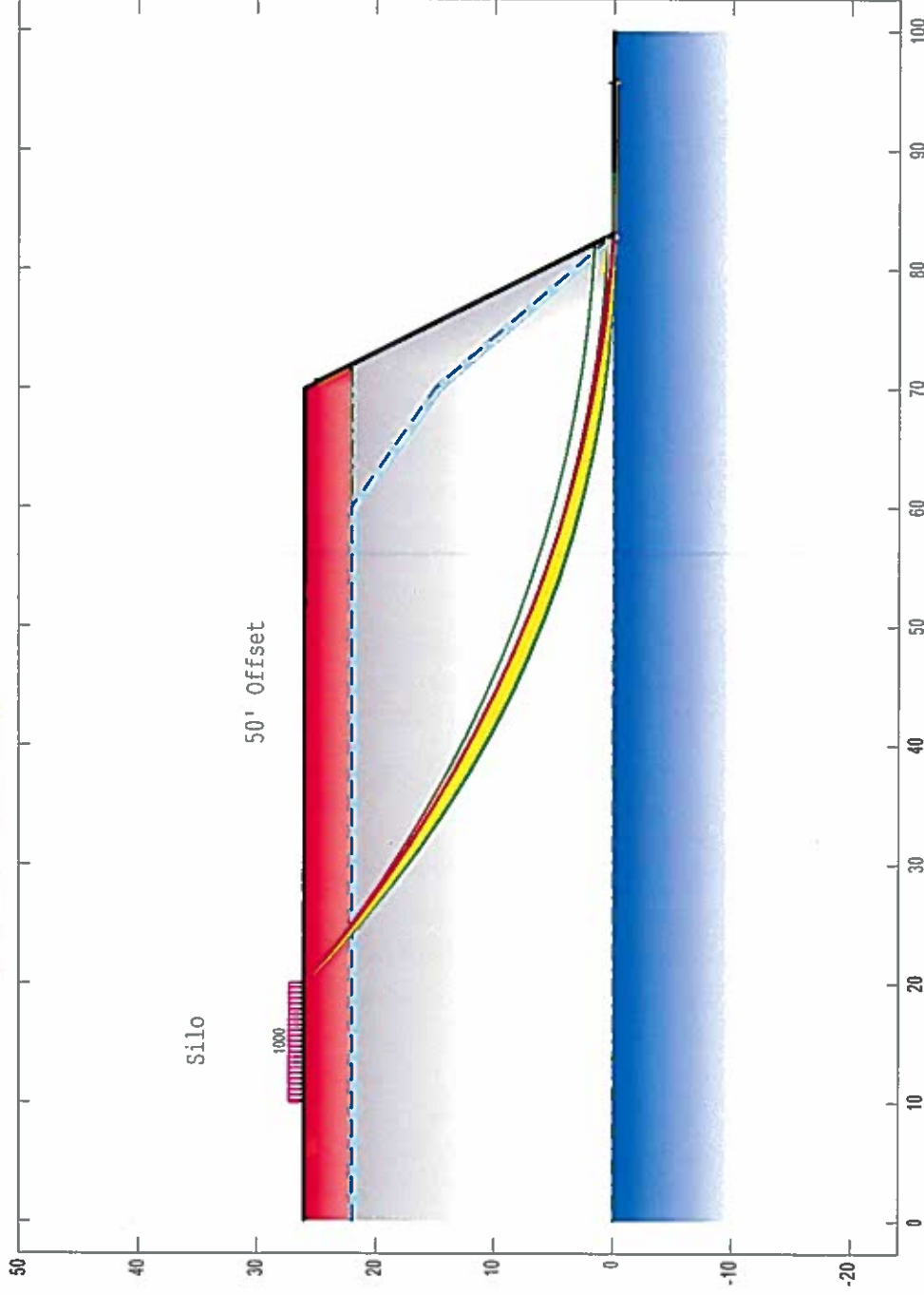
Results

Critical Factor of Safety: 1.35

Edited: 22 Jan 2018 Processed: 22 Jan 2018



FoS Ranges ≤ 1.00 $> 1.00 \leq 1.20$ $> 1.20 \leq 1.40$ > 1.40



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Project Knox Pit

Mine Slope Analysis - 50' Offset

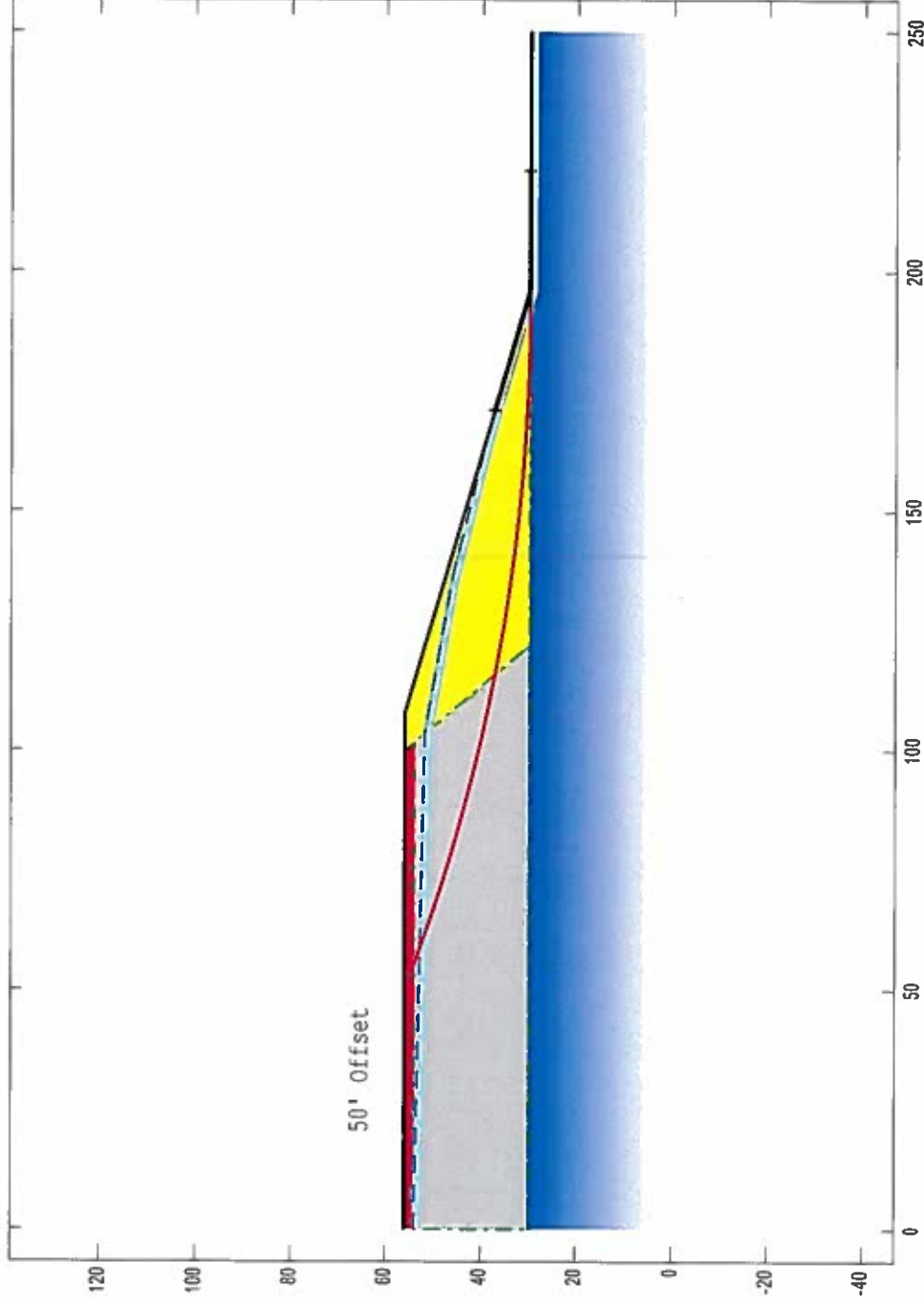
File: C:\Users\PSHIM\My Projects\7 Galena - Stability Analysis Models\Knox Pit\Typical Mine Slope 50 foot offset.gmf

FoS Ranges

≤ 1.00 $> 1.00 \leq 1.20$ $> 1.20 \leq 1.40$ > 1.40

Material Keys

- 1: Backfill
- 2: Topsoil
- 3: Sandy Gravel
- 4: Bedrock



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Project Knox Pit

Generic Worst-Case Post Reclamation Scenario

File: C:\Users\SHM\My Projects\7 Galena - Stability Analysis Model\Knox Pit\Generic Worst-Case Post Reclamation Scenario.gmf

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.88

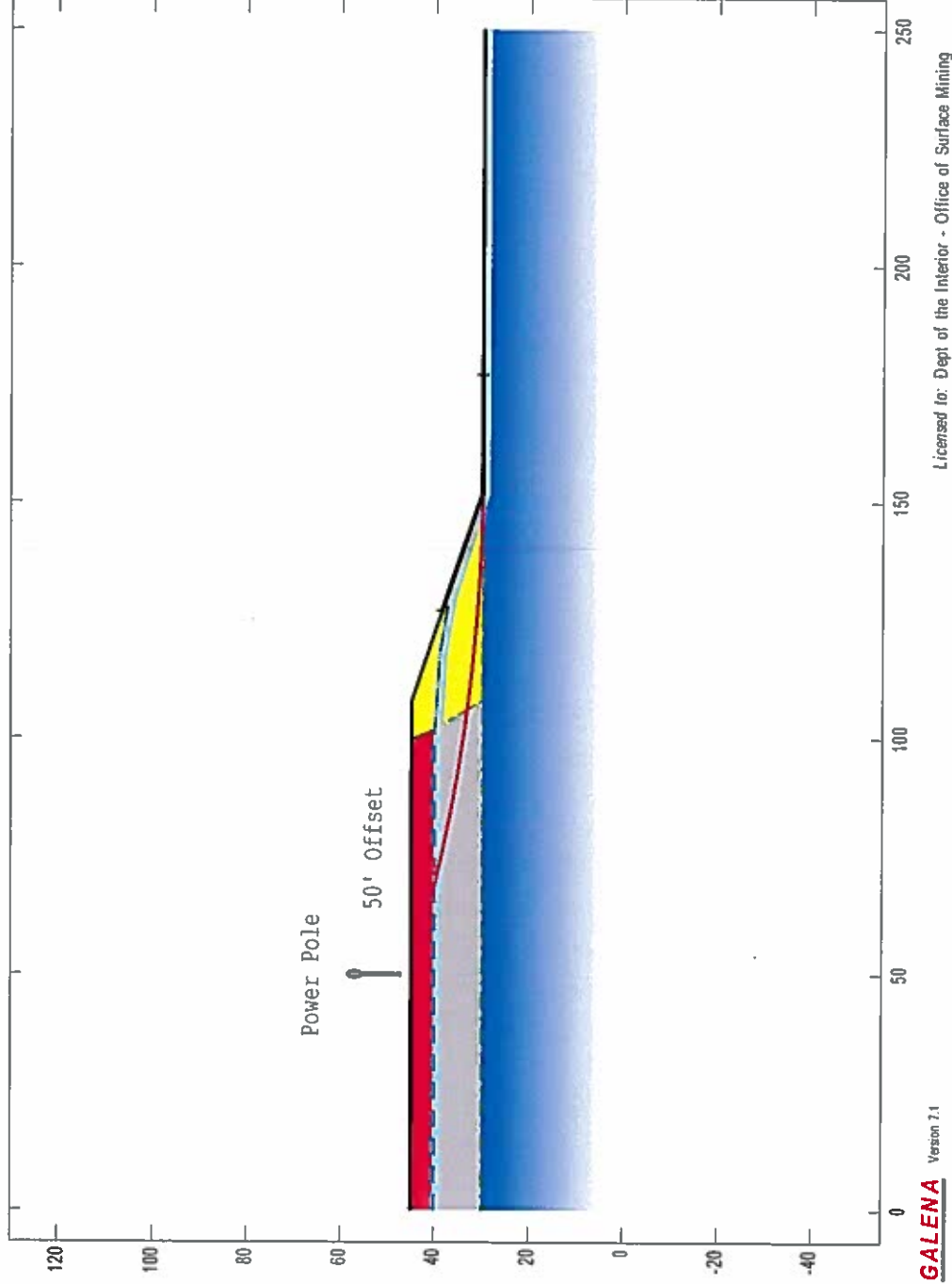


FoS Ranges

≤ 1.00 $> 1.00 \leq 1.20$ $> 1.20 \leq 1.40$ > 1.40

Material Keys

- 1: Backfill
- 2: Topsoil
- 3: Sandy Gravel
- 4: Bedrock



Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 3.28

Edited: 22 Jan 2018 Processed: 22 Jan 2018

Project Knox Pit

Post Reclamation Platte River Power Authority Cross-Section

File: C:\Users\p...l\Post Reclamation Platte River Power Authority Cross-Section 50' Offset.gmf

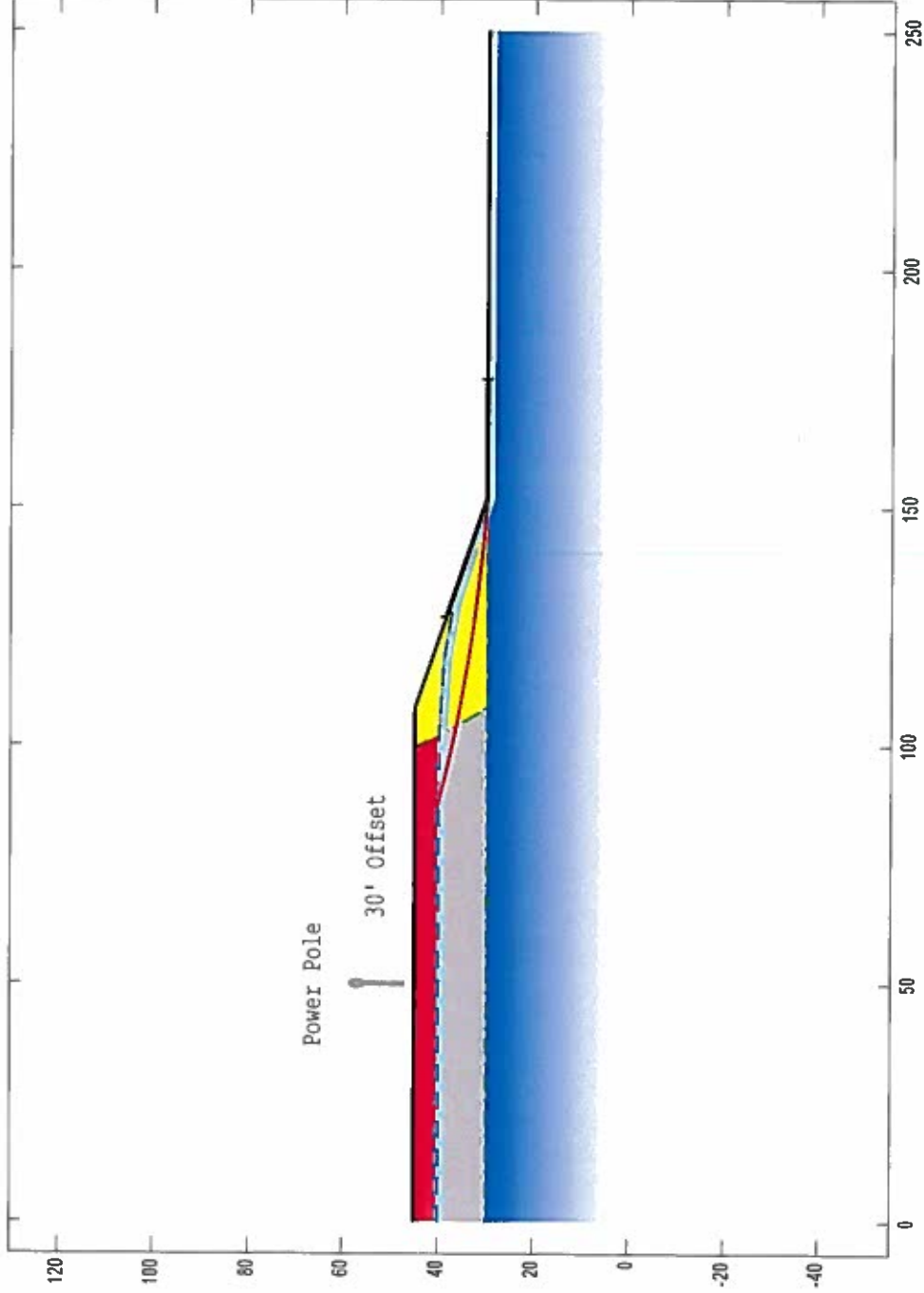


FoS Ranges

≤ 1.00 $> 1.00 \leq 1.20$ $> 1.20 \leq 1.40$ > 1.40

Material Keys

- 1: Backfill
- 2: Topsoil
- 3: Sandy Gravel
- 4: Bedrock



Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.51

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Project Knox Pit

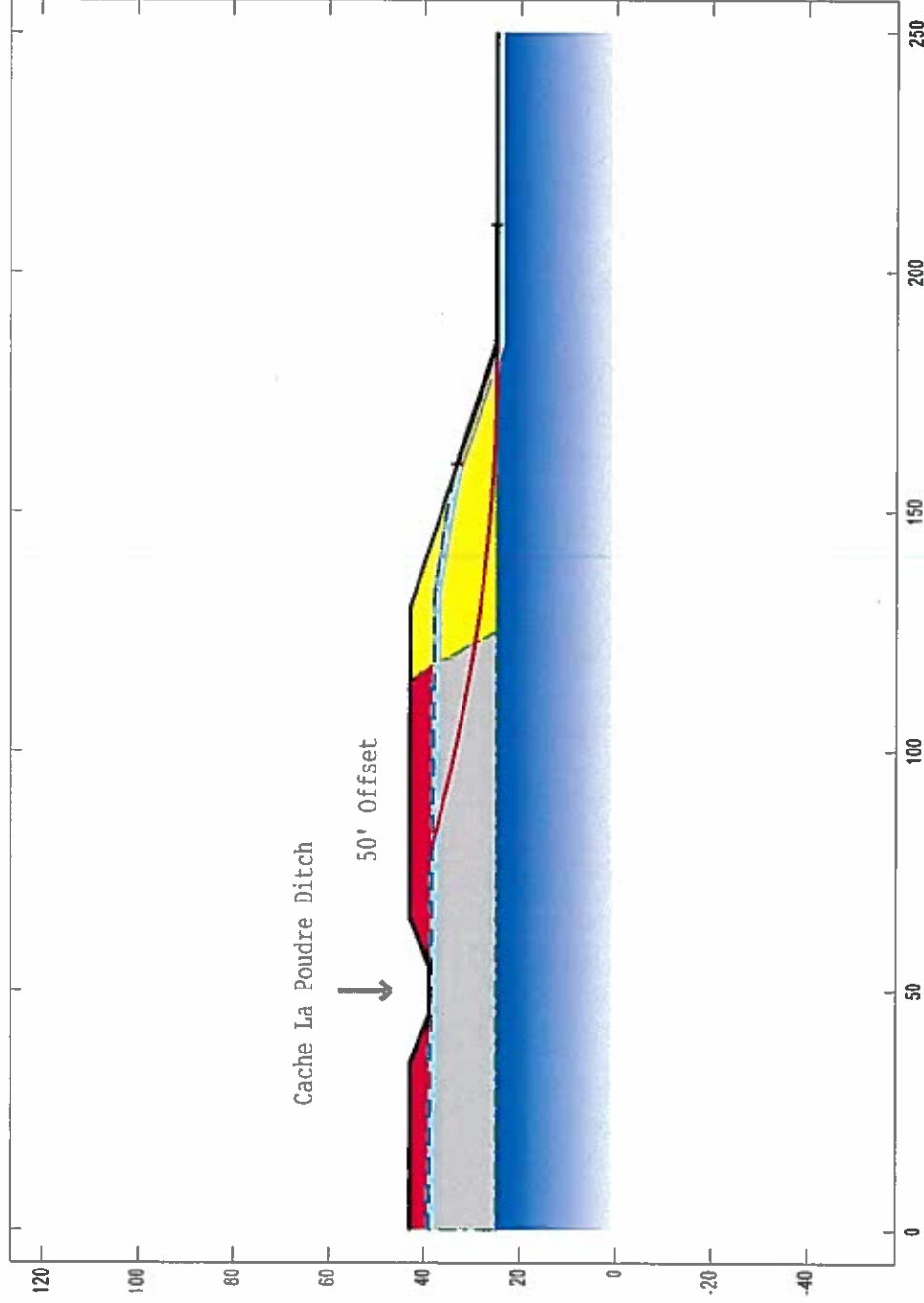
Post Reclamation Platte River Power Authority Cross-Section

File: C:\Users\p...Post Reclamation Platte River Power Authority Cross-Section 30' Offset.gmf



FoS Ranges

≤ 1.00 $> 1.00 \leq 1.20$ $> 1.20 \leq 1.40$ > 1.40



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Material Keys

- 1: Backfill
- 2: Topsoil
- 3: Sandy Gravel
- 4: Bedrock

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.84

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Project Knox Pit

Post Reclamation Cache La Poudre Ditch Cross-Section

File: C:\Users\p...Post Reclamation Cache La Poudre Ditch Cross-Section 50' Offset.gml

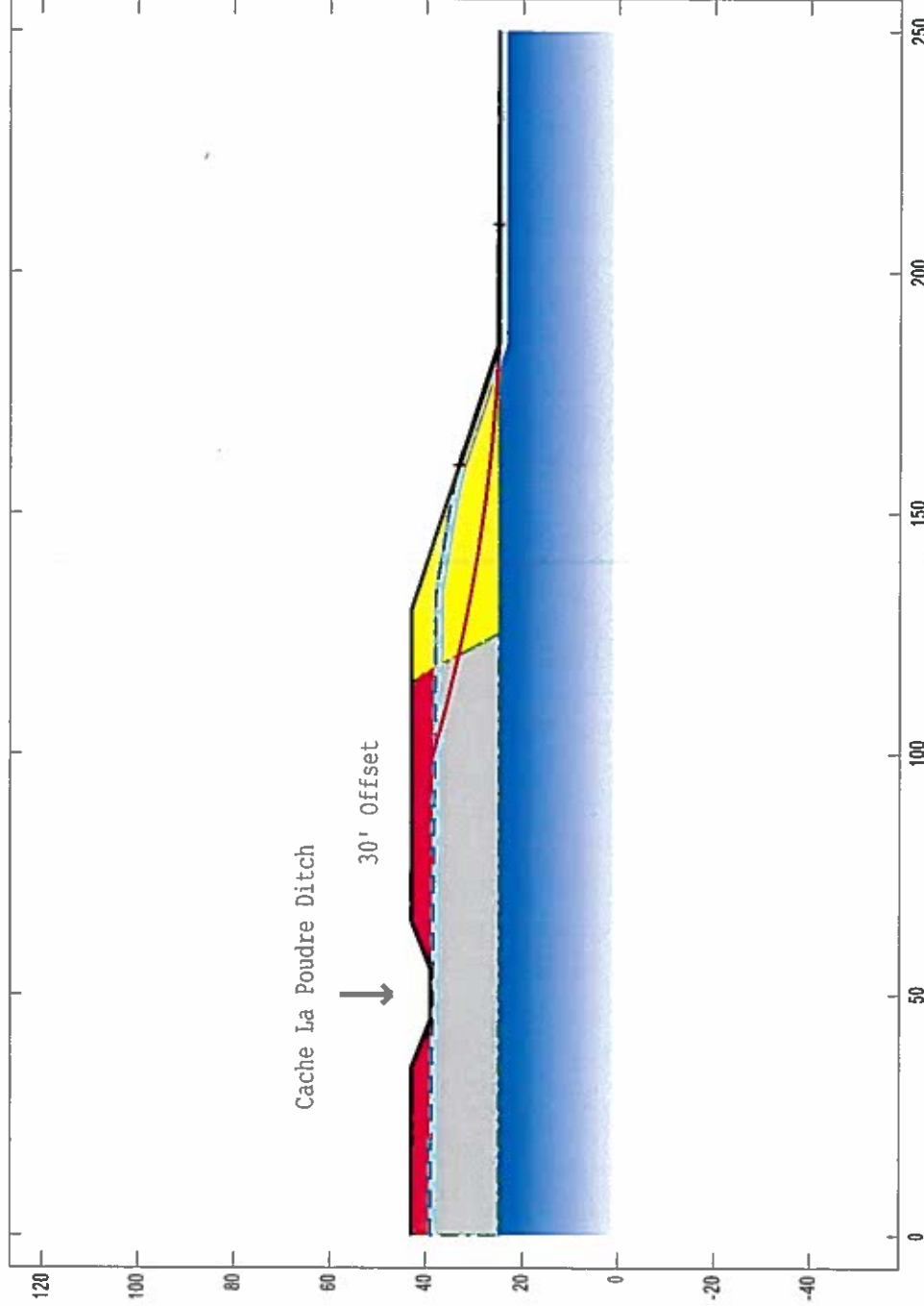


FoS Ranges

≤ 1.00 $> 1.00 \leq 1.20$ $> 1.20 \leq 1.40$ > 1.40

Material Keys

- 1: Backfill
- 2: Topsoil
- 3: Sandy Gravel
- 4: Bedrock



Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.23

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Project Knox Pit

Post Reclamation Cache La Poudre Ditch Cross-Section

File: C:\Users\p...Post Reclamation Cache La Poudre Ditch Cross-Section 30' Offset.gmf

