



August 10, 2022

Raptor Materials, LLC
8120 Gage Street
Frederick, Colorado 80516
Attn: Garrett Varra

RE: Revised Two Rivers Slope Analysis
Technical Adequacy Review
DRMS Letter Date June 1, 2022

Dear Mr. Varra:

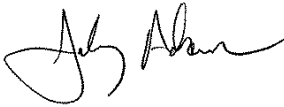
This letter report presents an updated geotechnical stability analysis performed by American Water Engineering Services, LLC (AWES) for the Raptor Materials, LLC (Raptor) mine located near Evans, Colorado. This report is intended to address the issues raised in the Division of Reclamation, Mining and Safety (DRMS) letter dated June 1, 2022. The review letter is provided as Attachment A.

The following summarize DRMS comments by item.

1. **Comment 1 – Please provide an updated slope stability models and associated FoS using the correct friction angle for bedrock.** We reran the four slope configurations with the suggested friction angle of 22 degrees. Predicted factors of safety for the four mine wall scenarios varied between 1.3 and 1.5. Model outputs are presented in Attachment B.
2. **Comment 2 – Please provide additional discussion in regards to conditions or scenarios which determine one of the four proposed highwall slope configuration.** The different mine wall slope analyses were intended to represent, as much as possible, the different soil profiles and mine depths that will be encountered. As such, it is anticipated that each slope profile will be encountered at various locations during mining.
3. **Comment 3 – Please provide slope stability analyses for the four highwall scenarios under seismic conditions including rational for the seismic coefficient used in the analyses.** The four slope configurations were ran using a uniform horizontal and vertical acceleration factor of 0.075. This factor was chosen based on the United States Seismic Zone Map, which was based on the Uniform Building Code seismic values. Predicted safety factors varied between 1.15 and 1.26. Model outputs are presented in Attachment C. Included in Attachment C is the United States Seismic Zone Map.

Based on model predictions it appears that the proposed mine wall configurations meet or exceed the minimum required safety factors. If you have any questions or need additional information, please contact me at (970) 590-3807.

Sincerely,
AWES, LLC

A handwritten signature in black ink, appearing to read 'Joby Adams', written in a cursive style.

Joby Adams, P.G., REM
Principal/Hydrogeologist



ATTACHMENT A

TECHNICAL ADEQUACY REVIEW LETTER



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

Date: June 1, 2022
To: Rob Zuber
CC: Jason Musick, Michael Cunningham
From: Zach Trujillo
RE: Two Rivers Application, DRMS File No. M-2022-013
Technical Adequacy Review

Rob,

As requested I have reviewed the proposed 112c Permit Application for the Two Rivers Sand, Gravel and Reservoir Project (Twin Rivers) submitted by Raptor Materials, LLC (RM) in relation to the requested and applicable Rules, Regulations and Policies. The primary focus of this review as requested is to ensure Rule 6.5 of the Mineral Rules and Regulations of the Colorado Mined Land Reclamation Board for the Extraction of Construction Materials has been satisfied. Additionally, proposed geotechnical stability support material as part of the application was reviewed in relation to Section 30 of the Policies of the Mined Land Reclamation Board (Section 30).

Rule 6.5

- Per Rule 6.5(1)[o]n a site-specific basis, an Applicant shall be required to provide a geotechnical evaluation of all geologic hazards that have the potential to affect any proposed impoundment, slope, embankment, highwall, or waste pile within the affected area. A geologic hazard is one of several types of adverse geologic conditions capable of causing damage or loss of property and life. The Applicant may also be required to provide a geotechnical evaluation of all geologic hazards, within or in the vicinity of the affected lands, which may be de-stabilized or exacerbated by mining or reclamation activities.
- Per Rule 6.5(2), [o]n a site-specific basis, an Applicant shall be required to provide engineering stability analyses for proposed final reclaimed slopes, highwalls, waste piles and embankments. An Applicant may also be required to provide engineering stability analyses for certain slopes configuration as they will occur during operations, including, but not limited to embankments. Information for slope stability analyses may include, but would not be limited to, slope angles and configurations, compaction and density, physical characteristics of earthen materials, pore pressure information, slope height, post-placement use of site, and information on structures or facilities that could be adversely affected by slope failure.
- Per Rule 6.5(3), [w]here there is the potential for off-site impacts due to failure of any geologic structure or constructed earthen facility, which may be caused by mining or reclamation activities, the Applicant shall demonstrate through appropriate geotechnical and stability analyses

Two Rivers Review Memo

June 1, 2022



that off-site areas will be protected with appropriate factors of safety incorporated into the analysis. The minimum acceptable safety factors will be subject to approval by the Office, on a case-by-case basis, depending upon the degree of certainty of soil or rock strength determinations utilized in the stability analysis, depending upon the consequences associated with a potential failure, and depending upon the potential for seismic activity at each site.

As part of Snake River's application, a geotechnical site investigation and stability analysis was provided under Exhibit 6.5: Slope Stability Analyses (Report). Material strength properties used in the analyses were determined from field investigation and lab testing. A total of twelve investigative borings were drilled throughout the proposed permit area where bulk samples were obtained and then lab tested. Material strength properties are summarized in Table 1 – Soil Strength Properties of the Report as well as associated lab results. Each borehole after completion was then converted to monitoring wells 1 through 12 as shown on Figure 1 of the Report. Detailed borehole logs showing subsurface conditions are also provided within the Report.

As part of the Report, multiple slope stability analyses were performed using the strength material properties and associated profiles attained from the site investigation and lab testing. The proposed set of analyses within the Report takes into consideration four general highwall scenarios under static conditions for the Snake River operation.

1. 40 foot mine depth with a bank cut of 1.25H:1V (Plate 1),
2. 47 foot mine depth with a bank cut of 2H: 1V for the bottom 20 feet and 1.25 H: 1V for the remaining slope (Plate 2),
3. 47 foot mine depth with a bank cut of 2H: 1V for the bottom 20 feet and 1.25H: 1V for the remaining slope with overburden (Plate 3) and,
4. 37 foot mine depth with a lower 20 foot bank cut of 2H: 1V with the remaining slope of 1.25H: 1V (Plate 4)

The resulting Factors of Safety (FoS) are shown below in Table 1. of this memo:

Table 1. Snake River FoS	
Analysis	FoS
Plate 1	1.303
Plate 2	1.407
Plate 3	1.533
Plate 4	1.41

Each resulting FoS from the four analyses indicate slope stability however, there appears to be inconsistencies in the friction angle used for Bedrock as detailed in the cross-sectional slope stability result printouts provided at the end of the Report. Based on Table 1 – Soil Strength Properties, Bedrock has been assigned a friction angle of 22 degrees however of the four analyses, only Plate 4 uses this friction angle. Plate 1, 2 and 3 use a friction angle of 14 degrees. Please see Comments at the end of this memo for requested information.

Additionally, it is unclear on what conditions would determine the proposed highwall to be constructed to one of the four scenarios. Based on the differing material profiles within the cross-sectional slope stability result printouts provided, it appears to the Division that it might be based the strata and/or location within the proposed permit. Additional clarification will be necessary. Please refer to the Comments section of this memo.

Section 30

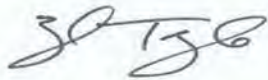
Based on the information in the Report provided by Snake River and Table 1 of Section 30.4, FoS will be compared to strength measurements resulting from multiple tests for a critical structure. For static conditions, minimum required factor of safety is 1.3 and for seismic conditions, minimum required factor of safety is 1.15. As noted earlier under section Rule 6.5 of this memo, each resulting FoS from the four analyses indicate slope stability under static conditions. However, additional discussion will be need to be provided which will be outlined under the Comments at the end of this memo. In addition, the four scenarios provided in the Report were only analyzed on under static conditions and no models were ran or provided under seismic conditions as required under Section 30.

Comments

1. **Please provide updated slope stability models and associated FoS using the correct friction angle for bedrock.**
2. **Please provide additional discussion in regards to conditions or scenarios which determine one of the four proposed highwall slope configuration.**
3. **Please provide slope stability analyses for the four highwall scenarios under seismic conditions including rational for the seismic coefficient used in the analyses.**

Upon receipt of the requested responses and clarifications, a slope stability analysis "check" will be performed by the Division and provided within an additional memo. This concludes my review and comments for the proposed 112c Permit Application for the Two Rivers Sand, Gravel and Reservoir Project submitted by Raptor Materials, LLC in relation to the requested and applicable Rules, Regulations and Policies. If you have any questions feel free to contact me.

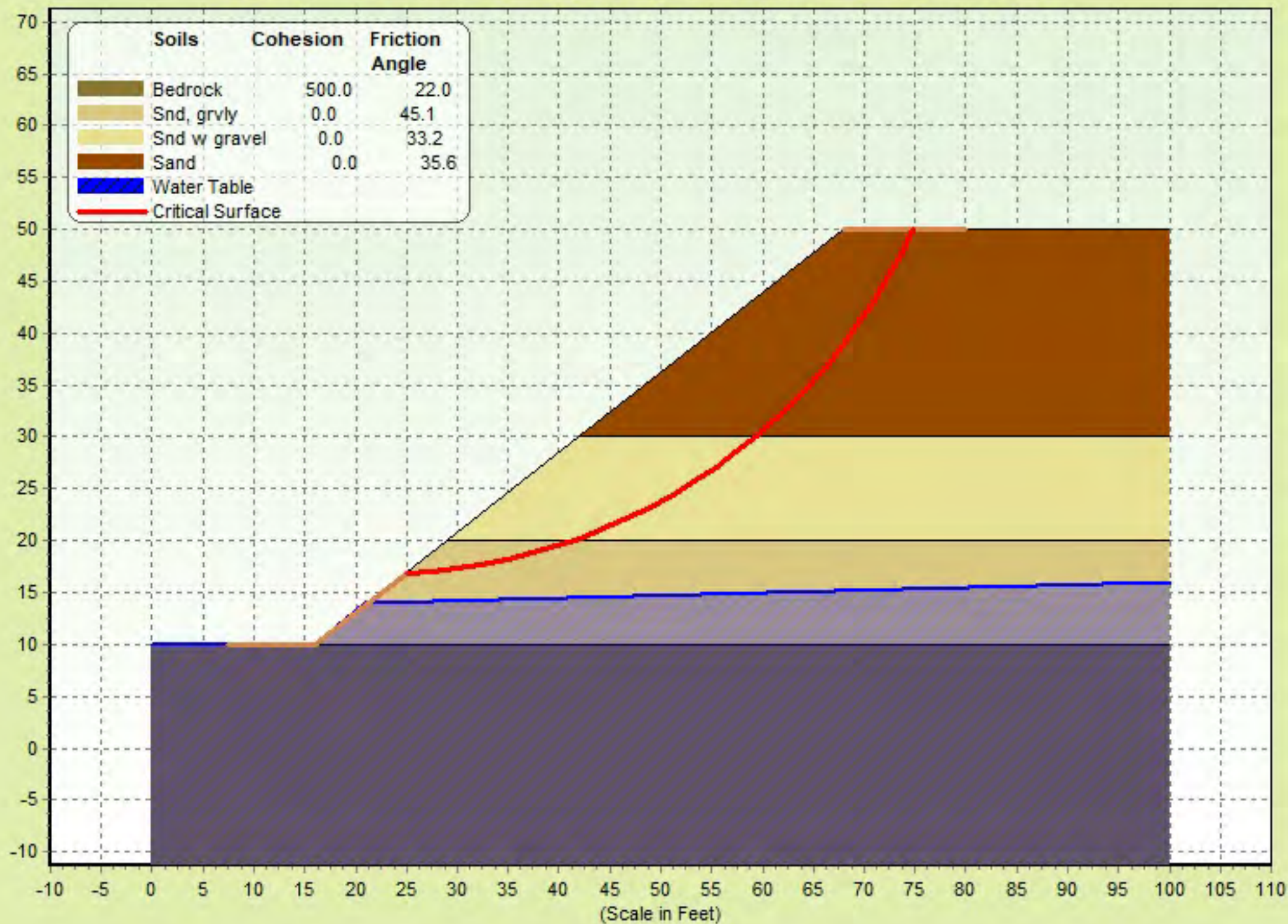
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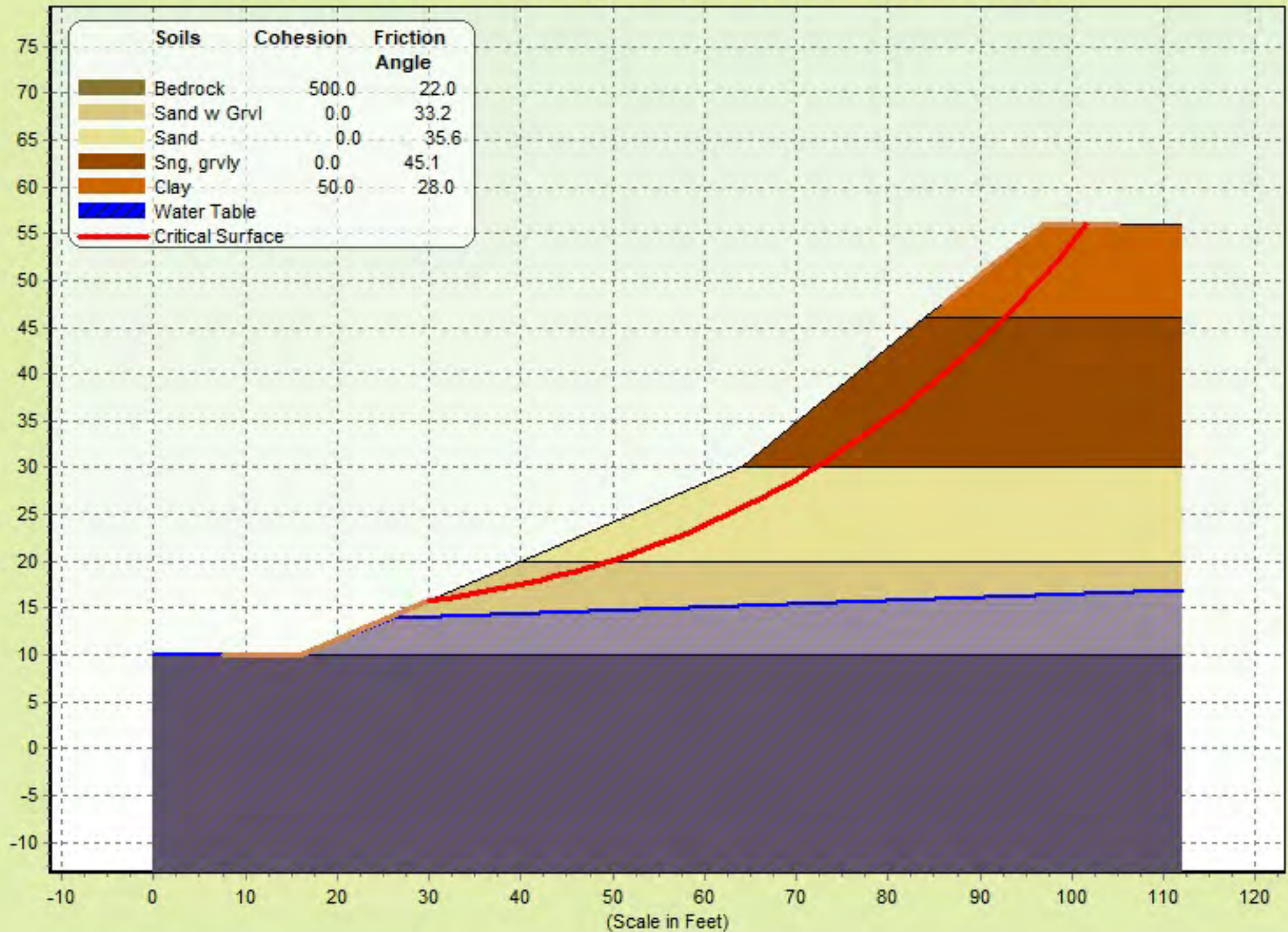


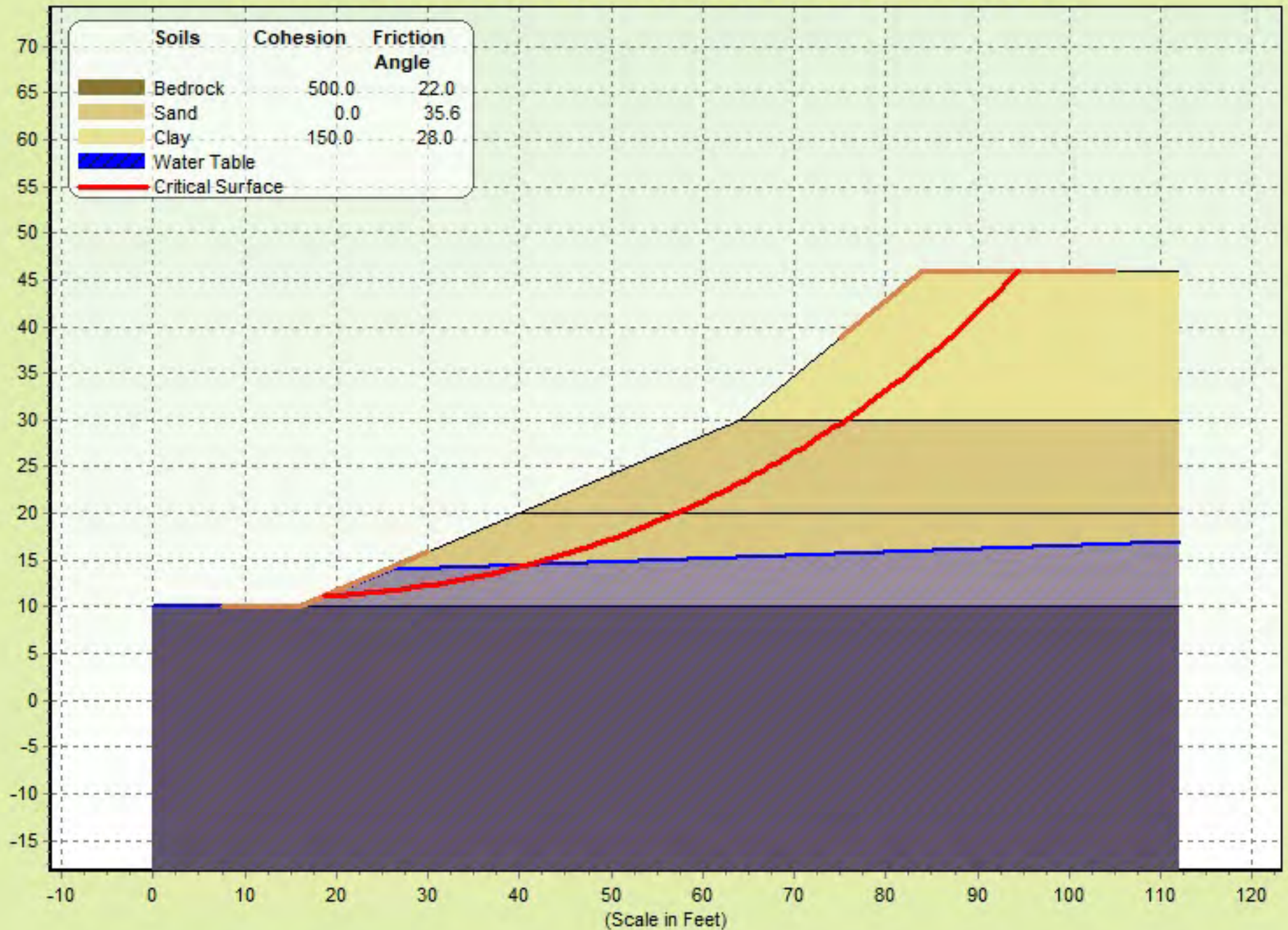
Zach Trujillo
Environmental Protection Specialist
(303) 866-3567 ext. 8164
Zach.Trujillo@state.co.us

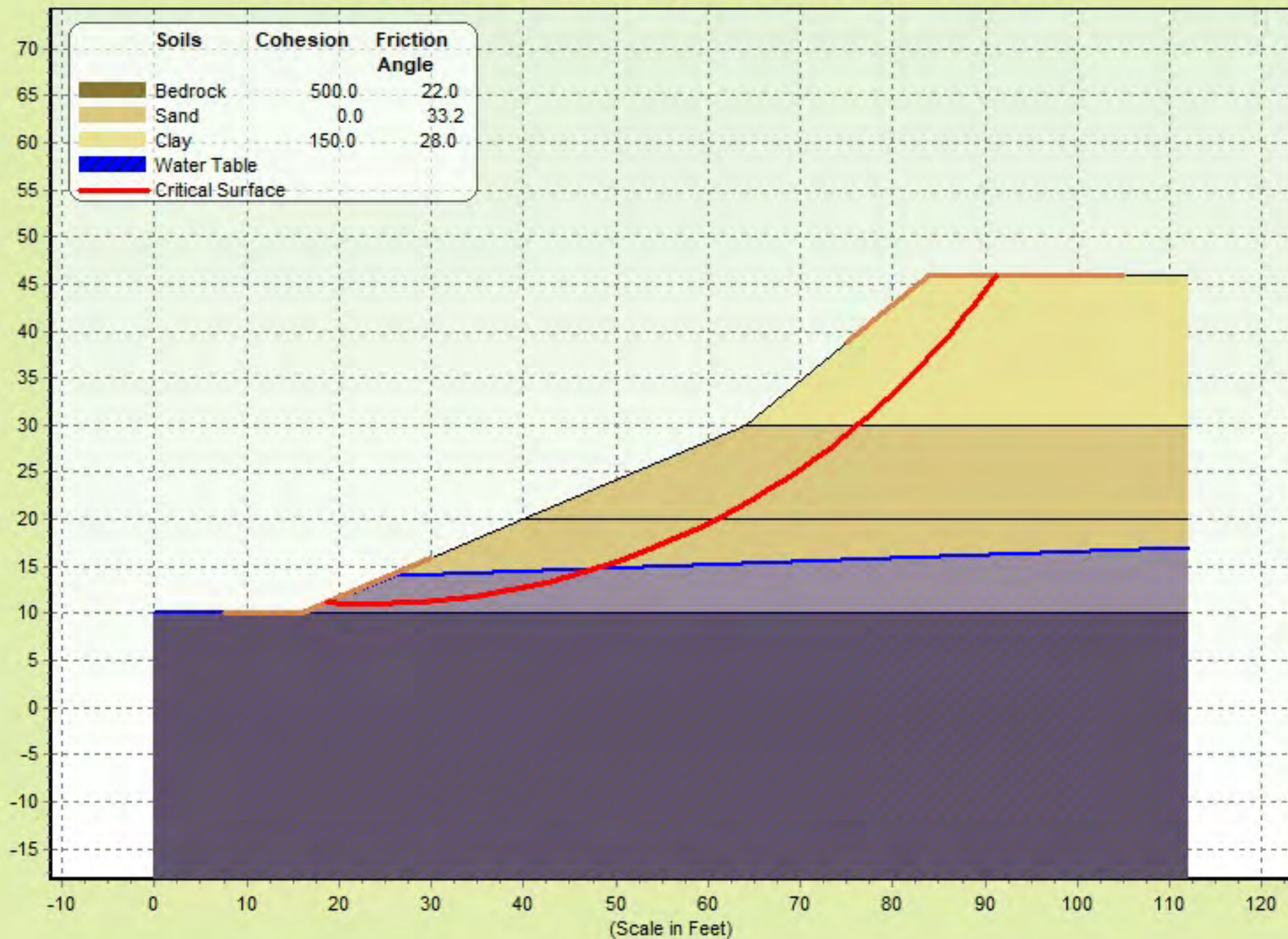
ATTACHMENT B

NON-SEISMIC STABILITY MODEL OUTPUTS





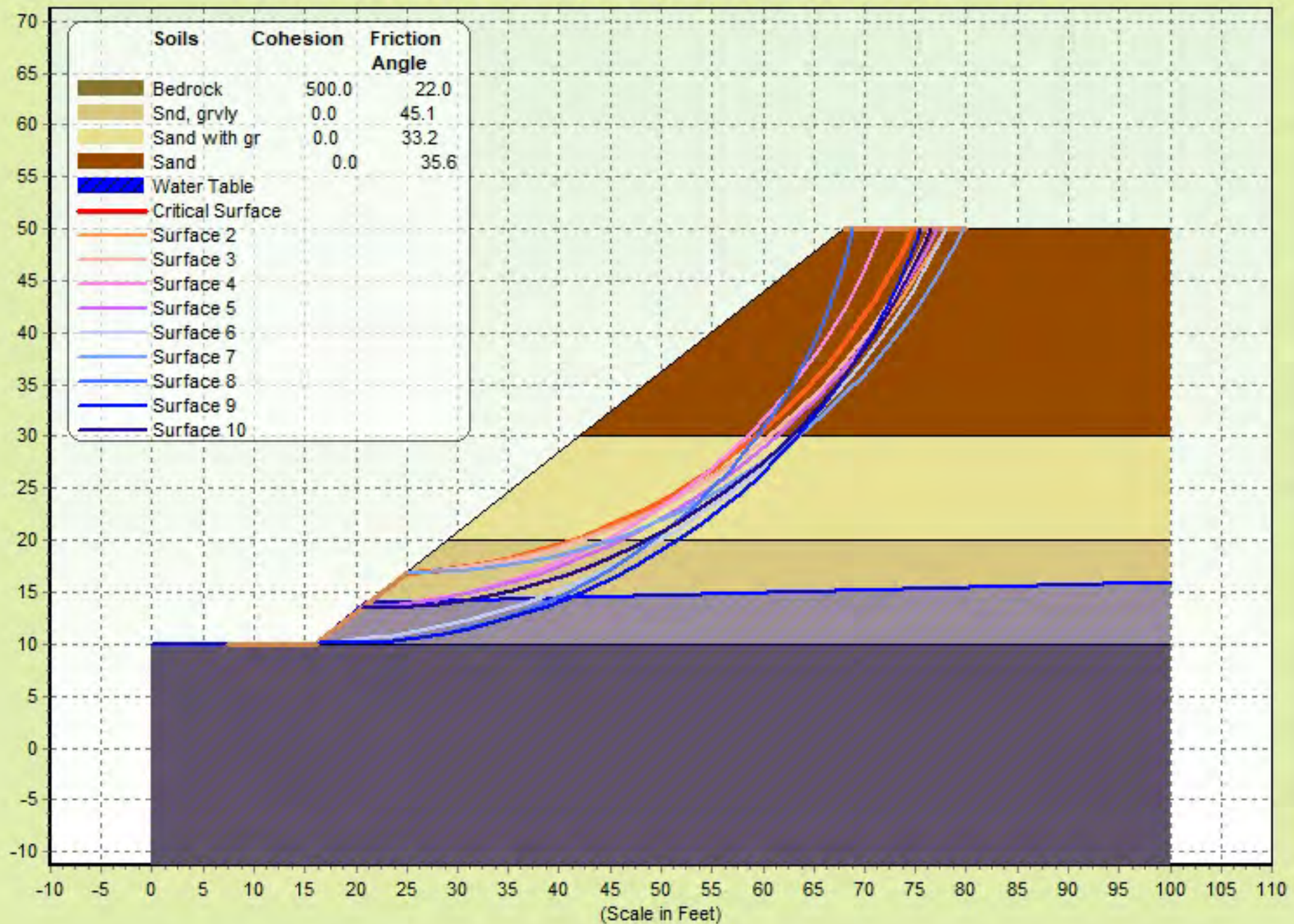


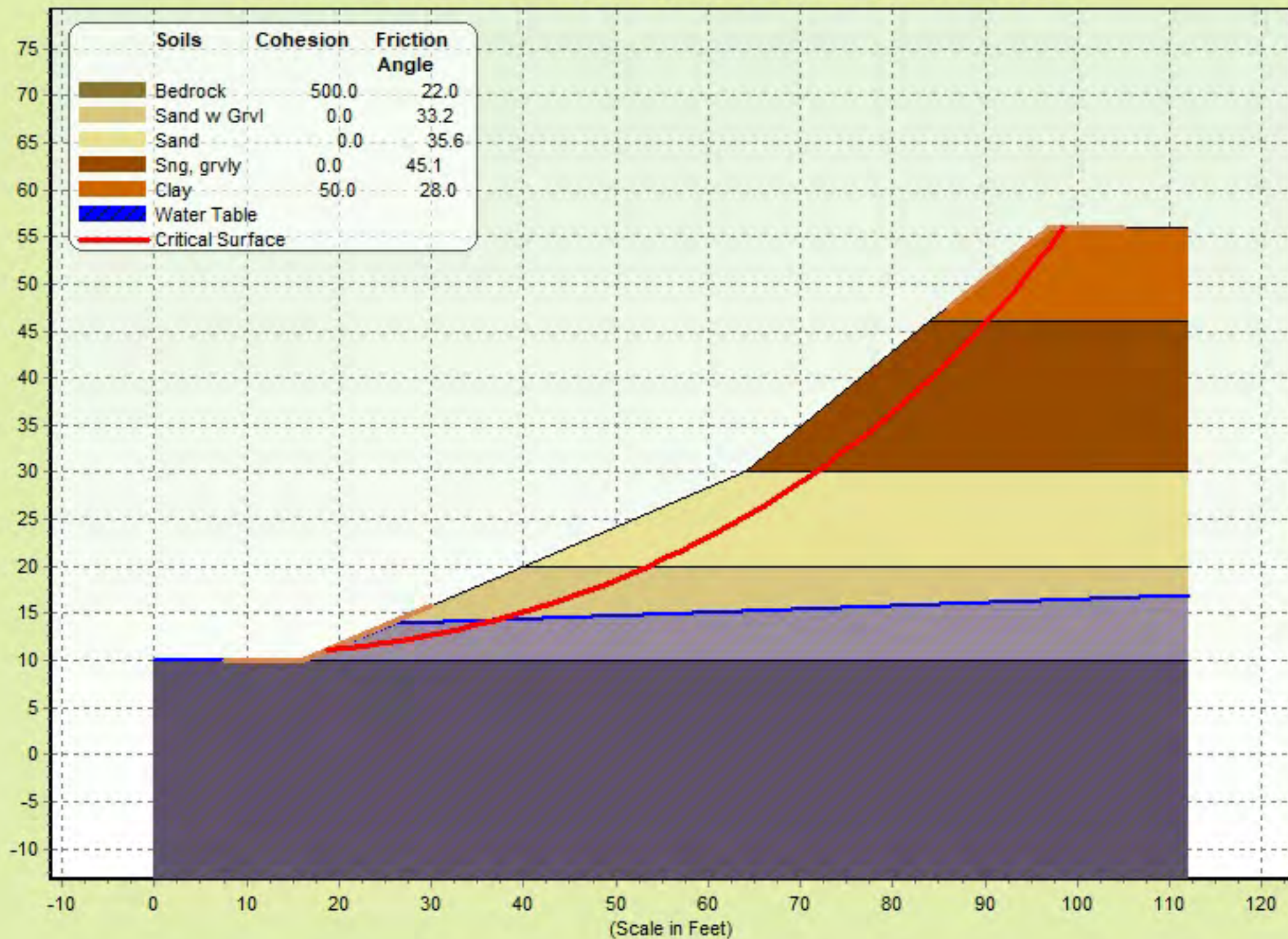


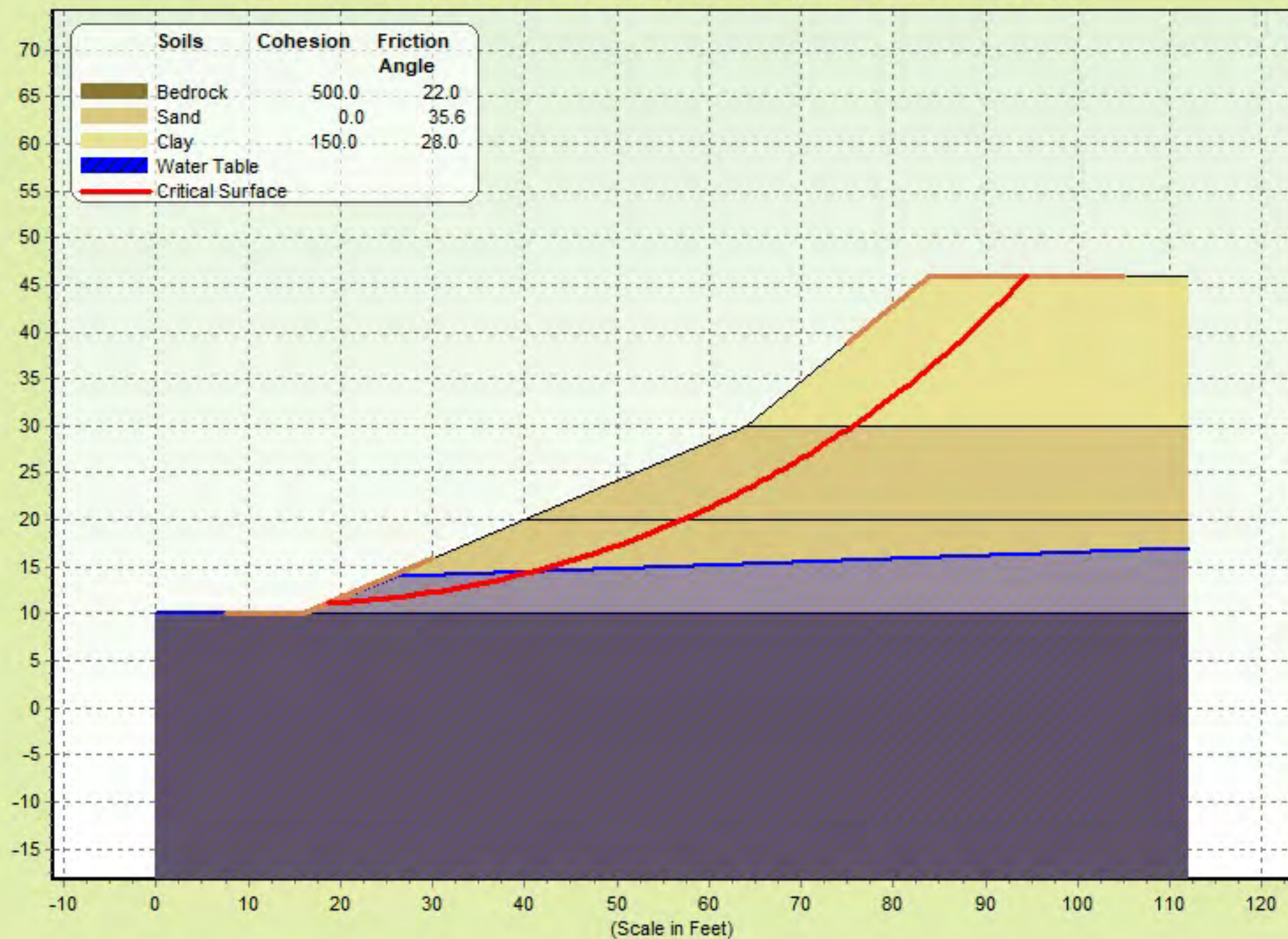
ATTACHMENT C

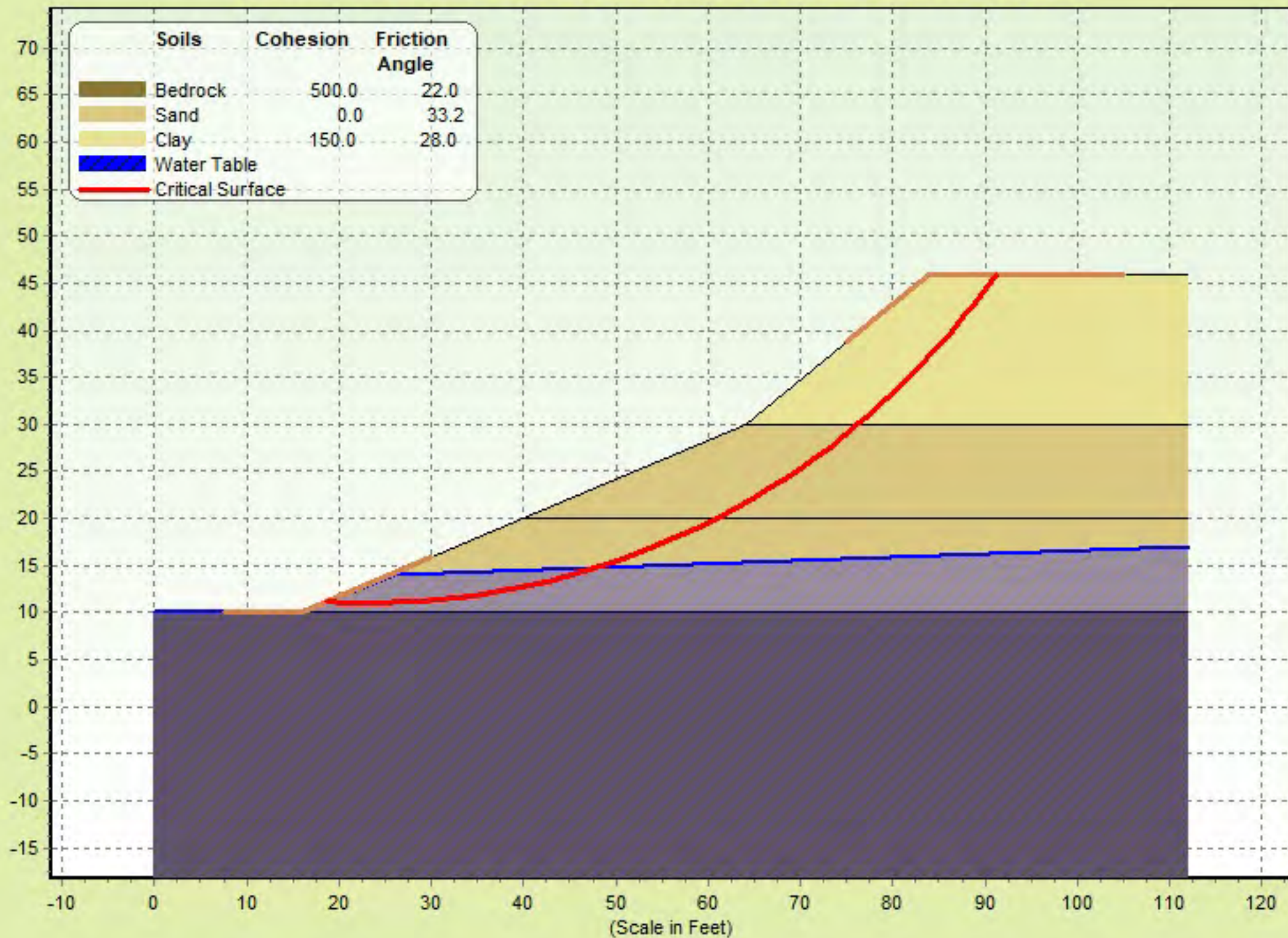
SEISMIC STABILITY MODEL OUTPUTS

UNITED STATES SEISMIC ZONE MAP









United States Seismic Zones Map

